Summary of JENDL-3.2

(Eds.) Keiichi SHIBATA and Tsutomu NARITA

Department of Reactor Engineering Tokai Research Establishment Japan Atomic Energy Research Institute Tokai-mura, Naka-gun, Ibaraki-ken Tel: +81-29-282-5481 Fax: +81-29-282-5766 e-mail: shibata@cracker.tokai.jaeri.go.jp

The second revision of JENDL-3 (JENDL-3.2) was released in 1994. The library contains evaluated neutron nuclear data for 340 nuclides which are needed for the design of fission and fusion reactors and for shielding calculation. This report presents the File-1 part of JENDL-3.2 which summarizes the evaluation method for each nuclide.

Keywords: JENDL-3.2, Neutron Nuclear Data, Fission Reactors, Fusion Reactors, Shielding, Evaluation Method, Summary

1. Introduction

The second revision¹⁾ of JENDL-3, referred to as JENDL-3.2, was released in 1994, and it contains evaluated neutron nuclear data for 340 nuclides in the energy region from 10^{-5} eV to 20 MeV. The JENDL-3.2 data are being used in the various application fields such as fission reactors, fusion reactors, and shielding research.

The official version of JENDL-3.2 was prepared in the ENDF-6 format², although the ENDF-5 format³ version is also available. The ENDF-5 format version is consistent with the ENDF-6 format one, because the File-6, which represents angle-dependent energy distributions of emitted particles, was not employed in JENDL-3.2. The JENDL-3.2 data were stored in 15 different files, as given in Table 1.

The graphs and tables of the JENDL-3.2 cross sections were published as JAERI-Data/Code reports^{4,5)}. This report presents the File-1 part of JENDL-3.2 which describes how the evaluation was performed for each nuclide, and the report must be helpful for both data users and evaluators.

References

- Nakagawa T., Shibata K., Chiba S., Fukahori T., Nakajima Y., Kikuchi Y., Kawano T., Kanda Y., Ohsawa T., Matsunobu H., Kawai M., Zukeran A., Watanabe T., Igarasi S., Kosako K. and Asami T.: "Japanese Evaluated Nuclear Data Library Version 3 Revision-2: JENDL-3.2", J. Nucl. Sci. Technol., **32**, 1259 (1995).
- 2) McLance V., Dunford C.L. and Rose P.F.: "ENDF 102 Data Formats and Procedures for the Evaluated Nuclear Data File ENDF-6", BNL-NCS-44945, Rev. 11/95 (1995).
- Kinsey R.: "ENDF 102 Data Formats and Procedures for the Evaluated Nuclear Data File, ENDF", BNL-NCS-50496, 2nd Edition (ENDF/B-V) (1979).
- Shibata K., Nakagawa T., Sugano H. and Kawasaki H.: "Curves and Tables of Neturen Cross Sections in JENDL-3.2", JAERI-Data/Code 97-003 (1997).
- Fukahori T., Iwamoto O., Nakagawa T., Shibata K., Narita T., Hasegawa A. and Katakura J.: "JENDL-3.2 Plots and Data (CD-ROM)", JAERI-Data/Code 97-044 (1997).

Tape No.	No.	Nuclide	MAT No.	Records
301	1	${}^{1}\mathrm{H}$	125	286
	3	³ He	225	532
	4	⁴ He	228	1276
	5	⁶ Li	325	2445
	6	⁷ Li	328	3534
	7	⁹ Be	425	2732
	8	$^{10}\mathbf{B}$	525	3709
	9	$^{11}\mathbf{B}$	528	5140
	10	^{12}C	625	2614
	11	14 N	725	7456
	12	15 N	728	3567
	13	16 O	825	5664
	14	19 F	925	4526
	15	²³ Na	1125	5227
	16	Mg	1200	4376
	17	24 Mg	1225	1604
	18	25 Mg	1228	2050
	19	26 Mg	1231	1681
	20	²⁷ Al	1325	6414
			(Tot	tal 65950)
302	1	Si	1400	8169
	2	² 8Si	1425	4723
	3	²⁹ Si	1428	5781
	4	³⁰ Si	1431	448
	5	$^{31}\mathbf{P}$	1525	2330
	6	S	1600	4845
	7	32 S	1625	1801
	8	³³ S	1628	1554
	9	34 S	1631	1439
	10	³⁶ S	1637	1299
	11	Cl	1700	8013
	12	³⁵ Cl	1725	5527

Table 1 Nuclides contained in JENDL-3.2 (ENDF-6 format).

Tape No.	No.	Nuclide	MAT No.	Records
302	13	³⁷ Cl	1731	4758
	14	^{40}Ar	1837	7085
	15	Κ	1900	3458
	16	³⁹ K	1925	1347
	17	40 K	1928	1361
	18	41 K	1931	1233
			(Tot	al 69208)
303	1	Ca	2000	7731
	2	⁴⁰ Ca	2025	4101
	3	⁴² Ca	2031	2546
	4	⁴³ Ca	2034	2603
	5	⁴⁴ Ca	2037	2387
	6	⁴⁶ Ca	2043	2022
	7	⁴⁸ Ca	2049	1582
	8	⁴⁵ Sc	2125	2226
	9	Ti	2200	7385
	10	⁴⁶ Ti	2225	2444
	11	⁴⁷ Ti	2228	2961
	12	⁴⁸ Ti	2231	2900
	13	⁴⁹ Ti	2234	2836
	14	⁵⁰ Ti	2237	2433
	15	51 V	2328	3754
	16	Cr	2400	9456
	17	⁵⁰ Cr	2425	2441
	18	⁵² Cr	2431	3372
	19	⁵³ Cr	2434	3531
	20	⁵⁴ Cr	2437	2359
	21	⁵⁵ Mn	2525	19006
			(Tot	al 90076)

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
304	1	Fe	2600	10692
	2	⁵⁴ Fe	2625	5005
	3	⁵⁶ Fe	2631	6419
	4	⁵⁷ Fe	2634	5235
	5	⁵⁸ Fe	2637	4328
	6	⁵⁹ Co	2725	5540
	7	Ni	2800	10156
	8	⁵⁸ Ni	2825	3936
	9	⁶⁰ Ni	2831	4082
	10	⁶¹ Ni	2834	2591
	11	⁶² Ni	2837	2684
	12	⁶⁴ Ni	2843	2579
	13	Cu	2900	6480
	14	⁶³ Cu	2925	5701
	15	⁶⁵ Cu	2931	5486
			(Tot	al 80914)
305	1	Ga	3100	8454
	2	⁶⁹ Ga	3125	5627
	3	⁷¹ Ga	3131	5775
	4	Ge	3200	11073
	5	⁷⁰ Ge	3225	4454
	6	⁷² Ge	3231	4674
	7	⁷³ Ge	3234	6170
	8	⁷⁴ Ge	3237	4644
	9	⁷⁶ Ge	3243	4541
	10	⁷⁵ As	3325	3385
	11	⁷⁴ Se	3425	1486
	12	⁷⁶ Se	3431	2564
	13	⁷⁷ Se	3434	2786
	14	⁷⁸ Se	3437	2079
	15	⁷⁹ Se	3440	2932
	16	⁸⁰ Se	3443	2486

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
305	17	⁸² Se	3449	1422
			(Tot	al 74552)
306	1	$^{79}\mathrm{Br}$	3525	3268
	2	81 Br	3531	3011
	3	⁷⁸ Kr	3625	2589
	4	⁸⁰ Kr	3631	2523
	5	⁸² Kr	3637	1860
	6	⁸³ Kr	3640	1919
	7	⁸⁴ Kr	3643	1853
	8	⁸⁵ Kr	3646	1835
	9	⁸⁶ Kr	3649	1664
	10	⁸⁵ Rb	3725	1920
	11	⁸⁷ Rb	3731	1621
	12	⁸⁶ Sr	3831	1731
	13	87 Sr	3834	1706
	14	⁸⁸ Sr	3837	2107
	15	89 Sr	3840	1891
	16	⁹⁰ Sr	3843	1493
	17	⁸⁹ Y	3925	1935
	18	⁹¹ Y	3931	2911
	19	Zr	4000	6545
	20	⁹⁰ Zr	4025	2128
	21	91 Zr	4028	2935
	22	92 Zr	4031	2823
	23	⁹³ Zr	4034	2161
	24	⁹⁴ Zr	4037	2840
	25	⁹⁵ Zr	4040	2565
	26	⁹⁶ Zr	4043	2168
			(Tot	al 62002)
307	1	⁹³ Nb	4125	6346
	2	⁹⁴ Nb	4128	3165

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
307	3	⁹⁵ Nb	4131	2631
	4	Мо	4200	8895
	5	⁹² Mo	4225	2827
	6	94 Mo	4231	3227
	7	⁹⁵ Mo	4234	3458
	8	⁹⁶ Mo	4237	3098
	9	⁹⁷ Mo	4240	3550
	10	98 Mo	4243	3152
	11	⁹⁹ Mo	4246	2363
	12	100 Mo	4249	2612
	13	⁹⁹ Tc	4331	2459
	14	⁹⁶ Ru	4425	2049
	15	⁹⁸ Ru	4431	2084
	16	⁹⁹ Ru	4434	2187
	17	100 Ru	4437	2264
	18	101 Ru	4440	3114
	19	102 Ru	4443	2292
	20	103 Ru	4446	2109
	21	104 Ru	4449	1695
	22	106 Ru	4455	1485
			(To	tal 67062)
308	1	103 Rh	4525	2522
	2	105 Rh	4531	2349
	3	102 Pd	4625	2249
	4	104 Pd	4631	1905
	5	105 Pd	4634	3031
	6	106 Pd	4637	2512
	7	107 Pd	4640	2728
	8	108 Pd	4643	2268
	9	110 Pd	4649	1914
	10	Ag	4700	9543
	11	$^{107}\mathrm{Ag}$	4725	7040

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
308	12	¹⁰⁹ Ag	4731	6757
	13	^{110m} Ag	4735	3322
	14	Cd	4800	7284
	15	106 Cd	4825	2084
	16	108 Cd	4831	2819
	17	110 Cd	4837	2484
	18	111 Cd	4840	2183
	19	112 Cd	4843	1955
	20	113 Cd	4846	2246
	21	114 Cd	4849	1781
	22	116 Cd	4855	1614
	23	113 In	4925	2775
	24	115 In	4931	2481
			(Tot	al 77846)
309	1	112 Sn	5025	2386
	2	114 Sn	5031	2478
	3	¹¹⁵ Sn	5034	2179
	4	^{116}Sn	5037	1744
	5	117 Sn	5040	2076
	6	^{118}Sn	5043	1610
	7	^{119}Sn	5046	2374
	8	^{120}Sn	5049	2155
	9	122 Sn	5055	1604
	10	123 Sn	5058	2092
	11	124 Sn	5061	2140
	12	126 Sn	5067	1505
	13	Sb	5100	4907
	14	¹²¹ Sb	5125	3476
	15	¹²³ Sb	5131	3163
	16	¹²⁴ Sb	5134	1990
	17	¹²⁵ Sb	5137	2966
	18	¹²⁰ Te	5225	1882

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
309	19	¹²² Te	5231	1990
	20	¹²³ Te	5234	2508
	21	¹²⁴ Te	5237	2455
	22	¹²⁵ Te	5240	2603
	23	¹²⁶ Te	5243	2203
	24	^{127m} Te	5247	2536
	25	¹²⁸ Te	5249	1746
	26	^{129m} Te	5253	2786
	27	¹³⁰ Te	5255	1600
	28	$^{127}\mathrm{I}$	5325	2592
	29	129 I	5331	2595
	30	131 I	5337	2432
			(Tot	al 70773)
310	1	¹²⁴ Xe	5425	2338
	2	¹²⁶ Xe	5431	2087
	3	¹²⁸ Xe	5437	2402
	4	¹²⁹ Xe	5440	2402
	5	¹³⁰ Xe	5443	1552
	6	¹³¹ Xe	5446	2046
	7	132 Xe	5449	1840
	8	¹³³ Xe	5452	2291
	9	134 Xe	5455	1625
	10	¹³⁵ Xe	5458	2204
	11	¹³⁶ Xe	5461	1851
	12	¹³³ Cs	5525	2643
	13	134 Cs	5528	3309
	14	¹³⁵ Cs	5531	2037
	15	¹³⁶ Cs	5534	1773
	16	^{137}Cs	5537	2013
	17	¹³⁰ Ba	5625	1962
	18	132 Ba	5631	2054
	19	134 Ba	5637	2170

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
310	20	¹³⁵ Ba	5640	2204
	21	¹³⁶ Ba	5643	1954
	22	¹³⁷ Ba	5646	1951
	23	¹³⁸ Ba	5649	2317
	24	140 Ba	5655	1880
	25	¹³⁸ La	5725	2565
	26	¹³⁹ La	5728	2307
	27	¹⁴⁰ Ce	5837	2568
	28	¹⁴¹ Ce	5840	3192
	29	¹⁴² Ce	5843	2249
	30	¹⁴⁴ Ce	5849	1757
	31	141 Pr	5925	2248
	32	143 Pr	5931	2408
	33	142 Nd	6025	2167
	34	¹⁴³ Nd	6028	2434
	35	144 Nd	6031	2107
	36	¹⁴⁵ Nd	6034	2812
	37	146 Nd	6037	2256
	38	¹⁴⁷ Nd	6040	2492
	39	148 Nd	6043	2303
	40	150 Nd	6049	2255
			(To	tal 89025)
311	1	¹⁴⁷ Pm	6149	2376
	2	¹⁴⁸ Pm	6152	2016
	3	^{148m} Pm	6153	1918
	4	¹⁴⁹ Pm	6155	2660
	5	144 Sm	6225	3194
	6	147 Sm	6234	2731
	7	148 Sm	6237	2375
	8	149 Sm	6240	2589
	9	150 Sm	6243	2821
	10	¹⁵¹ Sm	6246	3026

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
311	11	152 Sm	6249	2413
	12	¹⁵³ Sm	6252	3334
	13	154 Sm	6255	3249
	14	Eu	6300	7715
	15	¹⁵¹ Eu	6325	4578
	16	¹⁵² Eu	6328	2568
	17	¹⁵³ Eu	6331	4641
	18	¹⁵⁴ Eu	6334	2292
	19	¹⁵⁵ Eu	6337	2355
	20	¹⁵⁶ Eu	6340	1933
	21	152 Gd	6425	3170
	22	154 Gd	6431	3069
	23	155 Gd	6434	3487
	24	156 Gd	6437	2887
	25	157 Gd	6440	3360
	26	158 Gd	6443	2758
	27	160 Gd	6449	2333
	28	¹⁵⁹ Tb	6525	3150
			(Tot	tal 84998)
312	1	Hf	7200	6763
	2	$^{174}\mathrm{Hf}$	7225	4245
	3	$^{176}\mathrm{Hf}$	7231	5247
	4	$^{177}\mathrm{Hf}$	7234	5021
	5	$^{178}\mathrm{Hf}$	7237	5043
	6	$^{179}\mathrm{Hf}$	7240	4422
	7	$^{180}\mathrm{Hf}$	7243	3944
	8	¹⁸¹ Ta	7328	4629
	9	W	7400	8478
	10	182 W	7431	3669
	11	183 W	7434	3395
	12	184 W	7437	3207
	13	$^{186}\mathbf{W}$	7443	3362

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
312	14	Pb	8200	7506
	15	²⁰⁴ Pb	8225	5270
	16	²⁰⁶ Pb	8231	5823
	17	²⁰⁷ Pb	8234	5189
	18	²⁰⁸ Pb	8237	5472
	19	²⁰⁹ Bi	8325	4163
			(Tot	al 94848)
313	1	223 Ra	8825	1277
	2	224 Ra	8828	1069
	3	²²⁵ Ra	8831	847
	4	²²⁶ Ra	8834	1393
	5	²²⁵ Ac	8925	612
	6	²²⁶ Ac	8928	568
	7	²²⁷ Ac	8931	990
	8	²²⁷ Th	9025	668
	9	²²⁸ Th	9028	1597
	10	²²⁹ Th	9031	857
	11	²³⁰ Th	9034	1551
	12	²³² Th	9040	2984
	13	²³³ Th	9043	1852
	14	²³⁴ Th	9046	1925
	15	²³¹ Pa	9131	1756
	16	²³² Pa	9134	720
	17	²³³ Pa	9137	1670
	18	²³² U	9219	1339
	19	²³³ U	9222	4154
	20	²³⁴ U	9225	3033
	21	²³⁵ U	9228	6920
	22	²³⁶ U	9231	2824
	23	²³⁷ U	9234	3116
	24	²³⁸ U	9237	8245
	25	²³⁶ Np	9343	934

Table 1 (continued)

Tape No.	No.	Nuclide	MAT No.	Records
313	26	²³⁷ Np	9346	3140
	27	²³⁸ Np	9349	2341
	28	²³⁹ Np	9352	942
			(Tot	al 59324)
314	1	²³⁶ Pu	9428	1056
	2	²³⁸ Pu	9434	2454
	3	²³⁹ Pu	9437	6202
	4	²⁴⁰ Pu	9440	5821
	5	²⁴¹ Pu	9443	2503
	6	²⁴² Pu	9446	2492
	7	²⁴¹ Am	9543	1894
	8	²⁴² Am	9546	1598
	9	^{242m} Am	9547	2197
	10	²⁴³ Am	9549	1544
	11	²⁴⁴ Am	9552	2223
	12	^{244m} Am	9553	2237
	13	²⁴¹ Cm	9628	866
	14	²⁴² Cm	9631	954
	15	²⁴³ Cm	9634	1815
	16	²⁴⁴ Cm	9637	1448
	17	²⁴⁵ Cm	9640	2906
	18	²⁴⁶ Cm	9643	2320
	19	²⁴⁷ Cm	9646	1877
	20	²⁴⁸ Cm	9649	1125
	21	²⁴⁹ Cm	9652	1238
	22	²⁵⁰ Cm	9655	849
	23	249 Bk	9752	1872
	24	²⁵⁰ Bk	9755	1936
	25	²⁴⁹ Cf	9852	1675
	26	²⁵⁰ Cf	9855	2229
	27	²⁵¹ Cf	9858	2148
	28	²⁵² Cf	9861	1298

Table 1 (continued)

Tape No	No	Nuclide	MAT No.	Records
314	29	²⁵⁴ Cf	9867	804
514	30	²⁵⁴ Fs	9914	795
	31	²⁵⁵ Es	9915	907
	32	²⁵⁵ Fm	9936	790
	52		(Tot	al 62073)
315	1	²³² Th	9040	3313
	2	²³³ U	9222	4948
	3	²³⁵ U	9228	4948
	4	²³⁶ U	9231	1673
	5	²³⁸ U	9237	3312
	6	²³⁷ Np	9346	1673
	7	²³⁹ Pu	9437	4948
	8	²⁴⁰ Pu	9440	1672
	9	²⁴¹ Pu	9443	3310
	10	242 Pu	9446	1672
	11	²⁴¹ Am	9543	69
	12	²⁴³ Am	9549	69
			(Tot	al 31607)

Table 1 (continued)

*) The nuclide without a mass number stands for a natural element.

**) Tape 315 contains fission product yields.

MAT number = 125 1-H - 1 JAERI JAERI-1261 HISTORY EVAL-DEC84 K.SHIBATA DIST-SEP89 REV2-APR93 83-03 COMPILED BY K.SHIBATA FOR JENDL-2
 MAIN PART WAS CARRIED OVER FROM JENDL-1 DATA EVALUATED BY M.YAMAMOTO. DETAILS ARE GIVEN IN REF. /1/.
 83-11 MF=2 WAS ADDED. THE TRANSFORMATION MATRIX GIVEN FOR MT=2 OF 83-11 MF=2 WAS ADDED. THE TRANSFORMATION MATRIX GIVEN FOR MI=2 MF=4.
 84-12 RE-EVALUATED BY K.SHIBATA (JAERI) FOR JENDL-3 ELASTIC SCATTERING CROSS SECTION WAS RE-CALCULATED BELOW 100 KEV. MU-BAR WAS ALSO RE-CALCULATED. PHOTON-PRODUCTION CROSS SECTION WAS ADDED.
 93-04 JENDL-3.2 COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * ==1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 SCATTERING RADIUS ONLY MF=3 NEUTRON CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS AND RES. INTEGRALS 2200M/S (B) RES. INTEG. (B) TOTAL 20.806 -ELASTIC 20.474 -CAPTURE 0.332 0.1491 MT=1 TOTAL CROSS SECTION SUM OF ELASTIC AND CAPTURE CROSS SECTIONS MT=2 ELASTIC SCATTERING CROSS SECTION BELOW 100 KEV, CALCULATED BY USING EFFECTIVE RANGE AND SCATTERING LENGTH PARAMETERS OF POENITZ AND WHALEN /2/ ABOVE 100 KEV, THE DATA OF HOPKINS AND BREIT/3/ WERE RECOMMENDED. MT=102 CAPTURE CROSS SECTION THE DATA OF HORSLEY/4/ WERE RECOMMENDED. MT=251 MU-BAR CALCULATED FROM THE DATA IN ME-4 .ÉN /2/. WERE CALCULATED FROM THE DATA IN MF=4. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2BELOW 100 KEV, ISOTROPIC IN THE CENTER OF MASS SYSTEM WAS ASSUMED. ABOVE 100 KEV, THE DATA OF HOPKINS AND BREIT/3/WERE RECOMMENDED. =12 MT=102 M=1.0 PHOTON PRODUCTION MULTIPLICITY MF=12 MF=14 PHOTON ANGULAR DISTRIBUTION MT=102 ASSUMED TO BE ISOTROPIC. REFERENCES AFFERENCES 1) IGARASI S. ET AL.: JAERI-1261 (1979). 2) POENITZ W.P. AND WHALEN J.F.: NUCL. PHYS. A383 (1982) 224 3) HOPKINS J.C. AND BREIT G.: NUCL. DATA TABLE A9(1971) 137. 4) HORSLEY A.: NUCL. DATA A2(1966) 243. 224.

MAT number = 128 1-H - 2 JAERI JAERI-M 83-006 HISTORY EVAL-JUL82 K.SHIBATA,T.NARITA,S.IGARASI DIST-MAR83 REV2-APR93 83-01 NEW EVALUATION FOR JENDL-2. DETAILS ARE GIV DATA WERE COMPILED BY THE AUTHORS. 83-11 MF=2 WAS ADDED. 87-05 CARRIED OVER FROM JENDL-2. 93-04 JENDL-3.2 COMPILED BY T.NAKAGAWA (NDC/JAERI) DETAILS ARE GIVEN IN REF. /1/. * MF = 1RESONANCE PARAMETERS 51 SCATTERING RADIUS ONLY MF=2MT = 151NEUTRON CROSS SECTIONS 2200-M/S CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200-M/S RES. INTEG. ELASTIC 3.389 B CAPTURE 0.00055 B 0.000286 B MF=3TOTAL 3.390 R TOTAL BASED ON A LEAST-SQUARES FIT TO THE EXPERIMENTAL DATA OF /2/-/8/. ELASTIC ELASTIC = TOTAL - (N,2N) - CAPTURE. (N,2N) BASED ON A LEAST-SQUARES FIT. DATA LISTED IN /9/-/11/ WERE USED. CAPTURE PELOW 1 KEV 1/V FORM NORMALIZED TO THE DATA OF MT = 1MT=2MT = 16MT=102 BELOW 1 KEV, 1/V FORM NORMALIZED TO THE DATA OF ISHIKAWA /12/. ABOVE 1 KEV, EVALUATED ON THE BASIS OF THE INVERSE REACTION /13/. MU-BAR CALCULATED FROM THE DATA IN MF=4. MT=251 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2,16 CALCULATED FROM THE THREE-BODY MODEL BASED ON THE FADDEEV EQUATION /14/. MF = 5ENERGY DISTRIBUTIONS OF SECONDARY MT=16 THE THREE-BODY MODEL CALCULATION. ERENCES SHIBATA, K. ET AL.: JAERI-M 83-006 (1983). ADAIR, R.K. ET AL.: PHYS. REV. 89 (1953) 1165. SEAGRAVE, J.D. AND HENKEL, R.L.: PHYS. REV. 98 (1955) 666. STOLER, P. ET AL.: PHYS. REV. C8 (1973) 1539. DAVIS, J.C. AND BARSCHALL, H.H.: PHYS. REV. C3 (1971) 1798. DILG, W. ET AL.: PHYS. LETT. 36B (1971) 208. CLEMENT, J.M. ET AL.: NUCL. PHYS. A183 (1972) 51. FOSTER, JR., D.G. AND GLASGOW, D.W.: PHYS. REV. C3(1971)576. HOLMBERG, M.: NUCL. PHYS. A129 (1969) 327. PAULETTA, G. AND BROOKS, F.D.: NUCL. PHYS. A255 (1975) 267. CATRON, H.C. ET AL.: PHYS. REV. 123 (1961) 218. ISHIKAWA, H.: NUCL. INSTR. METH. 109 (1973) 493. GUNN, J.C. AND IRVING, J.: PHIL. MAG. 42 (1951) 1353. EBENHOH, W.: NUCL. PHYS. A191 (1972) 97. REFERENCES 1) Зĺ 4 5 6 8) 9) 10) 11) 13 14)

MAT number = 225 2-HE- 3 JAERI JAERI-M 90-024 EVAL-JUN87 K.SHIBATA DIST-SEP89 REV2-JAN94 HISTORY HISTORY 87-06 NEWLY EVALUATED BY K.SHIBATA 94-01 MODIFIED BY K.SHIBATA FOR JENDL-3.2 *** MODIFIED PARTS FOR JENDL-3.2 (3,102),(12,102),(14,102) ADDED (3,3) (3,1) CALCULATED (3,1) SUM OF PARTIAL CROSS SECTIONS GENERAL INFORMATION DESCRIPTIVE DATA MF = 1MT=451 MF=2 MT=151 RESONANCE PARAMETERS SCATTERING RADIUS ONLY NEUTRON CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS AND RES. INTEGRALS 2200M/S (B) RES.INTEG (B) DTAL 5331.1 -ASTIC 3.135 -APTURE 5.401E-5 2.4691E-4 N,P) 5328.0 -MF=3TOTAL ELASTIC CAPTURE (N,P) MT = 1TOTAL BELOW 1 MEV, THE EXPERIMENTAL DATA /1/ WERE ANALYZED USING THE R-MATRIX THEORY. ABOVE 1 MEV, BASED ON EXPERIMENTAL DATA /2-4/. ABOVE 1 MEV, BASED ON EXPERIMENTAL DATA /2-4/. ELASTIC BELOW 1 MEV, THE EXPERIMENTAL DATA /1/ WERE ANALYZED USING THE R-MATRIX THEORY. ABOVE 1 MEV, (ELASTIC) = (TOTAL) - (NON ELASTIC) NON-ELASTIC SUM OF (3,102), (3,103) AND (3,104) 2 CAPTURE S- AND P-WAVE CAPTURE, BASED ON EXPERIMENTAL DATA /5,6,7/. 3 (N,P) BELOW 1 MEV, THE EXPERIMENTAL DATA /8/ WERE ANALYZED USING THE R-MATRIX THEORY. ABOVE 1 MEV, BASED ON EXPERIMENTAL DATA /9,10/. 4 (N,D) EVALUATION WAS PERFORMED ON THE BASIS OF EXPERIMENTAL DATA /9.10/. MT=2MT = 3MT=102 MT = 103MT = 104MT=251 MU-BAR CALCULATED FROM THE DATA IN FILE-4. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS ELASTIC BASED ON THE FOLLOWING EXPERIMENTAL DATA: 1.0E-5 EV TO 500 KEV : ISOTROPIC IN C.M. 1.0, 2.0, 3.5 MEV : SEAGRAVE ET AL. /11/ 5 TO 20 MEV : HAESNER /9/ MF=4 MT=2 PHOTON PRODUCTION MULTIPLICITY MF = 12MT=102 CAPTURE M=1.0 FOR THE TRANSITION TO G.S OF HE-4. F=14 PHOTON ANGULAR DISTRIBUTION MT=102 CAPTURE ASSUMED TO BE ISOTROPIC. MF = 14REFERENCES 1) ALFIMENKOV V.P. ET AL.: YAD. FIZ., 33, 891 (1981), TRANSLATION SOV. J. NUCL. PHYS., 33, 467 (1981). 2) LOS ALAMOS PHYSICS AND CRYOGENICS GROUPS: NUCL. PHYS., 12, LÓS ALAMOS PHYSICS AND CRYOGENICS GROUPS: NUCL. PHYS., 12, 291 (1959). GOULDING C.A. ET AL.: NUCL. PHYS., A215, 253 (1973). HAESNER B. ET AL.: PHYS. REV., C28, 995 (1983). WOLFS F.L.H. ET AL.: PHYS. REV. LETT., 63, 2721 (1989). WELVELMAN R. ET AL.: NUCL. SCI. ENG., 102, 428 (1989). WARD L. ET AL.: PHYS. REV., C24, 317 (1981). BORZAKOV S.B. ET AL.: YAD. FIZ., 35, 532 (1982), TRANSLATION SOV. J. NUCL. PHYS., 35, 307 (1982). HAESNER B.: KFK-3395 (1982). DROSG M.: DEDUCED FROM INVERSE REACTION, LA-7269-MS (1978). SEAGRAVE J.D. ET AL.: PHYS. REV., 119, 1981 (1961). 3) ă١ 5 Ì 6) Ś١ 9) 10í (11)

MAT number = 228 2-HE- 4 JAERI EVAL-FEB87 K.SHIBATA DIST-SEP89 HISTORY 87-02 NEWLY EVALUATED BY K.SHIBATA F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MF = 1F=2 RESONANCE PARAMETERS MT=151 SCATTERING RADIUS ONLY MF=2CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS TOTAL 0.7593 BARN ELASTIC 0.7593 BARN MF=3 MT=1,2 SIG-T, SIG-EL EXPERIMENTAL DATA /1/-/6/ WERE ANALYZED USING THE R-MATRIX THEORY. MT=251 MU-BAR CALCULATED FROM THE DATA IN FILE-4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS ELASTIC R-MATRIX CALCULATIONS MF = 4MT=2 REFERENCES 1) GOULDING, C.A. ET AL.: NUCL. PHYS. A215, 253 (1973). 2) HAESNER, B. ET AL.: PHYS. REV. C28, 995 (1983). 3) BATTAT, M.E. ET AL.: NUCL. PHYS. 12, 291 (1959). 4) AUSTIN, S.M. ET AL.: PHYS. REV. 126, 1532 (1962). 5) LAMAZE, G.P. ET AL.: TAKEN FROM EXFOR (1979). 6) MORGAN, G.L. AND WALTER, R.L.: PHYS. REV. 168, 1114 (1968).

MAT number = 32 3-LI- 6 JAERI JAERI-M 88-164 HISTORY 325 EVAL-MAR85 S.CHIBA AND K.SHIBATA DIST-SEP89 REV2-DEC93 NEWLY EVALUATED BY K.SHIBATA DATA OF MF=4 (MT=16,91) AND MF=5 (MT=16,91) WERE REVISED. COMMENT WAS ALSO MODIFIED. MODIFIED BY S. CHIBA DATA OF MF=3 (MT=59,63) AND MF=4 (MT=59,63) WERE ADDED. DATA OF MF=3 (MT=16), MF=4 (MT=2,16,53), MF=5 (MT=16) WEDE DEVISED 83-12 84-07 85-03 WERE REVISED. WERE REVISED. PSEUDO-LEVEL REPRESENTATION WAS ADOPTED FOR THE (N,N')ALPHA-D CONTINUUM (MT=51,52,54-56,58,60-62,64-86). MODIFIED BY S. CHIBA FOR JENDL-3.2 DATA OF MF=3 (MT=2,3,4,54-56,58,82) AND MF=4 (MT=16,51,52, 54-58,60-86) WERE ADJUSTED MAMUALLY TO REPRODUCE THE DDX DATA AT 14 AND 18 MEV /1,2,3/. 93-12

 MODIFIED PARTS FOR JENDL-3.2

 (3,2),(3,3),(3,4),(3,54-56),(3,58-82)
 ABOVE 10 MEV

 (4,16),(4,51-52),(4,54-58),(4,60-86)

 MF=1 MT=451 GENERAL INFORMATION DESCRIPTIVE DATA RESONANCE PARAMETERS SCATTERING RADIUS ONLY. MF=2 MT=151
 CROSS SECTIONS

 CALCULATED 2200M/S CROSS SECTIONS AND RES. INTEGRALS

 2200M/S (B)

 RES. INTEG. (B)

 TOTAL
 94.11

 ELASTIC
 0.735

 CAPTURE
 0.039

 0.017
 94.03
 MF=3TOTAL ELASTIC CAPTURE (N,T) (N,T) 94.03
SIG-T
BELOW 1 MEV BASED ON THE R-MATRIX CALCULATION. SIG-CAP
WAS ADDED TO THE CALCULATED CROSS SECTION.
ABOVE 1 MEV, BASED ON THE EXPERIMENTAL DATA /4,5,6/.
SIG-EL
BELOW 1 MEV, BASED ON THE R-MATRIX CALCULATION.
ABOVE 1 MEV, THE CROSS SECTION WAS OBTAINED BY SUBTRACTING
THE REACTION CROSS SECTION FROM THE TOTAL CROSS SECTION.
NON-ELASTIC
SUM OF MT=4, 16, 102, 103 AND 107.
TOTAL INELASTIC
SUM OF MT=51, 52, 53, 54 AND 91.
(N,2N)LI5
BASED ON THE EXPERIMENTAL DATA /1,2,3,6,10,11,12,13/.
SIG-IN 2.185 MEV
BASED ON THE EXPERIMENTAL DATA /1,2,3,6,10,11,12,13/.
SIG-IN 3.562 MEV
BASED ON THE EXPERIMENTAL DATA /1,2,3,6,14/
SIG-IN 4.31 MEV
BASED ON A COUPLED-CHANNEL CALCULATION. THE SYMMETRIC
ROTATIONAL MODEL WAS ASSUMED. THE COUPLING SCHEME WAS
1+(G,S) - 3+(2.185) - 2+(4.31) - 1+(5.7).
THE POTENTIAL PARAMETERS WERE;
V = 45.0766 MEV, R = 1.1875 FM, A = 0.57335 FM
WS = 0.4432*EL-1.1631 MEV, RI= 1.6113 FM, AI = 0.26735 FM
WS = 0.4432*EL-1.1631 MEV, RI= 1.615 FM, ASO= 0.5 FM
BETA(2) = 1.1395.
WHERE EL MEANS THE INCIDENT NEUTRON ENERGY IN THE LAB.
SYSTEM (MEV).
ABOVE 10 MEV, BASED ON EXPERIMENTAL DATA /1,2,3/.
SIG-IN 5.7 MEV
BASED ON THE CC CALCULATION NORMALIZED TO THE EXPERIMENTAL DATA /1,2,3/.
SIG-IN 5.7 MEV
BASED ON THE CC CALCULATION NORMALIZED TO THE EXPERIMENTAL DATA /1,2,3/.
SIG-IN 5.7 MEV
BASED ON THE CC CALCULATION NORMALIZED TO THE EXPERIMENTAL DATA /1,2,3/.
SIG-IN 5.7 MEV
BASED ON THE CC CALCULATION NORMALIZED TO THE EXPERIMENTAL DATA /1,2,3/.
SIG-IN 5.7 MEV
BASED ON THE CC CALCULATION NORMALIZED TO THE EXPERIMENTAL DATA /1,2,3/.
SIG-IN 5.7 MEV MT = 1MT=2MT=3MT = 4MT = 16MT = 53MT = 57MT = 59MT = 63DATA /9/. ABOVE 10 MEV, BASED ON EXPERIMENTAL DATA /1,2,3/. MT=51,52,54-56,58,60-62,64-86 (N,N')ALPHA-D CONTINUUM REPRESENTED BY PSEUDO-LEVELS, BINNED IN 0.5 MEV INTERVALS. THE (N,N')ALPHA-D CROSS SECTION WAS BASED ON THE MEASURE-MENT OF ROSEN AND STEWART /15/. THE CONTRIBUTION FROM MT=53, 59 AND 63 WAS SUBTRACTED SO THAT SIG-T MIGHT BE EQUAL TO THE SUM OF PARTIAL CROSS SECTIONS. THE CROSS SECTION FOR EACH LEVEL WAS CALCULATED BY THE 3-BODY PHASE-SPACE DISTRIBUTION WITH A CORRECTION OF THE COULOMB INTERACTION IN THE FINAL STATE, ASSUMING ISOTROPIC CENTER-OF-MASS DISTRIBUTIONS. ADJUSTED TO REPRODUCE THE DDX DATA AT 14 AND 18 MEV /1,2,3/

2 CAPTURE BELOW 100 KEV, 1/V CURVE NORMALIZED TO THE THERMAL DATA OF JURNEY /16/. ABOVE 100 KEV, THE INVERSE REACTION DATA OF FERDINANDE ET AL./17/ WERE ADDED. MT=102 PERDINANDE ET AL./17/ WERE ADDED. 3 (N,P) BASED ON THE EXPERIMENTAL DATA /18,19/. 5 (N,T)ALPHA BELOW 1 MEV, R-MATRIX CALCULATION. ABOVE 1 MEV, BASED ON THE EXPERIMENTAL DATA /20,21/. 1 MU-BAR 0 ALOULATED FROM THE DATA IN FILE 4 MT = 103MT = 105MT=251 CALCULATED FROM THE DATA IN FILE4. MF=4 MT=2 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS BELOW 500 KEV, R-MATRIX CALCULATION. BETWEEN 500 KEV AND 14 MEV, BASED ON THE EXPERIMENTAL DATA /4,10,22/. ABOVE 15 MEV, BASED ON THE CC CALCULATION. MT = 16BASED ON THE EXPERIMENTAL DATA /1,2,3,9/. ANGULAR DISTRIBUTIONS ARE GIVEN IN THE LABORATORY SYSTEM. MT = 53BELOW 4.8 MEV, ASSUMED TO BE ISOTROPIC IN CM. BETWEEN 4.8 AND 14 MEV, BASED ON THE EXPERIMENTAL DATA /10,23/. ABOVE 15 MEV, THE CC CALCULATION. MT = 57BASED ON EXPERIMENTAL DATA /1,2,3/. MT = 59BASED ON THE CC CALCULATION. MT = 63BASED ON EXPERIMENTAL DATA /1,2,3/. MT=51,52,54-56,58,60-62,64-86 ADJUSTED TO REPRODUCE THE DATA /1,2,3/. MF=5 MT=16 ENERGY DISTRIBUTION OF SECONDARY NEUTRONS THE EVAPORATION MODEL WAS ASSUMED. THE EVAPORATION TEMPERATURE OF REF./9/ WAS ADOPTED. IT WAS EXTRAPOLATED AS T T = 0.176497*SQRT(EL) MEV, WHERE EL MEANS THE INCIDENT NEUTRON ENERGY IN THE LAB. SYSTEM (MEV). PHOTON-PRODUCTION MULTIPLICITIES MF = 12MT=57 M=1.0 MT=102^{marched} BASED ON THE THERMAL MEASUREMENT OF JURNEY /15/. PHOTON ANGULAR DISTRIBUTIONS MF = 14MT=57 ISOTROPIC MT=102 ASSUMED TO BE ISOTROPIC. ASSUMED TO BE ISOIROPIC. REFERENCES 1) TAKAHASII A. ET AL., TO BE PUBLISHED. 2) MATSUYAMA S. ET AL., TO BE PUBLISHED. 3) CHIBA S. ET AL., PPROC OF MITO CONF, P.253(1988). 4) KNITTER H.-H. ET AL.: EUR-5726E (1977). 5) LAMAZE G.P. ET AL.: BULL. AM. PHYS. SOC. 24 (1979) 862. 6) GUENTHER P. ET AL.: ANL/NDM-52 (1980). 7) MATHER D.S. AND PAIN L.F.: AWRE-0-47/69 (1969). 8) ASHBY V.J. ET AL.: PHYS. REV. 129 (1963) 1771. 9) CHIBA S. ET AL.: J. NUCL. SCI. TECHNOL. 22 (1985) 771. 10) HOGUE H.H. ET AL.: NUCL. SCI. TECHNOL. 22 (1985) 771. 11) LISOWSKI P.W. ET AL.: LA-8342 (1980). 12) FOERTSCH H. ET AL.: ZFK-443 (1981), P.13. 13) DRAKE D.D.: DOE/NDC-224/U (1981), P.72. 14) BESOTOSNYJ ET AL.: YK-19 (1975), P.77. 15) ROSEN L. AND STEWART L.: PHYS. REV. 126 (1962) 1150. 16) JURNEY E.T.: USNDC-9 (1973), P.109. 17) FERDINANDE H. ET AL.: NUCL. PHYS. A131 (1969) 679. 19) MERCHEZ F. ET AL.: NUCL. PHYS. A132 (1977) 428. 18) PRESSER G. ET AL.: NUCL. PHYS. A131 (1969) 679. 19) MERCHEZ F. ET AL.: NUCL. PHYS. A330 (1979) 1. 21) BARTLE C.M.: NUCL. PHYS. A330 (1979) 1. 22) KNOX H.D. ET AL.: NUCL. SCI. ENG. 69 (1979) 223. 23) HOPKINS J.C. ET AL.: NUCL. PHYS. A107 (1968) 139.

MAT number = 328 3-LI- 7 JAERI JAERI-M 88-164 EVAL-DEC84 S.CHIBA AND K.SHIBATA DIST-SEP89 REV2-NOV92 HISTORY
B3-12 NEWLY EVALUATED BY K.SHIBATA
84-07 DATA OF MF=4 (MT=16,91) AND MF=5 (MT=16,91) WERE REVISED. COMMENT WAS ALSO MODIFIED.
84-12 MODIFIED BY S. CHIBA DATA OF MT=62 AND 64 (MF=3,4) WERE ADDED. DATA OF MF=4 (MT=2,51,57,16) AND MF=5 (MT=16,91) WERE MODIFIED. PSEUDO-LEVEL REPRESENTATION WAS ADOPTED FOR THE (N,N')ALPHA-T CONTINUUM (MT=52-56,58-61,63,65-84). COMMENT WAS ALSO MODIFIED.
87-02 L17(N,NT) CROSS SECTION WAS MODIFIED.
88-02 L17(N,NC) CROSS SECTION AND ANG. DIST. WERE MODIFIED. LI7(N,NO) WAS ALSO MODIFIED SO AS TO GIVE THE TOTAL CROSS SECTION WHICH IS EQUAL TO JENDL-3PR1. THE L17(N,N1) ANG. DIST. WAS ALSO MODIFIED. L17(N,NT) CROSS SECTION WAS FIXED TO 87-02 VERSION BY MODIFYING THE PSEUDO-LEVEL CROSS SECTIONS. COMMENT WAS ALSO MODIFIED.
92-11 JENDL-3.2 COMPILED BY T.NAKAGAWA HISTORY * GENERAL INFORMATION DESCRIPTIVE DATA MF = 1MT=451 RESONANCE PARAMETERS SCATTERING RADIUS ONLY. MF=2MT=151 CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS AND RES. I 2200 M/S (B) RES. INTEG. (B) TOTAL 1.015 ELASTIC 0.97 CADETUDE 0.045 0.020 MF = 3INTEGRALS TOTAL ELASTIC CAPTURE ELASTIC 0.9/ CAPTURE 0.045 0.020
MT=1 SIG-T BELOW 100 KEV, SIG-T = 0.97 + SIG-CAP (BARNS). ABOVE 100 KEV, BASED ON THE EXPERIMENTAL DATA /1/-/4/. SIG-EL BELOW 100 KEV, SIG-EL = 0.97 (BARNS). ABOVE 100 KEV, SIG-EL = 0.97 (BARNS). MIT=4
MON-ELASTIC SUM OF MT=4.16, 102 AND 104. TOTAL INELASTIC SUM OF MT=51 TO 84.
MT=41 (N, 2N) BASED ON THE EXPERIMENTAL DATA /5/,/6/.
MT=51 SIG-IN 0.478 MEV BASED ON THE KPRENMENTAL DATA /5/,/6/.
MT=57 SIG-IN 4.63 MEV BASED ON THE EXPERIMENTAL DATA /8/-/10/.
MT=62 SIG-IN 6.68 MEV BASED ON THE EXPERIMENTAL DATA /8/-/10/.
MT=62 SIG-IN 6.68 MEV BASED ON A COUPLED-CHANNEL CALCULATION NORMALIZED TO THE EXPERIMENTAL DATA /13,14/. THE SYMMETRIC ROTATIONAL MODEL WAS ASSUMED. THE COUPLING SCHEME WAS 3/2-(G.S.) - 1/2-(0.478) - 7/2-(4.63) - 5/2-(6.68). THE POTENTIAL PARAMETERS WERE AS FOLLOWS; V = 49.6 - 0.3622*L MEV, R = 1.28 FM, A = 0.620 FM WS= -13.2 + 1.88*EL MEV, R = 1.28 FM, A = 0.104 FM VSO= 5.500 MEV, RSO=1.150 FM, ASO=0.50 FM
BETA(2) = 0.952, WHERE EL MEANS LABORATORY INCIDENT ENERGY IN MEV.
MT=64 SIG-IN 7.467 MEV ASSUMED TO HAVE THE SAME EXCITATION FUNCTION AS MT=53, NORMALIZED TO THE EXPERIMENTAL DATA /13.14/.
MT=52-565 S8-61 G3, 65-84, (N, N') ALPHA-T CONTINUUM REPRESENTED BY PSEUDO-LEVELS, BINNED IN 0.5 MEV INTERVALS. THE CROSS SECTION WAS OBTAINED DR SUBTRACTING THE CONTRIBUTION OF MT=57, 62 AND 64 FROM THE (N, N') ALPHA-T CROSS SECTION (MT=205). THE CROSS SECTION FOR EACH LEVEL WAS CALCULATED TO THE 3.BODY PHASE-SPACE DISTRIBUTION WITH A CORRECTION OF THE COULOMB INTERACTION IN THE FINAL STATE.
MT=102 CAPTURE
MT=102 CAPTURE 0.045 0.020 STATE. MT=102 CAPTURE 1/V NORMALIZED TO THE THERMAL MEASUREMENT /15/. MT=104 (N,D)

THE (N,D) CROSS SECTION WAS CALCULATED WITH DWBA. NORMALIZATION WAS TAKEN SO THAT THE CALCULATED CROSS SECTION MIGHT BE CONSISTENT WITH THE ACTIVATION DATA /16. MT=205 (N,N')ALPHA-T	1.
BASED ON THE EXPERIMENTAL DATA /17/-/22/. MT=251 MU-BAR CALCULATED FROM THE DATA IN FILE4.	
MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS	
MI=2 BELOW 4 MEV, AN R-MATRIX CALCULATION WITH THE PARAMETERS OF KNOX AND LANE/23/. BETWEEN 4 MEV AND 14 MEV, BASED ON THE EXPERIMENTAL DATA /8/,/24/.	
MT=16 BASED ON THE EXPERIMENTAL DATA /13/ AT 14 2 MEV	
ANGULAR DISTRIBUTIONS ARE GIVEN IN THE LABORATORY SYSTEM MT=51	•
4 TO 10 MEV, THE R-MAIRIX CALCULATION. 4 TO 10 MEV, EVALUATION OF LISKIEN/25/ WAS ADOPTED. ABOVE 10 MEV, THE COUPLED-CHANNEL CALCULATION.	
BELOW 8 MEV, THE R-MATRIX CALCULATION. BETWEEN 8 MEV AND 14 MEV, BASED ON THE EXPERIMENTAL DATA /10/-/12/-	
MT=62 AT THE THRESHOLD AN ISOTROPIC DISTRIBUTION WAS ASSUMED	
ABOVE 10 MEV, THE COUPLED-CHANNEL CALCULATION. MT=64	
ISOTROPIC DISTRIBUTIONS WERE ASSUMED IN THE CENTER-OF-MAS SYSTEM. MT=52-56,58-61,63,65-84 EXPERIMENTAL DATA/13/ WERE ADOPTED	SS
MF=5 ENERGY DISTRIBUTION OF SECONDARY NEUTRONS	
MT=16 THE EVAPORATION MODEL WAS ASSUMED, WITH THE TEMPERATURE DEDUCED EXPERIMENTALLY/13/ AT 14.2 MEV. THE TEMPERATURE	
T = 0.229 * SQRT(EL) MEV. WHERE EL MEANS LABORATORY INCIDENT ENERGY IN MEV.	
MF=12PHOTON-PRODUCTION MULTIPLICITIES	
MI=51 M=1.0 MT=102 MULTIPLICITIES WERE OBTAINED FROM REF /26/	
ME=14 PHOTON ANGULAR DISTRIBUTIONS	
MT=51 ISOTROPIC MT=102	
REFERENCES	
 T) MEADOWS J.W. AND WHALEN J.F.: NUCL. SCI. ENG. 41 (1970) 351. 2) FOSTER, JR. D.G. AND GLASGOW D.W.: PHYS. REV. C3 (1971) 576. 3) GOULDING C.A. ET AL.: USNDC-3 (1972), P.161. 4) LAMAZE G.P. ET AL.: BULL. AM. PHYS. SOC. 24 (1979) 862. 5) MATHER D.S. AND PAIN L.F.: AWRE-0-47/69 (1969). 6) ASHBY V.J. ET AL.: PHYS. REV. 129 (1963) 1771. 7) MORGAN G.L.: ORNL/TM-6247 (1978). 	
 B) HOGUE H.H. ET AL.: NUCL. SCI. ENG. 69 (1979) 22. BABA M. ET AL.: PROC. INT. CONF. NUCLEAR CROSS SECTIONS FOR TECHNOLOGY, KNOXVILLE, 1979, (1980) P.143. 	
10) LISOWSKI P.W. EL AL.: LA-8342 (1980). 11) SCHMIDT D. ET AL.: NUCL. SCI. ENG. 96 (1987) 159. 12) CHIBA S. ET AL.: J. NUCL. SCI. TECHNOL. 25 (1988) 210. 13) CHIBA S. ET AL.: J. NUCL. SCI. TECHNOL. 22 (1985) 771.	
15) JURNEY E.T.: USNDC-9 (1973), P.109. 16) BATTAT M.E. AND RIBE F.L.: PHYS. REV. 89 (1953) 80. 17) SMITH D.L. ET AL.: NUCL. SCI. ENG. 78 (1981) 359.	
18) LISKIEN H. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, ANTWERP 1982, (1983) P.349. 19) SMITH D.L. ET AL.: ANL/NDM-87_(1984).	
20) TAKAHASHI A. ET AL.: PROC. 13TH SYMP. FUSION TECH., VARESE, ITALY (1984)	
21) GOLDBERG E. ET AL.: NUCL. SCI. ENG. 91, 1/3 (1985). 22) MAEKAWA H. ET AL.: JAERI-M 86-125, P.130 (1986).	

23) KNOX H.D. AND LANE R.O.: NUCL. PHYS. A359 (1981) 131.
24) KNOX H.D. ET AL.: NUCL. SCI. ENG. 69 (1979) 223.
25) LISKIEN H.: PRIVATE COMMUNICATION.
26) AJZENBERG-SELOVE F. AND LAURITSEN T.: NUCL. PHYS. A227(1974)1.

MAT number = 425 4-BE- 9 JAERI JAERI-M 84-226 HISTORY EVAL-AUG84 K.SHIBATA DIST-SEP89 REV1-OCT90 84-08 REEVALUATED FOR JENDL-3 BY K.SHIBATA. DETAILS OF THE EVALUATION ARE GIVEN IN REF/1/. 89-01 MODIFIED BY CONSIDERING NEUTRON EMISSION SPECTRA 90-10 MF=5, MT=16, 24, 46, 47: SPECTRA AT THRESHOLD ENERGIES WERE MODIFIED. GENERAL INFORMATION DESCRIPTIVE DATA MF = 1MT=451 RESONANCE PARAMETER SCATTERING RADIUS ONLY. MF=2MT=151 CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS AND RES. INTEGRALS 2200M/S (B) RES. INTEG. (B) MF = 3TOTAL ELASTIC CAPTURE 6.1586 6.1510 0.0076 0.0034 CAPTURE0.00760.0034SIG-TBELOW 1 EV, SUM OF SIG-EL AND SIG-CAP. BETWEEN 1 EV AND830 KEV, THE CROSS SECTION WAS CALCULATED ON THE BASIS OFTHE R-MATRIX THEORY. THE R-MATRIX PARAMETERS WEREOBTAINED SO AS TO GIVE THE BEST FIT TO THE EXPERIMENTALDATA /2/-/6/. ABOVE 830 KEV, BASED ON THE MEASUREMENTS/5/,/7/,/8/.SIG-ELBELOW 1 EV, SIG-EL = 6.151 BARNS.ABOVE 1 EV, THE CROSS SECTION WAS OBTAINED BY SUBTRACTINGTHE REACTION CROSS SECTION FROM THE TOTAL CROSS SECTION.NON-ELASTICSUM OF MT=51 AND 52.7, 16, 51, 52THE SHAPE OF THE INELASTIC SCATTERING CROSS SECTION WASOBTAINED FROM THE STATISTICAL MODEL CALCULATION. THEABSOLUTE VALUE WAS DETERMINED SO THAT A SUM OF THEINELASTIC SCATTERING AND (N, A1) REACTION CROSS SECTIONSMIGHT BE EQUAL TO THE (N, 2N) REACTION CROSS SECTION INJENDL-2. OPTICAL POTENTIAL PARAMETERS OF AGEE AND ROSEN/9/ WERE USED.V = 49.3 - 0.33E, WS = 5.75 , VSO = 5.5 (MEV)R = 1.25 , RS = 1.25 , RSO = 1.25 (FM)A = 0.65 , B = 0.70 , ASO = 0.65 (FM)LEVEL SCHEMENOENERGY(MEV)SPIN-PARITYG.S.0.0SPIN-PARITYG.S.0.0 MT = 1MT=2MT=3MT = 4MT = 6, SPIN-PARITY 3/2-1/2+ 5/2-1/2+ NŌ ENERGY(MEV) G.S. 0.0 0.0 1.68 2.429 2.800

 2:429
 5/2

 3
 2:800
 1/2+

 4
 3:06
 5/2+

 5
 4:7
 3/2+

 6
 6:8
 7/2

 7
 7.9
 5/2-*

 9
 11:28
 9/2-*

 10
 13:79
 5/2-*

 11
 14:396
 3/2-*

 *)
 SPIN-PARITY VALUE WAS TENTATIVELY ASSIGNED.

 ALL THE EXCITED LEVELS EXCEPT 7.9 AND 13:79 MEV ONES

 DECAY BY EMITTING NEUTRONS, CONTRIBUTING TO THE (N,2N)

 CROSS SECTION.
 WITHIN THE FRAMEWORK OF THE CURRENT

 ENDF/B FORMAT, DIFFERENT MT NUMBERS WERE ASSIGNED TO

 THESE LEVELS.
 MT NO.

 6
 2ND COST

 1 2 3 67 * THE (N,2N) CROSS SECTIONS IS GIVEN AS A SUM OF MT=6, 7, * 16, AND 24. (N,2N ALPHA) THIS IS THE CROSS SECTION FOR THE (N,A1) REACTION. THE 1ST EXCITED LEVEL OF HE-6 DECAYS BY EMITTING 2 NEUTRONS. MT=24

THE (N,A1) CROSS SECTION WAS CALCULATED WITH THE STATISTICAL MODEL. STATISTICAL MODEL. ALPHA POTENTIAL PARAMETERS ARE THE FOLLOWING /10/: V = 125.0, WS = 15.0, VS0 = 0.0 (MEV) R = 1.56, RS = 1.56, RC = 1.22 (FM) A = 0.50, B = 0.11 (FM) THE CROSS SECTION WAS NORMALIZED TO THE DATA OF PERROUD AND SELLEM /11/ AT 14 MEV. MT=46, 47 SIG-IN SAME AS MT=6, 7, RESPECTIVELY. MT=102 CAPTURE (MEV) (FM) SAME AS MT=6, 7, RESPECTIVELY. 2 CAPTURE THERMAL CROSS SECTION OF 7.6E-3 BARN WAS OBTAINED FROM THE RECOMMENDATION BY MUGHABGHAB ET AL./12/ 1/V CURVE WAS ASSUMED OVER THE WHOLE ENERGY RANGE. 3 (N,P) CALCULATED WITH THE STATISTICAL MODEL. PROTON POTENTIAL PARAMETERS ARE THE FOLLOWING /13/: V = 59.5 - 0.36E, WS = 12.0 + 0.07E, VSO = 4.9 (MI R = 1.24 , RS = 1.36 , RSO = 1.2 (FI RC= 1.3 MT=102 MT = 103(MEV) (FM) (FM) (FM) RC = 1.3A = 0.63THE CROSS S A = 0.63THE CROSS SECTION WAS NORMALIZED TO THE EXPERIMENTAL OF AUGUSTSON AND MENLOVE /14/, WHO MEASURED DELAYED NEUTROS, BY TAKING ACCOUNT OF THE BRANCHING RATIO OF 49.5% FOR LI-9 => BE-9* => 2A + N. `DÄŤA UF 49.5% FOR LI-9 => BE-9 => 2A + N. 4 (N,D) 5 (N,T) 5 UM OF MT=740 AND 741. 7 (N,AO) BASED ON THE EXPERIMENTAL DATA /10/,/11/,/16/-/19/. 1 MU-BAR CALCULATED FROM THE DATA IN ELLEA MT = 104MT=105 MT = 107MT=251 MU-BAR CALCULATED FROM THE DATA IN FILE4. MT=740, 741 (N,T0),(N,T1) CALCULATED WITH THE STATISTICAL MODEL. TRITON POTENTIAL PARAMETERS ARE THE FOLLOWING /20/: V = 140.0, WS = 7.5, VSO = 6.0 (MEV) R = 1.20, RS = 2.69, RSO = 1.20, RC = 1.30 (FM) A = 0.45, B = 0.36, ASO = 0.7 (FM) NORMALIZATION WAS TAKEN SO THAT THE TOTAL (N,T) CROSS SECTION MIGHT BE CONSISTENT WITH THE EXPERIMENTAL DATA OF BOEDY ET AL./21/ MT=251 (MEV) (FM) MF = 4ANGULAR DISTRIBUTIONS MT=2ISOTROPIC IN CM. BASED ON THE EXPERIMENTAL DATA /22/-/27/. OPTICAL-MODEL CALCULATIONS USING THE POTENTIAL PARAMETERS OF 1.0E-5 EV TO 50 KEV 50 KEV TO 14 MEV 14 MEV TO 20 MEV AGEE AND ROSEN /9/. MT=6LEGENDRE COEFFICIENTS WERE DERIVED FROM THE EXPERIMENTAL DATA /27/,/28/. MT = 7STATISTICAL MODEL CALCULATION MT = 16KALBACH-MANN SYSTEMATICS/31/ MT=24, 46, 47 CALCULATED BY ASSUMING THE TWO-STEP SEQUENTIAL REACTION /29/. MF = 5ENERGY DISTRIBUTION MŤ=16 EVAPORATION PLUS 3-BODY PHASE SPACE MT=24, 46, 47 CALCULATED BY ASSUMING THE TWO-STEP SEQUENTIAL REACTION /29/. PHOTON-PRODUCTION MULTIPLICITIES MF = 12MT = 102BASED ON THE MEASUREMENT OF JURNEY /30/. MT=741 M = 1.0MF = 14PHOTON ANGULAR DISTRIBUTIONS MT = 102ASSUMED TO BE ISOTROPIC. MT = 741ISOTROPIC REFERENCES

1)	SHIBATA, K.: JAERI-M 84-226 (1984).
2)	BOCKELMÁN, C.K.: PHYS. REV. 80 (1950) 1011.
3)	HIBDON, C.T. AND LANGSDORF, JR., A.: PHYS. REV. 98 (1955) 223.
4)	BILPUCH, E.G. ET_AL.: TAKEN FROM EXFOR (1962).
5)	SCHWARIZ, R.B. EL AL.: BULL, AM. PHYS. SOC. 16 (1971) 495.
5	CABE, J AND CANCE, M.: CEA-K-4524 (1973).
{}	FUSIER, JR. D.G. AND GLASGOW, D.W. PHIS. Rev. GS (1971) 576.
8	ACCE E D AND ROSEN I \cdot 14.3538-MS (1966)
101	SHIBATA K AND SHIRATO S J PHYS SOC IPN 52 (1983) 3748
iĭſ	PERROUD, I.P. AND SELLEM CH · NUCL PHYS A227 (1974) 330
iżí	MUGHABGHAB. S.F. ET AL.: NEUTRON CROSS SECTIONS VOL.1.
,	ACADEMIC PRESS, 1981.
13)	VOTAVA, H.J. ET AL.: NUCL. PHYS. A204 (1973) 529.
14)	AUGUSTSON, R_H. AND MENLOVE, H.O.; NUCL. SCI. ENG. 54(1974)190
15)	SCOBEL, W.: Z. NATURFORSCH. A24 (1969) 289. (1950) 00
16)	BALLAL, M.E. AND RIBE, F.L.: NUCL. PHYS. 89 (1953) 80.
16	BASS D ET AL AND CAMPBELL, E.C., NUCL. PHYS. 100 (1957) 1252.
	$PAIC G = T AI \cdot NUCL PHYS AGG (1907) 122.$
201	
211	BOEDY. Z'T, ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE
,	AND TÉCHNOLOGY. ANTWERP 1982. (1983). P.368.
22)	MARION, J.B. ET AL.: PHYS. RÉV. 1147 (1959) 1584.
23)	LEVIN, J.S. AND CRANBERG, L.: TAKEN FROM EXFOR (1960).
24)	PHILLIPS, D.D.: TAKEN FROM EXFOR (1961).
25)	LANE, R.O. EL AL.: ANN, PHYS. 12 (1961) 135.
26	LANE, R.U. ELAL: PHYS. REV. 133B (1964) 409.
21	DADA M ET AL . NUCL. SCI. ENG. 00 (1970) 30.
20)	DATA, MI. ELACTORS AND OTHER APPLIED PURPOSES HARWELL 1978
	(1979) P 198
29)	BEYNON' T.D. AND OASTLER. A.J.: ANN. NUCL. ENERGY 6(1979)537.
305	JŪRNĖY, Ė.T.: PROČ. THĪRD SYMP. NEUTRON ČAPTŪRĖ GAMMA RAYŠ.
	BNL 1978, (1979), P.46.
~	

MAT number = 525 5-B - 10 JAERI EVAL-MAR87 S.CHIBA DIST-SEP89 HISTORY NEWLY EVALUATED BY S.CHIBA (JAERI) FOR JENDL-3. DATA FOR MF=3(MT=1,2,3,4,51,103,107,113,780,781) WERE MODIFIED. DATA FOR MF=12(MT=102,781), MF=13(MT=4,103), MF=14(MT=4,102,103,781) WERE ADDED. COMMENT WAS ALSO MODIFIED. 87-03 88-11 GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 RESONANCE PARAMETERS SCATTERING RADIUS ONLY. THE 2200M/S AND 14 MEV CROSS SECTIONS ARE IN TABLE 1. MF=2MT = 151MF=3NEUTRON CROSS SECTIONS NEUTRON CROSS SECTIONS TOTAL BELOW 1.2 MEV, SUM OF THE PARTIAL CROSS SECTIONS. 1.2 TO 17 MEV, BASED ON THE EXPERIMENTAL DATA /1/-/9/. ABOVE 17MEV, OPTICAL MODEL CALCULATION WAS NORMALIZED AT 17 MEV. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS/10/ ARE LISTED IN TABLE 2. ELASTIC SCATTERING BELOW 10 KEV, BASED ON THE R-MATRIX CALCULATION. THE R-MATRIX PARAMETERS ARE MAINLY BASED ON REF./11/. 10 KEV TO 1.2 MEV, BASED ON THE EXPERIMENTAL DATA /12/-/14/ MT = 1MT=2R-MATRIX PARAMETERS ARE MAINLY BASED ON REF./11/. 10 KEV TO 1.2 MEV, BASED ON THE EXPERIMENTAL DATA /12/-/14/. ABOVE 1.2 MEV, CALCULATED BY SUBTRACTING ALL THE OTHER PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=3 NON-ELASTIC SUM OF MT=4, 16, 102, 103, 104, 107 AND 113. MT=4 TOTAL INELASTIC SUM OF MT=51 TO 89. MT=16 (N.2N) BASED ON THE EXPERIMENTAL DATA /15/. CROSS SECTION WAS EXTRAPOLATED AS 0.0120*SQRT(E-ETH). WHERE E IS INCIDENT NEUTRON ENERGY AND ETH THRESHOLD ENERGY IN MEV. NOTE THAT THIS REACTION PRODUCES 1 PROTON AND 2 ALPHA PARTICLES, I.E. (N.2NP)2ALPHA. MT=51-59, 61, 62, 64-66. INELASTIC SCATTERING TO REAL LEVELS CROSS SECTIONS WERE CALCULATED BY THE COLLECTIVE MODEL DWBA AND NORMALIZED TO THE EXPERIMENTAL DATA/16/ AT 14 MEV. CALCULATED LEVELS AND ASSUMED ORBITAL ANGULAR MOMENTUM TRANSFERS (L) ARE SUMMARIZED IN TABLE 3. DATA FOR MT=51 WAS NORMALIZED TO THE EXPERIMENTAL DATA/T7/ BELOW GMEV. ABOVE GMEV. THE DEFORMATION PARAMETER DEDUCED FROM (P.P') REACTION/18/ WAS USED. MT=60,63,67-89 (N,N'D)2ALPHA CONTINUUM. REPRESENTED BY PSEUDO-LEVELS, BINNED IN 0.5 MEV INTERVALS. THE (M,N'D)2ALPHA CONTINUUM. MT=60,63,67-89 (N,N'D)2ALPHA CONTINUM. MT=60,63,67-89 (N,N'D)2ALPHA CONS SECTION FOR EACH LEVEL WAS CALCULATED BY THE 3.BODY PHASE SPACE DISTRIBUTION. ASSUMING ISOTROPIC CENTER-OF-MASS ANGULAR DISTRIBUTIONS. MT=102 (APTURE 1/V SHAPE WAS NORMALIZED TO THE EXPERIMENTAL DATA /20/. MT=103 (N,P) SUM OF MT = 700 TO 705. MT=104 (N,D) SUM OF MT = 720 AND 721. MI=103 (N,P) SUM OF MT = 700 TO 705. MT=104 (N,D) SUM OF MT = 720 AND 721. MT=107 (N,ALPHA) SUM OF MT = 780 AND 781. THE THERMAL CROSS SECTION OF 3837 BARNS WAS ADOPTED/21/. MT=113 (N,T)2ALPHA BASED ON THE EXPERIMENTAL DATA /19/,/22/-/29/ MT=251 MU-BAR CALCULATED FROM THE DATA IN FILE4. MT=700 (N,P) TO THE GROUND STATE OF BE-10. BELOW 100 KEV, ASSUMED TO BE 1/V. THE THERMAL CROSS SECTION WAS ASSUMED TO BE 3MB/30/. FROM 100 KEV TO 500 KEV, ASSUMED TO BE CONSTANT. FROM 500 KEV TO 1 MEV, LINEARLY INTERPOLATED. ABOVE 1 MEV, THE STATISTICAL MODEL CALCULATION WAS NORMALIZED BY A FACTOR OF 0.704. THE OPTICAL POTENTIAL LEVEL SCHEMES AND LEVEL DENSITY PARAMETERS USED IN THE CALCULATION ARE SUMMARIZED IN TABLES 2, 3 AND 4. MT=701-705 (N,P) TO THE LOW LYING EXCITED STATES OF BE-10. THE STATISTICAL MODEL CALCULATION WAS NORMALIZED TO THE EXPERIMENTAL DATA/26/ AT 14 MEV. POTENTIAL.

MT=720 7327 WERE CONVERTED BY THE PRINCIPLE OF DETAILED BALANCE. FROM 7.6 TO 14 MEV, INTERPOLATED LINEARLY. ABOVE 14 MEV, DWBA CALCULATION WITH THE PROTON PICKUP MECHANISM WAS NORMALIZED TO THE EXPERIMENTAL DATA, 733/-7347 AT 14 MEV. THE D + BE-9 AND BOUND PROTON POTENTIALS OF VALKOVIC+7347 WERE USED. DEPTH OF THE PROTON POTENTIAL WAS SEARCHED BY THE SEPARATION ENERGY METHOD. THE POTENTIAL PARAMETERS ARE LISTED IN TABLE 2. METHOD. THE POTENIIAL PARAMETERS ARE LISTED IN TABLE 2. MT=721 (N,D2) DWBA CALCULATION WITH THE PROTON PICKUP MECHANISM WAS NORMALIZED TO THE EXPERIMENTAL DATA/26/,/33/-/34/ AT 14 MEV. THIS IS REALLY THE (N,D) REACTION TO THE SECOND LEVEL OF BE-9. MT=780, (N,ALPHA0) BELOW 10 KEV, R-MATRIX CALCULATION. FROM 10 KEV TO 800 KEV, BASED ON THE EXPERIMENTAL DATA /35/-/36/. FROM 800 KEV TO 7.5 MEV, THE EXPERIMENTAL DATA/37/ WERE NORMALIZED BY A FACTOR OF 1.38 AND FITTED BY THE SPLINE FUNCTION. NORMALIZED BY A FACTOR OF 1.38 AND FITTED BY THE SPLINE FUNCTION. ABOVE 7 MEV, THE EXPERIMENTAL DATA/26/ WERE ADOPTED. ((N,ALPHA1) BELOW 10 KEV, THE R-MATRIX CALCULATION. FROM 10 KEV TO 100 KEV, BASED ON THE EXPERIMENTAL DATA/36/ /38/. MT=781 /38/. FROM 100 KEV TO 2 MEV, RECOMMENDATION BY LISKIEN AND WATTECAMPS/39/ WAS ADOPTED. FROM 2 TO 7.5 MEV, THE EXPERIMENTAL DATA/37-40/ WERE NORMALIZED BY A FACTOR OF 1.38 AND FITTED BY THE SPLINE ABOVE 7 MÉV, THE EXPERIMENTAL DATA/40/ WAS ADOPTED. MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS $M\dot{T}=2$ BELOW 100 KEV, THE R-MATRIX CALCULATION. FROM 100 KEV TO 6 MEV, ENDF/B-V WAS ADOPTED. ABOVE 6 MEV, BASED ON THE OPTICAL MODEL CALCULATION. MT = 16CALCULATED BY THE METHOD OF NAKAGAWA/41/. ANGULAR DISTRIBUTIONS ARE GIVEN IN THE LABORATORY SYSTEM. MT=51-59, 61, 62, 64-66. DWBA CALCULATION. MT=60, 63, 67-89 ASSUMED TO BE ISOTROPIC IN CM. MF = 5ENERGY DISTRIBUTION OF SECONDARY NEUTRONS MT=16 THE EVAPORATION MODEL WAS ASSUMED. THE EVAPORATION TEMPERATURE WAS ASSUMED TO BE 1 MEV AT 14 MEV. IT WAS EXTRAPOLATED AS T = 0.2673*SQRT(EN) MEV, WHERE EN MEANS THE INCIDENT NEUTRON ENERGY IN THE LABORATORY SYSTEM IN MEV. MF = 12PHOTON MULTIPLICITIES MT=102 . MULTIPLICITIES WERE GIVEN ACCORDING TO A COMPILATION OF AJZENBERG ET AL./43/. HOWEVER, THEY WERE NORMALIZED FOR THE TOTAL SECONDARY GAMMA-RAY ENERGY TO MATCH THE AVAILABLE ENERGY IN THE FINAL STATE. MT=781 MULTIPLICITY FOR THE 0.478-MEV GAMMA-RAY WAS GIVEN AS 1.0. MF=13 MT=4 PHOTON PRODUCTION CROSS SECTIONS EXPERIMENTAL DATA/41,44/ WERE ADOPTED FOR 0.4138-, 0.7183- AND 1.0219-MEV GAMMA-RAYS. FOR 1.44- AND 2.15-MEV GAMMA-RAYS, EXCITATION FUNCTION OF THE 0.4138-MEV GAMMA-RAY PRODUCTION WAS NORMALIZED TO THE DATA/41/ AT 14.8MEV. FOR 2.87-, 3.01-, 4.44- AND 6.03-MEV GAMMA-RAYS, SHAPES OF THE CORRESPONDING (N,N') EXCITATION FUNCTIONS IN MF=3 WERE NORMALIZED TO THE DATA/41/ AT 14.8MEV. MT = 103FOR 3.368- AND 2.592-MEV GAMMA-RAYS, SHAPES OF THE CORRESPONDING (N,P) EXCITATION FUNCTIONS IN MF=3 WERE NORMALIZED TO THE EXPERIMENTAL DATA/41/ AT 14.8MEV.

MF=1 MT	14 ANGULAR E T=4,102,103,113 ASSUMED TO BE	DISTRIBUTION OF	SECONDARY PHOTONS	
REFE 1) 3) 4) 5) 6) 7) 8) 9) 10) 11) 12) 13) 14) 15) 16) 17) 18) 22) 21) 22) 24) 22) 24) 22) 24) 22) 24) 22) 24) 22) 23) 30) 31) 32) 33) 34) 35) 36) 37) 38) 30) 31) 32) 33) 44) 22) 23) 24) 24) 25) 26) 27) 28) 29) 30) 31) 32) 33) 44) 35) 36) 37) 38) 39) 41) 42) 33) 34) 35) 36) 37) 38) 39) 41) 42) 33) 34) 35) 36) 37) 38) 39) 41) 42) 33) 34) 35) 36) 37) 38) 39) 41) 42) 43) 44) 42) 43) 44) 42) 43) 44) 42) 43) 44) 45)	ERENCES AUCHAMPAUGH, G.F. ET COOK, C.E. ET AL.: F TSUKADA, K.: EXFOR 2 COON, J.H. ET AL.: F FOSSAN, D.B. ET AL.: COOKSON, J.A. ET AL.: BECKER, R.L. ET AL.: BECKER, R.L. ET AL.: BECKER, R.L. ET AL.: BECKER, R.L. ET AL.: F HAUSLADEN, S.L. ET A ASAMI, A. ET AL.: J. LANE, R.O. ET AL.: F WILLARD, H.B. ET AL.: MATHER, D.S. AWRE-O-2 SWINIARSKI, R.D. ET FRYE, G.M. ET AL.: F BATHOLOMEW, G.A. ET MUGHABGHAB, S.F. ET A (ACADEMIC PRESS WYMAN, M.E. ET AL.: SELLEM, C. ET AL.: F SUHAINI, A. ET AL.: F SUHAINI, A. ET AL.: F CSERPAK, F. ET AL.: SUHAINI, A. ET AL.: SUHAIMI, S.M. ET AL.: SUHAIM	AL.: NUCL. SCI PHYS. REV. 94, 20324,003(1963). PHYS.REV. 88,5, PHYS.REV. 102, A.: LA-1655(1954) PHYS.REV. 102, A.: PHYS.REV. 102, AL.: PHYS. REV. PHYS.REV. C28,21 AL.: NUCL.PHYS. NUCL.ENERG. 24, PHYS. REV. C4, 3 PHYS. REV. C4, 3 PHYS. REV. C4, 3 PHYS. REV. 04, 3 PHYS. REV. 04, 3 PHYS. REV. 103, 3 AL.: CAN.J.PHYS. AL.: NEUTRON C 1981, NEW YORK) PHYS.REV. 112, EXFOR 12654,002 AL.: NUCL.PHYS. A NUCL.INSTRUM.MET EXFOR 30474,003 RADIOCHIMICA AC PHYS.REV. 120, 1 PHYS.REV. 120, 1 PHYS.REV. 139, NUCL.PHYS. 6 PHYS.REV. 139, PHYS.REV. 130, PHYS.REV. 130, PHYS.	. ENG. 69,30(1979). 651(1954). 209(1961). 146, 417(1970). 1384(1956). 84, 69(1951). 12(1983). A217,563(1973). 85(1970). 80(1971). 3669(1958). A 43, 237(1970). 35, 1347(1957). 35, 1347(1957). 305(1967). 443, 237(1970). 305(1967). 1264(1958). (1966). 139, 10(1969). 305(1967). H. 128, 495(1975). (1978). TA 40, 113(1986). NUCL. DATA FOR SCI 988. 976) VOL.1 (1979) 369(1960). 309(1965). 44(1954). 976). 2149(1976). 448(1961). 35(1984). 35(1984). 35(1984). 35(1984). 375(1984). 369(1978). 2149(1976). 448(1961). 369(1979). 369(1978). 2149(1976). 369(1978). 375(1984). 375(1984). 375(1984). 375(1984). 32(1979). 369(1978). 375(1984). 32(1979). 32(1979). 32(1979). 33(1979). 33(1979). 35(1979). 35(1970). 35(1970). 36(1977). 36(1977). 375(1984). 375(1984). 32(1979). 32(1979). 32(1979). 32(1979). 32(1979). 32(1979). 32(1979). 32(1979). 32(1979). 33(1979). 33(1979). 33(1979). 33(1979). 33(1979). 33(1979). 34(1979). 35(1969). 34(1979). 35(1969). 35(1969). 35(1970).	6). .1 PART . AND 1978).
1	TABLE 1 THE 2200-N	//S AND 14 MEV C	ROSS SECTIONS	
-		2200-M/S (B)	14 MEV (B)	
_	ELASTIC (N,N') (N,P) (N,D) (N,T) (N,ALPHA) (N,2N) CAPTURE TOTAL	2.144 0.003 0.012 3837.0 0.50 3839.7	0.943 0.269 0.038 0.047 0.095 0.049 0.027 0.027 0.000 1.467	
	TABLE 2 OPTICAL PO	DTENTIAL PARAMET	ERS	
E	B-10 + N /10/ V= 47.91 - 0.3 R= 1.387 A= 0.464	346EN, WS= 0.657 , RS= 1.336 , AS= 0.278	+ 0.810EN, VS0=5.5 , RS0=1.1 , AS0=0.5	5 (MEV) (FM) (FM)
E	BE-10 + P /45/ V = 60.0 + 27 WS = 0.64ECM + = 9.60-0.06 VSO= 5.5	7.0(N-Z)/A -0.3E + 10.0(N-Z)/A SECM + 10.0(N-Z)	CCM ,(ECM < 13.8 MEV /A ,(ECM > 13.8 MEV	(MEV) (MEV) (MEV) (MEV) (MEV)

	R = RS = A A = ASO =	RSO = 1.15 0.57, AS=	0.5 (FM)		
BE-9	+ D /34/ V= 80.0 , R= 1.0 , A= 1.0 ,	WV= 30.0 RV= 1.0 AV= 0.8	, VSO=6.0 , RSO=1.0 ,R , ASO=1.0	C= 1.3 (ME (FN (FN	V) }
TABLE	3 LEVEL MODEL	SCHEMES US CALCULATIO	SED IN THE D	WBA OR STA	TISTICAL
	B-10			BE-10	
MT 2 51 52 53 54 55 56 57 58 59 61 62 64 65 66	ENERGY (MEV) 0.0 0.7183 1.7402 2.154 3.587 4.774 5.110 5.163 5.920 6.025 6.127 6.561 6.561 7.00 7.430 7.470 7.470 7.470 7.470 7.670 7.670 8.650 8.890 8.894	JP L 3+ 2 1+ 2 0+ 4 2+ 2 2+ 2 2+ 2 2+ 2 2+ 2 3+ 3 2+ 2 3+ 3 3+ 3 1+ 2 3+ 3 2+ 2 2+ 2+ 2 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2+ 2	MT 700 701 702 703 704 705	ENERGY (MEV) 0.0 3.368 5.958 5.960 6.179 6.263	JP 0+ 2+ 2+ 1- 0+ 2-
TABLE	4 LEVEL	DENSITY_P	ARAMETERS US	ED IN THE	STATISTICAL
	MODEL				
	A(1/MEV)	I (MEV)	U(1/MEV)	PAIK. (ME	:V) EX(MEV)
В-10 ВЕ-10	1.088	5.581 5.866	0.066	0.0 5.13	16.17 19.63

MAT number = 528 5-B - 11 JAERI JAERI-M 89-046 HISTORY EVAL-MAY88 T.FUKAHORI DIST-SEP89 NEWLY EVALUATED BY T.FUKAHORI (JAERI) REVISED BY T.FUKAHORI (JAERI) (N,D),(N,ND),(N,T),(N,NT) AND (N,N2A) ADDED 87-03 88-05 MF=1 MT=451 GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY RESONANCE PARAMETERS ONLY SCATTERING RADIUS IS GIVEN. MF=2 MT=151 =3 CROSS SECTIONS 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS MF=32200 M/SEC RES. INTEG. TOTAL ELASTIC CAPTURE 5.050 B 5.045 B CAPTURE 5:075 MB 2.542 MB TOTAL CROSS SECTION BELOW 1 MEV, CALCULATED WITH THE MULTI-LEVEL BREIT-WIGNER FORMULA AND THE RESONANCE PARAMETERS TAKEN FROM REF. /1/. IN THE RANGE OF 1 TO 4 MEV, BASED ON THE R-MATRIX CALCULATION WHICH WAS PERFORMED BY USING KOEHLER ET AL.'S PARAMETERS /2/. ABOVE 4 MEV, SMOOTH CURVE WAS OBTAINED BY FITTING TO THE EXPERIMENTAL DATA OF AUCHAMPAUGH ET AL./3/. ELASTIC SCATTERING CROSS SECTION BELOW 1 MEV BASED ON THE MULTI-LEVEL BREIT-WIGNER FORMULA. IN THE RANGE OF 1 TO 2.2 MEV, THE R-MATRIX CALCULATION WAS ADOPTED. ABOVE 2.2 MEV, THE CROSS SECTION WAS OBTAINED BY SUBTRACTING THE REACTION CROSS SECTIONS FROM THE TOTAL CROSS SECTION. TOTAL INELASTIC SCATTERING CROSS SECTION SUM OF MT=51-57 AND 91. (N.2N)B-10 CROSS SECTION CALCULATED WITH GNASH /4/. THE OPTICAL POTENTIAL PARAMETERS, THE LEVEL DENSITY PARAMETERS AND THE LEVEL SCHEME ARE SHOWN IN TABLES 1-3, RESPECTIVELY. (N. N'ALPHA)LI-7 CROSS SECTION CALCULATED WITH GNASH. THE OPTICAL POTENTIAL PARAMETERS, THE LEVEL DENSITY PARAMETERS AND THE LEVEL SCHEME ARE SHOWN IN TABLES 1-3, RESPECTIVELY. (N. N'ALPHA)LI-7 CROSS SECTION CALCULATED WITH GNASH. THE OPTICAL POTENTIAL PARAMETERS, THE LEVEL DENSITY PARAMETERS AND THE LEVEL SCHEME ARE SHOWN IN TABLES 1-3, RESPECTIVELY. (N.N'P)BE-10 CROSS SECTION BASED ON THE GNASH CALCULATION. THE PARAMETERS USED ARE LISTED IN TABLES 1-3. (N.N'2ALPHA)T CROSS SECTION BASED ON THE GNASH CALCULATION. THE PARAMETERS USED ARE LISTED IN TABLES 1-3. (N.N'2ALPHA)T CROSS SECTION BASED ON (N.N.T) CROSS SECTION OF THE GNASH CALCULATION AND NORMALIZED TO HE PRODUCTION CROSS SECTION OF KNEFF ET AL. /57. (N.N'D)BE-9 CROSS SECTION 5.075 MB 2.542 MB MT = 1MT=2MT = 4MT = 16MT = 22MT = 28MT = 29MI-23 BASED (N N, N'T) CROSS SECTION OF THE GNASH CALCULATION AND NORMALIZED TO HE PRODUCTION CROSS SECTION OF KNEFF ET AL. /5/.
MT=32 (N, N'D)BE-9 CROSS SECTION BASED ON THE GNASH CALCULATION. THE PARAMETERS USED ARE LISTED IN TABLES 1-3.
MT=33 (N, N'T)BE-8 CROSS SECTION BASED ON THE GNASH CALCULATION. THE PARAMETERS USED ARE LISTED IN TABLES 1-3.
MT=51 IN TABLES 1-3.
MT=51 IN LASTIC SCATTERING THE R-MATRIX CALCULATION WITH KOEHLER ET AL.'S PARAMETERS WAS ADOPTED BELOW 7 MEV. ABOVE 7 MEV, THE GNASH AND DWBA CALCULATIONS WERE PERFORMED. THE SUM OF BOTH RESULTS WAS ADOPTED, AND NORMALIZED TO THE EXPERIMENTAL DATA OF KOEHLER ET AL. /2/ AND GLENDINNING ET AL. /6/.
MT=52,53 INELASTIC SCATTERING BELOW 7 MEV, BASED ON THE R-MATRIX CALCULATION WITH THE SEARCHED PARAMETERS. ABOVE 7 MEV. THE SUM OF THE GNASH AND DWBA CALCULATIONS WAS ADOPTED, AND FITTED TO THE EXPERIMENTAL DATA OF GLENDINNING ET AL..
MT=54 7 INELASTIC SCATTERING MI SUM OF RESULTS OF THE GNASH AND DWBA CALCULATIONS WAS NORMALIZED TO BE THE RESULT OF OKTAVIAN'S DDX DATA /7/. CONTINUUM INELASTIC SCATTERING ABOVE 7.2 MEV, CONTINUUM LEVELS WERE ADOPTED. BASED ON THE GNASH CALCULATION.
MT=102 CAPTURE CROSS SECTION CALCULATED FROM THE MULTI-LEVEL BREIT-WIGNER FORMULA. THE DIRECT CAPTURE /1/ IS ALSO CONSIDERED.
MT=103 (N, P)BE-11 CROSS SECTION BASED ON THE GNASH CALCULATION WITH BEING NORMALIZED TO THE EXPERIMENTAL DATA OF STEPANCIC ET AL.. /8/. THE PARAMETERS USED ARE SHOWN IN TABLES 1-3, RESPECTIVELY.
MT=104 (N, D)BE-10 CROSS SECTION

BASED ON THE GNASH CALCULATION. 5 (N,T)BE-9 CROSS SECTION BASED ON THE GNASH CALCULATION. 7 (N,ALPHA)LI-8 CROSS SECTION THE GNASH CALCULATION WAS PERFORMED, AND NORMALIZED TO THE EXPERIMENTAL DATA OF ANTOLKOVIC ET AL. /9/ AND SCOBEL ET AL. /10/. THE PARAMETERS USED ARE SHOWN IN TABLES 1-3, RESPECTIVELY. 1 MU-BAR CALCULATED FROM THE DATA IN ME-4 MT = 105MT = 107MT=251 CALCULATED FROM THE DATA IN MF=4. MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2MI=2 THE R-MATRIX AND DWBA CALCULATIONS WERE ADOPTED BELOW 8 MEV AND ABOVE 8 MEV, RESPECTIVELY. MT=16,22,28,29,32,33,91 MT=16,22,28,29,32,33,91 ASSUMED TO BE ISOTROPIC IN THE CENTER OF MASS SYSTEM. MT=51,52,53 BELOW 8 MEV BASED ON R-MATRIX CALCULATION. AB BASED ON THE DWBA AND THE GNASH CALCULATIONS. MT=54,55,56,57 BASED ON THE DWBA AND THE GNASH CALCULATIONS. ABOVE 8 MEV, =5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,29,32,33,91 BASED ON THE GNASH CALCULATION. MF = 5GAMMA-RAY DATA BASED ON THE GNASH CALCULATION. MF=12-15 TABLE 1 THE OPTICAL POTENTIAL PARAMETERS - - - - -V = 41.8-0.005E MEV* WS= 1.01E MEV* RO= 1.40 FM RI= 1.15 FM AO= 0.35 FM AI= 0.50 FM NEUTRON REF.12 ۶ ۴М* V = 66.1-0.273E MEV WS= 1.50+0.581E MEV VSYM = 5.5 MEV RO= 1.15 FM RI= 1.15 FM RO= 1.15 FM AO= 0.57 FM AI= 0.5 FM **REF.13** PROTON $A_{0} = 0.5$ $A_{0} = 0.57$ DEUTERON V = 80.0 WV= 30.0 VSYM = 6.0 FM* REF.14 FM* FM* MEV* FM* R0 = 1.0A0= 1.0 MEV MEV* FM* FM* AI = 0.8A0 = 1.0RI = 1.0R0 = 1.0V = 103.0+20.0E MEV* WV= 1.49E MEV* VSYM = 8.55 MEV* R0= 0.85 R1= 2.06 R0= 0.85 FM FM FM TRITON A0= 0.70 FΜ **REF.15** AI= 0.72 FM AO= 0.70 FM V = 285.2-2.40E MEV* WS= 16.16-0.70E MEV* RO= 1.61 FM RI= 1.81 FM AO= 0.55 FM* AI= 0.65 FM ALPHA REF.16 NOTE : E IS INCIDENT NEUTRON ENERGY IN LAB. SYSTEM. * MEANS THAT PARAMETER IS MODIFIED FROM ORIGINAL ONE. TABLE 2 THE LEVEL DENSITY PARAMETERS A(1/MEV) T(MEV) PAIR.(MEV) 7.990 - - - - ------- -B-10 1.196 0.0 B - 11 B - 12 BE - 8 BE - 9 1.431 6.112 2.67 1.491 1.115 1.125 6.201 9.187 0.0 5.13 2.46 8.248 0.248 10.029 7.277 7.197 8.170 5.13 2.46 2.67 0.0 BE - 10 BE - 11 1.088 1.419 LI-7 1.138 LI-8 1.115 TABLE 3 THE LEVEL SCHEME (ENERGY(MEV), SPIN AND PARITY) /17-18/ _ _ _ _ _ _ _ _ _ _ _ _ _ - - - - - -- - - - - - - -- - - - - -- - - - - - - -0.0 GS 1 2 3 4 56 7 8 9

10 11 12 13 14 15 16 17 18 20 21 22 23 24	$\begin{array}{c} 6.025 \\ 4.127 \\ 3.561 \\ 4.561 \\ 3.561 \\ 4.873 \\ 1 \\ 7.002 \\ 2 \\ 7.430 \\ 2 \\ 7.430 \\ 2 \\ 7.430 \\ 2 \\ 7.479 \\ 2 \\ 7.561 \\ 0 \\ 7.670 \\ 1 \\ 7.819 \\ 1 \\ 8.700 \\ 2 \\ 8.889 \\ 3 \\ 8.895 \\ 2 \end{array}$	+ - + + + + + + + + + + + + + + + + +							
REFE 1) 2) 3) 4) 5) 6) 7) 8) 9) 10)	RENCES MUGHABG PARTA (KOEHLER AUCHAMP YOUNG P NUCLEAR- EMISSION KNEFF D GLENDIN TAKAHAS STEPANC ANTOLKO SC (1470)	HAB S.F ACADEMI(P.E.E AUGH G.F MODEL CO SPECTR/ .W. ET / NING S.C HI, A.E IC B.F VIC B.F W. ET A	ET AL PRESS AL.: A AL.: GN AL.: GN AL.: NU AL.: NU AL.: NU AL.: NU AL.: AL ET AL ET AL ET AL ET AL ET AL	. : 'NE 1981, NUCL. F L.: NUC ASH, A CALCUL 947 (19 CL. SCI L.: BUL INDC(J : BULL. NUCL. TSCHRIF	UTRON NEW YC PHYS A PREEQU ATION 777). L. AMG. ING. ING. PN)-1C INST. PHYS. TF. N	CROSS ORK) (394 (1 ENG. JILIBRI OF CRO 92 (1 PHYS. 37L (1 BORIS A325 (IATURFO	SECTION 983) 22 69 (19 UM,STAT SS SECT 986) 49 SOC. 2 986) KIDRI(1979) 1 RSCHUNG	NS' VOL.1 21 79) 30 ISTICAL TON AND 24 (1979) 24 (1979) 25 17 (1966 89 3, SECTION	656 5) 237 I A
11) 12) 13) 14) 15) 16) 17) 18)	25 (1970) COOKSON GLENDIN WATSON MILJANI HERLING MATSUKI AJZENBE AJZENBE	J.A. E NING S.C B.A. ET C D. ET G.H. E S. ET RG-SELO RG-SELO	Γ ΑL.: G. ET Α ΑL.: Ρ ΑL.: Ν Γ ΑL.: ΔL.: J. ΛΕ F. : ΛΕ F. :	NUCL. F L.: NUC HYS. RE UCL. PH PHYS. F PHYS. F NUCL. IBID.	2HYS. A 2L. SCI 2V. 182 1YS. A1 2EV. 17 SOC. J PHYS. A433 (146 (1 - ENG. 2 (1969 76 (19 78 (196 JAPAN 2 A413 (1985)	970) 41 80 (19 977) 110 9) 178 6 (1969 1984) 1	982) 256))) 1344	

MAT number = 625 6-C - 12 JAERI JAERI-M 83-221 HISTORY EVAL-AUG83 K.SHIBATA DIST-SEP89 REV2-DEC93 NEWLY EVALUATED BY K.SHIBATA DETAILS OF THE EVALUATION ARE GIVEN IN REF./1/. DATA OF MF=4 MT=91 WERE REVISED. COMMENT WAS ALSO MODIFIED. DATA OF MT=2, 3, 4, 53 OF MF=3 WERE REVISED ABOVE 10.45 MEV. ANGULAR DISTRIBUTIONS FOR MT=52, 53 WERE ALSO 83-08 84-07 85-02 MEV. ANGULAR DISTRIBUTIONS FOR MT=52, 53 WERE ALSO REVISED. DATA OF MT=1, 3, 4, 52 OF MF=3 WERE REVISED ABOVE 8.3 MEV. JENDL-3.2 INELASTIC SCATTERING AND CAPTURE CROSS SECTIONS WERE REEVALUATED BY K. SHIBATA (JAERI). PSEUDO LEVELS WERE GENERATED TO REPRODUCE VAILABLE DDX 88-07 93-12 DĂTĂ DATA. THE TOTAL CROSS SECTION WAS REPLACED WITH THE R-MATRIX CALCULATION DONE IN REF./1/. ALL DATA WERE COMPILED BY K. SHIBATA. ***** MODIFIED PARTS FOR JENDL-3.2 (3,1) R-MATRIX CALCULTION/1/. (3,2) TOTAL - NOELASTIC (3,3) SUM OF PARTIAL REACTION CROSS SECTIONS (3,4) SUM OF (3,51-91) (3,51) MODIFIED BY CONSIDERING EXPERIMENTAL DATA. (3,53) (3,58) (3,51) (3,53),(3,58) (3,52),(3,54-57),(3,59-75) PSEUDO LEVELS. (3,91) 4-BODY BREAKUP. WODIELED BY TAKING ACCOUNT OF P-WAVE C (3,91) 4-BODY BREAKUP. (3,102) MODIFIED BY TAKING ACCOUNT OF P-WAVE CAPTURE. (4,51-91) (5,91) 4-BODY PHASE SPACE (12,102) EXPERIMENTAL DATA FOR 20-200 KEV. GENERAL INFORMATION DESCRIPTIVE DATA MF = 1MT = 451**RESONANCE PARAMETERS** MF=2MT = 151SCATTERING RADIUS ONLY. MF = 3CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS AND RES. INTEGRALS 2200M/S (B) RES.INTEG. (B) 4.750 TOTAL ELASTIC CAPTURE 4.746 0.0035 ELASIIU 0:0035 0.0018
MT=1 SIG-T BELOW 10 EV, SUM OF SIG-EL AND SIG-CAP. BETWEEN 10 EV AND 4.8 MEY. THE CROSS SECTION WAS CALCULATED ON THE BASIS OF THE R-MATRIX THEORY. THE R-MATRIX PARAMETERS WERE OBTAINED SO AS TO GIVE THE BEST FIT TO THE EXPERIMENTAL DATA /2/-/7/. ABOVE 4.8 MEV, BASED ON THE MEASUREMENTS /8/-/10/. SIG-EL
MT=2 SIG-EL VIE CROSS SECTION WAS OBTAINED BY SUBTRACTING THE REACTION CROSS SECTION WAS OBTAINED BY SUBTRACTING THE REACTION CROSS SECTION FROM THE TOTAL CROSS SECTION.
MT=3 NON-ELASTIC SUM OF MT=4, 102 103, 104 AND 107.
MT=4 TOTAL INELASTIC SUM OF MT=51-75 AND 91.
MT=51 SIG-IN 4.44 MEV LEVEL BASED ON THE EXPERIMENTAL DATA /11,27,30,31/.
MT=53,58 SIG-IN 7.65 MEV (0+), 9.64 MEV (3-) LEVELS THE CROSS SECTIONS WERE OBTAINED FROM COUPLED-CHANNEL AND STATISTICAL MODEL CALCULATIONS.
MT=52,54-57,59-75 PSEUDO LEVELS (N.N'3ALPHA) PSEUDO LEVELS WITH AN INTERVAL OF 500 KEV WERE MADE IN ORDER TO SIMULATE SEQUENTIAL (N.N') DECAY (EVAPORATION SHAPE) AND 3-BODY BREAKUP (PHASE SPACE) LEADING TO (N.N'3ALPHA). THE SUM OF THE CROSS SECTIONS FOR PSEUDO LEVELS AND MT=91 IS CONSISTENT WITH THE MEASUREMENT/12/ EXCEPT AROUND THE THRESHOLD ENERGY WHERE THE CALCULATED CROSS SECTIONS WERE ENHANCED. (N.N'3ALPHA).
MT=91 (N'3ALPHA)
CONTRIBUTION FROM 4-BODY BREAKUP. THE CROSS SECTION WAS ADJUSTED SO THAT THE CALCULATED SPECTRUM COULD GIVE A GOOD FIT TO EXPERIMENTAL DATA AT 14 MEV. TOTAL (N,N')3A CROSS SECTION IS THE SUM OF MT=52-75 0.0018

AND 91. MT=102 CAPTURE BELOW 100 EV, 1/V CURVE. BETWEEN 100 EV AND 5 MEV, S-WAVE PLUS P-WAVE CAPTURE BY CONSIDERING THE DATA OF IGASHIRA/32/. ABOVE 5 MEV, THE INVERSE REACTION DATA OF COOK /13/ WERE ADDED. (N,P) BASED ON THE MEASUREMENT OF RIMMER AND FISHER /14/. (N,D) CALCULATED WITH DWBA. MT = 103MT = 104MT = 107(N,A) BASED ON THE EXPERIMENTAL DATA /15/-/23/. MU-BAR CALCULATED FROM THE DATA IN FILE4. MT=251 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4 $M\dot{T}=2$ BELOW 10 EV, ISOTROPIC IN THE CENTER-OF-MASS SYSTEM (CM). BETWEEN 10 EV AND 4.8 MEV, CALCULATED WITH THE R-MATRIX THEORY ABOVE 4.8 MEV, BASED ON THE EXPERIMENTAL DATA /24/-/28/. MT = 51BASED ON THE EXPERIMENTAL DATA /24/-/28//33/. MT=53, MT=53, 50 BASED ON THE EXPERIMENTAL DATA /33/. MT=52,54-57,59-75 ISOTROPIC IN CM. MT = 91ISOTROPIC DISTRIBUTIONS IN LAB. MF = 5ENERGY DISTRIBUTION OF SECONDARY NEUTRONS MT=91 4-BODY PHASE SPACE. PHOTON-PRODUCTION MULTIPLICITIES (N,N') GAMMA MF = 12 $M\dot{T} = 51$ M=1.0 M=1.0 2 BASED ON THE MEASUREMENT OF SPILLING ET AL./29/ AND OF IGASHIRA /32/. MT = 102MF = 14PHOTON ANGULAR DISTRIBUTIONS MT=51 BASED ON THE EXPERIMENTAL DATA OF MORGAN ET AL./11/. MT = 102ASSUMED TO BE ISOTROPIC. REFERENCES 1) SHIBATA, K.: JAERI-M 83-221 (1983). 2) MEADOWS, J.W. AND WHALEN, J.F.: NUCL. SCI. ENG. 41 (1970) 351. 3) CABE, J. AND CANCE, M.: CEA-R-4524 (1973) 4) STOOKSBERRY, R.W. AND ANDERSON, J.H.: NUCL. SCI. ENG. 51 (1073) 235 CABE, J. AND CANCE, M.: CEA-R-4524 (1973)
STOOKSBERRY, R.W. AND ANDERSON, J.H.: NUCL. SCI. ENG. 51 (1973) 235.
HEATON, II, H.T. ET AL.: JAERI-M 6883 (1977)
SMITH, A. ET AL.: JAERI-M 6883 (1977)
SMITH, A. ET AL.: NUCL. SCI. ENG. 70 (1979) 281.
LAMAZE, G.P. ET AL.: NUCL. SCI. ENG. 69 (1979) 30.
CIERJACKS, S. ET AL.: NUCL. INSTRUM. METH. 169 (1980) 185.
MORGAN, G.L. ET AL.: NUCL. INSTRUM. METH. 169 (1980) 185.
MORGAN, G.L. ET AL.: NUCL. INSTRUM. METH. 169 (1980) 185.
MORGAN, G.L. ET AL.: NUCL. PHYS. A394 (1983) 87.
COOK, B. C.: PHYS. REV. 106 (1957) 300.
RIMMER, E.M. AND FISHER, P.S.: NUCL. PHYS. A108 (1968) 567.
RIMMER, E.M. AND SEN, B.: NUCL. PHYS. A108 (1968) 567.
CHATTERJEE, M.L. AND SEN, B.: NUCL. PHYS. A108 (1968) 567.
CHATTERJEE, M.L. AND SEN, B.: NUCL. PHYS. A108 (1968) 567.
CHATTERJEE, M.L. AND YAMAMURO, N.: J. PHYS. S0C. JPN. 26(1969)600.
KARDONSKY, S. ET AL.: PHYS. REV. C4 (1971) 840.
STEVENS, A.P.: INIS-MF-3596 (1976).
RETZ-SCHMIDT, T. ET AL.: BULL. AM. PHYS. S0C. 5 (1960) 110.
VERBINSKI, V.V. ET AL.: PHYS. REV. C7 (1972) 738.
DECONNINCK, G. AND MEULDERS, J.-P.: PHYS. REV. C1 (1970) 1326.
GALATI, W. ET AL.: CEA-R-4641 (1975).
THUMM, M. ET AL.: NUCL. PHYS. A344 (1980) 446.
SPILLING, P. ET AL.: NUCL. PHYS. A113 (1968) 395.
JAERI-M 88-065, P.279, (19883).
GLASGOW D.W. ET AL.: DNA 3495F (1974). 5) 67 8 10) 11) 12 13) 14) 15 16 17 18) 19) 20 21 22 23 24 25) 26) 275 29) 30) 31)

32) IGASHIRA M.: PRIVATE COMMUNICATION (1993). 33) BABA M. ET AL.: JAERI-M 90-025, P.383 (1990).
MAT number = 725 7-N - 14 JNDC EVAL-JUN89 Y.KANDA(KYU) T.MURATA(NAIG)+ DIST-SEP89 REV2-FEB94 HISTORY 89-06 NEW EVALUATION FOR JENDL-3 SUB-WORKING GROUP ON EVALUATION OF N-14, WORKING GROUP ON NUCLEAR DATA FOR FUSION, JAPANESE NUCLEAR DATA COMMITTEE IN CHARGE SIG-T K.SHIBATA (JAERI) SIG-EL T.ASAMI (NEDAC) T.MURATA (NAI HISTORY IN CHARGE SIG-T K.SHIBATA (JAERI) SIG-EL T.ASAMI (NEDAC), T.MURATA (NAIG) SIG-IN T.AASMI, T.MURATA (N,2N), (N,P), (N,T), (N,A) Y.KANDA(KYU) (N,NA), (N,AP), (N,ND), (N,D) T.ASAMI CAPTURE T.ASAMI PHOTON PRODUCTION T ASAMI T.ASĂMI COMPILATION EVALUATED DATA WERE COMPILED BY T.FUKAHORI (JAERI). MF=5: SPECTRA WERE MODIFIED AT LOW ENERGIES OF EMITTED NEUTRONS BY T.ASAMI(DATA ENGINEERING CO. LTD.) REEVALUATION WAS MADE FOR THE DATA CONCERNING WITH THE NEUTRON EMISSION DOUBLE DIFFERENTIAL CROSS SECTIONS. THE INELASTIC SCATTERING CROSS SECTIONS AND THE ANGULAR DISTRIBUTIONS FOR THE INELASTICALLY EMITTED NEUTRONS WERE REVISED CONSIDERABLY/25/. JENDL-3.2 MF=3, MT=1,2,4,22,32,52-90,103,105: CROSS SECTION MODIFIED AND MF=4, MT=54-90: ISOTOROPIC ANGULAR DIST. ADDED BY T.FUKAHORI(JAERI). MF=12,MT=102: MULTIPLICITY MODIFIED BY K.SHIBATA (JAERI). COMPILATION 90 - 1090 - 1194-02

 MODIFIED PARTS FOR JENDL-3.2

 (3,2)
 ABOVE 1 MEV

 (3,22), (3,32)
 ALL ENERGY REGION

 (3,22), (3,32)
 9-14 MEV

 (3,72)+(3,73)
 0F JENDL-3.1

 (3,74)
 0F JENDL-3.1

 (3,72)
 0F JENDL-3.1

 <t ***** MODIFIED PART (3,1),(3,2) (3,4),(3,22),(3,32) (3,52-71) (3,72) (3,73) (3,74-90) (3,103) (3,105) (4,74-90) (12,102) GENERAL INFORMATION DESCRIPTIVE DATA MF = 1MT=451 MF=2**RESONANCE PARAMETERS** SCATTERING RADIUS ONLY. MT=151 CROSS SECTIONS CALCULATED 2200 M/S CROSS SECTIONS AND RES. INTEG. 2200 M/S (B) RES. INTEG. (B) MF=311.851 TOTAL ÉLASTIC 10.007 0.075 0.0034 SIG-T BELOW 1 EV, A SUM OF PARTIAL CROSS SECTIONS. ABOVE 1 EV, BASED ON THE EXPERIMENTAL DATA /1,2,3,4/. SIG-EL BELOW 1 EV, SIG-EL = 10 BARNS. ABOVE 1 EV, THE ELASTIC SCATTERING CROSS SECTION WAS OBTAINED BY SUBTRACTING THE REACTION CROSS SECTIONS FROM THE TOTAL CROSS SECTION. TOTAL INELASTIC SUM OF MT=51 TO 91. (N, 2N) BASED ON EXPERIMENTAL DATA/5/-/7/. (N, N ALPHA) ADOPTED THE HALF OF VALUES CALCULATED WITH THE GNASH CODE/8/. (N,NP) MT = 1MT=2MT = 4MT = 16MT=22 (N,NP) CALCULATED WITH THE GNASH CODE/8/, AND NORMALIZED TO THE EXPERIMENTAL DATA/9/. (N,ND) ADOPTED THE HALF OF VALUES CALCULATED WITH THE GNASH MT=28 MT=32 CODE/8/.

PO SIG-IN THE CROSS SECTIONS WERE CALCULATED WITH THE STATISTICAL MODEL. THE LOW-ENERGY PORTION WAS ANALYZED WITH THE RESONANCE THEORY/10/. FOR MT=51 TO 73, THE DIRECT COMPONENTS WERE CALCULATED WITH THE DWUCK CODE/26/. FOR 74 TO 90, PSEUD-LEVELS WERE ASSUMED AND ADJUSTED TO FIT TO THE EXPERIMENTAL DATA/27/. THE OPTICAL POTENTIAL PARAMETERS USED ARE THE FOLLOWING /11/: V = 50.08-0.01E, WS = 9.0 + 0.62E, VSO = 5.5 (MEV R = 1.22, RS = 1.45, RSO = 1.15 (FM) A = 0.66, B = 0.13, ASO = 0.50 (FM) LEVEL SCHEME NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 1 + 1. 2.3129 0 + 2. 3.9478 1 + MT=51-90 $\begin{array}{rrrr} VSO &=& 5.5 & (MEV) \\ RSO &=& 1.15 & (FM) \\ ASO &=& 0.50 & (FM) \, . \end{array}$ 0.0 2.3129 3.9478 ż. + -1 3. 4. 4.9150 021313221 5.1059 5.6900 5.8320 6.2040 -5. 6. 7. 2 +++---++++--8. 9. 6.4440 7.0280 7.9670 10. 11. 12. 13. 14. 15. 16. 7.30 8.0620 8.0620 8.6180 8.91 8.96 9.13 9.17 9.51 10.23 10.81 11.05 11.07 11.24 11.5 11.75 8.0620 4003532215313 17. 18. 19. 20. 21. 22. + + + (SUMMING UP) 23. 24. 25. 26. 27. (PSEUD-LEVEL) PSEUD - LEVEL PSEUD - LEVEL PSEUD - LEVEL 11.75 12.0 12.25 12.2 12.5 13.0 13.5 14.0 14.5 15.0 15.5 (PSEUD-LEVEL (PSEUD-LEVEL (PSEUD-LEVEL (PSEUD-LEVEL (PSEUD-LEVEL (PSEUD-LEVEL (PSEUD-LEVEL 28. 29. 30. 31. 32. 33. 34. 35. 36. PSEUD - LEVEL PSEUD - LEVEL PSEUD - LEVEL 16.5 PSEUD - LEVEL PSEUD - LEVEL PSEUD - LEVEL 17.0 17.5 18.0 37. 38. 39. 38. 17.5 39. 18.0 40. (PSEUD-LEVEL) 40. 18.5 CAPTURE CALCULATED WITH THE CASTHY CODE/12/. (N,P) BELOW 7 MEV, BASED ON EXPERIMENTAL DATA/13/-/18/. ABOVE 7 MEV, BASED ON EXPERIMENTAL DATA/28/. (N,D) BELOW 8.5 MEV, BASED ON EXPERIMENTAL DATA/28/. (N,T) BELOW 8.5 MEV, CALCULATED WITH GNASH. (N,T) BELOW 9 MEV, BASED ON EXPERIMENTAL DATA/20/. ABOVE 8.5 MEV, CALCULATED WITH GNASH. (N,T) BELOW 9 MEV, BASED ON EXPERIMENTAL DATA/20/. ABOVE 9 MEV, BASED ON EXPERIMENTAL DATA/20/. (N,ALPHA) BASED ON THE EXPERIMENTAL DATA/17/-/20/. (N,2ALPHA) CALCULATED WITH GNASH AND NORMALIZED AT 14.1 MEV TO AN AVERAGE VALUE AMONG THE EXPERIMENTAL DATA/21/-/22/. MU-BAR CALCULATED FROM ANGULAR DISTRIBUTIONS IN MF=4. MT = 102MT = 103MT = 104MT=105 MT = 107MT=108 MT=251 MU-BAR CALCULATED FROM ANGULAR DISTRIBUTIONS IN MF=4. (N, ALPHAO) BASED ON EXPERIMENTAL DATA. (N, ALPHA1) BASED ON EXPERIMENTAL DATA. (N, ALPHA) CONTINUUM BASED ON EXPERIMENTAL DATA. MT=780 MT=781 MT=798 MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

MT = 21.E-5 EV TO 8 MEV CALCULATED WITH THE RESONANCE THEORY. 8 MEV TO 20 MEV CALCULATED WITH CASTHY. 22,28,32 ASSUMED TO BE ISOTROPIC IN THE CENTER OF MASS SYSTEM. MT=16,22 MT=51-73 CALCULATED WITH CASTHY/12/ AND DWUCK/26/. MT=74-90 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. =5 ENERGY DISTRIBUTION FOR SECONDARY NEUTRONS MT=16,22,28,32 CALCULATED WITH THE GNASH CODE/8/. MF = 5MF = 12PHOTON PRODUCTION MULTIPLICITIES MT=102,103 CALCULATED WITH THE GNASH CODE. FOR MT=102, MODIFIED BY CONSIDERING ENERGY BALANCE. PHOTON PRODUCTION CROSS SECTIONS MF = 13MT=3CALCULATED WITH THE GNASH CODE/8/. F=14 PHOTON ANGULAR DISTRIBUTIONS MT=3,102,103 ISOTROPIC MF = 14MF=15 PHOTON ENERGY DISTRIBUTIONS MT=3,102,103 CALCULATED WITH THE GNASH CODE/8/. FOR MT=102, MODIFIED BY USING THE EXPERIMENTAL DATA/24/ AT THERMAL ENERGY. AT THERMAL ENERGY.
REFERENCES
MELKONIAN E.: PHYS. REV., 76, 1750 (1949).
BILPUCH E.G. ET AL.: BULL. AM. PHYS. SOC. 4, 42 (1959).
BILPUCH E.G. ET AL.: TAKEN FROM EXFOR (1962).
HEATON, II H.T. ET AL.: BULL. AM. PHYS. SOC. 15, 568 (1970).
FERGUSON J.W. ET AL.: PHYS. REV., 118, 228 (1966).
BORMANN N. ET AL.: NUCL. PHYS., 63, 438 (1965).
RYVES T.B. ET AL.: J. PHYS. G4, 1783 (1978).
YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
CSIKAI J. AND NACY S.: NUCL. PHYS., 91, 422 (1967).
MURATA T.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO 1988, P.557 (1988).
TTEMPLON J.A. ET AL.: NUCL. SCI. ENG., 91, 451 (1985).
IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
BATCHELOR R.: AERE-N/R.370 (1949).
CON J.H. ET AL.: PHYS. REV., 75, 1358 (1949).
CURE P. ET AL.: J. PHYS. REV., 75, 1358 (1961).
HANNA G.C. ET AL.: ANUCL. SCI. ENG., 70, 163 (1979).
FELBER H. ET AL.: NUCL. SHIMM., 12, 6 (1951).
GABBARD F. ET AL.: NUCL. PHYS., 14, 277 (1959).
CHILIE A.B.: PHYS. REV., 87, 726 (1952).
SCHMIDT G. ET AL.: NUCL. PHYS., A103, 238 (1967).
BARTHOLOMEW G.A. ET AL.: NUCL. PHYS., A103, 238 (1967).
BARTHOLOMEW G.A. ET AL.: NUCL. PHYS., A103, 238 (1967).
BARTHOLOMEW G.A. ET AL.: NUCL. PHYS., 14, 277 (1959).
LILIE A.B.: PHYS. REV., 766 (1952).
SCHMIDT G. ET AL.: JAEREI-M 91-032 (1991) P.376.
KUNZ P.D.: UNPUBLISHED.
ZTSABA M. ET AL.: PROC. OF INT. CONF. ON NUCL. DATA FOR BASIC AND APPLIED SCI. AT SANTA FE IN MAY 13-17, P.223 (1985).
SMANDA Y. ET AL.: JAERI-M 91-032 (1991) P.376.
KUNZ P.D.: UNPUBLISHED.
SANDA PPLIED SCI. AT SANTA FE IN MAY 13-17, P.223 (1985).
SMANDA M. ET AL.: PHYS. IN MEDICINE AND BIOLOGY, 25, 637 (1980).

MAT number = 728 7-N - 15 JAERI JAERI-M 89-047 EVAL-DEC88 T.FUKAHORI DIST-SEP89 REV2-APR94 HISTORY 88-12 NEWLY EVALUATED BY T.FUKAHORI (JAERI)/1/ 94-04 JENDL-3.2 COMPILED BY T.FUKAHORI AND K.SHIBATA (NDC/JAERI) MODIFIED PARTS FOR JENDL-3.2 (2,151) OMITTED EXCEPT SCATTERING RADIUS (3, 1) BELOW 5.5 MEV, CHANGED TO POINT-WISE CROSS SECTION (3, 2) BELOW 5.5 MEV, CHANGED TO POINT-WISE CROSS SECTION (3,102) BELOW 5.5 MEV, CHANGED TO POINT-WISE CROSS SECTION (3,102) FROM ENERGY BALANCE GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 MF=2 MT=151 RESONANCE PARAMETERS ONLY SCATTERING RADIUS IS GIVEN. 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/SEC RES. INTEG. TOTAL 4.590 B -ELASTIC 4.590 B -CAPTURE 0.024 MB 0.016 MB CAPTURE 0.024 MB 0.016 MB F=3 CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 5.5 MEV, RESONANCE PARAMETERS OF THE MULTI-LEVEL BREIT-WIGNER FORMULA /2,3/ ARE ADJUSTED TO REPRODUCE THE EXPERIMENTAL DATA OF B.ZEITNITZ ET AL./4/, AND GIVEN AS POINT-WISE DATA. ABOVE 5.5 MEV, SMOOTH CURVE WAS OBTAINED BY FITTING TO THE EXPERIMENTAL DATA OF B.ZEITNITZ ET AL. MT=2 ELASTIC SCATTERING CROSS SECTION BELOW 5.5 MEV, POINT-WISE CROSS SECTION OBTAINED FROM MLBW CALCULATION IS GIVEN. ABOVE 5.5 MEV, THE CROSS SECTION WAS OBTAINED BY SUBTRACTING THE REACTION CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4 TOTAL INELASTIC SCATTERING CROSS SECTION SUM OF MT=51-66 AND 91. MT=16,22,28,32,33,103,104,105,107 CALCULATED WITH GNASH /5/. THE OPTICAL POTENTIAL POTENTIAL PARAMETERS, THE LEVEL DENSITY PARAMETERS AND THE LEVEL SCHEME ARE SHOWN IN TABLES 1-3, RESPECTIVELY. MT=51-91 INELASTIC SCATTERING CALCULATED WITH CASTHY /6/. THE PARAMETERS ARE ALSO SHOWN IN TABLES 1-3. MT=102 CAPTURE CROSS SECTION BELOW 5.5 MEV, POINT-WISE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED WITH CASTHY /6/. THE CROSS SECTION OBTAINED FROM MLBW CALCULATED FROM THE DATA IN MF=4. MF=3 MT=1 CALCULATED FROM THE DATA IN MF=4. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT = 2,51 - 66MT=2, BASED ON THE CASTHY CALCULATION. MT=16,22,28,32,33,91 ASSUMED TO BE ISOTROPIC IN THE CENTER OF MASS SYSTEM. E=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,32,33,91 BASED ON THE GNASH CALCULATION. MF = 5GAMMA-RAY DATA BASED ON THE GNASH CALCULATION. FOR MF=1 MODIFICATION WAS DONE FOR ENERGY BALANCE. MF=12-15 FOR MF=12, MT=102,
 TABLE 1
 THE OPTICAL POTENTIAL PARAMETERS
 NEUTRON V = 50.08-0.012E MEV WS = 8.91+0.618E MEV VSYM= 5.50 MEV $\begin{array}{rcl} RO &=& 1 . 22 & FM \\ RI &=& 1 . 45 & FM \\ RO &=& 1 . 15 & FM \end{array}$ V = 51.30-0.220E MEV WS = 6.40-0.050E MEV VSYM= 6.00 MEV PROTON DEUTERON PEREY-PEREY'S POTENTIAL/7/

TRI	TON	BE	ССНЕТТ	I-GRE	ENLEES'S	POTENTIA	L/8/			
ALF	ALPHA V = 43.9 WV = 3.85			9 35	MEV MEV	R0 = 1 RI = 1	.91 FM .91 FM	A0 = AI =	0.45 FM 0.45 FM	
			TABLE 2	2 T	HE LEVEL	DENSITY	PARAMETER	RS		
		Α(1/MEV)	Τ	(MEV)	PAIR.(ME	V) EX(M	MEV)		
B - C - C - C - N - N - N -	B - 11 B - 12 C - 12 C - 13 C - 14 C - 15 N - 14 N - 15 N - 16		1.431 1.491 1.700 1.846 1.988 1.988 1.600 2.130 2.130		$\begin{array}{c} 6.149\\ 6.201\\ 5.971\\ 5.382\\ 4.887\\ 4.600\\ 5.000\\ 3.758\\ 4.547\\ \end{array}$	$\begin{array}{c} 2.67\\ 0.0\\ 5.60\\ 2.80\\ 5.00\\ 0.0\\ 0.0\\ 2.20\\ 0.0\\ 0.0\\ \end{array}$	25 26 37 30 28 19 10 22	25.58 26.78 37.91 30.57 28.94 19.28 10.00 10.07 22.11		
TABL	.E 3 T	ΉE	LEVEL S	SCHEN	IE (ENERG)	Y(MEV), S	PIN AND F	PARITY)/3,9,10/	/
	N - 1	4	N - 1	15	N-16	C-15	C - 1	4	C-13	
GS 1 2 3 4 5 6 7	0.0 2.313 3.948 4.915 5.106 5.691 5.834	1+ 0+ 1+ 2- 1- 3-	0.0 5.270 5.299 6.324 7.155 7.301 7.567 8.313	1/2- 5/2+ 1/2+ 3/2- 5/2+ 3/2+ 7/2+	0.0 2	0.0 1 0.740 5	/2+ 0.0 /2+ 6.094 6.589 6.728 6.903 7.012 7.34	$\begin{array}{c} 0+ & 0 \\ 1- & 3 \\ 0+ & 3 \\ 3- & 3 \\ 3- & 3 \\ 0- \\ 2- \\ 2+ \\ 1- \\ 2- \end{array}$.0 1/2- .089 1/2- .685 3/2- .854 5/2-	 + - +
8	6.446	3+	8.571	$\frac{1}{2+}$ $\frac{3}{2+}$		C-12	B-11		B-12	
10 11 12 13 14 15 16	7.023	2.1	9.152 9.155 9.225 9.758 9.829 9.928 10.070	3/2- 5/2+ 1/2- 5/2- 7/2- 3/2- 3/2+	GS 1 2 3 4 5 6	0.0 0	+ 0.0 2.125 4.445 5.020 6.743 6.793 7.286	8/2- 0 1/2- 0 5/2- 1 3/2- 2 7/2- 2 1/2+ 5/2+	.0 1+ .953 2+ .674 2- .620 1- .720 0+	
REFE 1) 2) 3) 4) 5) 6) 7) 8) 9) 10)	RENCES FUKAHO MUGHABE (ACADE AJZENNI YOUNG NUCLEA IGAREY BECCHE IN SECCHE (1971) AJZENB AJZENB	RI GHA ERG FZ G R-M S FTI ERG ERG	T.: JAH B S.F. PRESS -SELOVH B.ET AI ODEL CO SPECTR AND F JR.F R REAC -SELOVH -SELOVH	ERI-M ET A 1981 E F.: DE F.: DE F DE LA EUKAH S. REA S. D. A TIONS E F.:	1 89-047 , NEW YOL. PI KFK-1443 NASH, A I OR CALCUI OR CALCUI OR T.: V. 131 (ND GREENI ', THE UI NUCL. PI NUCL. PI	(1989). JTRON ČRO RK) HYS. A460 (1971) PREEQUILI ATION OF 977) JAERI 132 1963) 745 LEES G.W. NIVERSITY HYS. A449 HYS. A433	SS SECTIO (1986) 7 BRIUM, ST/ CROSS SE 1 (1991) 7 : 'POLAR OF WISCO (1986) 7	DNS' V ATISTI ECTION IZATIO DNSIN	OL.1 PART CAL AND N PHENOME PRESS	Γ Α ΞΝΑ

MAT number = 825 8-0 - 16 JNDC JAERI-M 90-012 HISTORY EVAL-DEC83 Y.KANDA(KYU) T.MURATA(NAIG)+ DIST-SEP89 REV2-DEC93 NEW EVALUATION FOR JENDL-3 SUB-WORKING GROUP ON EVALUATION OF 0-16, WORKING GROUP ON NUCLEAR DATA FOR FUSION, JAPANESE NUCLEAR DATA COMMITTEE IN CHARGE SIG-T Y.NAKAJIMA K.SHIBATA(JAERI) 83-12 84-07 87-01 90-10 93-12 (3,102) (3,2),(3,3) (12,102) (12,51;57;62) (13,3) GENERAL INFORMATION DESCRIPTIVE DATA MF = 1MT=451 RESONANCE PARAMETERS SCATTERING RADIUS ONLY. MF=2MT = 151CROSS SECTIONS CALCULATED 2200M/S CROSS SECTIONS AND RES. INTEGRALS 2200M/S (B) RES. INTEG. (B) MF=3TOTAL 3.780 ÉLÁSTIC CAPTURE 3.780 1.9E-4 6.33E-4 SIG-T BELOW 3 MEV, THE TOTAL CROSS SECTION WAS CALCULATED WITH THE R-MATRIX THEORY. ABOVE 3 MEV, BASED ON THE EXPERIMENTAL DATA OF CIERJACKS ET AL./1/. SIG-EL BELOW 3 MEV, CALCULATED WITH THE R-MATRIX THEORY. ABOVE 3 MEV, THE ELASTIC SCATTERING CROSS SECTION WAS OBTAINED BY SUBTRACTING THE REACTION CROSS SECTION WAS OBTAINED BY SUBTRACTION. NON-ELASTIC SUM OF MT=4, 16, 102, 103, 104 AND 107. TOTAL INELASTIC SUM OF MT=51 TO 91. (N,2N) MT = 1MT=2SECTIONS FROM MT=3MT = 4 $\begin{array}{c} \text{MT-4} \\ \text{SUM OF MT=51 TO 91.} \\ \text{MT=16} & (N,2N) \\ \text{BASED ON EXPERIMENTAL DATA/2/.} \\ \text{MT=51-79,91 SIG-IN} \\ \text{SHAPE OF THE EXCITATION FUNCTIONS WAS CALCULATED WITH } \\ \text{THE STATISTICAL MODEL.} \\ \text{THE OPTICAL POTENTIAL PARAMETERS ARE THE FOLLOWING:} \\ \text{V} = 48.25 \cdot 0.053E, \quad \text{WS} = 3.0 + 0.25E, \quad \text{VSO} = 5.5 \quad (1000 \text{ M}) \\ \text{R} = 1.255 \quad , \quad \text{RS} = 1.352 \quad , \quad \text{RSO} = 1.15 \quad (1000 \text{ M}) \\ \text{A} = 0.536 \quad , \quad \text{B} = 0.205 \quad , \quad \text{ASO} = 0.50 \quad (1000 \text{ M}) \\ \text{LEVEL SCHEME} \\ \text{NO} \qquad \text{ENERGY(MEV)} \quad \text{SPIN-PARITY} \\ \text{G.S.} \qquad 0.0 \qquad 0 + \\ 1 \qquad 6.0490 \qquad 0 + \\ 2 \qquad 6.1300 \qquad 3 - \end{array}$ (MEV) (FM) (FM). ERGY (ME 0.0 6.0490 6.1300 6.9170 7.1169 8.8720 9.6300 9.8470 3 -2+ 1 -2 3 4 2 -1 -2+ 5 6 7 10.360 4+ 8 ğ <u>0</u>-10 11.080 3+ 11 12 11.100 4+ 2+ 3-13

11.600

	14 12.050 0+ 15 12.440 1- 16 12.530 2- 17 12.800 0- 18 12.970 2- 19 13.020 2+ 20 13.090 1- 21 13.120 3- 22 13.260 3- 23 13.660 1+ 24 13.870 4+ 25 13.980 2- 26 14.030 0+ 27 14.100 3- 28 14.300 4+ 29 14.400 5+ CONTINUUM LEVELS WERE ASSUMED ABOVE 14.4 MEV. CONSTANT TEMPERATURE OF 3.4 MEV WAS USED. FOR THE INELASTIC SCATTERING TO THE SECOND AND THIRD LEVELS, THE (N,N')GAMMA DATA OF NORDBORG ET AL./3/ AND LUNDBERG ET AL./4/ BELOW 10MEV. FOR MT=51 TO 55, THE 14 MEV CROSS SECTIONS WERE NORMALIZED TO THE EXPERIMENTAL DATA/5/-/8/. CROSS SECTIONS FOR MT=56-64 AND 67 WERE NORMALIZED TO REPRODUCT THE DDX DATA AT 14 MEV/8/ (9/
MT=102	CAPTURE 1/V CURVE NORMALIZED TO THE RECOMMENDED VALUE IN THE 4TH EDITION OF BNL-325 /10/ AT 0.0253 EV.
MT=103	ABOVE 100 EV, P-WAVE CAPTURE WAS CONSIDERED./28/ (N,P) BASED ON EXPERIMENTAL DATA/11/-/14/
MT=104	(N,D) BASED ON THE EVALUATION OF FOSTER, JR. AND YOUNG /15/.
MI=107 MT-251	(N,ALPHA) BASED ON EXPERIMENTAL DATA/3/,/16/-/21/. MULBAR
m1-201	CALCULATED FROM ANGULAR DISTRIBUTIONS IN MF=4.
MF=4 MT=2	ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
	3 MEVTO 5 MEVBASED ON THE EXPERIMENTAL DATA OF LISTER AND SAYRES /22/.5 MEV TO 9 MEVMULTI-LEVEL FORMULA/23/.9 MEV TO 15 MEVBASED ON THE EXPERIMENTAL DATA OF GLENDINNING ET AL./24/15 MEV TO 20 MEVCALCULATED WITH THE SPHERICAL OPTICAL MODEL.0 MEV TO 20 MEVOPTICAL MODEL.15 MEV TO 20 MEVCALCULATED WITH THE SPHERICAL OPTICAL MODEL.0 MEV TO 20 MEVOPTICAL MODEL.0 M
MT=16 MT=51-7	ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.
	CALCULATED WITH THE STATISTICAL MODEL. FOR MT=51, 52 AND 55, EXPERIMENTAL DATA/8/ AT 14.2 MEV. FOR MT=53 AND 54 ENDE/B-IV WAS ADOPTED
MT=91	ISOTROPIC DISTRIBUTIONS IN THE CENTER OF MASS SYSTEM WERE TRANSFORMED INTO THE ONES IN THE LABORATORY SYSTEM. THE FORMULA IS GIVEN IN REF./25/.
MF=5 MT=16	ENERGY DISTRIBUTION FOR SECONDARY NEUTRONS
	EVAPORATION SPECTRUM WAS ASSUMED. CONSTANT TEMPERATURE WAS DEDUCED FROM THE EXPERIMENTAL DATA OF CHIBA ET AL. /26/ FOR LI-7 ACCORDING TO THE SQRT(E/A) LAW.
MT=9T	EVAPORATION SPECTRUM WAS ASSUMED. CONSTANT TEMPERATURE OF 3.4 MEV WAS DETERMINED FROM THE STAIR CASE PLOTTING.
MF=12 MT=52-6	PHOTON PRODUCTION MULTIPLICITIES 58,102,103,107 CALCULATED WITH GNASH/27/.
MF=13 MT=3	PHOTON PRODUCTION CROSS SECTIONS CALCULATED WITH GNASH/27/.
MF=14 MT=3,52	PHOTON ANGULAR DISTRIBUTIONS 2-68,102,103,107 ISOTROPIC

MF=15 PHOTON ENERGY DISTRIBUTIONS MT=3,102,103,107 CALCULATED WITH GNASH/27/.

CALCULATED WITH GNASH/27/.
REFERENCES

CIERJACKS, S. ET AL.: NUCL. INSTR. METH. 169 (1980) 185.
BRILL, O.D. ET AL.: SOVIET PHYS. DOKLADY 6 (1961) 24.
NORDBORG, C. ET AL.: NUCL. SCI. ENG. 66 (1978) 75.
LUNDBERG, B. ET AL.: NUCL. SCI. ENG. 66 (1978) 75.
LUNDBERG, B. ET AL.: NUCL. PHYS. 47 (1963) 241.
MCDONALD, W.J. ET AL.: NUCL. PHYS. 75 (1966) 353.
MEIER, D. ET AL.: RUCL. DATA FOR BASIC AND APPLIED SCIENCE", SANTÀ FE 1985 P223.
TAKAHASHI, A. ET AL.: NUCL. DATA FOR BASIC AND APPLIED SCIENCE", SANTÀ FE 1985, 1981.
NORDARAN, N. ET ÁL.: FIRST IAEA CONF. NUCLEAR DATA FOR REACTORS, 1 (1967) 225.
DE JUREN, J. A. ET AL.: BHYS. REV. 127 (1962) 1229.
SEEMAN, K.W. ET AL.: HYS. REV. 93 (1954) 498.
FOSTER JR. D. G. AND YOUNG P. G.: LA-4780 (1972).
DAVIS, E.A. ET AL.: HUYS. ACTA 41 (1968) 573.
DICKENS, J.K. ET AL.: HUYS. ACTA 41 (1968) 573.
DICKENS, J. K. ET AL.: HUYS. ACTA 41 (1968) 573.
DICKENS, J.K. ET AL.: HUYS. SCI. ENG. 40 (1972).
DOAVIS, E.A. ET AL.: HUY. PHYS. ACTA 41 (1968) 159.
SIGNANK, Y. ET AL.: HUUL. SCI. ENG. 40 (1970) 283.
OORPHAN, V.J. ET AL.: NUCL. SCI. ENG. 40 (1970) 352.
BAIR, J.K. ET AL.: HYS. REV. C7 (1972) 1356.
DICKENS, J.K. ET AL.: NUCL. SCI. ENG. 42 (1970) 352.
BAIR, J.K. ET AL.: HYS. REV. C7 (1972) 1356.
CUNTITA, A.S. ET AL.: NUCL. SCI. ENG. 42 (1970) 352.
BAIR, J.K. ET AL.: NUCL. SCI. ENG. 42 (1970) 352.
BAIR, J.K. ET AL.: NUCL. SCI. ENG. 42 (1970) 352.
MURATA, T.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY. MITO, 1988, P.557, (1988).
CHNOINNG, S.G. ET AL.: NUCL. SCI. ENG. 82(1982) 393.
SONKAGAWA, T. JAERI-M 84-103 (1964).
CHBA, S. ET AL.: J. NUCL. SCI. TECH. 22(1985)771.
GONFAN, V.J. ET AL.: NUCL. SCI. TECH. 22(1985)771.
MURATA, T. PARC. IN V.L. PHYS. A536 (1992) 285.

MAT number = 925 9-F - 19 JAERI EVAL-JUL89 T.SUGI DIST-SEP89 REV2-JUN94 HISTORY 83-11 EVALUATION FOR JENDL-2 WAS PERFORMED BY SUGI AND NISHIMURA 83-11 EVALUATION FOR JENDL-2 WAS PERFORMED DI SOGT AND MISTING (JAERI)/1/.
89-07 RESONANCE PARAMETERS AND TOTAL CROSS SECTION WERE RE-EVALUATED FOR JENDL-3.
89-07 COMPILED BY T. NARITA (JAERI).
94-06 JENDL-3.2. GAMMA PRODCTION DATA MODIFIED BY T.ASAMI (DATA ENG.) OTHER DATA WERE MAINLY ADOPTED FROM JENDL FUSION FILE. COMPILED BY T.NAKAGAWA (NDC/JAERI) (3,2), (3,4), (3,22), (3,28), (3,52-91), (3,104), (3,251) ALL ANGULAR DISTRIBUTIONS ALL ENERGY DISTRIBUTIONS NEW EVALUATION FOT GAMMA-RAY PRODUCTION DATA * * * * * - - - - -JENDL FUSION FILE /2/ (AS OF JUN. 1994) EVALUATED AND COMPILED BY S.CHIBA (NDC/JAERI). THE CALCULATIONS HAVE BEEN CARRIED OUT WITH THE SINCROS-II CODE SYSTEM (DWUCKY, EGNASH AND CASTHY2Y) /3/. THE FOLLOWING SET OF OMPS WERE SELECTED: N : YAMAMURO (MODIFIED WALTER-GUSS) /3/ P : PEREY AND WALTER-GUSS COMBINED /4/ D : LOHR-HAEBERLI /5/ T : BECCHETTI-GREENLEES /6/ HE-3 : BECCHETTI-GREENLEES /6/ ALPHA : LEMOS SET MODIFIED BY ARTHUR-YOUNG /7/ THE FOLLOWING VALUES OF LEVEL DENSITY PARAMETERS (1/MEV) WERE USED TO REPRODUCE THE DDX AT 14 MEV: F-20 F-19 F-18 0-19 0-18 0-17 N-17 N-16 N-15 N-14 C-15 C-14 4.49 3.50 2.50 2.50 3.00 2.99 3.51 2.00 2.00 2.03 2.84 2.46 THE DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING: MF=3, MT= 2: ADJUSTED TO CONSERVE THE TOTAL C.S. MF=3, MT= 3: CALCULATED AS A SUM OF REACTION C.S. MF=3, MT= 4: CALCAULATED AS A SUM OF REACTION C.S. MF=3, MT=4: CALCAULATED AS A SUM OF INELASTIC C.S. MF=3, MT=22, 28, 32, 91 : TAKEN FROM THE SINCROS-II CALCULATION MF=3, MT=52: REPLACED BY THE SINCROS-II CALCULATION ABOVE 2.5 MEV MF=3, MT=53-60: REPLACED BY THE SINCROS-II CALCULATION MF=3, MT=203,204,205,207: TAKEN FROM THE SINCROS-II CALCULATION MF=6, MT=22, 28, 32, 91 : TAKEN FROM THE SINCROS-II CALCULATION. KUMABE'S SYSTEMATICS WAS USED. MF=6, MT=203,204,205,207: TAKEN FROM THE SINCROS-II CALCULATION. KALBACH'S SYSTEMATICS WAS USED. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS : 1.0E-5 EV - 100 KEV THE MULTI-LEVEL BREIT-WIGNER FORMULA WAS USED. RES. ENERGIES AND GAM-N : THE FIRST TWO LEVELS WERE BASED ON JOHNSON ET AL. /8/. THE 3RD AND 4TH LEVELS WERE ADJUSTED SO AS TO FIT TO THE EXPERIMENTAL DATA OF LARSON ET AL./9/ GAM-G : THE FIRST THREE LEVELS WERE BASED ON MACKLIN AND WINTERS /10/. THE 4TH LEVEL WAS ADJUSTED SO AS TO FIT TO THE RECOMMENDED THERMAL CAPTURE CROSS SECTION OF MUGHABGHAB ET AL./11/. SCATTERING RADIUS: 5.525 FM MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200 M/S RES. INTEG. ELASTIC 3.643 B -CAPTURE 9.6 MILLI-B 19.5 MILLI-B TOTAL 3.652 B -F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION MF = 3

BELOW 100 KEV: NO BACKGROUND. ABOVE 100 KEV: BASED ON THE EXPERIMENTAL DATA OF LARSON ET AL./9/ ABOVE 100 KEV: BASED ON THE EXPERIMENTAL DATA OF LARSON ET AL./9/ MT=2 ELASTIC SCATTERING CROSS SECTION DERIVED BY SUBTRACTING THE NONELASTIC CROSS SECTION FROM THE TOTAL CROSS SECTION. MT=4 TOTAL INELASTIC SCATTERING CROSS SECTION SUM OF MT=51-60,91. MT=16 (N,2N) CROSS SECTION CALCULATED BY FITTING THE PEARLSTEIN'S FUNCTION /12/ TO THE EXPERIMENTAL DATA. MT=22 (N,N' ALPHA) AND (N,ALPHA N') CROSS SECTIONS CALCULATED BY THE SINCROS-II CODE SYSTEM. MT=28 (N,N' P) AND (N,P N') CROSS SECTIONS CALCULATED BY THE SINCROS-II CODE SYSTEM. MT=51 (TAKEN FROM JENDL-3.1) UP TO 1 MEV : BASED ON THE EXPERIMENTAL DATA OF BRODER ET AL. /13/. 1 MEV - 5.5 MEV : CALCULATED WITH THE HAUSER-FESHBACH METHOD (ELIESE-3 /14/) TAKING INTO ACCOUNT (N,ALPHA) AND (N,P) AS COMPETING PROCESSES. THE LEVEL SCHEME OF F-19, N-16 AND 0-19 WAS TAKEN FROM AJZENBERG-SELOVE /15,16/. THE OPTICAL POTENTIAL PARAMETERS ARE : V = 51.566 - 1.492*E (MEV), WS = 11.82 V = 51.566 - 1.492*E (MEV), NG = RS = RSO = 1.31 (FM), A = ASO = 0.66 (FM), B = 0.47 (FM), THE LEVEL DENSITY PARAMETER OF 3.609 (1/MEV)/17/ AND PAIRING ENERGY OF 2.52 MEV /18/ WERE USED. MT=52 UP TO 2.5 MEV: TAKEN EROM JENDL-3.1, WHICH IS BASED ON THE MT=52MT=52 UP TO 2.5 MEV: TAKEN FROM JENDL-3.1, WHICH IS BASED ON THE DATA OF BRODER ET AL. /13/. ABOVE 2.5 MEV: CALCULATED BY THE SINCROS-II CODE SYSTEM. MT=53 - 60 CALCULATED BY THE SINCROS-II CODE SYSTEM. THE SINCROS-II CALCULATION ADOPTED THE FOLLOWING DISCRETE LEVELS. THE LEVELS WITH L AND BETA-L INCLUDE THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING, WHICH WAS CALCULATED ASSUMING THE WEAK-COUPLING MODEL BY THE DWBA METHOD: METHOD: MT EX(MEV) SPIN-PARITY L BETA-L - - - - - - - -0.0 0.1099 0.1972 1.3457 2 1/2 +1/2+ 1/2- 5/2+ 5/2- 3/2- 3/2+ 9/2+51 Š2 2 0.4 53 1.3457 1.4585 1.5541 2.7798 3.9071 3.9985 4.0325 54 55 56 57 2 4 0.6 3/2+ 7/2-9/2-58 <u>5</u>9 60 4.3777 7/2+ 4 0.4 MT=91 INELASTIC TO CONTINUUM CALCULATED WITH SINCROS-II CODE SYSTEM. MT=102 CAPTURE CROSS SECTION BELOW 100 KEV : NO BACKGROUND. 100 KEV - 1.87 MEV : BASED ON THE EXPERIMENTAL DATA OF GABBARD ET AL. /19/. 1.87 MEV - 20 MEV : ASSUMED TO DECREASE WITH 1/V LAW. MT=103 (N,P) CROSS SECTION UP TO 9 MEV : BASED ON THE EXPERIMENTAL DATA OF BASS ET AL. /20/. 9 MEV - 20 MEV : CALCULATED WITH THE STATISTICAL MODEL BY USING PEARLSTEIN' EMPIRICAL FORMULA. MT=104 (N,D) CROSS SECTION CALCULATED BY THE SINCROS-II CODE SYSTEM. MT=105 (N,T) CROSS SECTION CALCULATED BY THE SINCROS-II CODE SYSTEM. MT=107 (N,ALPHA) CROSS SECTION BELOW 9 MEV, BASED ON THE FOLLOWING EXPERIMENTAL DATA: UP TO 4MEV DAVIS ET AL. /21/, 4MEV - 5.5MEV SMITH ET AL. /22/, 5.5MEV - 9MEV BASS ET AL. /20/.

ABOVE 9 MEV, CALCULATED WITH THE PEARLSTEIN'S FORMULA. MT=251 AVERAGE COSINE IN THE LABORATORY SYSTEM DERIVED FROM THE ANGULAR DISTRIBUTIONS.

MF = 4

=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL BY THE SINCROS-II CODE SYSTEM.

MT=16,22,28 CALCULATED BASED ON KUMABE'S SYSTEMATICS /23/. MT=51-60

CALCULATED BY THE SINCROS-II CODE SYSTEM.

MT = 91CALCULATED BASED ON KUMABE'S SYSTEMATICS /23/.

E=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28.91 CALCULATED BY THE SINCROS-II CODE SYSTEM. MF = 5

REFERENCES
1) SUGI T. AND NISHIMURA K.: JAERI-M 7253 (1977), ENGLISH TRANS-LATION : ORNL-TR-4605.
2) CHIBA, S. ET AL.: JAERI-M 92-027, P.35(1992).
3) YAMAMURO, N.: JAERI-M 90-006 (1990).
4) WALTER, R.L. AND GUSS, P.P.: INT. CONF. ON NUCL. DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE, N.M. P.1079(1985).
5) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
6) BECCHETTI, F.D. AND GREENLEES, G.W.: "POLARIZATION PHENOMENA IN NUCLEAR REACTIONS", UNIV. OF WISCONSIN PRESS, P.682 (1971). 6) BECCHEITI, F.D. AND GULLAUT, OF WISCONSIN PRESS, P.682 IN NUCLEAR REACTIONS", UNIV. OF WISCONSIN PRESS, P.682 (1971).
7) ARTHUR, E.D. AND YOUND, P.G.: LA-8626-MS (1980).
8) JOHNSON C.H. ET AL.: ORNL-5025 (1975).
9) LARSON D.C. ET AL.: ORNL/TM-5612 (1976).
10) MACKLIN R.L. AND WINTERS R.R.: PHYS. REV. C7, 1766 (1973).
11) MUGHABGHAB S.F. ET AL.: NEUTRON CROSS SECTIONS, VOL.1, PART A, Z=1-60, ACADEMIC PRESS (1981).
12) PEARLSTEIN S.: NUCL. SCI. ENG. 23, 238 (1965).
13) BRODER ET AL.: 70 HELSINKI CONF. 2, 295 (1970).
14) IGARASI S.: JAERI 1224 (1972).
15) AJZENBERG-SELOVE F.: NUCL. PHYS. A166, 1 (1971).
16) AJZENBERG-SELOVE F.: NUCL. PHYS. A190, 1 (1972).
17) ABDELMALEK N.N. AND STAVINSKY V.S.: NUCL. PHYS. 58, 601 (1964)
18) NEWTON T.D.: CAN. J. PHYS. REV. 114, 201 (1959).
20) BASS R. ET AL.: EANDC(E) 66-64.
21) DAVIS E.A. ET AL.: NUCL. PHYS. REV. 114, 201 (1959).
23) KUMABE, I. ET AL.: NUCL. SCI. AND ENG., 104, 280 (1990).

MAT number = 1125 11-NA- 23 SRI EVAL-MAR87 H.YAMAKOSHI(SHIP RESEARCH INST.) DIST-SEP89 REV2-NOV93 HISTORY NEW EVALUATION WAS MADE FOR JENDL-3. THE DATA FOR MF=15,MT=102 MODIFIED. JENDL-3.2 MF=3,MT=1: MODEFIED BY T.FUKAHORI(JAERI) MF=4,MT=91: CHANGED TO LAB. SYSTEM BY T.NAKAGAWA(JAERI) GAMMA-RAY PART: MODEFIED BY T.ASAMI(DATA ENG. CO. LTD.) 87-03 89-08 93-11 (15,102) ***** RECALCULATION BY CASTHY AT 1.0E-5,0.0253 EV. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY #F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 350 KEV. PARAMETERS WERE MAINLY TAKEN FROM THE RECOMMENDED DATA OF BNL /2/, AND THE DATA FOR SOME LEVELS WERE MODIFIED SO THAT THE CALCULATED TOTAL CROSS SEC-TIONS FOR NA-23 WERE FITTED TO THE EXPERIMENTAL DATA. THE SCATTERING RADIUS WAS ASSUMED TO BE 5.2 FERMI. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: MF=22200 M/S CROSS SECTION(B) 3.024 0.531 3.555 RES. INTEGRAL(B) ELASTIC CAPTURE 0.3122 TOTAL E=3 NEUTRON CROSS SECTIONS BELOW 350 KEV, BACKGROUND CROSS SECTION WAS GIVEN FOR THE TOTAL AND ELASTIC SCATTERING CROSS SECTIONS. THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA. ABOVE 350 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN POINTWISE. MF=3 WITH MLBW FORMULA. ABOVE 350 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN POINTWISE. MT=1 TOTAL IN THE ENERGIES BETWEEN 350 KEV AND 14 MEV, EVALUATED BASED ON THE EXPERIMENTAL DATA OF CIERJACKS/3/ IN TRACING THEIR FINE STRUCTURES. ABOVE 14 MEV, BASED ON THE EXPERIMENTAL DATA OF LANGSFORD/4/, STOLER/5/ AND LARSON/1/. MODEFICATION WAS DONE BY T.FUKAHORI(JAERI) TO BE BASED ON THE EXPERIMENTAL DATA OF ONLY LARSON/1/ ABOVE 1 MEV. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4, 51-77, 91 INELASTIC SCATTERING BELOW 5 MEV, THE INELASTIC SCATTERING CROSS SECTION TO THE 1ST LEVEL(MT=51) WAS EVALUATED BASED ON THE EXPERIMENTAL DATA OF TOWLE AND GILBOY/6/, CHRIEN AND SMITH/7/, AND LIND AND DAT/8/. BELOW 5 MEV, THE INELASTIC SCATTERING CROSS SECTION TO THE 2ND AND 3RD LEVEL(MT=52, 53) WAS EVALUATED BASED ON THE EXPERIMENTAL DATA OF FREEMAN AND MONTAGUE/9/. LIND AND DAT/8/, AND TOWLE AND OWENS/10/. FOR THE INELASTIC SCATTERING CROSS SECTIONS TO THE 1ST TO 3RD LEVEL(MT=52, 53) WAS EVALUATED BASED ON THE LASTIC SCATTERING DATA, OPTICAL AND STATISTICAL MODEL CALCULATIONS WERE MADE WITH THE CASTHY CODE/11/, TAKING ACCOUNT OF THE CONTRIBUTION FROM THE COMPETING PROCESSES. THE DIRECT COMPONENT WAS CALCULATED WITH WITH THE DWUCK CODE/12/ FOR FIVE LOWEST LEVELS. THE DEFORMATION PARAMETERS WERE ESTIMATED BASED ON A WEAK COUPLING MODEL. THE OPTICAL AND STATISTICAL MODEL CALCULATIONS WERE MADE WITH WITH THE DWUCK CODE/12/ FOR FIVE LOWEST LEVELS. THE DEFORMATION PARAMETERS WERE ESTIMATED BASED ON A WEAK COUPLING MODEL. THE OPTICAL OPTATIAL PARAMETERS USED ARE: V = 46.0 - 0.25*EN, VSO = 6.0 (MEV) WS = 14.0 - 0.2*EN, WV = 0.125*EN (MEV) R = 1.286, RS = 1.39, RSO = 1.07 (FM) A = 0.62, ASO = 0.62, B = 0.7 (FM) THE LEVEL DATA USED IN THE ABOVE TWO CALCULATIONS WERE TAKEN

FROM REF./13/ AS FOLLOWS: MT LEVEL ENERGY(MEV) SPIN-PARITY
MT LIVEL ENERGY(MEV) SPIN-PARITY 0.0 3/2+ 51 0.4399 5/2+ 52 2.0764 7/2+ 53 2.3909 1/2+ 54 2.6398 1/2- 55 2.7037 9/2+ 56 2.9824 3/2+ 57 3.6783 3/2- 58 3.8480 5/2- 59 3.9147 5/2+ 60 4.4320 1/2+ 61 4.7756 7/2+ 62 5.3800 3/2+ 63 5.5360 11/2+ 64 5.7410 3/2+ 63 5.5360 11/2+ 64 5.7410 3/2- 67 5.9670 3/2- 68 6.0430 1/2- 69 6.1170 11/2+ 70 6.1910 11/2+ 71 6.2360 13/2+ 72 6.3080 1/2+ 73 6.3506 9/2- 74 6.577
<pre>MT=16 (N,2N) MAINLY BASED ON THE EXPERIMENTAL DATA OF ADAMSKI/14/. MT=22 (N,NA) CALCULATED WITH THE GNASH CODE/15/ AND NORMALIZED TO THE EXPERIMENTAL DATA OF WOELFER/16/ AT 16.4 MEV. MT=28 (N,NP) CALCULATED WITH THE GNASH CODE/15/. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/11/ AND NORMALIZED TO 0.3 MB AT 500 KEV. MT=103 (N,P) BELOW 10 MEV, BASED ON THE EXPERIMENTAL DATA/17,18/. ABOVE 10 MEV, CALCULATED WITH THE GNASH CODE/15/ AND NORMALIZ- ED TO CONNECT SMOOTHLY WITH THE DATA BELOW 10 MEV. MT=107 (N,A) BELOW 12 MEV, BASED ON THE EXPERIMENTAL DATA/17,18/. ABOVE 12 MEV, CALCULATED WITH THE GNASH CODE/15/ AND NORMALIZ- ED TO CONNECT SMOOTHLY WITH THE GNASH CODE/15/ AND NORMALIZ- MT=251 MU-BAR</pre>
CĂLCULATED WITH THE OPTICAL MODEL.
MT=2 CALCULATED WITH THE CASTHY CODE/11/. MT=51-77 CALCULATED WITH THE CASTHY CODE/11/ AND THE DWUCK CODE/7/. MT=91 CALCULATED WITH THE CASTHY CODE/11/ AND TRANSFORMED INTO THE LABORATORY SYSTEM. MT=16, 22, 28 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.
MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 CALCULATED WITH THE GNASH CODE/15/.
<pre>MF=12 PHOTON PRODUCTION MULTIPLICITIES MT=51-67,102,103 CALCULATED WITH THE GNASH CODE. FOR THE JENDL-3.2, MODIFICATIONS WERE DONE FOR ENERGY BALANCE AND FOR CHANGING UPPER ENERGY LIMIT FROM 5.21937 MEV TO 6.26325 MEV.</pre>
MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 CALCULATED WITH THE GNASH CODE/15/. FOR THE JENDL-3.2, LOWER ENERGY LIMIT WAS CHANGED TO 6.26325
MEV, ACCORDING TO MF=12 MODIFICATION. MF=14 PHOTON ANGULAR DISTRIBUTIONS

MT=3,51-67,102,103 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA

MT=3,103 .._CALCULATED WITH THE GNASH CODE/15/.

MT=102 CALCULATED WITH THE GNASH CODE/15/ AND MODIFIED AT THERMAL BASED ON THE EXPERIMENTAL DATA OF MAERKER/19/ AND CASTHY CALCULATION.

REFERENCES

LARSON D.C. ET AL. : ORNL-TM-5614 (1976).
MUGHABGHAB S.F. AND GARBER D.I. : "NEUTRON CROSS SECTIONS", VOL. 1, PART B (1984).
CIERJACKS S. ET AL. : KFK-1000 (1969).
LANGSFORD A. ET AL. : 1965 ANTWERP CONF. 529 (1965).
STOLER P. ET AL. : 1971 KNOXVILLE CONF. VOL.1, 311 (1971).
TOWLE J.H. AND GILBOY W.B. : NUCL. PHYS. 32, 610 (1962).
CHRIEN J.P. AND SMITH A.B. : NUCL. ENG. 26, 500 (1966).
LIND D.A. AND DAY R.B. : ANN. PHYS. 12, 485 (1961).
FREEMAN J.M. AND MONTAGUE J.H. : NUCL. PHYS. 9, 181 (1958).
TOWLE J.H. AND FUKAHORI T.: JAERI 1321 (1991).
KUNZ P.D. : UNPUBLISHED.
ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE)
ADAMSKI L. ET AL. : ANNA. NUCL. ENER. 7, 397 (1980).
YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).
WOELFER G. ET AL. : Z. PHYS. 194, 75 (1966).
WOELFER R.E. : ORNL-TM-5203 (1976).

MAT number = 1200 12-MG- 0 DEC,NEDAC EVAL-MAR87 M.HATCHYA(DEC),T.ASAMI(NEDAC) DIST-SEP89 REV2-NOV93 HISTORY 87-03 NEW EVALUATION WAS MADE FOR JENDL-3. 87-03 COMPILED BY T.ASAMI. 93-11 JENDL-3.2. GAMMA-PRODUCTION DATA MODIFIED BY T.ASAMI(DATA ENG.) COMPILED BY T.NAKAGAWA (NDC/JAERI)

 MODIFIED
 PARTS
 FOR
 JENDL-3.2

 (12,102)
 BELOW 3
 MEV

 (13,4)
 BELOW 3
 MEV

 (14,4)
 NEW
 MODIFIED
 AT.1.0E-5

 (15,102)
 MODIFIED
 AT.1.0E-5
 AND

 * NEW MODIFIED AT 1.0E-5 AND 0.0253 EV MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY IF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 520 KEV. THE DATA ARE CONSTRUCTED FROM THE EVALUATED RESONANCE PARAMETERS FOR MG-24, -25 AND -26, CONSIDERING THEIR ABUNDANCES IN THE MG ELEMENT/1/. MF=22200 M/S CROSS SECTION(B) 3.53 0.063 RES. INTEGRAL(B) ELASTIC CAPTURE 0.0366 TOTAL 3.59 =3 NEUTRON CROSS SECTIONS BELOW 520 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN. ABOVE 520 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN POINTWISE. MF=3ALL THE CROSS-SECTION DATA WERE CONSTRUCTED FROM THE EVALUATED ONES FOR THREE STABLE ISOTOPES OF MG CONSIDERING THEIR ABUNDANCES IN THE MG ELEMENT, ABUNDANCES IN THE MG ELEMENT, MT=1 TOTAL CONSTRUCTED FROM THE EVALUATED DATA FOR STABLE ISOTOPES OF MG. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4, 51-90, 91 INELASTIC SCATTERING CONSTRUCTED FROM THE EVALUATED DATA FOR STABLE ISOTOPES OF MG AS FOLLOWS: MT LEVEL ENERGY(MEV) MG-24 MG-25 MG-26 0 0 54 55 57 58 56 9 62 53 57 65 66-67 78 **Š**9

5.6900 6.0103 6.4322 7.3479 7.5530 7.6162 7.7472 7.8120 63 83 84 55 56 57 85 86 58 59 87 88 ÕÕ 89 90 7.8120 61 LEVELS ABOVE 7.98 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16, 22, 28, 102, 103 AND 107 (N,2N), (N,NA), (N,NP), (N,GAMMA), (N,P) AND (N,A) CONSTRUCTED FROM THE EVALUATED DATA FOR THREE STABLE ISOTOPES OF MG, TAKING ACCOUNT OF THEIR ABUNDANCES IN THE MG ELEMENT. THE CALCULATED CAPTURE CROSS SECTIONS WERE NORMALIZED SO AS TO REPRODUCE THE ELEMENT MG DATA OF 72 MB AT 500 KEV/2/. MT=251 MU-BAR CONSTRUCTED FOR THE EVALUATED DATA FOR CTARLE LOOTOPEC CONSTRUCTED FROM THE EVALUATED DATA FOR STABLE ISOTOPES OF MG, TAKING ACCOUNT OF THEIR ABUNDANCES IN THE MG ELEMENT. $\mathsf{MF}{=}4$ Angular distributions of secondary neutrons $\mathsf{MT}{=}2$ MI=2 CONSTRUCTED FROM THE EVALUATED DATA FOR STABLE ISOTOPES OF MG, TAKING ACCOUNT OF THEIR ABUNDANCES IN THE MG ELEMENT. MT=51-90, 91 CONSTRUCTED WITH THE EVALUATED DATA FOR STABLE ISOTOPES OF MG, TAKING ACCOUNT OF THEIR ABUNDANCES IN THE MG ELEMENT. MT=16, 22, 28 ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 CONSTRUCTED FROM THE EVALUATED DATA FOR STABLE ISOTOPES OF MG, TAKING ACCOUNT OF THEIR ABUNDANCES IN THE MG ELEMENT. MF=12 PHOTON PRODUCTION MULTIPLICITIES MT = 102FROM ENERGY BALANCE. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 3 MEV) CALCULATED WITH THE GNASH CODE/3/. MT=4 (BELOW 3 MEV) CALCULATED FROM INELASTIC CROSS SECTIONS AND TRANSITION PROBABITIES OF MG ISOTOPES. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3, 4, 102 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3CĂLCULATED WITH THE GNASH CODE/3/. MT=102 CALCULATED WITH THE CASTHY CODE/4/ BELOW 0.0253 EV AND WITH THE GNASH CODE/3/ AT HIGHER ENERGIES. REFERENCES 1) HOLDEN N.E., MARTIN R.L. AND BARNES I.L. : PURE & APPL. CHEM. 56, 675 (1984).
2) GRENIER ET AL. : CEA-N-2195 (1981).
3) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).
4) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).

MAT number = 1225 12-MG- 24 DEC,NEDAC EVAL-MAR87 M.HATCHYA(DEC), T.ASAMI(NEDAC) DIST-SEP89 REV2-APR93 HISTORY NEW EVALUATION WAS MADE FOR JENDL-3. COMPILED BY T.ASAMI. JENDL-3.2 COMPILED BY T.NAKAGAWA (NDC/JAERI) 87-03 87-03 93 - 04***** MODIFIED PARTS FOR JENDL-3.2 * * * * * * * * * * * * * * * * * * (4,91) CHĂNGĔD TO THẾ LABORATORY SYSTEM IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 520 KEV. PARAMETERS WERE TAKEN FROM THE RECOMMENDED DATA OF BNL/1/ AND THE DATA FOR A NEGATIVE RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL CROSS SECTIONS FOR CAPTURE AND SCATTERING/1/. THE DATA FOR SOME LEVELS WERE MODIFIED SO THAT THE CALCULATED TOTAL CROSS SECTIONS OF THE ELEMENT MG WERE FITTED TO THE EXPERIMENTAL DATA OF HIBDON/2/ AND SINGH/3/. THE SCATTERING RADIUS WAS ASSUMED TO BE 5.4 FERMI. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: MF=22200 M/S CROSS SECTION(B) ELASTIC 3.75 CAPTURE 0.050 TOTAL 3.80 RES. INTEGRAL(B) 0.0312 TOTAL 3.80 WF=3 NEUTRON CROSS SECTIONS BELOW 520 KEV, NO BACKGROUND CROSS SECTION IS GIVEN AND ALL THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED RESOLVED RESONANCE PARAMETERS WITH THE MLBW FORMULA. ABOVE 520 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS ARE GIVEN IN THE POINTWISE FORM. MT=1 TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY CODE/4/. THE OPTICAL POTENTIAL PARAMETERS USED ARE: V = 49.68, VSO = 7.12 (MEV) WS = 7.76 - 0.5*EN, WV = 0 (MEV) R = 1.17, RS = 1.09, RSO = 1.17 (FM) A = 0.6, ASO = 0.6, B = 0.69 (FM) MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4, 51-61, 91 INELASTIC SCATTERING CALCULATED WITH CASTHY /4/, TAKING ACCOUNT OF THE CONTRIBUTION FROM THE COMPETING PROCESSES. THE DIRECT COMPONENTS FOR MT=51 AND 52 WERE, CALCULATED WITH THE DWUCK/5/. THE CALCULATED DATA FOR THE FIRST LEVEL WERE NORMALIZED AT 12 MEV TO THE EXPERIMEN-TAL DATA/6/. THE LEVEL DATA USED IN THESE TWO CALCULATED DATA FOR THE FIRST LEVEL WERE NORMALIZED AT 12 MEV TO THE EXPERIMEN-TAL DATA/6/. THE LEVEL DATA USED IN THESE TWO CALCULATIONS WERE TAKEN FROM REF./7/ AS FOLLOWS: MT LEVEL ENERGY(MEV) SPIN-PARITY 0.0 0+ 51 1.3686 2+ 52 4.1200 4+ MF=351 52 53 1.3686 2+ 4+ 4.1200 4.2384 5.2361 6.0103 2+3+ 54 55 4+ 6.4322 7.3479 7.5530 56 0+ 57 2+ 58 1 -59 7.6162 3-60 7.7472 1+ 61 7.8120 3+ LEVELS ABOVE 10.0 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16, 22, 28, 103, 107 (N,2N), (N,NA), (N,NP), (N,P), (N,A) CALCULATED WITH THE GNASH CODE/8/ USING THE ABOVE OPTICAL MODEL PARAMETERS. THE (N,2N) CROSS SECTIONS WERE MODIFIED SO AS TO FIT TO THE EXPERIMENTAL DATA. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/4/ AND NORMALIZED TO 1.8 MB AT 20 KEV AT 30 KEV. MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

CÂLCULATED WITH THE CASTHY CODE/4/.

CALCULATED WITH THE CASTHY CODE/4/. MT=51-61 CALCULATED WITH THE CASTHY CODE/4/, AND CONTRIBUTIONS FROM THE DIRECT PROCESS CALCULATED WITH THE DWUCK CODE/5/ WERE ADDED TO MT=51 AND 52. MT=91 CALCULATED WITH THE CASTHY CODE/4/ AND TRANSFORMED INTO THE LABORATORY SYSTEM. MT=16, 22, 28 ASSUMED TO BE ISOTOROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 CALCULATED WITH THE GNASH CODE/8/.

REFERENCES
1) MUGHABGHAB S.F. AND GARBER D.I. :"NEUTRON CROSS SECTIONS", VOL.
1, PART B (1984).
2) HIBDON C.T. : TAKEN FROM EXFOR (1969).
3) SINGH U.N. ET AL. : PHYS. REV. C10, 2150 (1974).
4) IGARASI S. : J. NUCL. SCI. TECH. 12, 67 (1975).
5) KUNZ P.D. : UNPUBLISHED.
6) FOERTSCH ET AL. : NUCL. INSTR. METH. 169, 533 (1980).
7) ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE)
8) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

MAT number = 1228 12-MG- 25 DEC,NEDAC EVAL-MAR87 M.HATCHYA(DEC),T.ASAMI(NEDAC) DIST-SEP89 HISTORY 87-03 NEW EVALUATION WAS MADE FOR JENDL-3. 87-03 COMPILED BY T.ASAMI. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1=2 RESONANCE PARAMETERS T=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 220 KEV. PARAMETERS WERE TAKEN FROM THE RECOMMENDED DATA OF BNL/1/ AND MODIFIED FOR SOME LEVELS SO AS TO REPRODUCE THE EXPERI-MENTAL TOTAL CROSS SECTION OF THE ELEMENT MG. THE DATA FOR A NEGATIVE RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL CROSS SECTIONS FOR CAPTURE AND SCATTER-ING/1/ MF=2MT=151 <u>ĮNĒ/1/</u> ING/1/. THE DATA FOR SOME LEVELS WERE MODIFIED SO THAT THE CALCULATED TOTAL CROSS SECTIONS OF THE ELEMENT MG WERE FITTED TO THE EXPERIMENTAL DATA OF HIBDON/2/ AND SINGH/3/. THE SCATTERING RADIUS WAS ASSUMED TO BE 4.9 FERMI. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B) ELASTIC 2.60 CAPTURE 0.190 0.0989 TOTAL 2.79 F=3 NEUTRON CROSS SECTIONS BELOW 220 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED RESOLV-ED RESONANCE PARAMETERS WITH MLBW FORMULA. ABOVE 220 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN MF=3 POINTWISE. 5/2+ 1/2+ 3/2+ 7/2+ 5/2+ 1/2+ 7/2+ 0.0 0.5851 0.9748 51 52 53 1.6118 54 55 $\begin{array}{c} 1.9647\\ 2.5638\\ 2.7377\\ 2.8011\\ 3.4052\\ 3.4137\\ 3.9078\\ 4.0596\\ 4.2770\\ 4.3594\\ 4.7114\\ 4.7220\\ 5.0122\\ \end{array}$ 56 57 58 3/2+ 9/2+ 3/2-5/2+ 7/2-59 60 61 62 63 9/2+ 1/2-**6**4 3/2+ 65 9/2+ 1/2-7/2+ 66 67 LEVELS ABOVE 8.0 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16, 22, 28, 103, 107 (N,2N), (N,NA), (N,NP), (N,P), (N,A) CALCULATED WITH THE GNASH CODE/5/ USING THE ABOVE OPTICAL MODEL PARAMETERS THE (N,P) CROSS SECTIONS WERE NORMALIZED TO THE EXPERIMENTAL DATA AT 14 MEV OF BORMANN/6/. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/2/ AND NORMALIZED TO 4.7 MP CALCULATED WITH THE CASTHY CODE/2/ AND NORMALIZED TO 4.7 MB

AT 30 KEV. MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 ____CALCULATED WITH THE CASTHY CODE/2/.

MT=51-67 CALCULATED WITH THE CASTHY CODE/2/ AND THE DWUCK CODE/3/. MT=91 CALCULATED WITH THE CASTHY CODE/2/. MT=16, 22, 28 ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 CALCULATED WITH THE GNASH CODE/5/.

REFERENCES 1) MUGHABGHAB S.F. AND GARBER D.I. :"NEUTRON CROSS SECTIONS", VOL. 1, PART B (1984). 2) HIBDON C.T. : TAKEN FROM EXFOR (1969). 3) SINGH U.N. ET AL. : PHYS. REV. C10, 2150 (1974). 4) IGARASI S. : J. NUCL. SCI. TECH. 12, 67 (1975). 5) KUNZ P.D. : UNPUBLISHED. 6) ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE) 7) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977). 8) BORMANN M. ET AL. : 1966 PARIS CONF. VOL.1, 225 (1967).

MAT number = 1231 12-MG- 26 DEC,NEDAC EVAL-MAR87 M.HATCHYA(DEC),T.ASAMI(NEDAC) DIST-SEP89 HISTORY 87-03 NEW EVALUATION WAS MADE FOR JENDL-3. 87-03 COMPILED BY T.ASAMI. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 12 RESONANCE PARAMETERS 1=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 450 KEV. PARAMETERS WERE TAKEN FROM THE RECOMMENDED DATA OF BNL/1/ AND THE DATA FOR A NEGATIVE RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL CROSS SECTIONS FOR CAPTURE AND SCATTER-NACIONAL MF=2MT=151 ING/1/ ING/1/. THE SCATTERING RADIUS WAS ASSUMED TO BE 4.3 FERMI. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: 2200 M/S CROSS SECTION(B) 2.83 0.038 RES. INTEGRAL(B) ELASTIC CAPTURE 0.0190 TOTAL 2.87 WF=3 NEUTRON CROSS SECTIONS BELOW 450 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED RESOLV-ED RESONANCE PARAMETERS WITH MLBW FORMULA. ABOVE 450 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN POINTWISE. MT=1 TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH THE CASTHY CODE/2/. THE OPTICAL POTENTIAL PARAMETERS USED ARE: V = 49.68, VSO = 7.12 (MEV) WS = 7.76 - 0.5*EN, WV = 0 (MEV) R = 1.17, RS = 1.09, RSO = 1.17 (FM) A = 0.6, ASO = 0.6, B = 0.69 (FM) MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4, 51-63, 91 INELASTIC SCATTERING CALCULATED WITH CASTHY /2/, TAKING ACCOUNT OF THE CONTRIBUTION FROM THE COMPETING PROCESSES. THE DIRECT COMPONENT WAS CALCULATED WITH THE DWUCK CODE/3/. THE LEVEL DATA USED IN THE ABOVE TWO CALCULATIONS WERE TAKEN FROM REF./4/ AS FOLLOWS: MT LEVEL ENERGY(MEV) SPIN-PARITY 0.0 51 1.8087 2+ TOTAL 2.87 ME = 3

 MT
 LÉVÉL
 ENERGY (MEV)
 SPIN-PARITY

 0.0
 0+

 51
 1.8087
 2+

 52
 2.9384
 2+

 53
 3.5880
 0+

 54
 3.9405
 3+

 55
 4.3180
 4+

 56
 4.3320
 2+

 57
 4.3500
 3+

 58
 4.8340
 2+

 59
 4.9000
 4+

 60
 4.9720
 0+

 61
 5.2910
 2+

 63
 5.6900
 1+

 LEVELS
 ABOVE
 8.0

 MT=16, 22, 28, 103, 107 (N,2N), (N,NA), (N,NP), (N,P), (N,A) CALCULATED WITH THE GNASH CODE/6/ USING THE ABOVE OPTICAL MODEL PARAMETERS THE (N,A) CROSS SECTIONS WERE NORMALIZED TO THE EXPERIMENTAL DATA OF BORMANN/5/ AT 14 MEV. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/2/ AND NORMALIZED TO 1.7 MB AT 30 KEV AT 30 KEV. MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS _CĂLCULATED WITH THE CASTHY CODE/2/. MT = 51 - 63

CALCULATED WITH THE CASTHY CODE/2/ AND THE DWUCK CODE/3/.

MT=91 CALCULATED WITH THE CASTHY CODE/2/. MT=16, 22, 28 ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 CALCULATED WITH THE GNASH CODE/6/.

- REFERENCES 1) MUGHABGHAB S.F. AND GARBER D.I. :"NEUTRON CROSS SECTIONS", VOL. 1. PART B (1984). 2) IGARASI S. : J. NUCL. SCI. TECH. 12, 67 (1975). 3) KUNZ P.D. : UNPUBLISHED. 4) ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE) 5) BORMANN M. ET AL. : 1966 PARIS CONF. VOL.1, 225 (1967). 6) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

| MAT number = 1325
13-AL- 27 TIT,JAERI EVAL-MAR88 Y.HARIMA,H.KITAZAWA,T.FUKAHORI
88MITO, 473 DIST-DEC89 REV2-DEC93 |
|--|
| 88-03 EVALUATION WAS PERFORMED FOR JENDL-3 BY HARIMA, KITAZAWA
(TOKYO INSTITUTE OF TECH.) AND FUKAHORI (JAERI). DETAILS
ARE GIVEN IN REF /1/ |
| 88-03 COMPILED BY FUKAHORI.
93-12 JENDL-3.2.
COMPILED BY T.NAKAGAWA (NDC/JAERI) |
| ***** MODIFIED PARTS FOR JENDI-3 2 ********************** |
| (3,2)
(3,66-91) TAKEN FROM JENDI FUSION FILE* |
| (3,4), (3,51-70) CROSS-SECTION CURVES WERE SMOOTHED.
(4,16-28), (4,91) TAKEN FROM JENDL FUSION FILE |
| (5,16-91), (12,102)
(12,51-70), (12,102) |
| * * * * * * * * * * * * * * * * * * * |
| JENDL FUSION FILE /2/ (AS IS SEP. 1993) |
| EVALUATED BY B.YU (ČIAE) AND S.CHIBÅ (NDC/JAERI)
COMPILED BY B.YU. |
| CROSS SECTIONS WERE MAINLY TAKEN FROM JENDL-3.1, EXCEPT |
| REACTIONS WHICH WERE TAKEN FROM THE CALCULATION WITH
SINCROS-11/3/ ANGULAR DISTRIBUTIONS OF THESE LEVELS |
| WERE TAKEN TO BE EQUAL TO THAT OF MT=66 IN JENDL-3.
EDXS FOR MT=16, 22, 28 AND 91 WERE REPLACED BY THE |
| SINCROS-II CALCULATION. MF=6 WERE CREATED BY F15TOB
PROGRAM. KUMABE'S SYSTEMATICS/4/ WAS USED. THE PRE- |
| COMPOUND/COMPOUND RATIO WAS TAKEN FROM THE SINCROS-II
CALCULATION. |
| OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED
IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./3/. |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/5/. |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| MF=2_RESONANCE PARAMETERS: |
| RESOLVED RESONANCES : 1.0E-5 EV - 0.21 MEV |
| AN INITIAL GUESS OF THE PARAMETERS SEARCH WAS TAKEN FROM REF.
/7/. |
| CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS |
| ELASTIC 1.414 B -
CARTURE 0.221 B - |
| TOTAL 1.645 B - |
| MF=3 NEUTRON CROSS SECTIONS
MT=1 TOTAL CROSS SECTION |
| BETWEEN 0.21 AND 20 MEV, THE CROSS SECTIONS WERE OBTAINED BY
AN EYE-GUIDE SO AS TO FOLLOW THE EXPERIMENTAL DATA. |
| MT=2 ELASTIC SCATTERING CROSS SECTIONS
OBTAINED BY SUBTRACTING PARTIAL CROSS SECTIONS FROM THE |
| TOTAL CROSS SECTIONS.
MT=4,51-70,91 INELASTIC_SCATTERING_CROSS_SECTIONS |
| FOR JENDL-3.1, CROSS SECTIONS UP TO 17-TH LEVEL WERE CALCULATED
WITH THE STATISTICAL-MODEL CODE CASTHY /8/ AND THE COUPLED- |
| OF COMPETITIVE PROCESSES FOR NEUTRON, PROTON, ALPHA-PARTICLE |
| TAKEN INTO ACCOUNT. |
| NO. ENERGY(MEV) SPIN-PARITY
G S 0 0 5/2 + |
| 1. 0.8438 $1/2 + 2.$ 1.0145 $3/2 + 2.$ |
| $\overline{3}$. 2.2100 $\overline{7/2}$ +
4. 2.7340 $5/2$ + |
| 5. 2.9814 3/2 +
6. 3.0040 9/2 + |
| 7. 3.6780 1/2 +
8. 3.9560 5/2 + |
| 9. 4.0540 3/2 - |

5/2 11/2 7/2 5/2 3/2 5/2 5/2 4.4090 4.5103 4.5800 10. 11. 12. + + 4.5600 4.8120 5.1550 5.2460 5.4199 13. + 14. 15. + 16. + 17. 5.4330 9/2 + CONTINUUM LEVELS WERE ASSUMED ABOVE 5.6 MEV. LEVEL CALCULATED, USING THE GILBERT-CAMERON FORMULA. THE DENSITY PARAMETERS WERE OBTAINED FROM A CUMULATIVE OBSERVED LEVELS/1/. LEVEL DENSITY WAS LEVEL-ΤĦĒ PLŌŤ FOR JENDL-3.2, CROSS SECTIONS FOR MT'S FROM 66 TO 70 AND CONTINUUM INELASTIC WERE REPLACED WITH JENDL FUSION FILE. THESE MT'S CORRESPOND TO THE FOLLOWING LEVELS. 5/2 + 5/2 + 5/2 + 7/2 + 16. 5.4199 5.4328 5.4384 5.4384 5.4998 7/2 + 5.5507 3/2 + CROSS SECTIONS WERE SUMMED UP AS THE CONTINUUM 17. 18. 19. 20. 5.4 ABOVE 5.6 MEV, CRO INELASTIC (MT=91). SEVERAL ENERGY POINTS WERE ADDED TO MT= 4, 51-70 IN ORDER TO SMOOTH THEIR CROSS SECTION CURVES. MT=16 (N,2N) CROSS SECTION CORVES.
MT=16 (N,2N) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL WITH THE GNASH CODE/1,12/.
MT=22 (N,NA) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL WITH THE GNASH CODE/1,12/.
OPTICAL POTENTIAL FOR ALPHA-PARTICLES WAS DETERMINED, USING THE DISPERSION THEORY /13/.
MT=28 (N,NP) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL WITH THE GNASH CODE/1,12/.
MT=102 CAPTURE CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY/8/ AND THE DIRECT-SEMIDIRECT-MODEL CODE HIKARI/14/. THE STATISTICAL-MODEL CALCULATIONS WERE NORMALIZED TO 0.6 MB AT 0.6 MEV.
MT=103 (N,P) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL WITH THE GNASH CODE/1,12/.
MT=107 (N,A) CROSS SECTIONS OBTAINED BY AN EYE-GUIDE TO FOLLOW OBSERVED VALUES /15/.
MT=111 (N,2P) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL WITH THE GNASH CODE/1,12/.
MT=251 MU-BAR CALCULATED BY THE STATISTICAL MODEL WITH THE GNASH CODE/1,12/. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2_CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /1,8/. MT=16,22,28 TAKEN FROM JENDL FUSION FILE. MT=51-66 INCOHERENT SUM OF THE STATISTICAL MODEL AND COUPLED-CHANNE MODEL CALCULATIONS/1/. CALCULATED WITH CASTHY AND ECIS OR COUPLED-CHANNEL MODEL CALC JUPITOR-1. MT=67-70 ASSUMED TO BE THE SAME AS MT=66. MT=91 TĂKEN FROM JENDL FUSION FILE. F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE. MF = 5MF = 12GAMMA-RAY MULTIPLICITIES (BELOW 5.80993 MEV) MT=51-70 MULTIPLICITIES WERE CALCULATED FROM TRANSITION PROBABILITIES. MT=102 CALCULATED FROM ENERGY BALANCE. MT=103,107 CALCULATED BY USING THE GNASH CODE/1,12/. GAMMA-RAY PRODUCTION CROSS SECTIONS (ABOVE 5.80993 MEV) MF=13 MT=3CALCULATED BY THE STATISTICAL MODEL AND COUPLED-CHANNEL MODEL, USING THE GNASH CODE /12/ AND THE ECIS /9/ OR JUPITOR-1 CODE /10/. BRANCHING RATIOS FOR TRANSITIONS BETWEEN DISCRETE LEVELS WERE TAKEN FROM REF./3/. GAMMA-RAY TRANSITION STRENGTH IN THE CONTINUUM WAS CALCULATED BY THE BRINK-AXEL GIANT RESONANCE MODEL FOR E1 TRANSITION AND BY THE WEISSKOPF SINGLE-PARTICLE MODEL FOR E2 AND M1 TRANSITION/1/.

MF=14 GAMMA-RAY ANGULAR DISTRIBUTIONS MT=3,51-70,102,103,107 ISOTROPIC DISTRIBUTION WAS ASSUMED.

MF=15 GAMMA-RAY SPECTRA MT=3,102,103,107 CALCULATED WITH THE GNASH CODE/1,12/

REFERENCES

- REFERENCES

 KITAZAWA H. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988, P.473, (1988).
 CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
 YAMAMURO N.: JAERI-M 90-006 (1990).
 KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 ENSDF: EVALUATED NUCLEAR STRACTURE DATA FILE.
 NAKAGAWA T.: JAERI-M 84-192 (1984).
 MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1 PART A", ACADEMIC PRESS (1981).
 IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 RAYNAL J.: COMPUTER PROGRAM ECIS79 FOR COUPLED-CHANNEL CALCULATIONS, 1979 (UNPUBLISHED).
 TAMURA T.: RÉV. MOD. PHYS., 37, 679 (1965).
 ENDT P.M. AND VAN DER LEUN C.: NUCL. PHYS., A310, 1 (1978).
 YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
 KITAZAWA H. ET AL.: UNPUBLISHED.
 KITAZAWA H. ET AL.: UNPUBLISHED.
 YONACH H.: NUCLEAR DATA STANDARDS FOR NUCLEAR MEASUREMENTS, IAEA TECHNICAL REPORTS SERIES NO. 227 (1983).

MAT number = 1400 14-SI- 0 TIT, JAERI EVAL-MAR88 H.KITAZAWA,Y.HARIMA,T.FUKAHORI DIST-SEP89 REV2-NOV93 HISTORY NEW EVALUATION WAS PERFORMED FOR JENDL-3 BY KITAZAWA, HARIMA (TOKYO INSTITUTE OF TECH.) AND FUKAHORI (JAERI). DETAILS ARE GIVEN IN REF./1/. COMPILED BY FUKAHORI. JENDL-3.2 88-03 88-03 93-11 COMPILED BY T.NAKAGAWA (NDC/JAERI) MODIFIED PARTS FOR JENDL-3.2EFFECTS OF MODIFICATION OF INELASTIC
SCATTERING CROSS SECTIONS.(3,51-89)CROSS-SECTION CURVES WERE SMOOTHED.28), (4,91)TAKEN FROM JENDL FUSION FILE
91)91)TAKEN FROM JENDL FUSION FILE
•71)UPPER BOUNDARIES OF ENERGY RANGE WHERE
MULTIPLICITIES ARE GIVEN.2)FROM ENERGY BALANCE (3, 2)(3,4), (3,51-89) (4,16-28), (4,91) (5,16-91) (12,51-71) (12,102) JENDL FUSION FILE /2/ (AS OF NOV. 1993) EVALUATED AND COMPILED BY S.CHIBA (NDC/JAERI) ALL CROSS SECTION DATA, ANGULAR DISTRIBUTIONS OF DISCRETE LEVELS AND ENERGY DISTRIBUTIONS WERE TAKEN FROM JENDL-3.1. THE ENERGY DISTRIBUTIONS WERE MODIFIED TO A SINGLE TABLE TYPE DISTRIBUTION. MF=6 OF MT=16, 22, 28, AND 91 WERE CREATED BY F15TOB PROGRAM/2/ BY USING KUMABE'S SYSTEMATICS/3/. THE PRECOMPOUND/COMPOUND RATIO WAS TAKEN FROM THE SINCROS-II CALCULATION/4/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1MF = 2**RESONANCE PARAMETERS:** MT=151 RESOLVED RESONANCES RÉSOLVED RESONANCES : 1.0E-5 EV - 1.81 MEV THE RESONANCE PARAMETERS WERE SEARCHED, USING MLBW FORMULA/5/. AN INITIAL GUESS OF THE PARAMETERS SEARCH WAS TAKEN FROM REF. /6/. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/SEC RES. INTEG. ELASTIC CAPTURE TOTAL 2.172 B 0.171 B 0.104 B 2.343 B MF=3 NEUTRON CROSS SECTIONS F=1 TOTAL CROSS SECTION BETWEEN 1.81 AND 12.5 MEV, THE CROSS SECTIONS WERE OBTAINED BY AN EYE-GUIDE SO AS TO FOLLOW MAINLY THE EXPERIMENTAL DATA OF CIERJACKS ET AL./7/ ABOVE 12.5 MEV, THE CROSS SECTIONS WERE CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY./1,8/ MT = 1=2 ELASTIC SCATTERING CROSS SECTIONS OBTAINED BY SUBTRACTING PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTIONS. MT=2MT=4,51-90,91 INELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /8/ AND THE COUPLED-CHANNEL MODEL CODE ECIS /9/ OR JUPITOR-1 /10/, TAKING ACCOUNT OF COMPETITIVE PROCESSES FOR NEUTRON, PROTON, ALPHA-PARTICLE AND GAMMA-RAY EMISSION./1/ BELOW 11 MEV, THE IMAGINARY POTENTIAL STRENGTH OF THE NEUTRON SPHERICAL OPTICAL POTENTIAL WAS MODIFIED FROM THAT IN REF./1/ TO BE W = 1.09 + 0.55*E (MEV). LEVEL SCHEME WAS TAKEN FROM REF./11/. SI-30 ENERGY(MEV) J-PI SI-29 SI-28 ENEŘĠY(MEV) J-PI ENERGY(MEV) J-PI 0 + 2 + 4 + 0 + 1/2+ 3/2+ 3/2+ 7/2-0.0 2.2355 3.7696 0.0 0.0 0 + 1.7789 4.6178 0.0 1.2733 2.4256 3.6235 2 + 1 + 4.9791 4.8090 2 +

| 6.2765
6.6914
6.8786
6.8888
7.3807
7.4173
7.7988
7.9334
8.2590
8.3280
8.4133
8.5890 | 3 + + - + + + + + + + + + + + + + + + + | 4.7410
4.8950
5.2546
5.6520
6.1910
6.4240
6.5220
6.6970
6.7150
6.9070 | 9/2+
5/2+
9/2-
9/2+
3/2+
7/2-
7/2+
3/2+
3/2+
3/2+
1/2- | 5.2300
5.3720
5.6130
6.5030
6.6340
6.7447
6.9140 | 3 +
0 +
2 +
4 -
2 -
1 -
2 + |
|--|---|--|--|--|---|
|--|---|--|--|--|---|

Q-VALUES GIVEN IN JENDL-3.2 WERE SLIGHTLY CHANGED TO BE CONSISTENT WITH AWR AND THRESHOLD ENERGIES.

CONTINUUM LEVELS WERE ASSUMED ABOVE 6.999 MEV. LEVEL DENSITY WAS CALCULATED, USING THE GILBERT-CAMERON FORMULA. THE LEVEL DENSITY PARAMETERS WERE OBTAINED FROM A CUMULATIVE PLOT OF OBSERVED LEVELS./1/.

FOR JENDL-3.2, CROSS SECTIONS AT THRESHOLD ENERGIES OF THE LEVELS WERE INSERTED BY INTERPOLATING THE CALCULATED CROSS SECTIONS.

MT=16 (N,2N) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE./1, 12/ BELOW 11 MEV, THE IMAGINARY POTENTIAL STRENGTH OF THE NEUTRON SPHERICAL OPTICAL POTENTIAL WAS MODIFIED FROM THAT IN REF./1/ TO BE W = 1.09 + 0.55*E (MEV).

MT=22 (N,NA) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE./1, 12/ OPTICAL POTENTIAL FOR ALPHA-PARTICLES WAS DETERMINED, USING THE DISPERSION THEORY./13/

MT=28 (N,NP) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE/1,12/.

MT=102 CAPTURE CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /8/ AND THE DIRECT-SEMIDIRECT-MODEL CODE HIKARI /14/. Q-VALUE WAS DETERMINED AS A MEAN VALUE OF THOSE OF ISOTOPES.

MT=103 (N,P) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE./1, 12/ THE IMAGINARY POTENTIAL STRENGTH OF THE PROTON SPHERICAL OPTICAL MODEL WAS MODIFIED FROM THAT IN REF./1/ TO BE W = 11.0 MEV BETWEEN 11 AND 20 MEV AND W = 8.8 + 0.2*E (MEV) BELOW 11 MEV.

MT=107 (N,A) CROSS SECTIONS CNSTRUCTED FROM THE ISOTOPIC DATA.

MT = 111

=111 (N.2P) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE./1, 12/

-=251 MU-BAR CALCULATED WITH STATISTICAL-MODEL CODE CASTHY /1,8/. MT=251

ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4

MT=2CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /1,8/.

MT=51-90 INCOHERENT SUM OF THE STATISTICAL MODEL CODE CASTAT /1,8/. MODEL CALCULATIONS./1/ CALCULATED WITH CASTHY AND ECIS OR JUPITOR-1. MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB. SYSTEM.

MF = 5

IF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB. SYSTEM.

MF=12 GAMMA-RAY MULTIPLICITIES (BELOW 9.22087 MEV) MT=51-90,103,107 CALCULATED BY USING THE GNASH CODE./1,12/

MT=102 FROM ENERGY BALANCE.

=13 GAMMA-RAY PRODUCTION CROSS SECTIONS T=3 (ABOVE 9.22087 MEV) CALCULATED BY THE STATISTICAL MODEL AND COUPLED-CHANNEL MODEL, USING THE GNASH CODE /12/ AND THE ECIS /9/ OR JUPITOR-1 CODE /10/. BRANCHING RATIOS FOR TRANSITIONS BETWEEN DISCRETE LEVELS WERE TAKEN FROM REF./11/. GAMMA-RAY TRANSITION STRENGTH IN THE CONTINUUM WAS CALCULATED BY THE BRINK-AXEL GIANT RESONANCE MODEL FOR E1 TRANSITION AND BY THE WEISSKOPF SINGLE-PARTICLE MODEL FOR E2 AND M1 TRANSITION./1/ MF=13 MT=3

MF=14 GAMMA-RAY ANGULAR DISTRIBUTIONS MT=3,51-90,102,103,107 ISOTROPIC DISTRIBUTION WAS ASSUMED.

MF = 15

IF=15 GAMMA-RAY SPECTRA MT=3,102,103,107 CALCULATED WITH THE GNASH CODE./1,12/

REFERENCES

KITAZAWA H. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988, P.473, (1988).
CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
YAMAMURO N.: JAERI-M 90-006 (1990).
NAKAGAWA T.: JAERI-M 94-192 (1984).
MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1 PART A", ACADEMIC PRESS (1981).
CIÉRJACKS S. ET AL.: KFK-1000, SUPP., (1968).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
RAYNAL J.: COMPUTER PROGRAM ECIS79 FOR COUPLED-CHANNEL CALCULATIONS, 1979 (UNPUBLISHED).
TAMURA T.: REV. MOD. PHYS., 37, 679 (1965).
ENDT P.M. AND VAN DER LEUN C.: NUCL. PHYS., A310, 1 (1978).
YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
KITAZAWA H. ET AL.: UNPUBLISHED.
KITAZAWA H.: COMPUTER PROGRAM HIKARI FOR DIRECT-SEMIDIRECT CAPTURE CALCULATIONS, 1980 (UNPUBLISHED).

| MAT 1
14-5 | numbe
SI- 2 | er =
28 1 | = 1 4 | 425
, Jae | RI | E \
D I | AL-
ST- | MAF
Sef | 888
89 | H.
Re | K I
V 2 | TAZ
- JA | ZAW/
N94 | А, Ү
4 | .H/ | ARII | MA,ī | Γ.Fl | JKAI | HOR I | |
|--|---|---|--|--|--|---|---|---------------------------------------|--|--|---|---|---|---|--------------------------------------|--|--|---|--|--|-----------------------------|
| 88-03 | JRY
3 NE
H/
DE | EW E
ARIN
ETAI | EVAL
MA (
ILS | UAT
(TOP
ARE | TION
(YO
E GI | WA
INS
VEN | STIT | E R F
U T E
R E | OR
O
F. | MEC
F T
/1/ |) F
F
E
C | OR
H.) | JEI
Al | NDL
ND | -3
FUł | BY
(AH) | KIT
DRI | TAZA
(JA | AWA
AER | İ). | |
| 88-03
94-02 | 3 C
1 JE
C | OMP I
ENDL
OMP I | |) B1
.2.
) B1 | Ϋ́FÜ
(Τ. | KĀH
NAK | IOR I
(AGA | WA | (N | DC/ | ′JA | ER I |) | | | | | | | | |
| | (3 | * *
, 2) | MC | DIF | IED | PA | RTS | FC
EFF
SCA | OR
EC | JEN
TS
ERI | NDL
OF
NG | -3.
MC
CF | 2
D I I
2053 | = I C
S S | AT I
ECI | * * * *
I O N
F I O I | 0F
NS. | * * * *
I N E | ELAS | STIC | * |
| | (3
(4
(5
(12 | ,4),
,16-
,16-
2,1(| -28
-91
(2)
(2) | 8,51
), (
) | -66
(4,9 |)
1)
*** | : * * * | ČŘ(
TAP
TAP | ÓŚŚ
(EN
(EN | - SE
FR
FR | | I ŎŇ
JE
JE | | ĴRŬ
_ F
_ F | ËŠ
US
US | WĚI
I ON
I ON | RË
FIL
FIL | SMO(
_E
_E |)THI | ED. | * |
| | JEN | NDL
E\ | FUS
/ALU | SI ON
JATE | N FI
ED A | LE
ND | /2/
CON | | (AS
ED | O F
B Y | J | AN.
.CH | 19
 | 994
A (|)
ND(| | AER | | | | |
| | BI
At
S`
Ff | CF
JTIC
ND 9
YSTE
ROM
OF
N TH | ROSS
DNS
D1 V
EMAT
THE
PTI(
HE S | S SE
WERE
VERE
SICS
SINC | CTI
CR
CR
CR
CR
CR
CR
CR
CR
CR
CR
CR
CR
CR | ONS
AKE
EAT
OS-
EL,
- II | S, A
ED
THE
THE
CA | NGU
ROM
BY
CAL
VEL
LCU | JLA
F1
REC
CU
JLA | R D
END
5TC
OMF
LAT
ENS
TIC |) S
)L -
)B
POU
10
S T
)N | TRI
3.1
PRC
ND/
N/4
Y A
ARE | BU
GR/
CON
I/ .
ND
DE | FIO
MF
MPO
OT
SC | NS
=6
2/
UNI
HEF
RIE | ANI
OF
BY
D R/
SED | D EN
MT=
USI
ATIO
ARAN
IN | NERO
ING
OWA
METE
REF | GY [
, 22
KUI
AS
RS
. / 4 | DISTI
2, 23
MÅBE
TAKEI
USEI
4/. | R I -
8
' Ś
N
D |
| MF=1 | GEN | | | |)RMA | TIC |)N
A A | ΔΝΓ | חו | ICT | -10 | | v
v | | | | | | | | |
| MF=2 | RES | SONA | | E PA | ARAM | ETE | ERS: | | , , | 101 | 10 | NAT | ¹ | | | | | | | | |
| MT=2
RE
TH
AN | 151
ESOL\
HE RE
N IN | /ED
ESON
ITI/ | RES
NANG | SONA
CE F
Gues | ANCE
PARA
SS 0 | S
MET
F T | : 1
ERS
HE | . OE
We
PAF | E-5
ERE
RAM | EV
SE
ETE | / -
AR
RS | 1.
CHE
WA | 81
D,
S | ME
US
FAK | V
IN(
EN | G MI
FR(| LBW
DM F | FOF | RMUI
. / 5 | LA.
/. | |
| (| CALCU | JLAI | ΓED | 220 |)0-M
220 | /S | | SS | SE | | ON | S A | ND | RE | SON | NAN | CE | INTE | EGR | ALS | |
| | EL/
CAP
TO | ASTI
PTUF
FAL | I C
RE | | 2
0
2 | . 14
. 17
. 32 | 9 E
7 E
25 E | Ū | | C |).0 | 85
- | В | - | | | | | | | |
| MF=3
MT=7
BE
AN
ME | NEU
TWEE
TWEE
TWEE
V
DDEL | JTRO
EN 1
E-GL
FHE
COD | ON (
FOT /
I.8
JIDE
CR(
DE (| CROS | SS
CROS
ND 1
D AS
SEC
THY. | SEC
S 5
2.5
TC
TIC
/1, | CTIC
SECT
ME
DFC
NS
6/ | NS
ION
V,
ULLC
WEF | N
TH
QW
RE | E C
THE
CAL | CRO
E
E
CU | SS
XPE
LAT | SE(
ERIM
ED | CTI
MEN
WI | ONS
TAL
TH | S WI
_ D/
THI | ERE
ATA
E ST | ОВТ
/
ГАТ | F A I I
A B O Y
I S T | NED I
VE 12
ICAL | BY
2.5
- |
| MT=2
OE
CF | 2
BTAIN
ROSS | E
NED
SEC | ELAS
BY
CTIC | STIC
SUE
DNS. | C SC
BTRA | АТТ
СТІ | ERI
NG | NG
PAF | CR
RTI | OSS
AL | S S
CR | ECT
OSS | -101
5 SE | NS
ECT | 101 | NS I | FROM | N TH | HE - | ΓΟΤΑΙ | L |
| MT=4
CA
CO
AC
PA
PO
WA | 4,51
ALCUL
DUPLE
CCOUM
ARTIC
DTEN
AS MO
MEV) | - 66
ED - (
NT (
CLE
FIAL
DD IF | 91
D V
CHAN
DF (
AN[
S]
IE[| IN
VITH
NNEL
Comf
D GA
FREN
D FF | NELA
MO
ETI
AMMA
NGTH
ROM | STI
ES
DEL
TIV
- RA
OF
THA | C STAT
CC
CC
C
C
C
C
C
C
C
C
C
C
C
C
C
C
C | IST
DE
ROC
MIS
N
F | TEC
EC
SSI
NEU
REF | RIN
AL-
IS
SES
ON.
TRC
./1 | NG
/7
/7
/7
/7
/7 | CRC
DEL
/ C
OR
/ E
SPH
TO |)SS
C(
)R
NE(
3EL(
1ER
BE | SE
DDE
JUP
JTR
DW
ICA
W | CT
CA
IT
ON
11
L
(| ION
ASTI
DR -
ME
OPT
1.09 | S
HY /
ROT(
V
IČAI
9 + | /6/
3/,
ON,
THE
_ P(
0.5 | ANI
TAI
ALI
IM/
DTEI
55*I |) THI
XING
PHA-
AGIN/
NTIAI
E | E
ARY
L |
| LE | EVEL | SCH
NO G
G . ST
SCH
SCH
SCH
SCH
SCH
SCH
SCH
SCH
SCH
SCH | HEME
 | | AS T
ERGY
1.77
1.61
1.97
1.69
5.88
7.38
7.38
7.38
7.38
7.39
7.79 | AKE
(ME
89
791
64
88
73
88
73
88 | N F
V) | R O N
S F | R
0
2
4
0
3
0
3
4
2
2
3 | E - P A
+ + + + + + + + + + + + + + + + + + + | / 9
AR I | /.
TÝ | | | | | | | | | |

| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
|--|
| CONTINUUM LEVELS WERE ASSUMED ABOVE 8.9 MEV. LEVEL DENSITY WAS
CALCULATED, USING THE GILBERT-CAMERON FORMULA. THE LEVEL
DENSITY PARAMETERS WERE OBTAINED FROM A CUMULATIVE PLOT OF
OBSERVED LEVELS/1/. |
| FOR JENDL-3.2, CROSS SECTIONS AT THRESHOLD ENERGIES OF THE
LEVELS WERE INSERTED BY INTERPOLATING THE CALCULATED CROSS
SECTIONS. |
| MT=16 (N.2N) CROSS SECTIONS
CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH
CODE/1,10/. BELOW 11 MEV, THE IMAGINARY POTENTIAL STRENGTH OF
THE NEUTRON SPHERICAL OPTICAL POTENTIAL WAS MODIFIED FROM THAT
IN REF./1/ TO BE W = 1.09 + 0.55*E (MEV). |
| MT=22 (N,NA) CROSS SECTIONS
CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH
CODE/1.10/. OPTICAL POTENTIAL FOR ALPHA-PARTICLES WAS
DETERMINED, USING THE DISPERSION THEORY./11/ |
| MT=28 (N,NP) CROSS SECTIONS
CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE. |
| <pre>MT=102 CAPTURE
CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /6/ AND THE
DIRECT-SEMIDIRECT-MODEL CODE HIKARI /12/. THE STATISTICAL-
MODEL CALCULATIONS WERE NORMALIZED TO 0.6 MB AT 2.0 MEV.</pre> |
| <pre>MT=103 (N,P) CROSS SECTIONS
CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE. THE
IMAGINARY POTENTIAL STRENGTH OF THE PROTON SPHERICAL OPTICAL
MODEL WAS MODIFIED FROM THAT IN REF./1/ TO BE W = 11.0 MEV
BETWEEN 11 AND 20 MEV AND W = 8.8 + 0.2*E (MEV) BELOW 11 MEV.
THE STRENGTH WAS DETERMINED SO AS TO REPRODUCE OBSERVED VALUES
/13/.</pre> |
| MT=107 (N,A) CROSS SECTIONS
CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE.
OPTICAL POTENTIAL FOR ALPHA-PARTICLES WAS DETERMINED, USING
THE DISPERSION THEORY/11/. |
| <pre>MT=111 (N,2P) CROSS SECTIONS
CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE.</pre> |
| MT=251 MU-BAR
CALCULATED WITH STATISTICAL-MODEL CODE CASTHY /1,6/. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2
CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /1.6/. |
| MT=51-66
INCOHERENT SUM OF THE STATISTICAL MODEL AND COUPLED-CHANNEL
MODEL CALCULATIONS./1/ CALCULATED WITH CASTHY AND ECIS OR
JUPITOR-1.
MT=16,22,28,91
TAKEN FROM JENDL FUSION FILE. |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,22,28,91
TAKEN FROM JENDL FUSION FILE. |
| MF=12 GAMMA-RAY MULTIPLICITIES (BELOW 9.22088 MEV)
MT=51-66,102,103,107
CALCULATED BY USING THE GNASH CODE/1,10/. MULTIPLICITIES OF
MT=102 WERE DETERMINED FROM ENERGY BALANCE. |
| <pre>MF=13 GAMMA-RAY PRODUCTION CROSS SECTIONS (ABOVE 9.22088 MEV)
MT=3
CALCULATED BY THE STATISTICAL MODEL AND COUPLED-CHANNEL MODEL,
USING THE GNASH CODE /10/ AND THE ECIS /7/ OR JUPITOR-1 CODE
/8/. BRANCHING RATIOS FOR TRANSITIONS BETWEEN DISCRETE LEVELS
WERE TAKEN FROM REF./9/. GAMMA-RAY TRANSITION STRENGTH IN
THE CONTINUUM WAS CALCULATED BY THE BRINK-AXEL GIANT RESONANCE
MODEL FOR E1 TRANSITION AND BY THE WEISSKOPF SINGLE-PARTICLE
MODEL FOR E2 AND M1 TRANSITION./1/</pre> |

MF=14 GAMMA-RAY ANGULAR DISTRIBUTIONS MT=3,51-66,102,103,107 ISOTROPIC DISTRIBUTION WAS ASSUMED.

MF=15 GAMMA-RAY SPECTRA MT=3,102,103,107 CALCULATED WITH THE GNASH CODE./1,10/

- REFERENCES

 KITAZAWA H. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988, P.473, (1988).
 CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
 KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 YAMAMURO N.: JAERI-M 90-006 (1990).
 MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1 PART A" ACADEMIC PRESS (1981).
 IGÁRÁSI S. AND FUKAHORI T.: JAERI 1321 (1991).
 RAYNAL J.: COMPUTER PROGRAM ECIS79 FOR COUPLED-CHANNEL CALCULATIONS, 1979 (UNPUBLISHED).
 TAMURA T.: RÉV. MOD. PHYS., 37, 679 (1965).
 ENDT P.M. AND VAN DER LEUN C.: NUCL. PHYS., A310, 1 (1978).
 YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
 KITAZAWA H.: COMPUTER PROGRAM HIKARI FOR DIRECT-SEMIDIRECT CAPTURE CALCULATIONS, 1980 (UNPUBLISHED).

| MAT number =
14-SI- 29 TI | 1428
T,JAERI EVAL-MAR88 H.KITAZAWA,Y.HARIMA,T.FUKAHORI
DIST-SEP89 REV2-JAN94 |
|---|--|
| HISTORY
88-03 NEW EV
HARIMA
DETAIL | ALUATION WAS PERFORMED FOR JENDL-3 BY KITAZAWA,
(TOKYO INSTITUTE OF TECH.) AND FUKAHORI (JAERI).
SARE GIVEN IN REF (1) |
| 88-03 COMPIL
94-01 JENDL-
COMPIL | ED BY FUKAHORI.
3.2.
ED BY T.NAKAGAWA (NDC/JAERI) |
| (3,2) | MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| (3,4),
(4,16-2
(5,16-9
(12,102 | (3,51-79) CROSS-SECTION CURVES WERE SMOOTHED.
8), (4,91) TAKEN FROM JENDL FUSION FILE
1) TAKEN FROM JENDL FUSION FILE
2) BELOW 2 MEV. |
| JENDL F
EVA | USION FILE /2/ (AS OF JAN. 1994)
LUATED AND COMPILED BY S.CHIBA (NDC/JAERI) |
| CRO
BUTION
AND 91
SYSTEM
FROM T
OPT
IN THE | SS SECTIONS, ANGULAR DISTRIBUTIONS AND ENERGY DISTRI-
IS WERE TAKEN FROM JENDL-3.1. MF=6 OF MT=16, 22, 28,
WERE CREATED BY F15TOB PROGRAM/2/ BY USING KUMABE'S
IATICS/3/. THE PRECOMPOUND/COMPOUND RATIO WAS TAKEN
HE SINCROS-II CALCULATION/4/.
TICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED
SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. |
| MF=1 GENERAL | |
| MF=2 RESONAN | ICE PARAMETERS: |
| MI=151
RESOLVED R
THE RESONA
AN INITIAL | ESONANCES : 1.0E-5 EV - 0.1 MEV
NCE PARAMETERS WERE SEARCHED, USING MLBW FORMULA.
. GUESS OF THE PARAMETERS WAS TAKEN FROM REF./5/. |
| CALCULATE
ELASTIC
CAPTURE
TOTAL | D 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS
2200-M/SEC RES. INTEG.
2.843 B -
0.101 B 0.067 B
2.944 B - |
| MF=3 NEUTRON
MT=1 TO
ABOVE 0.1
STATISTICA | I CROSS SECTIONS
ITAL CROSS SECTION
MEV, THE CROSS SECTIONS WERE CALCULATED WITH THE
IL-MODEL CODE CASTHY./1,6/ |
| MT=2 EL
OBTAINED B
CROSS SECT | ASTIC SCATTERING CROSS SECTIONS
Y SUBTRACTING PARTIAL CROSS SECTIONS FROM THE TOTAL
IONS. |
| MT=4,51-79,9
CALCULATED
COUPLED-CH
COMPETITIV
GAMMA-RAY
STRENGTH O
MODIFIED F | 1 INELASTIC SCATTERING CROSS SECTIONS
WITH THE STATISTICAL-MODEL CODE CASTHY /6/ AND THE
ANNEL MODEL CODE ECIS /7/, TAKING ACCOUNT OF
E PROCESSES FOR NEUTRON, PROTON, ALPHA-PARTICLE AND
EMISSION./1/ BELOW 11 MEV, THE IMAGINARY POTENTIAL
F THE NEUTRON SPHERICAL OPTICAL POTENTIAL WAS
ROM THAT IN REF./1/ TO BE W = 1.09 + 0.55*E (MEV). |
| LEVEL SCHE
NO.
G.S.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13. | ME WAS TAKEN FROM REF./8/. ENERGY(MEV) SPIN-PARITY 0.0 1/2 + 1.2730 3/2 + 2.0280 5/2 + 2.4250 3/2 + 3.0670 5/2 + 3.6240 7/2 - 4.0800 7/2 + 4.7410 9/2 + 4.8400 1/2 + 4.9340 3/2 - 5.2550 9/2 - 5.2650 9/2 + 5.6520 9/2 + |

| 14. | 5.8130 | 7/2 + |
|-----|---------------|-----------------------------|
| 15. | 5.9490 | 3/2 + |
| 16. | 6.1070 | 5/2 + |
| 17. | 6.1920 | 7/2 - |
| 18. | 6.3780 | 1/2 - |
| 19 | 6 4230 | $\frac{1}{7}/\frac{1}{2}$ + |
| 20 | 6 4960 | 1/2 + |
| 21 | 6 5220 | 3/2 + |
| 22 | 6 6150 | 9/2 ÷ |
| 23 | 6 6970 | 3/2 |
| 20. | 6 7100 | 5/2 + |
| 24. | 6 7150 | 3/2 + |
| 20. | 6 7920 | 11/2 |
| 20. | 0.7020 | 1/2 - |
| 27. | 6.9070 | 1/2 - |
| 28. | <u>6.9210</u> | 1/2 + |
| 29. | 7.0140 | 5/2 - |

CONTINUUM LEVELS WERE ASSUMED ABOVE 7.057 MEV. LEVEL DENSITY WAS CALCULATED, USING THE GILBERT-CAMERON FORMULA. THE LEVEL DENSITY PARAMETERS WERE OBTAINED FROM A CUMULATIVE PLOT OF OBSERVED LEVELS./1/.

FOR JENDL-3.2, CROSS SECTIONS AT THRESHOLD ENERGIES OF THE LEVELS WERE INSERTED BY INTERPOLATING THE CALCULATED CROSS SECTIONS.

MT=16 (N,2N) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE./1, 9/ BELOW 11 MEV, THE IMAGINARY POTENTIAL STRENGTH OF THE NEUTRON SPHERICAL OPTICAL POTENTIAL WAS MODIFIED FROM THAT IN REF./1/ TO BE W = 1.09 + 0.55*E (MEV).

MT=22 (N,NA) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE. OPTICAL POTENTIAL FOR ALPHA-PARTICLES WAS DETERMINED, USING THE DISPERSION THEORY./10/

MT=28 (N,NP) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE.

MT=102 CAPTURE CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /6/ AND THE DIRECT-SEMIDIRECT-MODEL CODE HIKARI /11/. THE STATISTICAL-MODEL CALCULATIONS WERE NORMALIZED TO 0.6 MB AT 0.1 MEV.

F=103 (N,P) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE. THE IMAGINARY POTENTIAL STRENGTH OF THE PROTON SPHERICAL OPTICAL MODEL WAS MODIFIED FROM THAT IN REF./1/ TO BE W = 11.0 MEV BETWEEN 11 AND 20 MEV AND W = 8.8 + 0.2*E (MEV) BELOW 11 MEV. THE STRENGTH WAS DETERMINED SO AS TO REPRODUCE OBSERVED VALUES /12/. MT = 103

MT=107 (N,A) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE. OPTICAL POTENTIAL FOR ALPHA-PARTICLES WAS DETERMINED, USING THE DISPERSION THEORY./10/

MT=111 (N.2P) CROSS SECTIONS CALCULATED BY THE STATISTICAL MODEL, USING THE GNASH CODE.

MT=251 MU-BAR CALCULATED WITH STATISTICAL-MODEL CODE CASTHY /1,6/.

MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2

CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /1,6/.

MT=51-79 INCOHERENT SUM OF THE STATISTICAL MODEL AND COUPLED-CHANNEL MODEL CALCULATIONS./1/ CALCULATED WITH CASTHY AND ECIS. MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE.

IF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE. MF = 5

MF=12 GAMMA-RAY MULTIPLICITIES (BELOW 7.30265 MEV) MT=51-79,102,103,107 CALCULATED BY USING THE GNASH CODE/1,9/. MULTIPLI MT=102 WERE DETERMINED FROM ENERGY BALANCE. MULTIPLICITIES OF MF = 13GAMMA-RAY PRODUCTION CROSS SECTIONS (ABOVE 7.30265 MEV) MT=3

I=3 CALCULATED BY THE STATISTICAL MODEL AND COUPLED-CHANNEL MODEL, USING THE GNASH CODE /9/ AND THE ECIS /7/ CODE. BRANCHING RATIOS FOR TRANSITIONS BETWEEN DISCRETE LEVELS WERE TAKEN FROM REF./8/. GAMMA-RAY TRANSITION STRENGTH IN THE CONTINUUM WAS CALCULATED BY THE BRINK-AXEL GIANT RESONANCE MODEL FOR E1 TRANSITION AND BY THE WEISSKOPF SINGLE-PARTICLE MODEL FOR E2 AND M1 TRANSITION./1/

IF=14 GAMMA-RAY ANGULAR DISTRIBUTIONS MT=3,51-79,102,103,107 ISOTROPIC DISTRIBUTION WAS ASSUMED. MF = 14

MF=15 GAMMA-RAY SPECTRA MT=3,102,103,107 CALCULATED WITH THE GNASH CODE./1,9/

REFERENCES

REFERENCES

KITAZAWA H. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988, P.473, (1988).
CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
YAMAMURO N.: JAERI-M 90-006 (1990).
MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1 PART A", ACADEMIC PRESS (1981).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
RAYNAL J.: COMPUTER PROGRAM ECIS79 FOR COUPLED-CHANNEL CALCULATIONS, 1979 (UNPUBLISHED).
ENDT P.M. AND VAN DER LEUN C.: NUCL. PHYS., A310, 1 (1978).
YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
KITAZAWA H. ET AL.: UNPUBLISHED.
KITAZAWA H. ET AL.: JAERI 1312 (1988).

| <pre>MAT number = 1431 14-SI- 30 TIT, JAERI EVAL-MAR88 H.KITAZAWA, Y.HARIMA, T.FUKAHORI DIST-SEP89 REV2-JAN94</pre> | |
|---|--|
| HISTORY
88-03 NEW EVALUATION WAS PERFORMED FOR JENDL-3 BY KITAZAWA,
HARIMA (TOKYO INSTITUTE OF TECH.) AND FUKAHORI (JAERI). | |
| 88-03 COMPILED BY FUKAHORI.
94-01 JENDL-3.2.
COMPILED BY T.NAKAGAWA (NDC/JAERI) | |
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ | |
| (3,4), (3,51-69)
(4,16-28), (4,91)
(4,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(5,16-91)
(| |
| (12,102)' BELOW 2 MEV. | |
| JENDL FUSION FILE /2/ (AS OF JAN. 1994)
EVALUATED AND COMPILED BY S.CHIBA (NDC/JAERI) | |
| CROSS SECTIONS, ANGULAR DISTRIBUTIONS AND ENERGY DISTRI-
BUTIONS WERE TAKEN FROM JENDL-3.1. MF=6 OF MT=16, 22, 28,
AND 91 WERE CREATED BY F15TOB PROGRAM/2/ BY USING KUMABE'S | |
| SYSTEMATICS/3/. THE PRECOMPOUND/COMPOUND RATIO WAS TAKEN
FROM THE SINCROS-II CALCULATION/4/.
OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED
IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF /4/ | |
| | |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS: | |
| MT=151
RESOLVED RESONANCES : 1.0E-5 EV - 0.5 MEV
THE RESONANCE PARAMETERS WERE SEARCHED, TAKENG MLBW FORMULA. | |
| CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS
2200-M/SEC RES. INTEG. | |
| ELASTIC 2.491 B -
CAPTURE 0.108 B 0.709 B
TOTAL 2.598 B - | |
| MF=3 NEUTRON CROSS SECTIONS
MT=1 TOTAL CROSS SECTION
ABOVE 0.5 MEV, THE CROSS SECTIONS WERE CALCULATED WITH THE | |
| STATISTICAL-MODEL CODE CASTHY./1,6/
MT=2 ELASTIC SCATTERING CROSS SECTIONS
OBTAINED BY SUBTRACTING PARTIAL CROSS SECTIONS FROM THE TOTAL | |
| CROSS SECTIONS.
MT=4,51-69,91 INELASTIC SCATTERING CROSS SECTIONS | |
| CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /6/ AND THE
COUPLED-CHANNEL MODEL CODE ECIS /7/, TAKING ACCOUNT OF
COMPETITIVE PROCESSES FOR NEUTRON, PROTON, ALPHA-PARTICLE AND
CAMMA-PAY EMISSION /1/ BELOW 11 MEV THE IMACINAPY POTENTIAL | |
| STRENGTH OF THE NEUTRON SPHERICAL OPTICAL POTENTIAL WAS
MODIFIED FROM THAT IN REF./1/ TO BE W = 1.09 + 0.55*E (MEV). | |
| LEVEL SCHEME WAS TAKEN FROM REF./8/.
NO. ENERGY(MEV) SPIN-PARITY
G.S. 0.0
1. 2.2355 2.4 | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| 12. 5.9500 4 +
13. 6.5030 4 - | |

| | | 14.
15.
16.
17.
18.
19. | 00
00
00
00
00
00 | 5.537
6.634
6.640
6.744
6.865
6.914 | 0
0
0
7
0
0 | | 2
2
1
2
2 | +
-
+
-
+ | | | | | | | | |
|----------|--|---|--|---|--|--|------------------------------------|--|--|---|---|--|---|--|---|---|
| | CONTIN
WAS CA
DENSIT
OBSERV | UUM
LCUL
Y PA
ED L | LEVEL
ATED,
RAMET
EVELS | S WE
USI
ERS
S./1/ | RE A
NG 1
WERE | ASSU
THE
E OB | MED
GILI
TAII | ABO
BERT
NED | VE 6
-CAN
FROM | 6.999
1ERON
1 A C |) MEN
I FOR
UMUI | /.
RMUL
_ATI | LEVE
A
VĖ P | L DEN
THE L
LOT C | ISITY
EVEL
)F | |
| | FOR JE
LEVELS
SECTIO | NDL-
WER
NS. | 3.2,
E INS | CROS
SERTE | S SE
D B\ | ECTI
(IN | ONS
TERI | AT
POLA | THRE
TING | SHOL
THE | D EN
CAI | NERG
_CUL | IES
ATED | OF TH
CROS | IE
SS | |
| Μ | T=16
CALCUL
9/ BEL
NEUTROI
REF./1 | (N,2
ATÉD
OW 1
N SP
/ TO | N) CR
BY T
1 MEV
HERIC
BE W | 20SS
HE S
(, TH
CAL 0
/ = 1 | SEC1
TATI
E IN
PTIC
.09 | ION
STI
MAGI
CAL
+ 0 | S
CAL
NAR
POTI
.55 | MOD
Y PO
ENTI
*E (| EL,
TENT
AL M
MEV) | USIN
TAL
VAS N | IG TH
STRE
IODII | HE G
ENGT
FIED | NASH
H OF
FRO | CODE
THE
M THA | ./1,
T IN | |
| Μ | T=22
CALCULA
OPTICA
THE DI | (N,N
ATĖD
L PO
SPER | A) CR
BY T
TENTI
SION | OSS
HE S
AL F
THEO | SECI
TATI
OR A
RY./ | TION
STI
ALPH
(10/ | S
CAL
A - P/ | MOD
ARTI | EL.
CLĖS | USIN
S WAS | IG T <u>I</u>
5 DE | HE G
FERM | NASH
INED | CODE
, USI | ŃG | |
| Μ | T=28
CALCUL | (N,N
ATĖD | P) CR
BY T | OSS
HE S | SEC1
TATI | TION
STI | S
Cal | MOD | EL, | USIN | IG TH | HE G | NASH | CODE | i. | |
| Μ | T=102
CALCUL
DIRECT
MODEL | CAPT
ATED
-SEM
CALC | URE
WITH
IDIRE
ULATI | I THE
CT-M
ONS | STA
ODEL
WERE | ATIS
CO
NO | TIC/
DE H
RMAI | AL-M
HIKA
LIZE | ODEL
RI /
D TC | COD
/11/.
) 0.6 | DE CA
TH
S MB | ASTH
HE S
AT | Y /6
TATI
0.5 | / AND
STICA
MEV. |) THE
\L- | |
| Μ | T=103
CALCUL
IMAGIN
MODEL
BETWEE | (N,P
ATÉD
ARY
WAS
N 11 |) CRC
BY T
POTEN
MODIF
AND | SS S
HE S
ITIAL
IED
20 M | ECTI
TATI
STF
FROM
EV A | ONS
STI
RENG
M TH
AND | CAL
TH (
AT
W = | MOD
DF T
IN R
8.8 | EL,
HE F
EF./
+ C | USIN
PROTC
1/ T
.2*E | IG TH
ON SI
O BI
E (MI | HE G
PHER
W
V) | NASH
ICAL
= 11
BELO | CODE
OPTI
.0 ME
W 11 | CAL
V
MEV. | : |
| Μ | T=107
CALCUL
OPTICA
THE DI | (N,A
ATĖD
L PO
SPER |) CRC
BY T
TENTI
SION | SS S
HE S
AL F
THEO | ECTI
TATI
OR A
RY./ | ONS
STI
LPH
10/ | CAL
A-P/ | MOD
ARTI | EL,
CLĖS | USIN
S WAS | IG TH
DE | HE G
FERM | NASH
INED | CODE
, USI | NG | |
| Μ | T=111
CALCUL | (N,2
ATĖD | P) CR
BY T | OSS
HE S | SEC1
TATI | ION
STI | S
Cal | MOD | EL, | USIN | IG TH | HE G | NASH | CODE | Ξ. | |
| Μ | T=251 CALCUL | MU-B
ATED | AR
₩IT⊦ | I STA | тізт | TICA | L-M(| DDEL | COD | DE CA | STH | Y /1 | ,6/. | | | |
| M F
M | =4 AI
IT=2
CALCUL | NGUL
Atfd | AR DI | STRI
I THF | BUTI
STA | ONS | OF
TIC/ | SEC
AI-M | ONDA
Odfi | RY N
COF | IEUTE | RONS
ASTH | Y /1 | 6/ | | |
| M | T=51-69
INCOHE
MODEL
T=16,22
TAKEN | RENT
CALC
28,
FROM | SUM
ULATI
91
JEND | OF T
ONS.
DL FU | HE S
/1/
SION | STAT
CA | IST
LCUI
LE. | I C A L
LA T E | MOD
D WI | DEL A
TH C | ND (
ASTI | COUP
HY A | LED-
ND E | CHANN
CIS. | IEL | |
| M F
M | =5 El
T=16,22
TAKEN | NERG
,28
,
FROM | Y DIS
91
JEND | STRIB | UTIC
SION | DNS
N FI | OF S | SECO | NDAR | RY NE | UTR | ONS | | | | |
| M F
M | T=12 G
T=51-69
CALCUL
MT=102 | AMMA
,102
ATED
WER | -RAY
,107
BY L
E DET | MULT
ISING
ERMI | I PL I
The
Ned | CIT
GN
FRO | IES
ASH
M EI | (BE
COD
NERG | LOW
E/1,
Y BÅ | 7.23
9/.
LANC | 8453
MUI
CE. | MEV
_TIP |)
LICI | TIES | OF | |
| MF | E=13 G
T=3
CALCUL
USING
RATIOS
REF./8
CALCUL
TRANSI
AND M1 | AMMA
ATED
THE
FOR
ATED
TION
TRA | -RAY
BY T
GNASH
TRAN
GAMMA
BY T
AND
NSITI | PROD
HES
COD
ISITI
STTI
STRI
BY
HEB
BY
T
ON./ | UCTI
E /S
ONS
TRA
RINA
HE V
1/ | ON
STI
BET
ANSI
(-AX
VEIS | CROS
ND
WEEI
EL (
SKOI | SS S
MOD
THE
N DI
SIAN
PF S | ECTI
EL A
ECIS
SCRE
SCRE
T RE
INGL | ONS
ND C
TE L
TH I
SONA
E - PA | (ABC
COUPI
COU
EVEI
N TH
NCE
RTIC | DVE
_ED-
DE.
_S W
HE C
MOD
CLE | 7.23
CHANI
BRA
ERE
ONTI
EL F
MODE | 453 M
NEL M
NCHIN
TAKEN
NUUM
OR E1
L FOR | IEV)
IODEL,
IG
I FROM
WAS
R E2 | |
| M F
M | =14 G,
T=3,51-0 | AMMA
69,1 | -RAY
02,10 | ANGU
)7 | LAR | DIS | TRI | BUTI | ONS | | | | | | | |
| | | | | | | | | | | | | | | | | |
ISOTROPIC DISTRIBUTION WAS ASSUMED.

MF=15 GAMMA-RAY SPECTRA MT=3,102,107 CALCULATED WITH THE GNASH CODE./1,9/

- REFERENCES
 1) KITAZAWA H. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988, P.473, (1988).
 2) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
 3) KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 4) YAMAMURO N.: JAERI-M 90-006 (1990).
 5) MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1 PART A", ACADEMIC PRESS (1981).
 6) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 7) RAYNAL J.: COMPUTER PROGRAM ECIS79 FOR COUPLED-CHANNEL CALCULATIONS, 1979 (UNPUBLISHED).
 8) ENDT P.M. AND VAN DER LEUN C.: NUCL. PHYS., A310, 1 (1978).
 9) YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
 10) KITAZAWA H. ET AL.: UNPUBLISHED.
 11) KITAZAWA H.: COMPUTER PROGRAM HIKARI FOR DIRECT-SEMIDIRECT CAPTURE CALCULATIONS, 1980 (UNPUBLISHED).

MAT number = 1525 15-P - 31 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-DEC93 HISTORY 87-05 93-12 NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO.LTD) * * * * * (3,1) (3,2) (3,107) WF=12,13,14,15 NEWLY EVALUATED MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY 2 MT=151 RESONANCE PARAMETERS: RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 EV - 500 KEV PARAMETERS ARE TAKEN FROM BNL 325 4TH EDITION/1/, AND R.L.MACKLIN ET AL./2/. CROSS SECTIONS CALCULATED WITH THESE PARAMETERS ARE TO BE CORRECTED BY ADDING MF=3, MT=1,2AND 102 DATA. MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/SEC RES. INTEG. REF. ELASTIC 3.134 B - /1/ CAPTURE 0.166 B 0.081 B /1/ ELASTIC CAPTURE TOTAL 3.134 B 0.166 B 3.300 B B NEUTRON CROSS SECTIONS BELOW 500 KEV BACKGROUND CROSS SECTION. MT=1,2 0.07029 B MT=251 MU-BAR=0.0217 MF = 3ABOVE 500 KEV MT=1 NEW OPTICAL MODEL CALCULATION USING THE PARAMETER SET DETERMINED BY T. WATANABE V = 50.58 - 0.06476E (MEV) WS = 6.583 + 0.5927E (MEV) VSO= 3.391 (MEV) R = 1.36, A = 0.422(FM) RS= 1.23, B = 0.517(FM) RSO=0.938, ASO=0.600(FM) MT=2 TOTAL - NONELASTIC MT=4,51-56,91,102 TOTAL, ELASTIC, INELASTIC AND CAPTURE CALCULATED WITH CASTHY CODE/3/, CONSIDERING THE COMPETITION WITH THE THRESHOLD REACTION CHANNELS. OPTICAL POTENTIAL PARAMETERS OF C.Y.FU/4/ ARE ADJUSTED TO REPRODUCE THE FOLLOWING EXPERIMENTAL DATA: MT=1 TOTAL NESTOR DATA (MANY AUTHORS) MT=2 ELASTIC -MT=102 CAPTURE DATA ARE NORMALIZED TO 1.8 MB AT 500 KEV BASED ON (7 MB AT 30 KEV) BY R.L.MACKLIN ET AL./5/.
 THE DISCRETE LEVEL SCHEME TAKEN FROM REF./6/:
 NO.
 ENERGY (MEV)
 SPIN-PARITY

 (G.S.)
 0.0
 1/2 1

 1
 1.266
 3/2 +
 2

 2
 2.234
 5/2 +
 3.134 3.295 3.415 1/2 3 + 5/2 7/2 4 + 5 + 6 3.506 3/2 +CONTINUUM LEVELS ASSUMED ABOVE 4.0 MEV. THE LEVEL DENSITY PARAMETERS OF ASANO ET AL. /7/ ARE USED. MT=16(N,2N), 22(N,N'A), 28(N,N'P), 103(N,P), 107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE /8/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLE

| | MT= | AR
/9
MT
CO
LE
251
C | E C
/ A
=10
NSI
VEL
ALC | AL
ND
DE
DE
UL | CUI
ANI
REI
ENS
AR
ATI | LAT
UIZ
D 1
D T
SIT
ED | ED
EN
07
OG
Y | BY
GA-
ĔTH
PAR
TH | US
IGC
HE
IER
AME
OPT | SIN
E)
W
ETE | NG
10/
XPE
ITH
ERS
CAL | TH
ŘI
A
M | E C
RES
MEN
HE
RE
ODE | MP
PE
ITAI
CAI
BA | OF
CTI
LCU
SEC
(CA | VE
VE
DAT
JLA
0 0 | EC
LY
A
TI
N
HY | CHE
WEF
ONS
BUI | ETTI
IN T
RE A
S.
ILTA | I-G
The
Als
- In | | NLE
Ase
Alu | JES. |)F | |
|--------------------------|---|--|--|----------------------------|---------------------------------------|--|--------------------------------|--|--------------------------------------|--|---------------------------------------|---------------------------|---|---|---|-------------------------------|--------------------------------|-------------------------------------|--|---------------------------|------------------|-------------------|-----------------------------|-------------|--|
| MF= | =4
MT=
MT=
MT=
MT= | ANG
2
51-
16,
91 | ULA
CA
56
22, | R
LC
28 | DI:
UL/
AL(| STR
ATE
CUL
ISC
ISC
THE | IB
D
AT
TR
TR
D | UTI
ED
OPI
OPI
IST | ONS
H
C
C
R I E | 6 (
0F
FH
IN
DI 8
BU 1 | OF
HA
TH
STR
TIO | SE
CA
US
E
NS | CON
L N
ER-
LAB
UTI | IDAI
IODI
FES
OR
ONS | RY
EL(
SHE
ATC
S I
AB. | NE
CA
BAC
RY
N | UT
ST
H
CM | RON
HY
FOF
YST
WE | NS
).
RMUL
FEM
ERE | _A(
CC | C A S
N V E | STH
ERT | HY)
FED | то | |
| MF= | =5
MT= | ENE
16, | RGY
22, | ′D
28 | IS
, 9 | TR I
1 , 1 | BU
03 | ТІС
,1С |)NS
)7 | 0 F
E | F S
EVA | EC
PO | OND
RAT | AR`
I OI | Y N
N S | IEU
SPE | TR
CT | ONS
RA | 6 | | | | | | |
| MF= | =12
MT= | PH0
102 | TON
,10 | I P
03, | R01
10 | DUC
7 | ΤI | ON | MUL | _ T
(| I P L
C A L | 1 C
C U | ITY
LAT | ED | ΒY | ′S | ΙN | CRO |)S- | / | 11/ | 1. | | | |
| MF= | =13
MT=
MT= | РНО
3
4 | TON | ΙP | ROI | DUC | TI | ON | CRO | DSS
(

 | S S
CAL
DIS
ACC | EC
CU
CR
OU | TIC
LAT
ETE
NT | ED
ED
OF | BY
INE
BR | S
S
AN | IN
CA
CH | CRC
LCL
INC |)S-
JLAT
G R/ | /
 E D
 T | 11/
B)
0S | /.
ҮТ | ΓAK Ι | NG | |
| MF= | =14
MT= | PHO
3,4 | TON
,10 | ΙA
2, | NG
103 | ULA
3,1 | R
07 | DIS | STR | IBU | JTI
ISO | ON
TR | 0 P I | С | | | | | | | | | | | |
| MF= | =15
MT=
MT= | PHO
3,1
102 | TON
03, | I E
10 | NEI
7 | RGY | Ď | IST | RIE
CAL
CAL | 301
_Cl
_Cl | TIO
JLA
JLA | N
TE
TE | D B
D B | Y S
Y (| SIN
Cas | ICR
STH | 0S
Y/ | -
3/ | /11 | 1/. | | | | | |
| REF
1234
567
89 | ERE
MU
MA
FU
AS
YO
BE | NCE
GHA
CKL
ARA
CKL
DER
UNG
CCH | S
BGH
SI,,
SI,,
ER,
E
E
E
T
I | IAB
RS
RCAG | , L

AT

L.
JR | S.FE.
J.J.
OM.EEP
ANDA | | ET
AL.
UCL
ATA
AL.
VAT
RTH
GR | | SCI
SCI
SCI
SCI
SCI
SCI
SCI
SCI
SCI
SCI | NE
YS.
NU
YS.E
MMU
SS | UTRELRONI:, | RON
EV.
CH.
EV.
EV.
F
LA
G.W | CI
C:
12
AT
SO
10
- 6 | ROS
32,
2,
7,
29,
70
70
70
70
70
70
70
70
70
70
70
70
70 | S
67
AB2
PES | SE9
79
LE9
· 19
R | CT
197
S.
7TH
77
ZA1 | ION
1985
75)
17
(196
1 EE | , V
5). | ′0L.
27
∵: | . 1
(1
NOM | (19
1976
Men <i>a</i> | 981)
S). | |

- beccheff, JR. AND GREENLESS, G.W.. POLARIZATION PHENOMEN. IN NUCLEAR REACTIONS, P.682 (1971).
 HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS. 29, 462 (1962).
 YAMAMURO, N.: JAERI-M 90-006 (1990).

MAT number = 1600 16-S - 0 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) COMPILED BY T.FUKAHORI (JAERI). MODIFICATIONS ON (N,P) AND INELASTIC SCATTERING CROSS SECTIONS OF S-32. DIRECT INELASTIC COMPONENTS FROM DWBA CALCULATIONS WERE ADDED TO THE COMPOUND COMPONENTS AS TO REPRODUCE DDX DATA OF OKTAVIAN (OSA, 1986). MODIFIED DUE TO CORRECT S-32 DATA BY T.FUKAHORI (JAERI) IENDI-3.2 87-05 87-07 88-02 88-08 ĴĔŇĎĹ-3.2 NEW OPTICAL MODEL CALCULATION WAS PERFORMED BY T. WATANABE 94-02 NATURAL SULPHUR DATA CONSTRUCTED FROM S-ISOTOPES. GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION : 1.0E-5 EV - 1.57 MEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. PARAMETERS WERE ADOPTED FROM THE FOLLOWING SOURCES. S-32 : -10 KEV - 1.57 MEV, R = 3.92 FM S-33 : -7.1 - 260 KEV, R = 3.85 FM S-34 : -10 - 480 KEV, R = 3.60 FM MF=2MT=151 CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. RES. INTEG. 1.024 B 0.514 B 1.546 B ELASTIC CAPTURE 0.2428 B TOTAL MF=3 NEWTRON CROSS SECTIONS BELOW 1.57 MEV, BACKGROUND CROSS SECTIONS CONSISTING OF (N,P) AND (N,ALPHA) CROSS SECTIONS WERE GIVEN. MT=1 TOTAL SPHERICAL AND DEFORMED OPTICAL POTENTIAL PARAMETERS WERE DETERMINED SO AS TO REPRODUCE THE EXPERIMENTAL DATA OF CIERJACKS+/1/. THE SHERICAL POTENTIALS WERE USED IN CALCULATING THE CROSS SECTIONS OF S-32, WHILE THE DEFORMED ONES WERE USED IN CALCULATING THE CROSS SECTIONS OF THE OTHER ISOTOPES. THE ISOTOPIC CALCULATIONS WERE PERFORMED BY USING CASTHY CODE/2/.
MT=2 ELASTIC SCATTERING GIVEN AS TOTAL MINUS OTHER CROSS SECTIONS.
MT=4 TOTAL INELASTIC SCATTERING SUM OF MT=51-73, 91
MT=16,22,28,103,107 THE WEIGHTED SUM OF ISOTOPES WAS ADOPTED. THE CROSS SECTIONS OF ISOTOPES WERE CALCULATED USING GNASH CODE/3/.
MT=51-73,91 INELASTIC SCATTERING ISOTOPIC DATA WERE OBTAINED FROM THE CASTHY/2/ CALCULATION. ISOTOPIC LEVELS WERE SORTED WITH ENERGIES.
OPTICAL MODEL POTEMTIAL PARAMETERS USED FOR THE IENDI-3 2 TOTAL MT = 1OPTICAL-MODEL POTEMTIAL PARAMETERS USED FOR THE JENDL-3.2 EVALUATION: V = 58.83 - 0.5635EN WS = 3.609 + 0.1819EN (= 2.518 + 0.0302EN (MEV) (MEV) (MEV) FOR DEFORMED POT.) (= 2.0.0VSO = 4.1991.306(MEV) (MEV) (FM) (FM) R = 1.306, RS = 1.124,

 R
 =
 1.306
 A
 =
 0.452

 RS
 =
 1.124
 B
 =
 0.690

 RS0=
 1.010
 AS0=
 0.750

 MT=102 CAPTURE ABOVE 1.57 MEV, THE CASTHY/2/ CALCULATION WAS ADOPTED. MT=103(N,P), 107(N,ALPHA) FOR S-32 THE EVALUATION WAS MADE ON THE BASIS OF

EXPERIMENTAL DATA. FOR S-33,34,36, THE GNASH/3/ CALCULATION WAS ADOPTED. MT=251 MU-BAR CALCULATED WITH CASTHY/2/. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-73 OPTICAL AND STATISTICAL-MODEL CALCULATIONS. MT=16,22,28 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF = 4MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 CALCULATED WITH GNASH/3/. MF = 5MF=12 PHOTON PRODUCTION MULTIPLICITY MT=102,103,107 CALCULATED WITH SINCROS-II/4/. MF=13 PHOTON PRODUCTION CROSS SECTION MT=3 CALCULATED WITH SINCROS-11/4/. MT=4CALCULATED BY TAKING ACCOUNT OF BRANCHING RATIOS. MF=14 PHOTON ANGULAR DISTRIBUTION MT=3,4,102,103,107 ASSUMED TO BE ISOTROPIC. MF=15 PHOTON ENERGY DISTRIBUTION MT=3,102,103,107 CALCULATED WITH SINCROS-II/4/. REFERENCES AFFERENCES 1) CIERJACKS, S. ET AL.: KFK-1000 (1968) 2) IGARASI, S. : J. NUCL. SCI. TECHNOL., 12, 67 (1975). 3) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977). 4) YAMAMURO, N: JAERI-M 90-006 (1990).

MAT number = 1625 16-S - 32 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY 87-03 NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO.LTD.) 88-08 THE FOLLOWING QUANTITIES WERE MODIFIED BY H.NAKAMURA (N,P) CROSS SECTION INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF THE FIRST, THIRD AND CONTINUUM LEVELS JENDL-3.2 94-02 JENDL-3.2 COUPLED-CHANNEL CALCULATION WAS PERFORMED BY K. SHIBATA (JAERI) USING THE OMP SET DETERMINED BY T. WATANABE (KHI) THE TOTAL AND INELASTIC SCATTERING CROSS SECTIONS WERE REPLACED BY THE C.C. CALCULATIONS. DATA WERE COMPILED BY K. SHIBATA. MODIFIED PARTS FOR JENDL-3.2 (3,1), (3,4), (3,51-56,91), (3,251), (4,2), (4,51-56) CUPLED-CHANNEL CALCULATIONS. (3,2) ME-1 CENEDAL INFORMATION 94-02 BE (KHI). WERE MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 MT=151 RESONANCE PARAMETERS: RESOLVED RESONANCES FOR MLBW FORMULA: 1.0E-5 EV - 1500 KEV PARAMETERS ARE TAKEN FROM BNL 325 4TH EDITION/1/, AND SOME PARAMETERS ARE ASSUMED TO FIT THE MEASURED DATA. CROSS SECTIONS CALCULATED WITH THESE PARAMETERS ARE TO BE CORRECTED BY ADDING MF=3, MT=1, 2 AND 102 DATA. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/SEC RES. INTEG. REF. ELASTIC CAPTURE TOTAL 0.963 B 0.528 B 1.499 B 0.250 B /1/ MF=3 NEUTRON CROSS SECTIONS BELOW 1500KEV BACKGROUND DATA FOR MT=107 ABOVE 1500KEV MT=1, 2, 4, 0.007 B, BASED ON 2200-M/S DATA OF REF./1/. MIEO/ BOVE 1500KEV MT=1, 2, 4, 51-56, 91, 102 TOTAL, ELASTIC, INELASTIC AN CAPTURE CALCULATED WITH CASTHY CODE /2/, CONSIDERING THE COMPETITION WITH THE THRESHOLD REACTION CHANNELS. OPTICAL POTENTIAL PARAMETERS OF C.Y.FU/3/ ARE ADJUSTED TO REPRODUCE THE FOLLOWING EXPERIMENTAL DATA: MT=1 TOTAL -MT=2 ELASTIC G.A.PETITT ET AL./4/, A.VIRDIS/5/. MT=4 INELASTIC -THE SPHERICAL OPTICAL POTENTIAL PARAMETERS: V=38.0 VS0=5.37 (MEV) WS=9.13 WV =0.0 (MEV) R =RS0=1.26 RS=1.39 (FM) A=ASO =0.76 B =0.40(FM) MT=102 CAPTURE DATA ARE NORMALIZED TO THE EXPERIMENTAL DATA OF A.LINDHOLM ET AL. AT 3 - 6 MEV/6/. INELASTIC AND THE DISCRETE LEVEL SCHEME TAKEN FROM REF./7/: NO. ENERGY(MEV) SPIN-PARITY (G.S.) 0.0 - 0+ 0.0 2.230 3.779 4.282 2+ 1 ż 0+ 3 Ž+ 4+ 4.459 Δ 5 4.695 1 +6 5.006 3. CONTINUUM LEVELS ASSUMED ABOVE 5.4 MEV. THE LEVEL DENSITY PARAMETERS OF ASANO ET AL./8/ARE USED. JENDL-3.2 ************* * * * * * THE COUPLING SCHEME GROUND STATE 0.0 ME 0.0 MEV (0+)

1 PHONON STATE 2.230 MEV (2+), 5.006 MEV (3-) 2 PHONON STATE 3.779 MEV (0+), 4.280 MEV (2+) 4.459 MEV (4+) COUPLING CONSTANTS BETA-2 = 0.30 BETA-3 = 0.25 MT=16(N,2N), 22(N,N'A), 28(N,N'P), 103(N,P), 107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE/9/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLES ARE CALCULATED BY USING THE OMP OF BECCHETTI-GEENLEES /10/ AND HUIZENGA-IGO/11/, RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT-IN VALUES. MT=103 (N,P) CROSS SECTION ADJUSTED TO REPRODUCE R. RICAMO DATA ABOVE 14 MEV /12/. MT=251 MU-BAR CALCULATED WITH COUPLED-CHANNEL OPTICAL MODEL. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). MT=51-56 CALCULATED WITH COUPLED-CHANNEL STATISTICAL MODEL MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91,103,107 EVAPORATION SPECTRA,

REFERENCES
1) MUGHABGHAB,S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
2) IGARASI,S: J. NUCL. SCI. TECH. 12, 67 (1975).
3) FU,C.Y.: ATOM. DATA AND NUCL. DATA TABLES. 17, 127 (1976).
4) PETITT,G.A. ET AL.: NUCL. PHYS. 79, 231 (1960).
5) VIRDIS,A.: CEA-R-5144 (1981).
6) LINDHOLM,A. ET AL.: NUCL. PHYS. A279, 445 (1977).
7) LEDER,C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
8) ASANO ET AL.: PRIVATE COMMUNICATION.
9) YOUNG,P.G. AND ARTHUR,E.D.: LA-6947 (1977).
10) BECCHETI,JR. AND GREENLEES,G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS, P.682 (1971).
11) HUIZENGA,JR. AND IGO,G.J.: NUCL. PHYS. 29, 462 (1962).
12) RICAMO, R.: NC. 8, 383 (1951)

MAT number = 1628 16-S - 33 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY Y NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) JENDL-3.2 NEW OPTICAL MODEL CALCULATION WAS PERFORMED BY T. WATANABE (KHI). DATA WERE COMPILED BY K. SHIBATA (JAERI). ***** MODIFIED PARTS FOR JENDL-3.2 (3,1),(3,4),(3,51-57),(3,91),(3,251),(4,2),(4,51-57) OPTICAL AND STATISTICAL MODEL CALCULATIONS. (3,2). TOTAL - NONELASTIC 87-05 94-02 MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=451 2 MT=151 RESONANCE PARAMETERS: RESOLVED RESONANCES FOR MLBW FORMULA: 1.0E-5 EV - 260 KEV PARAMETERS ARE TAKEN FROM BNL325 4TH EDITION/1/, AND C.WAGEMANS AND H.WEIGMANN/2/. CROSS SECTIONS CALCULATED WITH THESE PARAMETERS ARE TO BE CORRECTED ADDING MF=3, MT=1, 2 AND 102 DATA. MF=2 MT=151 CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/SEC REF. RES. INTEG. ELASTIC CAPTURE TOTAL 2.84 B 0.35 B 3.36 B /1/ 0.164 B /1/ NO. (G.S.) MT=16(N,2N), 22(N,N'A),28(N,N'P),103(N,P),107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE /7/, WITHOUT THE PRECOMPOUND REACTION CORRECTION.

TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLES ARE CALCULATED BY USING THE OMP OF BECCHETTI-GEENLEES/8/ AND HUIZENGA-IGO/9/, RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT-IN VALUES. 251 MU-BAR CALCULATED WITH OPTICAL MODEL (CASTUX)

MT=251

CALCULATED WITH OPTICAL MODEL (CASTHY).

MF = 4

ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). MT=51-57 CALCULATED WITH HAUSER-FESHBACH FORMULA (CASTHY) MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91,103,107 EVAPORATION SPECTRA.

REFERENCES

- REFERENCES
 1) MUGHABGHAB, S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
 2) WAGEMANS, C. AND WEIGMAN, H.: GRENOBLE-CONF., 462 (1981).
 3) IGARASI, S.: J. NUCL. SCI. TECH., 12, 67 (1975).
 4) FU, C.Y.: ATOM.DATA AND NUCL. DATA TABLES, 17, 127 (1976).
 5) LEDRER, C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
 6) ASANO ET AL.: PRIVATE COMMUNICATION.
 7) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
 8) BECCHETI, JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA
 IN NUCLEAR REACTIONS, P.682 (1971).
 9) HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).

MAT number = 1631 16-S - 34 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY Y NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) JENDL-3.2 NEW OPTICAL MODEL CALCULATION WAS PERFORMED BY T. WATANABE (KHI). DATA WERE COMPILED BY K. SHIBATA (JAERI). ***** MODIFIED PARTS FOR JENDL-3.2 (3,1),(3,4),(3,51-55),(3,91),(3,251),(4,2),(4,51-55) OPTICAL AND STATISTICAL MODEL CALCULATIONS. (3,2). TOTAL - NONELASTIC 87-05 94-02 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 12 MT=151 RESONANCE PARAMETERS: RESOLVED RESONANCES FOR MLBW FORMULA: 1.0E-5 EV - 480 KEV PARAMETERS ARE TAKEN FROM BNL 325 4TH EDITION/1/, AND SOME PARAMETERS ARE ASSUMED TO FIT THE MEASURED DATA. CROSS SECTIONS CALCULATED WITH THESE PARAMETERS ARE TO BE CORRECTED BY ADDING MF=3, MT=1, 2 AND 102 DATA. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS MF=2 MT=151 2200-M/SEC RES.INTEG. REF. 2.08 B 0.22 B ELASTIC CAPTURE 0.101 B /1/ 2.30 B TOTAL 2.30 B =3 NEUTRON CROSS SECTIONS BELOW 480KEV NO BACKGROUND CROSS SECTION. MT=251 MU-BAR=0.0198 ABOVE 480 KEV. MT=1,2,4,51-55,91,102 TOTAL, ELASTIC, INELASTIC AND CAPTURE CALCULATED WITH CASTHY CODE/2/, CONSIDERING THE COMPETITION WITH THE THRESHOLD REACTION CHANNELS. OPTICAL POTENTIAL PARAMETERS OF C.Y.FU/3/ ARE ADJUSTED TO REPRODUCE THE FOLLOWING EXPERIMENTAL DATA: MT=1 TOTAL MT=2 ELASTIC CROSS SECTIONS OF S-32 MT=4 INELASTIC MT=4 INELASTIC MT=2 ELASTIC CROSS SECTIONS OF S-32 MT=4 INELASTIC MT=2 ELASTIC CROSS SECTIONS OF S-32 MT=4 INELASTIC MT=2 ELASTIC CROSS SECTIONS OF S-32 MT=4 INELASTIC WS = 9.13<</td> WV = 0.0 MT=102 CAPTURE DATA ARE NORMALIZED TO 0.3MB AT 480 KEV BASED ON S-32 CAPTURE CROSS SECTION. THE DISCRETE LEVEL SCHEME TAKEN FROM REF./4/: NO. O 1 2.127 2 </tr TOTAL MF=34 4.072 1 + 5 4.115 2 + CONTINUUM LEVELS ASSUMED ABOVE 4.5 MEV. THE LEVEL DENSITY PARAMETERS OF ASANO ET AL./5/ ARE USED. **** JENDL-3.2 MT=1,4,51-55,91,251 OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED BY USING THE OMP SET GIVEN AS FOLLOWS: V = 58.83 - 0.5635EN (MEV) WS = 3.609 + 0.1819EN (MEV) VSO= 4.199 (MEV) R = 1.306, A = 0.452 (FM) RS = 1.124, B = 0.690 (FM) RSO= 1.010, ASO= 0.750 (FM) MT=16(N 2N) 22(N N'A) 28(N N'A) 102(N A) Ā 4.072 1 MT=16(N,2N), 22(N,N'A), 28(N,N'P), 103(N,P), 107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE /6/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLE ARE CALCULATED BY USING THE OMP OF BECCHETTI-GEENLEES/7/ AND HUIZENGA-IGO/8/, RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT-IN VALUES. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL (COCTION)

CALCULATED WITH OPTICAL MODEL (CASTHY) .

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). MT=51-55 CALCULATED WITH HAUSER-FESHBACH FORMULA (CASTHY) MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91,103,107 EVAPORATION SPECTRA.

REFERENCES
1) MUGHABGHAB, S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
2) IGARASI, S.: JR. NUCL. SCI. TECH., 12, 67 (1975).
3) FU, C.Y.: ATOM. DATA AND NUCL. DATA TABLES., 17, 127 (1976).
4) LEDERER, C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
5) ASANO ET AL.: PRIVATE COMMUNICATION.
6) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
7) BECCHETI, JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS, P.682 (1971).
8) HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).

MAT number = 1637 16-S - 36 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY Y NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) JENDL-3.2 NEW OPTICAL MODEL CALCULATION WAS PERFORMED BY T. WATANABE (KHI). DATA WERE COMPILED BY K. SHIBATA (JAERI). ***** MODIFIED PARTS FOR JENDL-3.2 (3,1),(3,4),(3,51-55),(3,91),(3,251),(4,2),(4,51-55) OPTICAL AND STATISTICAL MODEL CALCULATIONS. (3,2). TOTAL - NONELASTIC 87-05 94-02 MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 MT=151 RESONANCE PARAMETERS: (NOT GIVEN) NEUTRON CROSS SECTIONS BELOW 1000 KEV ASSUMED CROSS SECTIONS, GUIDED BY THOSE OF S-32 (10**-5)EV (0.025)EV (1.0**4)EV (1.0**6)EV RES.INT. MT=2 2.2 B 2.18 B 2.185 B 2.32339 B -MT=102 3.5 B 0.15 B 0.001 B 0.00015 B 0.12095 MT=102 3.5 B 2.32 B -MT=102 3.5 B 0.15 B 0.001 B 0.00015 B 0.12095 MF=3MT=2 MT=102 5.7 B MT=102 3.5 B 0.15 B 0.001 B 0.00015 B 0.12095 D MT=1 5.7 B 2.33 B 2.186 B 2.32354 B -ABOVE 1000 KEV MT=1,2,4,51-55,91,102 TOTAL, ELASTIC, INELASTIC AND CAPTURE CALCULATED WITH CASTHY CODE /2/, CONSIDERING THE COMPETITION WITH THE THRESHOLD REACTION CHANNELS. OPTICAL POTENTIAL PARAMETERS OF C.Y.FU/3/ ARE ADJUSTED TO REPRODUCE THE FOLLOWING EXPERIMENTAL DATA: MT=1 TOTAL -MT=2 ELASTIC CROSS SECTIONS OF S-32 MT=4 INELASTIC -THE SPHERICAL OPTICAL POTENTIAL PARAMETERS: V = 38.0 VSO= 5.37 (MEV) 0.12095 B IHE SPHERICAL OPTICAL POTENTIAL PARAMETERS: V = 38.0 VSO= 5.37 (MEV) WS= 9.13 WV = 0.0 (MEV) R =RSO= 1.26 RS = 1.39 (FM) A =ASO= 0.76 B = 0.40 (FM) MT=102 CAPTURE DATA ARE NORMALIZED TO 0.15 MB AT 1 MEV BASED ON S-32 CAPTURE CROSS SECTION. THE DISCRETE LEVEL SCHEME TAKEN FROM REF./4/: NO. ENERGY (MEV) SPIN-PARITY (G.S.) 0.0 + MT=16(N,2N), 22(N,N'A), 28(N,N'P), 103(N,P), 107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE /6/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLE ARE CALCULATED BY USING THE OMP OF BECCHETTI-GEENLEES /7/ AND HUIZENGA-IGO/8/,RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT-IN VALUES. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL (CASTURY) MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL (CASTHY). ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). MT=51-55 CALCULATED WITH HAUSER-FESHBACH FORMULA(CASTHY) MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB. MF = 4

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91,103,107 EVAPORATION SPECTRA.

- REFERENCES
 1) MUGHABGHAB, S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
 2) IGARASI, S.: J. NUCL. SCI. TECH., 12, 67 (1975).
 3) FU, C.Y.: ATOM. DATA AND NUCL. DATA TABLES., 17, 127 (1976).
 4) LEDERER. C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
 5) ASANO ET AL.: PRIVATE COMMUNICATION.
 6) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
 7) BECCHETI, JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA
 IN NUCLEAR REACTIONS, P.682 (1971).
 8) HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).

MAT number = 1700 17-CL-0 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEW EVALUATION CONSTRUCTED FROM ISOTOPE DATA MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA.(BELOW 226.0 KEV) BELOW 226 KEV BACKGROUND CROSS SECTION WAS ALSO GIVEN. BETWEEN 202 TO 226 KEV: CL-37 SMOOTH CROSS SECTION WERE ADDED AS A BACKGROUND CROSS SECTION. BELOW 226KEV CL-35(N,P),(N,A) CROSS SECTION WAS ADDED ALSO BACKGROUND CROSS SECTION. THE DATA WERE CONSTRUCTED FROM THE EVALUATED CROSS SECTIONS FOR CL-35 AND CL-37, CONSIDERING THEIR ABUNDANCES/1/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 200 M/S RES. INTEG. TOTAL 49.03 -ELASTIC 15.89 -CAPTURE 33.14 13.57 MF=3 NEUTRON CROSS SECTIONS BELOW 226 KEV, RESONANCE PARAMETERS WERE GIVEN. ALSO BACKGROUND CROSS SECTIONS WERE GIVEN TO TOTAL,ELASTIC, CAPTURE,(N,P) AND (N,A) PARTIAL CROSS SECTIONS. ABOVE 202 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/2/. OPTICAL POTENTIAL PARAMETERS USED WERE AS FOLLOWS. DEPTH (MEV)R*A**(1/3)DIFFUSENESS(FM)V = 46.68-0.3459E, R0 = 1.450, A0 = 0.308WS = 3.584+1.224E, RS = 1.433, AS = 0.338WS0= 6.2, RS0= 1.200, AS0= 0.638 $\begin{array}{c} \dot{W}S = 3.5684 + 1.224E \\ \dot{W}S0 = 6.2 \\ \dot{W}S0 = 6.2 \\ \dot{W}S0 = 6.2 \\ \dot{W}S0 = 6.2 \\ \dot{W}S0 = 1.200 \\ \dot{W}S0 = 1.200 \\ \dot{W}S0 = 1.200 \\ \dot{W}S0 = 1.200 \\ \dot{W}S0 = 0.638 \\ \dot{W}S0 = 0.200

| 33
34
35
36
37 | 4.9210
4.9230
4.9600
5.0104
5.0093
5.0555 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | CL - 37
CL - 37
CL - 37
CL - 37
CL - 35
CL - 37
CL - 37 | |
|---|--|---|--|------------|
| LEVELS A | BOVE 5.02MEV | WERE ASSUMED T | D BE OVERLAPPING. | _ |
| PARAMETERS F
CAMERON WERE
SPIN CUT-OFF | OR THE COMPOS
EVALUATED.
PARAMETER C | SITE LEVEL DENS
1 WAS TAKEN AS (| ITY FORMULA OF GIRBER
D.146. | Υ - |
| | CL | - 35 CL- 36 | CL- 37 CL-38 | _ |
| A (MEV)
SPIN CUT-OFF
PAIRING ENER
NORMALIZATIO
E-JOINT (MEV | SPARAM. 3
GY (MEV) 1
N FACTOR 344 | .205 5.434
.564 3.711
.860 0.0
4.94 370.41
.542 3.561 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | - |
| MT=16,22,28,
(N,2N),(N
(N,A),(N,
WERE CONSTRU
ABUNDANCES.
CROSS SECTIO
AND MODIFIED | 32,102,103,10
,NA),(N,NP),
2P),MU-BAR
CTED FROM EAC
NS FOR EACH
EGNASH-2/3/ | D4,105,106,107,
(N,ND),(N,P),(N
CH CL ISOTOPE D.
ISOTOPE WERE EV.
PROGRAMM. | 111,251
,D),(N,T),(N,HE-3),
ATA CONSIDERING
ALUATED USING CASTHY/ | 2/ |
| MF=4 MT=2,16,
(N,2N),(N,NA
ANGULAR DİST
WERE CONSTRU
ABUNDANCES. | 22,28,32,51-{
},(N,NP),(N,1
RIBUTIONS OF
CTED FROM EA(| 37,91
ND) AND ELASTIC
SECONDARY NEUT
CH CL ISOTOPE D. | AND INELASTIC SCATTE
RONS
ATA CONSIDERING | RING |
| MF=5 MT=16,22
(N,2N),(N,NA
ENERGY DISTR
WERE CONSTRU
ABUNDANCES. | 2,28,32,91
(),(N,NP),(N,1
1BUTIONS OF S
CTED FROM EAG | ND) AND CONTINU
SECONDARY NEUTR
CH CL ISOTOPE D | M INELSTIC SCATTERING
ONS
ATA CONSIDERING | 3 |
| REFERENCES
1)C.M.LEDERER | ET.AL. | TABLE OF ISOTO | PES 7TH ED.(1978)
DNS INC. | |

2)S.IGARASHI,T.FUKAHORI 3)N.YAMAMURO JOHN WILEY & SONS INC. JAERI-1321 (1991) JAERI-M 90-006(1991)

MAT number = 1725 17-CL- 35 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS(BELOW 226KEV) RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA. NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE 2200M/S CROSS SECTIONS. EVALUATION WAS MAINLY BASED ON MACKLINS/1/ DATA AND MUGHABGHABS/2/ COMPILATION. BELOW 226KEV,(N,P) AND (N,A) CROSS SECTIONS WERE GIVEN AS BACKGROUND TOTAL CROSS SECTION. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 64.2 INTEGRALS (BARNS) ELASTIC 20.6 **4**3.6 17.8 MF=3 NEUTRON CROSS SECTIONS BELOW 226 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 226 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/ ABOVE 1.0MEV, DIRECT/SEMIDIRECT CAPTURE NORMALIZED TO 0.349MB AT 14MEV WERE ADDED TO CASTHYS RESULTS/5/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE SHOWN AS FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) , R0 = 4.743 , RI = 0.0 , RS = 4.6874 , RS0= 3.9253 V = 46.68-0.3459E WI =-0.0007E**2 WS = 3.584+1.224E , A0 = 0.308, A1 = 0.0, AS = 0.338, AI = , AS = , ASO= WSO = 6.20.638 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/6/. BETA2/BETA3 0.0 ĠŔ. 3/22 3/22 3/22 3/22 3/22 3/22 3/22 3/22 3/22 3/22 3/22 3/22 3/22 2/22 3/22 2/22 3/22 2/22 2/22 3/22 2/2 2/2 2/22 2/2 2/2 2/2 2/2 2/2 2/2 2/2 2/2 0.28 1 $\begin{array}{c} 1.2193\\ 1.7632\\ 2.6453\\ 3.0026\\ 3.1626\\ 3.9182\\ 3.9432\\ 3.9675\\ 4.0592\\ 4.1133\\ 4.1734\\ 4.1779\\ 4.3473\end{array}$ 0.20 0.15 0.2 0.25 0.2 0.25 0.2 0.25 0.2 0.2 0.15 0.25 2 3 456789 10 0.15 0.2 0.2 11 12 13 4.1779 4.3473 4.6242 4.7679 4.8406 4.8544 4.8817 5.0104 14 15 16 17 1/2 18 + 19 + 20 5.0104 1/2 -LEVELS ABOVE 5.02MEV WERE ASSUMED TO BE OVERLAPPING. PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. CL- 35 CL- 36 5.434 3.711 0.0 A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 5.205 3.564 1.860 344.94 7.542 370.41 E-JOINT (MEV) 3.561 THE CAPTURE CROSS SECTION WAS NORMALIZED TO 3 MILLIBARNS AT 100 KEV.

MT=16,22,28,32,103,104,105,106,107,111 (N,2N),(N,A),(N,NP),(N,ND),(N,P),(N,D),(N,T),(N,HE-3), (N,A),(N,2P) THESE CROSS SECTIONS WERE EVALUATED WITH MODIFIED EGNASH-2/7/ USING F2=0.5 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/8/ DEUTRON :PEREYS OMP/8/ DEUTRON :PEREY-PEREYS OMP/9/ TRITON :RAGAINIS OMP/10/ HE-3 :IUFT7ESHWARS OMP/11/ HE-3 ALPHA HE-3 :LUETZESHWABS OMP/11/ ALPHA :BOCKS OMP/12/ NORMALIZED TO FOLLOWING DATA. AND AV. EXP. DATA/13,14/ AV. EXP. DATA/16,17/ SYSTEMATICS/15/ AV. EXP. DATA/18/ (N,2N) (N,P) (N,D) (N,A) 9.6 125.0 12.6 117.0 MB MB MB MB BELOW 58.607KEV, (N,P) CROSS SECTION WAS CALCULATED USING KOEHLERS RESONANCE PARAMETERS/3/. ENERGY DEPENDENCE OF LOW ENERGY (N,A) CROSS SECTION WAS ASSUMED AS 1/V AND NORMALIZED TO 0.08MB AT 2200 M/S./2/ THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,22,28,32,51-70,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,NA), (N,NP),(N,ND) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. THE DIRECT INELASTIC SCATTERING CONTRIBUTION WAS EVALUATED WITH DWUCKY/19/. DEFORMATION PARAMETERS USED IN DWUCKY CALCULATION WERE EVALUTED FROM COMPILAITON/20,21/, AND ENSDF HALF LIFE DATA. AS FOR (N,2N),(N,NA),(N,NP),(N,ND) ISOTROPIC DISTRIBUTIONS WERE ASSUMED. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,32,91 FOR (N,2N),(N,NA),(N,NP),(N,ND) AND CONTINUM INELASTIC SCATTERING CROSS SECTIONS, SECONDARY NEUTRON ENERGY DISTRIBUTION WERE CALCULATED WITH EGNASH-2. INELASTIC
INTELASTIC
INTELASTIC2)S.F.MUGHABGHAB ET. AL.,
S.F.MUGHABGHAB ET. AL.,
P.C.KOEHLERPR
C29,1996(1984)
PR/C44,1675(1991)
PR/C44,1675(1991)3)P.E.KOEHLER
PR/C44,1675(1991)
4)S.IGARASHI,T.FUKAHORI
5)T.NAKAGAWA
(APDIR MANUAL
6)EVALUATED NUCLEAR STRUCTURAL DATA FILE
7)N.YAMAMURO
9)C.M.PEREY, F.G.PEREY
PR
10)R.C.RAGAINI ET. AL.
PR
11)J.W.LUETZELSCFWAB ET.AL
PR
12(12)CFWAB ET.AL
PR
13)Y.IKEDA ET AL.
14)G.PETO
15)R.A.FORREST
15)R.A.FORREST
15)R.A.FORREST
16)L.LALLAN
NP
17)W.SCANTL
17)W.SCANTL
18)W.NAGEL
19)N.YAMAMURO
21)R.H.SPEARPR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR
PR<

MAT number = 1731 17-CL- 37 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED F=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS(BELOW 202.0KEV) MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA WITH VARING SCAT-ERING RADIUS. NEGATIVE ENERGY LEVEL DATA WERE ADJUSTED TO REPRODUCE 2200M/S CROSS SECTIONS. EVALUATION WAS MAINLY BASED ON MACKLINS/1/ DATA AND MUGHABGHABS/2/ COMPILATION. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. 1.583 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 1.15 0.204 F=3 NEUTRON CROSS SECTIONS BELOW 202 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 202 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/3/. DIRECT/SEMIDIRECT CROSS SECTION WERE NORMALIZED TO 0.286MB AT 14 MEV, WERE CORRECTED TO CASTHY'S RESULTS/4/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS MF=3FOLLOWS. (MEV) RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) , RO = 4.8317 , RS = 4.7751 , RSO= 3.9987 V = 46.68-0.3459E WS = 3.584+1.224E WSO= 6.2 -----, AO = 0.308, AS = 0.338, ASO= 0.638 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/5/ NO. ENERGY(MEV) SPIN-PARITY GR. 0.0 3/2 + 1 1.7266 1/2 + 0 LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/5/. NO. ENERGY(MEV) SPIN-PARITY BETA2/BETA3 GR. 0.0 3/2 + 1 1.7266 1/2 + 0.2 2 3.0866 5/2 + 0.2 3 3.1033 7/2 - 0.25 4 3.6260 3/2 + 0.15 5 3.7078 3/2 + 0.15 6 3.7409 5/2 - 0.25 7 4.0099 9/2 - 0.2 8 4.0163 3/2 + 0.15 9 4.1766 3/2 - 0.2 10 4.2689 1/2 + 0.15 11 4.2726 7/2 - 0.2 10 4.2689 1/2 + 0.15 11 4.2726 7/2 - 0.2 12 4.3963 5/2 + 0.1 13 4.4600 7/2 -14 4.5460 11/2 -15 4.7700 13/2 + 16 4.8012 5/2 + 17 4.8109 7/2 + 18 4.8376 5/2 + 19 4.8540 1/2 -20 4.9042 7/2 + 18 4.8376 5/2 + 19 4.8540 1/2 -20 4.9042 7/2 + 18 4.8376 5/2 + 19 4.8540 1/2 -20 4.9042 7/2 + 21 4.9210 9/2 -22 4.9230 13/2 + 23 4.9608 3/2 + 24 4.9740 13/2 + 25 5.0093 5/2 + 26 5.0552 5/2 + 26 5.0552 5/2 + 26 5.0591 3/2 -LEVELS ABOVE 5.06 MEV WERE ASSUMED TO BE OVERLAPPING. BETA2/BETA3 PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. CL- 37 CL- 38 - - - - - - - -- - - - - -A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR E-JOINT (MEV) 5.564 3.824 2.040 389.80 7.099 6.299 4.142 0.0 453.22 3.313

THE CAPTURE CROSS SECTION WAS ADJUSTED TO DOVBENKOS DATA/6/. MT=16,22,28,32,33,103,104,105,106,107 (N,2N),(N,NA),(N,NP),(N,ND),(N,NT),(N,P),(N,D),(N,T), (N,HE-3),(N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/7/ USING F2=0.5 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/8/ DEUTRON :PEREYS OMP/8/ DEUTRON :PEREYS OMP/9/ TRITON :RAGAINIS OMP/10/ HE-3 :LUETZESHWABS OMP/11/ ALPHA :BOCKS OMP/12/ AND NORMALIZED TO FOLLOWING DATA. (N,NA) 3.93 MB SYSTEMATICS/13/ (N,P) 22.3 MB KAWADES DATA/14/ (N,D) 8.18 MB SYSTEMATICS (N,T) 0.84 MB SYSTEMATICS (N,A) 31.5 MB AV. EXP. DATA/15,16,17/ (N,A) 31.5 MΒ AV. EXP. DATA/15,16,17/ THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,22,28,32,51-77,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,NA), (N,NP) AND (N,ND) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. DIRECT INELASTIC CONTRIBUTION WERE CALCULATED WITH DWUCKY/18/. DEFORMATION PARAMETERS USED IN DWUCKY CALCULATION WERE EVALUATED FROM COMPILATIONS/19,20/ AND ENSDF HALF LIFE DATA. AS FOR (N,2N),(N,NA),(N,NP) AND (N,ND) ISOTROPIC DISTRIBUTIONS WERE ASSUMED. MF = 4F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,32,91 FOR (N,2N),(N,NA),(N,NP),(N,ND) AND CONTINUM INELASTIC SCATTERING CROSS SECTIONS, SECONDARY NEUTRON ENERGY DISTRIBUTIO WERE CALCULATED WITH EGANSH-2. MF = 5

 WERE CALCULATED WITH LOARD.L.

 REFERENCES

 1)R.L.MACKLIN ET. AT., PR C29,1996(1984)

 2)S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A

 ACADEMIC PRESS(1981)

 3)S.IGARASHI,T.FUKAHORI JAERI-1321 (1991)

 4)T.NAKAGAWA

 SEVALUATED NUCLEAR STRUCTURAL DATA FILE

 6)A.G. DOVBENKO ET AL.
 AE 23,151(1967)

 7)N.YAMAMURO
 JAERI-M 90-006(1991)

 8)F.G.PEREY
 PR 131,745(1963)

 9)C.M.PEREY,F.G.PEREY
 PR 132,752(1963)

 10)R.C.RAGAINI ET. AL.
 PR 22,1020(1970)

 11)J.W.LUETZELSCFWAB ET.AL
 PR 180,1023(1964)

 12)R.BOCK ET. AL.
 NP A92,539(1967)

 13)R.A.FORREST
 AERE-R 12419(1986)

 14)K.KAWADE ET AL.
 JAERI-M 90-171(1990)

 15)R.PRASAD
 NP 85,476(1966)

 16)I.N.NGOC
 NGOC

 17)R.S.SCALAN ET AL.
 NP 9,334(1958)

 18)N.YAMAMURO
 JAERI-M 88-140(1988)

 19)S.RAWAN ET.AL.
 AND 42,55(1989)

MAT number = 1837 18-AR- 40 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED F=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS(BELOW 1.49774MEV) REICH-MOORE FORMULA WAS ADOPTED. ABOVE 100KEV,BACKGROUND CROSS SECTION WAS GIVEN TO REPRODUCE WINTERS MEASUREMENT/1/. NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE 2200M/S CROSS SECTIONS. EVALUATION WAS MAINLY BASED ON WINTERS/1/, MACKLINS/2/ DATA AND MUGHABGHABS/3/ COMPILATION. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 1.307 ELASTIC 0.647 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 0.294 0.66 F=3 NEUTRON CROSS SECTIONS BELOW 1.49774 MEV, RESONANCE PARAMETERS WERE GIVEN. BELOW 5.0MEV, WINTERS TOTAL CROSS SECTION MEASUREMENT/1/ WAS FOLLOWED. ELASTIC SCATTERING CROSS SECTION WAS RECONSTRUCTED FROM DIFFERENCE BETWEEN TOTAL AND SUM OF OTHER PARTIAL CROSS MF=3FROM DIFFERENCE BETWEEN TOTAL AND SUM OF OTHER PARTIAL CROSS SECTIONS. ABOVE 1.5 MEV, INELASTIC SCATTERING AND CAPTURE CROSS SECTION AND ABOVE 5.0 MEV, TOTAL AND ELASTIC SCATTERING CROSS SECTION WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/. DIRECT PROCESS FOR INELASTIC SCATTERING WERE CORRECTED WITH DWBA CODE DWUCKY/5/. THE PARAMETERS USED IN DWUCKY CALCULATION WERE ESTIMATED FROM RAMANS/6/ COMPILATION AND HALF LIFE DATA OF ENSDF FILE/7/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS FOLLOWS. DEPTH (MEV) RADIUS(FM) V = 53.39-0.2233E , R0 = 4.4494 WS = 3.365+2.445E , RS = 3.7448 WS0= 4.705 , RS0= 4.8085 DIFFUSENESS(FM) , A0 = 0.536 , AS = 0.419 , AS0= 0.6 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE. NO. ENERGY(MEV) SPIN-PARITY GR. 0.0000 9 + BETA 2/3 020 1.4609 2.1208 2.5241 2.8930 3.2083 3.46451 2 0.25 + 3456789 10 2 4 2 0.15 + 0.2 3.26045 3.5113 3.5150 3.6810 3.9420 4.0429 4.0429 4.2290 4.2290 4.3012 4.3245 4.3245 4.41906 1 + 4 + 0.25 0.15 3 2 1 + 11 12 + 0 3 1 + 13 14 0.2 + 15 16 17 4 4 + 1 18 19 2 + 0.15 żŏ ż 0.15 20 4.4190 3 - 0.15 21 4.4270 3 + 22 4.4810 1 + 23 4.4941 5 -24 4.5621 1 -25 4.5780 2 + LEVELS ABOVE 4.58 MEV WERE ASSUMED TO BE OVERLAPPING. PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE ADOPTED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. AR- 40 AR- 41

A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 8.301 4.920 3.260 628.70 9.363 8.443 5.044 1.620 655.44 6.164 E-JOINT (MEV) THE CAPTURE CROSS SECTION WAS NORMALIZED TO REPRODUCE 1.35 MILLIBARN AT 300 KEV/2/. ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.523 MB AT 14.5 MEV WERE ADDED TO ABOVE CASTHY'S RESULTS/8/. MT=16,17,22,28,103,104,105,106,107 (N,2N),(N,3N),(N,NA),(N,NP),(N,P),(N,D),(N,T),(N,HE-3), (N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/9/ USING F2=1.4 AND FOLLOWING OPTICAL POTENTIALS, NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/10/ DEUTRON :PEREYS OMP/10/ DEUTRON :PEREY-PEREYS OMP/11/ TRITON :RAGAINIS OMP/12/ HE-3 :LUETZESHWABS OMP/13/ ALPHA :BOCKS OMP/14/ AND_NORMALIZED TO FOLLOWING VALUES AT 14.5 MEV. AND NORMALIZED TO FOLLOWING VALUES AT 14.5 MEV. (N,NA) 2.17 MB SYSTEMATICS/15/ (N,NP) 0.06 MB SYSTEMATICS MB (N, NA) (N, NP) (N, P) (N, D) (N, A) RANAKUMARŠ DATA/16/ GRAYS DATA/17/ AV. OF EXP. DATA/16,18,19/ 16.0 2.9 10.0 MΒ M B M B THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,17,22,28,51-75,91 ELASTIC AND INELASTIC SCATTERING,(N,2N),(N,3N),(N,NA),(N,NP) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. THE DIRECT INELASTIC SCATTERING CONTRIBUTION WAS EVALUATED WITH DWUCKY MF = 4AS FOR (N,2N),(N,3N),(N,NA) AND (N,NP),ISOTROPIC DISTRIBUTION WAS ASSUMED. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 FOR (N,2N) (N,3N) (N,NA) (N,NP) AND CONTINUM INELASTIC SCATTER-ING,SECONDARY NEUTRON ENERGY DISTRIBUTION WAS CALCULATED WITH EGNASH-2.

 REFERENCES

 1) R.R.WINTERTS ET. AT., AAA 216, 109(1989)

 3) S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A ACADEMIC PRESS(1981)

 4) S.IGARASHI, T.FUKAHORI JAERI-1321 (1991)

 5) N.YAMAMURO JAERI-M 88-140(1988)

 6) S.RAMAN ET AL. AND 36, 1(1987)

 7) EVALUATED NUCLEAR STRUCTURAL FILE

 8) T.NAKAGAWA CAPDIR MANURL

 9) N.YAMAMURO JAERI-M 90-006 (1991)

 10) F.G.PEREY PR 131, 745 (1963)

 11) C.M.PEREY, F.G.PEREY PR 132, 752 (1963)

 12) R.C.RAGAINI ET. AL. PR C2, 1020 (1970)

 13) J.W.LUETZELSCFWAB ET.AL PR 180, 1023 (1964)

 14) R.BOCK ET. AL. NP A92, 539 (1967)

 15) R.A.FORREST AERE R 12419 (1986)

 16) N.RANAKUMAR ET AL. NP/A 128, 333 (1969)

 17) P.R.GRAY ET AL. NP 62, 172 (1965)

 18) S.KARDONSKY ET AL. PR C4, 840 (1971)

 19) L.HUSAIN JIN 30, 355 (1968)

 REFERENCES 1)R.R.WINTERTS ET. AT., 2)R.L.MACKLIN ET. AT., 3)S.F.MUGHABGHAB ET. AL.,

MAT number = 1900 19-K - O FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY 87-05 NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) 87-07 COMPILED BY T.FUKAHORI (JAERI). 94-02 JENDL-3.2 TOTAL CROSS SECTION WAS CALCULATED BY T. WATANABE (KHI). INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED BY K.SHIBATA (JAERI). GAMMA PRODUCTION DATA WERE EVALUATED BY T. ASAMI (DE). DATA WERE COMPILED BY K.SHIBATA. **** MODIFIED PARTS FOR JENDL-3.2 (3,1),(3,4),(3,51-91),(3,251),(4,2),(4,51-61) NEW OPTICAL AND STATISTICAL MODEL CAL. (3,2) TOTAL - NONELASTIC (5,16-91) SUBSECTIONS WERE COMBINED. MF=12,13,14,15 NEWLY EVALUATED HISTORY NATURAL POTASSIUM CONSTRUCTED FROM ITS ISOTOPES. GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION : 1.0E-5 EV - 200 KEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. PARAMETERS WERE ADOPTED FROM THE FOLLOWING SOURCES. K-39 : -4.0 - 200 KEV, R = 1.80 FM K-41 : -6.6 - 125 KEV, R = 2.00 FM MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200-M/S RES. INTEG. ELASTIC 2.096 B -CAPTURE 2.058 B 1.118 B В TOTAL 4.159 MF=3 NEUTRON CROSS SECTIONS BELOW 200 KEV, BACKGROUND CROSS SECTIONS CONSISTED OF ELASTIC, CAPTURE, (N,P) AND (N,ALPHA) CROSS SECTIONS WERE GIVEN. MT=1 TOTAL FOR ENERGIES 0.2 - 20 MEV, THE WEIGHTED SUM OF ISOTOPES DATA WERE TAKEN. THE ISOTOPIC CALCULATIONS WERE PERFORMED BY USING CASTHY CODE/1/. MT=2 ELASTIC SCATTERING GIVEN AS TOTAL MINUS OTHER CROSS SECTIONS. MT=4 TOTAL INELASTIC SCATTERING SUM OF MT=51-61, 91 MT=16,22,28,103,107 THE WEIGHTED SUM OF ISOTOPES WAS ADOPTED. THE CROSS SECTIONS OF ISOTOPES WERE CALCULATED USING GNASH CODE/2/. MT=51-61,91 INELASTIC SCATTERING ISOTOPIC DATA WERE OBTAINED FROM THE CASTHY/1/ CALCULATION. ISOTOPIC LEVELS WERE SORTED WITH ENERGIES. OPTICAL POTENTIAL PARAMETERS USED IN THE CALCULATION ARE AS FOLLOWS: V = 46.72, R0 = 1.26, A0 = 0.76 $WS_{-} = 9.13$, RS_{-} = 1.39, AS_{-} = 0.40 = 46.72, R0 = 1.26, A0 = 0.76 S = 9.13, RS = 1.39, AS = 0.40 S0 = 5.37, RS0 = 1.26, AS0 = 0.76 ENERGIES IN MEV UNIT, LENGTHS IN FM UNIT. ENDL - 3.2 VŠ0= ENERGIES IN MEV UNIT, LENGTHS IN FM UNIT. THE CROSS SECTIONS WERE CALCULATED BY USING THE OMP SET DETERMINED BY T. WATANABE. V = 54.36 - 0.325EN (MEV) WS= 2.258 + 0.1698EN (MEV) VSO=3.341 (MEV) R = 1.200 , A = 0.658 (FM) RS = 1.320 , B = 0.602 (FM) RSO= 1.100 , ASO= 0.406 (FM) MT=102 CAPTURE ABOVE 200 KEV, THE CASTHY/1/ CALCULATION WAS ADOPTED. MT=103(N,P), 107(N,ALPHA) ABOVE 200 KEV, BASED ON CALCULATIONS USING THE GNASH/2/ CODE. MT=251 MU-BAR

CALCULATED WITH CASTHY/1/.
MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-61 OPTICAL AND STATISTICAL-MODEL CALCULATIONS. MT=16,22,28 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MT=91 ISOTROPIC DISTRIBUTIONS IN C.M. WERE CONVERTED TO THE DISTRIBUTIONS IN LAB.
MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 CALCULATED WITH GNASH/2/.
MF=12 PHOTON PRODUCTION MULTIPLICITY MT=102,103,107 CALCULATED WITH SINCROS-II/3/.
MF=13 PHOTON PRODUCTION CROSS SECTION MT=3 CALCULATED WITH SINCROS-II/3/.
MF=4 GENERATED BY TAKING ACCOUNT OF BRANCHING RATIOS.
MF=14 PHTON ANGULAR DISTRIBUTION MT=3,4,103,107 CALCULATED WITH SINCROS-II/3/.
MF=15 PHOTON ENERGY DISTRIBUTION MT=3,4,103,107 CALCULATED WITH SINCROS-II/3/.
MF=15 PHOTON ENERGY DISTRIBUTION MT=3,4,03,07 CALCULATED WITH SINCROS-II/3/.
MF=15 PHOTON ENERGY DISTRIBUTION MT=3,4,03,07 CALCULATED WITH SINCROS-II/3/.
MF=15 PHOTON ENERGY DISTRIBUTION MT=3,4,03,07 CALCULATED WITH SINCROS-II/3/.
MF=16,2,2,67 (1975).
YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
YAMAMURO, N: JAERI-M 90-006 (1990). MAT number = 1925 19-K - 39 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY NEWLY EVALUATED BY H. NARAWONG (1993. ---94-02 JENDL-3.2 TOTAL CROSS SECTION WAS CALCULATED BY T. WATANABE (KHI). INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED BY K.SHIBATA (JAERI). DATA WERE COMPILED BY K.SHIBATA.
**** MODIFIED PARTS FOR JENDL-3.2
(3,1), (3,4), (3,51-91), (3,251), (4,2), (4,51-54) NEW OPTICAL AND STATISTICAL MODEL CAL.
(3,2) TOTAL - NONELASTIC NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) 87-05 (3,2) GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1IT=151 RESONANCE PARAMETERS: RESOLVED RESONANCES FOR MLBW FORMULA: 1.0E-5 EV - 200 KEV PARAMETERS ARE TAKEN FROM BNL 325 4TH EDITION/1/, AND SOME PARAMETERS ARE ASSUMED TO FIT THE MEASURED DATA. CROSS SECTIONS CALCULATED WITH THESE PARAMETERS ARE TO BE CORRECTED BY ADDING MF=3, MT=1, 2 AND 102 DATA. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGLALS MF=2 MT=151 2200-M/SEC RES.INTEG. REF. 2.06 B 2.10 B ELASTIC CAPTURE 1.1 B /1/ TOTAL 4.16 B MF = 3NEUTRON CROSS SECTIONS NEUTRON CROSS SLOTTONS BELOW 200 KEV BACKGROUND DATA FOR MT=1 : (MT=107)-CROSS SECTIONS. MT=107 (N,A)=0.04 B (10**-5 EV), 0.0043 B (2200M/S)/1/, INT=5. $\begin{array}{c} \text{MI=107} \quad \text{(N}, \text{A}_{1}\text{-0.05} \quad \text{C}_{1},$ D. NO. (G.S) 1 2 3 CALCULATION. 200 KEV - 1.0 MEV MT=107 (N,A)-CROSS SECTION = 2.6*10**-5 B (CONSTANT): ASSUMED FROM THE CALCULATED VALUE AT 1.0 MEV. ABOVE 1.0 MEV MT=16,22,28,103,107 (N,2N), (N,NA), (N,NP), (N,P), (N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE/6/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLE ARE CALCULATED BY USING THE OMP OF BECCHETTI-GREENLEES /7/ AND HUIZENGA-IGO/8/, RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT-IN VALUES. AT THE ENERGY RANGE OF 4 - 20 MEV, (N,P) CROSS SECTION WAS BASED ON THE EXPERIMENTAL DATA/9-11/.

MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL (CASTHY).

ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). MT=51-54 CALCULATED WITH HAUSER-FESHBACH FORMULA (CASTHY) MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB. MF = 4

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91,103,107 EVAPORATION SPECTRA.

- REFERENCES
 1) MUGHABGHAB, S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
 2) IGARASI, S.: J. NUCL. SCI. TECH., 12, 67 (1975).
 3) FU, C.Y.: ATOM. DATA AND NUCL. DATA TABLES., 17, 127 (1976).
 4) LEDERER, C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
 5) ASANO ET AL.: PRIVATE COMMUNICATION.
 6) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
 7) BECCHETI, JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS, P.682 (1971).
 8) HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).
 9) BASS, R. ET AL.: NUCL. PHYS., 56, 569 (1964).
 10) BORMANN, M. ET AL.: ZEITSCHRIFT F. NATURFORSCHUNG, SECTION A, 15, 200 (1960).
 11) ALEKSANDROV, D.V. ET AL.: ATOMNAYA ENERGIYA, 39(2), 137 (1975).

MAT number = 1928 19-K - 40 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY NEWLY EVALUATED BY H. NARAWONG (1993. ---JENDL-3.2 TOTAL CROSS SECTION WAS CALCULATED BY T. WATANABE (KHI). INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED BY K.SHIBATA (JAERI). DATA WERE COMPILED BY K.SHIBATA.
**** MODIFIED PARTS FOR JENDL-3.2
(3,1), (3,4), (3,51-91), (3,251), (4,2), (4,51-55) NEW OPTICAL AND STATISTICAL MODEL CAL. TOTAL - NONELASTIC. NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) 87-05 MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 MT=151 RESONANCE PARAMETERS: (NOT GIVEN) MF=3 NEUTRON CROSS SECTIONS BELOW 30 KEV ASSUMED OR INTERPOLATED CROSS SECTIONS, GUIDED BY K-39: (10**_-5) (2200M/S) THOSE OF (3.10**4) 2.75 B 0.023 B 0.012 B (5.10**2) 2.75 B 0.2 B RES.INT 2.75B 1509.0 B 370.0 B 2.2 B 1884.0 B 2.75 B 30.0 B /1/ 4.4 B /1/ 0.39 B /1/ 37.54 B MT=2 MT=102 13.45 B 0.012 B 0.04 B MT=103 0.015 B 2.8 B MT = 107-MT=10/ 1884.0 В 37.54 В 3.010 в 2.0 С KEV - 1.0 MEV MT=1,2,4,102 : CALCULATED WITH CASTHY CODE /2/. MT=103 : 0.012 B, GUIDED BY MEASUREMENTS OF H.WEIGMANN/3/. 0.04 B 3.016 B 30 $\begin{array}{c} \text{MT}=1,2,4,102\\ \text{MT}=103:0.012 \text{ B, GUIDED BY MEASUREME.}\\ \text{MT}=103:0.012 \text{ B, GUIDED BY MEASUREME.}\\ \text{ABOVE 30 KEV.}\\ \text{MT}=1,2,4,51-91.102\\ \text{TOTAL, ELASTIC, INELASTIC AND CAPTURE CALCULATION WITH THE CASTHY CODE /2/, CONSIDERING THE COMPETITION WITH THE THE THRESHOLD REACTION CHANNELS.\\ \text{OPTICAL POTENTIAL PARAMETERS OF C.Y.FU/3/ ARE USED.\\ \text{THE SPHERICAL OPTICAL POTENTIAL PARAMETERS :}\\ \text{V}=46.72 \quad \text{VSO}=5.37 \quad (\text{MEV})\\ \text{WS}=9.13 \quad \text{WV}=0.0 \quad (\text{MEV})\\ \text{R}=\text{RSO}=1.26 \quad \text{RS}=1.39 \quad (\text{FM})\\ \text{A}=\text{ASO}=0.76 \quad \text{B}=0.40 \quad (\text{FM})\\ \text{MT}=102 \quad \text{CAPTURE DATA ARE NORMALIZED TO 4.2 \text{ MB AT 200 KEV.}\\ \text{THE DISCRETE LEVEL SCHEME TAKEN FROM REF. /4/:}\\ \text{NO.} \quad \text{ENERGY(MEV}) \quad \text{SPIN-PARITY}\\ \text{(G.S.)} \quad 0.0 \quad 4 \quad - \\ 0.0206 \quad 3 \quad - \\ \end{array}$ 0.0 0.0296 0.800 3 2 3 0.892 5 Δ 1.644 0 CALCULATION. MT=16(N,2N), 22(N,N'A), 28(N,N'P), 103(N,P), 107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE /6/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLE ARE CALCULATED BY USING THE OMP OF BECCHETTI-GEENLEES /7/ AND HUIZENGA-IGO/8/, RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT -IN VALUES. MT=261 MU BAD MU-BAR MT=251 CALCULATED WITH OPTICAL MODEL (CASTHY). ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). MT=51-55 CALCULATED WITH HAUSER-FESHBACH FORMULA(CASTHY) MF = 4

- MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED TO THE DISTRIBUTIONS IN LAB.
- MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91,103,107 EVAPORATION SPECTRA.

- REFERENCES
 1) MUGHABGHAB, S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
 2) IGARASI, S.: J. NUCL. SCI. TECH., 12, 67 (1975).
 3) WEIGMANN, H.: NESTOR DATA.
 4) FU, C.Y.: ATOM. DATA AND NUCL. DATA TABLES., 17, 127 (1976).
 5) LEDERER, C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
 6) ASANO ET AL.: PRIVATE COMMUNICATION.
 7) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
 8) BECCHETI, JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS, P.682 (1971).
 9) HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).

MAT number = 1931 19-K - 41 FUJI E.C. EVAL-MAY87 H.NAKAMURA DIST-SEP89 REV2-FEB94 HISTORY NEWLY EVALUATED BY T. NARAWONG (1993. ---94-02 JENDL-3.2 TOTAL CROSS SECTION WAS CALCULATED BY T. WATANABE (KHI). INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED BY K.SHIBATA (JAERI). DATA WERE COMPILED BY K.SHIBATA.
***** MODIFIED PARTS FOR JENDL-3.2
***** MODIFIED PARTS FOR JENDL-3.2
***** (3,1), (3,4), (3,51-91), (3,251), (4,2), (4,51-52) NEW OPTICAL AND STATISTICAL MODEL CAL.
***** NONELASTIC NEWLY EVALUATED BY H.NAKAMURA (FUJI ELECTRIC CO. LTD.) 87-05 (3,2) TOTAL - NONELASTIC MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY IT=151 RESONANCE PARAMETERS: RESOLVED RESONANCES FOR MLBW FORMULA: 1.0E-5 EV - 125 KEV PARAMETERS ARE TAKEN FROM BNL 325 4TH EDITION /1/, AND SOME PARAMETERS ARE ASSUMED TO FIT THE MEASURED DATA. CROSS SECTIONS CALCULATED WITH THESE PARAMETERS ARE TO BE CORRECTED BY ADDING MF=3, MT=1, 2 AND 102 DATA. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS MF=2 MT=151 REF. 2200-M/SEC RES. INTEG. ELASTIC CAPTURE TOTAL 2.57 B 1.46 B 4.03 B 1.58 B /1/ =3 NEUTRON CROSS SECTIONS BELOW 125 KEV MT=251 MU-BAR= 0.0164 ABOVE 125 KEV. MT=1,2,4,51-,91,102 TOTAL, ELASTIC, INELASTIC AND CAPTURE CALCULATED WITH CASTHY CODE /2/, CONSIDERING THE COMPETITION WITH THE THRESHOLD REACTION CHANNELS. OPTICAL POTENTIAL PARAMETERS OF C.Y.FU/3/ ARE USED. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS: V = 46.72 VSO= 5.37 (MEV) WS= 9.13 WV = 0.0 (MEV) R = RSO= 1.26 RS = 1.39 (FM) A = ASO= 0.76 B = 0.40 (FM) MT=102 CAPTURE DATA ARE NORMALIZED TO THE EXPERIMENTAL DATA OF 15 MB AT 150 KEV /4/ THE DISCRETE LEVEL SCHEME TAKEN FROM REF./5/: NO. ENERGY(MEV) SPIN-PARITY (G.S.) 0.0 3/2 + 1 0.9804 1/2 + MF=30.0 3/2 MT=16(N,2N), 22(N,N'A), 28(N,N'P), 103(N,P), 107(N,A) BASED ON THE STATISTICAL MODEL CALCULATIONS WITH GNASH CODE /7/, WITHOUT THE PRECOMPOUND REACTION CORRECTION. TRANSMISSION COEFFICIENTS FOR PROTON AND ALPHA PARTICLE ARE CALCULATED BY USING THE OMP OF BECCHETTI-GEENLEES /8/ AND HUIZENGA-IGO/9/, RESPECTIVELY. LEVEL DENSITY PARAMETERS ARE BASED ON BUILT-IN VALUES. (N,2N), (N,P) AND (N,A) CROSS SECTIONS WERE NORMALIZED TO THE EXPERIMENTAL DATA OF ADAM+/10/ FOR (N,2N), AND OF BASS+/11/ FOR (N,P) AND (N,A). MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL (CASTHY). CĂLCULĂTED WITH OPTICAL MODEL (CASTHY). MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

| | MT=2 CALCULATED WITH OPTICAL MODEL (CASTHY). |
|---|--|
| | MT=51-52 CALCULATED WITH HAUSER -FESHBACH FORMULA (CASTHY) |
| | MT=16,22,28 ISOTROPIC IN THE LABORATORY SYSTEM. |
| | MT=91 ISOTROPIC DISTRIBUTIONS IN CM WERE CONVERTED |
| | TO THE DISTRIBUTIONS IN LAB. |
| F | ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS |

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEULKUNS MT=16,22,28,91,103,107 EVAPORATION SPECTRA.

REFERENCES
1) MUGHABGHAB, S.F. ET AL.: NEUTRON CROSS SECTION, VOL.1 (1981).
2) IGARASI, S.: J. NUCL. SCI. TECH. 12, 67 (1975).
3) FU, C.Y.: ATOM. DATA AND NUCL. DATA TABLES., 17, 127 (1976).
4) STUPEGIA ET AL.: J. NUCL. ENERG., 22, 267 (1968).
5) LEDERER, C.M. ET AL.: TABLE OF ISOTOPES. 7TH EDIT.
6) ASANO ET AL.: PRIVATE COMMUNICATION.
7) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
8) BECCHETI, JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS, P.682 (1971).
9) HUIZENGA, JR. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).
10) ADAM, A. ET AL.: EANDC(E)-57U, 1 (1965).

| MAT nu
20-CA | l mber
∖- 0 | = 20
Dec | 000 | | EV | AL- | MAR | 87 | M. | HA | TČŀ | HYA | (D | AT | A | ΕN | G. | C | D.) | | | |
|--|---|---|---|--|--|---|-------------------------------------|--------------------------------|----------------------------------|-----------------------------|--------------------------------|------------------------------|-------------------------|---------------------------|--------------------------|------------------------|----------------------|-------------------------------|---------------------------------|--------------------------------|--|---------------|
| HISTOR
87-03 | Y
NEW E | VAL | JATI | ON | WAS | MA | DE | T0 | GI | VE | - Ar
A | FL | ,4
JLL | R | ΕV | ١S | 10 | NI | FOR | JE | NDL | - 2 |
| 87-03 | DATA.
COMPI | LED
MT- | BY | T.A | SAM | I(N | EDA | C) | F_/ | ı w | | = N | חחו | IF | IF | п | | | | | | |
| 94-04 | JENDL
GAMM
OTHE
COMPI | -3.2
IA PI
IR D/
LED | ZÖDC
ATA
BY | TIO
WER
T.N. | N D
E M
AKA | ATA
AIN
GAW | MC
LY
A (| DII
AD
ND | FIE
0P1
C/J | D
ED
ED
JAE | BY
FF
RI) | - "
T.
RON | AS
I J | AM
EN | I
DL | (D.
F | AT
US | A
10 | ENG
N F | i) | Ξ. | |
| * | × * * *
ΔΙΙ (| M | DIE | IED | PAI | RTS | FC | R, | JEN | | - 3 | 2 | 16 | * *
) | * * | * *
2 | * *
1 0 | x * ; | * * * | * * *
2 1 | * * *
07) | * |
| * | ALL A
ALL E
(12,4
(13,3
(15,1 | NGUI
NER
),
02) | LAR
GY D
(12,
(13,
, (1 | DIS
IST
102
4)
5,1 | TRII
RIB
),
03) | BUT
JTI
(12 | I ON
ONS
, 1 C | IS
3)
10 | ĂŇĊ
EXC
, (
7), |) (
)
EP
(12 | 3,1
T (
,1(| (4,
(4,
)7) |) 2) |),
.
* * | ** | * * | ** | ** | * * * | * * * | *** | * |
| - | JENDL | FUS
EV
COI | SION
ALUA
MPIL | FI
TED
ED | LE
BY
BY | /1/
K.
K. |
коз
коз | AS
AK
SAK | 0F
0 (
0 (| J
NE | AN.
DAC | 1
) | 99
AN | 4)
D |
S . |
СН |
I B |
A | (N D | C/J | IAER | I) |
| | - NA
- TH
DI
CC
DW | TUR/
IE II
STR
NTII
/UCK | AL C
NELA
IBUT
NUUM
Y IN | A D
STI
ION
IN
SI | ATA
C S(
S OI
ELA
NCR(
REA | WE
CAT
FI
STI | RE
TER
NEL
C) | | NST
G (
T I (
RE
STE | RU
CRO
CAL
CA | CTE
SS
LY
LCI
2/ | ED
SE
SC
JLA | FR
CT
AT
ICL | OM
IO
TE
D
UD | D
NS
RE
WI | AT
D
TH
G | A
ND
NE
CO | FOI
AI
UTI
AS
NTI | R I
NGU
RON
THY
RIB | SOT
LAR
S (
2Y
UTI | OPE
EXC
AND
ONS | S.
EPT |
| | - TH | IE (I | N, 2N
6, 2 |),
2, 1 | (N,I
28) | ŇÅ)
WE | AN
RE | ÍĎ
Cai | (N,
LCl | NP
JLA |) F
Tec | REA
D E | NCT
SY | IO
EG | N
N A | C R
S H | 0S
2 | S S
IN | SEC
TH | TIC
E | NS | |
| | - EN
BY
CC | NCR
IERG
TH
NTII | DS-I
Y DI
DSE
NUUM
/3/ | I.
STR
CAL
NE
USI | IBU
CUL/
UTR(
NG I | TIO
ATE
DNS
F15 | NS
DE
WE | OF
Y
RE | SE
EGN
CA
1/. | | NDA
H2
ULA
THE | | ′N
TH
D
RE | EU
E
BY
CO | TR
DD
K
MP | ON
X'
UM | S
S
A B
N D | WEI
OF
E': | RE
TH
SSS | REF
E
YST
OUN | PLAC
EMA | ED
- |
| | - TH
(N
EL | IE RI
I, 2P
AST | WAS
ESON
) CR
ICAL | ANC
OSS
LY | E P/
SE(
SCA | ARA
CTI
TTE | ED
MET
ONS
RED | ER:
ER:
Al | S,
ND
EUT | CA
AN
RO | STN
PTU
GUL
NS | | OS
D
RE | - I
(N
IS
T | I
TR
AK |)
)
IB
EN | UT | N , /
I 01
R 01 | YST
A)
NS
M_J | EM.
AND
OF
END |)
)L-3 | .1. |
| - | - OF
TF
LE | VEL | AL-M
INCR
SCH | ODE
OS-
EME | L,
 (
S
 | LEV
CAL
ERE | EL
CUL
DE | DEI
AT
TEI | NSI
ION
RMI | NE | AN
RE
D (| DE
DE
N | SC
TH | HE
RI
E | R
BE
BA | PA
D
SI | RA
IN
S
 | ME
RI
OF | EF. | S (
/2/
SDF | SED
 4/ | |
| MF=1
MT=45 | GENER
51 DE | AL
SCR | INFO
IPTI | RMA
VE | TIOI
DAT/ | N
A A | ND | DI | сті | ON | AR١ | (| | | | | | | | | | |
| MF=2
MT=15
RES
REG
THE
PAR
THE | RESON
51 RE
50LVED
10N F
DATA
AMETE
1R AE | IANCI
SOL
PAI
ROM
WEI
RS I
SUND | E PA
VED
RAME
1.0
RE C
FOR
ANCE | RAM
RES
E-5
ONS
EAC
S I | ETEI
ONAI
S F(
EV
TRU(
H C)
N TI | RS
NCE
DR
TO
CTE
A I
HE | PA
MLE
50
D F
S0T
CA | RAI
3W
ROI
OPI
ELI | MET
FOF
KE\
M T
E E | ER
MU
/.
HE
XC | S
LA
EP1
/5/ | WE
/AL
/ F | RE
UA
OR | G
TE
C | IV
D
A - | EN
RE
46 | I
SO | N ⁻
NAI
COI | THE
NCE
NSI | EN
Der | IERG
R I NG | Y |
| EL
CA
TC | ASTIC
PTURE
TAL | 220 | 00 M
3
0
3 | /S
.01
.43
.45 | CR08
93
58
51 | SS | SEC | TI |) N (| (B) | | | RE | S.
0. | ا
22 | NT
62 | ΕG | RAI | L(B |) | | |
| MF=3
BEL
ELA
ENE
TO
BAC | NEUTR
OW 50
STIC
RGIES
500 K
KGROU | CON (
CON KI
SCA
SOF
CEV,
IND (| CROS
EV
TTÉR
300
MUL
CROS | S S
BAC
ING
TO
TIP
S S | ECT
KGR(
ANI
50(
LIEI
ECT | ION
DUN
DC
DK
DB
ION | S
D C
APT
EV
Y T
S F | UR
UR
ANI
HE
OR | SS
E C
D C
IR
MT | SE
CRO
F
AB
[=1 | CTI
SS
CA-
UNI
, 2 | 0N
SE
43
0AN
2 A | I W
CT
S I
ICE | AS
IO
N
S,
1 | G
NS
TH
W
02 | IV
O
E
E
R | EN
F
EN
ERE | ĊA
ER(
GI
SPI | TH
- 42
GIE
VEN
ECT | E T
IN
S C
AS
IVE | OTA
I TH
IF 4
I TH
I TH
I LY. | L,
EO
E |
| A B C
C O N | VE 50
ISTRUC | 0 KI
TED | EV
FRO | ALL
M T | THI
HE I | E C
E V A | ROS
LUA | SS S
TEI | SEC
D C | CT I
DNE | ONS
S F | 6 E
7 0 F | XC | E P
T A | T
BL | F0
E | R
IS | THI
OT(| E T
OPE | OTA
S. | L W | ERE |
| MT=1
THE
MAI
STR | TOTAL
DATA
NLY T
UCTUR | E IN
HE I
RES. | THE
EXPE | EN
RIM | ERG
ENT/ | I E S
A L | AE
ONE | 30VI
S (| E 5
DF/ | 500
'6, | КЕ
77 | EV
V E | WE
Y | RE
FO | E
L L | V A
O W | LU
IN | АТ <u>I</u>
G | ED
THE | BAS
I R | SED
FIN | O N
E |
| MT=2 | ELAST | 10 3 | SCAT | TER | ING | | | | | | | | | | | | | | | | | |

OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. =4, 51-84, 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE WHICH WAS CONSTRUCTED FROM THOSE OF CA ISOTOPES AS FOLLOWS: MT = 4ENERGY(MEV) CA-40 CA-42 CA-43 CA-44 CA-46 CA-48 0.3728 51 0.5934 52 MT 52 54 55 0.9903 1.157 1.346 $\begin{array}{c} 1.5246\\ 1.6773\\ 1.903184\\ 1.9$ 57 58 57,58 ÕÕ 53 63 64 65 66 67 55 70 71 72 73 57 58,59 60 56,57 75 76 77 78 79 **Š**5 58 84 91 5.6296 5.9033 1.957 1 MT=16, 22, 28, 102, 103, 107, 111 (N,2N), (N,NA), (N,NP), CAPTURE, (N,P), (N,A) AND (N,2P) CONSTRUCTED FROM THE EVALUATED DATA FOR CA ISOTOPES. THE DATA FOR MT=103, 107 AND 111 ARE THE SAME AS JENDL-3.1. THOSE OF MT=22 AND 28 WERE MAINLY TAKEN FROM JENDL FUSION FILE. THE CAPTURE CROSS SECTION ABOVE 3 MEV WAS LARGELY CHANGED FROM JENDL-3.1 BRCAUSE OF CA-40. MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 ____CALCULATED WITH THE CASTHY CODE/8/. MT=51-84 TAKEN FROM JENDL FUSION FILE. MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB SYSTEM. MF=12 PHOTON PRODUCTION MULTIPLICITIES MT=102 (BELOW 4 MEV) CALCULATED FROM ENERGY BALANCE. MT=103, 107 (BELOW 4 MEV) CALCULATED WITH THE GNASH CODE/9/. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 4 MEV) CALCULATED WITH THE GNASH CODE/9/. MT=4 (BELOW 4 MEV) CALCULATED FROM THE INELASTIC SCATTRING CROSS SECTIONS AND THE TRANSITION PROBABILITIES OF ISOTOPES.

MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3, 4, 102, 103, 107 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3, 103, 107 CALCULATED WITH THE GNASH CODE/9/. MT=102 ASSUMED TO BE THE SAME AS THOSE OF CA-40 WHICH WERE CALCULATED WITH CASTHY BELOW 10 KEV AND WITH GNASH ABOVE 200 KEV.

REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) HOLDEN N.E., MARTIN R.L. AND BARNES I.L. : PURE & APPL. CHEM. 56, 675 (1984).
6) CIERJACKS S. ET AL. : KFK-1000 (1968).
7) FOSTER JR. D.G. ET AL. : PHYS. REV. C3, 576 (1971).
8) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
9) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

| MAT number = 2028
20-CA- 40 DEC | EVAL-MAR87 M.HATCHYA(DATA ENG. CO.) | |
|--|--|----------------------------|
| HISTORY
87-03 NEW EVALUAT | ION WAS MADE TO GIVE A FULL REVISION FOR JENDL | 2 |
| DATA.
87-03 COMPILED BY | T.ASAMI(NEDAC) | |
| GAMMA PROL
OTHER DATA
COMPILED BY | CTION DATA MODIFIED BY T.ASAMI (DATA ENG.)
WERE MAINLY ADOPTED FROM JENDL FUSION FILE.
T.NAKAGAWA | |
| ***** MOD
ALL CROSS S
ALL ANGULAF
ALL ENERGY
(12,4), (12
(13,3)
(15,102) | FIED PARTS FOR JENDL-3.2 ************************************ | * * |
| JENDL FUSIC
EVALU
COMP | N FILE /1/ (AS OF NOV. 1993)
ATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAEF
LED BY K.KOSAKO. | ····
{) |
| - THE TOTA
ABOVE 10 | L CROSS SECTION WAS MODIFIED IN THE ENERGY RAN | NGE |
| - THĚ ĪNĖĽ
DISTRIBU
CONTINUU
DWUCKY | AŜTIĊ SCATTERING CROSS SECTIONS AND ANGULAR
TIONS OF INELASTICALLY SCATTERED NEUTRONS (EXC
M INELASTIC) WERE CALCULATED WITH CASTHY2Y AND
N SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
ECT DECETIONS | CEPT |
| - THE (N,2
(MT=16, | N, (N, NA) AND (N, NP) REACTION CROSS SECTIONS
22, 28) WERE CALCULATED BY EGNASH2 IN THE | |
| SINCROS
- ENERGY [
BY THOSE
CONTINUI | II.
ISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLAC
CALCULATED BY EGNASH2. THE DDX'S OF THE
W NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA | CED
A- |
| TICS /37
RATIO WA
- THE RESC | USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
S CALCULATED BY THE SINCROS-II CODE SYSTEM.
NANCE PARAMETERS. CAPTURE. (N.P). (N.A) AND | |
| (N,2P) (
ELASTICA
- OPTICAL | ROSS SECTIONS AND ANG. DISTRIBUTIONS OF
LLY SCATTERED NEUTRONS WERE TAKEN FROM JENDL-3
WODEL LEVEL DENSITY AND OTHER PARAMETERS USED | 3.1.
) IN |
| ŤHĖ ŠĨŇ
LEVEL SC | RÓS-II CALCULATIÓN ARE DESCRIBED IN RÉF./2/.
HEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/ | / <u>.</u> |
| ME-1 GENERAL ING | | |
| MT=451 DESCRIPT | IVE DATA AND DICTIONARY | |
| MF=2 RESONANCE F
MT=151 RESOLVED
RESOLVED PARAN
REGION FROM 1
THE RECOMMENDE
RESONANCE WERE
CROSS SECTIONS
RADIUS WAS ASS
CROSS SECTIONS | ARAMETERS
RESONANCE PARAMETERS
ETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERG
DE-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FRO
D DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
ADDED SO AS TO REPRODUCE THE RECOMMENDED THEF
FOR CAPTURE AND SCATTERNG/5/. THE SCATTERING
UMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
AND RESONANCE INTEGRALS ARE AS FOLLOWS: | }Y
)M
}MAL
} |
| 2200 M
ELASTIC
CAPTURE
TOTAL | /S CROSS SECTION(B) RES. INTEGRAL(B)
.022
.408 0.2125
.430 | |
| MF=3 NEUTRON CRO
BELOW 500 KEV
THE CROSS-SEC
RESOLVED RESON | SS SECTIONS
ZERO BACKGROUND CROSS SECTION WAS GIVEN AND A
ION DATA ARE REPRODUCED FROM THE EVALUATED
ANCE PARAMETERS WITH MLBW FORMULA. | \LL |
| FOR JENDL-3.2,
(N,P) AND (N,
FILE. THEIR (
ADOPTING WALTE
PEREY OMP /6/
YOUNG/7/ FOR /
BECCHETTII-GRE
LEVEL DENSITY | ALL CROSS-SECTION DATA EXCEPT FOR THE CAPTURE
) CROSS SECTIONS WERE ADOPTED FROM JENDL FUSIC
ALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/
R-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON
FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND
LPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
ENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDAF
PARAMETERS OF SINCROS-II SYSTEM. | E,
DŇ
BY
N,
RD |

MT=1 TOTAL

| OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH
CASTHY /10/. THE OPTICAL POTENTIAL PARAMETERS USED ARE:
V = 49.68, $VSO = 7.12$ (MEV)
WS = 7.76 - 0.5*EN, $WV = 0$ (MEV)
R = 1.17, $RS = 1.09$, $RSO = 1.17$ (FM)
A = 0.66, $ASO = 0.60$ | |
|--|---|
| ABOVE TO MEV, MODIFIED TO REPRODUCE THE EXPERIMENTAL DATA/11,
12/. | |
| MI=2 ELASTIC SCATTERING
OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS
FROM THE TOTAL CROSS SECTION. | |
| <pre>MT=4, 51-60, 91 INELASTIC SCATTERING
THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE
LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE
DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'
USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./13/ AND
SPEAR/14/.</pre> | , |
| NO. ENERGY (MEV) SPIN-PARITY (DIRECT PROCESS) 0.0 $0 +$ 1 3.3521 $0 +$ 2 3.7369 $3 -$ 3 3.9045 $2 +$ 4 4.4915 $5 -$ 5 5.2129 $0 +$ 6 5.2488 $2 +$ 7 5.2788 $4 +$ 8 5.6142 $4 -$ 9 5.6296 $2 +$ | |
| LEVELS ABOVE 5.9033 MEV WERE ASSUMED TO BE OVERLAPPING. THE
DIRECT INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED FO
THE LEVELS AT 6.026, 6.286, 6.583, 6.751, 7.114, 7.466, 7.659
8.099 AND 8.424 MEV, AND ADDED TO MT=91. | Ŗ |
| MT=16 (N,2N)
THE CALCULATION FOR JENDL FUSION FILE WAS NOT ADOPTED. THIS
CROSS SECTION FOR JENDL-3.1 WAS EVALUATED ON THE BASIS OF
EXPERIMENTAL DATA OF ARNORD ET AL./15/ THE THRESHOLD ENERGY
WAS SLIGHTLY MODIFIED FOR JENDL-3.2. | |
| MT=22, 28 (N,NA),(N,NP)
ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS
MADE WITH SINCROS-II. | |
| MT=102 CAPTURE
CALCULATED WITH THE CASTHY CODE/16/ AND NORMALIZED TO 6.7 MB
AT 30 KEV. ABOVE 5.38 MEV, CROSS SECTIONS WERE DETERMINED
ON THE BASIS OF THE EXPERIMENTAL DATA/17,18/. | |
| <pre>MT=103, 107, 111 (N,P), (N,A), (N,2P)
CALCULATED WITH THE GNASH CODE/19/ USING THE ABOVE MENTIONED
OPTICAL MODEL PARAMETERS. THE (N,P) CROSS SECTIONS WERE
NORMALIZED SO AS TO FIT TO THE EXPERIMENTAL DATA OF URECH AT
5.95 MEV/20/. THE (N,A) CROSS SECTIONS WERE NORMALIZED TO TH
EXPERIMENTAL DATA OF BARNES/21/ AT 14.1 MEV.</pre> | E |
| MT=251 MU-BAR
CALCULATED WITH THE OPTICAL MODEL. | |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2
CALCULATED WITH THE CASTHY CODE/10/. MT=51-60
TAKEN FROM JENDL FUSION FILE CALCULATED WITH THE CASTHY AND
DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 22, 28, 91
TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB
SYSTEM. | |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 22, 28, 91
TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB
SYSTEM. | |
| MF=12 PHOTON PRODUCTION MULTIPLICITIES
MT=4 (UP TO 4.0 MEV)
MULTIPLICITY OF 1.0 WAS GIVEN.
MT=102 (UP TO 4.0 MEV)
FROM ENERGY BALANCE.
MT=103, 107 | |

CALCULATED WITH THE GNASH CODE/19/.

MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 4.0 MEV) CALCULATED WITH THE GNASH CODE/19/.

MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=4,3,102 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3, 102, 103, 107 CALCULATED WITH THE GNASH CODE/19/. CAPTURE GAMMA SPECTRAUM AT THERMAL ENERGY WAS CALCULATED WITH CASTHY/10/.

REFERENCES 1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 2) YAMAMURO, N.: JAERI-M 90-006 (1990). 3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). 4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. 5) MUGHAGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS", VOL. 1, PART

b) MUGHAGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS", VOL. 1, PALA (1981).
c) PEREY, F.G.: PHYS. REV., 131, 745 (1963).
c) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
e) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
e) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1071) PHENOMERAL IN NUCL. REACTIONS, "UNIV. WISCONSIN PRESS, P.002 (1971).
10) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
11) FOSTOER D.G AND GLASGOW D.W.: PHYS. REV. C3, 576 (1971).
12) CAMARDA H.S. ET AL.: PHYS. REV. C34, 810 (1986).
13) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
14) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
15) ARNOLD D.W. : TAKEN FROM EXFOR (1965).
16) ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE)
17) BERGQVIST I. ET AL.: NUCL. PHYS. A231, 29 (1974).
18) BUDNAR M. ET AL.: INDC(YUG)-6 (1979).
19) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).
20) URECH S. : NUCL. PHYS. A111, 184 (1968).
21) BARNES J.W. ET AL.: J. INORG. NUCL. CHEM. 37, 399 (1975).

| MAT number =
20-CA- 42 D | 2031
EC | EVAL-MAR87 M.HATCHYA(DATA ENG. CO.) |
|--|---|---|
| HISTORY
87-03 NEW EV | ALUATION V | VAS MADE TO GIVE A FULL REVISION FOR JENDL-2 |
| 87-03 COMPIL
93-11 JENDL-3
DATA | ED BY T.AS
3.2
WERE MAINL | SAMI(NEDAC)
LY ADOPTED FROM JENDL FUSION FILE. |
| COMPIL | ED BY T.NA | AKAGAWA |
| ALL CR
ALL AN
ALL EN | OSS SECTIC
GULAR DIST
ERGY DISTE | DNS EXCEPT (3,102), (3,103) AND (3,107)
TRIBUTIONS EXCEPT FOR (4,2).
RIBUTIONS. |
| JENDL | FUSION FIL
EVALUATED
COMPILED | -E /1/ (AS OF NOV. 1993)
BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
BY K.KOSAKO. |
| - THE
DIS
CON | INELASTIC
TRIBUTIONS
TINUUM INE | C SCATTERING CROSS SECTIONS AND ANGULAR
S OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
ELASTIC) WERE CALCULATED WITH CASTHY2Y AND |
| FROI
- THE
(MT) | M DIRECT F
(N,2N), (
=16, 22, 2 | EACTIONS.
(N,NA) AND (N,NP) REACTION CROSS SECTIONS
28) WERE CALCULATED BY EGNASH2 IN THE |
| - ENE
BY
CON | RGY DISTRI
THOSE CALC | BUTIONS OF SECONDARY NEUTRONS WERE REPLACED
CULATED BY EGNASH2. THE DDX'S OF THE
JTRONS_WERE CALCULATED_BY KUMABE'S SYSTEMA- |
| RAT
- THE
CROS | S /3/ USIN
IO WAS CAL
RESONANCE
SS SECTION | G F15IOB /1/. THE PRECOMPOUND/COMPOUND
CULATED BY THE SINCROS-II CODE SYSTEM.
È PARAMETERS, TOTAL, CAPTURE, (N,P) AND (N,A)
NS AND ANG. DISTRIBUTIONS OF ELASTICALLY |
| SCA
- OPT
THE
LEV | TTERED NEU
ICAL-MODEL
SINCROS-I
EL SCHEMES | JTRONS WERE TAKEN FROM JENDL-3.1.
., LEVEL DENSITY AND OTHER PARAMETERS USED IN
I CALCULATION ARE DESCRIBED IN REF./2/.
S WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| | | |
| | | |
| MF=1 GENERA
MT=451 DES | L INFORMAT
CRIPTIVE D | TION
DATA AND DICTIONARY |
| MF=1 GENERA
MT=451 DES
MF=2 RESONA
MT=151 RES
RESOLVED
REGION FR
THE RECOM
RESONANCE
CROSS SEC
RADIUS WA
CROSS SEC | L INFORMAT
CRIPTIVE D
OLVED RESC
PARAMETERS
OM 1.0E-5
MENDED DAT
WERE ADDE
TIONS FOR
S ASSUMED
TIONS AND | TION
DATA AND DICTIONARY
DNANCE PARAMETERS
S FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 300 KEV. PARAMETERS WERE TAKEN FROM
TA OF BNL/5/ AND THE DATA FOR A NEGATIVE
ED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CAPTURE AND SCATTERING/5/. THE SCATTERING
TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
RESONANCE INTEGRALS ARE AS FOLLOWS: |
| MF=1 GENERA
MT=451 DES
MF=2 RESONA
MT=151 RES
RESOLVED
REGION FR
THE RECOM
RESONANCE
CROSS SEC
RADIUS WAS
CROSS SEC
2:
ELASTIC
CAPTURE
TOTAL | L INFORMAT
CRIPTIVE D
NCE PARAME
OLVED RESC
PARAMETERS
OM 1.0E-5
MENDED DAT
TIONS FOR
S ASSUMED
TIONS AND
200 M/S CF
1.222
0.683
1.905 | TION
DATA AND DICTIONARY
ETERS
DNANCE PARAMETERS
S FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 300 KEV. PARAMETERS WERE TAKEN FROM
TA OF BNL/5/ AND THE DATA FOR A NEGATIVE
D SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CAPTURE AND SCATTERING/5/. THE SCATTERING
TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
RESONANCE INTEGRALS ARE AS FOLLOWS:
ROSS SECTION(B) RES. INTEGRAL(B)
0.3762 |
| MF=1 GENERA
MT=451 DES
MF=2 RESONA
MT=151 RES
RESOLVED
REGION FR
THE RECOM
RESONANCE
CROSS SEC
RADIUS WAS
CROSS SEC
22
ELASTIC
CAPTURE
TOTAL
MF=3 NEUTRO
BELOW 300
THE CROSS
RESOLVED | L INFORMAT
CRIPTIVE C
NCE PARAME
OUVED RESC
PARAMETERS
OM 1.0E-5
MENDED DATE
TIONS FOR
S ASSUMED
TIONS AND
200 M/S CF
1.222
0.683
1.905
N CROSS SE
KEV.ZERC
-SECTION C | TION
DATA AND DICTIONARY
TERS
DNANCE PARAMETERS
S FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 300 KEV. PARAMETERS WERE TAKEN FROM
TA OF BNL/5/ AND THE DATA FOR A NEGATIVE
ED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CAPTURE AND SCATTERING/5/. THE SCATTERING
TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
RESONANCE INTEGRALS ARE AS FOLLOWS:
ROSS SECTION(B) RES. INTEGRAL(B)
0.3762
ECTIONS
D BACKGROUND CROSS SECTION WAS GIVEN AND ALL
DATA ARE REPRODUCED FROM THE EVALUATED
PARAMETERS WITH MLBW FORMULA. |
| MF=1 GENERA
MT=451 DES
MF=2 RESONA
MT=151 RES
RESOLVED
REGION FR
THE RECOM
RESONANCE
CROSS SEC
RADIUS WA
CROSS SEC
22
ELASTIC
CAPTURE
TOTAL
MF=3 NEUTROI
BELOW 300
THE CROSS
RESOLVED
FOR JENDL
CAPTURE,
FUSION FII
/2/ BY AD
NEUTRON,
AND YOUNG
BECCHETTI
LEVEL DEN | L INFORMAT
CRIPTIVE E
NCE PARAME
OLVED RESC
PARAMETERS
OM 1.0E-5
MENDED DAT
WERE ADT
TIONS FOR
S ASSUMED
TIONS AND
200 M/S CF
1.222
0.683
1.905
N CROSS SE
KEV ZERC
-SECTION E
RESONANCE
-3.2, ALL
(N,P) AND
LE. THE
CN,P) AND
DPTING WAL
PEREY OMP
/7/ FOR AL
I-GREENLEE
SITY PARAM | TION
DATA AND DICTIONARY
ETERS
DNANCE PARAMETERS
S FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 300 KEV. PARAMETERS WERE TAKEN FROM
TA OF BNL/5/ AND THE DATA FOR A NEGATIVE
D SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CAPTURE AND SCATTERING/5/. THE SCATTERING
TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
RESONANCE INTEGRALS ARE AS FOLLOWS:
ROSS SECTION(B) RES. INTEGRAL(B)
0.3762
ECTIONS
D BACKGROUND CROSS SECTION WAS GIVEN AND ALL
DATA ARE REPRODUCED FROM THE EVALUATED
PARAMETERS WITH MLBW FORMULA.
CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
(N,A) CROSS SECTIONS WERE ADOPTED FROM JENDL
CALCULATION WAS MADE WITH SINCROS-II SYSTEM
TER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR
TER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR
ACTION, LEMOS OMP MODIFIED BY ARTHUR
PHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
S OMP/9/ FOR TRITON AND HE-3, AND STANDARD
METERS OF SINCROS-II SYSTEM. |
THIS SET OF OMP WAS USED ALSO FOR CALCULATION OF THE CAPTURE, $({\rm N},{\rm P})$, $({\rm N},{\rm A})$ CROSS SECTION AND ELASTIC ANG. DISTRIBUTIONS. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. T=4, 51-60, 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*', USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./11/ AND SPEAR/12/. NO. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) MT = 40.0 1.5246 1.8373 2.4236 2.7523 0 + 2 + 1 02 2 + 3 * 4 Δ 5 3.1893 6 3.2539 3.3000 3.3910 3.4464 67 4 Ó 8 ğ 3 1Õ 3.6530 LEVELS ABOVE 3.653 MEV WERE ASSUMED TO BE OVERLAPPING. T=16, 22, 28 (N,2N), (N,NA),(N,NP) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. MT = 16MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 12.6 MB AT 45 KEV/13/. MT=103, 107 (N,P), (N,A) CALCULATED WITH GNASH/14/. MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. IF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 MF = 4CALCULATED WITH THE CASTHY CODE/10/. MT=51-60 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY J DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB CALCULATED WITH THE CASTHY AND SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 22, 28, 91
TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB
SYSTEM. REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) MUGHABGHAB S.F. AND GARBER D.I. : "NEUTRON CROSS SECTIONS",
VOL. 1, PART B (1984).
6) PEREY, F.G.: PHYS. REV., 131, 745 (1963).
7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION
PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682
(1971). PHENOMENA IN NUCL. REACTIONS, C.1.1. (1971).
10) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
11) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
12) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
13) MUSGROVE A.R.DE L. ET AL.: NUCL. PHYS., A279, 317 (1977).
14) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

| MAT number =
20-CA- 43 [| EC EVAL-MAR87 M.HATCHYA(DATA ENG. CO.)
DIST-SEP89 REV2-NOV93 |
|--|---|
| HISTORY
87-03 NEW ENDATA | ALUATION WAS MADE TO GIVE A FULL REVISION FOR JENDL-2 |
| 93-11 JENDL-
DATA | ED BY I.ASAMI(NEDAC)
3.2
WERE MAINLY ADOPTED FROM JENDL FUSION FILE. |
| (3,2)
ALL AN
ALL EN | MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| JENDL | FUSION FILE /1/ (AS OF NOV. 1993)
EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. |
| - THE
DIS
CON
DWU
FRHE
SEC
- THE
SEC
- ENE
CON
THO
CON
THO
COPT | INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR
TRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
ITINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND
ICKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
M DIRECT REACTIONS.
(N,2N), (N,3N), (N,NA) AND (N,NP) REACTION CROSS
TIONS (MT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2
THE SINCROS-II.
IRGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
H THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE
ITINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
S /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
TO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM.
E RESONANCE PARAMETERS. TOTAL, CAPTURE, (N,P) AND (N,A)
DSS SECTIONS AND ANG. DISTRIBUTIONS OF ELASTICALLY
ITTERED NEUTRONS WERE TAKEN FROM JENDL-3.1.
TCAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
S SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. |
| MF=1 GENER/ | L INFORMATION |
| MT=431 DEC
MT=151 RES
RESOLVED
REGION FF
THE RECOM
RESONANCE
CROSS SEC
RADIUS WA
CROSS SEC | NCE PARAMETERS
SOLVED RESONANCE PARAMETERS
PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
OM 1.0E-5 EV TO 40 KEV. PARAMETERS WERE TAKEN FROM
IMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
E WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
TIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
S ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: |
| ELASTIC
CAPTURE
TOTAL | 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
4.160
11.66 5.798
15.82 |
| MF=3 NEUTRO
BELOW 40
THE CROSS
RESOLVED | N CROSS SECTIONS
KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
3-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESONANCE PARAMETERS WITH MLBW FORMULA. |
| FOR JENDI
CAPTURE,
FUSION FI
/2/ BY AU
NEUTRON,
AND YOUNO
BECCHETTI
LEVEL DEN | -3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
(N,P) AND (N,A) CROSS SECTIONS WERE ADOPTED FROM JENDL
LE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM
OPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR
PEREY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR
5/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
I-GREENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDARD
USITY PARAMETERS OF SINCROS-II SYSTEM. |
| MT=1 TOTAL
OPTICAL /
CASTHY CO
V = 2
WS = 7
R = 1
A = 0 | ND STATISTICAL MODEL CALCULATION WAS MADE WITH THE
DE/10/. THE OPTICAL POTENTIAL PARAMETERS USED ARE:
9.68, $VSO = 7.12$ (MEV)
7.76 - 0.5*EN, $WV = 0$ (MEV)
.17, $RS = 1.09$, $RSO = 1.17$ (FM)
0.6, $ASO = 0.6$, $B = 0.69$ (FM) |

| MT=2 ELASTIC SCATTERING
OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS
FROM THE TOTAL CROSS SECTION. | |
|--|-----|
| <pre>MT=4, 51-58, 91 INELASTIC SCATTERING
THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE
LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT
PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*' BY MEAN
OF DWUCKY.</pre> | S |
| NO. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS)
G.S. 0.0 7/2-
1 0.3728 5/2- *
2 0.5934 3/2- *
3 0.9903 3/2+ *
4 1.3946 5/2+ *
5 1.6778 11/2- *
6 1.9018 7/2+
7 1.9314 5/2-
8 1.9574 1/2+
LEVELS ABOVE 1.957 MEV WERE ASSUMED TO BE OVERLAPPING. DWUCK
CALCULATION WAS MADE FOR THE FOLLOWING LEVELS TOO, AND RESULT
WERE ADDED TO THE CONTINUUM INELASTIC SCATTERING CROSS SECTIO
(MT=91). | YSN |
| 2.0462 3/2-
2.2490 9/2-
2.4098 9/2+ | |
| MT=16, 17, 22, 28 (N,2N), (N,3N), (N,NA),(N,NP)
ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS
MADE WITH SINCROS-II. | |
| <pre>MT=102 CAPTURE
CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 22 MB
AT 45 KEV/11/.</pre> | |
| <pre>MT=103, 107 (N,P), (N,A)
CALCULATED WITH THE GNASH CODE/12/ USING THE OPTICAL MODEL
PARAMETERS LISTED IN MT=1.</pre> | |
| MT=251 MU-BAR
CALCULATED WITH THE OPTICAL MODEL. | |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2
CALCULATED WITH THE CASTHY CODE/10/. | |
| MT=51-58
TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY AND
DWUCKY IN THE SINCROS-II SYSTEM. | |
| TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB
SYSTEM. | |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 17, 22, 28, 91
TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB
SYSTEM. | |
| REFERENCES 1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 2) YAMAMURO, N.: JAERI-M 90-006 (1990). 3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). 4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. 5) MUGHABGHAB S.F. AND GARBER D.I. : "NEUTRON CROSS SECTIONS", VOL. 1, PART B (1984). 6) PEREY, F.G.: PHYS. REV., 131, 745 (1963). 7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). 8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974). 9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). | |
| 10) IGARASI S. : J. NUCL. SCI. TECH. 12, 67 (1975).
11) MUSGROVE A.R.DE L. ET AL.: NUCL. PHYS., A279, 317 (1977).
12) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977). | |

| MAT number = 2037
20-CA- 44 DEC EVAL-MAR87 M.HATCHYA(DATA ENG. CO.)
DIST-SEP89 REV2-NOV93 |
|---|
| HISIORY
87-03 NEW EVALUATION WAS MADE TO GIVE A FULL REVISION FOR JENDL-2
DATA |
| 87-03 ČÖMPILED BY T.ASAMI(NEDAC)
93-11 JENDL-3.2
 |
| COMPILED BY T.NAKAGAWA |
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| ÀĽĽ ÁNĞULAR DISTRIBUTIONS EXCEPT FOR (4,2).
ALL ENERGY DISTRIBUTIONS. |
| JENDL FUSION FILE /1/ (AS OF NOV. 1993)
EVALUATED BY K.KOŠAKO (NEDAC) AND S.CHIBA (NDC/JAERI)
COMPILED BY K.KOŠAKO. |
| THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR
DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND
DWUCKY IN SINCROS-III SYSTEM/2/ INCLUDING CONTRIBUTIONS |
| - THE (N,2N), (N,3N), (N,NA) AND (N,NP) REACTION CROSS
SECTIONS (MT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2 |
| IN THE SINCROS-IL. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED WITH THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE
CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA - |
| RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM.
- THE RESONANCE PARAMETERS, TOTAL, CAPTURE, (N,P) AND (N,A)
- CROSS SECTIONS AND ANG DISTRIBUTIONS OF ELASTICALLY |
| SCATTERED NEUTRONS WERE TAKEN FROM JENDL-3.1.
- OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
THE SINCROS-LL CALCULATION ARE DESCRIBED IN REF /2/ |
| |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FEMIL. CALCULATED 2200 M/SEC |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES INTEGRAL(B) |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.320
CAPTURE 0.888 0.4254
TOTAL 4.208 |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.320
CAPTURE 0.888 0.4254
TOTAL 4.208
MF=3 NEUTRON CROSS SECTIONS
BELOW 500 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA. |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.320
CAPTURE 0.888 0.4254
TOTAL 4.208
MF=3 NEUTRON CROSS SECTIONS
BELOW 500 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE, (N,P) AND (N,A) CROSS SECTIONS WERE ADOPTED FROM JENDL
FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-11 SYSTEM
(200 FILE DESCRIPTION WAS MADE WITH SINCROS-11 SYSTEM |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.320
CAPTURE 0.888 0.4254
TOTAL 4.208
MF=3 NEUTRON CROSS SECTIONS
BELOW 500 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE, N,P) AND (N, A) CROSS SECTIONS WERE ADOPTED FROM JENDL
FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM
/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR
NEUTRON, PEREY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR
AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
BECCHETTII-GREENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDARD
IEVENTON FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
BECCHETTII-GREENLEES OF SINCROS OF MODIFIED BY YAMADARD |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING'5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.320
CAPTURE 0.888 0.4254
TOTAL 4.208
MF=3 NEUTRON CROSS SECTIONS
BELOW 500 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE, (N.P.) AND (N.A) CROSS SECTIONS WERE ADOPTED FROM JENDL
FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-11 SYSTEM
/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR
NEUTRON, PEREY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR
AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
BECCHETTII-GREENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDARD
LEVEL DENSITY PARAMETERS OF SINCROS-11 SYSTEM.
MT=1 TOTAL
MT=1 TOTAL |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/.
MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
TE151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 500 KEV. PARAMETERS WERE TAKEN FROM
THE RECOMMENDED DATA OF BNL/5/ AND THE DATA FOR A NEGATIVE
RESONANCE WERE ADDED SO AS TO REPRODUCE THE RECOMMENDED THERMAL
CROSS SECTIONS FOR CAPTURE AND SCATTERING/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 3.6 FERMI. CALCULATED 2200 M/SEC
CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.320
CAPTURE 0.888 0.4254
TOTAL 4.208
MF=3 NEUTRON CROSS SECTIONS
BELOW 500 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE, (N,P) AND (N,A) CROSS SECTIONS WERE ADOPTED FROM JENDL
FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM
/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMR0/2/ FOR
NEUTRON, PEREY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR
AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
BECCHETTII-GREENLESS OMF MODIFIED BY YAMAMR0/2/ FOR
NEUTRON, PEREY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR
AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON,
BECCHETTI-GREENLESS OF SINCROS-II SYSTEM.
MT=1 TOTAL
OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH THE
CASTHY CODE/10/. THE OPTICAL POTENTIAL PARAMETERS USED ARE:
VS = 49.68, VSO = 7.12 (MEV) |

MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. F=4, 51-59, 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*' BY MEANS OF DWUCKY. DEFORMATION PARAMETERS WERE ADOPTED FROM RAMAN ET AL./11/ AND SPEAR/12/. MT = 4NO. SPIN-PARITY (DIRECT PROCESS) ENERGY(MEV) 0.0 1.157 1.8835 2.2831 2.6565 0 + 2 + 1 ō 2 + 3 4 2 + * 4 4 2.0305 2 + 5 3.0443 4 + * 6 3.2849 5 + 7 3.3013 2 + 8 3.3079 3 - * 9 3.3572 2 + LEVELS ABOVE 3.357 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16, 17, 22, 28 (N,2N), (N,3N), (N,NA), (N,NP) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE (N,NP) CROSS SECTION WAS NORMALIZED TO THE EXPERIMENTAL DATA OF IKEDA ET AL./13/ MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 7.1 MB AT 45 KEV/14/. MT=103, 107 (N,P), (N,A) CALCULATED WITH THE GNASH CODE/15/ USING THE SAME OPTICAL MODEL PARAMETERS AS THE TOTAL CROSS SECTION. =251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. MT = 251MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2CALCULATED WITH THE CASTHY CODE/10/. MT=51-58 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY / DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB CALCULATED WITH THE CASTHY AND SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB SYSTEM. REFERENCES REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
MUGHABGHAB S.F. AND GARBER D.I. : "NEUTRON CROSS SECTIONS", VOL. 1, PART B (1984).
PEREY, F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). (1971)(1971).
10) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
11) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987).
12) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
13) IKEDA Y. ET AL.: JAERI 1312 (1988).
14) MUSGROVE A.R.DE L. ET AL.: NUCL. PHYS., A279, 317 (1977).
15) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

| DISI-FED04 REVZ-NUV95 |
|--|
| HISTORY
80-04 NEW EVALUATION WAS MADE BY M.HATCHYA (MITSUI).
83-11 ANG. DIST. WAS MODIFIED.
84-02 COMMENT WAS ADDED.
88-10 UNCHANGED FROM JENDL-2.
93-11 JENDL-3.2 |
| DATA WERE MAINLY ADOPTED FROM JENDL FUSION FILE.
COMPILED BY T.NAKAGAWA |
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| JENDL FUSION FILE /1/ (AS OF NOV. 1993)
EVALUATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. |
| THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR
DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND
DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
FROM DIRECT REACTIONS. THE (N,2N), (N,3N), (N,NA) AND (N,NP) REACTION CROSS
SECTIONS (MT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2
IN THE SINCROS-II. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
WITH THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE |
| CÓNTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM.
- THE TOTAL, CAPTURE, (N,P) AND (N,A) CROSS SECTIONS AND
ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS WERE
TAKEN FROM JENDL-3.1.
- OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDE/4/ |
| ME-1 GENERAL INFORMATION |
| MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 NO RESONANCE PARAMETERS |
| MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 NO RESONANCE PARAMETERS
2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS
2200-M/SEC RES.INTEG.
ELASTIC 2.900 B -
CAPTURE 0.7400 B 0.339 B
TOTAL 3.640 B - |
| <pre>MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS 2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS 2200-M/SEC RES.INTEG. ELASTIC 2.900 B - CAPTURE 0.7400 B 0.339 B TOTAL 3.640 B - MF=3 NEUTRON CROSS SECTIONS THERMAL REGION WAS ASSUMED BELOW 1.0 KEV. THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE 0.74 BARNS /5/ AND 2.9 BARNS AT 0.0253 EV, RESPECTIVELY. THE TOTAL CROSS SECTION WAS CALCULATED AS A SUM OF THESE TWO.</pre> |
| <pre>MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 NO RESONANCE PARAMETERS
2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS
2200-M/SEC RES.INTEG.
ELASTIC 2.900 B -
CAPTURE 0.7400 B 0.339 B
TOTAL 3.640 B -
MF=3 NEUTRON CROSS SECTIONS
THERMAL REGION WAS ASSUMED BELOW 1.0 KEV. THE CAPTURE AND
ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE 0.74 BARNS
/5/ AND 2.9 BARNS AT 0.0253 EV, RESPECTIVELY. THE TOTAL CROSS
SECTION WAS CALCULATED AS A SUM OF THESE TWO.
FOR JENDL-3.2, ABOVE 1 KEV, ALL CROSS-SECTION DATA EXCEPT FOR
THE TOTAL, CAPTURE, (N,P) AND (N,A) CROSS SECTIONS WERE ADOPTED
FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH
SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY
YAMAMURO/2/ FOR NEUTRON, PEREY OMP /67 FOR PROTON, LEMOS OMP
MODIFIED BY ARTHUR AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/
FOR DEUTERON, BECCHETTII-GREENLEES OMP/9/ FOR TRITON AND HE-3,
AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.</pre> |
| <pre>MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS 2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS 2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS 2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS 2200-M/SEC CROSS SECTIONS FORAL REGION WAS ASSUMED BELOW 1.0 KEV. THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE 0.74 BARNS 75/ AND 2.9 BARNS AT 0.0253 EV, RESPECTIVELY. THE TOTAL CROSS SECTION WAS CALCULATED AS A SUM OF THESE TWO. FOR JENDL-3.2, ABOVE 1 KEV, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL, CAPTURE, (N,P) AND (N,A) CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PERFY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. MT=1 TOTAL CROSS SECTION THE OPTICAL MODEL CALCULATION WITH CASTHY /10/ WAS ADOPTED. </pre> |

| <pre>MT=2 ELASTIC SCATTERING CROSS SECTION
DERIVED BY SUBTRACTING PARTIAL CROSS SECTIONS FROM THE TOTAL
CROSS SECTION.</pre> |
|--|
| MT=4,51-53.91 INELASTIC SCATTERING CROSS SECTIONS
THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE
LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE
DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'
BY MEANS OF DWUCKY. DEFORMATION PARAMETERS WERE ADOPTED FROM
RAMAN ET AL./12/ AND SPEAR/13/. |
| NO. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS)
0.0 0 + *
1 1.346 2 + *
2 2.4231 0 +
3 2.5747 4 +
4 2.9739 6 +
5 3.0226 2 + *
6 3.6140 3 - *
7 3.6389 2 +
8 3.8597 4 +
LEVELS ABOVE 3.86 MEV WERE ASSUMED TO BE OVERLAPPING. |
| MT=16, 17, 22, 28 (N,2N), (N,3N), (N,NA),(N,NP)
ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS
MADE WITH SINCROS-II. |
| MT=102 CAPTURE CROSS SECTION
CALCULATED WITH CASTHY /10/. |
| <pre>MT=103.107 (N,P) AND (N,ALPHA) CROSS SECTIONS
STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS USING THE
OPTICAL POTENTIAL PARAMETERS FOR THE TOTAL CROSS SECTION.</pre> |
| MT=251 MU-BAR
CALCULATED WITH OPTICAL MODEL. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 OPTICAL MODEL CALCULATION MT=51-58 |
| <pre>MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB SYSTEM.</pre> |
| REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) MUGHABGHAB S.F. ET AL.: NEUTRON CROSS SECTIONS, VOL. 1, PART A
(1981). |
| 6) PEREY, F.G.: PHYS. REV., 131, 745 (1963). 7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). 8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974). 9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971) |
| 10) IĞARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
11) FU C.Y.: ATOMIC DATA AND NUCLEAR DATA TABLE 17, 127 (1976).
12) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1
(1987)
13) SPEAD R.H.: ATOM. DATA AND NUCL. DATA TABLE 42, 55 (1980) |
| IS/ SFEAR, K.H AIUM. DATA AND NUGL. DATA TABLE, 42, 33 (1989). |

| ļ | MAT numbe
20-CA- 4 | er = 20
18 dec | 49 | EVAL- | MAR87 | M.HAT | ГСНҮА(| DATA | ENG. | CO.) | |
|---|---------------------------------------|---|---|-------------------------------------|--------------------------------|----------------------------|----------------------------|------------------------|------------------------------|-----------------------------|---------------------------|
| | HISTORY
87-03 NEV | V_EVALU | ATION \ | VAS MA | DE TO | GIVE | A FUL | L RE | /15101 | I FOR . | JENDL-2 |
| | 87-03 CON
93-11 JEN | MPILED | BY T.AS | SAMI(N | EDAC) | | | | | - | |
| | COM | ATA WER
IPILED | E MAINI
BY T.N/ | AKAGAW | A
A | FROM | JENDL | FUSIC | ON FIL | .E. | |
| | (3, | ** MO
1), (3
103). | DIFIED
,2), (3 | PARTS
3,4), | FOR
(3,16 | JENDL·
), (3 | -3.2
,17), | (3,28 | 3), (3 | 3,51-9 ⁻ | 1), |
| | ALL
ALL | (3,2
_ ANGUL
_ ENERG
_ ENERG | 2), (3
AR DIS
Y DISTI
***** | : 53 - 58
TR I BUT
R I BUT I |): DE
10NS
0NS.
***** | LETED
EXCEPT | F FOR | (4,2) |). | * * * * * * * | * * * * * * |
| | JEN | NDL FUS
EVA
COM | ION FII
LUATED
PILED | _E /1/
BY K.
BY K. | (AS
KOSAK
KOSAK | OF N(
0 (NE[
0. | DV. 19
DAC) A | 93)
ND S | . CH I B <i>i</i> | A (NDC) | /JAERI) |
| | - | THE IN
DISTRI
CONTIN | ELASTIONS
BUTIONS | C SCAT
5 OF I
Elasti | TERIN
NELAS
C) WE | G CROS
TICALI
RE CAI | SS SEC
_Y SCA
_CULAT | TIONS
TTERE | S AND
ED NEL | ANGULA
JTRONS | AR
(EXCEPT
Y AND |
| | - | DWUCKY
FROM D
THE (N | IN SIN
IRECT N
, 2N), | NCROS-
REACTI
(N,3N) | IÍ SY
ONS.
AND | STEM/2 | 2/ INC
)_REAC | LUDIN | IG CON | NTRIBU
S.S <u>ect</u> i | TIONS
IONS |
| | - | SINCRO
ENERGY
WITH T | Ś-II.
DISTR | 28) WE
IBUTIO
ALCULA | NS OF | SECON | NDARY | NEUTE | RONS V | VERE RE | EPLACED |
| | | CONTIN
TICS /
RATIO | UUM NEU
3/ USII
WAS CAI | JTRONS
NG F15
CULAT | WERE
TOB /
FD BY | CALCU
1/.
THE S | JLATĖD
THE PR
SINCRO | BY H
ECOMF | CODE | COMPOL | ŚTEMA-
JND |
| | - | THE RE
CROSS
SCATTE | SONANCI
SECTION
RED NEU | E PARA
NS AND
JTRONS | METER
ANG.
WFRF | S, TOT
DISTE
TAKEN | TÁL, Č
RIBÚTI
N FROM | APTUR
ONS (| RĚ, (N
)F ELA
)I - 3 1 | N,P) ĀN
ASTICAL | ND (N,A)
LLY |
| | - | ÖPTICA
THE SI
LEVEL | L-MODEI
NCROS-
SCHEMES | II CAL
S WERE | EL DE
CULAT
DETE | NSITY
ION AF
RMINE[| AND O
RE DES
D ON T | CRIBE
HE BA | PARAN
D IN
Asis (| NÉTERS
REF./2
DF ENSI | USED IN
2/.
DF/4/. |
| | MF=1_GEN | NERALI | NFORMA | TION . | | 0 | | | | | |
| ļ | MT=451
MF=2RES | SONANCE | | ETERS | | | AKY | | | | |
| | MI=151
RESOL\
REGION | RESOLV
/ED PAR
N FROM | ED RESO
AMETERS
1.0E-5 | DNANCE
S FOR
EV TO | PARA
MLBW
500 | METERS
FORMUL
KEV. | S
_A WER
_PARAM | E GIV | /EN IN
S WERE | N THE E | ENERGY
N FROM |
| | THE RE
RESONA
CROSS | SECTIO | DED DA
RE ADDI
NS FOR | IA OF
ED SO
CAPTU | BNL/5
AS TO
RE AN | / AND
REPRO
D_SCAT | THE D
DDUCE
TTERIN | AIA H
THE F
G/5/ | COR A | NEGAT
MENDED
SCAT | THERMAL |
| | RADIUS
CROSS | S WAS A
SECTIO | SSUMED
NS AND | TO BE
RESON | 3.6
ANCE | FERMI | . CAL
RALS A | RE AS | FED 22
S FOLL | 200 M/S
LOWS: | SEC |
| | ELASTI
CAPTUF
TOTAL | 2200
I C
RE | M/S CF
3.717
1.092
4.809 | ROSS S | ECTIO | N(B) | RE | S. IN
0.48 | NTEGR <i>4</i>
359 | AL(B) | |
| l | MF=3 NEU
BELOW
THE CF
RESOLV | JTRON C
500 KE
ROSS-SE
/ED RES | ROSS SE
V, ZERO
CTION E
ONANCE | ECTION
D BACK
DATA A
PARAM | S
GROUN
RE RE
ETERS | D CROS
PRODUC
WITH | SS SEC
CED FR
MLBW | TION
OM TH
FORMU | WAS (
HE EVA | GIVEN ALUATED | AND ALL
D |
| | FOR JE
Captur | ENDL-3.
RE, (N, | 2, ALL
P) AND | CROSS
(N,A) | -SECT
CROS | ION DA
S SECT | ATA EX
FIONS | CEPT | FOR 1
ADOP1 | THE TO
TED FRO | TAL,
DM JENDL |
| | FUSIÓN
/2/ BY
NEUTRO | N FILE.
(ADOPT
)N, PER | THE (
ING WAI
EY OMP | CÀLĆUĹ
_TER-G
/6/ F | ATIÓN
USS O
OR PR | WAS N
MP MOD
OTON. | MADE W
DIFIED
LEMOS | BY
OMP | SINCRO
AMAMU
MODIF |)S-II
JRO/2/
FIED BY | SYSTEM
FOR
Y ARTHUR |
| | AND YO
BECCHE
LEVEL | DUŃG/7/
ETTII-G
DENSIT | FOR AI
REENLER
Y PARAN | PHA,
ES OMP
METERS | LOHR-
/9/ F
OF S | HAEBÉF
OR TR
INCROS | RLI ÖM
ITON A
S-II S | P/8/
ND HE
YSTEN | FOR [
-3, /
1. | DEUTER
AND STA | ON,
ANDARD |
| | MT=1 TOT
OPTICA | TAL
Al and | STATIS | TICAL | MODEL | CALCI | JLATIO | N WAS | S_MADE | E.WITH | THE |

R = 1.17, RS = 1.09, RSO = 1.17 (FM) A = 0.6, ASO = 0.6, B = 0.69 (FM) THE SHAPE OF THE TOTAL CROSS SECTION WAS SLIGHTLY MODIFIED FOR JENDL-3.2. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4, 51-52, 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*' BY MEANS OF DWUCKY. DEFORMATION PARAMETERS WERE ADOPTED FROM RAMAN ET AL./11/ AND SPEAR/12/. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) NO. 0 + 2 + 0.0 3.8317 1 3.8317 2 + 2 4.2842 0 + LEVELS ABOVE 4.284 MEV WERE ASSUMED TO BE OVERLAPPING. THE LEVELS FOR MTS=53 TO 58 GIVEN IN JENDL-3.1 WERE NOT CONSIDERED IN JENDL FUSION FILE. THE DIRECT INELSTIC CROSS SECTION TO THE LEVELS AT 4.507 MEV WAS CALCULATED WITH DWUCKY AND ADDED TO THE CONTINUUM INELASTIC CROSS SECTION (MT=91). MT=16, 17, 28 (N,2N), (N,3N), (N,NP) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE (N,2N) CROSS SECTION WAS NORMALIZED TO THE EXPERIMENTAL DATA OF IKEDA ET AL./13/ (0.759 B AT 13.99 MEV) MT=103, 107 (N,P), (N,A) CALCULATED WITH THE GNASH CODE/14/ USING THE OPTICAL MODEL PARAMETERS LISTED AT MT=1. THE (N,P) CROSS SECTIONS WERE NORMALIZED TO THE EXPERIMENTAL DATA OF TIWARI ET AL./15/ AT 14.5 MEV. THE SHAPE OF (N,P) CROSS SECTION AROUND THE THRESHOLD ENERGY WAS CHANGED FOR JENDL-3.2. MT = 102CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 1.05 MB AT 30 KEV/16/. =251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. MT=251 MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2CALCULATED WITH THE CASTHY CODE/10/. MT=51-52 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY , DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 17, 28, 91 TAKEN FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB SYSTEM. CALCULATED WITH THE CASTHY AND IF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 28, 91 TAKEN_FROM JENDL FUSION FILE, AND TRANSFORMED INTO THE LAB SYSTEM. REFERENCES FERENCES) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).) YAMAMURO, N.: JAERI-M 90-006 (1990).) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.) MUGHABGHAB S.F. AND GARBER D.I. :"NEUTRON CROSS SECTIONS", VOL. 1, PART B (1984).) PEREY, F.G.: PHYS. REV., 131, 745 (1963).) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). 1) 3 5) 6) 8) 9) (1971) IGARAŠI S. AND FUKAHORI T.: JAERI 1321 (1991). RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 10) ÌĞÁRÁ 11) RAMAN RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TADL (1987) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, IKEDA Y. ET AL.: JAERI 1312 (1988). YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977). TIWARI P.N. ET AL. : PHYS. REV. 167, 1091 (1968). DATA TABLE, 42, 55 (1989). 12) 13) 14)

16) CARTON R.F. ET AL.: NUCL. PHYS., A465, 274 (1987).

MAT number = 2125 21-SC- 45 KHI EVAL-AUG88 T.WATANABE DIST-SEP89 REV2-SEP93 HISTORY 88-08 JENDL-2 MODIFIED BY T.WATANABE (KAWASAKI HEAVY INDUSTRIES, LTD.) 93-09 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) * (2,151) PARAMETERS OF 3.295-KEV RESONANCE (3,2), (3,102) GENERAL INFORMATION 1 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 MF=2 MT=151 1 RESONANCE PARAMETERS : 1.0E-5 EV - 100 KEV RESOLVED RESONANCES FOR MLBW FORMULA: PARAMETERS WERE EVALUATED BASED ON EXPERIMENTAL DATA /1/,/2/,/3/ AND MODIFIED TO REPRODUCE EXPERIMENTAL TOTAL CROSS SECTIONS. NEGATIVE ENERGY LEVELS WERE ADDED TO REPRODUCE THE TOTAL AND CAPTURE CROSS SECTIONS/4/ AT THERMAL AND THE TOTAL CROSS SECTION /5/ AT 2 KEV. FOR JENDL-3.2, CAPTURE WIDTH OF 3.295-KEV RESONANCE WAS CHANGED TO 0.71 EV/4/. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/SEC RES. INTEG. ELASTIC 22.48 B -CAPTURE 27.14 B 11.85 B TOTAL 49.62 B -MF=3 NEUTRON CROSS SECTIONS MT=1,2,4,51-74,91,102 TOTAL ELASTIC, INELASTIC AND CAPTURE CALCULATED WITH OPTICAL AND STATISTICAL MODEL. DIRECT INELASTIC REACTION CROSS SECTIONS WERE EVALUATED WITH DWBA /6/ AND ADDED TO COMPOUND PROCESSES. STATISTICAL MODEL CALCULATION WITH CASTHY CODE /7/ WAS PERFORMED. MT=102 CAPTURE CROSS SECTION WAS NORMALIZED TO THE EXPERIMENTAL DATA OF VOIGNIER+/8/, 11.2 MB AT 500 KEV. DIRECT CAPTURE CROSS SECTION WAS CALCULATED FROM A SIMPLE FORMULA OF BENZI AND REFF0/9/ AND NORMALIZED TO 1.0 MB AT 14.0 MEV. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS WERE EVALUATED TO REPRODUCE TOTAL EXPERIMENTAL CROSS SECTIONS /10,11,12/. V = 56.2 - 0.3244*EN MEV RO= 1.155 FM AO= 0.666 FM WS= 8.638-0.003093*EN MEV RS= 1.473 FM B = 0.262 FM VSO=5.254 MEV RSO=1.003 FM ASO=0.485 FM THE LEVEL SCHEME TAKEN FROM REF./13/: NO. ENERGY(MEV) SPIN-PARITY BETA ENERGY (ME 0.0 0.12396 0.37659 0.543 0.72017 0.9392 0.97461 1.0672 1.23723 1.30342 SPIN-r 7/2-3/2+ 3/2-5/2-1/2+ 7/2+ 3/2-11/2-3/2+ G.S 1 2 0.108 345678 0.0867 0.0211 0.0586 9 10 3/2+ 7/2-1.30342 1.40887 1.43367 1.5564 1.66231 1.8004 9/2+ 3/2-9/2-11 12 13 0.0843 5/2+14 CONTINUUM LEVELS ASSUMED ABOVE 1.9 MEV LEVEL DENSITY PARAMETERS WERE EVALUATED USING DO/4/, AND LEVEL DATA /13/. EX 10.08 7.328 SIG**2(0) A 7.855 7.231 Т 21-SC-45 21-SC-46 1.282 7.602 1.268 MT=16 (N,2N) THE JENDL-2 DATA WERE MODIFIED BY USING EXPERIMENTAL DATA /14/. MT=103 (N,P)

TAKEN FROM COMPILATION BY ALLEY AND LESSLER /15/ MT=107 (N,ALPHA) SAME AS MT=103, BUT SLIGHTLY MODIFIED TO REPRODUCE EXPERIMENTAL DATA/14/. MT=251 MU-BAR CALCULATED FROM THE DATA IN MF=4. =4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH OPTICAL MODEL. MT=51-91 CALCULATED WITH HAUSER-FESHBACH FORMULA ADDED WITH MF = 4DIRECT REACTION. ISOTROPIC IN THE LABORATORY SYSTEM MT = 16MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS CALCULATED WITH SINCROS /16/. REFERENCES

LIOU, H.I. ET AL.: NUCL. SCI. ENG. 67, 326 (1978).
KENNY, M.J. ET AL.: AUSTRALIAN J. PHYS. 30, 605 (1977).
ALLEN, B.J. ET AL.: NUCL. SCI. ENG. 82, 230 (1982).
MUGHABGHAB, S.F., ET AL.: 'NEUTRON CROSS SECTIONS VOL.1 PART A' ACADEMIC PRESS (1981)
FUJITA, Y: J. NUCL. SCI. TECHNOL. 20, 191 (1983).
KUNZ, P.D.: UNPUBLISHED (1974).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
VOIGNIER, J, ET AL.: NUCL. SCI. ENG.)3, 43 (1986). DATA WERE TAKEN FROM EXFOR
BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
POENITZ, W.P. AND WHALEN, J.F.: ANL/NDM-80 (1983).
BARNARD, E. ET AL.: Z. PHYS. 245, 36 (1971).
FOSTER, JR. D.G. AND GLASGOW D.W.: PHYS. REV. C3, 576 (1971).
BURROWS, T.W.: NUCLEAR DATA SHEETS 40, 216 (1983).
IKEDA, Y., ET AL.: JAERI 1312 (1988).

ALLEY, W.E. AND LESSLER, R.M: NUCLEAR DATA TABLES A11,648 (1973).
YAMAMURO, N.: JAERI-M 88-140 (1988).

| MAT number = 2200
22-TI- 0 KUR | EVAL-SEP88 K.KOBAYASHI(KUR),H.HASHIKURA(TOK)
DIST-SEP89 REV2-FEB94 |
|--|---|
| 88-09 COMPILED BY T.AS | AMI(NEDAC) |
| 94-02 JENDL-3.2
DATA WERE MAINLY
GAMMA-RAY PRODUC
COMPILED BY T.NA | ADOPTED FROM JENDL FUSION FILE.
TION DATA WERE REVISED BY T.ASAMI(DATA ENG.)
KAGAWA |
| ***** MODIFIED
ALL CROSS SECTIO
ALL ANGULAR DIST
ALL ENERGY DISTR
(12.102)(13.4). | PARTS FOR JENDL-3.2 ************************************ |
| JENDL FUSION FIL
EVALUATED
COMPILED | E /1/ (AS OF FEB. 1994)
BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
BY K.KOSAKO. |
| - THE INELASTIC
DISTRIBUTIONS
CONTINUUM INE
DWUCKY IN SIN
FROM DIRECT R
THE (N,2N), (
SECTIONS (MT=
IN THE SINCRO
- ENERGY DISTRI
BY THOSE CALC
CONTINUUM NEU
TICS /3/ USIN
RATIO WAS CAL
- THE RESONANCE
SECTIONS AND
NEUTRONS WERE
- OPTICAL-MODEL
THE SINCROS-I | SCATTERING CROSS SECTIONS AND ANGULAR
OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
LASTIC) WERE CALCULATED WITH CASTHY2Y AND
CROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
EACTIONS.
N,NA), (N,NP) AND (N,P) REACTION CROSS
16, 22, 28, 103) WERE CALCULATED BY EGNASH2
S-II.
BUTIONS OF SECONDARY NEUTRONS WERE REPLACED
ULATED BY EGNASH2. THE DDX'S OF THE
TRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
G F15TOB /1/. THE PRECOMPOUND/COMPOUND
CULATED BY THE SINCROS-II CODE SYSTEM.
PARAMETERS, TOTAL, CAPTURE AND (N,A) CROSS
ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED
TAKEN FROM JENDL-3.1.
LEVEL DENSITY AND OTHER PARAMETERS USED IN
I CALCULATION ARE DESCRIBED IN REF./2/.
WERE CALCULATED ON THE BASIS OF ENSDF/4/. |
| | |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D | ION
ATA AND DICTIONARY |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D
MF=2 RESONANCE PARAME
MT=151 RESOLVED RESO
RESOLVED PARAMETERS
REGION FROM 1.0E-5
WITH THE EVALUATED
STABLE ISOTOPES, CO
ELEMENT. THE ABUNDA | ION
ATA AND DICTIONARY
TERS
NANCE PARAMETERS
FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 100 KEV. PARAMETERS WERE CONSTRUCTED
DATA FOR TI-46, -47, -48, -49 AND -50 OF TI
NSIDERING THEIR ABUNDANCES IN THE TI
NCE DATA WERE TAKEN FROM REF./5/. |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D
MF=2 RESONANCE PARAME
MT=151 RESOLVED RESO
RESOLVED PARAMETERS
REGION FROM 1.0E-5
WITH THE EVALUATED
STABLE ISOTOPES, CO
ELEMENT. THE ABUNDA
2200 M/S CI
ELASTIC
CAPTURE
TOTAL | ION
ATA AND DICTIONARY
TERS
NANCE PARAMETERS
FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 100 KEV. PARAMETERS WERE CONSTRUCTED
DATA FOR TI-46, -47, -48, -49 AND -50 OF TI
NSIDERING THEIR ABUNDANCES IN THE TI
NCE DATA WERE TAKEN FROM REF./5/.
ROSS SECTION(B) RES. INTEGRAL(B)
4.087
6.092 2.92
10.18 |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D
MF=2 RESONANCE PARAME
MT=151 RESOLVED RESO
REGION FROM 1.0E-5
WITH THE EVALUATED
STABLE ISOTOPES, CO
ELEMENT. THE ABUNDA
2200 M/S C
ELASTIC
CAPTURE
TOTAL
MF=3 NEUTRON CROSS SE
BELOW 100 KEV, NO B | ION
ATA AND DICTIONARY
TERS
NANCE PARAMETERS
FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 100 KEV. PARAMETERS WERE CONSTRUCTED
DATA FOR TI-46, -47, -48, -49 AND -50 OF TI
NSIDERING THEIR ABUNDANCES IN THE TI
NCE DATA WERE TAKEN FROM REF./5/.
ROSS SECTION(B) RES. INTEGRAL(B)
4.087
6.092 2.92
10.18
CTIONS
ACKGROUND CROSS SECTION WAS GIVEN. |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D
MF=2 RESONANCE PARAME
MT=151 RESOLVED RESO
REGION FROM 1.0E-5
WITH THE EVALUATED
STABLE ISOTOPES, CO
ELEMENT. THE ABUNDA
2200 M/S CI
ELASTIC
CAPTURE
TOTAL
MF=3 NEUTRON CROSS SEC
BELOW 100 KEV, NO B
ALL THE CROSS-SECTIO
FOR FIVE STABLE ISO
THE TI ELEMENT, EXCL
ENERGY RANGE ABOVE | ION
ATA AND DICTIONARY
TERS
NANCE PARAMETERS
FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 100 KEV. PARAMETERS WERE CONSTRUCTED
DATA FOR TI-46, -47, -48, -49 AND -50 OF TI
NSIDERING THEIR ABUNDANCES IN THE TI
NCE DATA WERE TAKEN FROM REF./5/.
ROSS SECTION(B) RES. INTEGRAL(B)
4.087
6.092 2.92
10.18
CTIONS
ACKGROUND CROSS SECTION WAS GIVEN.
ON DATA WERE DEDUCED FROM THE EVALUATED ONES
TOPES OF TI CONSIDERING THEIR ABUNDANCES IN
EPT FOR THE TOTAL CROSS SECTONS IN THE
100 KEV. |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D
MF=2 RESONANCE PARAME
MT=151 RESOLVED RESOL
RESOLVED PARAMETERS
REGION FROM 1.0E-5
WITH THE EVALUATED
STABLE ISOTOPES, COL
ELEMENT. THE ABUNDAL
2200 M/S CL
ELASTIC
CAPTURE
TOTAL
MF=3 NEUTRON CROSS SEM
BELOW 100 KEV, NO B
ALL THE CROSS-SECTION
FOR FIVE STABLE ISON
THE TI ELEMENT, EXCL
ENERGY RANGE ABOVE
MT=1 TOTAL
THE DATA AT THE ENEL
THE EXPERIMENTAL ON
THE MEASURED CROSS
WERE CONSTRUCTED FROM
TI. | ION
ATA AND DICTIONARY
TERS
NANCE PARAMETERS
FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 100 KEV. PARAMETERS WERE CONSTRUCTED
DATA FOR TI-46, -47, -48, -49 AND -50 OF TI
NSIDERING THEIR ABUNDANCES IN THE TI
NCE DATA WERE TAKEN FROM REF./5/.
ROSS SECTION(B) RES. INTEGRAL(B)
4.087
6.092 2.92
10.18
CTIONS
ACKGROUND CROSS SECTION WAS GIVEN.
ON DATA WERE DEDUCED FROM THE EVALUATED ONES
TOPES OF TI CONSIDERING THEIR ABUNDANCES IN
EPT FOR THE TOTAL CROSS SECTONS IN THE
100 KEV.
RGIES ABOVE 100 KEV WERE EVALUATED BASED ON
ES/6,7,8/, FOLLOWING FINE STRUCTURES IN
SECTIONS. |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D
MF=2 RESONANCE PARAMET
MT=151 RESOLVED RESOL
RESOLVED PARAMETERS
REGION FROM 1.0E-5
WITH THE EVALUATED
STABLE ISOTOPES, COL
ELEMENT. THE ABUNDAL
2200 M/S CL
ELASTIC
CAPTURE
TOTAL
MF=3 NEUTRON CROSS SEC
BELOW 100 KEV, NO B
ALL THE CROSS-SECTION
FOR FIVE STABLE ISON
THE TI ELEMENT, EXCL
ENERGY RANGE ABOVE
MT=1 TOTAL
THE DATA AT THE ENEL
THE EXPERIMENTAL ON
THE MEASURED CROSS
WERE CONSTRUCTED FROM
TI.
MT=2 ELASTIC SCATTERINE
OBTAINED BY SUBTRAC
FROM THE TOTAL CROSS | ION
ATA AND DICTIONARY
TERS
NANCE PARAMETERS
FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
EV TO 100 KEV. PARAMETERS WERE CONSTRUCTED
DATA FOR TI-46, -47, -48, -49 AND -50 OF TI
NSIDERING THEIR ABUNDANCES IN THE TI
NCE DATA WERE TAKEN FROM REF./5/.
ROSS SECTION(B) RES. INTEGRAL(B)
4.087
6.092 2.92
10.18
CTIONS
ACKGROUND CROSS SECTION WAS GIVEN.
ON DATA WERE DEDUCED FROM THE EVALUATED ONES
TOPES OF TI CONSIDERING THEIR ABUNDANCES IN
EPT FOR THE TOTAL CROSS SECTONS IN THE
100 KEV.
RGIES ABOVE 100 KEV WERE EVALUATED BASED ON
ES/6,7,8/, FOLLOWING FINE STRUCTURES IN
SECTIONS. THE DATA IN THE OTHER ENERGY RANGE
OM THE EVALUATED ONES FOR FIVE ISOTOPES OF
NG
TING THE SUM OF THE PARTIAL CROSS SECTIONS
S SECTION. |

| MT | LEVEL | ENERGY(MEV) | TI-46 | TI-47 | TI-48 | TI-49 | TI-50 |
|-------------------------------|---------------------------------------|---|--|--|------------------------------------|-----------------------------|----------------------------------|
| 51
52 | Ŭ
0 | . 1594
. 8893 | 51 | 51 | - 4 | | |
| 53
54
55 | 0
1
1 | .9835
.2521
.3818 | | 52,53 | 51 | 51 | |
| 56
57 | 1 | . 4442
. 5421 | | 54
55 | | 52 | |
| 58
59
60 | 1
1
1 | .5538
.5860
.7235 | | 56
57 58 | | 53,54
55,56 | 51 |
| 61
62 | 2 | . 0098
. 1630 | 52 | 59,60 | | | |
| 63
64
65 | 2
2
2 | .2595
.2956
3440 | | 61
62
63 64 | 52 | 57 | |
| 66
67 | 22 | . 4062
. 5044 | | 65,66 | 53 | 58
59-62 | |
| 68
69
70 | 2
2
2 | .6112
.7201
9620 | 53
54 | | | 63
64,65 | 52 |
| 71
72 | 33 | .0585
.1682 | 55
56 | | | | 53 |
| 73
74
75 | 333 | .2133
.2990
.3332 | 57,58
59 | | 55,56
57-59 | | |
| 76
77 | 33 | .5085
.6168 | | | 60
61,62 | | |
| 78
79
80 | 333 | .6994
.7386
.7710 | | | 63,64
65
66 | | 54 |
| 81
82 | 33 | .8028
.8522 | | | 67
68 | | 55 |
| 83
84
85 | 3
4
4 | .9748
.1473
1718 | | | | | 56
57
58 59 |
| 86
87 | 4 | .3110
.4105 | | | | | 60
61 |
| UHE I
WAS S | HRESHOI
ET TO I | LD ENERGY FOI
BE 2.416 MEV | R THE CO | NIINUUM | OF INE | LASIIC | SCATTERING |
| MT=16
ADOP
MADE
NORM | 22, 28
TED FR(
FOR E/
ALIZED | , 103 (N,2N)
OM JENDL FUS
ACH ISOTOPE (
TO EXPERIMEN | (N,NA)
ION FILE
WITH SIN
NTAL DAT | ,(N,NP)
. THEO
CROS-II
A (SEE | (N,P)
RETIČAL
THE
COMMENT | CALCUL
RESULTS
OF EAC | ATION WAS
WERE
H ISOTOPE). |
| MT=102
COMP
CODE | C/
OSED FI
/9/. (| APTURE
ROM THE ISOT(
Q-VALUE IS A | OPIC DAT
MEAN VA | A CALCU
LUE OF | LATED W
THOSE O | ITH THE
F ISOTO | CASTHY
PES. |
| MT=107
COMP | (I
OSED FI | N,A)
RÓM THE ISOT(| OPIC DAT | Α. | | | |
| MT=251
CALC | | U-BAR
BASED ON OP | TICAL MO | DEL. | | | |
| MF=4 AN | GULAR I | DISTRIBUTION | S OF SEC | ONDARY | NEUTRON | S | |
| MT=2ALC
MT=51-8 | ULATED | WITH THE CAS | STHY COD | E/9/. | | | |
| I AKE
I SOT | N FROM
OPIC D/
ASTIC S | JENDL FUSIO
ATA BY SUMMII
SCATTERING CI | N FILE W
NG UP TH
ROSS SEC | HICH WA
E DATA
TIONS | S CONST
AS SHOW | RUCIED
N IN TH | E TABLE OF |
| MT=16,
TAKE | 22, 28
N FROM | , 91
JENDL FUSIO | N FILE. | i i ono : | | | |
| MF=5 EN
MT=16 | ERGY D | ISTRIBUTIONS | OF SECO | NDARY N | EUTRONS | | |
| TĂKE | Ñ FROM | JENDL FUSIO | N FILE. | 17150 | | | |
| MF=12 P
MT=102
FROM | (BELOW
ENERG | 2.5 MEV)
Y BALANCE. | JLIIPLIC | IIIE5 | | | |
| MF=13 P
MT=3 (A | HOTON I
BOVE 2 | PRODUCTION CI | ROSS SEC | TIONS | | 10/ 11 | |
| MEASE
MEAS
MT=4 (B | UREMEN
ELOW 2 | TS BY MORGAN | ET AL./ | ne GNAS
11/ | n GUDE/ | 107, AN | U INC |
| CALĈ | ULATED | FROM ĠAMMA-I | RAY TRAN | SITION | PROBABI | LITIES | AND CROSS |

SECTIONS OF ISOTOPES.

MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3, 4, 102 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

- MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3 (ABOVE 2.5 MEV) CALCULATED WITH THE GNASH CODE/10/. MT=102 (BELOW 2.5 MEV) CALCULATED WITH THE GNASH CODE/10/ EXCEPT FOR THERMAL WHERE THE SPECTRA WERE CALCULATED WITH CASTHY/9/.

- REFERENCES

 CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
 YAMAMURO, N.: JAERI-M 90-006 (1990).
 KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
 HOLDEN, N.E., MARTIN, R.L. AND BARNES, I.L.: PURE & APPL. CHEM. 56, 675 (1984).
 FOSTER, JR., D.G. AND GLASGOW D.W.: PHYS. REV. C3,576 (1971).
 BARNARD, E. ET AL.: CEA-R-4524 (1973).
 SCHWARZ : NBS-MONO-138 (1974).
 IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
 YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).

| MAT number = 2225
22-TI- 46 KUR | EVAL-SEP88 K.KOBAYASHI(KUR),H.HASHIKURA(TOK) |
|--|---|
| HISTORY
88-09 COMPILED BY T | ASAMI (NEDAC) |
| 93-11 JENDL-3.2
DATA WERE ADO
COMPILED BY T.1 | PTED FROM JENDL FUSION FILE.
NAKAGAWA |
| ***** MODIFIEI
ALL CROSS SECT
ALL ANGULAR DIS
ALL ENERGY DIS | D PARTS FOR JENDL-3.2 ************************************ |
| JENDL FUSION F | ILE /1/ (AS OF NOV. 1993) |
| EVALUATEI | D BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI) |
| COMPILED | BY K.KOSAKO. |
| - THE INELAST | IC SCATTERING CROSS SECTIONS AND ANGULAR |
| DISTRIBUTIOI | NS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT |
| CONTINUUM II | NELASTIC) WERE CALCULATED WITH CASTHY2Y AND |
| DWUCKY IN S | INCROS-11 SYSTEM/2/ INCLUDING CONTRIBUTIONS |
| FROM DIRECT | REACTIONS. |
| - THE (N,2N), | (N,NA), (N,NP) AND (N,P) REACTION CROSS |
| SECTIONS (M | I=16, 22, 28, 103) WERE CALCULATED BY EGNASH2 |
| IN THE SINCI | ROS-11. |
| - ENERGY DISTI | RIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED |
| BY THOSE CA | LCULATED BY EGNASH2. THE DDX'S OF THE |
| CONTINUUM NI | EUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA- |
| TICS /3/ US
RATIO WAS C/
- THE RESONAN
SECTIONS AND
NEUTRONS AND | ING F1STOB /1/. THE PRECOMPOUND/COMPOUND
ALCULATED BY THE SINCROS-II CODE SYSTEM.
CE PARAMETERS, TOTAL, CAPTURE AND (N,A) CROSS
D ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED |
| - OPTICAL-MODI | EL, LEVEL DENSITY AND OTHER PARAMETERS USED IN |
| THE SINCROS | I. CALCULATION ARE DESCRIBED IN REF./2/. |
| LEVEL SCHEMI | S WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| MF=1 GENERAL INFORM | ATION |
| MT=451 DESCRIPTIVE | DATA AND DICTIONARY |
| MF=2 RESONANCE PARAM | METERS |
| MT=151 RESOLVED RES | SONANCE PARAMETERS |
| RESOLVED PARAMETI | ERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY |
| REGION FROM 1.0E | -5 EV TO 180 KEV. PARAMETERS WERE TAKEN FROM |
| REF./5/, FOR POS | ITIVE RESONANCES. PARAMETERS FOR NEGATIVE |
| RESONANCE WERE OF | STAINED SO THAT THE REPRODUCED CROSS SECTIONS |
| FOR BOTH SCATTER | ING AND CAPTURE GAVE THE 2200 M/S VALUES OF |
| 2.78+-0.24 AND 0 | .59+-0.18 BARN, RESPECTIVELY/5/. THE SCATTER- |
| ING RADIUS WAS AS | SSUMED TO BE 4.5 FERMI INSTEAD OF 3.5 FERMI IN |
| REF./5/. CALCUL/ | ATED 2200 M/SEC CROSS SECTIONS AND RESONANCE |
| INTEGRALS ARE AS | FOLLOWS: |
| 2200 M/S | CROSS SECTION(B) RES. INTEGRAL(B) |
| ELASTIC 2 | .75 |
| CAPTURE 0 | .596 0.35 |
| TOTAL 3 | .34 |
| MF=3 NEUTRON CROSS S | SECTIONS |
| BELOW 180 KEV, NO B | BACKGROUND CROSS SECTION WAS GIVEN. |
| FOR JENDL-3.2, ALL | CROSS SECTION DATA EXCEPT FOR THE TOTAL, |
| CAPTURE AND (N,A) (| WERE ADOPTED FROM JENDL FUSION FILE. THE |
| CALCULATION WAS MAI | DE WITH SINCROS-II SYSTEM/2/ BY ADOPTING |
| WALTER-GUSS OMP MOI | DIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP |
| /6/ FOR PROTON, LEI | MOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ |
| FOR ALPHA, LOHR-HAI | EBERLI OMP/8/ FOR DEUTERON, BECCHETTII- |
| GREENLEES OMP/9/ FO | DR TRITON AND HE-3, AND STANDARD LEVEL |
| DENSITY PARAMETERS | OF SINCROS-II SYSTEM. |
| MT=1 TOTAL
OPTICAL AND STAT
CASTHY CODE/10/.
V = 50.75
WS = 10.9 -
R = 1.26,
A = 0.52, | ISTICAL MODEL CALCULATION WAS MADE WITH THE
THE OPTICAL POTENTIAL PARAMETERS USED ARE:
- 0.120*EN, VSO = 4.72 (MEV)
0.234*EN, WV = 0.0 (MEV)
RS = 1.02 , RSO = 1.16 (FM)
ASO = 0.52, B = 0.40 (FM) |
| WIZZ ELASIIU SUAIIEI | |

OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. 4, 51-59, 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*' USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./11/ AND MT = 4SPEAR/12/. NO. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) 0.0 0+ 2+ 4+ G.S. 1 2 1 0.8893 2+ * 2 2.0098 4+ * 3 2.6112 0+ 4 2.962 2+ * 5 3.0585 3- * 6 3.1682 1-7 3.2133 0+ 8 3.2358 2+ * 9 3.299 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16, 22, 28, 103 (N,2N), (N,NA), (N,NP), (N,P) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO (N,2N) 0.0549 B AT 15.01 MEV MEASURED BY IKEDA ET AL./13/ (N,P) 0.210 B AT 14.91 MEV MEASURED BY IKEDA ET AL./13/ 102 CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 26.9 MB AT 30 KEV. MT = 102MT=107 (N,A) CALCULATED WITH GNASH CODE/14/. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. $\mathsf{MF}{=}4$ Angular distributions of secondary neutrons $\mathsf{MT}{=}2$ CALCULATED WITH THE CASTHY CODE/10/ MT=16, 22, 28, 51-59, 91 TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND 91 WERE TRANSFORMED INTO THE LAB SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. THE DATA WERE TRANSFORMED INTO THE LAB SYSTEM. REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
KUMABE, I. ET AL.: NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS ", VOL.1, PART A (1981).
PEREY, F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). REFERENCES PHENOMENA IN NOOL: REASTRONG, 2011 (1971).
10) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
11) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
12) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (198
13) IKEDA, Y. ET AL.: JAERI 1312 (1988).
14) YOUNG, P.G. AND ARTHUR, E.D. : LA-6947 (1977). DATA TABLE, 42, 55 (1989).

| MAT number = 2228
22-TI- 47 KUR EVAL-SEP88 K.KOBAYASHI(KUR),H.HASHIKURA(TOK)
DIST-SEP89 REV2-DEC93 |
|--|
| HISTORY
88-09 COMPILED BY T.ASAMI(NEDAC) |
| 93-12 JENDL-3.2
DATA WERE ADOPTED FROM JENDL FUSION FILE.
COMPILED BY T.NAKAGAWA |
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| JENDL FUSION FILE /1/ (AS OF DEC. 1993)
EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. |
| THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR
DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND
DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
FROM DIRECT REACTIONS. THE (N.2N), (N.NA), (N.NP) AND (N.P) REACTION CROSS |
| SECTIONS (MT=16, 22, 28, 103) WERE CALCULATED BY EGNASH2
IN THE SINCROS-11.
- ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE |
| CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM.
- THE RESONANCE PARAMETERS, TOTAL, CAPTURE AND (N.A) CROSS |
| NEUTRONS AND ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED
NEUTRONS WERE TAKEN FROM JENDL-3.1.
- OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDE/4/. |
| |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| <pre>MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
3.1+-0.2 AND 1.7+-0.2 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 3.6 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:</pre> |
| 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.10
CAPTURE 1.70 1.44
TOTAL 4.80 |
| MF=3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN. |
| FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE AND (N.A) WERE ADOPTED FROM JENDL FUSION FILE. THE
CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING
WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP
/6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR
ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON, BECCHETTII-GREENLEES
OMP/9/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY
PARAMETERS OF SINCROS-II SYSTEM. |
| $ \begin{array}{l} MT=1\ TOTAL \\ OPTICAL\ AND\ STATISTICAL\ MODEL\ CALCULATION\ WAS\ MADE\ WITH \\ CASTHY\ CODE/10/.\ THE\ OPTICAL\ POTENTIAL\ PARAMETERS\ USED\ ARE: \\ V\ =\ 50.75\ -\ 0.120^{*}EN, \qquad VSO\ =\ 4.72 \qquad (MEV) \\ WS\ =\ 10.9\ -\ 0.234^{*}EN, \qquad WV\ =\ 0.0 \qquad (MEV) \\ R\ =\ 1.26, \qquad RS\ =\ 1.02, \qquad RSO\ =\ 1.16 \qquad (FM) \\ A\ =\ 0.52, \qquad ASO\ =\ 0.52, \qquad B\ =\ 0.40 \qquad (FM) \end{array} $ |
| MT=2 ELASTIC SCATTERING |

OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. 4, 51-66, 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'. MT = 4SPIN-PARITY (DIRECT PROCESS) 5/2 - * 7/2 - * 9/2 - * 1/2 - * 1/2 - * 1/2 - * 3/2 - * 3/2 - * 3/2 - * 5/2 + 5/2 + 5/2 + 5/2 + 5/2 - * 1/2 - * 5/2 - * 1/2 - * 1/2 - * 3/2 - * 1/2 - * 3/2 - * 1/2 - * 3/2 - * 1/2 - * (N ND) (N D) (N D) * NO. ENERGY(MEV) 0.0 0.1594 1.2521 1.254 G.S. 1 2 3 1.254 1.4442 1.5499 1.67 1.7941 1.825 2.163 2.1667 2.2595 2.2595 2.344 4 5 6 7 8 9 10 11 12 13 2.2971 13 2.344 14 2.3649 15 2.4062 16 2.4163 LEVELS ABOVE 2.416 MEV WERE ASSUMED 16, 22, 28, 103 (N,2N), (N,NA),(N,NP), (N,P) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO MT = 16(N,2N) 0.200 B AT 14.9 MEV SYSTEMATICS BY KASUGAI/11/ (N,NP)+(N,D) 0.080 B AT 14.98 MEV MEASURED BY IKEDA ET AL./12/ (N,P) 0.1215 B AT 14.91 MEV MEASURED BY IKEDA ET AL./12/ MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 65.5 MB AT 30 KEV. MT=107 (N,A) CALCULATED WITH THE GNASH CODE/13/. 251 MU-BAR CALCULATED WITH OPTICAL MODEL. MT=251 MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2
CALCULATED WITH THE CASTHY CODE/10/.
MT=16,22,28,51-66, 91
TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND
91 WERE TRANSFORMED INTO THE LAB SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,51-66, 91 TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND 91 WERE TRANSFORMED INTO THE LAB SYSTEM. REFERENCES REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS ", VOL.1
PART A (1981).
6) PEREY, F.G.: PHYS. REV., 131, 745 (1963).
7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION
PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682
(1971). ŬÓL.1, (1971). (1971). 10) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). 11) KASUGAI Y.: PRIVATE COMMUNICATION (1993). 12) IKEDA, Y. ET AL.: JAERI 1312 (1988). 13) YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

| MAT
22- | numb
TI- | er
48 | κU | 22 3
R | 31 | | E V
D I | AL
ST | - SE
- SE | P8
P8 | 8
9 | K.
RĒ | K0
V1 |) B A
- A | YA | SH
93 | (
 | ΚL | JR) | , H | . H | AS | HII | (UR | А(Т | 0K) |
|--|---|--|---|--|--|--|---|--|---|---|---|----------------------------|--|----------------------------|----------------------------|----------------------------------|---------------------------------|---|---|--------------------------------|-------------------------------------|-----------------------------|---------------------------------------|-------------------------------|--------------------------------------|-------------------------|
| HISI
88-0
93-0 | 0RY
9 C
3 (| OMF
4,9 | PIL
91) | ED
ÇH | BY
IAN | T.
GED | ASA
IN | MI
TO | (NE
L/ | EDA
AB | C)
SY | sт | ΕM | ۱. | | | | | | | | | | | | |
| 92-1 | Z JE
D
CO | AT A
MP I | LE | ERE
DE | M
B Y | A I N
T . N | ILY
IAKA | A D (
G A) | ОРТ
NA | ΓED | F | RO | М | JE | ND | L | FU | SI | ON | F | ILI | Ε. | | | | |
| | * * *
AL
AL
* * * | * *
L (
L /
L Ę | CRO
NG
NE | MOD
SS
ULA
RGY | OIF
SE
R
(D | IED
CTI
DIS
IST | PA
ONS
TRI
RIE | RT
BU
BU
BUT | S F
XCE
TIC
ION | OR
PT
NS
NS | J
(
E | EN
3,
XĊ
** | DL
10
EP | - 3
2)
T | F0 | ND
R
* * |) (
(4
*** | 3,
2,
* * | 10
2). | * *
7)
* * | * * * | * * | * * * | * * * | * * * | * |
| | JE | NDL | - F
E
C | USI
VAL
OMF | ON
UA
PIL | FI
TED
ED | LE
BY
BY | /1
/ K
/ K | /
. K0
. K0 | (A
)SA
)SA | S
KO
KO | 0F
(| D
NE | EC
DA | Ċ) | 19
A | 93
ND |)
)
S |
6 . | СН |
I B/ |
A |
(N[|
DC/ | JAE |
RI) |
| | - | | HE
ST
ONT | INE
RIE
INU
KY | LA
BUT
JUM | ST I
I O N
I N
S I | C S
IS C
IELA | | TTE
INE
IC)
- II | | NG
ST
ER
YS | IC
E
TE | RO
AL
CA
M/ | SS
LY
LC
2/ | S
S
UL
I | E C
C A
A T
N C | TT
ED
LU | ON
ER
DU | IS
ED
/IT
NG | AN
N
H
C | D
EU
CAS
ON | AN
TR
ST
TR | GUI
ONS
HY2
IBU | _AR
5 (
2 Y
J T I | EXC
AND
ONS | EPT |
| | - | TH | | U I
(N,
I ON | 2N
S | СТ
),
(МТ
МСР | (N,
=16 | | 10r
),
22, | (N
2 | ,N
8, | P)
1 | А
03 | ND
5) | wÉ | N,
RĖ | P)
C | F
A L | REA
LCU | CT | 101
TEI | N
D | CR(
BY | DSS
EG | NAS | H2 |
| | - | | NER
()
NT
CS
(T) | GY
HOS
INU
OS
RES | DI
SE
JUM
JAS | | | | ONS
ED
S V
5 T C
5 T C
5 T C | BY
VER
DB
DB
DB
ETE | F
E
/1
Y
RS | SE
GN
CA
/.
TH | CO
AS
LC
E
TO | ND
H2
UL
TH
SI | AR
AT
NC | Y
ED
PR
C | NE
HE
E
S
S
- | | RO
DX
KU
IPO
JRE | NS
MA
UN
OD
A | U
B
D
D
N
D | ER
FS
COY
SY(| E F
THE
S`
MP(
STE
N,/ | REP
YST
DUN
M. | LAC
EMA
D
CRO | ED
-
SS |
| | - | NE
OF
TH
LE | | RON
CAL
SIN
L S | IS
- M
ICR
SCH | WER
ODE
OS -
EME | E T
L,
II
S V | AKI
LE
CAI | EN
VEL
LCU
E D | FR
JLA
DET | | J
SI
ON
MI | EN
TY
NE | | - 3
ND
D | ES | ŤH
CR
HE | | R P
BED
BAS | AR
IS | | ET
RE
F | ERS
F.J | S U
/2/
SDF | SED
/4/ | IN |
| MF=1
MT= | GE
451 | NE F
De | RAL
ESC | IN
RIF | IFO
PTI | RMA
VE | T I C
D A T | ON
A | AND |) D | IC | ΤI | ON | IAR | Y | | | | | | | | | | | |
| MF=2
MT=
R
R
R
R
F
4
F
I
R | RE
151
ESOL
EGIO
EF./
ESON
OR B
.61+
NG R
EF./
NTEG | SON
RED
N F
SANC
SANC
OTF
ADI
5/1 | AN
SOP
FRF
ES
US | CE
LVE
ARA
OR
WER
CAL
AND
ARE | PA
DE
PO
PO
EE
SU
A | RAM
RES
TE-55
SOBT
ROBT
ASS
LAT
S | ETE
ONA
SEVEN
IVE
IVE
IG
IC
IC
IC
IC
IC
IC
IC
IC
IC
IC
IC
IC
IC | RS
NCI
OR
IED
ND
220 | E F
D 1
E SC
E SC
5 O
S : | PAR
BW
00
NA
DNA
PT
BAR
M/ | AM
FK
NCA
UR
SE | ETR
EV
ES
C | ER
MU
TH
GA
F
CR | SAPP
IEVSEOS | AR
R
E
E
S | ER
AN
PR
HE
TI
SE | ETTD2EVES | | VE
SSED
ZED
ZAD | N EOC/
M/.OA | IN
RE
RO
S
F
ND | TTESSVA
VA
TH
3 R | HE
GA
SE
LUE
9 E
ES | EN
FIV
SCA
SER | ERG
FRO
ION
OF
MI
NCE | Y
M
S
R-
IN |
| | ELAS
CAPT
TOTA | TIC
URE
L | 2 | 200 |) M | /S
4.
7.
12. | CRC
61
84
45 |)SS | SE | ЕСТ | 10 | N (| B) | | | R | ES | 3. | IN
69 | ΤE | GR | AL | (B) |) | | |
| MF=3
BE | NE
LOW | UTF
100 | RON
K | CR
EV, | ROS
N | S S
O B | ECT
ACK | GR(| NS
DUN | ١D | CR | 0 S | S | SE | СТ | IC | N | WA | S | GΙ | VEI | Ν. | | | | |
| FO
CA
WA
/6
AL
PA | R JE
PTUR
LCUL
/ FO
PHA,
P/9/
RAME | NDL
E A
ATI
- GL
R F
F
C
TEF | - 3
ND
ION
JSS
JSS
PRO
OHR
OR
S | . 2 ,
(N
0N
TON
- HA
TR I
OF | A
I,A
IP
I,
EB
TO
SI | LL
) W
MOD
MOD
LEN
ERL
NCR | CRC
ERE
IFI
IOS
I C
ND | SS
ITI
ED
OMI
MP
HE
II | - SE
DOF
H S
B N
P M
/ 8 /
- 3 ,
S N | CTE
SIN
MOD
Y ST | IO
D
CR
AM
IF
OR
ND
EM | N
FRSAMEDS | DA
OM
- I
UR
D
EU
TA | I J
I J
BY
ITE | EN
SY
2/
RO
AR | XC
DL
ST
RT
N, | E P
E M
E M
H U
L E | TUS
US
IN
IN
IN
IN
IN
IN
IN
IN
IN
IN
IN
IN
IN | FO
FO
FO
FO
FO
FO
FO
FO
FO
FO
FO
FO
FO
F | R
BY
TR
D
ET
DE | THI
FII
ON
YOI
TI
NS | E
DO
ŮN
I -
I T | TO
PT
PE
G/T
GRE
Y | TAL
TH
REY
7/
EEN | Ġ
OM
FOR
LEE | P
S |

 $\begin{array}{l} \mbox{MT=1 TOTAL} \\ \mbox{OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH} \\ \mbox{CASTHY CODE/10/. THE OPTICAL POTENTIAL PARAMETERS USED ARE:} \\ \mbox{V} = 50.75 - 0.120*EN, VSO = 4.72 (MEV) \\ \mbox{WS} = 10.9 - 0.234*EN, WV = 0.0 (MEV) \\ \mbox{R} = 1.26, RS = 1.02, RSO = 1.16 (FM) \\ \mbox{A} = 0.52, ASO = 0.52, B = 0.40 (FM) \\ \mbox{IN JENDL-3.1, THE TOTAL CROSS SECTION WAS NOT THE SAME AS THIS} \end{array}$

CALCULATION. FOR JENDL-3.2, IT WAS REPLACED WITH THE CASTHY CALCULATION. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. =4, 51-68, 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*', USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./11/ AND SPEAR/12/. MT = 4NO. SPIN-PARITY (DIRECT PROCESS) ENERGY(MEV) G.S. 2 3 0.0 0.98356 2.2956 2.421 3.224 3.2398 3.3332 3.3332 3.3508 3.50868 3.61688 3.63364 3.7116 3.7386 0+ 2+ 4+ 2+ * 4 5 6 7 8 9 10 0+ 3+ 4+ 6+ 3-2+ 6+ 2+ 2+ 11 12 1+ 13 14 1 +15 1+ 16 3.7825 4-17 3.8028 1+ 18 3.8522 3-LEVELS ABOVE 3.852 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16, 22, 28, 103 (N,2N), (N,NA), (N,NP), (N,P) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO (N,NP)+(N,D) 0.0207 B AT 15.0 MEV MEASURED BY IKEDA ET AL./13/ (N,P) 0.0596 B AT 14.93 MEV MEASURED BY IKEDA ET AL./13/ MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 4.3 MB AT 20 KEV. MT=107 (N,A) EVALUATED BASED ON THE EXPERIMENTAL DATA. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. $\mathsf{MF}{=}4$ ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS $\mathsf{MT}{=}2$ MI=2 CALCULATED WITH THE CASTHY CODE/10/ MT=16, 22, 28, 51-68, 91 TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND 91 WERE TRANSFORMED INTO THE LAB SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND 91 WERE TRANSFORMED INTO THE LAB SYSTEM. REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS ", VOL.1,
PART A (1981).
6) PEREY, F.G.: PHYS. REV., 131, 745 (1963).
7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION
PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682
(1971). (1971)
10) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
11) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
12) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).

13) IKEDA, Y. ET AL.: JAERI 1312 (1988).

| MAT number = 2234
22-TI- 49 KUR EVAL-SEP88 K.KOBAYASHI(KUR),H.HASHIKURA(TOK) |
|---|
| HISTORY
88-09 COMPILED BY T.ASAMI(NEDAC) |
| 93-12 JENDL-3.2
DATA WERE ADOPTED FROM JENDL FUSION FILE.
COMPILED BY T.NAKAGAWA |
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| (3,22) NEWLY ADDED.
ALL ANGULAR DISTRIBUTIONS EXCEPT FOR (4,2).
ALL ENERGY DISTRIBUTIONS. |
| JENDL FUSION_FILE /1/ (AS OF DEC. 1993) |
| EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. |
| THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR
DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND |
| DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
FROM DIRECT REACTIONS.
- THE (N,2N), (N,NA), (N,NP) AND (N,P) REACTION CROSS |
| SECTÍOŃS (MT≐16, 22,`28, 103) WÉRÉ CALCULATED BY EGNASH2
IN THE SINCROS-II.
- ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED |
| BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE
CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND |
| RATIO WAS CALCULATED BY THE SINCROS- II CODE SYSTEM.
- THE RESONANCE PARAMETERS, TOTAL, CAPTURE AND (N,A) CROSS
SECTIONS AND ANG DISTRIBUTIONS OF FLASTICALLY SCATTERED |
| NEUTRONS WERE TAKEN FROM JENDL-3.1.
- OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. |
| LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MIBW FORMULA WERE GIVEN IN THE ENERGY |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
PADILYS WAS ASSUMED TO PE 4 F EEPMIL INSTEAD OF 4 0 EEPMIL IN |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
(ADDUCE) 1.000000000000000000000000000000000000</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
CAPTURE 2.21 1.06
NE 2. NEUTRON CROSS CECTIONS</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
CAPTURE 2.21 1.06
WF=3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.
DETEMPTION CROSS SECTIONS
DELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
CAPTURE 2.21 1.06
TOTAL 2.90
MF=3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE AND (N.A) WERE ADOPTED FROM JENDL FUSION FILE. THE
CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING
DATA</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
CAPTURE 2.21 1.06
TOTAL 2.90
MF=3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL,
CAPTURE AND (N.A) WERE ADOPTED FROM JENDL FUSION FILE. THE
CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING
WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP
/6/ FOR PROTON. LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR
ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON, BECCHETTII-GREENLEES</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7++0.3 AND 2.2++0.3 BARNS, RESPECTIVELY20. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
CAPTURE 2.21 1.06
TOTAL 2:90
MF=3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL.
CAPTURE ADD (N.A) WERE ADOPTED FROM JENDL FUSION FILE. THE
CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING
WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP
/6/ FOR PROTON, LEMOS OMP MODIFIED BY AARHURANDY // FOR NEUTRON, PEREY OMP
/6/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY
PARAMETERS OF SINCROS-II SYSTEM.</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESOLVED RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF
0.7+-0.3 AND 2.2++0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING
RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN
REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE
INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 0.69
CAPTURE 2.21 1.06
TOTAL 2.90
MF=3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.
FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL
CAPTURE AND (N,A) WERE ADOPTED FROM JENDL FUSION FILE. THE
CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING
WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP
/6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR
ALPHA, LOHR-HAZEBELI OMP/8/ FOR DEUTERON, BECCHETTII-GREENLEES
OMP/9/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY
PARAMETERS OF SINCROS-II SYSTEM.
MT=1 TOTAL
OFICIAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH</pre> |
| <pre>MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 100 KEV. PARAMETERS WERE TAKEN FROM REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUES OF 0.7+-0.3 AND 2.2+-0.3 BARNS, RESPECTIVELY/5/. THE SCATTERING RADIUS WAS ASSUMED TO BE 4.5 FERMI INSTEAD OF 4.0 FERMI IN REF./5/. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B) ELASTIC 0.69 CAPTURE 2.21 1.06 TOTAL 2.90 MF=3 NEUTRON CROSS SECTIONS BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN. FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL, CAPTURE ADD (N.A) WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMUKO/2/ FOR THEY OMP /6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DELTERON, BECCHETTII-GREENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. MT=1 TOTAL MT=1 TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY CODE/2/. THE OPTICAL POTENTIAL PARAMETERS USED ARE:</pre> |

| <pre>MT=2 ELASTIC SCATTERING
OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS
FROM THE TOTAL CROSS SECTION.</pre> |
|---|
| MT=4, 51-65, 91 INELASTIC SCATTERING
THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE
LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE
DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'. |
| NO. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS)
G.S. 0.0 7/2 -
1 1.3818 3/2 - *
2 1.5421 11/2 -
3 1.586 3/2 - *
4 1.6229 5/2 -
5 1.7235 1/2 -
6 1.762 5/2 - *
7 2.2613 7/2 - *
8 2.4714 7/2 -
9 2.5044 1/2 + *
10 2.5058 15/2 -
11 2.5135 5/2 -
12 2.5174 5/2 +
13 2.6643 3/2 + *
14 2.7201 11/2 -
15 2.7213 3/2 -
LEVELS ABOVE 2.721 MEV WERE ASSUMED TO BE OVERLAPPING. |
| MT=16, 22, 28, 103 (N,2N), (N,NA), (N,NP), (N,P)
ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS
MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO |
| (N,NP)+(N,D) 0.00897B AT 14.98 MEV MEASURED BY IKEDA ET AL./10/
(N,P) 0.023 B AT 14.7 MEV MEASURED BY QAIM ET AL./11/ |
| MT=102 CAPTURE
CALCULATED WITH THE CASTHY CODE/12/ AND NORMALIZED TO 22.5 MB
AT 30 KEV. |
| MT=107 (N,A)
CALCULATED WITH THE GNASH CODE/13/. |
| MT=251 MU-BAR
CALCULATED WITH OPTICAL MODEL. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2 |
| CALCULATED WITH THE CASTHY CODE/12/.
MT=16, 22, 28, 51-65, 91
TAKEN FROM JENDI FUSION FUE THE DATA OF MT=16, 22, 28 AND |
| 91 WERE TRANSFORMED INTO THE LAB SYSTEM. |
| MT=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 22, 28, 91
TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND
91 WERE TRANSFORMED INTO THE LAB SYSTEM. |
| REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS ", VOL.1,
PART A (1981). |
| 6) PEREY, F.G.: PHYS. REV., 131, 745 (1963). 7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). 8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974). 9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971) |
| 10)`İKİDA;
11) QAIM, S.M. ET AL.: JAERI 1312 (1988).
11) QAIM, S.M. ET AL.: NUCL. PHYS., A283, 269 (1977).
12) İGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
13) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977). |

| MAT number = 2237
22-TI- 50 KUR EVAL-SEP88 K.KOBAYASHI(KUR),HASHIKURA(TOK)
DIST-SEP89 REV2-NOV93 |
|--|
| HISTORY
88-09 COMPILED BY T.ASAMI(NEDAC)
93-11 LENDL 2-2 |
| DATA WERE MAINLY ADOPTED FROM JENDL FUSION FILE.
COMPILED BY T.NAKAGAWA |
| ***** MODIFIED PARTS FOR JENDL-3.2 *******************
ALL CROSS SECTIONS EXCEPT (3,1) AND (3,102)
ALL ANGULAR DISTRIBUTIONS EXCEPT FOR (4,2).
ALL ENERGY DISTRIBUTIONS. |
| JENDL FUSION FILE /1/ (AS OF NOV. 1993)
EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. |
| THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR
DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND
DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS
FROM DIRECT REACTIONS. THE (N,2N), (N,NA), (N,NP), (N,P) AND (N,A) REACTION
CROSS SECTIONS (MT=16, 22, 28, 103, 107) WERE CALCULATED
BY EGNASH2 IN THE SINCROS-II. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE
CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM. THE RESONANCE PARAMETERS, TOTAL AND CAPTURE CROSS
SECTIONS AND ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED
NEUTRONS WERE TAKEN FROM JENDL-3.1. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| <pre>MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 200 KEV. PARAMETERS WERE TAKEN FROM
REF./5/, FOR POSITIVE RESONANCES. PARAMETERS FOR NEGATIVE
RESONANCE WERE OBTAINED SO THAT THE REPRODUCED CROSS SECTIONS
FOR BOTH SCATTERING AND CAPTURE GAVE THE 2200 M/S VALUE OF
3.7+-0.3 AND 0.179+-0.003 BARNS, RESPECTIVELY/5/. THE
SCATTERING RADIUS WAS ASSUMED TO BE 4.5 FERMI. CALCULATED 2200
M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS:</pre> |
| 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 3.71
CAPTURE 0.18 0.086
TOTAL 3.88 |
| MF=3 NEUTRON CROSS SECTIONS
BELOW 180 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN. |
| FOR JENDL-3.2, ALL CROSS-SECTION DATA EXCEPT FOR THE TOTAL AND
CAPTURE WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION
WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP
MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /6/ FOR PROTON,
LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR ALPHA, LOHR-
HAEBERLI OMP/8/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/9/ FOR
TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF
SINCROS-II SYSTEM. |
| $ \begin{array}{llllllllllllllllllllllllllllllllllll$ |
| MT=2 ELASTIC SCATTERING
OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS |

FROM THE TOTAL CROSS SECTION.

| <pre>MT=4, 51-61, 91 INELASTIC SCATTERING
THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE
LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE
DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*',
USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./11/ AND
SPEAR/12/.</pre> |
|---|
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| MT=16, 22, 28, 103 (N,2N), (N,NA),(N,NP), (N,P)
ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS
MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO |
| <pre>(N,2N) 1.0 B AT 14.9 MEV (SYSTEMATICS BY KASUGAI/13/),
(N,P) 0.0134 B AT 14.94 MEV MEASURED BY IKEDA ET AL./14/,
(N,A) 0.0104 B AT 14.95 MEV MEASURED BY IKEDA ET AL./14/.</pre> |
| MT=102 CAPTURE
CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO 2.3 MB
AT 25 KEV. |
| MT=251 MU-BAR
CALCULATED BASED ON OPTICAL MODEL |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2
CALCULATED WITH THE CASTHY CODE(10/ |
| MT=16, 22, 28, 51-61, 91
TAKEN FROM JENDL FUSION FILE. THE DATA OF MT=16, 22, 28 AND
91 WERE TRANSFORMED INTO THE LAB SYSTEM. |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 22, 28, 91 |
| 91 WERE TRANSFORMED INTO THE LAB SYSTEM. |
| REFERENCES
1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO, N.: JAERI-M 90-006 (1990).
3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
5) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS ", VOL.1, |
| 6) PEREY, F.G.: PHYS. REV., 131, 745 (1963). 7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). 8) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974). 9) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971) |
| 10) İĞARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
11) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 |
| 12) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
13) KASUGAI Y.: PRIVATE COMMUNICATION (1993).
14) IKEDA, Y. ET AL.: JAERI 1312 (1988). |

| MAT number = 2328 | EVAL-AUG88 T.WATANABE |
|---|---|
| 23–V – 51 KHI | DIST-SEP89 REV2-MAR94 |
| HISTORY
88-08 JENDL-2 MODIFIE | D BY T.WATANABE |
| 94-03 MODIFICATION FO
GAMMA-RAY PRODUC
COMPILED BY S.C | (KAWASAKI HEAVY INDUSTRIES, LID.)
R JENDL FUSION FILE WAS MADE BY S.CHIBA
CTION DATA EVALUATED BY T.ASAMI(DATA ENG.)
HIBA AND T.NAKAGAWA(NDC/JAERI) |
| **** MODIFIED PARTS (3,2) | FOR JENDL-3.2 ************************************ |
| (3,16) BELOW 15 MEV
(3,4),(3,22),(3,28),(3,4),(3,22),(4,28),(4,22),(4,28),(5,16),(5,22),(5,28),(12,51-64),(12,102),(13,3),(14,51-64),(14,3),(14,51-64),(14,15,3),(15,102),(15,10),(15, | TAKEN FROM JENDL FUSION FILE 3,51-65),(3,91) TAKEN FROM JENDL FUSION FILE (4,51-65),(4,91)TAKEN FROM JENDL FUSION FILE (5,91) TAKEN FROM JENDL FUSION FILE (2,103),(12,107) NEW EVALUATION ,102),(14,103),(14,107) NEW EVALUATION NEW EVALUATION |
| JENDL FUSION FII | ************************************** |
| DATA WERE TAKEN | FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING: |
| - THE DISCRETE | AND CONTINUUM INELASTIC SCATTERING CROSS |
| SINCROS-II S | YSTEM/2/. |
| - ANGULAR DISTI | RIBUTIONS OF DISCRETE INELASTICS WERE ALSO |
| - THRESHOLD W
- THRESHOLD RE
REPLACED WITI
SINCROS-II | ACTION CROSS SECTIONS (MT=16, 22, 28) WERE
H THOSE CALCULATED BY EGNASH2 IN THE
ABOVE 15 MEV, THE (N,2N) CROSS SECTION IS THE |
| SAME AS JENDI | L-3.1. |
| - ENERGY DISTR | IBUTIONS OF SECONDARY NEUTRONS WERE REPLACED |
| BY THOSE_CAL | CULATED BY EGNASH2., THE DDX'S OF THE CONTI- |
| /3/ USING F1:
WAS CALCULAT | S WERE CALCULATED BY KUMABE'S SYSTEMATICS
5TOB /1/. THE PRECOMPOUND/COMPOUND RATIO
ED BY THE SINCROS- II CODE SYSTEM. |
| - OPTICAL-MODEL | L LEVEL DENSITY AND OTHER PARAMETERS USED IN |
| THE SINCROS- | II CALCULATION ARE DESCRIBED IN REF./2/. |
| LEVEL SCHEMES | S WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| MF=1 GENERAL INFOR | MATION |
| MT=451 DESCRIPTIV | E DATA AND DICTIONARY |
| MF=2
MT=151 RESONANCE | PARAMETERS : 1.0E-5 EV - 100 KEV |
| RESOLVED RESONAN | CES FOR MEBW FORMULA: |
| PARAMETERS WEI | RE EVALUATED BASED ON EXPERIMENTAL DATA |
| /5,6,7,8/ AND | MODIFIED TO REPRODUCE EXPERIMENTAL TOTAL |
| CROSS SECTION | S. NEGATIVE ENERGY LEVELS WERE ADDED TO |
| REPRODUCE 2200 | O M/S TOTAL AND CAPTURE CROSS SECTIONS. |
| CALCULATED 2200 | M/S CROSS SECTIONS AND RESONANCE INTEGRALS
2200 M/SEC RES. INTEG. |
| ELASTIC | 4.83 B - |
| CAPTURE | 4.90 B 2.56 B |
| TOTAL | 9.73 B - |
| MF=3 NEUTRON CROSS | SECTIONS : ABOVE 100 KEV |
| FOR JENDL-3.1, TO | OTAL, ELASTIC, INELASTIC AND CAPTURE CROSS |
| SECTIONS WERE CAU | LCULATED WITH OPTICAL AND STATISTICAL MODEL. |
| DIRECT INELASTIC | REACTION CROSS SECTIONS WERE EVALUATED WITH |
| DWBA METHOD /9/ | AND ADDED TO COMPOUND PROCESSES. |
| THE SPHERICAL OP | TICAL POTENTIAL PARAMETERS WERE EVALUATED |
| TO REPRODUCE EXP | ERIMENTAL TOTAL CROSS SECTIONS /10,11,12/. |
| V = 50.71-0.4 | 793*EN MEV RO= 1.227 FM A0= 0.663 FM |
| WS= 5.307-0.1 | 911*EN MEV RS= 1.370 FM B = 0.394 FM |
| VSO= 6.560 ME | V RS0=0.046 FM AS0=0.535 FM |
| OPTICAL AND STAT
WITH CASTHY CODE | ISTICAL MODEL CALCULATION WAS PERFORMED /13/. |
| FOR JENDL-3.2. CI | ROSS SECTIONS FOR (N,2N), (N,NP), (N,NA) AND |
| INELASTIC SCATTEN | RING WERE ADOPTED FROM JENDL FUSION FILE. |
| THE CALCULATION | WAS MADE WITH SINCROS-II CODE SYSTEM/2/ BY |

ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/14/ FOR ALPHA, LOHR-HAEBERLI/15/ FOR DEUTERON, BECHETTI-GREENLEES /16/ FOR TRITON AND HE-3. LEVEL DENSITY PARAMETERS USED ARE: V-52 9.0 (1/MEV) V-51 8.6 V-50 8.6 TL-51 9 9 TI-51 TI-50 SC-48 9.8 8.6 DEFAULT IN SINCROS-II DEFAULT IN SINCROS-II ŠČ - 47 ■1 TOTAL 100 KEV -2 MEV: BASED ON THE EXPERIMENTAL DATA /11,12/ FOR NATURAL V. ABOVE 2 MEV: CALCULATED MT = 1MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=4,51-65,91 INELASTIC SCATTERING ADOPTED FROM JENDL FUSION FILE. THE LEVEL SCHEME TAKEN FROM REF./17/: REF./17/: SPIN-PARITY 7/2-5/2-3/2-11/2-9/2-3/2-1/2+ 3/2+ 15/2-9/2-5/2-3/2-3/2-NŌ. G.S 1 ENERGY (MEV) BETA ENERGY 0.0 3201 0.9270 1.6089 1.8131 2.4108 2.5474 2.6774 2.6996 2.79 3.0836 3.15 0.250 0.250 0.250 2 34 56789 1Ŏ 3.15 3.1951 3.2148 3/2-3/2-3/2-11 12 13 14 15 3.2640 3.2800 5/2-5/2-CONTINUUM LEVELS ASSUMED ABOVE 3.28 MEV :16 (N,2N) TAKEN FROM JENDL FUSION FILE. BELOW 15 MEV: SINCROS-II CALCULATION ABOVE 15 MEV: GUIDED BY EXPERIMENTAL DATA /18/. MT = 16MT=22,28 (N,NA), (N,NP) DATA FOR JENDL FUSION FILE WERE ADOPTED, WHICH WERE CALCULATED WITH SINCROS-II. MT=102 CAPTURE STATISTICAL MODEL CALCULATION WITH CASTHY CODE /13/ WAS PERFORMED. THE CAPTURE CROSS SECTION WAS NORMALIZED TO EXPERIMENTAL DATA OF DUDEY+ /19/ AT 0.5 MEV 2.63 MB. THE MT=103 (N,P) GUIDED BY EXPERIMENTAL DATA /20,21/. MT=104,105 (N,D), (N,HE-3) JENDL-2 EVALUATED DATA /22/ WERE ADOPTED. MT=107 (N,ALPHA) GUIDED BY EXPERIMENTAL DATA /22,23,24,25/. MT=251 MU-BAR CALCULATED FROM THE DATA IN MF=4. =4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 ____ CALCULATED WITH OPTICAL MODEL. MF = 4MT=2 CALCULATED WITH OPTICAL MODEL. MT=51-65 TAKEN FROM JENDL FUSION FILE FOR WHICH THE CALCULATION WAS MADE WITH HAUSER-FESHBACH FORMULA (CASTHY) AND DWBA (DWUCK4). MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE. F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 TAKEN FROM JENDL FUSION FILE. MF = 5

MF=12 PHOTON PRODUCTION MULTIPLICITIES (UP TO 3.34494 MEV) MT=51-64 MULTIPLICITIES WERE CALCULATED WITH EGNASH2/2/. MT=102 FROM ENERGY BALANCE. MT=103, 107 CALCULATED WITH THE EGNASH2 CODE/2/. MF=13 PHOTON PRODUCTION CROSS SECTIONS (ABOVE 3.34494 MEV) $M\dot{T}=3$ ČALCULATED WITH THE EGNASH2 CODE/2/. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3,51-64,102,103,107 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3, 102, 103, 107 CALCULATED WITH THE EGNASH2 CODE/2/. CAPTURE GAMMA SPECTRUM AT THERMAL ENERGY WAS CALCULATED WITH CASTHY/6/. REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
WINTERS, R.R. ET AL.: PHYS. REV. C18, 2092 (1978).
GARG, J.B. ET AL.: NUCL. SCI. ENG. 65, 76 (1978).
MUGHABGHAB S.F ET AL.: NUCL. SCI. ENG. 65, 76 (1978).
MUGHABGHAB S.F ET AL.: NUCL. SCI. ENG. 78, 110 (1981).
MACKLIN, R.L. ET AL.: NUCL. SCI. ENG. 78, 110 (1981).
KUNZ P.D.: UNPUBLISHED (1974).
ROHR, G. AND FRIEDLAND, E.: NUCL. PHYS. A104, 1 (1967).
SMITH, A.B. ET AL.: PHYS. REV. C1, 581 (1970).
CIERJACKS, S.: KFK-1000 (1968).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS. A232, 381 (1974).
BCCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.00 (1971). AUCHAMPAUGH, G.F. ET AL.: NUCLEAR DATA SHEETS 48, 111 (1986). AUCHAMPAUGH, G.F. ET AL.: BNL-NCS-50681, P.231 (1977). DUDEY, N.D. ET AL.: J. NUCL. ENERGY 23,443 (1969). IKEDA Y. ET AL.: JAERI 1312 (1988). SMITH, D.L. ET AL.: ANL/NDM-85 (1984). TANAKA S.: JAERI-M 82-151 (1982). KANNO, I. ET AL.: ANNALS NUCL. ENERGY 11, 623 (1984). LU HAN-LIN, ET AL.: PHYSICA ENERGIAE FORTIS ET PHYSICA NUCLEARIS 3, 88 (1979). ZUPRANSKA, E ET AL.: ACTA PHYSICA POLONICA SECTION B 11, 853 (1980). 17) 18) 19) 20) 21) 22) 231 245 25)

| MAT number = 2400 | EVAL-MAR87 T.ASAMI(NEDAC) |
|---|---|
| 24-CR- 0 NEDAC | DIST-SEP89 REV2-DEC93 |
| HISTORY
87-03 NEW EVALUATION
88-12 MF/MT=3/107 MOI
89-08 MF/MT=15/102 MO
93-12 JENDL-3.2 | WAS MADE BY T.ASAMI.
DIFIED.
DIFIED. |
| GAMMA-RAY PROL | DUCTION DATA REVISED BY T.ASAMI (DATA ENG.) |
| COMPILED BY T.1 | NAKAGAWA (NDC/JAERI) |
| ***** MODIFIED
(3,1), (3,2)
(4,16-28), (4,9
(5,16-91)
(12,102)
(13,3), (13,4)
(15,102) | PARTS FOR JENDL-3.2 ************************************ |
| JENDL FUSION FIL | E /1/ (AS IS AUG. 1993) |
| EVALUATED B.YU | J (CIAE) AND S.CHIBA (NDC/JAERI) |
| COMPILED BY B | YU. |
| ALL OF CROSS | S SECTINOS WERE TAKEN FROM JENDL-3. MF=6 OF |
| MT=16, 22, 28 | AND 91 WERE CREATED FROM SINCROS-II /2/ AND |
| F15TOB/1/ PRO | GRAM. MODIFIED-KUMABE'S SYSTEMATICS /1/ WAS |
| USED. THE PRE | ECOMPOUND/COMPOUND RATIO WAS CALCULATED BY |
| THE SINCROS-I | I CODE SYSTEM. |
| OPTICAL-MODE | EL, LEVEL DENSITY AND OTHER PARAMETERS USED |
| IN THE SINCROS | S-II CALCULATION ARE DESCRIBED IN REF./2/. |
| LEVEL SCHEMES | WERE DETERMINED ON THE BASIS OF ENSDF/3/. |
| MF=1 GENERAL INFORMAT | TION |
| MT=451 DESCRIPTIVE | DATA AND DICTIONARY |
| MF=2 RESONANCE PARAME | ETERS |
| MT=151 RESOLVED RESO | DNANCE PARAMETERS |
| RESOLVED PARAMETERS | S FOR MLBW FORMULA WERE GIVEN IN THE ENERGY |
| REGION FROM 1.0E-5 | EV TO 300 KEV. THE DATA WERE CONSTRUCTED |
| FROM THE EVALUATED | RESONANCE PARAMETERS FOR EACH CR ISOTOPE, |
| CONSIDERING THEIR | ABUNDANCES IN THE CR ELEMENT/4/. |
| 2200 M/S (
ELASTIC 3.38
CAPTURE 3.07
TOTAL 6.45 | CROSS SECTION(B) RES. INTEGRAL(B)
1.53 |
| MF=3 NEUTRON CROSS SE | ECTIONS |
| BELOW 300 KEV, BACH | (GROUND CROSS SECTION WAS GIVEN. AS THE |
| EVALUATED DATA ON | THE RESONANCE PARAMETERS OF CR-53 WERE GIVEN |
| BELOW 120 KEV, THE | CROSS SECTIONS OF CR-53 FOR TOTAL, ELASTIC |
| SCATTERING AND CAPT | FURE IN THIS ENERGY RANGE, MULTIPLIED BY ITS |
| ABUNDANCE, ARE PROV | (IDED AS THE BACKGROUND CROSS SECTIONS FOR |
| MT=1, 2 AND 102. | ALL THE CROSS-SECTION DATA WERE DEDUCED FROM |
| THE EVALUATED ONES | FOR FOUR STABLE ISOTOPES OF CR CONSIDERING |
| THEIR ABUNDANCES IN | N THE CR ELEMENT/4/, EXCEPT FOR THE TOTAL |
| CROSS SECTIONS IN | THE ENERGIES ABOVE 300 KEV. |
| MT=1 TOTAL
THE DATA IN THE ENE
ON THE EXPERIMENTAL
USED TO DETERMINE
AND /7/ WERE USED F
AND FOR THE EVALUAT
OBTAINED CROSS SECT
EXPERIMENTAL RESOLU | ERGY RANGE ABOVE 300 KEV WERE EVALUATED BASED
DATA OF/5.6.7/. THE DATA IN REF./5/ WERE
THE FINE STRUCTURE AND THOSE IN REFS. /6/
FOR THE RE-NORMALIZATION OF THE ABOVE DATA
FION IN THE HIGH ENERGY REGION. THUS
FION WAS UNFOLDED BY CONSIDERING THE
JTION OF 0.054 NSEC/M/5/ BELOW 4.4 MEV. |
| MT=2 ELASTIC SCATTER | ING |
| OBTAINED BY SUBTRAC | CTING THE SUM OF THE PARTIAL CROSS SECTIONS |
| FROM THE TOTAL CROS | SS SECTION. |
| MT=4, 51-90, 91 INEL/ | ASTIC SCATTERING |
| THE DATA FOR EACH I | EVEL WERE CONSTRUCTED FROM THE EVALUATIONS |
| FOR EACH CR ISOTOPE | AS FOLLOWS: |
| MT LEVEL ENERGY
G.S. 0.0
51 0.5640 | (MEV) CR-50 CR-52 CR-53 CR-54
51 |

| 52 | 0.7833 | 51 | | | | |
|--------------------------|-------------------------------|--------------|-------------------------|----------|------------|-------|
| 53
54 | 0.8349 | | | 52 | 51 | |
| 55 | 1.2895 | | | 53 | | |
| 56
57 | 1.4341
1.5366 | | 51 | 54 | | |
| 58 | 1.8237 | 50 | | 01 | 52 | |
| 59
60 | 1.8814
1.9736 | 52 | | 55 | | |
| 61 | 2.1724 | | | 56 | | |
| 62
63 | 2.2330 | | | 57
58 | | |
| 64 | 2.3696 | | 52 | 50 | | |
| 65 | 2.4531 | | | 59 | 53 | |
| 67 | 2.6470 | | 53 | | 55 | |
| 68 | 2.6570 | | 54 | 60 | | |
| 70 | 2.7720 | | 54 | 61 | | |
| 71 | 2.8266 | | | 62 | E / | |
| 73 | 2.9245 | 53 | | | 54 | |
| 74 | 2.9648 | | 55 | 60 | | |
| 75
76 | 2.9930
3.0739 | | | 63 | 55 | |
| 77 | 3.1138 | | 56 | | 50 | |
| 78
79 | 3.1600 | 54 | | | 56 | |
| 80 | 3.1617 | | 57 | | | |
| 81
82 | 3.3247
3.4152 | 55 | 58 | | | |
| 83 | 3.4722 | | 59 | | | |
| 84
85 | 3.6158 | | 60
61 | | | |
| 86 | 3.7717 | | 62 | | | |
| 87
88 | 3.9460
4.0154 | | 63
64 | | | |
| 89 | 4.5630 | | 65 | | | |
| 90
91 | 4.6270 | 91 | 66
91 | 91 | 91 | |
| UT 40 | | 01 | 0.1 | 01 | 01 | |
| MI=16
CONSTRUC | (N,2N)
TED FROM THE EVA | UNTED DATA | A FOR F | OUR CR | ISOTOPES | |
| SO AS TO | REPRODUCE THE E | XPER IMENTAL | DĂTA | ŎF FREH | AUT/8/. | |
| MI=22
CONSTRUC | (N,NA)
TED FROM THE EVA | UNATED DATA | A FOR F | OUR CR | ISOTOPES | |
| MT=28 | (N,NP) | | | | | |
| CONSTRUC
MT=102 | LED FROM THE EVA | LUAIED DAIA | A FOR F | OUR CR | ISOTOPES. | |
| <u> </u> | ED WITH THE CAST | HY CODE/9/ | AND NO | RMALIZE | D_TO_10 MB | AT |
| 50 KEV.
VALUES | Q-VALUE IS A WE | IGHIED AVE | RAGE VA | LUE OF | ISOTOPE Q | |
| MT=103 | -(N,P) | | | | | |
| MT=107 | (N,A) | ALUATED DATA | A FUR F | OUR CR | ISUIUPES. | |
| CONSTRUC | TED FROM THE EVA | LUATED DATA | A <u>F</u> Q <u>R</u> F | OUR CR | ISOTOPES | |
| SU AS IU
MT=251 | MU-BAR | XPERIMENIAL | DATA | OF PAUL | SEN/10/. | |
| CALCULAT | ED WITH OPTICAL | MODEL. | | | | |
| MF=4 ANGUL | AR DISTRIBUTIONS | S OF SECONDA | ARY NEU | TRONS | | |
| MT=2 | | | | | | |
| MT=51-90 | ED WITH THE CAST | HY CODE/9/ | | | | |
| CALCULAT | ED WITH THE CAST | THY CODE. | | | | |
| TAKEN FR | OM JENDL FUSION | FILE. | | | | |
| | | | | DONO | | |
| MF=5 ENERG
MT=16. 22. | 28. 91 | OF SECONDAR | KY NEUI | RUNS | | |
| TÁKÉN FR | OM JENDL FUSION | FILE. | | | | |
| MF=12 PHOT | ON PRODUCTION MU | | -s | | | |
| MT=102 (BE | LOW 2.5 MEV) | | - 0 | | | |
| FROM EN | ERGY BALANCE. | | | | | |
| MF=13 PHOT | ON PRODUCTION CR | ROSS SECTION | ١S | | | |
| MI=3 (ABOV
FVALUAT | E 2.5 MEV)
ED BASED ON THE | EXPERIMENT | | OF MOR | GAN/11/ | BELOW |
| 4.75 ME | V, THE FINE STRU | JCTURES IN | INELAST | IC SCAT | TERING WER | Ē |
| CONSIDE | KED.
W 2 5 MEVN | | | | | |
| | | | | | | |

CALCULATED FROM INELASTIC SCATTERING CROSS SECTIONS AND GAMMA-RAY BRANCHING RATIOS OF ISOTOPES.

MF=14 PHOTON ANGULAR DISTRIBUTIONS

MT=3, 4, 102 ASSUMED TO BE ISOTROPIC.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA

MT=3 CALCULATED WITH THE GNASH CODE/12/.

MT=102 CALCULATED WITH THE CASTHY IN THE THERMAL ENERGY REGION AND WITH GNASH ABOVE 100 KEV.

REFERENCES

CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO N.: JAERI-M 90-006 (1990).
EVALUATED NUCLEAR STRUCTURAL DATA FILE, BNL/NNDC.
HOLDEN N.E., MARTIN R.L. AND BARNES I.L. : PURE & APPL. CHEM. 56, 675 (1984).
CIERJACKS S. ET AL. : KFK-1000 (1968).
FOSTER JR. D.G. ET AL. : PHYS. REV. C 3, 576 (1971).
PEREY F.G. : EXFOR DATA NO.10342 (1973).
FREHAUT J. ET AL. : 1980 BNL CONF. 399 (1980).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
PAULSEN A. : NUCL. SCI. ENG. 78, 377 (1981).
MORGAN G.L. ET AL. : ORNL/TM-5098 (1976).
YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

MAT number = 2425 24-CR- 50 NEDAC EVAL-MAR87 T.ASAMI(NEDAC) DIST-SEP89 REV2-SEP93 HISTORY NEW EVALUATION WAS MADE BY T.ASAMI. MF/MT=3/107 MODIFIED. JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) 87-03 88-12 93 - 09* * * * * JENDL FUSION FILE /1/ (AS OF SEP. 1993) EVALUATED B.YU (CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY B.YU. ALL OF CROSS SECTIONS WERE TAKEN FROM JENDL-3. MF=6 OF MT=16, 22, 28 AND 91 WERE CREATED WITH SINCROS-II /2/ AND F15TOB/1/ PROGRAM. MODIFIED-KUMABE'S SYSTEMATICS /1/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/3/. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 300 KEV. EVALUATION WAS BASED ON THE EXPERIMENTAL DATA OF STIEGLITZ+71/4/, BEER+74/5/, ALLEN+77/6/, KENNY+77/7/ AND BRUSEGAN+86/8/. EFFECTIVE SCATTERING RADIUS = 6 0 EM(0) MF=2 5.0 FM/9/. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRAL. 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B) ELASTIC 2.31 CAPTURE 15.9 7.41 TOTAL 18.2 MF=3 NEUTRON CROSS SECTIONS BELOW 300 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN. MT=1 TOTAL =1 TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH THE CASTHY CODE/10/. THE OPTICAL POTENTIAL PARAMETERS USED ARE: V = 46.78 - 0.262*EN, VSO = 7.0 (MEV) WS = 4.87 + 0.352*EN, WV = 0 (MEV) R = 1.30, RS = 1.40, RSO = 1.30 (FM) A = 0.55, B = 0.40, ASO = 0.48 (FM) SURFACE IMAGINARY PART IS IN DERIVATIVE WOODS-SAXON FORM. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. 4, 51-55, 91 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/10/, TAKING ACCOUNT OF THE CONTRIBUTION FROM THE COMPETING PROCESSES AND USING THE DISCRETE LEVEL DATA/11/ SHOWN BELOW. THE CONTRIBUTIONS FROM THE DIRECT PROCESS FOR THE LEVEL MARKED WITH '*' WERE CALCULA-TED WITH THE DWUCK CODE/12/. THE DEFORMATION PARAMETERS USED IN THE CALCULATION WERE ASSUMED BASED ON PETERSON'S DATA/13/. MT = 4LEVEL ENERGY(MEV) SPIN-PARITY G.S. 0+ 0.0 U.U 0.7833 1.8814 2.9245 3.1611 3.1641 2+ 1 2 3 2+ 4+ 2+ * * * 2+ 4 5 6+ 6 3.3247 4+ 4+ 3.5946 3.6101 8 4 +9 3.6295 1 +

| | 10
11
12
13
14
15
16
17
18
19
20
20 | 3.6940
3.6978
3.7924
3.8261
3.8443
3.8500
3.8752
3.8953
3.8983
3.9377
4.0517 | | 0+
2+
5+
6+
3+
0+
2+
4+
3+
0+ | | | |
|----|--|--|--------|--|----------|---------|--------|
| | LEVĔLS | ABOVE 4.066 | MEV WI | ERE ASSUME | ED TO BE | OVERLA | PPING. |
| IF | CALCUI | ATED DATA E | OR THE | INFLASTIC | C SCATTE | RING WE | RE EIN |

LUMPED FOR THE CONVENIENCE ON THE CONSTRUCTION OF THE ELEMENTA DATA AS FOLLOWS:

| MT NO. | LEVEL ENERGY(MEV) | LUMPING OF LEVEL |
|--------|-------------------|------------------|
| 51 | 0.7833 `´´ | 1 |
| 52 | 1.8814 | 2 |
| 53 | 2.9245 | 3 |
| 54 | 3.1611 | 4 - 5 |
| 55 | 3.3247 | 6 |
| 91 | 3.5946 | OVER 7 |

FURTHERMORE, THE DATA OF MT=51 WERE MODIFIED BY CONSIDERING EXPERIMENTAL DATA. THE TOTAL INELASTIC SCATTERING CROSS SEC-TION (MT=4) IS THE SUM OF MT'S FROM 51 TO 91.

MT=16 (N,2N) MAINLY BASED ON THE EXPERIMENTAL DATA OF BORMANN /14/.

MAINLY BASED ON THE EXPERIMENTAL DATA OF BORMANN /14/. MT=22 (N,NA) CALCULATED WITH THE GNASH CODE/15/. MT=28 (N,NP) CALCULATED WITH THE GNASH CODE/15/. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/10/ AND NORMALIZED TO REPRODUCE THE ELEMENT DATA OF 10 MB AT 50 KEV. MT=103 (N,P) CALCULATED WITH THE GNASH CODE/15/. MT=107 (N,A) CALCULATED WITH THE GNASH CODE AND NORMALIZED AT 14.8 MEV IN REFERRING TO GRIMES'S DATA/16/. THE DATA NEAR THE THRESHOLD WERE MODIFIED IN REFERRING TO THE EXPERIMENTAL DATA FOR THE ELEMENT CR(N,ALPHA)/17/. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 ELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/10/. MT=16, 22, 28, 91 (N,2N), (N,NA), (N,NP), CONTINUUM INELASTIC APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE. MT=51-55 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE AND THE DWUCK CODE/12/.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 22, 28, 91
APPROXIMATELY TRANSFRMED FROM THE MF=6 DATA (DDX) OF JENDL
FUSION FILE.

REFERENCES

CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO N.: JAERI-M 90-006 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
STIEGLIZ R.G. ET AL.: NUCL. PHYS. A163, 592 (1971).
BEER H. AND SPENCER R.P. : KFK-2063 (1974), ALSO NUCL. PHYS. A240, 29 (1975).
ALLEN B.J. AND MUSGROVE A.R.DE L. : NEUTRON DATA OF STRUCTURAL MATERIALS FOR FBR, 1977 GEEL MEETING, P.447, PERGAMON PRESS (1979).
KENNY M.J. ET AL. : AAEC/E-400 (1977).
BRUSEGAN A. ET AL. : SSANTA FE VOL.1 P.633 (1986).
MUGHABGHAB S.F. ET AL. : "NEUTRON CROSS SECTIONS", VOL.1, PART A (1981).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
DATA TAKEN FROM ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE).
KUNZ P.D. : UNPUBLISHED.
PETERSON R.J. AND PERLMAN, D.E.: NUCL. PHYS. A117,185(1968).
BORMANN M. : THE DATA (1965) IN EXFOR FILE.
YOUNG P.G. AND ARTHUR E.D. : LA-6947 (1977).

16) GRIMES S.M. ET AL. : PHYS. REV. C19, 2127 (1979). 17) PAULSEN A. : NUCL. SCI. ENG. 78, 377 (1981).

| MAT number = 2431
24-CR- 52 NEDAC | EVAL-MAR87 T.ASAMI(NEDAC)
DIST-SEP89 REV2-SEP93 |
|--|--|
| 87-03 NEW EVALUATION
88-12 MF/MT=3/107 MOD | WAS MADE BY T.ASAMI.
DIFIED. |
| GOMPILED BY T.N | NAKAGAWA (NDC/JAERI) |
| ***** MODIFIED
(3.2) | PARTS FOR JENDL-3.2 ******************** |
| (3,4), (3,91)
(3,66-67) | TAKEN FROM JENDL FUSION FILE
DELETED |
| (4,16-28), (4,91
(5,16-91)
********* | 1) TAKEN FROM JENDL FUSION FILE
TAKEN FROM JENDL FUSION FILE |
| IENDI EUSION ELL | F /1/ (AS OF SEP 1993) |
| EVALUATED B.YU
COMPILED BY B. | J (CIÁE) AND S.CHIBA (NDC/JAERI)
.YU. |
| CROSS SECT
(N,N') CONTINU | TIONS WERE MAINLY TAKEN FROM JENDL-3. THE
JUM_CROSS SECTION (MT=91) IN_THE WHOLE ENERGY |
| REGION AND IIS
CALCULATION.
SECTIONS (MT-6 | S SPECIRA WERE TAKEN FROM THE SINCROS-11/2/
SEVERAL DISCRETE LEVEL SCATTERING CROSS
33 64 65 66) AND THE R ANGULAR DISTRIBUT |
| TION WERE DELE
CONTINUUM INEL | TED BECAUSE THEY WERE INCLUDED IN THE NEW
LASTIC SCATTERING CROSS SECTION(MT=91) TAKEN |
| FROM THE SINCE
WAS CHANGED FR | ROS-II CALCULATION. THE THRESHOLD OF MT=91 |
| Z8 AND 91 WERE
KUMABE'S SYSTE
POUND RATIO WA | E CREATED BY FISIOB PROGRAM/17. MODIFIED-
EMATICS/1/ WAS USED. THE PRECOMPOUND/COM-
AS TAKEN FROM THE SINCROS-IL CALCULATION |
| OPTICAL-MODE | LEVEL DENSITY AND OTHER PARAMETERS USED |
| LEVEL SCHEMES | WERE DETERMINED ON THE BASIS OF ENSDF/3/. |
| MF=1 GENERAL INFORMAT
MT=451 DESCRIPTIVE D | FION
DATA AND DICTIONARY |
| MF=2 RESONANCE PARAME | |
| RESOLVED PARAMETERS | S FOR MLBW FORMULA WERE GIVEN IN THE ENERGY |
| THĚ ĚXPERIMENTAL ĎA
ALLEN+77/6/, KENNY+ | ATA OF ŠTIEGLITZ+ 7174/, BEER+74/5/,
+77/7/, AGRAWAL+84/8/ AND BRUSEGAN+86/9/. |
| CALCULATED 2200 M/ | NG RADIUS = 5.2 FM /10/
/S CROSS SECTIONS AND RESONANCE INTEGRAL |
| 2200 M/S C
ELASTIC 2.96 | CROSS SECTION(B) RES. INTEGRAL(B) |
| TOTAL 0.76 | 0.46 |
| MF=3 NEUTRON CROSS SE
BELOW 300 KEV, ZER | ECTIONS
RO BACKGROUND CROSS SECTION WAS GIVEN. |
| ABOVE 300 KEV, THE
POINTWISE. | E TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN |
| MT=1 TOTAL
OPTICAL_AND_STATIS | STICAL_MODEL_CALCULATION WAS MADE_WITH |
| V = 46.78 - 0.26 | 1/. THE OPTICAL POTENTIAL PARAMETERS USED ARE
52*EN, VSO = 7.0 (MEV)
2*EN, WV = 0 (MEV) |
| R = 1.30, RS = A = 0.55, B = 0.55 | 1.40, RSO = 1.30 (FM)
0.40, ASO = 0.48 (FM) |
| SURFACE IMAGINA | ARY PÁRT IS IN DERIVATIVE WOODS-SAXON FORM. |
| OBTAINED BY SUBTRA
FROM THE TOTAL CRC | ACTING THE SUM OF THE PARTIAL CROSS SECTIONS |
| MT=4, 51-62, 91 INELA
CALCULATED WITH TH | ASTIC SCATTERING
HE CASTHY CODE/11/. TAKING ACCOUNT OF THE |
| CONTRIBUTION FROM
DISCRETE LEVEL DAT | THE COMPETING PROCESSES AND USING THE
[A/12/_SHOWN_BELOWTHE CONTRIBUTIONS FROM |
| CALCULATED WITH TH | ATION WERE ASSUMED BASED ON A WEAK COUPLING |
MODEL.

| G.S.
234567890
11234567890
11234567890
11234567890
11234507890 | LEVEL ENERGY(MEV)
0.0
1.4341
2.3696
2.6470
2.7677
2.9648
3.1138
3.1617
3.4152
3.4722
3.6158
3.7000
3.7717
3.9460
3.9512
4.0154
4.0380
4.5630
4.5630
4.6270
4.7060
4.7410 | SPIN-PARITY
0+
2+
4+
0+
2+
6+
2+
4+
3+
5+
2+
2+
4+
1+
5+
4+
3-
5+
2+
2+
2+
2+
2+
4+
2+
2+
2+
4+
2+
2+
4+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+ | *
*
* |
|--|--|---|---|
| 21
22
23
LEVELS
THE CALCUL | 4.7507
4.7940
4.8045
ABOVE 4.816 MEV WERE
ATED DATA FOR THE IN
THE CONVENIENCE ON | 8+
0+
6+
ASSUMED TO
IELASTIC SCAT
THE CONSTRUC | BE OVERLAPPING.
TERING WERE FINALLY
TION OF THE FIEMENT |
| DATA AS FO
MT NO.
51
52
53
54
55
56
57
58
59
60
61
62
63
64
63
64
66
91 | LEVEL ENERGY(MEV)
1.4341
2.3696
2.6470
2.7677
2.9648
3.1138
3.1617
3.4152
3.4722
3.6158
3.7000
3.7717
3.9460
4.0154
4.5630
4.6270
4.7060 | LUMPING
1
2
3
4
5
6
7
8
9
10
11
12
13-14
15-16
17
18
0VER 19 | TION OF THE ELEMENT |
| THE DATA (
MENTAL DAT
(MT-4) IS | DF MT=51 AND 52 WERE
FA. THE TOTAL INELAS
THE SUM OF MT'S FROM | MODIFIED BY
STIC SCATTERI | CONSIDERING EXPERI-
NG CROSS SECTION
FOR LENDL-3 2 CROS |

IG EXPERI-SECTION 3.2, CROSS М (MT=4) IS THE SUM OF MT'S FROM 51 TO 91. FOR JENDL-3.2, SECTIONS OF MT'S FROM 63 TO 66 WERE INCLUDED INTO MT=91. Q-VALUE OF MT=91 WAS CHANGED TO 3.8 MEV.

MT=16 (N,2N) ADOPTED WERE THE EVALUATED DATA IN JENDL-2 WHICH HAVE BEEN EVALUATED BASED ON THE EXPERIMENTAL DATA OF WENUSCH+62/14/, BORMANN+68/15/, MASLOV+72/16/, QAIM72/17/, SAILER+77/18/ AND GHORAI+87/19/. MT=22 (N,NA) CALCULATED WITH THE GNASH CODE/20/ AND NORMALIZED. MT=28 (N,NP) CALCULATED WITH THE GNASH CODE/20/ AND NORMALIZED. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/11/ AND NORMALIZED TO 28.5 MB AT 50 KEV SO AS TO REPRODUCE THE ELEMENT DATA OF 10 MB. MT=103 (N,P) CALCULATED WITH THE GNASH CODE/20/ AND NORMALIZED AT 14.8 MEV TO THE RECOMMENDED VALUE OF FORREST/21/. MT=107 (N,A) CALCULATED WITH THE GNASH CODE AND NORMALIZED AT 14.8 MEV TO THE AVERAGE VALUES OF THE EXPERIMENTAL DATA/22,23/. THE DATA WERE MODIFIED NEAR THE THRESHOLD IN REFERRING TO THE THE EXPERIMENTAL DATA OF PAULSEN /24/ FOR THE ELEMENT CR(N,A). MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. WE-4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

MT=2 ELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/11/.
MT=51-62 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/11/ AND THE DWUCK CODE/13/.
MT=6.22 28.91 (N.2N) (N.NA) (N.PP) CONTINUUM INELASTIC APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE.
MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MI=16.22 28.91 APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE.
REFERENCES 1) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO N.: JAERI-M 90-006 (1990).
3) ENSOF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
4) STIEGLIZ R.G. ET AL.: NUCL. PHYS. A163, 592 (1971).
5) BEER H. AND SPENCER R.P.: KFK-2063 (1974), ALSO NUCL. PHYS. A20, 29 (1975).
6) ALLEN B.J. AND MUSGROVE A.R.DE L.: NEUTRON DATA OF STRUCTURAL MATERIALS FOR FBR, 1977 GEEL MEETING, P.447, PERGAMON PRESS (1979).
7) KENNY M.J. ET AL.: AAEC/E-400 (1977).
8) AGRAWAL H.M. ET AL.: BYSANTA FE VOL.1 P.633 (1986).
9) BRUSEGAN A. ET AL.: SSANTA FE VOL.1 P.633 (1986).
9) BRUSEGAN A. ET AL.: NUCL. CONST. VOL.9, 50 (1972).
11) IGARSI S. AND FUKAFORI T.: JAERI 1321 (1991).
12) DATA TAKEN FROM ENSDF(EVALUATED NUCLEAR STRUCTURE DATA FILE).
14) WUSCH R. ET AL.: 10SA 99 1 (1962).
15) BORMANN M. ET AL.: NUCL. CONST. VOL.9, 50 (1972).
16) MASLOV G.N. ET AL.: NUCL. CONST. VOL.9, 20 (1977).
18) SALER K. ET AL.: 1977 KIEV CONF. VOL.9, 246 (1977).
19) GHORAI S.K. ET AL.: 1977 KIEV CONF. VOL.9, 216 (1977).
19) GHORAI S.K. ET AL.: 1977 KIEV CONF. VOL.9, 216 (1977).
20) MUG P.G. AND ARTHUR E.D.: LA-6947 (1977).
21) FORREST R.A.: AERE-R:12419 (1986).
22) GRIMES S.M. ET AL.: 1973 KIEV CONF. VOL.9, 3131 (1973).
24) PAULSEN A.: NUCL. SCI. ENG. 78, 377 (1981). MAT number = 2434 24-CR- 53 NEDAC EVAL-MAR87 T.ASAMI(NEDAC) DIST-SEP89 REV2-SEP93 HISTORY NEW EVALUATION WAS MADE FOR JENDL-3 MF/MT=3/107 MODIFIED. JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) 87-03 88-12 93 - 09* JENDL FUSION FILE /1/ (AS OF SEP. 1993) EVALUATED B.YU (CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY B.YU. ALL OF CROSS SECTIONS WERE TAKEN FROM JENDL-3. MF=6 OF MT=16, 22, 28 AND 91 WERE CREATED WITH SINCROS-II /2/ AND F15TOB/1/ PROGRAM. MODIFIED-KUMABE'S SYSTEMATICS /1/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/3/. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY IF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 120 KEV. EVALUATED BASED ON THE EXPERIMENTAL DATA OF STIEGLITZ+71/4/, BEER+74/5/, ALLEN+77/6/, KENNY+77/7/, BRUSEGAN+86/8/ AND MUELLER+71/9/. EFFECTIVE SCATTERING RADIUS = 5.4 FM/10/. MF=2 CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRAL. 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B) ELASTIC 7.78 CAPTURE 18.2 8.61 TOTAL 25.9 MF=3 NEUTRON CROSS SECTIONS BELOW 120 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN. ABOVE 120 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN POINTWISE. MT=1 TOTAL =1 TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH THE CASTHY CODE/11/. THE OPTICAL POTENTIAL PARAMETERS USED ARE V = 46.78 - 0.262*EN, VSO = 7.0 (MEV) WS = 4.87 + 0.352*EN, WV = 0 (MEV) R = 1.30, RS = 1.40, RSO = 1.30 (FM) A = 0.55, B = 0.40, ASO = 0.48 (FM) SURFACE IMAGINARY PART IS IN DERIVATIVE WOODS-SAXON FORM. MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION. 4, 51-63, 91 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/11/, TAKING ACCOUNT OF THE CONTRIBUTION FROM THE COMPETING PROCESSES AND USING THE DISCRETE LEVEL DATA/3/ SHOWN BELOW. THE CONTRIBUTIONS FROM THE DIRECT PROCESS FOR THE LEVELS MARKED WITH '*' WERE CALCULATED WITH THE DWUCK CODE/12/. THE DEFORMATION PARAME-TERS USED IN THE CALCULATION WERE ASSUMED BASED ON A WEAK COUPLING MODEL. LEVEL ENERGY(MEV) SPIN-PARITY 3/2-1/2-G.S. 0.5640 * * 5/2-7/2-1.0063 3 1.2895 1.5366 7/2-4 5/2-* 5 11/2 -6 2.1724

| 7 | 2 2330 | 0/2- |
|----------|--------|---------------|
| 8 | 2 3208 | 3/2- |
| ğ | 2.4531 | 3/2- |
| 1Õ | 2.6570 | 5/2- |
| 11 | 2.6695 | 1/2- |
| 12 | 2.7065 | 13/2- |
| 13 | 2.7080 | 3/2- |
| 14 | 2.7720 | 5/2- |
| 15 | 2.8266 | 11/2- |
| 16 | 2.9930 | 1/2- |
| 17 | 3.0841 | 15/2- |
| 10 | 3.0930 | 5/2- |
| 19 | 3.1300 | 5/Z-
2/2 |
| 20
21 | 3 2/30 | 3/2-
11/2- |
| 22 | 3 2610 | 5/2- |

LEVELS ABOVE 3.435 MEV WERE ASSUMED TO BE OVERLAPPING.

THE CALCULATED DATA FOR THE INELASTIC SCATTERING WERE FINALLY LUMPED FOR THE CONVENIEINCE ON THE CONSTRUCTION OF THE ELEMENT DATA AS FOLLOWS:

| LEVEL ENERGY(MEV) | LUMPING |
|-------------------|---|
| 0.5640 | 1 |
| 1.0063 | 2 |
| 1.2895 | 3 |
| 1.5366 | 4 |
| 2.1724 | 5 |
| 2.2330 | 6 |
| 2.3208 | 7 |
| 2.4531 | 8 |
| 2.6570 | 9 |
| 2.7720 | 10-13 |
| 2.8266 | 14 |
| 3.0020 | 15 |
| 2.8266 | 15 |
| 2.9930 | 16 |
| 2.9930 | OVER 17 |
| | LEVEL ENERGY(MEV)
0.5640
1.0063
1.2895
1.5366
2.1724
2.2330
2.3208
2.4531
2.6570
2.7720
2.8266
2.9930
2.9930 |

MT=16 (N,2N) CALCULATED WITH THE GNASH CODE/13/. MT=22 (N,NA) CALCULATED WITH THE GNASH CODE AND NORMALIZED. MT=28 (N,NP) CALCULATED WITH THE GNASH CODE AND NORMALIZED. MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/11/ AND NORMALIZED AT 50 KEV TO REPRODUCE THE ELEMENT DATA OF 10 MB. MT=103 (N,P) BELOW 9 MEV, EVALUATED BASED ON THE EXPERIMENTAL DATA OF SMITH/14/. ABOVE 9 MEV, CALCULATED WITH THE GNASH CODE/13/ AND NORMALIZED SO AS TO BE CONNECTED WITH SMITH'S EXPERIMENTAL DATA/14/.

DATA/14/.

MT=107 (N,A) CALCULATED WITH THE GNASH CODE/13/ AND NORMALIZED AT 14.7 MEV TO DOLJA'S EXPERIMENTAL DATA/15/. THE DATA NEAR THRESHOLD WERE MODIFIED IN REFERRING TO THE EXPERIMENTAL DATA FOR THE ELEMENT CR(N,ALPHA)/16/. MT=251 MU-BAR MD-BAR

ČĂLCULATED WITH OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 ELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/11/. MT=51-63 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE AND THE DWUCK CODE/12/. MT=16, 22, 28, 91 (N,2N), (N,NA), (N,NP), CONTINUUM INELASTIC APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE.

- REFERENCES
 1) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
 2) YAMAMURO N.: JAERI-M 90-006 (1990).
 3) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
 4) STIEGLIZ R.G. ET AL.: NUCL. PHYS. A163, 592 (1971).
 5) BEER H. AND SPENCER R.P.: KFK-2063 (1974), ALSO NUCL. A240, 29 (1975). PHYS.

- 6) ALLEN B.J. AND MUSGROVE A.R.DE L.: NEUTRON DATA OF STRUCTURAL MATERIALS FOR FBR, 1977 GEEL MEETING, P.447, PERGAMON PRESS (1979).
 7) KENNY M.J. ET AL.: AAEC/E-400 (1977).
 8) BRUSEGAN A. ET AL.: 85SANTA FE VOL.1 P.633 (1986).
 9) MUELLER K.N. ET AL.: NUCL. PHYS. A164, 97 (1971).
 10) MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS", VOL.1, PART A (1981).
 11) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 12) KUNZ P.D.: UNPUBLISHED.
 13) YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
 14) SMITH D.L. ET AL.: 1973 KIEV CONF. VOL.3, 131 (1973).
 16) PAULSEN A.: NUCL. SCI. ENG. 78, 377 (1981).

| MAT number = 2437
24-CR- 54 NEDAC EVAL-MAR87 T.ASAMI(NEDAC)
DIST-SEP89 REV2-SEP93
HISTORY
87-03 NEW EVALUATION WAS MADE FOR JENDL-3. |
|--|
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| (4, 10-20), (4, 91) TAKEN FROM JENDL FUSION FILE
(5, 16-91) TAKEN FROM JENDL FUSION FILE |
| JENDL FUSION FILE /1/ (AS OF SEP. 1993)
EVALUATED B.YU (CIAE) AND S.CHIBA (NDC/JAERI)
COMPILED BY B.YU. |
| ALL OF CROSS SECTIONS WERE TAKEN FROM JENDL-3. MF=6 OF
MT=16, 22, 28 AND 91 WERE CREATED WITH SINCROS-II /2/ AND
F15TOB/1/ PROGRAM. MODIFIED-KUMABE'S SYSTEMATICS /1/ WAS
USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY
THE SINCROS-II CODE SYSTEM.
OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED
IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/3/. |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| <pre>MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 300 KEV. EVALUATED BASED ON THE
EXPERIMENTAL DATA OF STIEGLITZ+71/4/, BEER+74/5/, ALLEN+77/6/,
KENNY+77/7/ AND BRUSEGAN+86/8/. EFFECTIVE SCATTERING RADIUS =
5.3 FM/9/.</pre> |
| CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRAL.
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 2.54
CAPTURE 0.36 0.18
TOTAL 2.90 |
| MF=3 NEUTRON CROSS SECTIONS
BELOW 300 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN.
ABOVE 300 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN
POINTWISE. |
| <pre>MT=1 TOTAL
OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH THE
CASTHY CODE/10/. THE OPTICAL POTENTIAL PARAMETERS USED ARE:
V = 46.78 - 0.262*EN, VSO = 7.0 (MEV)
WS = 4.87 + 0.352*EN, WV = 0 (MEV)
R = 1.30, RS = 1.40, RSO = 1.30 (FM)
A = 0.55, B = 0.40, ASO = 0.48 (FM)
SURFACE IMAGINARY PART IS IN DERIVATIVE WOODS-SAXON FORM.</pre> |
| <pre>MT=2 ELASTIC SCATTERING
OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS
FROM THE TOTAL CROSS SECTION.</pre> |
| MT=4, 51-60, 91 INELASTIC SCATTERING
CALCULATED WITH THE CASTHY CODE/10/, TAKING ACCOUNT OF THE
CON- TRIBUTION FROM THE COMPETING PROCESSES AND USING THE
DISCRETE LEVEL DATA/3/ SHOWN BELOW. THE CONTRIBUTIONS FROM
THE DIRECT PROCESS FOR THE LEVELS MARKED WITH '*' WERE CALCU-
LATED WITH THE DWUCK CODE/11/. THE DEFORMATION PARAMETERS USED
IN THE CALCULATION WERE ASSUMED BASED ON A WEAK COUPLING
MODEL |
| LEVEL ENERGY(MEV) SPIN-PARITY
G.S. 0.0 0+
1 0.8349 2+ *
2 1.8237 4+ *
3 2.6195 2+ *
4 2.8294 0+ *
5 3.0739 2+ *
6 3.1600 2+ *
7 3.2225 6+
8 3.3920 1+ |

| 9
10
11
12
13
14
15
16
17
18
19
20
21
LEVELS ABO
THE CALCULATE
LUMPED FOR TH | 3.4366
3.4680
3.5140
3.6552
3.7198
3.7858
3.7989
3.8640
3.9340
3.9340
4.0160
4.0450
4.0450
4.0832
VE 4.088 MEV WER
D DATA FOR THE I | 2+
1+
2+
4+
2+
4+
4+
2+
1+
3+
0+
6+
4+
E ASSUMED TO BE
NELASTIC SCATTER
I THE CONSTRUCTIO | OVERLAPPING.
ING WERE FINALLY
N OF THE ELEMENT |
|---|---|---|--|
| MT NO.
51
52
53
54
55
56
57
58
59
60
91 | WS:
LEVEL ENERGY(MEV
0.8349
1.8237
2.6195
2.8294
3.0739
3.1600
3.2225
3.3920
3.4366
3.4680
3.5140 | () LUMPING
1
2
3
4
5
6
7
8
9
10
OVER 11 | |
| $ \begin{array}{c} MT=16 & (N,2\\ CALCULATED & WI\\ MT=22 & (N,N\\ CALCULATED & WI\\ MT=28 & (N,N\\ CALCULATED & WI\\ MT=102 & CAPT\\ CALCULATED & WI\\ SO & AS & TO & REPR\\ MT=103 & (N,P\\ CALCULATED & WI\\ TO & AN & AVERAGE\\ MT=107 & (N,A\\ CALCULATED & WI\\ TO & AN & AVERAGE\\ MT=251 & MU-B\\ CALCULATED & WI \end{array} $ | N)
TH THE GNASH COD
A)
TH THE GNASH COD
P)
TH THE GNASH COD
URE
TH THE GNASH COD
VALUE OF THE EX
VALUE OF THE EX
AR
TH OPTICAL MODEL | DE/12/.
DE AND NORMALIZED
DE AND NORMALIZED
DE/10/ AND NORMA
IT DATA OF 10 MB.
DE/12/ AND NORMAL
DERIMENTAL DATA/
DE AND NORMALIZED
DERIMENTAL DATA/ | LIZED AT 50 KEV
IZED AT 14.7 MEV
13,14,15/.
AT 14.8 MEV
14,15,16/. |
| MF=4 ANGULAR DIS
MT=2 ELASTIC S
CALCULATED WI
MT=51-60 INELA
CALCULATED WI
MT=16, 22, 28, 9
APPROXIMATELY
FUSION FILE.
MF=5 ENERGY DIST
MT=16, 22, 28, 9
APPROXIMATELY | TRIBUTIONS OF SE
CATTERING
TH THE CASTHY CC
STIC SCATTERING
TH THE CASTHY CC
1 (N.2N), (N.NA
TRANSFORMED FRC
RIBUTIONS OF SEC
1
TRANSFORMED FRC | CONDARY NEUTRONS
DDE/10/.
DDE AND THE DWUCK
), (N,NP), CONTI
M THE MF=6 DATA
CONDARY NEUTRONS
M THE MF=6 DATA | CODE/11/.
NUUM INELASTIC
(DDX) OF JENDL
(DDX) OF JENDL |
| REFERENCES
1) CHIBA S. ET A
2) YAMAMURO N.:
3) DATA TAKEN FR
4) STIEGLIZ R.G.
5) BEER H. AND S
A240, 29 (197
6) ALLEN B.J. AN
MATERIALS FOR
(1979).
7) KENNY M.J. ET
8) BRUSEGAN A. E
9) MUGHABGHAB S.
A (1981).
10) IGARASI S. AN
11) KUNZ P.D.: UN
12) YOUNG P.G. AN | L.: JAERI-M 92-C
JAERI-M 90-006 (
OM ENSDF(EVALUAT
ET AL.: NUCL. F
PENCER R.P.: KFK
5).
D MUSGROVE A.R.C
FBR, 1977 GEEL
AL.: AAEC/E-40C
T AL.: ASSANTA F
F. ET AL.: "NEUT
D FUKAHORI T.: J
PUBLISHED.
D ARTHUR E.D.: L | 27, P.35 (1992).
1990).
ED NUCLEAR STRUC
HYS. A163, 592 (
2-2063 (1974), AL
EL.: NEUTRON DA
MEETING, P.447,
(1977).
E VOL.1 P.633 (1)
RON CROSS SECTIO
AERI 1321 (1991)
A-6947 (1977). | TURE DATA FILE).
1971).
SO NUĊL. PHYS.
TA OF STRUCTURAL
PERGAMON PRESS
986).
NS ", VOL.1, PART |

13) VALKONEN M.: TAKEN FROM EXFOR (1976).
14) HUSAIN L. ET AL.: J. INORG. NUCL. CHEM. 29, 2665 (1967).
15) QAIM S.M. ET AL.: NUCL. PHYS. A283, 269 (1977).
16) SAILER K. ET AL.: 1977 KIEV CONF. VOL.1, 246 (1977).

MAT number = 2525 25-MN- 55 JAERI, MAPI EVAL-MAR87 K.SHIBATA, T.HOJUYAMA NST 26, 955 (1989) DIST-SEP89 REV2-AUG93 HISTORY

87-03

88-01

88-03

91-08

NST 26, 955 (1989) DIST-SEP89 REV2-AUG93 HISTORY 87-03 RESONANCE PARAMETERS WERE EVALUATED BY T.HOJUYAMA (MAPI). MULTISTEP HAUSER-FESHBACH CALCULATIONS WERE PERFORMED BY K.SHIBATA (JAERI). 88-03 COVARIANCE DATA ADDED 91-08 MODIFED BY B.YU (CIAE) AND S.CHIBA (NDC/JAERI) AS FOLLOWS FOR JENDL FUSION FILE/20/. COMPILED BY B.YU CROSS SECTIONS WERE MAINLY TAKEN FROM JENDL-3.1. THE (N,N') CONTINUMM CROSS SECTION (MT=91) IN THE WHOLE ENERGY REGION AND ITS SPECTRA WERE TAKEN FROM THE SINCROS-II /21/ CALCULATION. SEVERAL DISCRETE LEVEL SCATTERING CROSS SECTIONS (MT=67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79) AND THEIR ANGULAR DISTRI-BUTIONS WERE DELETED AS WELL AS THEIR COVARIANCE MATRICES BECAUSE THEY ARE INCLUDED IN THE NEW CONTINUUM INELASTIC SCATTERING CROSS SECTION TAKEN FROM THE SINCROS-II CALCULATION. 93-08 JENDL-3.2 FILE-6 OF THE JENDL FUSION FILE WAS CONVERTED TO FILES 4 AND 5. 93-08

AND 5. DATA WERE COMPILED BY K. SHIBATA (JAERI).

MF=1 MT=451 GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY

MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA THE PARAMETERS OF THE LOWEST FOUR RESONANCES WERE TAKEN FROM THE WORK OF MACKLIN /1/. OTHERS WERE TAKEN FROM THE COMPILATION OF MUGHABGHAB ET AL./2/ EXCEPT THAT THE PARAMETERS OF TWO NEGATIVE RESONANCES WERE ADJUSTED SO AS TO FIT TO EXPERIMENTAL THERMAL CROSS SECTIONS. RESONANCE REGION : 1.0E-5 EV TO 100 KEV. SCATTERING RADIUS: 5.15 FM CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200-M/S RES. INTEG. ELASTIC 2.167 B -

ELASTIC CAPTURE TOTAL 2.167 B - -

| PIURE | 13.413 B | 11.77 | В |
|-------|----------|-------|---|
| TAL | 15.579 B | - | |

MF=3 MT=1

 $\begin{array}{cccc} \hline TOTAL & 15.579 \ B & - \\ \hline TOTAL & BELOW 100 \ KEV & : NO BACKGROUND \\ ABOVE 100 \ KEV & : BASED ON THE EXPERIMENTAL DATA /3,4,5/. \\ \hline MT=2 & ELASTIC SCATTERING \\ (TOTAL) - (NONELASTIC CROSS SECTION) \\ \hline MT=3 & NON ELASTIC SCATTERING \\ SUM OF MT=4, 16, 22, 28, 102, 103, 104, 105, 106 \ AND 107 \\ \hline MT=4, 51-66, 91 \ INELASTIC SCATTERING \\ STATISTICAL-MODEL CALCULATIONS WERE PERFORMED USING THE \\ TNG CODE /6/. THE PRECOMPOUND PROCESS WAS CONSIDERED \\ ABOVE 5 MEV. THE CALCULATED CROSS SECTION OF MT=51 \\ WAS MULTIPLIED BY A FACTOR OF 1.2. \\ FOR THE LEVELS OF MT=51, 52, 57, 61, 64, 65, 67, 70, \\ THE DIRECT PROCESS COMPONENTS WERE TAKEN INTO ACCOUNT \\ BY THE DWBA CALCULATIONS. \\ THE OPTICAL POTENTIAL PARAMETERS USED ARE AS FOLLOWS/7/ (IN THE UNITS OF MEV AND FM): \\ V = 49.747 - 0.4295*E - 0.0003*E**2 \ RS = 1.345 \ AS = 0.47 \\ VSO= 6.2 \\ THE LEVEL SCHEME WAS TAKEN FROM REF./8/. \\ NO. ENERGY(MEV) \ SPIN-PARITY \\ G.S. 0.0 \\ S/2 \\ G.S. 0.0 \\ S/2 \\ T/2 \\ \end{array}$

5/2 -

| NU. | | |
|------|--------|--------|
| G.S. | 0.0` ´ | 5/2 - |
| 1. | 0.126 | 7/2 - |
| 2. | 0.984 | 9/2 - |
| 3. | 1.290 | 1/2 - |
| 4. | 1.292 | 11/2 - |
| 5. | 1.293 | 1/2 - |
| 6. | 1.528 | 3/2 - |
| 7. | 1.884 | 7/2 - |
| 8. | 2.015 | 7/2 - |
| 9. | 2.198 | 7/2 - |
| 10. | 2.215 | 5/2 - |
| 11. | 2.252 | 3/2 - |
| 12. | 2.267 | 5/2 - |
| 13. | 2.312 | 13/2 - |
| | | |

2 366

14

| | 15.
16.
17.
19.
201.
223.
224.
225.
227.
227.
229. | $\begin{array}{c} 2.398\\ 2.427\\ 2.563\\ 2.727\\ 2.753\\ 2.822\\ 2.824\\ 2.873\\ 2.954\\ 2.976\\ 2.996\\ 3.036\\ 3.036\\ 3.038\\ 3.040 \end{array}$ | 9/2 +
1/2 +
3/2 -
5/2 -
5/2 -
5/2 -
1/2 -
3/2 -
3/2 -
1/2 -
1/2 -
1/2 -
3/2 + | | | |
|-----------------|--|--|---|---|--|----------------------------------|
| | LEVELS A
THE CROS
MT=91 WA
GIVE A E | ABOVE 3.046 MI
JENDL-3.2 ***
SS SECTIONS F(
AS MODIFIED S(
BETTER FIT TO | EV WERE
OR MT=67
OTHAT T
THE MEA | ASSUMED TO
7-79 WERE DI
HE CALCULA
SURED DDX I | BE OVERLA
ELETED AND
TED SPECTR
DATA . | PPING.
THAT FOR
A COULD |
| MT=16,
CF | 22,28,10
ROSS SECT
CALCULAT
GLOBAL C
FOR PROT | 03,107 (N,2N)
IONS
ED WITH TNG.
OPTICAL-POTEN
ONS AND ALPH/ | ,(N,N'A)
TIAL PAR
A-PARTIC | ,(N,N'P),(1
AMETERS WEF
LES /9,10/ | N,P) AND (
RE EMPLOYE | N,A)
D |
| MT=102 | 2 RADI
BELOW 10
ABOVE 10 | ATIVE CAPTURI
DO KEV : RESOI
DO KEV : BASEI | E CROSS
NANCE PA
D ON THE | SECTION
RAMETERS G
E EXPERIMEN | IVEN (NO BA | ACKGROUND)
11/-/15/. |
| MT=104 | I (N,E
THE EXCI
CALCULAT
SHIFTING
NORMALIZ | D) CROSS SECT
TATION FUNCT
ED WITH TNG V
THE THRESHOI
ED TO THE EXI | ION
ION OF T
NAS USED
LD ENERG
PERIMENT | HE (N,P) CA
FOR THE (1
GY. THE CRO
AL DATUM A | ROSS SECTIO
N.D) REACT
DSS SECTIO
T 14.1 MEV | ON
ION BY
NS WERE
/16/. |
| MT=105 | 5 (N,T
THE EXCI
CALCULAT
SHIFTING
NORMALIZ | T) CROSS SECT
TATION FUNCT
TED WITH TNG V
THE THRESHOI
ZED TO THE EXI | ION
ION OF T
WAS USED
LD ENERG
PERIMENT | HE (N,P) CA
FOR THE (1
SY. THE CR
AL DATUM A | ROSS SECTIO
N.T.) REACT
DSS SECTIO
T 14.7 MEV | ON
ION BY
NS WERE
/17/. |
| MT=106 | 6 (N,H
BASED ON | HE-3) CROSS SI
N THE EXPERIMI | ECTION
ENTAL DA | TA /18,19/ | | |
| MT=251 | MU-E
CALCULAT | BAR
TED FROM FILE | -4. | | | |
| MF=4
MT-2 F | AN | IGULAR DISTRI | BUTIONS | OF SECONDA | RY NEUTRON | S |
| MT-16 | ÓPTICAL
THE COMF
THE LEVE
CALCULAT | AND STATISTIC
ONENTS OF THI
LS OF MT=51,5
TIONS. | CAL-MODE
E DIRECT
52,57,61 | L CALCULAT
PROCESS WE
,64,65 BY | IONS
ERE ADDED ⁻
THE DWBA | ТО |
| MT = TO , | CONVERTÉ | D FROM THE F | ILE-6 OF | THE JENDL | FUSION FI | LE. |
| MF=5
MT=16, | 22, 28,
CONVERTE | 91
91
D FROM THE F | ILE-6 OF | F SECONDAR | Y NEUIRONS
FUSION FII | LE. |
| MF=12
MT=4,1 | PH
6,22,28,
CALCULAT
FOR MT=1
IN ENSDF | HOTON PRODUCT
102,103,107
ED WITH TNG.
102, MODIFIED
BELOW THERM/ | BY USIN | IPLICITIES | Y INTENSIT | Y DATA |
| MF=14
MT=4,1 | PH
6,22,28,
ASSUMED | IOTON ANGULAR
102,103,107
TO BE ISOTROI | DISTRIE
PIC. | BUTIONS | | |
| MF=15
MT=4,1 | PH
6,22,28,
CALCULAT
FOR MT=1
IN ENSDF | HOTON ENERGY I
102,103,107
TED WITH TNG.
102, MODIFIED
BELOW THERM | DISTRIBU
BY USIN
AL ENERG | ITIONS
IG GAMMA-RA'
IY. | Y INTENSIT ^Y | Y DATA |
| MF=33
MT=1,2 | CC
2,3,4,16, | VARIANCE DATA
22,28,51-66,9 | 4
91,102,1 | 03,104,105 | ,106,107 | |

- REFERNCES 1) MACKLIN

- ESTIMATED FROM EXPERIMENTAL DATA.
 REFERNCES

 MACKLIN, R.L.: NUCL. SCI. ENG., 89, 362 (1985).
 MUGABGHAB, S.F., DIVADEENAM, M. AND HOLDEN, N.E.: "NEUTRON CROSS SECTIONS", VOL. 1, PART A, ACADEMIC PRESS (1981).
 CIERJACKS, S., FORTI, P., KOPSCH., D., KROPP, L., NEUTRON CROSS SECTIONS, VOL. 1, PART A, ACADEMIC PRESS (1981).
 CIERJACKS, S., FORTI, P., KOPSCH., D., KROPP, L., NELT, K.K. AND UNSELD, H.: "HIGH RESOLUTION TOTAL CROSS SECTIONS FOR NA CL'K, V, MN AND CO BETWEEN 0.5 AND 30 MEV", KFK-1000 (1968).
 PINEO, W.F.E., DIVADEENAM, M., BILPUCH, E.G., SETH, K.K. AND NEWSON, H.W.: ANN. PHYS., 84, 165 (1974).
 GARG, J.B., RAINWATER, J. AND HAVENS, JR., W.W.: NUCL, SCI. ENG., 65. 76 (1978).
 FU.C.Y.: "A CONSISTENT NUCLEAR MODEL FOR COMPOUND AND PRECOMPOUND REACTIONS WITH CONSERVATION OF ANGULAR MOMENTUM", ORNLTM-7042 (1980).
 FU.C.Y.: PRIVATE COMMUNICATION (1985).
 ZHOU ENCHEN, HUO JUNDE, ZHOU CHUNMEI, LU XIANE AND WANG LIZHENG: NUCL. DATA SHEETS, 44, 463 (1985).
 PERY, F.G.: PHYS. REV., 131. 745 (1963).
 HUIZENGA, J.R. AND IGO, G.J.: NUCL. PHYS., 29, 462 (1962).
 GARG, J.B., MACKLIN, R.L. AND HALPERIN, J.: PHYS. REV., CIB, 2079 (1978).
 DOVBENKO, A.G., KOLESOV, V.E., KOROLEVA, V.P., TOLSTIKOV, V.A.: ATOM. ENERG, 26, 67 (1969).
 MENLÓVE, H.O., COÒP, KLL, GERNCH, H.A. AND SHER, R.: PHYS. REV., 163, 1299 (1967).
 SCHWERER, O., WINKLER-ROHATSCH, M., WARHANEK, H. AND WINKLER, G.: NUCL. PHYS., A264, 105 (1976).
 BUDNAR, M., CVELBAR, F., HODGSÓN, E., HUDOKLIN, A., INKALER, A., MIHALLOVIC, M.V. MARTINCIC, R., NAZER, M., PERDAN, A., POTOKAR, M. AND RAMSAK, V. MARTINCIC, R., NAZER, M., PERDAN, A., MICHALEVTI, M. AND FAMSAK, V. MARTINCIC, R., NAUZER, M., PERDAN, A., POTOKAR, M. AND FAMSAK, V. MARTINCIC, R., NAUZER, M., PERDAN, A., MICHALETTI, S. AND PIGNANELLI, M.: NUOVO, CIM., 21, 966 (1962).
 COLLI, L., IORI, P., MICHELETTI, S. AND PIGNANELLI, M.: NUOVO, CIM., 21, 966 (1962)

MAT number = 2600 26-FE- 0 JNDC EVAL-MAR87 S.IIJIMA, H.YAMAKOSHI DIST-SEP89 REV2-MAR94 HISTORY 87-03 EVALUATION WAS PERFORMED FOR JENDL-3. 87-05 COMPILED BY K.SHIBATA (JAERI). JENDL-3.2 92-09 MODIFICATION WAS MADE FOR TOTAL AND ELASTIC SCATTERING CROSS SECTIONS. 93-11 THE RESONACE PARAMETERS OF FE-58 WERE MODIFIED. INEALSTIC SCATTERING CROSS SECTIONS WERE REEVALUATED BY K. SHIBATA (JAERI). DISCRETE LEVELS WERE LUMPED SO THAT REACTION KINEMATICS COULD BE PROPERLY TAKEN INTO ACCOUNT. FILES 4 AND 5 FOR MT=16,22,28,91 WERE OBTAINED FROM THE FILE-6 OF THE JENDL FUSION FILE /16/. GAMMA PRODUCTION DATA WERE REVALUATED BY S.IGARASI (NEDAC). 94-03 FOR (3,3), (3,107), (13,107), SMALL CROSS-SECTION VALUES WERE REPLACED WITH 0.0. HISTORY NATURAL IRON DATA CONSTRUCTED FROM FE-ISOTOPES. =1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION = 1.0E-5 EV TO 250.0 KEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. PARAMETERS WERE ADOPTED FROM THE FOLLOWING SOURCES. FE-54 : PANDEY+/1/ FOR 0 - 680 KEV. R=5.6 FM FE-56 : PEREY+/2/ FOR -2.0 - 400 KEV. R=5.4 FM FROM FIT-TING TO TOTAL CROSS SECTION BELOW 60 KEV. PARAMETERS OF THE 1.15 KEV RESONANCE WERE TAKEN FROM THE RESULT OF THE NEANDC TASK FORCE /3/. MF=2FORCE /3/. FE-57 : ALLEN+/4/ FOR S-WAVE RESONANCES, AND BEER+/5/ FOR P-WAVE RESONANCES IN 0 - 185 KEV. FE-58 : MUGHABGHAB+/6/. FOR FE-56, A NEGATIVE LEVEL WAS ADDED AT -3.75 KEV WITH NEUTRON WIDTH OF 100 EV AND GAMMA WIDTH OF 1.0 EV. NEUT WIDTH OF 27.67-KEV RESONANCE WAS TAKEN AS 1420 EV. NEUTRON CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200-M/S RES. INTEG. 2200-M/S 11.36 B ELASTIC CAPTURE TOTAL 1.340 B 13.92 B MF=3 NEUTRON CROSS SECTIONS BELOW 250 KEV, BACKGROUND CROSS SECTIONS WERE GIVEN. τοται MT = 1FOR ENERGIES 250 KEV - 20 MEV, FINE RESOLUTION DATA WERE TAKEN BY EYE-GUIDE USING INTERACTIVE DISPLAY OF NDES NEUTRON DATA EVALUATION SYSTEM) DEVELOPED BY T.NAKAGAWA THE NUCLEAR DATA CENTER, JAERI. THE FOLLOWING DATA WERE MAINLY ADOPTED: AT THE NUCLEAR DATA CENTER, JAERI. THE FULLOWING DATA WERE MAINLY ADOPTED: BELOW 500 KEV : PATTENDEN+/12/ 500 KEV - 4.7MEV : CARLSON+/7/ 4.7 MEV - 12 MEV : CIERJACKS+/8/ BY CONSIDERING EXPERIMENTAL RESOLUTION, CROSS SECTION SHAPE WAS MADE SHARPER. MT=2 ELASTIC SCATTERING GIVEN AS TOTAL MINUS NONELASTIC CROSS SECTIONS MT=3 NONELASTIC SUM OF MT=4,16,22,28,102,103,107 MT=16,22,28,103 CALCULATED USING GNASH /9/. MT=4,51-90,91 INELASTIC SCATTERING ISOTOPIC DATA WERE OBTAINED FROM THE CASTHY/10/ AND GNASH CALCULATIONS. ISOTOPIC LEVELS WERE GROUPED INTO 25 LEVELS OF NATURAL ELEMENT. THE CONTRIBUTIONS FROM THE DIRECT PROCESS WERE INCLUDED IN THE LEVELS OF MT=55,58, 64,66,68,69,88,90. OPTICAL POTENTIAL PARAMETERS USED IN THE CALCULATION ARE AS FOLLOWS: BO =1 286 A0=0.620 ĂS FOLLOWS: , R0=1.286, A0=0.620 , RS=1.390, AS=0.700 V = 46.0-0.25*E WS = 14.0-0.2*E 14.8-0.2*E FOR FE-57 VSO= 6.0 SO= 6.0 , RSO=1.07 ,ASO=0.620 ENERGIES IN MEV UNIT, LENGTHS IN FM UNIT.

* * * * * JENDL-3.2 FOR MT=51, REŠOÑANCE STRUCTURE OF FE-57 WAS laken iniu ACCOUNT. MT=55 (1ST LEVEL OF FE-56) 850 KEV - 2.15 MEV EVALUATED ON THE BASIS OF THE MEASUREMENTS/12,13/. 2.15 MEV - 4.6 MEV MODIFIED BY CONSIDERING THE JENDL-2 DATA. MT=61,66,68,70 (2ND,3RD,4TH AND 5TH LEVELS OF FE-56) THESE CROSS SECTIONS WERE MODIFIED AROUNF THRESHOLD BY CONSIDERING THE MEASUREMENTS/14,15/. MT=68,70,76-79,81-85,88,91 ABOVE 10 MEV, THESE CROSS SECTIONS WERE SLIGHTLY MODIFIED ACCORDING TO THE JENDL FUSION FILE/16/, WHICH WAS OBTAINED FROM SINCROS-II /17/ CALCULATIONS. FOR MT=51, RESONANCE STRUCTURE OF FE-57 WAS TAKEN INTO 02 CAPTURE BACKGROUND CROSS SECTION WAS GIVEN BELOW 250 KEV. ABOVE 250 KEV, THE CASTHY CALCULATION WAS ADOPTED. 07 (N,ALPHA) FOR FE-56, THE EVALUATION WAS MADE ON THE BASIS OF EXPERIMENTAL DATA. FOR FE-54,57,58, THE GNASH CALCULATION WAS ADOPTED. 251 MU-BAR CALCULATED WITH CASTHY (10) MT=102 MT = 107MT=251 CALCULATED WITH CASTHY /10/. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2,51-90 OPTICAL AND STATISTICAL-MODEL CALCULATIONS. THE C.C. CALCULATIONS WERE ADDED TO THE LEVELS OF MT=55, 58,61,63,64,65,70,73,74. MT=16,22,28,91 OBTAINED FROM JENDL FUSION FILE. =5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 OBTAINED FROM JENDL FUSION FILE. MF = 5MF=12 PHOTON MULTIPLICITIES MT=3 MULTIPLICITIES WERE CALCULATED USING GNASH. ČĀLCULATED WITH CASTHY. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=4,103,107 BELOW 2.5 MEV, DISCRETE GAMMAS WERE GIVEN. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3,4,102,103,107 ASSUMED TO BE ISOTROPIC. MF=15 PHOTON ENERGY DISTRIBUTIONS MT=102 MT=102 BELOW 10 KEV, CALCULATED WITH CASTHY. ABOVE 10 KEV, BASED ON THE DATA OF IGASHIRA ET AL./11/. MT=3,103,107 CALCULATED WITH GNASH. REFERENCES (EFERENCES)
 (1) PANDEY M.S. ET AL.: PROC. CONF. NUCLEAR CROSS SECTIONS AND TECHNOLOGY, WASHINGTON D.C., (1975), P.748.
 (2) PEREY F.G. ET AL.: PROC. SPECIALIST MEETING ON NEUTRON DATA OF_STRUCTURAL MATERIALS FOR FAST REACTORS, GEEL, (1977), . 530 NĂŘAJIMA Y.: JAERI-M 85-035, P.196 (1985). ALLEN B.J. ET AL.: PROC. SPECIALIST MEETING ON NEUTRON DATA OF STRUCTURAL MATERIALS FOR FAST REACTORS, GEEL, (1977), 3) 4) b) BER H. AND SPENCER R.R.: KFK-2063 (1974).
c) BER H. AND SPENCER R.R.: KFK-2063 (1974).
c) MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
c) CARLSON A.D. AND CERBONE R.J.: NUCL. SCI. ENG., 42, 28 (1970). (1970) 8) CIERJACKS S. (1970). CIERJACKS S. ET AL.: KFK-1000 (1968). YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977). IGARASI S. : J. NUCL. SCI. TECHNOL., 12, 67 (1975). IGASHIRA M. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988, P.67, (1988). VOSS F. ET AL.: PROC. INT. CONF. ON NEUTRON CROSS SECTIONS AND TECHNOLOGY, KNOXVILLE 1971, P.191 (1971). 9) 10) 11) 12)

- 13) SMITH D.L.: ANL/NDM-20 (1976).
 14) HOPKINS J.C. AND SILBERT M.G.: NUCL. SCI. ENG., 19, 431(1964).
 15) GILBOY W.B. AND TOWLE J.H.: NUCL. PHYS., 64, 130 (1965).
 16) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
 17) YAMAMURO N.: JAERI-M 90-006 (1990).

MAT number = 2625 26-FE- 54 JNDC EVAL-MAR87 S.IIJIMA, H.YAMAKOSHI DIST-SEP89 REV2-NOV93 HISTORY Y EVALUATION WAS PERFORMED FOR JENDL-3. COMPILED BY K.SHIBATA (JAERI). JENDL-3.2 THE CROSS SECTIONS FOR MT=54,55 WERE MODIFIED BY K. SHIBATA (JAERI). THE Q-VALUE OF MT=102 WAS CORRECTED. ANGULAR DISTRIBUTIONS FOR MT=16,22,28,91 WERE OBTAINED FROM THE JENDL FUSION FILE /8/ (KALBACH'S SYSTEMATICS). THE GAMMA PRODUCTION DATA WERE REEVALUATED BY S. IGARASI (NEDAC) 87-03 87-05 93-11 ****** MODIFIED FANCEDIRECT COMPONENTS(3,54), (3,55)DIRECT COMPONENTS(3,102)Q-VALUE CORRECTED(3,4)RECALCULATED(3,2)TOTAL - NONELASTIC(4,16), (4,22), (4,28), (4,91)CONVERTED FROM JENDL FUSION FILE (4,10), (7,22), (12,102), (12,103) (12,28), (12,102), (12,103) (15.102) NEWLY CALCULATED BELOW 10 KEV =1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION = 1.0E-5 EV TO 250.0 KEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. PARAMETERS WERE ADOPTED MAINLY FROM PANDEY+/1/ BY ASSUMING THE AVERAGE RADIATIVE WIDTH TO BE 2.5 EV /2/. R=5.6 FM WAS TAKEN FROM REF. /3/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200-M/S RES. INTEG. ELASTIC 0.4929 B -0.4929 B 2.156 B 2.649 B ELASTIC CAPTURE TOTAL 1.33 B NEUTRON CROSS SECTIONS BELOW 250 KEV, BACKGROUND CROSS SECTIONS WERE GIVEN FOR THE TOTAL AND ELASTIC SCATTERING CROSS SECTIONS ON THE UPPER SIDE OF THE FIRST RESONANCE. ABOVE 250 KEV, THE CROSS SECTIONS WERE EVALUATED AS FOLLOWS. I TOTAL SEMENDAL OPTICAL MODEL CALCULATION WAS MADE BY USING CODE MF=3MT=1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS MADE BY USING CODE CASTHY /4/. OPTICAL POTENTIAL PARAMETERS ARE AS FOLLOWS: V = 46.0-0.250*E , R0=1.286, A0=0.620 WS = 14.00-0.200*E , RS=1.390, AS=0.700 VSO= 6.00 , RSO=1.070, ASO=0.620 (ENERGIES IN MEV, LENGTHS IN FM) MT=2 ELASTIC SCATTERING GIVEN AS TOTAL MINUS OTHER CROSS SECTIONS MT=16,22,28 (N,2N), (N,N'A), (N,N'P) CALCULATED USING THE GNASH CODE /5/. MT=4,51-69,91 INELASTIC SCATTERING BELOW 7 MEV, THE CROSS SECTIONS WERE CALCULATED USING CASTHY WITH WIDTH FLUCTUATION CORRECTIONS. ABOVE 7 MEV, THE GNASH CALCULATION WAS PERFORMED. FOR MT=51,52,53,55,59,68, THE DIRECT PROCESS COMPONENT WAS CONSIDERED BY THE C.C. THEORY. MT = 1LEVEL SCHEME IS GIVEN AS FOLLOWS: ENERGY(MEV) SPIN-PARITY NO. 0.0 1.4082 2.5382 2.5613 2.9499 2.9590 3.1661 G.S. 0 + 2 + 4 + 1. 2. + 3. 0 + 6 2 2 4. 5. + ++ 6. 7. 3.1661 3.2952 3.3450 4 + 8. 3 -9. 3.8338 4.0330 Ā + 1Ò. 4 + 4 +

11.

4.0472

4.0720 4.2632 4.2961 4.5980 12. 13. 14. 3 4 ++ 0 2 2 3 3 + + 15. 4.6550 4.7000 4.7800 16. + + 17 18. -19. 4.9490 4 + CONTINUUM LEVELS WERE ASSUMED ABOVE 5.145 MEV. MT=102 CAPTURE CASTHY CALCULATION WAS ADOPTED. MT=103 (N,P) BELOW 2.5 MEV, BASED ON THE DATA OF PAULSEN AND WIDERA/6/. BETWEEN 2.5 AND 10 MEV, BASED ON THE DATA OF SMITH AND MEADOWS/7/. ABOVE 10 MEV, CALCULATED WITH GNASH. MT=107 (N,ALPHA) GNASH CALCULATION MULTIPLIED BY 0.94. MT=251 MU-BAR MT=251 MU-BAR CALCULATED WITH CASTHY /4/. MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS F=4 ANGULAR DISTRIBUTIONS C. C_C_ MT=2,51-69 OPTICAL AND STATISTICAL-MODEL CALCULATION. FOR MT=51,52,53,54,59,68, THE DIRECT-PROCESS COMPONENT WAS TAKEN INTO ACCOUNT BY THE C.C. THEORY. MT=16,22,28,91 CONVERTED FROM THE FILE-6 OF THE JENDL FUSION FILE/8/. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 CALCULATED WITH GNASH. MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS MT=16,22,28,91,102,103,107 MULTIPLICITIES WERE CALCULATED WITH GNASH. FOR MT=28,102,103, CORRECTIONS WERE MADE. MT=51-69 TRANSITION PROBABILITY ARRAYS MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,22,28,51-69,91,102,103,107 ASSUMED TO BE ISOTROPIC. MF=15 PHOTON ENERGY DISTRIBUTIONS MT=16,22,28,91,102,103,107 CALCULATED WITH GNASH. FOR MT=102, REPLACED WITH NEW CALCULATIONS BELOW 10 KEV. REFERENCES
1) PANDEY M.S. ET AL.: PROC. CONF. NUCLEAR CROSS SECTIONS AND TECHNOLOGY, WASHINGTON D.C., (1975), P.748.
2) SPENCER R.R. AND BEER H.: KFK 2046, 79 (1975).
3) MUGHABGHAB S.F. AND GARBER D.I.: BNL 325, 3RD ED. VOL. 1 MUGHABGHAB S.F. AND GARBER D.T. DRE GLC, GRE LEA (1973). IGARASI S. : J. NUCL. SCI. TECHNOL., 12, 67 (1975). YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977). PAULSEN A. AND WIDERA R.: PROC. CONF. CHEMICAL NUCLEAR DATA, MEASUREMENTS AND APPLICATION, CANTERBURY, 1971. SMITH D.L. AND MEADOWS J.W.: NUCL. SCI. ENG., 58, 314 (1975). CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992). 4) 5) 6)

7) . 8 MAT number = 2631 26-FE-56 JNDC EVAL-MAR87 S.IIJIMA,H.YAMAKOSHI DIST-SEP89 REV2-MAR94 HISTORY 87-03 EVALUATION WAS PERFORMED FOR JENDL-3. 87-05 COMPILED BY K.SHIBATA (JAERI). ***** JENDL-3.2 93-07 MODFIFCATION WAS MADE FOR (3,51-55),(3,59),(3,91). FILES 4 AND 5 FOR MT=16,22,28,19 WERE OBTAINED FROM THE FILE-6 OF THE JENDL FUSION FILE /9/. DATA FOR (3,4) WERE RECONSTRUCTED. (3,2) = TOTAL - NONELASTIC 93-11 DATA FOR (12,102) AND (15,102) WERE REEVALUATED BY S. IGARASI (NEDAC). 94-03 AS FOR (3,2) AND (3,107), SMALL CROSS-SECTION VALUES WERE REPLACED WITH 0.0. DATA WERE COMPILED BY K. SHIBATA (JAERI). HISTORY MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION = 1.0E-5 EV TO 250.0 KEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. PARAMETERS WERE ADOPTED FROM THE EXPERIMENTAL DATA BY PEREY+ /1/. R=6.5 FM WAS SELECTED TO REPRODUCE THE 24-KEV WINDOW CROSS SECTION. NEUTRON WIDTH OF 27.67-KEV RESONANCE WAS TAKEN AS 1420 EV. THE PARAMETERS OF THE 1.15-KEV RESONANCE WERE TAKEN FROM THE RESULT OF THE NEANDC TASK FORCE /2/. MF=2 CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200-M/S RES. INTEG. ELASTIC 12.46 B CAPTURE 2.813 B 1.446 B TOTAL 15.27 B -MF=3 NEUTRON CROSS SECTIONS BELOW 250 KEV, BACKGROUND CROSS SECTIONS WERE GIVEN FOR THE TOTAL AND ELASTIC SCATTERING CROSS SECTIONS. ABOVE 250 KEV, CROSS SECTIONS WERE EVALUATED AS FOLLOWS. MT=1 TOTAL MT=1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS MADE BY USING CASTHY CODE /3/. PARAMETERS ARE AS FOLLOWS, V = 46.0-0.25*E , R0=1.286, A0=0.620 WS = 14.0-0.20*E , RS=1.390, AS=0.700 VSO= 6.0 , RSO=1.07, ASO=0.620 (ENERGIES IN MEV, LENGTHS IN FM). MT=2 ELASTIC SCATTERING GIVEN AS TOTAL MINUS NONELASTIC CROSS SECTIONS. MT=16,22,28 (N,2N), (N, N'A), (N, N'P) CALCULATED WITH GNASH /4/. MT=4,51-77,91 INELASTIC SCATTERING THE CASTHY AND GNASH CALCULATIONS WERE ADOPTED FOR NEUTRON ENERGIES BELOW AND ABOVE 7 MEV, RESPECTIVELY. THE DIRECT-PROCESS COMPONENT WAS CONSIDERED FOR MT= 51,52,53,54,77 BY THE C.C. THEORY.
 THE LEVEL
 SCHEME IS GIVEN AS FOLLOWS: NO.
 DENERGY (MEV)
 SPIN-PARITY

 G.S.
 0.0
 0
 +

 1.
 0.8468
 2
 +

 2.
 2.0851
 4
 +
 NERGY (M) 0.0 2.8468 2.0851 2.6576 2.9417 2.9600 3.1200 4202142 3. + 4. + 5. + 2.9000 3.1200 3.1229 3.3702 3.3884 3.4454 3.4493 3.6009 3.6019 6. 7. + + + 8. 9. ++ 631220 10. 11. + 12. 13. 14. +++++ 3.6019 3.6070 3.7480 3.7558 3.8320 ž 15. 16. 6 2 3 3 17. + 3.8565 4.0940 18. + 19. + 3 + 20. 4.1003

4.1200 4.2982 4.3020 4.3950 21. 22. 23. 4 4 + 03233 + 24. + 26. 4.4584 3 + 27. 4.5100 3 -CONTINUUM LEVELS WERE ASSUMED ABOVE 4.701 MEV. FOR MF/MT=3/51 BETWEEN THRESHOLD AND 2.1 MEV, EVALUATED DATA WERE OBTAINED FROM HIGH RESOLUTION DATA OF VOSS ET AL. /7/ BY TAKING ACCOUNT OF GAMMA-RAY ANGULAR DISTRI-BUTIONS /8/. THE CROSS SECTIONS FOR MT=54,91 WERE REPLACED WITH THOSE CONTAINED IN THE JENDL FUSION FILE. AS FOR MT=59, A POINT AT 11.7 MEV WAS DELETED. FURTHERMORE, THE CROSS SECTIONS FOR MT=52-55 WERE MODI-FIED AROUND THRESHOLD BY CONSIDERING THE MEASUREMENTS /11,12/. 25. 4.4010 + MT=102 CAPTURE BELOW 250 KEV, NO BACKGROUND. THE CASTHY CALCULATION WAS ADOPTED THE CASTHY CALCULATION WAS ADOPTED MT=103 (N,P) BELOW 7 MEV, BASED ON THE DATA OF SMITH AND MEADOWS/5/. 7 - 13 MEV, TAKEN FROM JENDL-2. 13 - 16 MEV, BASED ON THE DATA OF IKEDA ET AL./6/ 16 - 20 MEV, TAKEN FROM JENDL-2. MT=107 (N,ALPHÅ) BASED ON EXPERIMENTAL DATA. MT=251 MU-BAR CALCULATED WITH CASTHY /3/. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-77
OPTICAL AND STATISTICAL-MODEL CALCULATIONS WERE ADOPTED.
THE C.C. CALCULATIONS WERE ADDED TO THE LEVELS OF MT=51,52,
53,54,77.
MT=16,22,28,91
OBTAINED FROM JENDL FUSION FILE (KALBACH'S SYSTEMATICS). MF = 4ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 5MT=16,22,28,91 OBTAINED FROM JENDL FUSION FILE (SINCROS-II/10/ CAL-CULATIONS). MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS MT=16,22,28,91,103,107 MULTIPLICITIES WERE CALCULATED WITH GNASH. MT=102 ČĀLCULATED WITH CASTHY. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,22,28,51-77,91,102,103,107 ASSUMED TO BE ISOTROPIC. MF=15 PHOTON ENERGY DISTRIBUTIONS MT=16,22,28,91,103,107 CALCULATED WITH GNASH. MT=102 CALCULATED WITH CASTHY. REFERENCES PEREY F.G. ET AL.: PROC. SPECIALIST MEETING ON NEUTRON DATA OF STRUCTURAL MATERIALS FOR FAST REACTORS, GEEL, (1977), 1) DI STROCTORILL MALLANDE EN M P.530. NAKAJIMA Y.: JAERI-M 85-035, P. 196 (1985). IGARASI S. : J. NUCL. SCI. TECHNOL., 12, 67 (1975). YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977). SMITH D.L. AND MEADOWS J.W.: NUCL. SCI. ENG., 58, 314 (1975). IKEDA Y. ET AL.: JAERI 1312 (1988). VOSS F. ET AL.: JAERI 1312 (1988). VOSS F. ET AL.: PROC. THIRD CONF. ON NEUTRON CROSS SECTIONS AND TECHNOLOGY, 1971, KNOXVILLE, P.218 (1971). SMITH D.L.: ANL/NDM-20 (1976). CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO N.: JAERI-M 90-006 (1990). HOPKINS J.C. AND SILBERT M.G.: NUCL. SCI. ENG.19,431(1964). GILBOY W.B. AND TOWLE J.H.: NUCL. PHYS., 64, 130 (1965). . 530 $\binom{2}{3}$ 4 5) 6) 7) 8) 9) 10) 11 121

MAT number = 2634 26-FE- 57 JNDC EVAL-MAR87 S.IIJIMA,H.YAMAKOSHI DIST-SEP89 REV2-NOV93 HISTORY F EVALUATION WAS PERFORMED FOR JENDL-3. COMPILED BY K.SHIBATA (JAERI)> JENDL-3.2 ANGULAR DISTRIBUTIONS FOR MT=16,22,28,91 WERE CONVERTED FROM THE FILE-6 OF THE JENDL FUSION FILE /5/ (KALBACH'S SYSTEMATICS) 87-03 87-05 93-11 (12,102), (15,102) STATISTICAL MODEL CALCULATIONS. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION = 1.0E-5 EV TO 200.0 KEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. PAR WERE ADOPTED FROM ALLEN+/1/ FOR S-WAVE RESONANCES, BEER+/2/ FOR P-WAVE RESONANCES IN 0 - 185 KEV. PARAMETERS AND CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200-M/S RES. INTEG. ELASTIC 0.2021 B -CAPTURE 2.462 B 1.43 B TOTAL 2.664 B -NEUTRON CROSS SECTIONS BELOW 200 KEV, BACKGROUND CROSS SECTION WAS GIVEN FOR THE TOTAL AND CAPTURE CROSS SECTIONS. ABOVE 200 KEV, THE DATA WERE EVALUATED AS FOLLOWS. MF = 31 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY CODE /3/. PARAMETERS ARE AS FOLLOWS, V = 46.0-0.25*E, , R0=1.286, A0=0.620 WS = 14.08-0.20*E, , RS=1.390. AS=0.700 VS0= 6.00, , RS0=1.07,AS0=0.620 (ENERGIES IN MEV UNIT, LENGTHS IN FM UNIT) 2 ELASTIC SCATTERING GIVEN AS TOTAL MINUS NONELASTIC CROSS SECTIONS 3 NONELASTIC SUM OF MT=4.16.22.28.102.103.107 MT = 1MT=2MT=3MT=3 NONELASTIC SUM OF MT=4,16,22,28,102,103,107. MT=16,22,28,103,107 (N,2N),(N,N'A),(N,N'P),(N,P),(N,A) CALCULATED WITH GNASH /4/. MT=4,51-71,91 INELASTIC SCATTERING THE CASTHY AND GNASH CALCULATIONS WERE ADOPTED FOR NEUTRON ENERGIES BELOW AND ABOVE 7 MEV, RESPECTIVEL THE LEVEL SCHEME USED IS GIVEN AS FOLLOWS: NO. ENERGY(MEV) SPIN-PARITY G.S 0.0 1/2 -ŘĚSPĚČTÍVĚLY. NO. G.S 1. 2. 0.0 0.0144 0.1365 0.3668 0.7064 3. **4**. 1.0072 5. 6. 7. 1.2654 1.3562 1.6273 1.7254 1.9893 8. 9. 1Õ. 3/2 9/2 1/2 5/2 1/2 1/2 11.

 11.
 1.9893
 9/2

 12.
 1.9910
 1/2

 13.
 2.1180
 5/2

 14.
 2.2189
 5/2
 +

 15.
 2.3300
 1/2

 16.
 2.3560
 11/2

 17.
 2.4560
 9/2
 +

 18.
 2.5053
 5/2
 +

 19.
 2.5643
 3/2

 20.
 2.6000
 5/2
 +

 21.
 2.6974
 1/2

 20.
 2.6974
 1/2

 21.
 2.6974
 1/2

 20.
 2.6974
 1/2

 21.
 2.6974
 1/2

 21.
 2.6974
 1/2

 21.
 2.6974
 1/2

 21.
 2.6974
 1/2

 21.
 2.6974
 1/2

 21.
 2.6974
 1/2

 21.
 3.92

MT=102 CAPTURE CALCULATED WITH CASTHY. MT=251 MU-BAR CALCULATED WITH CASTHY. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-71 CASTHY CALCULATION MT=16,22,28,91 OBTAINED FROM JENDL FUSION FILE (KALBACH'S SYSTEMATICS) MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 103,107 MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS MT=6,22,28,91 103,107 MULTIPLICITIES WERE CALCULATED WITH GNASH. MT=102 CALCULATED WITH CASTHY. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,22,28,51-71,91,102,103,107 ASSUMED TO BE ISOTOPIC. MF=15 PHOTON ENERGY DISTRIBUTIONS MT=16,22,28,91,103,107 CALCULATED WITH CASTHY. REFERENCES 1) ALLEN B.J. ET AL.: PROC. SPECIALIST MEETING ON NEUTRON DATA OF STRUCTURAL MATERIALS FOR FAST REACTORS, GEEL, P. 476 (1977). 2) BÉER H. AND SPENCER R.R.: KFK-2063 (1974). 3) IGARASI S.: J. NUCL. SCI. TECHNOL, 12, 67 (1975). 4) YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977). 5) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).

| MAT number = 2637 | EVAL-MAR87 S.IIJIMA,H.YAMAKOSHI |
|--|--|
| 26-FE- 58 JNDC | DIST-SEP89 REV2-OCT93 |
| HISTORY
87-03 EVALUATION WAS
87-05 COMPLIED BY K.S | PERFORMED FOR JENDL-3.
SHIBATA (JAERI). |
| 93-10 JENDL-3.2.
RE-EVALUATION \
T.NAKAGAWA (1
S.IGARASI (NI
COMPILED BY T.1 | WAS MADE BY
NDC/JAERI): RESONANCE PARAMS, CROSS SECTIONS
EDAC): GAMMA-RAY PRODUCTION DATA BELOW 10 KEV
NAKAGAWA |
| ***** MODIFIED
(2,151)
(3.1), (3.2), (3 | PARTS FOR JENDL-3.2 ************************************ |
| (4,16-28), (4,9
(12,102), (4,9
(15,102)
(15,102) | 1) ´´ TĂKĒN ĒRÓM JĒŇDĹ ĒUSION FILE
BELOW 1 MEV
****** |
| JENDL FUSION FII | LE /1/ (AS OF AUG. 1993) |
| EVALUATED B | .YU (CIAE) AND S.CHIBA (NDC/JAERI) |
| COMPILED BY | B.YU. |
| ALL OF CR(| OSS SECTIONS WERE TAKEN FROM JENDL-3. MF=6 |
| OF MT=16, 22, | 28 AND 91 WERE CREATED WITH SINCROS-11 /2/ |
| AND F15TOB/1/ | PROGRAM. KALBACH'S SYSTEMATICS /3/ WAS |
| USED THE PR | ECOMPOUND/COMPOUND RATIO WAS TAKEN FROM THE |
| SINCROS-II CAI | CULATION. |
| OPTICAL-MO | DDEL, LEVEL DENSITY AND OTHER PARAMETERS USED |
| IN THE SINCROS | S-II CALCULATION ARE DESCRIBED IN REF./2/. |
| LEVEL SCHEMES | WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| MF=1 GENERAL INFORMA | TION |
| MT=451 DESCRIPTIVE | DATA AND DICTIONARY |
| MF=2 RESONANCE PARAM | ETERS |
| MT=151 RESOLVED RESO | DNANCES |
| RESONANCE REGIO | N = 1.0E-5 EV TO 350.0 KEV |
| THE MULTILEVEL E | BREIT-WIGNER FORMULA WAS USED. PARAMETERS |
| WERE DETERMINED | ON THE BASIS OF DATA BY GARG ET AL./5/, |
| KAEPPELER ET AL | ./6/, ALLEN AND MACKLIN/7/. |
| CALCULATED 2200 | -M/S CROSS SECTIONS AND RES. INTEGRALS.
2200-M/S RES. INTEG. |
| CAPTURE | 1.300 B 1.36 B
7.770 B - |
| MF=3 NEUTRON CROSS SI | ECTIONS |
| BELOW 350 KEV, NO B/ | ACKGROUND CROSS SECTIONS WERE GIVEN. |
| ABOVE 350 KEV, THE I | DATA WERE EVALUATED AS FOLLOWS. |
| MT=1,4,51-62,91,102 | TOTAL, INELASTIC AND CAPTURE |
| CALCULATED WITH | OPTICAL AND STATISTICAL MODEL CODE CASTHY |
| /8/ OPTICAL PO | OTENTIAL PARAMETERS/9/ ARE AS FOLLOWS: |
| V = 46.0-0.2 | 25*EN (MEV), |
| WS = 14.0-0.2 | 2*EN (MEV), (IN THE GAUSSIAN FORM) |
| WI = 0.125 * E | -0.0004*E**2 (MEV), |
| R = 1.286 (I | FM), AO = 0.62 (FM) |
| RS = 1.387 (I | FM), AS = 0.7 (FM) |
| RS0= 1.07 (I | FM), ASO= 0.62 (FM) |
| THE LEVEL SCHEME | USED IS: |
| NO. ENER | RGY(MEV) SPIN-PARITY |
| G.S. O.(| 0 0 + |
| 1. 0.8 | 8108 2 + |
| 2. 1.0 | 6747 2 + |
| 3. 2.0 | 0765 4 + |
| 4. 2. | 1339 3 + |
| 5. 2. | 2581 0 + |
| 6. 2. | 6004 4 + |
| (. 2. | 7819 1 + |
| 8. 2.8 | 8764 2 + |
| 9. 3.0 | 0840 2 + |
| 10. 3.
11. 3.
12. 3. | 2330 2 +
2440 0 + |

LEVELS ABOVE 3.389 MEV WERE ASSUMED TO BE OVERLAPPING. THE CAPTURE CROSS SECTION WAS NORMALIZED TO 3 MB AT 500 KEV/10/. DIRECT CAPTURE CROSS SECTION WAS CALCULATED WITH A SIMPLE FORMULA DERIVED BY BENZI AND REFF0/11/ AND ADDED TO THE CASTHY CALCULATION. MT=2 ELASTIC TOTAL CROSS SECTION - SUM OF PARTIAL CROSS SECTIONS MT=16,22,28,103,107 (N,2N),(N,N'A),(N,N'P),(N,P),(N,A) CALCULATED WITH GNASH /12/. MT=251 MU-BAR CALCULATED WITH CASTHY /8/ CALCULATED WITH CASTHY /8/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-62 CASTHY CALCULATION MT=16,22,28,91 APPROXIMATELY TRANSLATED FROM THE DATA IN MF=6 OF JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 CALCULATED WITH GNASH. MF=12 PHOTON MULTIPLICITIES AND TRASITION PROBABILITIES MT=16,22,28,91,103,107 _____MULTIPLICITIES WERE CALCULATED WITH GNASH. MT=51-62 TRANSITION PROBABILITIES WERE GIVEN. MT=102 MULTIPLICITIES WERE CALCULATED FROM ENERGY BALANCE. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,22,28,51-62,91,102,103,107 ASSUMED TO BE ISOTROPIC. MF=15 PHOTON ENERGY DISTRIBUTIONS MT=16,22,28,91,103,107 CALCULATED WITH GNASH. MT=102 BELOW 10 KEV, CALCULATED WITH CASTHY/8/. ABOVE 1 MEV, GNASH CALCULATION WAS ADOPTED. REFERENCES ERENCES CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO N.: JAERI-M 90-006 (1990). KALBACH C.: PHYS. REV., C37, 2350 (1988). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. GARG J.B. ET AL.: PHYS. REV., C18, 1141 (1978). KAEPPELER F. ET AL.: NUCL. SCI. ENG., 84, 234 (1983). ALLEN B.J. AND MACKLIN R.L.: J. PHYS. G., 6, 381 (1980). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). YAMAKOSHI H.: JAERI 1261, P.30 (1979). TROFIMOV JU.N.: ATOMNAJA ENERGIJA, 58, 278 (1985). BENZI V. AND REFFO G.: CCDN/NW/10 (1969). YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977). 1) 3 4) 5 6) 7) 8) 9) 10) 121

MAT number = 2725 27-CO- 59 KHI EVAL-AUG88 T.WATANABE DIST-SEP89 REV2-APR94 HISTORY HISIORY 88-08 NEWLY EVALUATED BY T.WATANABE (KAWASAKI HEAVY INDUSTRIES, LTD.) 94-04 JENDL-3.2. GAMMA PRODCTION DATA EVALUATED BY T.ASAMI (DATA ENG.) OTHER DATA WERE MAINLY ADOPTED FROM JENDL FUSION FILE. COMPILED BY T.NAKAGAWA **** MODIFIED PARTS FOR JENDL-3.2 (3,4), (3,51-91), (4,16-91), (5,16-91) ADOPTED FROM JENDL FUSION FILE (3,102) (3,2) TO COMPENSATE THE ABOVE CROSS SECTION CHANGES GAMMA-RAY PRODUCTION DATA: NEW EVALUATION JENDL FUSION FILE /1/ (AS OF NOV. 1993) EVALUATED BY B.YU (CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY B.YU CROSS SECTIONS WERE MAINLY TAKEN FROM JENDL-3.1 EXCEPT FOR THE (N,N') (MT=51 TO 91) REACTIONS WHICH WERE TAKEN FROM NEW CALCULATION WITH SINCROS-II/2/. ENERGY DISTRIBUTIONS FOR MT=16, 22, 28 AND 91 WERE REPLACED BY THE SINCROS-II CALCULATION. DDX (MF=6) WERE CREATED WITH F15TOB PROGRAM /1/ IN WHICH MODIFIED KUMABE'S SYSTEMATICS /3/ WAS USED. THE RATIO OF PRECOMPOUND TO COMPOUND WAS TAKEN FROM THE SINCROS-II CALCULATION. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF=2T=2 MT=151 RESONANCE PARAMETERS : 1.0E-5 EV - 100 KEV RESOLVED RESONANCES FOR MLBW FORMULA: PARAMETERS WERE EVALUATED BASED ON EXPERIMENTAL DATA /5,6,7/ AND MODIFIED TO REPRODUCE EXPERIMENTAL TOTAL CROSS SECTIONS. NEGATIVE ENERGY LEVELS WERE ADDED TO REPRODUCE 2200 M/S TOTAL AND CAPTURE CROSS SECTIONS. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/SEC RES. INTEG. ELASTIC 6.0 B CAPTURE 37.18 B 75.6 B TOTAL 43.19 B MF = 3NEUTRON CROSS SECTIONS : ABOVE 100 KEV MT=1 TOTAL
 UP TO 4 MEV, BASED ON EXPERIMENTAL DATA /8.9/. ABOVE 4 MEV, TOTAL CROSS SECTION WAS CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/10/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS WERE EVALUATED TO REPRODUCE EXPERIMENTAL TOTAL CROSS SECTIONS /8,11/. V = 49.65 - 0.114*EN MEV R0= 1.241 FM A0= 0.533 FM WS= 8.625-0.05306*EN MEV RS= 1.421 FM B = 0.292 FM VSO= 7.724 MEV RS0=1.151 FM AS0=0.7 FM MT=2 ELASTC SCATTERING TOTAL CROSS SECTION - SUM OF PARTIAL CROSS SECTIONS MT= 4, 51 - 70, 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. SPIN-PARITY (DIRECT PROCESS) 7/2-3/2-* NO ENERGY(MEV) Ğ,Š 0.0 9/2-3/2-1/2-1.1905 ż * * 3 4 1.4343 11/2-5/2-7/2-5 1.4595 6 7 1.4820

1.7450

2.0630 2.0880 2.1460 2.1533 2.205 2.3971 2.479 2.537 2.5416 5/2 -7/2 -7/2 -15/2 -5/2 -9/2 -7/2 -9/2 -3/2 -8 9 * 1Ŏ 11 12 13 15 16 17 2.5816 2.584 4.0 9/2+ 5/2-18 19 5/2-20 LEVELS ABOVE 2.584 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16 (N,2N) BASED ON EXPERIMENTAL DATA /12,13,14,15/ AND YAMAMURO'S THEORETICAL CALCULATIONS /16/. MT=22,28,104 (N.N ALPHA),(N.NP),(N.D) YAMAMURO'S EVALUATION WAS ADOPTED /16/. MT=102 CAPTURE STATISTICAL MODEL CALCULATION WITH CASTHY CODE /10/ WAS PERFORMED. ABOVE 800 KEV, EYE-GUIDED CURVE TO THE EXPERIMENTAL DATA /6,17,18,19/. MT=103 (N,P) BASED ON EXPERIMENTAL DATA /12,20,21,22/. MT=107 (N,ALPHA) JENDL-2 DATA WERE ADOPTED WITH SLIGHT MODIFICATION BASED ON EVAIN'S EVALUATION /23/ AND EXPERIMENTAL DATA /12,24/. MT=251 MU-BAR CALCULATED FROM THE DATA IN MF=4. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2MI=Z OPTICAL MODEL CALCULATION. MT=16,22,28,51-70,91 ADOPTED FROM JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 ADOPTED FROM JENDL FUSION FILE. GAMMA-RAY PRODUCTION MUTIPLICITIES AND TRANSITION MF=12 PROBABILITIES MT=16,22,28,91,103,104,107 __MULTIPLICITIES WERE CALCULATED WITH GNASH /25/ MT=51-68 TRANSITION PROBABILITIES WERE GIVEN. MT=102 FROM ENERGY BALANCE. E=14 GAMMA-RAY ANGULAR DISTRIBUTIONS MT=16,22,28,51-68,91,102,103,104,107 ISOTROPIC DISTRIBUTIONS WERE ASSUMED. MF = 14F=15 GAMMA-RAY ENERGY DISTRIBUTIONS MT=16,22,28,91,103,104,107 ___CALCULATED WITH GNASH /25/ MF = 15MT=102 CALCULATED WITH CASTHY /10/ AT THERMAL ENERGY AND WITH GNASH ABOVE 100 KEV. REFERENCES ERENCES CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO, N.: JAERI-M 90-006 (1990). KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. GARG J.B. ET AL.: NUCL. SCI. ENG. 65,76 (1978). SPENCER R.R. AND MACKLIN, R.L.: NUCL.SCI.ENG. 61,346 (1976). MUGHABGHAB S.F. ET AL.: "NEUTRON CROSS SECTIONS VOL.1 PART A", ACADEMIC PRESS (1981). FOSTER,JR. D.G. AND GLASGOW D.W.: PHYS. REV. C3, 576 (1973). HARVEY J.A.: TAKEN FROM EXFOR (1986). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). CIERJACKS S.: KFK-1000 (1969). 1) 2) 3) 4) 5) 6) 7) 8) 9) 10) 11)

- 12) IKEDA Y. ET AL.: JAERI 1312 (1988).
 13) HASAN S.J. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE, 1985, P.155 (1986).
 14) HUANG JIAN-ZHOU ET AL.: CHINESE NUCL. PHYS. 3,59 (1981).
 15) VEESER L.R. ET AL.: PHYS. REV. C16, 1792 (1977).
 16) YAMAMURO N.: PRIVATE COMMUNICATION.
 17) PAULSEN A.: Z. PHYS. 205, 226 (1967).
 18) RIGAUD F. ET AL.: NUCL. PHYS. A273, 551 (1971).
 19) BUDNAR M. ET AL.: INDC(YUG)-6 (1979).
 20) SMITH D.L. ET AL.: NUCL. SCI. ENG. 58, 314 (1975).
 21) WILLIAMS J.R. AND ALFORD, W.L.: PROC. INT. CONF. NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE, 1985, P.215 (1986).
 22) HASAN S.J. ET AL.: J. PHYS. G12, 397 (1986).
 23) EVAIN B.P. ET AL.: ANL/NDM-89 (1985).
 24) MEADOWS J.W. ET AL.: ANN. NUCL. ENERGY 14, 603 (1987).
 25) YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977).

| MAT number = 2800
28-NI- 0 NAIG EV
DI | /AL-MAR87 S.IIJIMA
ST-SEP89 REV2-NOV93 |
|---|---|
| HISTORY
87-03 EVALUATION WAS PE
87-05 COMPILED BY K.SHI | RFORMED FOR JENDL-3.
BATA (JAERI). |
| GAMMA-RAY PRODU
INELASTIC SCATT
COMPILED BY T.NAK | ICTION DATA REVISED BY S.IGARASI (NEDAC).
ERING CROSS SECTIONS BY K.SHIBATA(JAERI).
AGGAWA (NDC/JAERI). |
| ***** MODIFIED PA
(3,1)
(3,2) | RTS FOR JENDL-3.2 ************************************ |
| (3,4), (3,51-91)
(3,103), (3,111)
(4,16) - (4,28), (
(5,16) - (5,91)
ALL GAMMA-RAY PROD | RE-GROUPING INELASTIC SCATTERINGSIGS.
SLIGHT MODIFICATION
4,91) FROM JENDL FUSION FILE
FROM JENDL FUSION FILE
DUCTION DATA |
| JENDL FUSION FILE
EVALUATED AN | /1/ (AS OF NOV. 1993)
D COMPILED BY S. CHIBA (NDC/JAERI) |
| CROSS SECTIONS WE
DISTRIBUTIONS OF
THOSE CALCULATED
CONTINUUM REACTIO
THE RATIO OF PREC
SINCROS-II CALCUL
OPTICAL-MODEL, LE
THE SINCROS-II CA
SCHEMES WERE DETE | RE TAKEN FROM JENDL-3.1. HOWEVER, ENERGY
MT=16, 17, 22, 28 AND 91 WERE REPLACED BY
WITH SINCROS-II SYSTEM/2/. DDXS OF
ONS WERE CREATED WITH F15TOB PROGRAM /1/.
COMPOUND TO COMPOUND WAS TAKEN FROM
ATION. KUMABE'S SYSTEMATICS/3/ WAS USED.
EVEL DENSITY AND OTHER PARAMETERS USED IN
LCULATION ARE DESCRIBED IN REF./2/. LEVEL
RMINED ON THE BASIS OF ENSDF/4/. |
| MF=1,MT=451 COMMENTS A | ND DICTIONARY |
| MF=2,MT=151 RESOLVED R
CONSTRUCTED FROM R
WERE MAINLY BASED | ESONANCE PARAMETERS : 1.0E-5 EV - 557 KEV
ESONANCE PARAMETERS FOR 5 ISOTOPES WHICH
ON THE FOLLOWING DATA: |
| NI-58 SYME ET
NI-60 PERY ET
NI-61 JENDL-2
NI-62 JENDL-2
NI-64 JENDL-2 | AL./5/, JENDL-2/6/
AL./7,8/
2/6/, MOXON/9/
2/6/
/6/ |
| CALCULATED 2200 M/S | VALUES AND RESONANCE INTEGRALS (BARN):
2200 M/S VALUE RES.INT.
22 241 |
| ELASTIC
CAPTURE | 17.859 -
4.383 2.143 |
| <pre>MF=3 NEUTRON CROSS SECT
BELOW 557 KEV, BACKGRO
102.</pre> | IONS
DUND CROSS SECTIONS APPLIED TO MT=1, 2 AND |
| CROSS SECTIONS ABOVE R | ESONANCE REGION WERE EVALUATED AS FOLLOWS: |
| MT=1 : TOTAL CROSS SEC
BASED ON THE HIGH-R
SECTION SHAPE WAS U
RESOLUTION. | TION
ESOLUTION DATA OF LARSON+/10/. THE CROSS
NFOLDED BY CONSIDERING EXPERIMENTAL |
| MT=2 : ELASTIC SCATTER
(TOTAL) - (NONELAST | ING
IC CROSS SECTIONS). |
| MT=16,17,22,28,103,104
(N,N'A).(N,N'P),(N
CONSTRUCTED FROM IS | ,105,106,107,111: (N,2N),(N,3N),
,P),(N,D),(N,T),(N,HE-3),(N,A),(N,2P)
OTOPIC DATA. |
| MT=4,51-70,91 : INELAS
ISOTOPIC LEVELS WER
ELEMENT. THE CONTR
TAKEN INTO ACCOUNT
63, 69, 70. | TIC SCATTERING
E GROUPED INTO 20 LEVELS OF NATURAL
IBUTIONS FROM THE DIRECT PROCESS WERE
FOR THE LEVELS OF MT=56, 59, 60, 61, 62, |
| MT=102 : CAPTURE
CALCULATED WITH THE | STATISTICAL MODEL CODE CASTHY /11/. |

MT=251 : MU-BAR CALCULATED WITH CASTHY /11/. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS 2 : CALCULATED WITH OPTICAL MODEL. 16,17,22,28,91 : TAKEN FROM JENDL FUSION FILE. 51-70 : CALCULATED WITH CASTHY. THE DIRECT PROCESS WAS CONSIDERED FOR MT=56,59,60,61,62,63,69, MF = 4MT=2 MT=16,17,22,28,91 MT=51-70 70 F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 : TAKEN FROM JENDL FUSION FILE. MF = 5MF=12 PHOTON MULTIPLICITIES MT=102 (BELOW 2 MEV) MULTIPLICITIES OBTAINED FROM ENERGY BALANCE. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 2 MEV) CONSTRUCTED FROM THE DATA OF NI-58 AND NI-60 CALCULATED WITH GNASH, AND FOLLOWING FACTOR WAS MULTIPLIED BETWEEN 2.0 AND 18.0 MEV, BECAUSE THEY WERE TOO LOW COMPARED WITH EXPERIMENTS FROM 4.0 TO 16.0 MEV; F(E)=EXP(0.0042(E-2.0)(18.0-E)). MT=4 (BELOW 2 MEV) COMPOSITE DATA FROM LEVEL EXCITATION CROSS SECTIONS AND BRANCHING RATIOS OF 5 ISOTOPES BELOW 2.0 MEV. MT=103, 107 (BELOW 2 MEV) CALCULATED WITH GNASH. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3,4,102,103,107: ISOTROPIC MF=15 PHOTON ENERGY DISTRIBUTIONS MT=3 CALCULATED WITH GNASH. MT=102 MI=102 CALCULATED WITH CASTHY FOR 5 ISOTOPES, TAKING PRIMARY TRANSITIONS ON NI-58 AND 60, AT 1.0E-5, 2.53E-2, 1.0E+3 AND 1.0E+4 EV. MT=103, 107 CALCULATED WITH GNASH. ERENCES CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO, N.: JAERI-M 90-006 (1990). KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. SYME D.B. ET AL.: PROC. SPECIALIST'S MEETING ON NEUTRON DATA OF STRUCTURAL MATERIALS FOR FAST REACTORS, GEEL, 508 DEC. 1977, P.703 (1979). KIKUCHI Y AND SEKINE N.: JAERI-M 85-101 (1985). PEREY F.G. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE, 13-17 MAY 1985, P.1639 (1986). MOXON M.C.: KFK-2046, P.156 (1975). LARSON D.C. ET AL.: ORNL-TM-8203 (1983). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). REFERENCES 1) 2) 3) 4) 5) 6) 8) 9) 10) 11)

| MAT number = 2825
28-NI- 58 NAIG EVAL-MAR87 S.IIJIMA
DIST-SEP89 REV2-SEP93 |
|---|
| 87-03 EVALUATION WAS PERFORMED FOR JENDL-3. SHORT DESCRIPTION
ON THE EVALUATION IS GIVEN IN REF./1/
87-05 COMPILED BY K.SHIBATA (JAERI). |
| 90-10 MF=5, MI=16, 22 AND 28: DATA AT THRESHOLD ENERGIES WERE
MODIFIED. MF=12, MT=16, 91 AND 102 WERE SLIGHTLY MODIFIED.
93-09 JENDL-3.2.
COMPILED BY T.NAKAGAWA (NDC/JAERI) |
| *****MODIFIED PARTS FOR JENDL-3.2********************************* |
| JENDL FUSION FILE /2/ (AS OF SEP. 1993)
EVALUATED BY S.CHIBA (NDC/JAERI)
COMPILED BY S.CHIBA |
| ALL OF CROSS SECTIONS WERE TAKEN FROM JENDL-3. EDX'S OF
MT=16, 22, 28 AND 91 WERE REPLACED BY THOSE CALCULATED
WITH SINCROS-II CODE SYSTEM/3/ IN ORDER TO MAKE THE
AGREEMENT WITH THE EDX OF NATURAL NI MEASURED BY BABA ET
AL./4/ AT 14.1 MEV. DDX'S OF CONTINUUM REACTIONS WERE
CREATED WITH F15TOB PROGRAM /2/. KUMABE'S SYSTEMATICS
/5/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS
CALCULATED BY THE SINCROS-II CODE SYSTEM.
OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED
IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./3/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. |
| MF=1,MT=451 COMMENTS AND DICTIONARY |
| MF=2,MT=151 RESOLVED RESONANCE PARAMETERS : 1.0E-5 EV - 420 KEV
EVALUATION BASED ON THE FOLLOWING DATA.
S-WAVE RESONANCE PARAMETERS FROM SYME+/7/
P-WAVE RESONANCE PARAMETERS FROM JENDL-2 AND SYME+/7/
TWO NEGATIVE RESONANCES DUE TO PEREY+/8/ WERE ADOPTED
WITH MODIFICATION: |
| E = -50 KEV GAMMA-N = 28.0 KEV GAMMA-G = 0.0
E = -6.5 KEV GAMMA-N = 1400 EV GAMMA-G = 2.31 EV
GAMMA WIDTH OF 2.0 EV AND 1.0 EV WERE ASSUMED FOR UNKNOWN
GAMMA WIDTHS OF S-WAVE AND P-WAVE RESONANCES, RESPEC-
TIVELY.
SCATTERING RADIUS : 6.0 FM |
| CALCULATED 2200 M/S VALUES AND RESONANCE INTEGRALS (BARN):
2200 M/S VALUE RES. INT.
TOTAL 30.754 -
ELASTIC 26.251 -
CAPTURE 4.503 2.16 |
| MF=3 NEUTRON CROSS SECTIONS
BACKGROUND CROSS SECTIONS APPLIED TO THE RESONANCE REGION FOR
MT=1 AND 102. CROSS SECTIONS ABOVE 420 KEV EVALUATED AS
FOLLOWS: |
| <pre>MT=1 : TOTAL CROSS SECTION
BETWEEN 420 KEV TO 677 KEV, EXPERIMENTAL DATA OF FARREL ET
AL./9/ WERE ADOPTED. FROM 677 KEV TO 20 MEV, CALCULATED
WITH OPTICAL MODEL. POTENTIAL PARAMETERS WERE OBTAINED BY
FITTING NAT-NI DATA /10/:
V =51.33 - 0.331*EN, WS=8.068 + 0.112*EN ,VS0=7.0 (MEV)
R0=RS0=1.24 ,RS=1.40 (FM)
A0=AS0=0.541 ,AS=0.4 (FM)
SURFACE IMAGINARY PART IS IN DERIVATIVE WOODS-SAXON FORM.</pre> |
| <pre>MT=2 : ELASTIC SCATTERING
(TOTAL) - (NONELASTIC CROSS SECTIONS).</pre> |
| <pre>MT=3 : NONELASTIC CROSS SECTION
SUM OF MT=4,16,22,28,102,103,104,105,106,107,111.</pre> |
| MT=16 (N,2N)
MAINLY BASED ON EXPERIMENTAL DATA OF IKEDA ET AL./11/ AND |

PAVLIK ET AL./12/ MT=28 (N,N'P) OBTAINED BY SUBTRACTIONG THE (N,D) CROSS SECTION CALCULA-TED WITH PEGASUS FROM THE (N,NP+PN+D)CO-57 CROSS SECTION BASED ON IKEDA ET AL./11/ AND PAVLIK ET AL./12/ INVERSE CROSS SECTIONS WERE CALCULATED FROM THE FOLLOWING OMP'S: PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ MT=22 (N,N'A) CALCULATED USING THE PEGASUS CODE /17/ AND NORMALIZED TO EXPERIMENTAL DATA/18/ MT=4,51-65,91 INELASTIC SCATTERING THE CASTHY /19/ AND GNASH /20/ CALCULATION WAS ADOPTED IN THE NEUTRON ENERGY REGION BELOW AND ABOVE 7 MEV, RESPEC-TIVELY. THE DIRECT PROCESS WAS TAKEN INTO ACCOUNT FOR MT= 51, 52, 53, 55 AND 65. FOR THE LEVEL OF MT=65, ONLY THE DIRECT PROCESS WAS CONSIDERED. THE LEVEL SCHEME USED IS CIVEN AS EQUIVES: NO ENERGY(MEV) SPIN-PARITY G.S 0.0 0 + 1. 1.4545 2. 2.4501 GIVEN AS FOLLOWS: ERGY (ME' 0.0 1.4545 2.4591 2.7755 2.9018 2.9424 3.2634 3.2634 3.2634 3.5240 3.5239 3.5239 3.5934 3.6200 3. 21 Ă. 5. 0223401 6. 7. 8. 9. 1Ŏ. 11. 3.6200 3.7744 3.8983 . 4 3 2 12. 13. 14. + CONTINUUM LEVELS ASSUMED ABOVE 3.932 MEV. MT=102 CAPTURE CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION OF 4.616E-5 WAS USED. LEVEL DENSITY PARAMETERS ARE: PAIRING SPIN-CUTOFF F. A(1/MEV) T(MEV) ENERGY(MEV) (MEV**0.5) EX(MEV) NI-58 6.850 1.30 NI-59 7.126 1.325 5.726 5.907 2.47 9.610 1.20 9.250 MT=103 (N,P) JENDL-2 WAS MODIFIED BY CONSIDERING EXPERIMENTAL DATA; BELOW 2 MEV, DATA OF SMITH ET AL./21/, AND ABOVE 13 MEV 2 MEV), DATA OF IKEDA ET AL./11/ AND PAVLIK ET AL./12/ PEGASUS CALCULATION WAS ALSO CONSIDERED ABOVE 15 MEV. MT=104,105,106,107,111 (N,D),(N,T),(N,HE-3),(N,A),(N,2P) THE CROSS SECTIONS WERE CALCULATED USING THE PEGASUS CODE /17/. THE (N,T) AND (N,A) CROSS SECTION WAS NORMALIZED TO THE DATA OF QAIM AND STOECKLIN/22/ AND GRIMES ET AL./18/, RESPECTIVELY. MT=251 : MU-BAR CALCULATED WITH OPTICAL MODEL. MF=4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2MT=2: CALCULATED WITH OPTICAL MODEL.
MT=51-64MT=51-64: CALCULATED WITH CASTHY. DIRECT PROCESS
INCLUDED IN MT=51, 52, 53, 55.MT=65: C.C. CALCULATION.
MT=16,22,28,91MT=16,22,28,91: APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA
(DDX) OF JENDL FUSION FILE. F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91 : APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE. MF = 5MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS

MT=16,22,28,91,103,107:

MULTIPLICITIES CALCULATED WITH GNASH.
MT=51-65 : TRANSITION PROBABILITY ARRAYS.
MT=102 : MULTIPLICITIES CALCULATED FROM ENERGY BALANCE.
MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,22,28,51-65,91,102,103,107: ISOTROPIC DISTRIBUTIONS.
MF=15 PHOTON ENERGY DISTRIBUTIONS MT=16,22,28,91,102,103,107: CALCULATED WITH GNASH. FOR MT=102 SPECTRA WERE CALCULATED WITH CASTH, TAKING PRIMARY TRANSITIONS AT 1.0E-5, 2.53E-2, 1.0E+3 AND 1.0E+4 EV.
REFERENCES
1) IIJIMA S. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOL. MITO. 1988. P. 627 (1988).
2) CHIBA S. ET AL.: JAERI-M 92-027 (JP.35) (1992).
3) YAMAMURO N.: JAERI-M 90-006 (1900).
4) BABA M. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOL., MITO. 1988, P. 291 (1988).
5) KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
6) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDL.
7) SYME D.B. ET AL.: NUCL SCI. ENG., 104, 280 (1990).
8) FECHNOL., MITO. 1988, P. 291 (1988).
9) FARELI J.A. ET AL.: NEUTRON DATA OF STRUCTURAL MATERIALS FOR FBR, 1977 GELL MEET. P.703, PERGAMON PRESS(1977).
8) PEREY C.M. ET AL.: ANN. PHYS., 37, 367 (1966).
9) FARRELL J.A. ET AL.: ANN. PHYS., 37, 367 (1966).
9) FARRELL J.A. ET AL.: ANN. PHYS., 37, 367 (1966).
9) FARRELL J.A. ET AL.: ANN. PHYS., 37, 367 (1966).
10) KAWAI M.: UNPUBLISHED.
11) IKEDA Y. ET AL: JAERI 1321 (1988).
12) PAVIKAA. ET AL: NUCL SCI. ENG., 90, 186 (1985).
13) PEREY F.G: PHYS. REV. 131, 745 (1963).
14) HUIZENGA JR. AND GO G.: NUCL. PHYS. A232 381 (1974).
16) BCCHTI F.D. JR. AND GREENLEES G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W.HAEBERLI] P. 682, THE UNIVERSITY OF WISCONSIN PRESS (1971).
11) IMA S. ET AL.: JAERI MS 7.025, P.337 (1987).
16) GRIMES S.M. ET AL.: PHYS. REV., 619, 2127 (1979).
16) GRIMES S.M. ET AL.: PHYS. REV., 6 MAT number = 2831 28-NI- 60 NAIG EVAL-MAR87 S.IIJIMA DIST-SEP89 REV2-SEP93 HISTORY EVALUATION WAS PERFORMED FOR JENDL-3. SHORT DESCRIPTION ON THE EVALUATION IS GIVEN IN REF./1/ COMPILED BY K.SHIBATA (JAERI). MF=5, MT=16, 22 AND 28: DATA AT THRESHOLD ENERGIES WERE MODIFIED. MF=12, MT=16, 91 AND 102 WERE SLIGHTLY MODIFIED. JENDL-3.2. 87-03 87-05 90-10 93-09 ČŌMPĪLĚĎ BY T.NAKAGAWA (NDC/JAERI) JENDL FUSION FILE /2/ (AS OF SEP. 1993) EVALUATED BY S.CHIBA (NDC/JAERI) COMPILED BY S.CHIBA ALL OF CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. EDX'S OF MT=16, 22, 28 AND 91 WERE REPLACED BY THOSE CALCULATED WITH SINCROS-II CODE SYSTEM/3/ BECAUSE NORMALIZATION ERRORS WERE FOUND IN THE DATA STORED IN JENDL-3.1. DDX'S OF CONTINUUM REACTIONS WERE CREATED WITH F15TOB PROGRAM /2/. KUMABE'S SYSTEMATICS /4/ WAS USED. THE PRECOM-POUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./3/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/5/. MF=1, MT=451 COMMENTS AND DICTIONARY 151 RESOLVED RESONANCE PARAMETERS : 1.0E-5 EV - 456 K EVALUATION BASED ON THE FOLLOWING DATA. PARAMETERS IN JENDL-2 WERE MODIFIED WITH THE DATA OF PEREY ET AL./6/ TWO NEGATIVE RESONANCES WERE ADDED. E = -50 KEV GAMMA-N = 12.8 KEV GAMMA-G = 0.0 EV E = -656 EV GAMMA-N = 0.60 EV GAMMA-G = 6.0 EV 1.0E-5 EV - 456 KEV MF=2, MT=151 CALCULATED 2200 M/S VALUES AND RESONANCE INTEGRALS (BARN): 2200 M/S VALUE RES. INT. TOTAL 4.316 ELASTIC 1.416 TOTAL ELASTIC CAPTURE 2.900 1.467 =3 NEUTRON CROSS SECTIONS NO BACKGROUND CROSS SECTIONS ARE GIVEN BELOW 456 KEV FOR MT=1, 2, 102. CROSS SECTIONS ABOVE 456 KEV WERE EVALUATED AS FOLLOWS: MF = 3MT=1 : TOTAL CROSS SECTION HIGH RESOLUSION EXPERIMENTAL DATA OF PEREY ET AL./6/ WERE TRACED UP TO 1.6 MEV, AND THOSE BY STOLER ET AL./7/ BETWEEN 1.6 AND 2.3 MEV. ABOVE 2.3 MEV, CROSS SECTION WAS CALCULATED WITH OPTICAL MODEL. POTENTIAL PARAMETERS WERE OBTAINED BY FITTING NAT-NI DATA /8/. THE DATA MEASURED BY STOLER ET AL./7/ ARE REPRODUCED WELL WITH THIS SET OF OMP. V =51.33 - 0.331*EN ,WS=8.068 + 0.112*EN ,VSO=7.0 (MEV) R0=RSO=1.24 ,RS=1.40 (FM) A0=ASO=0.541 ,AS=0.4 (FM) SURFACE IMAGINARY PART IS IN DERIVATIVE WOODS-SAXON FORM. 2 : ELASTIC SCATTERING (TOTAL) - (NONELASTIC CROSS SECTIONS). MT=23 : NONELASTIC CROSS SECTION SUM OF MT=4,16,22,28,102,103,104,105,106,107,111. MT=3MT = 16:16 : (N,2N) CALCULATED WITH GNASH/9/. MT=22,28,104,105,106,107,111: (N,N'A),(N,N'P),(N,D), (N,T),(N,HE-3),(N,A),(N,2P) THE CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/. THE (N,A), (N,NA) AND (N,D) CROSS SECTIONS WERE NORMALIZED TO

THE DATA OF GRIMES ET AL./11/ AND THE (N,T) WAS TO THE DATA OF QAIM AND STOECKLIN/12/ INVERSE CROSS SECTIONS WERE CALCULATED FROM THE FOLLOWING OMP'S: PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ MT=4,52-61,91 : INELASTIC SCATTERING THE CASTHY /17/ AND GNASH /9/ CALCULATIONS WERE ADOPTED FOR NEUTRON ENERGIES BELOW AND ABOVE 7 MEV, RESPECTIVELY. THE CONTRIBUTION FROM THE DIRECT PROCESS WAS INCLUDED FOR MT=51, 52, 53, 54, 61. FOR THE LEVEL OF MT=61, ONLY THE DIRECT PROCESS WAS CONSIDERED. THE LEVEL SCHEME USED IS AS FOLLOWS: NO ENERGY(MEV) SPIN-PARITY ŇŎ NERGY (MI 0.0 1.3325 2.1588 2.2849 2.5058 2.6260 3.1198 3.1240 3.1841 G.S 1. 2. 0 + 2 + 2 + 3. 4. 0 4 3 + 5. + 6. 7. 8. 4 2 3 + 9. 3.1941 1 + 10. 3.2696 2 + 11. 4.0397 3 -CONTINUUM LEVELS ASSUMED ABOVE 3.318 MEV. 102 : CAPTURE CALCULATED WITH CASTHY BY NORMALIZING TO 8.0 MB ANT 700 KEV /6/. GAMMA-RAY STRENGTH FUNCTION IS 2.925E-5. LEVEL DENSITY PARAMETERS ARE: MT = 102PAIRING SPIN-CUTOFF F. A(1/MEV) T(MEV) ENERGY(MEV) (MEV**0.5) EX(MEV) NI-60 7.700 1.15 NI-61 8.355 1.15 2.47 1.20 6.209 8.75 6.540 8.39 MT=103 : (N,P) MOST OF DATA WERE TAKEN FROM JENDL-2 WHICH REPRODUCES WELL THE DATA OF PAULSEN ET AL./18/, AND MODIFIED BELOW 6 MEV AND AROUND 14.5 MEV BASED ON EXPERIMENTAL DATA AND GNASH CALCULATION. MT=251 : MU-BAR CALCULATED WITH OPTICAL MODEL. F=4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2MT=2: CALCULATED WITH OPTICAL MODEL.
MT=16,22,28,91: APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA
(DDX) OF JENDL FUSION FILE.MT=51-60: CALCULATED WITH CASTHY.
INCLUDED IN MT=51, 52, 53, 54MT=61: C.C. CALCULATION. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,91: APPROXIMATELY TRANSFORMED FROM THE MF=6 DATA (DDX) OF JENDL FUSION FILE. MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS MT=16,22,28,91,103,107: MULTIPLICITIES CALCULATED WITH GNASH. MT=102 : MULTIPLICITIES CALCULATED FROM ENERGY BALANCE. MT=51-61 : TRANSITION PROBABILITY ARRAYS MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,22,28,51-61,91,102,103,107 ISOTROPIC DISTRIBUTIONS. MF=15 PHOTON ENERGY DISTRIBUTIONS MT=16,22,28,91,102,103,107: CALCULATED WITH GNASH. FOR MT=102, SPECTRA AT 1.0E-5, 2.53E-2, 1.0E+3 AND 1.0E+4 EV WERE CALCULATED WITH CASTHY, TAKING PRIMARY TRANSITIONS. REFERENCES 1) IIJIMA S. ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOL., MITO, 1988, P.627 (1988).
 2) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).

- $\binom{3}{4}$
- YAMAMURO N.: JAERI-M 90-006 (1990). KUMABE I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDL. PEREY C.M. ET AL.: ORNL-5893 (1982) AND PHYS. REV., C27, 2556 $\frac{1}{5}$
- 6) PEREY C.M. ET AL.: ORNL-5893 (1982) AND PHYS. REV., C27, 2556 (1983).
 7) P.STOLER ET AL.: PROC. 3RD CONF. NEUTRON CROSS SECTIONS AND TECHNOL., KNOXVILLE, 1971, VOL. 1, P.311 (1971).
 8) KAWAI M.: UNPUBLISHED.
 9) YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
 10) IIJIMA S. ET AL.: JAERI-M 87-025, P.337 (1987).
 11) GRIMES S.M. ET AL.: PHYS. REV., C19, 2127 (1979).
 12) QAIM S.M. AND STOECKLIN G.: NUCL. PHYS., A257, 233 (1976).
 13) PEREY F.G: PHYS. REV. 131, 745 (1963).
 14) HUIZENGA J.R. AND IGO G.: NUCL. PHYS. A232, 381 (1974).
 16) BECCHETTI F.D., JR. AND GREENLEES G.W.: POLARIZATION PHENOMENA IN NÚCLEAR REACTIONS (EDS) H.H. BARSHALL AND W.HAEBERLI P. 682, THE UNIVERSITY OF WISCONSIN PRESS (1971).
 17) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 18) PAULSEN A. ET AL.: NUKLEONIK, 10, 91 (1967) (EXFOR20388002).

| MAT number =
28-NI- 61 | = 2834
NAIG | EVAL-MAR87 S.IIJIMA
DIST-SEP89 REV2-SEP93 |
|--|---|---|
| 87-03 EVALI | UATION WAS | PERFORMED FOR JENDL-3. SHORT DESCRIPTION |
| 87-05 COMP
90-10 MF=5
93-09 JENDI | ILED BY K.S
: DATA AT T
L-3.2 | HIBATA (JAERT).
HRESHOLD ENERGIES WERE MODIFIED. |
| COMP | MODIFIED | AKAGAWA (NDC/JAERI) PARTS FOR JENDL-3.2 ************************************ |
| (4,16
(5,16)
*** | -28), (4,91
-91)
**** |) TAKEN FROM JENDL FUSION FILE
TAKEN FROM JENDL FUSION FILE |
| JENDL
EVAI
COMI | FUSION FIL
LUATED BY S
PILED BY S. | E /2/ (AS OF SEP. 1993)
.CHIBA (NDC/JAERI)
CHIBA |
| CI
MT=
WITI
ERR(
OF
/2/
PRF(| ROSS SECTIC
16, 22, 28
H SINCROS-I
ORS WERE FC
CONTINUUM F
WHERE KUMA
COMPOUND/CC | NS WERE TAKEN FROM JENDL-3.1. EDX'S OF
AND 91 WERE REPLACED BY THOSE CALCULATED
I CODE SYSTEM/3/ BECAUSE NORMALIZATION
UND IN THE DATA STORED IN JENDL-3.1. DDX'S
EACTIONS WERE CREATED WITH F15TOB PROGRAM
BE'S SYSTEMATICS /4/ WAS USED. THE
MPOUND RATIO WAS CALCULATED BY THE |
| SIN
OI
IN
LEVI | CROS-II COD
PTICAL-MODE
THE SINCROS
EL SCHEMES | E SYSTEM.
L. LEVEL DENSITY AND OTHER PARAMETERS USED
-11 CALCULATION ARE DESCRIBED IN REF./3/.
WERE DETERMINED ON THE BASIS OF ENSDF/5/. |
| MF=1,MT=451 | COMMENTS | AND DICTIONARY |
| MF=2,MT=151
PAR,
WID
54.(
SCA | RESOLVED
AMETERS WER
TH OF THE 6
O EV TO 535
TTERING RAD | RESONANCE PARAMETERS : 1.0E-5 EV - 57.0KEV
E TAKEN FROM JENDL-2 EXCEPT THAT THE NEUTRON
4.07-KEV S-WAVE RESONANCE WAS CHANGED FROM
EV /6/.
IUS: 6.4 FM |
| CALC | ULATED 2200 | M/S VALUES AND RESONANCE INTEGRALS (BARN):
2200 M/S VALUE RES.INT |
| | TOTAL
ELASTIC
CAPTURE | 11.239 -
8.731 -
2.509 2.44 |
| MF=3 NEUTRO
BACKGROUNI
CROSS SEC | ON CROSS SE
D CROSS SEC
TIONS ABOVE | CTIONS
TIONS WERE APPLIED TO THE RESONANCE REGION.
57.0 KEV WERE EVALUATED AS FOLLOWS : |
| MT=1 :
HIGI
57
OPT
PAR
V
RI
SUR | TOTAL CROS
H-RESOLUTIC
KEV AND 74.
ICAL-MODEL
AMETERS WER
=51.33 - C
0=RSO=1.24
0=ASO=0.541
FACE IMAGIN | S SECTION
N EXPERIMENTAL DATA/7/ WERE ADOPTED BETWEEN
6 KEV. ABOVE 74.6 KEV UP TO 20 MEV, THE
CALCULATION WAS PERFORMED. POTENTIAL
E OBTAINED BY FITTING NAT-NI DATA/8/:
.331*EN, WS=8.068 + 0.112*EN, VSO=7.0 (MEV)
,RS=1.40 (FM)
,AS=0.4 (FM)
ARY PART IS IN DERIVATIVE WOODS-SAXON FORM. |
| MT=2 :
(TO | ELASTIC SC
TAL) - (NON | ATTERING
ELASTIC CROSS SECTIONS). |
| MT=3 :
SUM | NONELASTIC
OF MT=4,16 | CROSS SECTION
,22,28,102,103,104,105,106,107,111. |
| MT=16,2
CALO
WERI | 22,28,103,1
CULATED WIT
E CALCULATE
PROTON
ALPHA
DEUTERON
HELIUM-3 | 04,105,106,107,111 (N,2N),(N,N'A),(N,N'P),
(N,P),(N,D),(N,T),(N,HE-3),(N,A),(N,2P)
H PEGASUS/9/. INVERSE CROSS SECTIONS
D FROM THE FOLLOWING OMP'S:
= PEREY/10/
= HUIZENGA AND IGO/11/
= LOHR AND HAEBERLI/12/
G AND TRITON = BECCHETTI AND GREENLEES/13/ |
| MT=4,5
CALC
THE | 1-70,91,102
CULATED WIT
LEVEL SCHE
NO ENER | : INELASTIC SCATTERING AND CAPTURE
H THE STATISTICAL MODEL CODE CASTHY /14/.
ME USED/15/ IS AS FOLLOWS:
GY(MEV) SPIN-PARITY |

| | CC
SCF
P/ | ONT I I
TREN
ROSS | G 12
G 12
G 12
G 12
G 12
G 12
G 11
G 11
G 11
G 11
G 11
G 12
G 11
C 10
C EV
FUNC
TION | 0.000.00000000000000000000000000000000 | 674
8360
5085
5003257
51003257
97300
1900
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
1000
1000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
12000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
1000
10000
1000
1000
1000
1000
10000
10000
10000
10000
10000
10000
10000
10000
10000
10000
10000
1000000 | UME
4.
IF | 3//
5//
3//
3//
3//
5//
7//
9
3///
5//
7//
9
1//
5//
5//
7//
5//
7//
5//
7// | 22222222222222222222222222222222222222 | E 22
WAS | 2.52
S OB
AL./ | 28 N
3TA
16, | ÆV
INE
∕ | D FI
LEVI | THEROM | GA
TH
DEN | MMA-
E CTY | RAY
PTURE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ' | A(1/
 | MEV |) T(

1 | MEV)
 | P
EN | AIR
ERG | I N G
Y (M
 | EV | SP
)
 | РТМ.
(Ме | - CU
EV *
54 | TOF
*0.;
 | F F
5)
 | | EX(M | EV) |
| | NI - | - 62 | . 8
 | 215 | 1 | .13 | | 2.6 | 1
 | | | 6 | 55 | 5 | | | 9.28 | 0
 |
| | MT=25
C/ | 51
Alcui | : MU
LATE | J-BAF
D W | ₹
I T H | ΟΡΤΙ | CAL | MO | DEL | | | | | | | | | |
| MF=
M
M | 4 ANGU
T=2
T=16,22
T=51-70 | JLAR
2,28
) | DIS
:
,91: | STRIE
CAL
APF
(DI
90
SYS | BUTI
CUL
ROX
DEG
DEG
STEM | ONS
ATED
IMAT
OF J
REE
, CA | OF
ELY
END
SYM | SEC
TH
L F
MET
LAT | OND
OPT
ANS
USI
RIC
ED | AR
ICA
FOF
ON
WIT | Y NE
AL M
RMED
FIL
N TH
TH C | UTF
IODE
E.
IE.
(CAST | RON
ROM
CEN
THY | S
THI
TER | E M
-OF | F=6
-MA | DAT.
SS | A |
| MF=
M | 5 ENE
T=16,22 | RGY
2,28 | DIST
,91: | RIBU
APF
(DD | UTIO
PROX
DX) | NS C
IMAT
OF J | F S
ELY
END | ECO
TR
L F | NDA
ANS
USI | RY
FOF
ON | NEU
RMED
FIL | JTR(
) FF
.E. | ONS
ROM | ТΗΙ | ΕM | F=6 | DAT | A |
| REF1)
2)
3)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)
16) | ERENCES
IJJHM
AND BA
CHIBA
YAMAMI
KUMABE
ENOSOFN
CHOLSIN
HELSIN
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HUHRCHON
HU | SAU JULY A FORMULA SCIENCE SHOULD SAU SAU SAU SAU SAU SAU SAU SAU SAU SAU | ET , A
DET , A
AL: A 19UT H. , A
S AL: A 19UT H. , A
F I, A
M S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
E H 17
F I, A
S A
S A
S A
S A
S A
S A
S A
S A
S A
S | AL.:
MIT
JAEF
JAEF
TED
JAEF
TED
JAEF
AL.:
ANI
AL.:
ANI
P. (
ANI
P. (
ANI
P. (
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
ANI
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.:
AL.: | PR
JA-MU
XINUC46
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
20046
2 | 0C198-0-
0C198-0-
0CL4
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5
0CL5 | INT
92006
SCT
1560
M 8
CCTUN
CCTUN
CCTUN
SND V | C2
-02
(1)
RUC1
7-02
(1)
RUC1
7-02
(1)
RUC1
7-02
7745
NUCC
ENLS
S.:
INT
OL. | ON / 99
99
99
90
10
10
10
10
10
10
10
10
10
10
10
10
10 | 1983
1983
1983
1983
1983
1983
1983
1983 | NUCL
38).
104,
DATA
NUC | LEAF
(199
28
28
28
28
28
28
29
30
29
40
19
20
28
28
28
28
28
28
28
28
28
28 | R D.
30
122)
30
128
46
32,
014
46
32,
014
507
507 | ATA
(199
, BI
TA I
7).
2 (⁷
38
RIZ/
RSH/
NSII
)
OPE:
DAT/
). | F0
90)
NL/
FOR
196
1 (
1 (
1 (
1 (
1 (
1 (
1 (
1 (
1 (
1 (| R S
NND
RE
197
ON
RES
7TH
OR | CIEN
L.
ACTO
4).
D
S (1
EDI | CE
RS,
971).
., |

| MAT number =
28-NI- 62 N | 2837
AIG | EVAL-MAR87 S.IIJIMA
DIST-SEP89 REV2-SEP93 | | | |
|---|---|---|---|---|---|
| 87-03 EVALU
ON TH
87-05 COMPI | ATION WAS
E EVALUATI
LED BY K.S | PERFORMED FOR JENDL-3. SHORT DESCRII
ON IS GIVEN IN REF./1/
HIBATA (JAERI). | PTION |
| 93-09 JENDL
COMPI | -3.2.
LED BY T.N | AKAGAWA (NDC/JAERI) | |
| * * * * *
(4,16-
(5,16-
* * * * * * | MODIFIED
28), (4,91
91)
******** | PARTS FOR JENDL-3.2 ************************************ | * * * * * * * |
| JENDL
EVAL
COMP | FUSION FIL
UATED BY S
ILED BY S. | E /2/ (AS OF SEP. 1993)
.CHIBA (NDC/JAERI)
CHIBA | |
| CR
MT=1
WITH
ERRO
OF C
/2/
PREC
II C
OP
IN T
LEVE | OSS SECTIO
6, 22, 28
SINCROS-I
RS WERE FO
ONTINUUM R
IN WHICH K
OMPOUND/CO
ODE SYSTEM
TICAL-MODE
HE SINCROS
L SCHEMES | NS WERE TAKEN FROM JENDL-3.1. EDX'S
AND 91 WERE REPLACED BY THOSE CALCUI
I CODE SYSTEM/3/ BECAUSE NORMALIZAT
UND IN THE DATA STORED IN JENDL-3.1
EACTIONS WERE CREATED WITH F15TOB PI
UMABE'S SYSTEMATICS /4/ WAS USED.
MPOUND RATIO WAS CALCULATED BY THE S
L. LEVEL DENSITY AND OTHER PARAMETEI
-II CALCULATION ARE DESCRIBED IN REI
WERE DETERMINED ON THE BASIS OF ENSI | S OF
LATED
ION
COGRAM
THE
SINCROS-
RS USED
F./3/.
DF/5/. |
| ME_1 NT_461 | COMMENTS | | |
| MF=2,MT=151
PARA
SCAT | RESOLVED
METERS WER
TERING RAD | RESONANCE PARAMETERS : 1.0E-5 EV -
E TAKEN FROM JENDL-2.
IUS: 6.2 FM | 557 KEV |
| CALCU
T
E
C | LATED 2200
OTAL
LASTIC
APTURE | M/S VALUES AND RESONANCE INTEGRALS
2200 M/S VALUE RES.INT
23.704 -
9.505 -
14.199 6.91 | (BARN): |
| MF=3 NEUTRO
BACKGROUND
CROSS SECT | N CROSS SE
CROSS SEC
IONS ABOVE | CTIONS
TIONS WERE APPLIED TO THE RESONANCE
557 KEV WERE EVALUATED AS FOLLOWS | REGION. |
| MT=1 :
EXPE
BETW
THE
PARA
V
RO
SURF | TOTAL CROS
RIMENTAL D
EEN 557 KE
OPTICAL-MO
METERS OBT
=51.33 - 0
=RSO=1.24
=ASO=0.541
ACE IMAGIN | S SECTION
ATA OF FARRELL ET AL./6/ WERE ADOPTI
V AND 670 KEV. ABOVE 670 KEV UP TO
DEL CALCULATION WAS PERFORMED. POTI
AINED BY FITTING NAT-NI DATA/7/:
.331*EN ,WS=8.068 + 0.112*EN ,VSO=7
,RS=1.40
,AS=0.4
ARY PART IS IN DERIVATIVE WOODS-SAX(| ED
20 MEV,
ENTIAL
.0 (MEV)
(FM)
(FM)
DN FORM. |
| MT=2 :
(TOT | ELASTIC SC
AL) - (NON | ATTERING
ELASTIC CROSS SECTION). | |
| MT=3 :
SUM | NONELASTIC
OF MT=4,16 | CROSS SECTION
,22,28,102,103,104,105,106,107,111. | |
| MT=16,2
(N,P),
CALC
CALC | 2,28,103,1
(N,D),(N,T
ULATED WIT
ULATED FRO
PROTON
ALPHA
DEUTERON
HELIUM-3 | 04,105,106,111 (N,2N),(N,N'A),(N,N
),(N,HE-3),(N,2P)
H PEGASUS/8/. INVERSE CROSS SECTION
M THE FOLLOWING OMP'S:
= PEREY/9/
= HUIZENGA AND IGO/10/
= LOHR AND HAEBERLI/11/
AND TRITON = BECCHETTI AND GREENLE | 'P),
NS WERE
ES/12/ |
| MT=4,51
CALC
CONS
COMP
AS F | -71,91,102
ULATED WIT
IDERING TH
ETING PROC
OLLOWS:
NO ENER | : INELASTIC SCATTERING AND CAPTURE
H THE STATISTICAL-MODEL CODE CASTHY
E SUM OF OTHER THRESHOLD REACTIONS /
ESSES. THE LEVEL SCHEME/14/ USED IS
GY(MEV) SPIN-PARITY | /13/ BY
AS
S GIVEN |
| | G.S
1.
2.
34.
5.
6.
7.
9.
10.
11.
12.
13.
14.
15.
14.
15.
178.
19.
201.
19.
201.
19.
201.
19.
201.
19.
201.
19.
201.
19.
201.
19.
201.
19.
20.
21.
20.
21.
20.
21.
20.
21.
20.
21.
20.
21.
20.
21.
20.
21.
21.
21.
21.
21.
21.
21.
21.
21.
21 | 0.0
1.1729
2.0486
2.3018
2.3304
2.8912
3.0582
3.1565
3.2577
3.2620
3.2620
3.2699
3.2774
3.2620
3.2699
3.2774
3.3703
3.4620
3.4860
3.5185
3.5287
3.5287
3.2699
3.7570
3.48530
3.8493
3.85300
LVELS AS
UNCTION O
UNCTION 0 +
2 +
0 +
2 +
4 +
2 +
4 +
2 +
4 +
4 +
4 +
4 +
4 +
4 +
4 +
4 +
4 +
4 | YE 3.967 MEV. T
WAS OBTAINED F
BEER AND SPENC | HE GAMMA-RAY
ROM THE
ER/15/. |
|--|---|--|--|--|--|
| | A(1/MI | EV) T(MEV |) ENERGY(N | IEV) (MEV**0.5 |) EX(MEV) |
| NI ·
NI · | -62 8.2 ⁻
-63 9.60 | 15 1.13
66 0.98 | 2.61
5 1.20 | 6.552
7.187 | 9.280
7.260 |
| MT=10
B/
E)
MT=25
C/ | 07 : (N,/
ASED ON TH
APERIMENT/
51 : MU-H
ALCULATED | A)
HE CACULA
AL DATA B
BAR
WITH OPT | TION WITH
Y QAIM ET
ICAL MODEL | PEGASUS. BELOW
AL./16/ WERE AD | 10 MEV,
OPTED. |
| MF=4 ANGU
MT=2
MT=16,22
MT=51-77 | JLAR DIST
: (
2,28,91: /
I : (| RIBUTIONS
CALCULATE
APPROXIMA
(DDX) OF
90 DEGREE
SYSTEM, C | OF SECOND
D WITH OPT
TELY TRANS
JENDL FUSI
SYMMETRIC
ALCULATED | PARY NEUTRONS
ICAL MODEL.
FORMED FROM THE
ON FILE.
IN THE CENTER-
WITH CASTHY. | MF=6 DATA
OF-MASS |
| MF=5 ENEF
MT=16,22 | RGY DISTR
2,28,91: / | IBUTIONS
APPROXIMA
(DDX) OF | OF SECONDA
TELY TRANS
JENDL FUSI | RY NEUTRONS
FORMED FROM THE
ON FILE. | MF=6 DATA |
| REFERENCES
1) IJIM/
AND TE
2) CHIBA
3) YAMAMU
4) KUMABE
5) ENSDFE
6) FARREL
(EXFOF
7) KAWAI
8) IJJIM/
9) PEREY
10) HUIZE
11) LOHR
12) BECCHE
PHENOM
WILEY
13) IGARAS
14) LEDERE
WILEY
15) BEER H
16) QAIM S | S. ET AL
ECHNOL. I
S. ET AL
JRO N.: J/
E I. ET AL
E EVALUATI
L J.A. E
R 11601009
M. : UNPI
A S. ET AL
F.G. PHY
J.M. AND I
F.G. J.R. AL
F.G. J.R. M
SI S. AND
SI S. AND
F. C.M. AL
F. C.M. AL
SI S. AND
SI S. AND SPI
S. M. ET AL | L.: PROC.
MITO, 198
.: JAERI-
AERI-M 90
L.: NUCLEA
ED NUCLEA
TAL.: AN
9).
UBLISHED.
L.: JAERI
9
S. REV. 19
AND IG
HAEBERLI
, JR. AND
UCLEAR REL
. 682, TH
FUKAHORI
ND SHIRLE
ENCE R.R.
ENCER R.R. | INT. CONF
8, P.627 (
92-027,
-006 (1990
SCI. ENG.
R STRUCTUF
N. PHYS.,
31, 745 (1
.: NUCL.
GREENLEES
ACTIONS (1
E. NUCL.
GREENLEES
ACTIONS (1
T.: JAERI
T.: JAERI
Y V.S.: TA
8).
.: NUCL. F
SCI. ENG. | NUCLEAR DATA
1988). P.35 (1992). P.35 (1992). P.35 (1992). P.337 (1987). P.337 (1987). 963). 964). 970. 980. 970. /ul> | FOR SCIENCE
0).
L/NNDL.
TION
PRESS (1971).
, 7TH EDI.,
(1975).
). |
| | | | | | |

| MAT number = 2843 | EVAL-MAR87 S.IIJIMA |
|--|--|
| 28-NI- 64 NAIG | DIST-SEP89 REV2-SEP93 |
| 87-03 EVALUATION WAS
ON THE EVALUATI
87-05 COMPILED BY K.S
93-09 JENDL-3.2.
COMPILED BY T.N | PERFORMED FOR JENDL-3. SHORT DESCRIPTION
ON IS GIVEN IN REF./1/
HIBATA (JAERI).
IAKAGAWA (NDC/JAERI) |
| ***** MODIFIED | PARTS FOR JENDL-3.2 |
| (3,106), (3,111) | DELETED. |
| (4,16-28), (4,91 |) TAKEN FROM JENDL FUSION FILE |
| (5,16-91) | TAKEN FROM JENDL FUSION FILE |
| ****** | ******* |
| JENDL FUSION FIL | E /2/ (AS OF SEP. 1993) |
| EVALUATED BY S | CHIBA (NDC/JAERI) |
| COMPILED BY S. | CHIBA |
| CROSS SECTIC
MT=16, 22, 28
WITH SINCROS-I
ERRORS WERE FC
OF CONTINUUM F
/2/ IN WHICH K
PRECOMPOUND/CC
II CODE SYSTEM
OPTICAL-MODE
IN THE SINCROS
LEVEL SCHEMES | NS WERE TAKEN FROM JENDL-3.1. EDX'S OF
AND 91 WERE REPLACED BY THOSE CALCULATED
I CODE SYSTEM/3/ BECAUSE NORMALIZATION
UND IN THE DATA STORED IN JENDL-3.1. DDX'S
EACTIONS WERE CREATED WITH F15TOB PROGRAM
UMABE'S SYSTEMATICS /4/ WAS USED. THE
MPOUND RATIO WAS CALCULATED BY THE SINCROS-
I. LEVEL DENSITY AND OTHER PARAMETERS USED
II CALCULATION ARE DESCRIBED IN REF./3/.
WERE DETERMINED ON THE BASIS OF ENSDF/5/. |
| | |
| MF=1, MT=451 COMMENTS
MF=2, MT=151 RESOLVED
PARAMETERS WER
SCATTERING RAD | RESONANCE PARAMETERS : 1.0E-5 EV - 553 KEV
E TAKEN FROM JENDL-2. |
| CALCULATED 2200
TOTAL
ELASTIC
CAPTURE | M/S VALUES AND RESONANCE INTEGRALS (BARN):
2200 M/S VALUE RES.INT
1.515 -
0.035 -
1.480 0.820 |
| MF=3 NEUTRON CROSS SE | CTIONS |
| BACKGROUND CROSS SEC | TIONS WERE APPLIED TO RESONANCE REGION. |
| CROSS SECTIONS ABOVE | 553 KEV WERE EVALUATED AS FOLLOWS : |
| MT=1 : TOTAL CROS | SS SECTION |
| EXPERIMENTAL D | DATA OF FARRELL ET AL./6/ WERE ADOPTED |
| BETWEEN 553 KE | VAND 698 KEV. ABOVE 698 KEV UP TO 20 MEV, |
| THE OPTICAL-MC | DEL CALCULATION WAS PERFORMED. POTENTIAL |
| PARAMETERS WER | E OBTAINED BY FITTING NAT-NI DATA /7/: |
| V =51.33 - C | 0.331*EN ,WS=8.068 + 0.112*EN ,VSO=7.0 (MEV) |
| R0=RSO=1.24 | ,RS=1.40 (FM) |
| A0=ASO=0.541 | ,AS=0.4 (FM) |
| SURFACE IMAGIN | JARY PART IS IN DERIVATIVE WOODS-SAXON FORM. |
| MT=2 : ELASTIC SC | ATTERING |
| (TOTAL) - (NON | IELASTIC CROSS SECTION). |
| MT=3 : NONELASTIC | CROSS SECTION |
| SUM OF MT=4,16 | 5,17,22,28,102,103,104,105,107. |
| MT=16,17,22,28,10 | J3,104,105: (N,2N),(N,3N),(N,N'A),(N,N'P), |
| CALCULATED WIT | TH PEGASUS/8/, INVERSE CROSS SECTIONS |
| WERE CALCULATE | D FROM THE FOLLOWING OMP'S: |
| PROTON | = PEREY/9/ |
| ALPHA | = HUIZENGA AND IGO/10/ |
| DEUTERON | I = LOHR AND HAEBERLI/11/ |
| HELIUM-3 | B AND TRITON = BECCHETTI AND GREENLEES/12/ |
| MT=4,51-70,91,102 | : INELASTIC SCATTERING AND CAPTURE |
| CALCULATED WIT | H THE STATISTICAL MODEL CODE CASTHY/13/. |
| THE LEVEL SCHE | ME/14/ USED IS GIVEN AS FOLLOWS: |
| NO ENERGY(ME | V) SPIN-PARITY |
| G.S 0.0 | 0 + |
| 1. 1.3459 | 2 + |

| | 2
3
4
5
6
7
8
9
0
11
12
134
15
16
17
18
20
NR
0
V
SCROV
LEV | · · · · · · · · · · · · · · · · · · · | 22222233333333333333333333333333333333 | 2750
27502
27502
275050
28650
29710
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
28502
29502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20502
20000
20000
20000
200000 |)))))))))))))))))))))))))))))))))))))) | AS:
N OI
TA (
RAMI | 042022042314324413544075E | ++++++++++++++++++++++++++++++++++++++ | | BO\
- 6A
REIS | /E
WA
ND | 4.(
S)(
SPI | D84
DBT
ENC | MI
AII
ER | |) F
5/. | TH | F. | G A M
T H E | IMA
C/ | - RAY | /
JRE |
|--|---|--|---|--|---|--|---|--|---|--|---|---|---|---|--|--|--|---|---|-----------------------|--------------------|----------|
| | N I - 6
N I - 6 | 4
5 1 | 9.30 | 00
5 | 1 | . 02 | / L
 | 2 | . 7(| 0 | |)
 | | 7.
7. | 124
370 | 0.

) | | | 8 | 3.94
3.4(| 40
10 | |
| N | IT=107
CAL
BAS | CULA
IS O | (N,
TED
F E |
A)
WIT
XPER |
R I M | PEG
ENT | ASU
Al | S A |
A N I
T A | D N
OF | | IF
AIN | IED
M E | T BI | ELC |) W
. / 1 | 11
6/ | М | EV | 0N | тне | |
| Ν | T=251
CAL | : !
CULA | MU-I
TED | BAR
WIT | Н | OPT | ICA | LN | 00 | DEL | | | | | | | | | | | | |
| MF=4
MT=2
MT=1
MT=5 | ANGUL
6,22,
51-70 | AR D
28,9 | I STI
1 : / | RIBU
CALC
APPR
(DDX
90 D
SYST | UL
COX
DEG
EM | ONS
ATEI
IMA
OF
REE
, C | OF
DW
TEL
JEN
SY
ALC | SE
ITE
Y
DL
MME
UL | EC(
FC)
FC
ETI | ONE
OPT
ANS
USI
RIC
ED | AR
IC
FO
ON
VI | Y I
AL
RMI
F
N
TH | NEU
MO
ED
ILE
THE
CA | TR(
DEI
FR(
CI
STI | DNS
DÅ
ENT
HY. | TH
TER | IE
- 0 | MF:
)F- | =6
MAS | DA ⁻
SS | ΓA | |
| MF=5
MT=1 | ENERG
6,22, | Y DI
28,9 | STR
1: | I BUT
APPR
(DDX | 10
20X
() | NS (
IMA
OF , | DF
TEL
JEN | SE(
Y
DL | COI
TR/
FI | NDA
ANS
USI | RY
SFO
ON | NI
RMI
F | EUT
ED
ILE | ROI
FR(| NS
DM | ΤH | IE | MF | =6 | DA | ΓA | |
| REFERE
1) II
2) CF
3) Y/
4) KL
5) F/
6) F/
8) F/
8) F/
10) HU
12) BF
W.
10) HU
11) LC
13) IC
14) LC
15) BF | INCES
JIMA
ID TECS
IDAS
IDAS
IDAS
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INABE:
INA | S.OLT.
S.NOLT.
S.NOLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OLT.
S.OL | T AI
AL
JJ
UNPI
T AT
UNPI
PHY
ND I
PHY
ND I
N P
A
S
S
PI
A | LITCJI
ALIO ALI
SALIO ALI
SALACTOJIIS ADA
JULSACA
SALACTOJIIS
SANA JUSACA
SALACTOJIIS
SANA JUSACA
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJIIS
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJI
SALACTOJ | PRENUC: HAVE SAVE R .HUC: SAVE R .HUC: SAVE R .HUC: NUC: SAVE R .HUC: | OCLEAN
CLEAN
CLEAN
GLAN
GLAN
GLAN
CLEAN
GLAN
CLEAN
GLAN
CLEAN
CLAN
CLEAN
CLAN
CLAN
CLAN
CLAN
CLAN
CLAN
CLAN
CL | B 90CS
R - S S
R - S S
- 31: GTU .
- 31: GTU .
- 31: GTU .
- 31: SC | T. (
2-(
6 1.
TRI
PH)
87-2
NU(
EIO
NU(
EIO
NU(
S
NU(
1. | C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221ECS
C221EC | ONF(
779901,
9901,
1007,
9901,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007,
1007, | (19)
(P)
(E)
(C)
(C)
(C)
(C)
(C)
(C)
(C)
(C)
(C)
(C | NU(8)
1D, 3).SW)02
S8
S8
S8
S8
S8
S8
S8
S8
S8
S8 | CLE
(1)
(1)
(1)
(1)
(1)
(1)
(1)
(1) | AR
992
FII
(19
232
FII
(19
199
10
10
10
10
10
10
10
10
10
10
10
10
10 | DA
2).
2).
2).
2).
2).
2).
2).
3).
2).
3).
2).
4.
6.
2).
4.
6.
2).
4.
6.
2).
4.
6.
2).
4.
5.
7.
1.
9.
8.
7.
2).
4.
5.
2).
4.
5.
7.
2).
4.
5.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
8.
7.
9.
7.
9.
8.
7.
9.
8.
7.
9.
7.
9.
8.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
9.
7.
7.
9.
7.
7.
9.
7.
7.
7.
7.
7.
7.
7.
7.
7.
7.
7.
7.
7. | (19
(19
(19
(19
(19
(19))
(19)
(19)
(19) | 19
19
19
11
14
12
19
13
14
10
19
14
19
10
19
10
19
10
19
10
10
10
10
10
10
10
10
10
10
10
10
10 | OR
)/N
622
(10)
PR
7
19 | SC
NDL
).
974
ANC
ESS
TH
75) |).
 | NCE
1971
1., |). |

MAT number = 2900 29-CU- 0 NAIG,MAPI EVAL-MAR87 N.YAMAMURO,T.KAWAKITA DIST-SEP89 REV2-SEP93 HISTORY Y EVALUATION WAS PERFORMED FOR JENDL-3. COMPILED BY K.SHIBATA (JAERI). JENDL-3.2. (3,1),(3,2),(3,102) MODIFIED BY T.NAKAGAWA(JAERI) (12,102),(13,4),(15,102) MODIFIED BY S.IGARASI(NEDAC) COMPILED BY T.NAKAGAWA (NDC/JAERI) 87-03 87-05 93 - 09

 (2,151)
 UPPER BOUNDARY
 ENERGY CHANGED TO 50 K

 (3,1),(3,2)
 50 KEV - 200 KEV

 (3,102)
 50 KEV - 200 KEV

 (4,16-32),(4,91)
 TAKEN FROM JENDL FUSION FILE

 (5,16-91)
 TAKEN FROM JENDL FUSION FILE

 (12,102),(13,4),(15,102)
 (13,4),(15,102)

 - - - -JENDL FUSION FILE /1/ (AS OF SEP. 1993) EVALUATED BY B.YU(CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY B.YU CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 (DDX'S) OF MT=16, 22, 28, 32 AND 91 WERE CREATED WITH F15TOB PROGRAM /17. MODIFIED KUMABE'S SYSTEMATICS /1/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM/2/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/3/. GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA CONSTRUCTED FROM PARAMETERS FOR EACH ISOTOPE WHICH WERE MAINLY TAKEN FROM THE WORK OF MUGHABGHAB ET AL. /4/ RESONANCE REGION : 1.0E-5 EV TO 50 KEV. UPPER BOUNDARY OF THE RESONANCE REGION WAS CHANGED FF 153 KEV OF JENDL-3.1 TO 50 KEV BECAUSE SERIOUS LEVEL MISSING WAS FOUND ABOVE 50 KEV. SCATTERING RADIUS: 6.70 FM FOR CU-63 AND CU-65 MF=2FROM CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200-M/S RES. INTEG. ELASTIC 7.868 B ELASTIC CAPTURE TOTAL 3.785 B 11.653 B 4.153 B MF = 3NEUTRON CROSS SECTIONS CONSTRUCTED FROM ISOTOPE DATA. TOTAL MT = 1TOTAL BELOW 50 KEV : NO BACKGROUND CROSS SECTIONS ARE GIVEN. 50 TO 200 KEV : BASED ON THE MEASURED DATA OF GARG ET AL./5/ BELOW 100 KEV AND OF WHALEN ET AL./6/ BETWEEN 100 AND 200 KEV. THE DATA WERE SMOOTHED WITH 5% RESOLUTION. 0.200 TO 3 MEV: BASED ON THE EXPERIMENTAL DATA OF NATURAL ELEMENT /7.8/ 3 TO 20 MEV : OPTICAL-MODEL CALCULATION USING CASTHY /9/ THE OPTICAL POTENTIAL PARAMETERS USED ARE AS FOLLOWS /10/ (IN THE UNITS OF MEV AND FM): V = 51.725 - 0.447*E R0 = 1.221 A0 = 0.683 WS = 8.44 + 0.055*E RS = 1.223 AS = 0.507 $\begin{array}{rrrr} R0 &=& 1.221 \\ RS &=& 1.223 \\ RS0 &=& 1.221 \end{array}$ ASO = 0.683₩SO= 8.0 MT=2 ELASTIC SCATTERING (TOTAL) - (REACTION CROSS SECTION) MT=4,51-87,91 INELASTIC SCATTERING STATISTICAL MODEL CALCULATIONS WERE MADE WITH CASTHY/9/ BELOW 3 MEV BY TAKING ACCOUNT OF COMPETING PROCESSES, AND WITH GNASH/11/ ABOVE 3 MEV INCLUDING PREEQUILIBRIUM

| | EFFC
FOR | ETS.
10 D | TH
ISCR | Е D
Е T E | I RE
LE | CT
VEL | PR
S. | OCE | SS | 6 C | OMP | ONE | NTS | S W | ERE | E C | ONS | SID | ERE | ΞD |
|--------------------------|---|--|---|---|---------------------------------------|--|---|---------------------------------------|---|-------------------------------------|--------------------------------------|---------------------------------------|------------------------|---------------------------------------|------------------------------|---|------------------------|-------------------------------|-----------------------|----------------|
| | CNO
G
123456789011234567
111234567
11234567 | - 63
Š. | E0.069344555 | RGY
6971
2700
4700
6110
6210
6210
6210
6210
6210
6210
62 | (ME | V)31//////////////////////////////////// | 222222222222222222222222222222222222222 | + | | | | COS: 12345678901123456789011234567890 | 65 | | | RGY
706
320
230
2250
2250
2250
2250
2250
2250
2 | ((M I | Ξ∨) | 315753751739957195555 | |
| | LEVE
OVER | LS AI
LAPP | BOVE
ING | FOR | 54
CU | MEV
-63 | A
A | ND
ND | 2.
Cl | 80
J-6 | ME
5, | RES | ERE
PE | E Â
CTI | SSI
VEI | JME
_Y. | D | ГО | BE | <u> </u> |
| MT=16,
(N, | 22,2
D) C
CALC
FOR
/12, | 8,32
ROSS
ULATI
PROT(
13,14 | ,103
SEC
ED W
ON,
4/. | ,10
†10
 TH
ALP | 4 (
NS
GN
HA- | N,2
ASH
PAR | N)
/1
T1 | ,(N
1/.
CLE | N, N
È ≠ | OP
ND |),(
TIC
DE | N,N
AL
UTE | P0
R01 |),(
TEN
N W | N,N
ITI/
ERE | N'D
Al
E A |),
PAI
SI | (N,
RAN
FOL | P)
IETE
LOV | ERS
VS |
| PRC | V =
WS =
VSO= | 59.
10.
7.5 | 11 -
4 | 0. | 55* | E | | RO
RS
RSC | =
=
=(| 1.
1.
1. | 25
25
25 | | AO
AS
AS(| =
=
=
= | 0.0 | 65
47
47 | | | | |
| ALF | PHA-P
V =
WV = | ARTI
164
22.4 | CLE
.7
4 | | | | | RO
RV
RC | = = | 1.
1.
1. | 442
442
30 | | A0
AV | = | 0.5
0.5 | 52
52 | | | | |
| DEU | UTEROI
V =
WS =
VSO= | N
106
13.9
7.0 | .69
92 | | | | | RO
RS
RSC
RC | =
=
=
= | 1.
1.
0.
1. | 05
43
75
3 | | AO
AS
AS(| =
=
=(| 0.8
0.7
0.5 | 36
704
5 | | | | |
| MT=107 | (N
CALC
EXPE
EXCI
CU-6 | ,A)
ULATI
RIMEI
TATIC
5, TI | CROS
ED C
NTAL
ON F
HE G | S S
ROS
DA
UNC
NAS | ECT
S S
TA
TIO
H C | ION
ECT
/15
N F
ALC | 10
/
0L
UL | NS
AT
LOV
AT I | 0F
10
VS
10N | F C
M
TH
W | U-6
EV.
E D
AS | 3 W
ATA
EMF | | E N
Ve
Yec | IORN
12
PAUL | MAL
Me
Se | IZI
V,
N/ | ED
TH
16/ | TO
IE | THE
FOR |
| MT=102 | THE
ACTI
CROS
AND
SECT
DATA | RADI
CU-6:
VATI
SSE
EXPEI
ION | ATIV
3 (N
ON F
CTIO
RIME
FOR | E C
GA
ILE
N O
NTA
NAT | APT
MMA
CA
F C
L D
URA | URE
) C
LCU
U-6
ATA
L C | C
R0
LA
5
/1
U | ROS
SS
TEL
WAS
8,1
WAS | 65
5
6
7
7
7
7
7
7
7
7
7
7
7
7
7
7
7
7
7 | SE
CT
VIT
SAS
20
CON | CTI
ION
H S
ED
/.
STR | ON
I WA
I NC
ON
TH
UCT | ROS
CAS
IE
ED | ADC
S - I
S T H
C A F
F R | PTE
I/
IY
TUF
OM | ED
17/
CAL
RE
TH | FR(
CUI
CR(
E | DM
TH
LAT
DSS
ISC | | NDL
N
Pe |
| | Q - VA
VALU | LUE (
ES. | 0F 7 | .76 | 61 | MEV | W | AS | GI | VE | ΝB | Y A | VE | RAG | i I N (| ΞI | S0 ⁻ | ГОР | PE (| ק - |
| MT=251 | CALC | MU-BAULATI | AR
ED W | ITH | 0P | тіс | AL | MC |)DE | EL. | 0.5 | | | | | | 0.11 | • | | |
| MF=4
MT=2,5
MT=16, | 51-87
CALC
COMP
BY U
22,
TAKE | AN
ULATI
ONEN
SING
28,
N FR | JULA
ED W
TS O
THE
32,
OM J | KU
ITH
FT
DW
91
END | L F | KIB
STH
DIR
CO
USI | UI
Y
EC
DE
ON | FOF
T F
/2 | NS
R E
PR(
217 | UF
QU
)CE | SE
ILI
SS | BRI | | Y
Pr
ADC | NEU
OCE
DED | ESS
TO | -
1 | S
TH
D L | IE
.eve | ELS |
| MF=5
MT=16, | 22,
TAKĖ | EN
28,
N FR(| ERGY
32,
OM J | DI
91
END | STR
L F | IBU
USI | T I
ON | ONS
FI | S C |)F | SEC | OND | AR | ΥN | IEUT | TR0 | NS | | | |

PHOTON PRODUCTION MULTIPLICITIES MF = 12 $M\dot{T} = 102$ DETERMINED FROM ENERGY BALANCE. F=13 PHOTON PRODUCTION CROSS SECTIONS
 MT=3 (ABOVE 2.5 MEV) CALCULATED WITH GNASH.
 MT=4 (BELOW 2.5 MEV) COMPOSITE DATA FROM LEVEL EXCITATION CROSS SECTIONS AND BRANCHING RATIOS OF 2 ISOTOPES BELOW 2.5 MEV.
 MT=103, 107 (BELOW 2.5 MEV) COMPOSED FROM 2 ISOTOPE DATA CALCULATED WITH GNASH. MF = 13F=14 PHOTON ANGULAR DISTRIBUTIONS MT=3,4,102,103,107 ASSUMED TO BE ISOTROPIC. MF = 14F=15 PHOTON ENERGY DISTRIBUTIONS MT=3 (ABOVE 2.5 MEV) CALCULATED WITH GNASH. MT=102 (BELOE 2.5 KEV) SPECTRA CALCULATED WITH CASTHY FOR 2 ISOTOPES, TAKING PRIMARY TRANSITIONS AT 1.0E-5, 2.53E-2, 1.0E+2, 1.0E+4, 1.0E+5, 2.0E+5, 5.0E+5, 1.0E+6, 2.0E+6 AND 2.5E+6 EV. MT=103, 107 (BELOW 2.5 MEV) COMPOSED FROM 2 ISOTOPE DATA CALCULATED WITH GNASH. MF = 15REFERENCES
1) CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992).
2) YAMAMURO N.: JAERI-M 90-006 (1990).
3) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDL.
4) MUGHABGHAB S.F., DIVADEENAM M. AND HOLDEN N.E.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A". ACADEMIC PRESS (1981).
5) GARG, J.B. ET AL.: CR-1860, (EXFOR 11646.015) (1964).
6) WHALEN, J.F. ET AL.: ANL-7710, 12, (EXFOR 10071.002) (1971).
7) FOSTER, JR., D.G. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). b) WHALEN, J.F. ET AL.: ANL-7710, 12, (EXPOR 10071.002) (1971).
7) FOSTER, JR., D.G. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
8) WHALEN, J.F. ET AL.: ANL-7710, 12 (1971).
9) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
10) HETRICK, D.M., FU, C.Y. AND LARSON, D.C.: "CALCULATED NEUTRON-INDUCED CROSS SECTIONS FOR CU-63,65 FROM 1 TO 20 MEV AND COMPARISONS WITH EXPERIMENTS", ORNL/TM-9083 (1984).
11) YOUNG, P.G. AND ARTHUR, E.D.: "GNASH, A PREEQUILIBRIUM, STATISTICAL NUCLEAR-MODEL CODE FOR CALCULATION OF CROSS SECTIONS AND EMISSION SPECTRA", LA-6974 (1977).
12) PEREY, F.G.: PHYS. REV. 131, 745 (1963).
13) MCFADDEN, L. AND SATCHLER, G.R.: NUCL. PHYS. 84, 177 (1966).
14) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
15) WINKLER, G., SMITH, D.L. AND MEADOWS, J.W.: NUCL. SCI. ENG. 76, 30 (1980).
16) PAULSEN, A.: NUCLEONIK, 10, 91 (1967)
17) YAMAMURO, N.: JAERI-M 90-006 (1990).
18) ZAIKIN G.G. ET AL.: ATOM. ENERGIJA, 10, 508(1961). EXFOR40248
19) JOHNSRUD A.E. ET AL.: PHYS. REV., 116, 927 (1959). EXFOR11675
20) VOIGNIER J. ET AL.: NUCL. SCI. ENG., 93, 43(1986). EXFOR22006
21) KUNZ, P.D.: UNIV. COLORADO (1974). MAT number = 2925 29-CU- 63 NAIG,MAPI EVAL-MAR87 N.YAMAMURO,T.KAWAKITA DIST-SEP89 REV2-SEP93 HISTORY Y EVALUATION WAS PERFORMED FOR JENDL-3. COMPILED BY K.SHIBATA. JENDL-3.2. (3,1),(3,2),(3,102) MODIFIED BY T.NAKAGAWA(JAERI) (12,102),(15,102) MODIFIED BY S.IGARASI(NEDAC) COMPILED BY T.NAKAGAWA (NDC/JAERI) 87-03 87-05 93 - 09

 (2,151)
 UPPER BOUNDARY EN

 (3,1),(3,2)
 50 KEV - 153 KEV

 (3,102)
 50 KEV - 20 MEV

 (4,16-32),(4,91)
 TAKEN FROM JENDL

 (5,16-91)
 TAKEN FROM JENDL

 (12,102),(15,102)
 102

 - - - -JENDL FUSION FILE /1/ (AS OF SEP. 1993) EVALUATED BY B.YU(CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY B.YU CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 (DDX'S) OF MT=16, 22, 28, 32 AND 91 WERE CREATED WITH F15TOB PROGRAM /1/. MODIFIED KUMABE'S SYSTEMATICS /1/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM/2/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/3/. GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA PARAMETERS WERE MAINLY TAKEN FROM THE WORK OF MUGHABGHAB ET AL./4/ RESONANCE REGION : 1.0E-5 EV TO 50 KEV. UPPER BOUNDARY OF THE RESONANCE REGION WAS CHANGED FROM 153 KEV OF JENDL-3.1 TO 50 KEV BECAUSE SERIOUS LEVEL MISSING WAS FOUND ABOVE 50 KEV. SCATTERING RADIUS: 6.70 FM CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200-M/S RES. INTEG. ELASTIC 5.102 B MF=2ELASTIC CAPTURE 5.102 B 4.506 B 5.01 B TOTAL 9.608 B MF=3NEUTRON CROSS SECTIONS TOTAL 50 TO 153 KEV : BASED ON THE MEASURED DATA OF ROHR ET AL./5/ THE DATA WERE SMOOTHED WITH 5% RESOLUTION. 0.153 TO 3 MEV: BASED ON THE EXPERIMENTAL DATA OF NATURAL ELEMENT /6,7/ 3 TO 20 MEV : OPTICAL-MODEL CALCULATION WITH CASTHY/8/ THE OPTICAL POTENTIAL PARAMETERS USED ARE AS FOLLOWS /9/ (IN THE UNITS OF MEV AND FM): V = 51.725 - 0.447*E RO = 1.221 AO = 0.683 WS = 8.44 + 0.055*E RS = 1.223 AS = 0.507 (DERIVATIVE WOODS-SAXON FORM) VSO= 8.0 RSO= 1.221 ASO = 0.683 MT = 1TOTAL ELASTIC SCATTERING (TOTAL) - (REACTION CROSS SECTIONS) MT=2 MT=4,51-67,91 INELASTIC SCATTERING STATISTICAL MODEL CALCULATIONS WERE MADE WITH CASTHY/8/ BELOW 3 MEV BY TAKING ACCOUNT OF COMPETING PROCESSES, AND WITH GNASH/10/ ABOVE 3 MEV INCLUDING PREEQUILIBRIUM EFFECTS. THE DIRECT-PROCESS COMPONENTS WERE CONSIDERED FOR THE LEVELS OF MT=51-54,65,91 BY THE DWBA CALCULATIONS WITH DWUCK/11/. THE LEVEL SCHEME WAS TAKEN FROM REF./12/. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 3/2 -

| 1
2
3
4
5
6
7
8
9
0
11
12
13
14
5
16
17 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 1/2 -
5/2 -
5/2 -
3/2 -
3/2 -
3/2 -
3/2 -
5/2 -
9/2 -
5/2 -
9/2 -
5/2 -
3/2 -
9/2 +
1/2 -
5/2 - | | |
|---|--|--|--|------------------------|
| LEVEI | LS ABOVE 2.54 MEV | WERE ASSUMED | TO BE OVERLAPP | PING. |
| MT=16,22,28
(N,D) CI
CALCI
OPTIC
AND I
PROTON | 8,32,103,104 (N,2
ROSS SECTIONS
ULATED WITH GNASH
CAL POTENTIAL PAR
DEUTERON WERE AS | 2N),(N,N'A),(N,
1/10/.
AMETERS FOR PF
FOLLOWS /13,14 | N'P),(N,N'D),(
ROTON, ALPHA-P/
4,15/. | (N,P)
Article |
| V =
WS = | 59.11 - 0.55*E
10.4 | R0 = 1.25
RS = 1.25 | A0 = 0.65
AS = 0.47 | |
| VSO=
ALPHA-P/ | 7.5
ARTICLE | RSO= 1.25 | ASO= 0.47 | |
| V =
WV = | 22.4 | RU = 1.442
RV = 1.442
RC = 1.30 | A0 = 0.52
AV = 0.52 | |
| DEUTEROI
V =
WS =
VSO= | N
106.69
13.92
7.0 | R0 = 1.05
RS = 1.43
RS0= 0.75
RC = 1.3 | A0 = 0.86
AS = 0.704
AS0= 0.5 | |
| MT=102
TAKEI
SECT | RADIATIVE CAPTURE
N FROM JENDL ACTI
ION WAS CALCULATE | E CROSS SECTION
VATION CROSS S
D BY N.YAMAMUF | N
SECTION FILE.
RO/16/ WITH SIN | THE CROSS
NCROS-II. |
| MT=107
CALCI
EXPEI
EXCI | (N,A) CROSS SECTI
ULATED CROSS SECT
RIMENTAL DATA/17/
TATION FUNCTION F | ON
TONS WERE NORM
AT 10 MEV. A
FOLLOWS THE DAT | MALIZED TO THE
ABOVE 12 MEV, T
TA OF PAULSEN/? | ГНЕ
18/. |
| MT=251 I
CALC | MU-BAR
ULATED WITH CASTH | IY | | |
| MF=4 | ANGULAR DISTRIE | UTIONS OF SECO | ONDARY NEUTRONS | 6 |
| MT=2,51-67
CALCI
COMP(
OF M
MT=16, 22,
TAKÉI | ULATED WITH CASTH
DNENTS OF THE DIR
T=51-54,65 BY USI
28, 32, 91
N FROM JENDL FUSI | Y FOR EQUILIBE
ECT PROCESS WE
NG THE DWUCK (
ON FILE. | RIUM PROCESS.
RE ADDED TO TH
CODE /13/. | THE
HE LEVELS |
| MF=5
MT=16, 22,
TAKE | ENERGY DISTRIBU
28, 32, 91
N FROM JENDL FUSI | ITIONS OF SECON
ON FILE. | NDARY NEUTRONS | |
| MF=12
MT=16,22,22
CALCI
MT=51-67
TRANS | PHOTON PRODUCTI
8,32,91,103,104,1
ULATED WITH GNASH
SITION PROBABILIT | ON MULTIPLICIT
07
1.
TIES ARE GIVEN. | TIES | |
| OBTA | INED FROM ENERGY | BALANCE. | | |
| MF=14
MT=16,22,28
ASSU | PHOTON ANGULAR
8,32,51-67,91,102
MED TO BE ISOTROF | DISTRIBUTIONS
,103,104,107
IC. | | |
| MF=15
MT=16,22,22
CALC
MT=102 | PHOTON ENERGY D
8,32,91,103,104,1
ULATED WITH GNASH | ISTRIBUTIONS
07
I. | | |
| CALC | ULATED WITH CASTH | ΙΥ. | | |
| REFERENCES | | | | |

CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO N.: JAERI-M 90-006 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDL. MUGHABGHAB S.F., DIVADEENAM M. AND HOLDEN N.E.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981). ROHR G. ET AL.: EANDC(E).89, P.1 (1968), EXFOR 20151003. FOSTER JR., D.G. AND GLASGOW D.W.: PHYS. REV., C3, 576 (1971). WHALEN J.F. ET AL.: ANL-7710, 12 (1971). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). HETRICK D.M., FU C.Y. AND LARSON D.C.: "CALCULATED NEUTRON-INDUCED CROSS SECTIONS FOR CU-63, 65 FROM 1 TO 20 MEV AND COMPARISONS WITH EXPERIMENTS", ORNL/TM-9083 (1984). YOUNG P.G. AND ARTHUR E.D.: "GNASH, A PREEQUILIBRIUM, STATISTICAL NUCLEAR-MODEL CODE FOR CALCULATION OF CROSS SECTIONS AND EMISSION SPECTRA", LA-6974 (1977). KUNZ P.D.: UNIV. COLORADO (1974). AUBLE R.L.: NUCL. DATA SHEETS 28, 559 (1979). PEREY F.G.: PHYS. REV. 131, 745 (1963). MCFADDEN L. AND SATCHLER G.R.: NUCL. PHYS. 84, 177 (966). LOHR J.M. AND HAEBERLI W.: NUCL. PHYS. A232, 381 (1974). YAMAMURO N.: PRIVATE COMMUNICATION. WINKLER G., SMITH D.L. AND MEADOWS J.W.: NUCL. SCI. ENG. 76, 30 (1980). PAULSEN A.: NUCLEONIK. 10. 91 (1967) ż 3) 4) 5) 6) 7) 8) 9) 10) 11) 125 13) 14) 15) 16) 17)

30 (1980). 18) PAULSEN A.: NUCLEONIK, 10, 91 (1967)

MAT number = 2931 29-CU- 65 NAIG,MAPI EVAL-MAR87 N.YAMAMURO,T.KAWAKITA DIST-SEP89 REV2-SEP93 HISTORY Y EVALUATION WAS PERFORMED FOR JENDL-3. COMPILED BY K.SHIBATA (JAERI). JENDL-3.2. (3,1),(3,2),(3,102) MODIFIED BY T.NAKAGAWA(JAERI) (12,102),(15,102) MODIFIED BY S.IGARASI(NEDAC) COMPILED BY T.NAKAGAWA (NDC/JAERI) 87-03 87-05 93 - 09- - - -JENDL FUSION FILE /1/ (AS OF SEP. 1993) EVALUATED BY B.YU(CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY B.YU CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 (DDX'S) OF MT=16, 22, 28, 32 AND 91 WERE CREATED WITH F15TOB PROGRAM /1/. MODIFIED KUMABE'S SYSTEMATICS /1/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM/2/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/3/. GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA PARAMETERS WERE MAINLY TAKEN FROM THE WORK OF MUGHABGHAB ET AL./4/ RESONANCE REGION : 1.0E-5 EV TO 50 KEV. UPPER BOUNDARY OF THE RESONANCE REGION WAS CHANGED FROM 153 KEV OF JENDL-3.1 TO 50 KEV BECAUSE SERIOUS LEVEL MISSING WAS FOUND ABOVE 50 KEV. SCATTERING RADIUS: 6.70 FM CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200-M/S RES. INTEG. ELASTIC 14.073 B -CAPTURE 2.168 B 2.22 B TOTAL 16.242 B -MF=2NEUTRON CROSS SECTIONS MF=3MT = 1TOTAL RESOLUTION. .3 TO 3 MEV : BASED ON THE EXPERIMENTAL DATA OF NATURAL LELMENT/6,7/. TO 20 MEV : OPTICAL-MODEL CALCULATION WITH CASTHY/8/. THE OPTICAL POTENTIAL PARAMETERS USED ARE AS FOLLOWS/9/ (IN THE UNITS OF MEV AND FM): V = 51.725 - 0.447*E R0 = 1.221 A0 = 0.683 WS = 8.44 + 0.055*E RS = 1.223 AS = 0.507 (DERIVATIVE WOODS-SAXON FORM) VSO= 8.0 RSO= 1.221 ASO = 0.683 0.3 TO 3 MEV 3 TO 20 MEV ELASTIC SCATTERING (TOTAL) - (REACTION CROSS SECTION) MT=2MT=4,51-70,91 INELASTIC SCATTERING STATISTICAL MODEL CALCULATIONS WERE MADE WITH CASTHY/8/ BELOW 3 MEV BY TAKING ACCOUNT OF COMPETING PROCESSES, AND WITH GNASH/10/ ABOVE 3 MEV INCLUDING PREEQUILIBRIUM EFFECTS. THE DIRECT-PROCESS COMPONENT WAS CONSIDERED FOR THE LEVELS OF MT=51-54,64,91 BY THE DWBA CALCULATIONS WITH DWUCK/11/. THE LEVEL SCHEME WAS TAKEN FROM REF./12/. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 3/2 -1. 0.7706 1/2 -

| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 2 -
2 -
2 -
2 -
2 -
2 -
2 -
2 - | |
|---|---|--|--|
| LEVELS ABOV | 'E 2.80 MEV \ | WERE ASSUMED TO BE OVERLAPPING. | |
| MT=16,22,28,32,10
(N,D) AND (N,A
CALCULATED
OPTICAL POT
AND DEUTERC
PROTON | 03,104,107 (1
A) CROSS SEC
WITH GNASH/
ENTIAL PARAN
ON WERE AS FO | N,2N),(N,N'A),(N,N'P),(N,N'D),(N,P)
TIONS
10/.
METERS FOR PROTON, ALPHA-PARTICLES
OLLOWS/13,14,15/. | |
| V = 59.11
WS = 10.4 | - 0.55*E | R0 = 1.25 A0 = 0.65
RS = 1.25 AS = 0.47 | |
| VŠO= 7.5
ALPHA-PARTICLE | | R\$0= 1.25 A\$0= 0.47 | |
| V = 164.7
WV = 22.4 | | $\begin{array}{rcl} \text{RO} &=& 1.442 & \text{AO} &=& 0.52 \\ \text{RV} &=& 1.442 & \text{AV} &=& 0.52 \\ \text{RO} &=& 1.20 & \text{AV} &=& 0.52 \end{array}$ | |
| DEUTERON
V = 106 69 |) | $R_0 = 1.05$ $A_0 = 0.86$ | |
| WS = 13.92
VS0= 7.0 | , | RS = 1.43 AS = 0.704
RS0= 0.75 AS0= 0.5 | |
| | | RC = 1.3 | |
| MT=102 RADIATI
BELOW 1.505
VALUE OF 0.
FUNCTION FO
SECTION CUR
18/. 0.5MB | VE CAPTURE (
MEV, CALCUI
001 WAS EMPI
DR S-WAVE NEU
VE WAS BASEI
3 WAS ASSUMEI | CROSS SECTION
LATION WITH CASTHY WAS ADOPTED. A
LOYED FOR THE GAMMA-RAY STRENGTH
UTRONS. ABOVE THIS ENERGY, CROSS
D ON THE EXPERIMENTAL DATA/16, 17,
D AT 14 MEV. | |
| MT=251 MU-BAR
CALCULATED | WITH CASTHY | | |
| MF=4 ANGUL | AR DISTRIBU | TIONS OF SECONDARY NEUTRONS | |
| MT=2, STATO
CALCULATED
COMPONENTS
OF MT=51-54
MT=16, 22, 28, 32
TAKEN FROM | WITH CASTHY
OF THE DIREC
,64 BY USING
,91
JENDL FUSIO | FOR EQUILIBRIUM PROCESS. THE
CT PROCESS WERE ADDED TO THE LEVELS
G THE DWUCK CODE /11/.
N FILE. | |
| MF=5 ENERG
MT=16, 22, 28, 32
TAKEN FROM | Y DISTRIBUT
91
JENDL FUSIO | IONS OF SECONDARY NEUTRONS | |
| MF=12 PHOTC
MT=16,22,28,32,91
CALCULATED
MT=51-70
TRANSITION | N PRODUCTION
103,104,107
WITH GNASH.
PROBABILITIN | N MULTIPLICITIES
7
ES ARE GIVEN. | |
| MT=102
OBTAINED FR | OM ENERGY B | ALANCE. | |
| MF=14 PHOTC
MT=16,22,28,32,51
ASSUMED TO | N ANGULAR D
-70,91,102,
BE ISOTROPIO | ISTRIBUTIONS
103,104,107
C. | |
| MF=15 PHOTO
MT=16,22,28,32,91
CALCULATED
MT=102 | DN ENERGY DIS
,103,104,107
WITH GNASH. | STRIBUTIONS
7 | |
| CALCULATED | WITH CASTHY | · · | |
| REFERENCES | | | |

CHIBA S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO N.: JAERI-M 90-006 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDL. MUGHABGHAB S.F., DIVADEENAM M. AND HOLDEN N.E.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981). ROHR G. ET AL.: ÉANDC(E)-89, P.1 (1968), EXFOR 20151003. FOSTER JR., D.G. AND GLASGOW D.W.: PHYS. REV., C3, 576 (1971). WHALEN J.F. ET AL.: ANL-7710, 12 (1971). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). HETRICK D.M., FU C.Y. AND LARSON D.C.: "CALCULATED NEUTRON-INDUCED CROSS SECTIONS FOR CU-63,65 FROM 1 TO 20 MEV AND COMPARISONS WITH EXPERIMENTS", ORNL/TM-9083 (1984). YOUNG P.G. AND ARTHUR E.D.: "GNASH, A PREEQUILIBRIUM, STATISTICAL NUCLEAR-MODEL CODE FOR CALCULATION OF CROSS SECTIONS AND EMISSION SPECTRA", LA-6974 (1977). KUNZ P.D.: UNIV. COLORADO (1974). WARD N.J. AND TULI J.K.: NUCL. DATA SHEETS, 47, 135 (1986). PEREY F.G.: PHYS. REV. 131, 745 (1963). MCFADDEN L. AND SATCHLER G.R.: NUCL. PHYS. 84, 177 (1966). LOHR J.M. AND HAEBERLI W.: NUCL. PHYS. A232, 381 (1974). ZAIKIN G.G. ET AL.: ATOM. ENERGIJA, 10, 508(1961). EXFOR40248 JOHNSRUD A.E. ET AL.: PHYS. REV., 116, 927 (1959). EXFOR11675 VOIGNIER J. ET AL.: NUCL. SCI. ENG., 93, 43(1986). EXFOR22006 ż $\frac{2}{3}$ 5) 6) 7) 8) 9) 10) (11)12) 13) 14) 15) 16) 17)

18)

| MA
3 | T
31- | num
GA- | ber
0 | ĸ. | 31
 | 00 | | | E | VA | L - | M A
A P | RS |)4 | Т | . W | /AT | - Al | N۸ | ΒE | | | | | | | | | | | | |
|-----------|----------------------------|---------------------------------|---------------------------------------|---|---|---------------------------------|--------------------------|---------------------------|----------------------------------|--|---|--------------------------|-----------------------|--------------------------------|------------------------|----------------------------|---|--|-----------------------|------------------------------|-------------------|------------------|---------------------|----------------|-------------|------------|--|--|---------------------------------|----------------|-------------------------|---|
| H I
94 | ST
 -3 | ORY
N | ΕW | EVA | ۱LU | AT | 10 | N | WA | s | co | NS | TF | , .
10 | ст | ΈC |) F | R | ЭΜ | I | sc | т | 0 P | ES | S [| DA | ТΑ | | | | | |
| MF | =1
MT | G
=45 | ENE
1 C | RAL
OMM | I
IEN | N F
T S | OR
A | M A
N D | T I
D | ON
IC | ΤI | 0 N | IAF | RΥ | | | | | | | | | | | | | | | | | | |
| MF | T=2
MT
RE | RI
SOL
THE
PAR
ABUI | ESO
1 R
VED
DA
AME
NDA | NAN
ESC
RE
TA
TEF
NCE | NCE
DLV
SO
WE
SS/ | P
ED
NA
RE
F0
1/ | AR
R
NC
C
R | AM
ES
ON
GA | ET
ON
PA
ST
- 6 | ER
AN
RA
RU
9 | S
CE
ME
CT
AN | P
TE
ED
D | AF
RS
GA | RAN
R
R
N - T | ИЕ
FO
DM
71 | TE
R
T | RS
ML
HE
CC | 3

] N 3 | ₩
EV
SI | F0
AL
DE | R N
U A
R I | IU
A T
N | LA
ED
G |)
F
T F | BES | | OW
NA | 5
NC | .ç | 9KE | V.) | |
| | CA | LCUI
T(
EI
C, | LAT
OTA
LAS
APT | ED
L
TIC
URE | 22 | 00 | - M | / S | C
22
9
7
2 | R0
00
.8
.0
.8 | SS
M | S
 S | EC | т | 10 | NS | 5 A | N I | C | RE | S.
F | ۲E | IN
S.
-
23 | ΤΕ
Ι
. ε | G F
N T | R A
F E | LS
G. | (| BA | AR N | S) | |
| MF | =3
BE
AB
CA
DA | NU
LOW
OVE
PTU
TA | EUT
5.
5.
RE
CAL | RON
9 k
6 k
PAF
CUL | | RO
ÅL
ED | SS
RE
TH
C
W | SO
E
RO
I T | EC
NA
TO
SS
H | TI
NC
TA
S
CA | ON
E
L
EĊ
ST | S
PA
E
TI
HY | R A
L A
ON
F | AME
AST
N
N
R
(| ET
TI
VE
DG | ER
C
RE | S
AN
M/ | WE
1D
31 \
2, | ER
I
VE
/. | E
NE
N | G I
L A
U S | V
S
S
I | EN
TI
NG | Ċ | SC
AC | CA
CH | TT
I | ER
SO | | NG,
)PÉ | AN
S | D |
| | MT
WE
AB | =16
(N
(N
RE
UND | , 22
, 2N
, A)
CON
ANC | ,28
),(
,(N
STF
ES | 3,3
(N,
1,2
RUC | 2
NÅ
P)
TE | 10
),
,
D
E0 | 2,
(Ň
U-
FR
R | 10
, N
BA
OM | 3,
Р)
R
Е | 10
,(
AC | 4,
N,
H | 10
NE
GA |)5
)) | , 1
, (
I S
= | 06
N,
0T | 5,1
P)
OF | 07
, PE | 7,
(Ň
D
= V | 11
, D
AT | 1,
),
A | 2
(
C | 51
N,
ON | T)
SI | , (
De | (N
ER | , H
I N
G | E-
G | 3) |),
 | | |
| | ÂN | D M. | ADI | FIE | ED | ĔG | NĂ | Sн | - 2 | /3 | /' | PR | 00 | GR/ | ĀM | M. | | - L | _ v | | .07 | \ | | L | | | 0 | | 51 | | | |
| | NE | UTR | ΟN | 0P1 | T I C | AL | P | 0T
• | E N | | AL | Ρ | AF | RAM | ИE | TE | :RS | 5 l | JS | ED | | /E | RE | A | \S
 | F | OL | | WS | 3.
 | | |
| | | V
WS
WS | -
=
=
0= | 49.
5.3 | 42
881
552 | - 0
+ 0 | EP

.5
.4 | 1 H
86
11 | (
7E
7E | ME
 | v)
 | | | | ,
, | R
R
R
S
R
S | A "
=
=
=
=
=
= | | (1

1
1 | / 3

. 2
. 3
. 5 |)
93
08 |
}
} | | | FF

, | | AO
AS
AS | NE
=
=
0= | 53 | 0.
0.
0. | M)
415
456
648 | |
| | тн | E LI | EVE | L SO
G F1252
507
507
101
111 | SCH
).
?
?
?
?
?
?
?
?
?
?
?
?
?
?
?
?
?
? | EM | E | WAE | SNE | ADC 20139845171871902010 | 0P(00726140038002161400380020 | TEME | D
V) | Ff | ۹۵ | M
1 | EPI//////////////////////////////////// | SIN 222222222222222222222222222222222222 | DF - P
 | FAR | | Ŧ | | | | I | SGAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA | T 66777676767 | P9911191911991 | - 7 | 1 | |
| | | | | 12
13
14
15 | 234555 | | | | 1.
1.
1.
1.
1.
1. | 10
13
39
47
48
49 | 93
40
662
59
80
37 | | | | | | 1/7/7/7/
7/7/5/
9/ | 22222222 | -
-
-
-
+ | | | | | | | | GA
GA
GA
GA
GA
GA | - 7
- 6
- 7
- 7
- 7
- 7 | 1
9
9
1
1
9
1 | | | |
| | | | | 17
18
20
21
22 | 7
}
)

2 | | | | 1.
1.
1.
1.
1. | 49
52
63
70
71
72
75 | 86
59
12
98
37
24 | | | | | | 533177 | 2222222222 | - + | | | | | | | | GA
GA
GA
GA
GA
GA | -76-76-76 | 1911910 | | | |
| | | | | 23 | 3 | | | | 1.
1.
1. | 89
90 | 40
16
40 | | | | | | 3/
3/
5/ | 22 | - | | | | | | | | G A
G A
G A | - 6
- 6
- 7 | 9
1 | | | |
| | | | | 24
25
26 | 1 | | | | 1.
1.
1. | 92
94
97 | 42
10
24 | | | | | | 7/
3/
9/ | 2222 | -
+
+ | | | | | | | | GA
GA
GA | - 6
- 7
- 6 | 9
1
9 | | | |
| | | | | 27 | 7 | | | | 2.
1. | 00
99 | 76
50 | | | | | | 3/ | 2
2
2 | - | | | | | | | | G A
G A | - 6
- 7 | 9
1 | | | |

| 28
29
30
31
32 | 2.0238
2.0452
2.0640
2.1342
2.1980
2.1913 | 5/2 -
5/2 -
1/2 -
5/2 -
13/2 -
5/2 - | GA
GA
GA
GA
GA | - 69
- 69
- 71
- 71
- 69
- 71 |
|--|--|--|--|--|
| 33
34 | 2.2060
2.2193
2.2510
2.2472 | 5/2 -
1/2 +
1/2 -
7/2 + | GA
GA
GA | - 71
- 69
- 69
- 71 |
| 35
36 | 2.2944
2.3195 | 1/2 - 7/2 + 1/2 | GA
GA | - 71
- 69 |
| 37
38 | 2.3273
2.3533
2.4233 | 5/2 -
13/2 - | GA
GA
GA | - 69
- 69 |
| LEVELS ABOVE 2 | .33 MEV WERE | ASSUMED TO I | BE OVERLAPP | ING. |
| PARAMETERS FOR THE
CAMERON WERE EVALUA
SPIN CUT-OFF PARAME | COMPOSITE L
ATED.
ETER C1 WAS | EVEL DENSITY
TAKEN AS 0.14 | FORMULA OF
46. | GIRBERT- |
| | GA- 6 | 9 GA-70 | GA- 71 | GA-72 |
| A (MEV)
SPIN CUT-OFF PARAM
PAIRING ENERGY (MEV
NORMALIZATION FACTO
E-JOINT (MEV) | 11.34
8.27
7) 1.50
0R 1481.6
6.92 | 0 11.590
1 8.442
0 0.0
0 1536.20
4 4.221 | 13.000
9.026
1.430
1747.70
6.326 | 12.900
9.075
0.0
1758.60
4.961 |
| MF=4 MT=2,16,22,28,3
(N,2N),(N,NA),(N,NF
ANGULAR DISTRIBUTIC
WERE CONSTRUCTED FF
ABUNDANCES. | 32,51-88,91
P),(N,ND) AN
DNS OF SECON
ROM EACH GA | D ELASTIC ANI
DARY NEUTRON
ISOTOPE DATA | D INELASTIC
S
CONSIDERIN | SCATTERING
G |
| MF=5 MT=16,22,28,32
(N,2N),(N,NA),(N,NF
ENERGY DISTRIBUTION
WERE CONSTRUCTED FF
ABUNDANCES. | ,91
P),(N,ND) AN
NS OF SECOND
ROM EACH GA | D CONTINUM II
ARY NEUTRONS
ISOTOPE DATA | NELASTIC SC
CONSIDERIN | ATTERING
G |
| REFERENCES
1)C.M.LEDERER ET.AL. | . TABLE
JOHN | OF ISOTOPES | 7TH ED.(19
INC. | 78) |

- 2)S.IGARASHI,T.FUKAHORI 3)N.YAMAMURO

JAERI-1321 (1991) JAERI-M 90-006(1991)

MAT number = 3125 31-GA- 69 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 5.9KEV.) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTER'S DATA/1/. EVALUATION WERE MAINLY BASED ON OHKUBO'S DATA/2/ AND MUGHABGHAB'S COMPILATION/3/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 10.36 ELASTIC 8.16 CAPTURE 2.20 18.23 MF=3 NEUTRON CROSS SECTIONS BELOW 5.9 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 5.9 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS FOLLOWS. AND DEPTH (MEV)RADIUS(FM)DIFFUSENESS(FM)V = 49.42-0.5867E, R0 = 5.3033, A0 = 0.415WS = 5.381+0.4117E, RS = 5.3648, AS = 0.456WS0= 8.552, RS0= 6.4928, AS0= 0.648
 THE LEVEL SCHEME
 WAS ADOPTED FROM ENSDF FILE/5/ NO.
 ENERGY (MEV)
 SPIN-PARITY
 B

 GR.
 0.0000
 3/2 1
 0.3187
 1/2 0

 2
 0.5741
 5/2 0
 3/2 0

 3
 0.8720
 3/2 0
 0
 0
 BETA2/BETA3 0.2 0.2 0.2 3/2 -1/2 -7/2 -7/2 -3/2 -3/2 -3/2 -3/2 -3/2 -3/2 -3/2 -3/2 -3/2 -3/2 -3/2 -12/2 -3/2 -13/2 -12/2 -1.0285 1.1068 1.1340 4 0.2 5 6 7 8 9 10 0.15 0.15 1.1340 1.3366 1.4880 1.5259 1.7237 1.7648 1.8916 0.15 0.15 Ŏ.15 0.15 11 12 1.9242 1.9724 1.9731 13 14 15 16 17

 5
 1.9731
 1/2

 6
 2.0076
 3/2

 7
 2.0238
 5/2

 8
 2.0452
 5/2

 9
 2.1980
 13/2

 10
 2.2193
 1/2

 11
 2.2510
 1/2

 2
 2.3195
 7/2

 3
 2.3533
 5/2

 4
 2.4233
 13/2

 5
 2.4287
 5/2

 6
 2.43
 MEV

 18 19 20 21 22 23 24 25 LEVELS PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GA- 69 GA- 70 11.340 8.271 1.500 1481.60 6.924 11.590 A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 8.442 0.0 1536.20 4.221 E-JOINT (MEV) THE CAPTURE CROSS SECTION WAS NORMALIZED TO 60 MILLIBARNS AT 100KEV TO REPRODUCE DOVBENKO'S DATA/6/. ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED

TO 0.77MB AT 14 MEV WERE ADED TO CASTHY'S RESULTS/7/. MT=16,22,28,32,33,103,104,105,106,107,111 (N,2N),(N,NA),(N,NP),(N,ND),(N,NT),(N,P).(N,D),(N,T), (N,HE-3),(N,A),(N,2P) WERE EVALUATED WITH MODIFIED EGNASH-2/8/ USING F2=0.6 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/9/ DEUTRON :LOHR-HAEBERLIS OMP/10/ TRITON :BECCHETTI-GREENLESS OMP/11/ HE-3 :BECCHETTI-GREENLESS OMP ALPHA :LEMOS OMP/12/ AND NORMALIZED TO FOLLOWING DATA. (N,2N) 886.0 MB CHATTERJEE'S DATA/13/ (N,NA) 2.2 MB SYSTEMATICS/14/ (N,NP) 17.3 MB SYSTEMATICS (N,P) 38.0 MB QAIMS DATA/15,16/ (N,P) 6.87 MB SYSTEMATICS (N,A) 22.0 MB AV. EXP. DATA/17/ THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,22,28,32,51-75,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,NA), (N,NP) AND (N,ND) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. DIECT INELASTIC CONTRIBUTIONS WERE EVALUATED WITH DWUCKY/18/, AND ADDED TO CASTHY'S RESULTS. DEFORMATION PARAMETERS USED IN THE DWUCKY CALCULATION WERE EVALUATED FROM COMPILATION/19,20/ AND ENSDF HALF LIFE DATA. AS FOR (N,2N),(N,NA),(N,NP) AND (N,ND),ISOTROPIC DISTRIBUTION WAS ASSUMED. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,32,91 FOR (N,2N), (N,NA), (N,NP), (N,ND) AND CONTINUM INELASTIC SCATTER-ING, SECONDARY NEUTRON ENERGY DISTRIBUTIONS WERE CALCULATED WITH EGNASH-2.

 REFERENCES
 J.L.KOESTER ET. AL.
 Z.PHYS. A318,347(1984)

 2)M.OHKUBO ET. AL.
 JAERI-M 90-213(1990)

 3)S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A

 ACADEMIC PRESS(1981)

 4)S.IGARASHI,T.FUKAHORI
 JAERI-1321 (1991)

 5)EVALUATED NUCLEAR STRUCTURAL DATA FILE

 6)A.G. DOVBENKO ET AL.
 AE 26,67(1969)

 7)T,NAKAGAWA
 CAPDIR MANUAL

 8)N.YAMAMURO
 JAERI-M 90-006(1991)

 9)F.G.PEREY
 PR 131, 745(1963)

 10)J.M.LOHR,W.HAEBERLI
 NP A232, 381(1974)

 11)F.D.BECCHETTI AND
 POLARIZATION PHENOMENA IN NUCLEAR

 G.W.GREENLESS
 REACTION 682(1971) UNIV. WISCONSI

 12)O.F.LEMOS
 ORSAY REP.SER.A NO.136(1972)

 13)A.CHATTERJEE ET AL.
 69 ROOKEE 2,117(1969)

 14)R.A.FORREST
 AERE-R 12419(1986)

 15)S.M.QAIM ET AL
 NP/A 283,269(1977)

 16)G.P. VINITSKAYA ET AL.
 VINITSKAYA (1969) ACC.NO.=40009008

 17)K.KAWADE ET AL
 JAERI-M 88-140(1988)

 19)S.RAMAN ET.AL.
 AND 42,1(1989)

 20)R.H.SPEAR
 AND 42,55(1989)

 REFERENCES 1)L.KOESTER ET. AL. 2)M.OHKUBO ET. AL. 3)S.F.MUGHABGHAB ET. AL., ŴĬŚĊÓŃSIN

MAT number = 3131 31-GA- 71 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 5.6KEV) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTERS 2200M/S DATA/1/. RESONANCE PARAMETERD WERE EVALUATRED MAINLY BASED ON OHKUBOS DATA/2/ AND MUGHABGHABS COMPILATION/3/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 8.945 -ELASTIC 5.236 -CAPTURE 3.709 32.19 INTEGRALS (BARNS) F=3 NEUTRON CROSS SECTIONS BELOW 5.6 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 5.6 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCUALTION WERE AS FOLLOWS MF=3FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 49.42 - 0.5867E , R0 = 5.3541WS = 5.381 + 0.4117E , RS = 5.4162WS0 = 8.552 , RS0 = 6.5549, A0 = 0.415 , AS = 0.456 , AS0= 0.648
 THE LEVEL SCHEME
 WAS ADOPTED FROM ENSDF FILE/5/ NO.
 ENERGY (MEV)
 SPIN-PARITY
 B

 GR.
 0.0
 3/2 1
 0.3900
 1/2 0

 2
 0.4872
 5/2 0
 3/2 0

 3
 0.5116
 3/2 0
 3/2 0
 ́₿Ė́ТА2∕ВЕТАЗ 0.0 0.3900 0.4872 0.5116 0.7140 0.9103 0.9648 0.2 0.2 0.2 456789 10112 0.2 0.9648 1.1074 1.1093 1.3952 1.4759 1.4937 1.4986 1.6316 1.7022 1.7198 1.7524 1.9040 1.9410 1.9450 0.15 0.15 Ŏ.15 0.1 ŏ.1 13 14 15 16 17 18 19

 18
 1.9410
 3/2 +

 19
 1.9950
 5/2

 20
 2.0640
 1/2

 21
 2.1324
 5/2

 22
 2.1913
 5/2

 23
 2.2060
 5/2

 24
 2.2472
 7/2 +

 25
 2.2944
 1/2

 26
 2.3273
 1/2

 LEVELS ABOVE
 2.33
 MEV

 PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GA- 71 GA- 72 - - - - - - - - -- - - - - - - -A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 13.000 9.026 1.430 1747.70 6.326 12.900 9.075 0.0 1758.60 4.961 E-JOINT (MEV) THE CAPTURE CROSS SECTION WAS NORMALIZED TO 12 MB AT 1MEV TO REPRODUCE THE EXPERIMENTAL CAPTURE CROSS SECTION/6/.

ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.74MB WERE ADDED TO CASTHY'S RESULTS/7/. MT=16,17,22,28,32,103,104,105,106,107 (N,2N),(N,3N),(N,NA),(N,NP),(N,ND),(N,NT),(N,P),(N,D), (N,T),(N,HE-3),(N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/8/ USING F2=0.6 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/9/ DEUTRON :LOHR-HAEBERLIS OMP/10/ TRITON :BECCHETTI-GREENLESS OMP/11/ HE-3 :BECCHETTI-GREENLESS OMP/11/ ALPHA :LEMOS OMP/12/ AND NORMALIZED TO FOLLOWING DATA. (N,2N) 950.0 MB CSIKAI'S DATA/13/ (N,NA) 2.4 MB QAIMS DATA/14/ (N,NP) 1.95 MB SYSTEMATICS/15/ (N,P) 20.5 MB QAIMS DATA/16/ (N,D) 3.63 MB SYSTEMATICS (N,A) 3.5 MB MEASURED DATA/17,18/ THE MU PAP(MT-251) WAS ALSO CALCULATED WITH CASTHY THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. MF=4 MT=2,16,17,22,28,32,51-76,91 (N,2N),(N,NA),(N,NP),(N,ND) AND ELASTIC AND INELASTIC SCATTERING ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. DIRECT INELASTIC SCATTERING CONTRIBUTIONS WERE EVALUATED WITH DWUCKY/19/ AND ADDED TO CASTHY'S RESULTS. DEFORMATION PARAMETERS USED IN THE DWUCKY CALCULATION WAS EVALUATED FROM COMPILATION/20,21/ AND ENSOF HALF LIFE DATA. AS FOR (N,2N),(N,3N),(N,NA),(N,NP) AND (N,ND),ISOTROPIC DISTRIBUTIONS WERE ASSUMED. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,32,91 FOR (N,2N),(N,3N),(N,NA),(N,NP),(N,ND) AND CONTINUM INELASTIC SCATTERING, SECONDARY NEUTRON ENERGY DISTRIBUTIONS WERE CALCULATED WITH EGNASH-2.

 REFERENCES
 1)L.KOESTER ET. AL.
 Z.PHYS. A318,347(1984)

 2)M.OHKUBO ET. AL.
 JAERI-M 90-213(1990)

 3)S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A

 ACADEMIC PRESS(1981)

 4)S.IGARASHI,T.FUKAHORI
 JAERI-1321

 1)SEVALUATED NUCLEAR STRUCTURAL DATA FILE

 6)G.G.ZAIKIN ET AL.
 UFZ 16,1205(1971)

 7)T.NAKAGAWA
 CAPDIR MANUAL

 8)N.YAMAMURO
 JAERI-M 90-006(1991)

 9)F.G.PEREY
 PR
 131,745(1963)

 10)J.M.LOHR,W.HAEBERLI
 NP A232,381(1974)

 11)F.D.BECCHETTI AND
 POLARIZATION PHENOMENA IN NUCLEAR

 G.W.GREENLESS
 REACTION 682(1971) UNIV. WISCONSIN

 12)O.F.LEMOS
 ORSAY REP.SER.A NO.136(1972)

 13)J.CSIKAI ET AL.
 AHP 23,87(1967)

 14)S.M.QAIM ET AL.
 UP/A 283,269(1977)

 17)K.KAWADE ET.AL.
 JAERI-M 90-171(1990)

 18)S.M.QAIM
 14 MEV ACTIVATION CROSS SECTIONS

 HANDBOOK OF SPECTROSCOPY, VOL.3 P.141
 CRC PRESS BOCA RATON FLORIDA,1981

 19)N.YAMAMURO
 JAERI-M 88-140(1988)

 20)S.RAMAN ET.AL.
 AND 42,55(1989)

 REFERENCES 1)L.KOESTER ET. AL. 2)M.OHKUBO ET. AL. 3)S.F.MUGHABGHAB ET. AL.,

MAT number = 3200 32-GE- 0 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEW EVALUATION WAS CONSTRUCTED FROM ISOTOPES DATA. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 62.0KEV) THE DATA WERE CONSTRUCTED FROM THE EVALUATED RESONANCE PARAMETERS FOR GE ISOTOPES CONSIDERING THEIR ABUNDANCIES/1/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 10.62 ELASTIC 8.51 CAPTURE 2.11 5.88 MF=3 NEUTRON CROSS SECTIONS BELOW 62 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 8.5 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AN CAPTURE CROSS SECTION WERE GIVEN AS BACKGROUND OR SMOOTH CROSS AND SECTION. THE DATA WERE CONSTRUCTED FROM THE EVALUATED CROSS SECTIONS FOR EACH GE ISOTOPE CONSIDERING THEIR ABUNDANCIES. MT=16,22,28,32,102,103,104,105,106,107,111,251 (N,2N),(N,NA),(N,NP),(N,ND),(N,P),(N,D),(N,T),(N,HE-3), (N,A),(N,2P),MU-BAR WERE CONSTRUCTED FROM EACH GE ISOTOPE DATA CONSIDERING ABUNDANCES. CROSS SECTIONS FOR EACH ISOTOPE WERE EVALUATED USING CASTHY/2/ AND MODIFIED EGNASH-2/3/ PROGRAMM. USED NEUTRON OPTICAL MODEL PARAMETERS WERE AS FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 52.07 - 0.7434E, R0 = 1.224, A0 = 0.492WS = 9.997 + 0.1299E, RS = 1.411, AS = 0.36WS0 = 10.99, RS0 = 1.470, AS0 = 0.65THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE. NO. ENERGY GE-70 GE-72 GE-73 GE-74 GE-76 (MEV) - - - - - - - - -. 0.000 GR. GR GR GR GR GR 0.0130.0670.3544, 5, 6 7, 8 9,10 11 12 1 2 3 0.499 0.551 0.596 4 56 7 8 9 10 11 12 13 14 15 16 17 1 11,12 1 0.692 0.742 0.809 1 13,14 15,16 $0.809 \\ 0.834 \\ 0.894 \\ 0.994 \\ 1.039 \\ 1.108 \\ 1.204 \\ 1.410 \\ 1.204 \\ 1.000 \\ 1.00$ 2 17 18-21 22,23 24 1 25,26 2 2 2 1.410 1.464 1.539 1.697 1.911 2.029 2.1538 2.307 2.396 2.396 2.4526 3 3 3, 4 4 3 4 5, 6 5, 6 5-7 4, 5 8, 9 10,11 7, 8 6 8, 9 10 11 7 9,10 8 12 2.536 2.561 2.670 2.753 2.807 2.876 28 29 30 13,14 15-17 11,12 13-15 ğ 12 13,14 18 16 31 32 19-21 10 17 15,16 17-19 18,19 11 12 2.926 22-24 33

 34
 2.974
 25

 35
 3.034
 13-15
 20-24

 36
 3.181
 16-18

 37
 3.297
 19-22

 38
 3.423
 23
 25

 39
 4.0
 24
 26

 LEVELS
 ABOVE
 1.14
 MEV

 20 23 24 PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. SPIN CUT- PAIRING OFF PARAM. EN.(MEV) A(MEV) NORMAL. E-JOINT (MĚV) FACTOR -----. - - -`- - - -13.430 13.600 15.020 14.970 13.550 13.500 14.230 14.230 GE - 70 GE - 71 GE - 72 GE - 73 GE - 74 GE - 75 GE - 76 GE - 77 1780.00 1828.30 2047.70 2069.20 9.088 9.232 9.793 9.867 2.860 8.234 2.860 1.360 2.790 1.360 3.240 1.360 2.830 1.360 8.064 7.841 7.828 9.473 9.540 9.882 1898.60 1917.20 2047.70 10.660 7.654 8.586 14.200 9.871 2043.40 GE - 77 1.360 6.872 MF=4 MT=2,16,22,28,32,51-89,91 (N,2N),(N,NA),(N,NP),(N,ND) AND ELASTIC AND INELASTIC SCATTERING ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CONSTRUCTED FROM EACH GE ISOTOPE DATA CONSIDERING ABUNDANCES. MF=5 MT=16,22,28,32,91 (N,2N),(N,NA),(N,NP),(N,ND) AND CONTINUUM INELASTIC SCATTERING ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CONSTRUCTED FROM EACH GE ISOTOPE DATA CONSIDERING ABUNDANCES. REFERENCES TABLE OF ISOTOPES 7TH ED.(1978) JOHN WILEY & SONS INC. JAERI-1321 (1991) JAERI-M 90-006(1991) 1)C.M.LEDERER ET.AL. 2)S.IGARASHI,T.FUKAHORI 3)N.YAMAMURO

MAT number = 3225 32-GE- 70 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 15 KEV) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTERS 2200M/S DATA/1/. PARAMETERS WERE EVALUATED MAINLY BASED ON MUGHABGHABS COMPILATION/2/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 15.43 -ELASTIC 12.5 -CAPTURE 2.93 2.51 INTEGRALS (BARNS) F=3 NEUTRON CROSS SECTIONS BELOW 15 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 15 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/3/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS MF=3FOLLOWS. DIFFUSENESS(FM) DEPTH (MEV) RADIUS(FM) V = 52.07-0.7434E , R0 = 5.0445 WS = 9.997+0.1299E , RS = 5.8151 WS0= 10.99 , RS0= 6.0583 , A0 = 0.492 , AS = 0.36 , AS0= 0.65 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/4/. NO. ENERGY(MEV) SPIN-PARITY GR. 0.0000 0 + BETA 2/3 $\begin{array}{c} 1.0392\\ 1.2154\\ 1.7079\\ 2.1534\\ 2.3069\\ 2.4515\\ 2.5358\\ 2.88067\\ 2.8067\\ 2.80452\\ 3.0468\\ 3.1070\\ 3.1810\\ 3.29458\\ 3.1070\\ 3.1810\\ 3.22966\\ 3.2973\\ 3.3716\\ 3.2973\\ 3.3716\\ 3.4230\\ 4.0000\end{array}$ 2 0.16 123 + 02 + 0.12 + 45678901234567 11234567 420323402340241 0.12 + 0.11 + 0.11 18 19 363522 20 21 22 23 24 0.11 0.11(DUMMY) + 24 4.0000 2 + 0.11(DU LEVELS ABOVE 3.43 MEV WERE ASSUMED TO BE OVERLAPPING. PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GE- 70 GE- 71 A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 13.430 13.600 9.088 2.860 1780.00 8.234 9.232 1.360 1828.30 E-JOINT (MEV) 8.064 THE CAPTURE CROSS SECTION WAS ADJUSTED TO 45 MILLIBARN S AT 200 KEV/5/. ABOVE 1MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.77MB AT 14MEV, WERE ADDED TO CASTHYS RESULTS/6/.

| MT= | =16,22,28,103,104,105,1
(N,2N),(N,NA),(N,NP),(| 06,107,111
N,P),(N,D),(N,T),(N,HE-3), |
|---|---|---|
| WEF | (N,A),(N,2P)
RE EVALUATED WITH MODIF
LOWING OPTICAL POTENTI
NEUTRON :SAME AS USE
PROTON :PEREYS OMP/
DEUTRON :LOHR-HAEBER
TRITON :BECCHETTI-G
ALPHA :LEMOS OMP/1
D NORMALIZED TO THE FOL | IED EGNASH-2/7/ USING F2=1.2 AND
AL
D IN CASTHY
8/
LIS OMP/9/
REENLESS OMP/10/
REENLESS OMP/10/
1/
LOWING DATA. |
| TU | | B SYSTEMATICS/13/
B AV. OF /14/,/15/ AND /16/
B SYSTEMATICS
B SYSTEMATICS |
| | E MU-BAR(MI=251) WAS AL | SO CALCULATED WITH CASTRY. |
| MF=4
MT=
ELA | ANGULAR DISTRIBUTIONS
=2.16.22.28.51-74.91
ASTIC AND INELASTIC SCA | TTERING CROSS SECTION, (N, 2N), (N, NA) |
| ANI
ST
INE
DWU
CAI
END | SULAR DISTRIBUTIONS WER
GULAR DISTRIBUTIONS WER
ELASTIC SCATTERING CONT
JCKY PROGRAMM/17/. DEFC
LCUALTION WERE EVALUATE
SDF HALF LIFE DATA AND
Y DATA (20/ | E CALCULATED WITH CASTHY FOR ELA-
Y SCATTERED NEUTRONS. THE DIRECT
RIBUTION WERE EVALUATED WITH
RMATION PARAMETERS USED IN DWUCKY
D FROM COMPILATIONS/18,19/ AND
ADJUSTED TO REPRODUCE |
| AS
WAS | FOR (N,2N),(N,NA),(N,N
S ASSUMED. | P) AND (N,ND), ISOTROPIC DISTRIBUTION |
| MF=5
MT=
FOF
SEC
EGT | ENERGY DISTRIBUTIONS
=16,22,28,91
R (N,2N),(N,NA),(N,NP)
CONDARY NEUTRON ENERGY
NASH-2. | OF SECONDARY NEUTRONS
AND CONTINUM INELSTIC SCATTERING
DISTRIBUTION WAS CALCULATED WITH |
| REFEF
1)L
2)S | RENCES
.KOESTER ET. AL.
.F.MUGHABGHAB ET. AL., | Z.PHYS. A327,129(1987)
NEUTRON CROSS SECTION VOL.1 PART A
ACADEMIC PRESS(1981) |
| 3) SE
5) GT
56) TN
7) FJ
7) FJ
90) F
10) C
12) RH
14) JG
14) SR
16) NS
16) NS
16) NS
16) NS
16) NS
17) SR
20) A | .IGARASHI,T.FUKAHORI
VALUATED NUCLEAR STRUCT
. WALTERS
. NAKAGAWA
.YAMAMURO
.G.PEREY
.M.LOHR,W.HAEBERLI
D.BECCHETTI AND
G.W.GREENLESS
.F.LEMOS
DNNO ET.AL.
A.FORREST
M.HOANG ET AL
.L.CASANOVA ET AL.
.YAMAMURO
.RAMAN ET AL.
.H.SPEAR
.TAKAHASHI ET.AL. | JAERI-1321 (1991)
URAL DATA FILE
KFK-3706(1984)
CAPDIR MANUAL
JAERI-M 90-006(1991)
PR 131, 745(1963)
NP A232, 381(1974)
POLARIZATION PHENOMENA IN NUCLEAR
REACTION 682(1971) UNIV. WISCONSIN
ORSAY REP.SER.A NO.136(1972)
JAERI-1329(1993)
AERE-R 12419(1986)
ZP.A342,283(1992)
ARS,72,(3),186(1976)
NESTOR LIST
JAERI-M 88-140(1988)
AND 42,1(1989)
AND 42,55(1989)
OKTAVIAN DATA PRIVATE COM. |

MAT number = 3231 32-GE- 72 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 40KEV) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTERS 2200M/S DATA/1/. LEVEL PARAMETERS WERE EVALUATED MAINLY BASED ON MUGHABGHABS COMPILATION/2/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 9.91 9.1 3 0.87 0.81 F=3 NEUTRON CROSS SECTIONS BELOW 40 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 40 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY /3/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS MF=3FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 52.07-0.7434E , R0 = 5.092 WS = 9.997+0.1299E , RS = 5.87 WS0= 10.99 , RS0= 6.1154 , A0 = 0.492 , AS = 0.36 , AS0= 0.65 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/4/. NO. ENERGY(MEV) SPIN-PARITY BETA 2/3 GR. 0.0000 0 + NO. ENERGY(MEV) SPIN-PARITY BETA 2/3 GR. 0.0000 0 + 1 0.6916 0 + 2 0.8341 2 + 0.16 3 1.4641 2 + 0.12 4 1.7284 4 + 5 2.0290 0 + 6 2.0490 0 + 7 2.0650 3 + 8 2.3962 1 + 9 2.4024 2 + 0.12 10 2.4640 4 + 11 2.5149 3 - 0.11 12 2.5835 1 + 13 2.7544 0 + 14 2.7722 6 + 15 2.8757 2 + 16 2.8970 0 + 17 2.9401 1 -18 2.9436 3 -19 2.9504 1 + 20 3.0340 2 + 21 3.0358 2 -22 3.0805 4 + 23 3.0942 2 + 0.11 24 3.1290 5 -25 3.5000 2 + 0.11(DUMMY) 26 4.0000 2 + 0.11(DUMMY) LEVELS ABOVE 3.26 MEV WERE ASSUMED TO BE OVERLAPPING. AMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBER PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GE- 72 GE- 73 - - - - - - -A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 15.020 9.793 2.790 2047.70 14.970 9.867 1.360 2069.20 7.841 E-JOINT (MEV) 7.828 THE CAPTURE CROSS SECTION WAS NORMALIZED USING DO=962 EV AND GG=0.162 EV ADOPTED FROM MUGHABGHABS COMPILATION/2/.

ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.76MB AT 14 MEV WERE ADDED TO CASTHYS RESULTS/5/. MT=16,17,22,28,32,103,104,105,106,107 (N,2N),(N,3N),(N,NA),(N,NP),(N,ND),(N,P),(N,D),(N,T), (N,HE-3),(N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/6/ USING F2=1.4 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/7/ DEUTRON :LOHR-HAEBERLIS OMP/8/ TRITON :BECCHETTI-GREENLESS OMP/9/ HE-3 :BECCHETTI-GREENLESS OMP/9/ ALPHA :LEMOS OMP/10/ AND NORMALIZED TO FOLLOWING DATA. (N,NA) 1.6 MB SYSTEMATICS/11/ (N,NP) 5.7 MB SYSTEMATICS (N,P) 33.4 MB AV.EXP.DATA/12,13/ (N,P) 5.3 MB SYSTEMATICS (N,T) 0.026 MB SYSTEMATICS (N,A) 14.0 MB AV. EXP. DATA/13,14/ THE MU DAD(MT 251) WAS ALSO CALCULATED WITH CASTHY THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,22,28,32,51-76,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,NA), (N,NP) AND (N,ND) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. THE DIRECT INELASTIC SCATTERING CONTRIBUTION WERE EVALUATED WITH DWUCKY PROGRAMM/15/. DEFORMATION PARAMETERS USED IN DWUCKY CALCUALTION WERE EVALUATED FROM COMPILATIONS/16,17/ AND ENSDF HALF LIFE DATA AND ADJUSTED TO REPRODUCE DDX DATA/18/. AS FOR (N,2N),(N,NA),(N,NP) AND (N,ND),ISOTROPIC DISTRIBUTION WAS ASSUMED. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,22,28,32,91 FOR (N,2N), (N,NA), (N,NP), (N,ND) AND CONTINUM INELASTIC SCATTER-ING, SECONDARY NEUTRON ENERGY DISTRIBUTIONS WERE CALCULATED WITH EGNASH-2. REFERENCES
1)L.KOESTER ET.AL.Z.PHYS. A327,129,(1987)
ACADEMIC PRESS(1981)2)S.F.MUGHABGHAB ET.AL., NEUTRON CROSS SECTION VOL.1 PART A
ACADEMIC PRESS(1981)3)S.IGARASHI,T.FUKAHORIJAERI-1321
(1991)4)EVALUATED NUCLEAR STRUCTURAL DATA FILE
5)T.NAKAGAWACAPDIR MANUAL
6)N.YAMAMURO6)N.YAMAMUROJAERI-M 90-006(1991)
7)F.G.PEREY7)F.G.PEREYPR9)F.D.BECCHETTIAND9)F.D.BECCHETTIAND9)F.D.BECCHETTIAND9)F.LEMOSORSAY REP.SER.A NO.136(1972)11)R.A.FORRESTAERE-R 12419(1986)
12)R.RIEPPO ET AL.12)R.RIEPPO ET AL.JIN 38,1927(1976)13)J.L.CASANOVA ET AL.ARS 72,186(1976)14)G.P.VINITSKAYA ET AL.AND 42,1(1988)
AND 42,1(1988)16)S.RAMAN ET AL.AND 42,1(1989)
ALRI-M 88-140(1988)16)S.RAMAN ET AL.AND 42,55(1989)
ALRIAN AND 42,55(1989)18)A.TAKAHASHI ET.AL.OKATVIAN DATA PRIVATE COM. REFERENCES 1)L.KOESTER ET.AL. 2)S.F.MUGHABGHAB ET. AL., 9)F.D.BECCHETTI AND G.W.GREENLESS 10)O.F.LEMOS 11)R.A.FORREST 12)R.RIEPPO ET AL. 13)J.L.CASANOVA ET AL. 14)G.P.VINITSKAYA ET AL. 15)N.YAMAMURO 16)S.RAMAN ET AL. 17)R.H.SPEAR 18)A TAKAHASHI ET AL WISCONSIN

18)A.TAKAHASHI ET.AL.

MAT number = 3234 32-GE- 73 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 8.53 KEV) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTERS 2200M/S DATA/1/. LEVEL PARAMETERS WERE EVALUATED MAINLY BASED ON MUGHABGHABS COMPILATION/2/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 19.2 -ELASTIC 4.8 -CAPTURE 14.4 62.3 INTEGRALS (BARNS) F=3 NEUTRON CROSS SECTIONS BELOW 8.53KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 8.53KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY /3/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS MF=3FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 52.07-0.7434E , R0 = 5.1155 WS = 9.997+0.1299E , RS = 5.897 WS0= 10.99 , RS0= 6.1436 , A0 = 0.492 , AS = 0.36 , AS0= 0.65 13 14 15 16 17 0.8090 0.8258 0.8680 0.8941 0.9040 0.9155 0.9317 0.9937 1.0260 1.0432 1.30518 19 20 21 22 22 0.993/ 11/2 + 23 1.0260 13/2 + 24 1.0432 3/2 -25 1.1305 9/2 -26 1.1319 1/2 -LEVELS ABOVE 1.14 MEV WERE ASSUMED TO BE OVERLAPPING. PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GE- 73 GE- 74 - - - - - - - - -- - - - - - - . A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 14.970 9.867 1.360 2069.20 13.550 9.473 3.240 1898.60 E-JOINT (MEV) 7.828 10.660 THE CAPTURE CROSS SECTION WERE NORMALIZED USING D0=82 EV AND GG=0.145 EV, ADOPTED FROM MUGHABGHABS COMPILATION/2/.

ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.76MB AT 14 MEV WERE ADDED TO CASTHYS RESULTS/5/. MT=16,17,22,28,32,103,104,105,106,107 (N,2N),(N,3N),(N,NA),(N,NP),(N,ND),(N,P),(N,D),(N,T), (N,HE-3),(N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/6/ USING F2=1.2 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/7/ DEUTRON :LOHR-HAEBERLIS OMP/8/ TRITON :BECCHETTI-GREENLESS OMP/9/ HE-3 :BECCHETTI-GREENLESS OMP/9/ ALPHA :LEMOS OMP/10/ AND NORMALIZED TO FOLLOWING DATA. (N,NA) 0.97 MB SYSTEMATICS/11/ (N,P) 20.7 MB KONNO'S EXP. DATA/12/ (N,D+NP) 4.77 MB KONNO'S EXP. DATA/12/ (N,T) 0.36 MB SYSTEMATICS (N,A) 7.79 MB SYSTEMATICS M⊾ MB THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,17,22,28,32,51-76,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,3N), (N,NA),(N,NP) AND (N,ND) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. THE DIRECT INELASTIC SCATTERING CONTRIBUTION WERE EVALUATED WITH DWUCKY PROGRAMM/13/. DEFORMATION PARAMETERS USED IN DWUCKY CALCULATION WERE EVALUATED FROM COMPILATIONS/14,15/ AND HALF LIFE DATA FROM ENSDF AND ADJUSTED TO REPRODUCE DDX DATA/16/. AS FOR (N,2N),(N,3N),(N,NA),(N,NP) AND (N,ND),ISOTROPIC DISTRIBUTIONS WAS ASSUMED. MF = 4=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,32,91 FOR (N,2N),(N,3N),(N,NA),(N,NP),(N,ND) AND CONTINUM INELASTIC SCATTERING,SECONDARY NEUTRON ENERGY DISTRIBUTIONS WERE CALCULATED WITH EGNASH-2. MF = 5REFERENCES
1)L.KOESTER ET. AL.Z.PHYS. A327,129(1987)
2)S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A
ACADEMIC PRESS(1981)3)S.IGARASHI,T.FUKAHORIJAERI-1321
4)EVALUATED NUCLEAR STRUCTURAL DATA FILE
5)T.NAKAGAWA(1991)
4)EVALUATED NUCLEAR STRUCTURAL DATA FILE
5)T.NAKAGAWA6)N.YAMAMUROJAERI-M 90-006(1991)
7)F.G.PEREY7)F.G.PEREYPR9)F.D.BECCHETTIAND
4)EVALUATED9)F.D.BECCHETTIAND
4)EVALUATES10)O.F.LEMOSORSAY REP.SER.A NO.136(1972)
11)R.A.FORREST11)R.A.FORRESTAERE-R 12419(1986)
12)C.KONNO ET AL12)C.KONNO ET ALJAERI-M 88-140(1988)
ALS.RAMAN ET AL.16)A.TAKAHASHI ET.AL.OKTAVIAN DATA PRIVATE COM. REFERENCES 1)L.KOESTER ET. AL. 2)S.F.MUGHABGHAB ET. AL.,

MAT number = 3237 32-GE- 74 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 62.0 KEV) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTERS 2200M/S DATA/1/. LEVEL PARAMETERS WERE EVALUATED MAINLY BASED ON MUGHABGHABS COMPILATION/2/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 7.2 -ELASTIC 6.8 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 0.46 0.42 F=3 NEUTRON CROSS SECTIONS BELOW 62 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 62 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY /3/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS MF=3FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 52.07-0.7434E , R0 = 5.1388 WS = 9.997+0.1299E , RS = 5.9239 WS0= 10.99 , RS0= 6.1716 , A0 = 0.492 , AS = 0.36 , AS0= 0.65 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/4/. NO. ENERGY(MEV) SPIN-PARITY BETA 2/3 GR. 0.0000 0 + 0224 0.5959 1.2042 1.4638 0.16 + 123 + PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GE- 74 GE- 75 13.500 13.550 A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 9.473 9.540 1.360 1917.20 1898.60 E-JOINT (MEV) 10.660 7.654 THE CAPTURE CROSS SECTION WERE NORMALIZED TO 26 MILLI-

BARNS AT 50KEV/5/. ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.77MB AT 14 MEV, WERE ADDED TO CASTHYS RESULT/6/. MT=16,17,22,28,103,104,105,107 (N,2N),(N,3N),(N,NA),(N,NP),(N,P),(N,D),(N,T),(N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/7/ USING F2=1.2 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/8/ DEUTRON :LOHR-HAEBERLIS OMP/9/ TRITON :BECCHETTI-GREENLESS OMP/10/ HE-3 :BECCHETTI-GREENLESS OMP/10/ HE-3 :BECCHETTI-GREENLESS OMP/10/ ALPHA :LEMOS OMP/11/ AND NORMALIZED TO FOLLOWING DATA. (N,NA) 0.6 MB SYSTEMATICS/12/ (N,NP) 0.67 MB WEBBERS DATA/13/ (N,P) 11.5 MB AV.EXP DATA/14,15/ (N,D) 2.0 MB KONNO'S DATA/18/-EXP.DATA/13/ (N,A) 18.0 MB AV.EXP.DATA/16,17/ M∟ MB THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,17,22,28,51-77,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,3N), (N,NA) AND (N,NP) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. THE DIRECT INELASTIC SCATTERING CONTRIBUTION WERE EVALUATED WITH DWUCKY PROGRAMM/19/. DEFORMATION PARAMETERS USED IN DWUCKY CALCULATION WERE EVALUATED FROM COMPILATIONS/20,21/ AND ENSDF HALF LIFE DATA AND ADJUSTED TO REPRODUCE DDX DATA/22/. AS FOR (N,2N),(N,3N),(N,NA) AND (N,NP),ISOTROPIC DISTRIBUTIONS WAS ASSUMED. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 FOR (N,2N), (N,3N), (N,NA), (N,NP) AND CONTINUM INELASTIC SCATTER-ING, SECONDARY NEUTRON ENERGY DISTRIBUTIONS WERE CALCULATED WITH EGNASH-2.

 WITH EGNASH-2.

 REFERENCES

 1)L.KOESTER ET AL.
 Z.PHYS. A327,129(1987)

 2)S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A

 ACADEMIC PRESS(1981)

 3)S.IGARASHI,T.FUKAHORI
 JAERI-1321 (1991)

 4)EVALUATED NUCLEAR STRUCTURAL DATA FILE

 5)V.A.TOLSTIKOV
 YFI-6.5 (1968)

 6)T.NAKAGAWA
 CAPDIR MANUAL

 7)N.YAMAMURO
 JAERI-M 90-006(1991)

 8)F.G.PEREY
 PR
 131, 745(1963)

 9)J.M.LOHR,W.HAEBERLI
 NP
 A232, 381(1974)

 10)F.D.BECCHETTI AND
 POLARIZATION PHENOMENA IN NUCLEAR

 G.W.GREENLESS
 REACTION
 682(1971) UNIV. WISCONSIN

 11)O.F.LEMOS
 ORSAY REP.SER.A NO.136(1972)

 12)R.A.FORREST
 AERE-R 12419(1986)

 13)L.D.WEBBER ET AL
 BAP 13, 1663(1968)

 14)R.RIEPPO ET AL.
 JIN 38, 1927(1976)

 15)R.E.WOOD ET AL.
 PR 154, 1108(1967)

 16)R.VAENSKAE ET AL
 NIM 179, 525(1981)

 17)J.L.CASANOVA ET AL.
 ARS 72, 186(1976)

 18)C.KONNO ET AL.
 JAERI-M 88-140(1988)

 20)S.RAMAN ET AL.
 AND 42, 1(1989)

 21)R.H.SPEAR
 AND 42, 1(1989)

MAT number = 3243 32-GE- 76 KHI EVAL-MAR94 T.WATANABE DIST-APR94 HISTORY 94-3 NEWLY EVALUATED. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 50.0 KEV) NEGATIVE ENERGY LEVEL PARAMETERS WERE ADJUSTED TO REPRODUCE KOESTERS 2200 M/S DATA/1/. LEVEL PARAMETERS WERE EVALUATED MAINLY BASED ON MUGHABGHABS COMPILATION/2/. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 7.86 7.71 0.15 1.32 F=3 NEUTRON CROSS SECTIONS BELOW 50 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 50 KEV, THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL AND STATISTICAL MODEL CODE CASTHY /3/. OPTICAL MODEL PARAMETERS USED IN CASTHY CALCULATION WERE AS MF=3FOLLOWS. DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 52.07-0.7434E , R0 = 5.1846 WS = 9.997+0.1299E , RS = 5.9767 WS0= 10.99 , RS0= 6.2267 , A0 = 0.492 , AS = 0.36 , AS0= 0.65 THE LEVEL SCHEME WAS ADOPTED FROM ENSDF FILE/4/. NO. ENERGY(MEV) SPIN-PARITY BETA 2/3 GR. 0.0000 0 + 0.5629 1.1084 1.4101 0.16 2 2 4 123 + + $\begin{array}{c} 1.4101\\ 1.5395\\ 1.9111\\ 2.0199\\ 2.2059\\ 2.2842\\ 2.4781\\ 2.5036\\ 2.5911\\ 2.6545\\ 2.6911\\ 2.7340\\ 2.7478\\ 2.7688\end{array}$ 456789 10112 3 0 4 1 3 1 0.11 + 2 1 0.11 + 4 13 14 15 16 17 344220 2.7478 2.7688 2.8416 2.8977 2.9198 3.0087 3.0405 3.0530 3.50000 4.6000 18 19 1 20 21 22 1 2 0.11 1 PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT-CAMERON WERE EVALUATED. SPIN CUT-OFF PARAMETER C1 WAS TAKEN AS 0.146. GE- 76 GE- 77 A (MEV) SPIN CUT-OFF PARAM. PAIRING ENERGY (MEV) NORMALIZATION FACTOR 14.230 14.200 9.882 2.830 2047.70 9.871 1.360 2043.40 E-JOINT (MEV) 8.586 6.872 THE CAPTURE CROSS SECTION WERE NORMALIZED TO 18 MILLI-BARNS AT 25 KEV/5/ ABOVE 1 MEV, DIRECT/SEMIDIRECT CAPTURE CROSS SECTION NORMALIZED TO 0.766MB AT 14 MEV,WERE ADDED TO CASTHGYS RESULT/6/.

MT=16,17,22,28,103,104,105,107 (N,2N),(N,3N),(N,NA),(N,NP),(N,P),(N,D),(N,T),(N,A) WERE EVALUATED WITH MODIFIED EGNASH-2/7/ USING F2=1.2 AND FOLLOWING OPTICAL POTENTIAL NEUTRON :SAME AS USED IN CASTHY PROTON :PEREYS OMP/8/ DEUTRON :LOHR-HAEBERLIS OMP/9/ TRITON :BECCHETTI-GREENLESS OMP/10/ HE-3 :BECCHETTI-GREENLESS OMP/10/ ALPHA :LEMOS OMP/11/ AND NORMALIZED TO FOLLOWING DATA. (N,2N) 1130 MB EXP. DATA /12,13,14,15/ (N,P) 2.9 MB EXP. DATA /16/ (N,D) 1.7 MB SYSTEMATICS/17/ (N,A) 1.63 MB SYSTEMATICS THE MU-BAR(MT=251) WAS ALSO CALCULATED WITH CASTHY. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,16,17,22,28,51-74,91 ELASTIC AND INELASTIC SCATTERING CROSS SECTION,(N,2N),(N,3N), (N,NA) AND (N, NP) ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY FOR ELA-STICALLY AND INELASTICALLY SCATTERED NEUTRONS. THE DIRECT INELASTIC SCATTERING CONTRIBUTION WERE EVALUATED WITH DWUCKY PROGRAMM/18/. DEFORMATION PARAMETERS USED IN DWUCKY CALCUALTION WERE EVALUATED FROM COMPILATIONS/19,20/ AND ENSDF HALF LIFE DATA AND ADJUSTED TO REPRODUCE DDX DATA/21/. AS FOR (N,2N),(N,3N),(N,NA) AND (N,NP),ISOTROPIC DISTRIBUTIONS WERE ASSUMED. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 FOR (N,2N) (N,3N),(N,NA).(N,NP) AND CONTINUM INELASTIC SCATTER-ING, SECONDARY NEUTRON ENERGY DISTRIBUTIONS WERE CALCULATED WITH EGNASH-2.

 WITH EGNASH-2.

 REFERENCES

 1)L.KOESTER ET. AL.
 Z.PHYS. A327,129(1987)

 2)S.F.MUGHABGHAB ET. AL., NEUTRON CROSS SECTION VOL.1 PART A

 ACADEMIC PRESS(1981)

 3)S.IGARASHI,T.FUKAHORI
 JAERI-1321 (1991)

 4)EVALUATED NUCLEAR STRUCTURAL DATA FILE

 5)G.WALTER
 KFK-3706(1984)

 6)T.NAKAGAWA
 CAPDIR MANUAL

 7)N.YAMAMURO
 JAERI-M 90-006(1991)

 8)F.G.PEREY
 PR

 9)J.M.LOHR,W.HAEBERLI
 NP

 NP
 A232, 381(1974)

 10)F.D.BECCHETTI
 AND

 POLARIZATION
 PHENOMENA IN NUCLEAR

 G.W.GREENLESS
 REACTION

 REACTION
 682(1971)

 10)F.LEMOS
 ORSAY REP.SER.A NO.136(1972)

 12)S.OKUMURA ET AL.
 NP/A 93,74(1967)

 13)E.STEINER ET AL.
 HPA 43,17(1969)

 14)R.VAENAKAE ET AL.
 NIM 179,525(1981)

 15)I.BIRN
 JUL-2803,37(1993)

 16)R.RIEPPO ET AL.
 JIN 38,1927(1976)

 17)R.A.FORREST
 AERE-R 12419(1986)

 18)N.YAMAMURO
 JAERI-M 88-140(1988)

 19)S.RAMAN ET AL.
 AND 42,1(1989)

 20)R.H.SPEAR
 WISCONSIN

| MAT number
33-AS- 75 | = 3325
JNDC | EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. |
|--|---|--|
| HISTORY
90-03 NEW E | VALUATION | FOR JENDL-3 WAS COMPLETED BY JNDC FPND |
| W.G./
94-02 JENDL
JEND
COMPI | 1/
3.2
L-3.1 WAS
LED BY T.N | REPLACED WITH JENDL FUSION FILE
AKAGAWA |
| *****
ALL C
ALL A
ALL E | MODIFIED
ROSS SECTI
3,32), (3,
NGULAR DIS
NERGY DIST | PARTS FOR JENDL-3.2 ************************************ |
| JENDL | FUSION FI
EVALUATED
COMPILED | LE /2/ (AS OF FEB. 1994)
BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
BY K.KOSAKO. |
| - TH
DI
CO
DW
- TH
(N
10
- TH
TA
- EA
WE
F1
CA
TA
CA
TH
CA
TH
CA
TL
CA | E INELASTI
STRIBUTION
NTINUUM IN
UCKY IN SI
E (N,2N),
, A) REACTI
E CAPTURE
STRIBUTION
KEN FROM
ERGY DISTR
TED BY EGN
RE OBTAINE
5TOB/2/.
LCULATED E
TICAL-MODE
E SINCROS-
VEL SCHEME | C SCATTERING CROSS SECTIONS AND ANGULAR
S OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
ELASTIC) WERE CALCULATED WITH CASTHY2Y AND
NCROS-II SYSTEM/3/.
(N,3N), (N,NA), (N,NP), (N,P), (N,D) AND
ON CROSS SECTIONS (MT=16, 17, 22, 28, 103,
RE CALCULATED BY EGNASH2 IN THE SINCROS-II.
CROSS SECTION, RESONANCE PARAMETERS AND ANG.
S OF ELASTICALLY SCATTERED NEUTRONS WERE
ENDL-3.1.
IBUTIONS OF SECONDARY NEUTRONS WERE CALCU-
ASH2. THE DDX'S OF THE CONTINUUM NEUTRONS
D FROM KUMABE'S SYSTEMATICS /4/ USING
THE PRECOMPOUND TO COMPOUND RATIO WAS
Y THE SINCROS- II CODE SYSTEM.
L, LEVEL DENSITY AND OTHER PARAMETERS USED IN
II CALCULATION ARE DESCRIBED IN REF./3/.
S WERE DETERMINED ON THE BASIS OF ENSDF/5/. |
| | | |
| MF = 1 GEN
MT=451 CO | ERAL INFOR | MATION |
| MF = 1 GEN
MT=451 CO
MF = 2 RES
MT=151 RESOLVED
RESOLVED
RESONAN
WERE EV
AL./6/
11960 E
AND RAD
DIFFERE
RESPECT | ERAL INFOR
MMENTS AND
ONANCE PAR
SOLVED AND
RESONANCE
CE PARAMET
ALUATED ON
RESONANCE
V WERE BAS
IATION WID
NT METHODS
IVELY. | MATION
DICTIONARY
AMETERS (SAME AS JENDL-3.1)
UNRESOLVED RESONANCE PARAMETERS
REGION (MLBW FORMULA) : BELOW 9.7 KEV
ERS FOR THE 39 LEVELS FROM 47.0 TO 2616 EV
THE BASIS OF THE DATA GIVEN BY MUGHABGHAB ET
ENERGIES FOR THE 210 LEVELS FROM 2676 TO
ED ON THE MEASUREMENT BY MACKLIN/7/. NEUTRON
THS FOR THE 210 LEVELS WERE DETERMINED BY
ACCORDING TO THE FOLLOWING THREE CONDITIONS, |
| MF = 1 GEN
MT=451 CO
MF = 2 RES
MT=151 RE
RESOLVED
RESONAN
WERE EV
AL./6/
11960 EA
AND RAD
DIFFERE
RESPECT
1) IN CC
MEASUREN
SOLVING | ERAL INFOR
MMENTS AND
ONANCE PAR
SOLVED AND
RESONANCE
CE PARAMET
ALUATED ON
RESONANCE
V WERE BAS
IATION WIC
NT METHODS
IVELY.
ASES WHERE
D BY MACKL
AND RADIA
A QUADRAT | MATION
DICTIONARY
AMETERS (SAME AS JENDL-3.1)
UNRESOLVED RESONANCE PARAMETERS
REGION (MLBW FORMULA) : BELOW 9.7 KEV
ERS FOR THE 39 LEVELS FROM 47.0 TO 2616 EV
THE BASIS OF THE DATA GIVEN BY MUGHABGHAB ET
ENERGIES FOR THE 210 LEVELS FROM 2676 TO
ED ON THE MEASUREMENT BY MACKLIN/7/. NEUTRON
THS FOR THE 210 LEVELS WERE DETERMINED BY
ACCORDING TO THE FOLLOWING THREE CONDITIONS,
TOTAL WIDTH AND NEUTRON CAPTURE AREA
IN ARE GIVEN FOR A RESONANCE LEVEL, THE
TION WIDTHS WERE SIMULTANEOUSLY OBTAINED BY
IC EQUATION. |
| MF = 1 GEN
MT=451 CO
MF = 2 RES
MT=151 RE
RESOLVED
RESONAN
WERE EV
AL./6/
11960 E
AND RAD
DIFFERE
RESPECT
1) IN C
MEASURE
NEUTRON
SOLVING
2) IN C
2G* (NEU
FOR A R
THE BOT | ERAL INFOR
MMENTS AND
ONANCE PAR
SOLVED AND
RESONANCE
CE PARAMET
ALUATED ON
RESONANCE
V WERE BAS
IATION WID
NT METHODS
IVELY.
ASES WHERE
D BY MACKL
AND RADIA
A QUADRAT
ASES WHERE
TRON WIDTH
ESONANCE L
H DATA. | MATION
DICTIONARY
AMETERS (SAME AS JENDL-3.1)
UNRESOLVED RESONANCE PARAMETERS
REGION (MLBW FORMULA) : BELOW 9.7 KEV
ERS FOR THE 39 LEVELS FROM 47.0 TO 2616 EV
THE BASIS OF THE DATA GIVEN BY MUGHABGHAB ET
ENERGIES FOR THE 210 LEVELS FROM 2676 TO
ED ON THE MEASUREMENT BY MACKLIN/7/. NEUTRON
THS FOR THE 210 LEVELS WERE DETERMINED BY
ACCORDING TO THE FOLLOWING THREE CONDITIONS,
TOTAL WIDTH AND NEUTRON CAPTURE AREA
IN ARE GIVEN FOR A RESONANCE LEVEL, THE
TION WIDTHS WERE SIMULTANEOUSLY OBTAINED BY
IC EQUATION.
NEUTRON CAPTURE AREA MEASURED BY MACKLIN AND
) GIVEN BY MUGHABGHAB ET AL. ARE AVAILABLE
EVEL, THE RADIATION WIDTHS WERE DERIVED FROM |
| MF = 1 GEN
MT=451 CO
MF = 2 RES
MT=151 RE
RESOLVED
RESOLVED
11960 E
AND RAD
DIFFERE
RESPECT
1) IN C
MEASURE
NEUTRON
SOLVING
2) * (NEU
FOR A R
THE BOT
3) IN C
AVAILAB
SMALLER
WAS ADO
THIS AV | ERAL INFOR
MMENTS AND
SOLVED AND
RESONANCE
CE PARAMET
ALUATED ON
RESONANCE
V WERE BAS
IATION WIE
NT METHODS
IVELY.
ASES WHERE
D BY MACKL
AND RADIA
A QUADRAT
ASES WHERE
TRON WIDTH
ESONANCE L
H DATA.
ASES WHERE
TRON WIDTH
ESONANCE L
H DATA.
ASES WHERE
TRON WIDTH
ESONANCE L
H DATA.
ASES WHERE
TRON WIDTH
ESONANCE L
H DATA. | MATION
DICTIONARY
AMETERS (SAME AS JENDL-3.1)
UNRESOLVED RESONANCE PARAMETERS
REGION (MLBW FORMULA) : BELOW 9.7 KEV
ERS FOR THE 39 LEVELS FROM 47.0 TO 2616 EV
THE BASIS OF THE DATA GIVEN BY MUGHABGHAB ET
ENERGIES FOR THE 210 LEVELS FROM 2676 TO
ED ON THE MEASUREMENT BY MACKLIN/7/. NEUTRON
THS FOR THE 210 LEVELS WERE DETERMINED BY
ACCORDING TO THE FOLLOWING THREE CONDITIONS,
TOTAL WIDTH AND NEUTRON CAPTURE AREA
IN ARE GIVEN FOR A RESONANCE LEVEL, THE
TION WIDTHS WERE SIMULTANEOUSLY OBTAINED BY
IC EQUATION.
NEUTRON CAPTURE AREA MEASURED BY MACKLIN AND
) GIVEN BY MUGHABGHAB ET AL. ARE AVAILABLE
EVEL, THE RADIATION WIDTHS WERE DERIVED FROM
ONLY NEUTRON CAPTURE AREA BY MACKLIN IS
RON CAPTURE AREA BY MACKLIN FOR A RESONANCE
E RADIATION WIDTH OF 318 MEV GIVEN BY MACKLIN
HE LEVEL. THE NEUTRON WIDTH WAS DERIVED FROM |
| MF = 1 GEN
MT=451 CO
MF = 2 RES
MT=151 CO
RESOLVED
RESOLVED
RESOLVED
ALI960 E
AND RAD
DIFFERE
RESPECT
1) IN C
MEASURE
NEUTRON
SOLVING
2) IN C
AVAILAB
SMALLE
WAS ADO
THIS AV
NEUTRON
ESTIMAT
SPIN J
RANDOM
MUGHABG
REPRODU
GIVEN B | ERAL INFOR
MMENTS AND
ONANCE PAR
SOLVED AND
RESONANCE
CE PARAMET
ALUATED ON
RESONANCE
V WERE BAS
IATION WID
NT METHODS
IVELY.
ASES WHERE
D BY MACKL
AND RADIA
A QUADRAT
ASES WHERE
TRON WIDTH
ESONANCE L
H DATA.
ASES WHERE
LE, OR G*I
THE AVERAG
PTED FOR T
ERAGE RADI
ORBITAL A
OF SOME RE
NUMBER MET
AL.
CE THE THE
Y MUGHABGE | MATION
DICTIONARY
AMETERS (SAME AS JENDL-3.1)
UNRESOLVED RESONANCE PARAMETERS
REGION (MLBW FORMULA) : BELOW 9.7 KEV
ERS FOR THE 39 LEVELS FROM 47.0 TO 2616 EV
THE BASIS OF THE DATA GIVEN BY MUGHABGHAB ET
ENERGIES FOR THE 210 LEVELS FROM 2676 TO
ED ON THE MEASUREMENT BY MACKLIN/7/. NEUTRON
THS FOR THE 210 LEVELS WERE DETERMINED BY
ACCORDING TO THE FOLLOWING THREE CONDITIONS,
TOTAL WIDTH AND NEUTRON CAPTURE AREA
IN ARE GIVEN FOR A RESONANCE LEVEL, THE
TION WIDTHS WERE SIMULTANEOUSLY OBTAINED BY
IC EQUATION.
NEUTRON CAPTURE AREA MEASURED BY MACKLIN AND
) GIVEN BY MUGHABGHAB ET AL. ARE AVAILABLE
EVEL, THE RADIATION WIDTHS WERE DERIVED FROM
ONLY NEUTRON CAPTURE AREA BY MACKLIN IS
NEUTRON WIDTH) BY MUGHABGHAB ET AL. IS
RON CAPTURE AREA BY MACKLIN FOR A RESONANCE
E RADIATION WIDTH OF 318 MEV GIVEN BY MACKLIN
HE LEVEL. THE NEUTRON WIDTH WAS DERIVED FROM
ATION WIDTH AND THE NEUTRON CAPTURE AREA.
NGULAR MOMENTUM L OF SOME RESONANCES WAS
METHOD OF BOLLINGER AND THOMAS/8/. TOTAL
SONANCES WAS TENTATIVELY ESTIMATED WITH A
HOD. SCATTERING RADIUS WAS TAKEN FROM
TWO NEGATIVE RESONANCES WERE ADDED SO AS TO
RMAL CAPTURE AND SCATTERING CROSS SECTIONS
AB ET AL. |

THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.700E-4, S1 = 1.100E-4, S2 = 0.773E-4, SG = 43.3E-4, GG = 0.300 EV, R = 7.248 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 9.930 -ELASTIC 5.430 -TOTAL ELASTIC CAPTURE 4.500 63.9

= 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. MF

FOR JENDL-3.1, ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/11/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:

IIJIMA-KAWAI POTENTIAL/11/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/. 18/

FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE ELASTIC SCATTERING AND CAPTURE WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/3/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/3/ FOR NEUTRON, PEREY OMP /19/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/20/ FOR ALPHA, LOHR-HAEBERLI OMP/21/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/22/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL TAKEN FROM JENDL FUSIO FILE. SPHERICAL OPTICAL MODEL CALCULA-ON WITH CASTHY AND MODIFIED WALTER-GUSS POTENTIAL WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./5/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

| NO. | ENERGY(ME | V) | SPIN-P/ | ARITY | (DIRECT | PROCESS) |
|---------------|------------|-------|---------|-------|---------|----------|
| GR. | 0.0 ` | , | 3/2 - | | , | , |
| 1 | 0.1986 | | 1/2 - | | * | |
| 2 | 0.2647 | | 3/2 - | | * | |
| 3 | 0.2795 | | 5/2 - | | * | |
| 4 | 0.3039 | | 9/2 + | | * | |
| 5 | 0.4007 | | 5/2 + | | * | |
| 6 | 0.4686 | | 1/2 - | | * | |
| 7 | 0.5722 | | 5/2 - | | * | |
| 8 | 0.5850 | | 1/2 - | | | |
| 9 | 0.6177 | | 1/2 - | | * | |
| 10 | 0.8216 | | 7/2 - | | * | |
| LEVELS ABOVE | 0.823 MÉV | WERE | ASSUMED | TO BE | OVERLA | PPING. |
| = 102 CAPTURE | E (SAME AS | JENDL | -3.1) | | | |

SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS

SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (3.84E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 350 MILLI-BARNS AT 50 KEV MEASURED BY MACKLIN/7/. WT = 16 (N,2N) CROSS SECTION WT = 17 (N,3N) CROSS SECTION WT = 22 (N,N'A) CROSS SECTION WT = 28 (N,N'P) CROSS SECTION WT =103 (N,P) CROSS SECTION WT =104 (N,D) CROSS SECTION WT =107 (N,ALPHA) CROSS SECTION ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO MT = 16 $\begin{array}{rcl} \text{MT} &=& 17\\ \text{MT} &=& 22 \end{array}$ MT = 28MT = 103MT = 104MT =107 (N,2N) 0.804-0.991 B IN 13.34-14.93 MEV BY KONNO+/24/, (N,D)+(N,NP) 0.0111 B AT 14.5 MEV (SYSTEMATICS OF FORREST/25/), (N,P) 0.0198-0.0172B IN 13.33-14.92 MEV BY KONNO+/24/, (N,A) 0.01007 B AT 13.98 MEV BY KONNO+/24/. MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 (SAME AS JENDL-3.1) CALCULATED WITH THE CASTHY CODE/9/. MT=16, 17, 22, 28, 51-91 TAKEN FROM JENDL FUSION FILE. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. << THE PARAMETERS USED IN THE CASTHY AND PEGASUS CALCULATIONS. >> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - '- - -- - - - -. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.332E+01 9.155E-01 1.399E+01 9.613E+00 1.430E+00 1.390E+01 9.028E-01 9.003E+01 8.399E+00 0.0 1.269E+01 8.264E-01 1.933E+00 7.808E+00 1.880E+00 1.350E+01 8.784E-01 5.236E+01 7.551E+00 0.0 31-GA- 71 31-GA- 72 31-GA- 73 31-GA- 73 * * 32-GE- 72 32-GE- 73 32-GE- 74 32-GE- 75 * 1.350E+01 9.028E-01 3.062E+00 1.086E+01 2.790E+00 * 1.409E+01 8.904E-01 1.973E+01 9.644E+00 1.360E+00 * 1.384E+01 8.784E-01 1.667E+00 1.106E+01 3.240E+00 * 1.368E+01 8.667E-01 1.100E+01 8.810E+00 1.360E+00 33-AS- 73 33-AS- 74 33-AS- 75 33-AS- 76 1.369E+01 8.904E-01 1.364E+01 9.389E+00 1.430E+00 1.132E+01 9.475E-01 1.967E+01 7.033E+00 0.0 1.250E+01 9.510E-01 6.830E+00 1.008E+01 1.880E+00 1.330E+01 7.860E-01 1.900E+01 5.611E+00 0.0 * SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.5 FOR AS- 75 AND 5.0 FOR AS- 76. REFERENCES REFERENCES 2) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 3) YAMAMURO, N.: JAERI-M 90-006 (1990). 4) KUMABE, İ. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). 5) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. 6) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 7) MACKLİN, R.L.: NUCL. SCI. ENG. 99, 133 (1988). 8) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). 9) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). 10) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 10)

- 11) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 12) PEREY, F.G: PHYS. REV. 131, 745 (1963).
 13) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 14) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 15) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

16) GILBERI, A. AND CAMERUN, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
17) I JIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
18) GRUPPELAAR, H.: ECN-13 (1977).
19) PEREY, F.G.: PHYS. REV., 131, 745 (1963).
20) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
21) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
22) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971)

- (1971). 23) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 24) KONNO, C. ET AL.: JAERI 1329 (1993). 25) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3425 34-SE- 74 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.6 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ AVERAGE RADIATION WIDTH OF 250 MEV WAS OBTAINED BY TAKING THE WEIGHTED AVERAGE OF RADIATION WIDTHS FOR SIX RESONANCE LEVELS, AND WAS ADOPTED FOR THE LEVELS OF 1.630 AND 7.216 KEV WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 51.8+-1.2 BARNS AT 0.0253 EV GIVEN BY MUGHABGHAB ET AL. MF

UNRESOLVED RESONANCE REGION : 2.6 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 WAS BASED ON THE SYSTEMATICS OF MHGHABGHAB ET AL., S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.290E-4, S1 = 1.000E-4, S2 = 0.780E-4, SG = 5.68E-4, GG = 0.280 EV, R = 7.514 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. INTEGRALS (BARNS)

| | 00.01 | |
|---------|-------|-----|
| ELASIIC | (.2/4 | - |
| CAPTURE | 51.80 | 580 |
| | | |

CAPIURE 51.80 580 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/.

/12/.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN-PARIT | Y |
|-----|-------------|------------|---|
| GR. | 0.0 ` ′ | 0 + | |
| 1 | 0.6348 | 2 + | |
| 2 | 0.8538 | 0 + | |
| 3 | 1.2689 | 2 + | |
| 4 | 1.3632 | 4 + | |

5 1.6000 2 + LEVELS ABOVE 1.658 MEV WERE ASSUMED TO BE OVERLAPPING. ΜT 102 CAPTURE = = 102 CAPTORE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (4.30E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 198 MILLI-BARNS AT 25 KEV MEASURED BY SRIRAMACHANDRA ET AL./16/ THE KALBACH'S CONSTANT K (= 69.8) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 135.00 MB (RECOMMENDED BY FORREST/18/) (N,ALPHA) 34.80 MB (SYSTEMATICS OF FORREST/18/) -CALCULATED WITH CASTHY. МТ F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 46.0-0.25EWS = 7.0VSO = 7.0THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 32-GE-70 * 1.236E+01 9.286E-01 1.710E+00 1.048E+01 2.860E+00 32-GE-71 * 1.293E+01 9.155E-01 1.132E+01 9.208E+00 1.360E+00 32-GE-72 * 1.350E+01 9.028E-01 3.062E+00 1.086E+01 2.790E+00 32-GE-73 * 1.409E+01 8.904E-01 1.973E+01 9.644E+00 1.360E+00 * 1.254E+01 9.155E-01 7.299E+00 9.012E+00 1.500E+00 * 1.311E+01 9.028E-01 5.047E+01 7.739E+00 0.0 * 1.369E+01 8.904E-01 1.364E+01 9.389E+00 1.430E+00 1.132E+01 9.475E-01 1.967E+01 7.033E+00 0.0 33-AS- 71 33-AS- 72 33-AS- 73 34-SE- 72 34-SE- 73 34-SE- 74 34-SE- 75 1.272E+01 9.028E-01 1.477E+00 1.034E+01 2.930E+00 1.404E+01 8.250E-01 7.927E+00 8.288E+00 1.430E+00 1.290E+01 8.620E-01 1.070E+00 9.612E+00 2.860E+00 1.391E+01 8.500E-01 9.741E+00 8.707E+00 1.430E+00 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.925 FOR SE- 74 AND 5.0 FOR SE- 75.
REFERENCES

- (EFERENCES)
 (AWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 (2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 (3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 (4) IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 (5) IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 6) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

- 10) ĜILBERT, A. AND CAMERUN, A.G.W.. GAN. G. HILG, J., (1965).
 11) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 14) NUCLEAR DATA SHEETS, 51, 225 (1987).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) SRIRAMACHANDRA MURTY, M., ET AL.: PROC. NUCLEAR AND SOLID STATE PHYSICS SYMP., MADURAI 1970, VOL.2, P. 29 (1970).
 17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3431 34-SE- 76 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 9 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ AVERAGE RADIATION WIDTH GIVEN BY MUGHABGHAB ET AL. WAS SLIGHTLY MODIFIED AND WAS ADOPTED FOR THE 16 RESONANCE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. SCATTERING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 9 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.640E-4, S1 = 0.939E-4, S2 = 0.760E-4, SG = 1.90E-4, GG = 0.230 EV, R = 7.363 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 103.4 -ELASTIC 18.40 -CAPTURE 85.00 41.1 INTEGRALS (BARNS) MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. ENERGY(MEV) SPIN-PARITY 0.0 GR. 020 + 0.5591 1.1223 1 + + 3 1.2161

| 4 1.3309 4 +
5 1.6890 3 +
6 1.7876 2 +
7 2.0260 4 +
8 2.1272 2 +
9 2.1705 0 +
10 2.2623 6 +
11 2.3629 2 +
12 2.4291 3 -
13 2.4886 5 +
14 2.5147 2 +
15 2.5700 4 +
16 2.6057 4 +
17 2.6184 4 +
18 2.6309 1 -
19 2.6553 1 -
20 2.6699 2 -
21 2.8045 2 +
22 2.8125 4 +
22 2.8125 4 +
23 2.8167 2 +
24 2.8248 5 -
25 2.8597 4 -
26 2.8698 4 +
27 2.9110 4 -
28 2.9200 4 +
29 2.9506 1 +
LEVELS ABOVE 2.968 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.59E-04) WAS ASSUMED. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 68.3) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N) (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 900.00 MB (RECOMMENDED BY BYCHKOV+/18/)
(N,P) 70.00 MB (RECOMMENDED BY FORREST/19/)
(N,ALPHA) 15.60 MB (SYSTEMATICS OF FORREST/19/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) |
| V = 46.0-0.25E R0 = 5.7 A0 = 0.62
WS = 7.0 RS = 6.2 AS = 0.35
VS0= 7.0 RS0= 5.7 AS0= 0.62
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCL | IDE SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|--|---|--|---|---|---|---|
| 32 - GI
32 - GI
32 - GI
32 - GI
32 - GI | - 72 *
- 73 *
- 74 *
- 75 * | 1.350E+01
1.409E+01
1.384E+01
1.368E+01 | 9.028E-01
8.904E-01
8.784E-01
8.667E-01 | 3.062E+00
1.973E+01
1.667E+00
1.100E+01 | 1.086E+01
9.644E+00
1.106E+01
8.810E+00 | 2.790E+00
1.360E+00
3.240E+00
1.360E+00 |
| 33 - A
33 - A
33 - A
33 - A
33 - A | 6-73 *
6-74
6-75
6-76 | 1.369E+01
1.132E+01
1.250E+01
1.330E+01 | 8.904E-01
9.475E-01
9.510E-01
7.860E-01 | 1.364E+01
1.967E+01
6.830E+00
1.900E+01 | 9.389E+00
7.033E+00
1.008E+01
5.611E+00 | 1.430E+00
0.0
1.880E+00
0.0 |
| 34 - SI
34 - SI
34 - SI
34 - SI
34 - SI | - 74
- 75
- 76
- 77 | 1.290E+01
1.391E+01
1.315E+01
1.438E+01 | 8.620E-01
8.500E-01
8.900E-01
8.000E-01 | 1.070E+00
9.741E+00
1.097E+00
7.140E+00 | 9.612E+00
8.707E+00
1.082E+01
8.015E+00 | 2.860E+00
1.430E+00
3.310E+00
1.430E+00 |
| SYS | Γ: * = L[| DP'S WERE [| DETERMINED | FROM SYSTE | MATICS. | |
| SPIN
IN TI
ASSUI | CUTOFF P/
HE CASTHY
MED TO BE | ARAMETERS V
CALCULATIO
6.780 FOR | VERE CALCUL
DN, SPIN CU
SE- 76 AND | ATED AS 0
JTOFF FACT(
0 6.517 FOF | .146*SQRT(/
DRS AT 0 ME
R SE- 77. | A)*A**(2/3).
EV WERE |
| REFERI
1) K/
2) Mi
2) Mi
3) Bi
4) Ii
5) I
6) I
7) Pi
8) Hi
9) Li
10) Bi | ENCES
AWAI, M. E
AWAI, M. E
DI TECHNOI
JGHABGHAB
ART A", A(
DLLINGER, A(
DLLINGER, A(
JIMA, S.
1983).
EREY, F.G
JIZENGA, A
DHR, J.M.
ECCHETTI. | ET AL.: PRO
OGY, MITO
S.F. ET A
ADEMIC PRE
L.M. AND T
ET AL.: JA
AND KAWAT
PHYS. REV
J.R. AND TO
AND HAEBEF
F.D. JR. | DC. INT. CC
AL.: "NEUTF
SS (1981).
THOMAS, G.E
SCI. TECH
AERI-M 87-C
M.: J. NUC
GO. G.: NUC
RLI, W.: NU
AND GREENU | DNF. ON NUC
1988)
RON CROSS S
100L., 12,
225, P. 337
10L. 963).
21. 9HYS. 2
10L. 9HYS.
20L. 9HYS.
20L. 9HYS. | CLEAR DATA
SECTIONS, N
REV., 171,
67 (1975),
7 (1987),
FECHNOL., 2
29, 462 (19
A232, 381
POLARIZA | FOR SCIENCE
/OL. I,
1293(1968).
20, 77
20, 77
962).
(1974). |
| 11) G | HENOMENA
HAEBERL
1971).
ILBERT, A | IN NUCLEAR
I), P. 682
. AND CAMEF | REACTIONS
, THE UNIVE
RON, A.G.W. | ((EDS) H.H
ERSITY OF V
.: CAN. J. | H. BARSHALL
VISCONSIN F
PHYS., 43 | _ AND
PRESS.
, 1446 |
| 12) (
13) GI
14) EI
15) NI
16) BI
17) K
18) B
19) F | IJIMA, S.
RUPPELAAR
NSDF: EVAL
JCLEAR DA
ENZI, V. /
IKUCHI, K
ACTIONS"
YCHKOV, V
DRREST, R | , ET AL.:
, H.: ECN-
LUATED NUCI
FA SHEETS,
AND REFFO,
AND KAWA
, NORTH HOI
M. ET AL.:
A.: AERE-F | J. NUCL. SC
13 (1977).
LEAR STRUCT
42, 233 (1
G.: CCDN-N
I, M.: CCDN-N
I, M.: NUC
LAND (1968
: INDC(CCP)
R 12419 (19 | CI. TECHNOL
FURE DATA F
1984).
NW/10 (1969
CLEAR MATTE
3).
19146/LJ (*
986). | 21, 10
FILE (JUNE
9).
ER AND NUCL
1980). | (1984).
1987).
_EAR |

MAT number = 3434 34-SE- 77 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

MF

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.7 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGE RADIATION WIDTH OF 380 MEV WAS OBTAINED BY TAKING THE WEIGHTED AVERAGE OF RADIATION WIDTHS FOR 17 RESONANCE LEVELS, AND WAS ADOPTED FOR THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 2.7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.280E-4, S1 = 0.760E-4, S2 = 0.740E-4, SG = 43.8E-4, GG = 0.390 EV, R = 7.608 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 50.43 ELASTIC 8.430 INTEGRALS (BARNS)

TOTAL ELASTIC CAPTURE 42.00 32.1

CAPIURE42.0032.1F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/6/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/7/
ALPHA = HUIZENGA AND IGO/8/
DEUTERON = LOHR AND HAEBERLI/9/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/13/.

/13/

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT =

' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

МТ

- 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 1/2 - |
| 1 | 0.1620 | 7/2 + |

| 2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24 | 0.1755
0.2390
0.2497
0.3011
0.4395
0.5206
0.5809
0.6800
0.7959
0.8084
0.8178
0.9115
0.9470
0.9699
0.9778
1.0051
1.0242
1.1284
1.1321
1.1725
1.1793
1.1868 | 9/2 +
3/2 -
5/2 +
5/2 -
5/2 +
5/2 -
7/2 +
7/2 +
7/2 +
7/2 +
3/2 -
3/2 +
1/2 +
3/2 +
1/2 +
3/2 -
3/2 +
1/2 +
3/2 -
3/2 +
1/2 +
3/2 -
3/2 | |
|---|---|---|---|
| ŽĞ
27
28
LEVELS ABC | 1.2306
1.2526
1.3513
VE 1.367 MEV WERE | 5/2 -
5/2 +
11/2 -
ASSUMED TO BE | OVERLAPPING. |
| MT = 102 CAPT
SPHERICAL OP
CASTHY WAS A
SECTIONS WER
AND REFFO/16 | URE
TICAL AND STATIST
DOPTED. DIRECT A
E ESTIMATED ACCOF
/ AND NORMALIZED | ICAL MODEL CAL
ND SEMI-DIRECT
DING TO THE PR
TO 1 MILLI-BAR | CULATION WITH
CAPTURE CROSS
OCEDURE OF BENZI
N AT 14 MEV. |
| THE GAMMA-RA
THE RADIATIC
LEVEL SPACIN | Y STRENGTH FUNCTI
N WIDTH (0.39 EV)
G (147+-30 EV) /2 | ON (2.65E-03)
AND AVERAGE S | WAS DETERMINED FROM
-WAVE RESONANCE |
| MT = 16 (N,2N
MT = 17 (N,3N
MT = 22 (N,N'
MT = 28 (N,N'
MT = 103 (N,P)
MT =104 (N,D)
MT =105 (N,T)
MT =106 (N,HE
MT =107 (N,AL
MT =111 (N,2P)
THESE REACTI
PREEQUILIBRI |) CROSS SECTION
) CROSS SECTION
A) CROSS SECTION
P) CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
3) CROSS SECTION
PHA) CROSS SECTION
ON CROSS SECTION
ON CROSS SECTIONS
UM AND MULTI-STEF | N
S WERE CALCULAT
V EVAPORATION M | ED WITH THE
ODEL CODE PEGASUS. |
| THE KALBACH'
FORMULA DERI
DENSITY PARA | S CONSTANT K (=
VED FROM KIKUCHI-
METERS. | 99.1) WAS ESTI
KAWAI'S FORMAL | MATED BY THE
ISM/17/ AND LEVEL |
| FINALLY, THE
NORMALIZED T
(N,P)
(N,ALPHA) | (N,P) AND (N,ALF
O THE FOLLOWING V
35.00 MB (RE
10.10 MB (SY | PHA) CROSS SECT
(ALUES AT 14.5
COMMENDED BY F
(STEMATICS OF F | IONS WERE
MEV:
ORREST/18/)
ORREST/18/) |
| MT = 251 MU-B
CALCULATED W | AR
ITH CASTHY. | | |
| MF = 4 ANGULAR
LEGENDRE POLYN
GIVEN IN THE C
TIC LEVELS, AN
CALCULATED WIT
BUTIONS IN THE | DISTRIBUTIONS OF
OMIAL COEFFICIENT
ENTER-OF-MASS SYS
D IN THE LABORATO
H CASTHY. FOR OT
LABORATORY SYSTE | SECONDARY NEUT
S FOR ANGULAR
TEM FOR MT=2 A
RY SYSTEM FOR
HER REACTIONS,
M WERE ASSUMED | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
MT=91. THEY WERE
ISOTROPIC DISTRI- |
| MF = 5 ENERGY D
ENERGY DISTRIB
PEGASUS FOR IN
OTHER NEUTRON | ISTRIBUTIONS OF S
UTIONS OF SECONDA
ELASTIC SCATTERIN
EMITTING REACTION | ECONDARY NEUTR
RY NEUTRONS WE
IG TO OVERLAPPI
IS. | ONS
RE CALCULATED WITH
NG LEVELS AND FOR |
| TABLE 1 NEUTRON | OPTICAL POTENTIA | L PARAMETERS | |
| V = 46. | DEPTH (MEV)
0-0.25E | RADIUS(FM)
RO = 5.7 | DIFFUSENESS(FM)
A0 = 0.62 |

| ABLE 2 LEVEL DENSITY PARAMETERS | |
|--|--|
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING | |
| 32-GE-73 * 1.409E+01 8.904E-01 1.973E+01 9.644E+00 1.360E+00
32-GE-74 * 1.384E+01 8.784E-01 1.667E+00 1.106E+01 3.240E+00
32-GE-75 * 1.368E+01 8.667E-01 1.100E+01 8.810E+00 1.360E+00
32-GE-76 * 1.352E+01 8.553E-01 1.533E+00 9.919E+00 2.830E+00 | |
| 33-AS-741.132E+019.475E-011.967E+017.033E+000.033-AS-751.250E+019.510E-016.830E+001.008E+011.880E+0033-AS-761.330E+017.860E-011.900E+015.611E+000.033-AS-771.300E+018.440E-014.637E+007.951E+001.470E+00 | |
| 34-SE-751.391E+018.500E-019.741E+008.707E+001.430E+0034-SE-761.315E+018.900E-011.097E+001.082E+013.310E+0034-SE-771.438E+018.000E-017.140E+008.015E+001.430E+0034-SE-781.287E+018.750E-011.163E+009.882E+002.900E+00 | |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. | |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.517 FOR SE- 77 AND 4.875 FOR SE- 78. | |
| EFERENCES 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). 2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). 3) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). 4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). 5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 | |
| (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). (1983). | |
| (1971). GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 2) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 3) GRUPPELAAR, H.: ECN-13 (1977). 4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). 5) NUCLEAR DATA SHEETS, 29, 75 (1980). 6) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 7) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). 8) FORREST, R.A.: AERE-R 12419 (1986). | |

MAT number = 3437 34-SE- 78 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 12 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGE RADIATION WIDTH WAS OBTAINED BY TAKING THE WEIGHTED AVERAGE OF RADIATION WIDTHS FOR FOUR RESONANCE LEVELS. AND WAS ADOPTED FOR THE 16 LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTE-RING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 12 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.230E-4, S1 = 1.730E-4, S2 = 0.730E-4, SG = 1.82E-4, GG = 0.230 EV, R = 7.274 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 8.830 -TOTAL ELASTIC CAPTURE 8.400 0.4300 4.74 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/4/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. ENERGY(MEV) SPIN-PARITY GR. 0.0 022 + Ŏ.<u>6</u>138 1 + 1.3086 + 3 1.4986 0 +

4 1.5026 4 + 5 1.7587 0 + 6 1.8540 2 + 7 1.9960 2 + 8 2.0983 4 + 9 2.2673 4 + 10 2.2998 1 + 11 2.3273 2 + 12 2.3347 0 + 13 2.3602 4 + 14 2.5076 3 -15 2.5374 0 + 16 2.5387 6 + 17 2.6476 0 + 18 2.6801 1 + 19 2.6821 1 -20 2.7192 4 + LEVELS ABOVE 2.748 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (1.655E-04) WAS DETERMINED FROM THE RADIATION WIDTH (0.23 EV) AND AVERAGE S-WAVE RESONANCE LEVEL SPACING (1390+-500 EV)/2/. MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 78.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1050.00 MB (RECOMMENDED BY BYCHKOV+/18/) (N,P) 18.00 MB (RECOMMENDED BY FORREST/19/) (N,ALPHA) 5.50 MB (RECOMMENDED BY FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) ------ - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 32-GE- 74 * 1.384E+01 8.784E-01 1.667E+00 1.106E+01 3.240E+00 32-GE- 75 * 1.368E+01 8.667E-01 1.100E+01 8.810E+00 1.360E+00 32-GE- 76 * 1.352E+01 8.553E-01 1.533E+00 9.919E+00 2.830E+00 32-GE- 77 * 1.334E+01 8.442E-01 6.660E+00 8.098E+00 1.360E+00

33-AS- 75

1.250E+01 9.510E-01 6.830E+00 1.008E+01 1.880E+00
33-AS- 76

1.300E+01 7.860E-01 1.900E+01 5.611E+00 0.0
33-AS- 78

1.150E+01 7.500E-01 5.001E+00 3.894E+00 0.0

34-SE- 76

1.315E+01 8.440E+01 4.637E+00 7.951E+00 1.470E+00
3.84E+07

1.438E+01 8.000E-01 7.140E+00 8.015E+00 1.430E+00
34-SE- 77

1.438E+01 8.000E-01 7.140E+00 8.015E+00 1.430E+00
34-SE- 78

2.870E+01 8.750E+01 1.163E+00 9.882E+00 2.900E+00

34-SE- 79

4.412E+01 8.000E-01 5.994E+00 7.842E+00 1.430E+00
34-SE- 79

4.412E+01 8.000E-01 5.994E+00 7.842E+00 1.430E+00

SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS.

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).

IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 4.875 FOR SE- 78 AND 4.672 FOR SE- 79.

REFERENCES

IN KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO. P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
MUGHABGHAB, S.F. AL.: JAERI-M 87-025, P. 337 (1987).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
HUIZENGA, J.R. AND IGO G.: NUCL. PHYS. REV. 171, 1293(1968).
HUIZENGA, J.R. AND GREENLEES, G.W.: POLARIZATION PHENOMENAI IN NUCLEAR REACTIONS (EDS) H-H. BARSHALL AND W. HAEBERLI, N.: NUCL. PHYS. A232, 381 (1974).
BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENAI IN NUCLEAR REACTIONS (EDS) H-H. BARSHALL AND W. HAEBERLI, P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
HUIZENGA, J. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
HUIZENGA DATA SHEETS, 33, 189 (1981).
BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PH

MAT number = 3440 34-SE- 79 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 38 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/, AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL./3/ THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS ESTIMATED FROM ITS SYSTEMATICS SYSTEMATICS. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.580E-4, S1 = 1.700E-4, S2 = 0.720E-4, SG = 4.40E-4, GG = 0.290 EV, R = 7.553 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 56.30 -ELASTIC 6.300 -CAPTURE 50.00 60.9 INTEGRALS (BARNS) F = 3 NEUTRON CROSS SECTIONS BELOW 38 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE THERMAL CAPTURE CROSS SECTION WAS DETERMINED BY THE SYSTEMATICS FROM THE NEIGHBORING SE ISOTOPES. THE SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 7.1 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 38 EV TO 100 KEV. MF ARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 38 EV TO 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY ILJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/. NO. SPIN-PARITY ENERGY(MEV) GŔ. 1 7/2 + 1/2 -0.0 0.0957 0.1280 ż 1/2 34 9/2 5/2 + 0.3650 0.4990 0.5279 1/2 3/2 5 6 -3/27 0.5720

| 8 0.6300 5/2 + 9 0.7286 5/2 + 10 0.7904 7/2 - 11 0.8188 7/2 - 12 0.8971 7/2 + 13 0.9746 3/2 - 14 0.9829 7/2 + 15 1.0082 5/2 - 16 1.0721 13/2 + 17 1.0800 1/2 + 19 1.1101 7/2 + 20 1.4450 1/2 + 20 1.4450 1/2 + 21 1.2534 5/2 + 23 1.2567 5/2 - 24 1.3399 5/2 - 25 1.3850 5/2 - 26 1.4910 1/2 + 27 1.5890 3/2 + 28 1.6670 5/2 + 29 1.7377 3/2 + LEVELS ABOVE 1.76 MEV |
|--|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCTION (3.82E-03) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.29 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (76 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 96.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 9.97 MB (SYSTEMATICS OF FORREST/16/)
(N,ALPHA) 9.93 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV)
V = 46.0-0.25E
WS = 7.0
VS = 7.0
VS = 7.0
RS = 6.2
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5.7
RS = 5. |
| TABLE 2 LEVEL DENSITY PARAMETERS |

NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 32-GE-75
 *
 1.368E+01
 8.667E-01
 1.100E+01
 8.810E+00
 1.360E+00

 32-GE-76
 *
 1.352E+01
 8.553E-01
 1.533E+00
 9.919E+00
 2.830E+00

 32-GE-77
 *
 1.334E+01
 8.442E-01
 6.660E+00
 8.098E+00
 1.360E+00

 32-GE-78
 1.234E+01
 8.699E-01
 7.304E-01
 9.395E+00
 2.930E+00

 33-AS- 76 33-AS- 77 33-AS- 78 33-AS- 79 1.330E+01 7.860E-01 1.900E+01 5.611E+00 0.0 1.300E+01 8.440E-01 4.637E+00 7.951E+00 1.470E+00 1.150E+01 7.500E-01 5.001E+00 3.894E+00 0.0 1.290E+01 8.230E-01 3.020E+00 7.585E+00 1.570E+00 34-SE- 77 34-SE- 78 34-SE- 79 34-SE- 80 1.438E+01 8.000E-01 7.140E+00 8.015E+00 1.430E+00 1.287E+01 8.750E-01 1.163E+00 9.882E+00 2.900E+00 1.412E+01 8.000E-01 5.994E+00 7.842E+00 1.430E+00 1.334E+01 8.130E-01 6.129E-01 9.136E+00 3.000E+00 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.672 FOR SE- 79 AND 2.952 FOR SE- 80. REFERENCES (EFERENCES)
(AWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(19 (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 6) 8) 9) (19/1) 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

MAT number = 3443 34-SE- 80 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93

HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

MF = 2

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 10 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. AVERAGE RADIATION WIDTH OF 220 MEV WAS OBTAINED BY TAKING THE WEIGHTED AVERAGE OF RADIATION WIDTHS FOR THE TWO LEVELS, AND WAS ADOPTED FOR THE 13 LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 10 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.610E-4, S1 = 1.800E-4, S2 = 0.700E-4, SG = 0.488E-4, GG = 0.230 EV, R = 6.989 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 7.560 ELASTIC 6.950 -

0.976

| | 0.000 | |
|---------|--------|--|
| CAPIURE | 0.6100 | |
| | | |

CAPIURE 0.6100 0.976 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV; THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
20
21
22
23
24
25
26
27
28
29
LEVELS ABO | ENERGY (MEV)
0.0
0.6662
1.4493
1.4791
1.7015
1.8734
1.9602
2.1211
2.3115
2.3441
2.4953
2.5143
2.6272
2.7174
2.7743
2.8255
2.8272
2.8363
2.9475
3.0250
3.0387
3.1262
3.1754
3.1995
3.2266
3.2485
3.2804
3.3504
VE 3.391 MEV WERE | SPIN-PARITY
0 +
2 +
2 +
2 +
2 +
4 +
1 -
1 -
2 +
2 +
0 +
3 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
3 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
1 -
2 +
1 -
1 -
1 -
2 +
1 -
1 -
2 +
1 -
1 -
1 -
2 +
1 -
1 -
1 -
1 -
2 +
1 -
1 -
1 -
1 -
2 +
1 -
1 -
1 -
1 -
2 +
1 -
1 -
1 -
1 -
1 -
1 -
1 -
2 +
1 -
1 -
1 -
1 -
1 -
1 -
1 -
1 - | OVERLAPPING. |
|---|--|--|---|
| MT = 102 CAPT
SPHERICAL OP
CASTHY WAS A
SECTIONS WER
AND REFFO/15 | URE
TICAL AND STATIST
DOPTED. DIRECT AN
E ESTIMATED ACCOR
/ AND NORMALIZED | ICAL MODEL CALO
ND SEMI-DIRECT
DING TO THE PRO
TO 1 MILLI-BARI | CULATION WITH
CAPTURE CROSS
DCEDURE OF BENZI
N AT 14 MEV. |
| THE GAMMA-RA
REPRODUCE TH
KEV MEASURED | Y STRENGTH FUNCTIO
E CAPTURE CROSS SI
BY WALTER/16/ | DN (4.66E-5) W/
ECTION OF 16 M | AS ADJUSTED TO
ILLI-BARNS AT 200 |
| MT = 16 (N,2N
MT = 17 (N,3N
MT = 22 (N,N'
MT = 28 (N,N'
MT =103 (N,P)
MT =104 (N,D)
MT =107 (N,AL
THESE REACTI
PREEQUILIBRI |) CROSS SECTION
) CROSS SECTION
A) CROSS SECTION
P) CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
PHA) CROSS SECTION
ON CROSS SECTIONS
UM AND MULTI-STEP | N
WERE CALCULATE
EVAPORATION MO | ED WITH THE
DDEL CODE PEGASUS. |
| THE KALBACH'
FORMULA DERI
DENSITY PARA | S CONSTANT K (= 9
VED FROM KIKUCHI-I
METERS. | 92.4) WAS ESTIN
KAWAI'S FORMAL | MATED BY THE
ISM/17/ AND LEVEL |
| FINALLY, THE
NORMALIŻED T
(N,P)
(N,ALPHA) | (N,P) AND (N,ALPI
O THE FOLLOWING V
16.00 MB (RE
17.00 MB (RE | HA) CROSS SECT
ALUES AT 14.5 M
COMMENDED BY FO
COMMENDED BY FO | IONS WERE
MEV:
DRREST/18/)
DRREST) |
| MT = 251 MU-B
CALCULATED W | AR
ITH CASTHY/3/. | | |
| MF = 4 ANGULAR
LEGENDRE POLYN
GIVEN IN THE C
TIC LEVELS, AN
CALCULATED WIT
BUTIONS IN THE | DISTRIBUTIONS OF 3
OMIAL COEFFICIENT
ENTER-OF-MASS SYS
D IN THE LABORATO
H CASTHY. FOR OTI
LABORATORY SYSTE | SECONDARY NEUT
S FOR ANGULAR I
TEM FOR MT=2 AI
RY SYSTEM FOR I
HER REACTIONS,
M WERE ASSUMED | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
MT=91. THEY WERE
ISOTROPIC DISTRI- |
| MF = 5 ENERGY D
ENERGY DISTRIB
PEGASUS FOR IN
OTHER NEUTRON | ISTRIBUTIONS OF SI
UTIONS OF SECONDAI
ELASTIC SCATTERING
EMITTING REACTION | ECONDARY NEUTRO
RY NEUTRONS WEF
G TO OVERLAPPIN
S. | DNS
RE CALCULATED WITH
NG LEVELS AND FOR |
| TABLE 1 NEUTRON | OPTICAL POTENTIA
DEPTH (MEV) | _ PARAMETERS
RADIUS(FM) | DIFFUSENESS(FM) |

| V = 46.0-0.25E R0 = 5.7 A0 = 0.62
WS = 7.0 RS = 6.2 AS = 0.35
VS0= 7.0 RS0= 5.7 AS0= 0.62
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
|---|
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 32-GE-76 * 1.352E+01 8.553E-01 1.533E+00 9.919E+00 2.830E+00
32-GE-77 * 1.334E+01 8.442E-01 6.660E+00 8.098E+00 1.360E+00
32-GE-78 1.234E+01 8.699E-01 7.304E-01 9.395E+00 2.930E+00
32-GE-79 1.362E+01 7.523E-01 2.737E+00 6.567E+00 1.360E+00 |
| 33-AS-771.300E+018.440E-014.637E+007.951E+001.470E+0033-AS-781.150E+017.500E-015.001E+003.894E+000.033-AS-791.290E+018.230E-013.020E+007.585E+001.570E+0033-AS-801.150E+017.250E-014.181E+003.535E+000.0 |
| 34-SE-781.287E+018.750E-011.163E+009.882E+002.900E+0034-SE-791.412E+018.000E-015.994E+007.842E+001.430E+0034-SE-801.334E+018.130E-016.129E-019.136E+003.000E+0034-SE-811.368E+017.490E-012.463E+006.614E+001.430E+00 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 2.952 FOR SE- 80 AND 5.0 FOR SE- 81. |
| REFERENCES KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1,
PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77
(1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). |
| 11) [IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 12) GRUPPELAAR, H.: ECN-13 (1977). 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). 14) NUCLEAR DATA SHEETS, 36, 127 (1982). 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 16) WALTER, G.: KFK-3706 (1984). 17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS", NORTH HOLLAND (1968). 18) FORREST, R.A.: AERE-R 12419 (1986). |

MAT number = 3449 34-SE- 82 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

ΜF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 18 KEV RESONANCE ENERGIES WERE BASED ON THE EXPERIMENTAL DATA BY BROWNE AND BERMAN/2/. THE VALUES OF NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J WERE ASSUMED TO BE 0 AND 0.5 FOR ALL RESONANCE LEVELS, RESPECTIVELY.

REDUCED NEUTRON WIDTH OF EACH RESONANCE LEVEL WAS ROUGHLY ESTIMATED ON THE BASIS OF THE DESCRIPTION FOR RESONANCE STRUCTURES GIVEN BY BROWNE AND BERMAN, AND OF THE REDUCED NEUTRON WIDTHS GIVEN BY MUGHABGHAB ET AL./3/ IN THE FIRST STAGE. NEXT, THERMAL SCATTERING CROSS SECTION WAS CALCULATED USING THE ROUGHLY ESTIMATED REDUCED NEUTRON WIDTHS, AND A NORMALIZATION FACTOR WAS OBTAINED SO AS TO REPRODUCE THE EXPERIMENTAL DATA OF 5.0+-0.2 BARNS GIVEN BY MUGHABGHAB ET AL. THE FINAL NEUTRON WIDTHS WERE DETERMINED BY USING THIS NORMALIZATION FACTOR AND THE RESONANCE ENERGIES GIVEN BY BROWNE AND BERMAN.

SCATTERING RADIUS WAS TAKEN FROM MUGHABGHAB ET AL. AVERAGE RADIATION WIDTH WAS ALSO DETERMINED SO AS TO REPRODUCE THERMAL CAPTURE CROSS SECTION OF 44.2 MB GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED AT -120 EV IN THE PRESENT ANALYSIS.

UNRESOLVED RESONANCE REGION : 18 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS DETERMINED FROM A SYSTEMATIC TREND OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.210E-4, S1 = 2.100E-4, S2 = 0.680E-4, SG = 0.572E-4, GG = 0.190 EV, R = 7.074 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 5.044 ELASTIC 5.000 S. INTEGRALS (BARNS) RES. INTEG.

TOTAL ELASTIC CAPTURE 0.04420 0.799

CAPTURE 0.04420 0.799 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/.

/13/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| | L | EVEI | NC
GR
1234
56
LS | AB | OVE | E
3. | NE
0.
1.
1.
2.
01 | RG
0
654
73
73
550
894
5 | Y(M
48
00
12
54
08
42
MEV | ΙΕ\
, γ | /)
/er | ٤E | S | PI
2024
35
SU | N- | PA
+++++
-D | R I
TO | ΤY | E | ٥v | ER | LA | PPI | NG | | |
|----------------------------------|--|---|---------------------------------|--|-------------------------------------|---|---|---|--|-----------------|----------------------------|-------------------------|----------------------------|------------------------|--------------------------|----------------------------|--------------------------|---------------------------------|---------------------|----------------------|---------------------------|----------------------|------------------------------------|----------------------|-------------------------|---------------------------|
| МТ | SPH
CAS
SEC
AND | 102
ERI(
THY
TIOI
REI | CAL
WA
NS
FFC | AP
0
S
WE
/ 1 | TUR
PTI
ADO
RE
6/ | E
CAL
PTE
EST
AND | D.
IM
N | ND
I
ATI
ORI | ST
DIR
ED
MAL | | | STI
AN
DRC
D T | CA
ND
DIN
TO | L
SE
G
1 | М О
М I
Т О
М I | DE
- D
T
LL | L
IR
HE
I- | CA
EC
BA | LC
T
RO
RN | UL
CA
CE
A | AT
PT
DU
T | IO
UR
RE
14 | N W
E C
ME | IT
RO
B
V | H
SS
ENZ | I |
| | THE
REP
WHI
PRO
CHA | GAI
RODI
CH \
DUC
UBE | MMA
UCE
WAS
TIC
Y A | - R
T
A
N
ND | AY
HE
SO
CRO
SE | STR
CAF
MEW
SS
HGA | REN
PTU
/HA
SE | GTI
RE
T I
CT
17 | H F
CR
AR
ION | | ICT
SS
R
)F | SE
VA
0. | ON
ECT
ALU
04 | (5
10
E
5 | .4
N
TH
BA | 6E
OF
AN
RN | - 0
0
A
A | 5)
.0
M
T | W
45
ET
24 | AS
B
A-
K | A
AR
ST
EV | DJ
N
AB
M | UST
AT
LE
EAS | ED
25
ST
UR | TO
KE
ATE
ED | V
B Y |
| МТ
МТ
МТ
МТ
МТ
МТ | =
=
=1
=1
=1
THE
PRE | 16
17
22
03
04
05
07
SE
U | | I,2
I,N
I,P
I,D
I,A
C
B
R | N)
'A)
'P)
CC
CH
ION | CRC
CRC
CRC
ROSS
ROSS
ROSS
ROSS
CR
AN | | SSEE
SSEE
SSEE
SSEE
SSEE
SSEE
SSEE
SSE | | | | | I
WE
EV | RE | COR | AL | CU
10 | LA | TEMO | D
DE | WI | TH
CO | TH
DE | IE
PE | GAS | US. |
| | THE
FOR
DEN | KAI
MUL/
SIT | LBA
A D
Y P | CH
ER
AR | 'S
IVE
AME | CON
D F
TER | IST
RO
SS. | AN
M I | r k
Kik | (
(U) | (=
 | - K | 96.
(AW | 6)
Al | ' S | AS
F | E
OR | ST
MA | IM | AT
SM | ED
/ 1 | В
8/ | Y T
AN | HE
ID | LEV | EL |
| | FIN
NOR
(| ALL`
MAL
N,21
N,P | Y
IŻE
N)
) | TH
D | E _O (| N,2
THE
110 | 2N)
F
00.
2. | AI
OLI
00
40 | ND
_OW
_N | (| I,F
IG
(N
(S | P)
VA
NEA
SYS | CR
ALU
ASU
STE | OS
ES
RE
MA | S
D
TI | SE
T
BY
CS | CT
14
F
0 | 10
.5
RE
F | NS
M
HA
FO | UT
RR | ER
:
+/
ES | E
19
T / | /)
20/ |) | | |
| МТ | CĀL | 251
CUL/ | ATE | U -
D | BAR
WIT | нc | CAS | ТΗ | Υ. | | | | | | | | | | | | | | | | | |
| MF =
GI
TI
CA
BL | = 4
GEN
VEN
C L
ALCU
JTIO | AN
DRE
IN
EVEI
LATI
NS | GUL
PC
TH
LS,
ED | AR
DLY
IE
A
WI
TH | DI
NOM
CEN
ND
TH
E L | STR
IAL
TER
IN
CAS | RIB
C
C
TH
TH
STH
ORA | UT
OEI
F-I
E I
Y
TOI | ION
FFI
MAS
_AB
_AB
F
RY | IS
CI
SOF | OF
SY
RAT
C
ST | ITS
ST
OF
TEN | SEC
FEM
Y
HER | ON
OR
SY
ER | DA
OR
ST
EA | RY
NG
EM
CT
AS | N
UL
F
IO
SU | EU
AR
2
OR
NS
ME | TR
D
AN
M | ON
IS
D
IS | S
TR
DI
91
0T | IB
SC
RO | UTI
RET
TH
PIC | ON
E
IEY
D | S A
INE
WE
IST | RE
LAS -
RE
RI - |
| MF =
EN
PE
OT | 5
NERG
GAS
HER | ENI
Y D
US I
NEI | ERG
IST
FOR
UTR | RI
ON | DIS
BUT
NEL
EM | TRI
ION
AST | BU
IS
IC | TI(
OF
S(
GI | ONS
SE
CAT
REA | | | SE
AF
NG | CO
Y
T | ND
NE
O | AR
UT
OV | Y
RO
ER | NE
NS
LA | U T
W
P P | RO
ER | NS
E
G | C A
L E | LC
VE | ULA
LS | TE
AN | D W
D F | ITH
OR |
| TABL | .E 1 | NI | EUT | RO | N O | PTI | CA | LI | POT | ΕN | ITI | AL | - P | AR | AM | ET | ER | S | | | | | | | | |
| TH | IE F | V
WS
VSC
ORM |
=
0=
0F | 46
7
7
8 | DE
0
0
URF | PTH
0.2
ACE | 1 (
25 E | BS | /)
 |
ידו | 0 | I F | RA
RO
RS
RS
AR | D I
=
0=
T | US

56
55
IS | (F
.7
.2
.7
D | M)
ER | | WO | DI
AO
AS
OD | FF

=
0=
S- | US
0
0
SA | ENE
- 62
- 35
- 62
XON | SS
T | (FM
YPE |) |
| TABL | .E 2 | LI | EVE | L | DEN | SIT | Y | PAI | RAN | IE 1 | ER | S | | | | | | | | | | | | | | |

| NUCLIDE SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|--------------|-----------|-----------|-----------|-----------|-----------|
| 32-GE- 78 | 1.234E+01 | 8.699E-01 | 7.304E-01 | 9.395E+00 | 2.930E+00 |
| 32-GE- 79 | 1.362E+01 | 7.523E-01 | 2.737E+00 | 6.567E+00 | 1.360E+00 |
| 32-GE- 80 * | 1.277E+01 | 8.125E-01 | 5.273E-01 | 8.551E+00 | 2.820E+00 |

32-GE- 81 * 1.255E+01 8.025E-01 2.496E+00 6.770E+00 1.360E+00
33-AS- 79 1.290E+01 8.230E-01 3.020E+00 7.585E+00 1.570E+00
33-AS- 80 1.150E+01 7.250E-01 4.181E+00 3.535E+00 0.0
33-AS- 81 * 1.293E+01 8.025E-01 2.772E+00 7.120E+00 1.460E+00
33-AS- 82 * 1.271E+01 7.927E-01 1.371E+01 5.344E+00 0.0
34-SE- 80 1.334E+01 8.130E-01 6.129E-01 9.136E+00 3.000E+00
34-SE- 81 1.368E+01 7.490E-01 2.463E+00 6.614E+00 1.430E+00
34-SE- 82 1.259E+01 7.980E-01 3.563E+01 8.246E+00 2.890E+00
34-SE- 83 1.381E+01 7.500E-01 2.466E+00 6.708E+00 1.430E+00
34-SE- 83 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00
34-SE- 83 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00
34-SE- 83 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00
34-SE- 83 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00
34-SE- 83 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00
34-SE- 84 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00
34-SE- 85UMED TO BE 6.291 FOR SE- 82 AND 5.0 FOR SE- 83.
REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY. MITO. P. 569 (1988).
2) BROWNE, J. C. AND BERMAN, B.L.: PHYS. REV. C26 .969 (1982).
3) WUGHABGHAB. S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
4) IGARASI, S. J. NUCL. SCI. TECHNOL. 12, 67 (1975).
5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
4) HUZENGA, J.R. AND IGO, G. NUCL. PHYS. A232, 381 (1974).
10 BECCHETTI, F.D., J. AND GG, G. NUCL. PHYS. A232, 381 (1974).
10 BECCHETTI, F.D., AND AND GRENLEES, G.W.: POLARIZATION W. HAEBERLI, W.: NUCL. SCI. TECHNOL. 21, 10 (1984).
3) GUPPELAAR, M. ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
3) GUPPELAAR, H.: ECN-13 (1977).
10 BECCHETTI, F.D., J. AND CAMERON, A.G.W.: CAN. J. PHYS., 43,

MAT number = 3525 35-BR- 79 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G. * * * * * (2.151)(3,102) (3,102) (3,4), (3,51-91) AND ANGULAR DISTRIBUTIONS SMALL EFFECTS OF THE RE-NORMALIZATION OF THE CAPTURE CROSS SECTION. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 5.5 KEV RESONANCE ENERGIES FOR THE 333 LEVELS AND FOR THE REMAINING 8 LEVELS WERE BASED ON THE MEASUREMENTS BY MACKLIN/2/ AND BY OHKUBO ET AL./3/, RESPECTIVELY. NEUTRON AND RADIATION WIDTHS WERE DETERMINED BY DIFFERENT METHODS ACCORDING TO THE FOLLOWING THREE CONDITIONS, RESPECTIVELY. MF = 21) IN CASES WHERE TOTAL WIDTH AND NEUTRON CAPTURE AREA MEASURED BY MACKLIN WERE GIVEN FOR A RESONANCE LEVEL. THE NEUTRON AND RADIATION WIDTHS WERE SIMULTANEOUSLY OBTAINED BY SOLVING A QUADRATIC EQUATION. 2) IN CASES WHERE NEUTRON CAPTURE AREA MEASURED BY MACKLIN AND G*(REDUCED NEUTRON WIDTH) MEASURED BY OHKUBO ET AL. WERE AVAILABLE, THE RADIATION WIDTHS WERE DERIVED FROM THE BOTH DATA 3) IN CASES WHERE ONLY NEUTRON CAPTURE AREA BY MACKLIN WAS AVAILABLE, OR G* (NEUTRON WIDTH) BY OHKUBO ET AL. WAS SMALLER THAN NEUTRON CAPTURE AREA BY MACKLIN, THE AVERAGE RADIATION WIDTH OF 308 MEV GIVEN BY MACKLIN WAS ADOPTED FOR THE LEVEL. THE NEUTRON WIDTH WAS DERIVED FROM THIS AVERAGE RADIATION WIDTH AND THE NEUTRON CAPTURE AREA. IN ADDITION, IF THE VALUE OF G* (AVERAGED RADIATION WIDTH) WAS SMALLER THAN NEUTRON CAPTURE AREA FOR SOME RESONANCE LEVELS, THE AVERAGE RADIATION WIDTH WAS INCREASED DEPENDING TO THE VALUE OF NEUTRON CAPTURE AREA, SO AS TO SATISFY THE FOLLOWING CONDITION : G* (AVERAGE RADIATION WIDTH) > NEUTRON CAPTURE AREA. VALUE TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE O FOR ALL RESONANCE LEVELS. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL./4/ A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. UNRESOLVED RESONANCE REGION : 5.5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/, AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION A 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.. AT TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.580E-4, S1 = 1.700E-4, S2 = 0.720E-4, SG = 95.4E-4, GG = 0.293 EV, R = 7.555 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 14.27 ELASTIC 3.269 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 11.00 129 MF = 3 NEUTRON CROSS SECTIONS

BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/7/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPONDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. /14/. T TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/15/ AND NUCLEAR DATA MT SHEETS/16/. SPIN-PARITY 3/2 -9/2 + 5/2 -3/2 -3/2 -3/2 -3/2 -5/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -7/2 -5/2 -7/2 -7/2 -5/2 -7/2 NO. ENERGY(MEV) GR. 0.0 0.2071 0.22613 0.22613 0.3836 0.3836 0.39752 0.5232 0.6060 0.7614 0.7937 0.8319 0.9107 0.9107 1.03888 1.05307 1.1245 1.1245 1.1245 1.1245 1.1245 1.1245 1.1245 1.1245 1.1245 1.33261 1.332601 2 3 456789012345678901234567 1.3951 1.4950 1.5016 1.5127 1.5751 28 29 LEVELS ABOVE 1.613 MEV WERE ASSUMED TO BE OVERLAPPING. F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = THE GAMMA-RAY STRENGTH FUNCTION (7.375E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 385 MILLI-BARNS AT 90 KEV MEASURED BY MACKLIN/2/. (N,2N) CROSS SECTION (N,3N) CROSS SECTION (N,N'A) CROSS SECTION (N,N'P) CROSS SECTION (N,N'P) CROSS SECTION (N,N'D) CROSS SECTION (N,N'T) CROSS SECTION МΤ 16 = = 10= 17 = 22 = 28 = 32 = 33 MT MT MT MT MT

MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =106 (N,HE3) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION MT =111 (N,2P) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 99.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 950.00 MB (MEASURED BY OKUMURA/19/) (N,P) 30.20 MB (SYSTEMATICS OF FORREST/20/) (N,ALPHA) 12.50 MB (RECOMMENDED BY FORREST/20/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) *.* ·---TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.250E+01 9.510E-01 6.830E+00 1.008E+01 1.880E+00 1.330E+01 7.860E-01 1.900E+01 5.611E+00 0.0 1.300E+01 8.440E-01 4.637E+00 7.951E+00 1.470E+00 1.150E+01 7.500E-01 5.001E+00 3.894E+00 0.0 33-AS- 75 33-AS- 76 33-AS- 77 33-AS- 78 34-SE- 76 34-SE- 77 34-SE- 78 34-SE- 79 1.315E+01 8.900E-01 1.097E+00 1.082E+01 3.310E+00 1.438E+01 8.000E-01 7.140E+00 8.015E+00 1.430E+00 1.287E+01 8.750E-01 1.163E+00 9.882E+00 2.900E+00 1.412E+01 8.000E-01 5.994E+00 7.842E+00 1.430E+00 35-BR- 77 35-BR- 78 35-BR- 79 35-BR- 80 * 1.440E+01 8.442E-01 7.380E+00 9.395E+00 1.880E+00 1.394E+01 7.570E-01 2.113E+01 5.482E+00 0.0 1.293E+01 8.690E-01 5.790E+00 8.381E+00 1.470E+00 1.318E+01 7.950E-01 1.882E+01 5.695E+00 0.0 - - - - - - - - - - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.724 FOR BR- 79 AND 5.0 FOR BR- 80. REFERENCES A) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 2) MACKLIN, R.L.: NUCL. SCI. ENG., 99, 133 (1988). 3) OHKUBO, M., KAWARASAKI, Y., AND MIZUMOTO, M.: NUCL. SCI. TECH. 18, 745 (1981). 4) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, NUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I PART A", ACADEMIC PRESS (1981).
5) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
6) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
7) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 8) 91

- 10) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 11) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
- (1971) 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. FILLS., 40, 1110 (1965).
 13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 14) GRUPPELAAR, H.: ECN-13 (1977).
 15) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 16) NUCLEAR DATA SHEETS, 37, 393 (1982).
 17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 19) OKUMURA, S.: NUCL. PHYS., A93, 74 (1967)
 20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3531 35-BR- 81 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G. * * * * * (2.151)

| | CROSS SECTION. |
|-------------------------|--|
| (3,102) | RE-NORMALIZED. |
| (3.4). (3.5 | 1-91) AND ANGULAR DISTRIBUTIONS |
| | SMALL EFFECTS OF THE RE-NORMALIZATION OF THE |
| | CAPTURE CROSS SECTION. |
| * * * * * * * * * * * * | * |

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 13 KEV RESONANCE ENERGIES FOR THE 304 LEVELS AND FOR THE REMAINING 3 LEVELS WERE BASED ON THE MEASUREMENTS BY MACKLIN/2/ AND BY OHKUBO ET AL./3/, RESPECTIVELY. NEUTRON AND RADIATION WIDTHS WERE DETERMINED BY DIFFERENT METHODS ACCORDING TO THE FOLLOWING THREE CONDITIONS, RESPECTIVELY.

1) IN CASES WHERE TOTAL WIDTH AND NEUTRON CAPTURE AREA MEASURED BY MACKLIN WERE GIVEN FOR A RESONANCE LEVEL. THE NEUTRON AND RADIATION WIDTHS WERE SIMULTANEOUSLY OBTAINED BY SOLVING A QUADRATIC EQUATION.

2) IN CASES WHERE NEUTRON CAPTURE AREA MEASURED BY MACKLIN AND G*(REDUCED NEUTRON WIDTH) MEASURED BY OHKUBO ET AL. WERE AVAILABLE, THE RADIATION WIDTHS WERE DERIVED FROM THE BOTH DATA

3) IN CASES WHERE ONLY NEUTRON CAPTURE AREA BY MACKLIN WAS AVAILABLE, OR G* (NEUTRON WIDTH) BY OHKUBO ET AL. WAS SMALLER THAN NEUTRON CAPTURE AREA BY MACKLIN FOR A RESONANCE LEVEL. THE AVERAGE RADIATION WIDTH OF 279 MEV GIVEN BY MACKLIN WAS ADOPTED. THE NEUTRON WIDTH WAS DERIVED FROM THIS AVERAGE RADIATION WIDTH AND THE NEUTRON CAPTURE AREA. IN ADDITION, IF THE VALUE OF G* (AVERAGED RADIATION WIDTH) WAS SMALLER THAN NEUTRON CAPTURE AREA FOR SOME RESONANCE LEVELS, THE AVERAGE RADIATION WIDTH WAS INCREASED DEPENDING ON THE VALUE OF NEUTRON CAPTURE AREA, SO AS TO SATISFY THE FOLLOWING CONDI-TION: TIÔN:

G*(AVERAGE RADIATION WIDTH) > NEUTRON CAPTURE AREA.

TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE O FOR ALL RESONANCE LEVELS. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL./4/ A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 13 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.800E-4, S1 = 2.000E-4, S2 = 0.690E-4, SG = 17.3E-4, GG = 0.300 EV, R = 7.334 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.307 -

| IVIAL | 0.307 | - |
|---------|-------|------|
| ELASTIC | 3.616 | - |
| CAPTURE | 2.690 | 46.7 |
| | | |

| <pre>MF = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/7/
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/8/
ALPHA = HUIZENGA AND IGO/9/
DEUTERON = LOHR AND HAEBERLI/10/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAI
/14/.</pre> |
|--|
| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> |
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> |
| MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR
STRUCTURE DATA FILE (1987 VERSION)/15/ AND NUCLEAR DATA
SHEETS/16/. |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 3/2 -
1 0.2760 5/2 -
2 0.5362 9/2 +
3 0.5382 1/2 -
4 0.5660 3/2 -
5 0.6499 3/2 -
6 0.7672 3/2 -
7 0.7925 3/2 +
8 0.8150 1/2 +
9 0.8283 3/2 -
10 0.8324 1/2 -
11 0.8364 7/2 -
12 1.1047 1/2 -
13 1.1899 5/2 -
14 1.2666 3/2 -
15 1.3228 5/2 -
16 1.3275 5/2 -
17 1.3525 1/2 -
18 1.3757 7/2 +
19 1.5428 1/2 -
18 1.3757 7/2 +
19 1.5428 1/2 -
11 1.9499 7/2 +
20 1.5870 1/2 +
21 1.9499 7/2 +
22 1.9852 3/2 +
23 2.0559 1/2 -
24 2.0846 7/2 +
25 2.1225 3/2 +
26 2.1641 1/2 -
LEVELS ABOVE 2.193 MEV WERE ASSUMED TO BE OVERLAPPING. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.65E-03) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 119 MILLI-BARNS AT 90
KEV MEASURED BY MACKLIN/2/. |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT = 103 (N,P) CROSS SECTION |

MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 120.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWA1'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 21.50 MB (RECOMMENDED BY FORREST/19/) (N,ALPHA) 5.00 MB (RECOMMENDED BY FORREST)

MT = 251 MU-BAR CALCULATED WITH CASTHY.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| | DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|--|---|---|---|
| V = 4
WS = 7
VSO= 7 | 6.0-0.25E
.0
.0 | RO = 5.7
RS = 6.2
RSO = 5.7
RO = 5.7 | A0 = 0.62
AS = 0.35
AS0= 0.62 |
| TABLE 2 LEVEL | DENSITY PARAMETERS | FART TO DER. | WOODS-SAXON TIFE. |
| NUCLIDE | A(1/MEV) T(MEV) | C(1/MEV) E | X(MEV) PAIRING |
| 33-AS- 77
33-AS- 78
33-AS- 79
33-AS- 80 | 1.300E+01 8.440E-0
1.150E+01 7.500E-0
1.290E+01 8.230E-0
1.150E+01 7.250E-0 | 01 4.637E+00 7
01 5.001E+00 3
01 3.020E+00 7
01 4.181E+00 3 | .951E+00 1.470E+00
894E+00 0.0
585E+00 1.570E+00
535E+00 0.0 |
| 34-SE- 78
34-SE- 79
34-SE- 80
34-SE- 81 | 1.287E+01 8.750E-0
1.412E+01 8.000E-0
1.334E+01 8.130E-0
1.368E+01 7.490E-0 | 01 1.163E+00 9
01 5.994E+00 7
01 6.129E-01 9
01 2.463E+00 6 |).882E+00 2.900E+00
.842E+00 1.430E+00
.136E+00 3.000E+00
.614E+00 1.430E+00 |
| 35-BR- 79
35-BR- 80
35-BR- 81
35-BR- 82 | 1.293E+01 8.690E-0
1.318E+01 7.950E-0
1.290E+01 8.310E-0
1.266E+01 6.900E-0 | 01 5.790E+00 8
01 1.882E+01 5
01 3.275E+00 7
01 5.789E+00 3 | 381E+00 1.470E+00
695E+00 0.0
733E+00 1.570E+00
665E+00 0.0 |
| SPIN CUTOFF P
IN THE CASTHY
ASSUMED TO BE | ARAMETERS WERE CALC
CALCULATION, SPIN
3.192 FOR BR- 81 A | ULATED AS 0.1
CUTOFF FACTOF
ND 5.0 FOR BF | 46*SQRT(A)*A**(2/3).
S AT 0 MEV WERE
- 82. |
| REFERENCES
1) KAWAI, M.
2) MACKLIN, R
3) OHKUBO, M. | ET AL.: J. NUCL. SC
.L.: NUCL. SCI. ENG
, KAWARASAKI, Y., | CI. TECHNOL.,
5., 99, 133 (1
ND MIZUMOTO, | 29, 195 (1992).
988).
M.:
18 745 (1981) |
| 4) MUGHABGHAB
PART A", A 5) IGARASI, S 6) IIJIMA, S. 7) IIJIMA, S. | , S.F. ET AL.: "NEL
CADEMIC PRESS (1981
.: J. NUCL. SCI. TE
ET AL.: JAERI-M 87
AND KAWAI, M.: J. | TRON CROSS SE
)
CHNOL., 12, 6
-025, P. 337
NUCL. SCI. TE | CTIONS, VOL. I,
77 (1975).
(1987).
CHNOL., 20, 77 |
| (1983). PEREY, F.G. PUIZENGA, LOHR, J.M. BECCHETTI,
PHENOMENA
W. HAEBERL
(1971). | : PHYS. REV. 131, 7
J.R. AND IGO. G.: N
AND HAEBERLI, W.:
F.D., JR. AND GREE
IN NUCLEAR REACTION
I), P. 682, THE UNI | 245 (1963).
IUCL. PHYS. 29
NUCL. PHYS. A
NLEES, G.W.:
IS ((EDS) H.H.
VERSITY OF WI | 9, 462 (1962).
1232, 381 (1974).
POLARIZATION
BARSHALL AND
SCONSIN PRESS. |

- 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 14) GRUPPELAAR, H.: ECN-13 (1977).
 15) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 16) NUCLEAR DATA SHEETS, 46, 487 (1985).
 17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3625 36-KR- 78 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.8 KEV RESONANCE PARAMETERS FOR THREE POSITIVE LEVELS WERE BASED ON MUGHABGHAB ET AL./2/ RESONANCE LEVELS AT 0.1719 KEV AND ABOVE 1.136 KEV WERE ABANDONED, BECAUSE THEY BELONG POSSIBLY TO KR-80. THE VALUES OF NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J WERE ASSUMED TO BE 0 AND 0.5 FOR ALL RESONANCE LEVELS, RESPECTIVELY. SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1. PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 6.2+-0.9 BARNS GIVEN BY MUGHABGHAB ET AL. MF AL.

UNRESOLVED RESONANCE REGION : 0.8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/, AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.580E-4, S1 = 1.700E-4, S2 = 0.730E-4, SG = 13.0E-4, GG = 0.230 EV, R = 7.556 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 14.03 ELASTIC 7.829 -CAPTURE 6.200 25.8

CAPTURE 6.200 25.6 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/5/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/6/
ALPHA = HUIZENGA AND IGO/7/
DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY ILJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/. /12/.

MT =

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

ΜT

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN- | PARITY |
|-----|-------------|-------|--------|
| GR. | 0.0 | 0 | + |
| 1 | 0.4550 | 2 | + |
| 2 | 1.0172 | 0 | + |

| 3 1.1195 4 +
4 1.1479 2 +
5 1.5647 3 +
6 1.6538 3 +
7 1.7559 2 +
8 1.7729 2 +
9 1.8729 4 +
10 1.9778 6 +
11 2.0075 0 -
12 2.2341 2 +
13 2.2407 2 +
14 2.2998 5 +
15 2.3990 3 -
16 2.4134 1 -
18 2.4718 2 +
19 2.5080 0 +
20 2.5733 2 +
19 2.5080 0 +
20 2.5733 2 +
21 2.6561 0 +
22 2.6776 3 -
23 2.7315 6 +
24 2.7498 5 -
25 2.7641 3 -
25 2.7641 3 -
26 2.8821 3 -
27 2.8828 1 -
28 2.9925 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 25 0 +
29 20 +
20 20 +
20 20 20 +
20 20 +
20 20 + | |
|--|--|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-RAY STRENGTH FUNCTION (10.3E-04) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 200 MILLI-BARNS AT 100
KEV MEASURED BY WALTER ET AL./16/ | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 85.5) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 245.00 MB (MEASURED BY KONDAIAH+/18/)
(N,P) 131.00 MB (SYSTEMATICS OF FORREST/19/)
(N,ALPHA) 39.30 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>### ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS- TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI- BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | |
| <pre>#F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> | |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPIH (MEV)RADIUS(FM)DIFFUSENESS(FM)V = 46.0-0.25ER0 = 5.7A0 = 0.62WS = 7.0RS = 6.2AS = 0.35 | |

VSO= 7.0 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|--------------|-------------|------------|------------|-----------|-----------|
| 34-SE-74 | 1.290E+01 | 8.620E-01 | 1.070E+00 | 9.612E+00 | 2.860E+00 |
| 34-SE-75 | 1.391E+01 | 8.500E-01 | 9.741E+00 | 8.707E+00 | 1.430E+00 |
| 34-SE-76 | 1.315E+01 | 8.900E-01 | 1.097E+00 | 1.082E+01 | 3.310E+00 |
| 34-SE-77 | 1.438E+01 | 8.000E-01 | 7.140E+00 | 8.015E+00 | 1.430E+00 |
| 35-BR-75 * | 1.407E+01 | 8.667E-01 | 1.329E+01 | 9.176E+00 | 1.430E+00 |
| 35-BR-76 * | 1.467E+01 | 8.553E-01 | 9.334E+01 | 7.957E+00 | 0.0 |
| 35-BR-77 * | 1.440E+01 | 8.442E-01 | 7.380E+00 | 9.395E+00 | 1.880E+00 |
| 35-BR-78 | 1.394E+01 | 7.570E-01 | 2.113E+01 | 5.482E+00 | 0.0 |
| 36-KR-76 * | 1.425E+01 | 8.553E-01 | 3.339E+00 | 1.024E+01 | 2.600E+00 |
| 36-KR-77 | 1.359E+01 | 8.250E-01 | 7.930E+00 | 7.711E+00 | 1.170E+00 |
| 36-KR-78 | 1.322E+01 | 8.690E-01 | 1.155E+00 | 1.019E+01 | 3.050E+00 |
| 36-KR-79 | 1.369E+01 | 8.400E-01 | 9.969E+00 | 8.080E+00 | 1.170E+00 |
| SYST: * = L | DP'S WERE I | DETERMINED | FROM SYSTE | EMATICS. | |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.780 FOR KR- 78 AND 5.0 FOR KR- 79.

REFERENCES

(EFERENCES)
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983)

6) 7)

IIJIMA, S. AND KAWAI, M. J. NOCL. COT. LEGINGL, LC, ... (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 8) 9)

(1971) 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FILS., 43, 1440 (1965).
11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 33, 189 (1981).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) WALTER, G., ET AL.: KFK-3652, 1 (1984).
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
18) KONDAIAH, E., ET AL.: NUCL. PHYS., A120, 337 (1968)
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3631 36-KR- 80 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ RESONANCE LEVELS AT 89.2 AND 171.9 EV, AND ABOVE 2.16 KEV WERE ABANDONED, BECAUSE THEY DO NOT POSSIBLY BELONG TO KR-80. NEUTRON WIDTHS OF THE RESONANCE LEVELS ABOVE 1.136 KEV WERE DERIVED FROM THE AVERAGE REDUCED NEUTRON WIDTH OF 18.34 MEV. AVERAGE RADIATION WIDTH OF 0.23 EV WAS ADOPTED FOR ALL RESONANCE LEVELS EXCEPT THE FIRST LEVEL AT 106 EV. THE VALUES OF NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J WERE ASSUMED TO BE 0 AND 0.5 FOR ALL RESONANCE LEVELS, RESPECTIVELY. SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 11.5+-0.5 BARNS GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 1 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/, AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.580E-4, S1 = 1.800E-4, S2 = 0.700E-4, SG = 8.51E-4, GG = 0.230 EV, R = 7.513 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 18.79 7.290 11.50 TOTAL ELASTIC CAPTURE 60.2 GAPTURE 11.50 60.2 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY ILJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MF /12/. ΜТ TOTAL 1 SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/. SPIN-PARITY NO. GR. ENERGY(MEV) 0.0 0 +

| 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16 | 0.6166
1.2562
1.3205
1.4360
1.7879
2.1458
2.3918
2.4390
2.6595
2.7928
2.8594
2.9570
3.0390
3.0416
3.1100
3.3455 | 2 + + + + + + + + + + + + + + + + + + + | |
|--|---|--|---|
| 17
18
19
20
21
22
23
24
25
26
27
28
29
LEVELS AB | 3.4096
3.4878
3.5300
3.5583
3.5815
3.6352
3.6994
3.9158
4.1258
4.1258
4.1530
4.1631
4.3929
OVE 4.562 MEV WERE | 8 +
5 -
7 -
7 -
7 -
7 +
8 +
6 +
6 -
6 -
8 -
10 +
9 -
ASSUMED TO BE | OVERLAPPING. |
| MT = 102 CAP
SPHERICAL O
CASTHY WAS
SECTIONS WE
AND REFFO/1 | TURE
PTICAL AND STATIST
ADOPTED. DIRECT A
RE ESTIMATED ACCOR
4/ AND NORMALIZED | ICAL MODEL CAL
ND SEMI-DIRECT
DING TO THE PRO
TO 1 MILLI-BARI | CULATION WITH
CAPTURE CROSS
DCEDURE OF BENZI
N AT 14 MEV. |
| THE GAMMA-R
REPRODUCE T
KEV MEASURE | AY STRENGTH FUNCTI
HE CAPTURE CROSS S
D BY WALTER ET AL. | ON (6.99E-04) \
ECTION OF 150
/15/ | WAS ADJUSTED TO
MILLI-BARNS AT 100 |
| MT = 16 (N,2
MT = 22 (N,N
MT = 28 (N,N
MT =103 (N,P
MT =104 (N,D
MT =105 (N,T
MT =106 (N,H
MT =107 (N,A
MT =111 (N,2
THESE REACT
PREEQUILIBR | N) CROSS SECTION
'A) CROSS SECTION
'P) CROSS SECTION
) CROSS SECTION
) CROSS SECTION
2 CROSS SECTION
E3) CROSS SECTION
LPHA) CROSS SECTION
P) CROSS SECTION
ION CROSS SECTIONS
IUM AND MULTI-STEP | N
WERE CALCULATI
EVAPORATION MO | ED WITH THE
DDEL CODE PEGASUS. |
| THE KALBACH
FORMULA DER
DENSITY PAR | 'S CONSTANT K (=
IVED FROM KIKUCHI-
AMETERS. | 69.7) WAS ESTII
KAWAI'S FORMAL | MATED BY THE
ISM/16/ AND LEVEL |
| FINALLY, TH
NORMALIZED
(N,P)
(N,ALPHA) | E (N,P) AND (N,ALP
TO THE FOLLOWING V
54.90 MB (SY
18.80 MB (SY | HA) CROSS SECT
ALUES AT 14.5 I
STEMATICS OF FO
STEMATICS OF FO | IONS WERE
MEV:
DRREST/17/)
DRREST) |
| MT = 251 MU-
CALCULATED | BAR
WITH CASTHY/3/. | | |
| MF = 4 ANGULAR
LEGENDRE POLY
GIVEN IN THE
TIC LEVELS, A
CALCULATED WI
BUTIONS IN TH | DISTRIBUTIONS OF
NOMIAL COEFFICIENT
CENTER-OF-MASS SYS
ND IN THE LABORATO
TH CASTHY. FOR OT
E LABORATORY SYSTE | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
RY SYSTEM FOR I
HER REACTIONS,
M WERE ASSUMED | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
MT=91. THEY WERE
ISOTROPIC DISTRI- |
| MF = 5 ENERGY
ENERGY DISTRI
PEGASUS FOR I
OTHER NEUTRON | DISTRIBUTIONS OF S
BUTIONS OF SECONDA
NELASTIC SCATTERIN
EMITTING REACTION | ECONDARY NEUTRO
RY NEUTRONS WEI
G TO OVERLAPPII
S. | DNS
RE CALCULATED WITH
NG LEVELS AND FOR |
| TABLE 1 NEUTRO | N OPTICAL POTENTIA | L PARAMETERS | |
| V = 46 | DEPTH (MEV)
.0-0.25E | RADIUS(FM)
RO = 5.7 | DIFFUSENESS(FM)
A0 = 0.62 |

| Tł | WS = 7.0
VSO= 7.0
HE FORM OF SURFACE ABSORF | RS = 6.2
RSO= 5.7
PTION PART IS DER. WO | AS = 0.35
ASO= 0.62
DODS-SAXON TYPE. |
|--|--|---|--|
| TABL | LE 2 LEVEL DENSITY PARAM | METERS | |
| NUC
34-
34-
34-
34-
34- | CLIDE SYST A(1/MEV) T(1
-SE- 76 1.315E+01 8.9
-SE- 77 1.438E+01 8.0
-SE- 78 1.287E+01 8.7
-SE- 79 1.412E+01 8.0 | MEV) C(1/MEV) EX
900E-01 1.097E+00 1.0
000E-01 7.140E+00 8.0
750E-01 1.163E+00 9.8
000E-01 5.994E+00 7.8 | (MEV) PAIRING
082E+01 3.310E+00
015E+00 1.430E+00
082E+00 2.900E+00
0342E+00 1.430E+00 |
| 35 -
35 -
35 -
35 -
35 - | -BR-77 * 1.440E+01 8.4
-BR-78 1.394E+01 7.4
-BR-79 1.293E+01 8.6
-BR-80 1.318E+01 7.5 | 442E-01 7.380E+00 9.3
570E-01 2.113E+01 5.4
390E-01 5.790E+00 8.3
950E-01 1.882E+01 5.4 | 395E+00 1.880E+00
482E+00 0.0
381E+00 1.470E+00
395E+00 0.0 |
| 36
36
36
36 | -KR-78 1.322E+01 8.6
-KR-79 1.369E+01 8.4
-KR-80 1.205E+01 8.4
-KR-81 1.503E+01 7.5 | 390E-01 1.155E+00 1.0
400E-01 9.969E+00 8.0
350E-01 5.500E-01 8.2
300E-01 6.057E+00 6. | 019E+01 3.050E+00
080E+00 1.170E+00
257E+00 2.640E+00
776E+00 1.170E+00 |
| SI | YST: * = LDP'S WERE DETE | ERMINED FROM SYSTEMA | FICS. |
| SP I
I N
ASS | IN CUTOFF PARAMETERS WERE
THE CASTHY CALCULATION,
SUMED TO BE 20.15 FOR KR | E CALCULATED AS 0.140
SPIN CUTOFF FACTORS
- 80 AND 5.0 FOR KR- | 6*SQRT(A)*A**(2/3).
AT 0 MEV WERE
81. |
| REFE
1)
2)
3)
4)
5) | ERENCES
KAWAI, M. ET AL.: PROC.
AND TECHNOLOGY, MITO, P
MUGHABGHAB, S.F. ET AL.
PART A", ACADEMIC PRESS
IGARASI, S.: J. NUCL. S(
IIJIMA, S. ET AL.: JAER
IIJIMA, S. AND KAWAI, M | INT. CONF. ON NUCLE/
. 569 (1988).
: "NEUTRON CROSS SEC"
(1981).
CI. TECHNOL., 12, 67
I-M 87-025, P. 337 (
.: J. NUCL. SCI. TECI | AR DATA FOR SCIENCE
FIONS, VOL. I,
(1975).
1987).
HNOL., 20, 77 |
| 6)
7)
8)
9) | (1983).
PEREY, F.G: PHYS. REV.
HUIZENGA, J.R. AND IGO,
LOHR, J.M. AND HAEBERLI
BECCHETTI, F.D., JR. ANI
PHENOMENA IN NUCLEAR RE/
W. HAEBERLI), P. 682, TH
(1971). | 131, 745 (1963).
G.: NUCL. PHYS. 29,
, W.: NUCL. PHYS. A23
D GREENLEES, G.W.: PO
ACTIONS ((EDS) H.H. E
HE UNIVERSITY OF WISC | 462 (1962).
32, 381 (1974).
DLARIZATION
3ARSHALL AND
CONSIN PRESS. |
| 10)
11)
12)
13)
14)
15)
16)
17) | ĠIĹĠĖŔŤ, A. AND CAMERON
(1965).
IJJIMA, S., ET AL.: J. M
GRUPPELAAR, H.: ECN-13
ENSDF: EVALUATED NUCLEAF
BENZI, V. AND REFFO, G.
WALTER, G., ET AL.: KFK
KIKUCHI, K. AND KAWAI, M
REACTIONS", NORTH HOLLAF
FORREST, R.A.: AERE-R 12 | , A.G.W.: CAN. J. PH
(1977).
STRUCTURE DATA FILE
CCDN-NW/10 (1969).
-3652, 1 (1984).
M.: "NUCLEAR MATTER /
ND (1968).
2419 (1986). | (S., 43, 1446
21, 10 (1984).
E (JUNE 1987).
AND NUCLEAR |

MAT number = 3637 36-KR- 82 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.4 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ THE RESONANCE LEVEL AT 1.55 KEV WAS ABANDONED, BECAUSE THIS LEVEL BELONGS POSSIBLY TO KR-83. NEUTRON WIDTHS OF THE RESONANCE LEVELS FROM 646 TO 1659 EV WERE DERIVED FROM THE REDUCED NEUTRON WIDTH (19.7 MEV) OF THE 1ST LEVEL AND THE RESONANCE ENERGY OF EACH LEVEL. AVERAGE RADIATION WIDTH OF 230 MEV GIVEN BY MUGHABGHAB ET AL. WAS ADOPTED FOR ALL RESONANCE LEVELS INCLUDING A NEGATIVE RESONANCE, AND WAS SLIGHTLY MODIFIED TO 227 MEV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 28+-20 BARNS GIVEN BY MUGHABGHAB ET AL. THE VALUES OF NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J WERE ASSUMED TO BE 0 AND 0.5 FOR ALL RESONANCE LEVELS, RESPECTIVELY. SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 0.4 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/, AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.580E-4, S1 = 2.100E-4, S2 = 0.680E-4, SG = 1.85E-4, GG = 0.230 EV, R = 7.392 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S INTEGRALS (BARNS) RES. INTEG. 46.46 18.46 TOTAL ELASTIC CAPTURE 28.00 228

CAPIURE 28.00 228 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/5/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/6/
ALPHA = HUIZENGA AND IGO/7/
DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/. MF

/12/

' = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

МΤ

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO.
GR.
1
2
3
4
5
6
7
7
8
9
10
11
12
13
14
LEVELS A | ENERGY(MEV)
0.0
0.7765
1.4748
1.4875
1.8205
1.9566
2.0939
2.1718
2.4268
2.4801
2.5474
2.5561
2.6483
2.8280
2.9200
ABOVE 2.944 MEV WERE | SPIN-PARITY
0 +
2 +
2 +
3 -
4 +
1 -
3 +
0 +
3 +
1 -
3 -
4 -
5 -
6 +
ASSUMED TO BE OVERLAPPING. |
|--|--|---|
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/ | APTURE
OPTICAL AND STATISTI
S ADOPTED. DIRECT AN
VERE ESTIMATED ACCORD
(15/ AND NORMALIZED T | CAL MODEL CALCULATION WITH
ID SEMI-DIRECT CAPTURE CROSS
)ING TO THE PROCEDURE OF BENZI
TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-
REPRODUCE
KEV MEASUR | -RAY STRENGTH FUNCTIO
THE CAPTURE CROSS SE
RED BY WALTER ET AL./ | NN (1.69E-04) WAS ADJUSTED TO
CTION OF 50 MILLI-BARNS AT 100
'16/ |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT =103 (N,
MT =104 (N,
MT =107 (N,
MT =107 (N,
THESE REAC
PREEQUILIB | ,2N) CROSS SECTION
,3N) CROSS SECTION
,N'A) CROSS SECTION
,N'P) CROSS SECTION
,P) CROSS SECTION
,D) CROSS SECTION
,T) CROSS SECTION
,ALPHA) CROSS SECTION
CTION CROSS SECTIONS
BRIUM AND MULTI-STEP | I
WERE CALCULATED WITH THE
EVAPORATION MODEL CODE PEGASUS. |
| THE KALBAC
FORMULA DE
DENSITY PA | CH'S CONSTANT K (= 7
ERIVED FROM KIKUCHI-K
ARAMETERS. | '8.0) WAS ESTIMATED BY THE
(AWAI'S FORMALISM/17/ AND LEVEL |
| FINALLY, T
NORMALIŻED
(N,P)
(N,ALPHA | THE (N,P) AND (N,ALPH
D TO THE FOLLOWING VA
23.00 MB (REC
A) 8.21 MB (SYS | IA) CROSS SECTIONS WERE
LUES AT 14.5 MEV:
COMMENDED BY FORREST/18/)
STEMATICS OF FORREST/18/) |
| MT = 251 MU
CALCULATED | J-BAR
D WITH CASTHY. | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED W
BUTIONS IN T | AR DISTRIBUTIONS OF S
_YNOMIAL COEFFICIENTS
E CENTER-OF-MASS SYST
AND IN THE LABORATOR
VITH CASTHY. FOR OTH
THE LABORATORY SYSTEM | ECONDARY NEUTRONS
FOR ANGULAR DISTRIBUTIONS ARE
EM FOR MT=2 AND DISCRETE INELAS
SYSTEM FOR MT=91. THEY WERE
IER REACTIONS, ISOTROPIC DISTRI-
WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRO | Y DISTRIBUTIONS OF SE
RIBUTIONS OF SECONDAR
INELASTIC SCATTERING
DN EMITTING REACTIONS | CONDARY NEUTRONS
Y NEUTRONS WERE CALCULATED WITH
TO OVERLAPPING LEVELS AND FOR |
| TABLE 1 NEUTR | RON OPTICAL POTENTIAL | PARAMETERS |
| V = 4
WS = 7
VS0= 7
THE FORM OF
TABLE 2 LEVEL | 46.0-0.25E
7.0
SURFACE ABSORPTION P
DENSITY PARAMETERS | $ \begin{array}{llllllllllllllllllllllllllllllllllll$ |
| NUCLIDE SYST
34-SE-78
34-SE-79
34-SE-80
34-SE-81
35-BR-79 | T A(1/MEV) T(MEV)
1.287E+01 8.750E-01
1.412E+01 8.000E-01
1.334E+01 8.130E-01
1.368E+01 7.490E-01
1.293E+01 8.690E-01 | C(1/MEV) EX(MEV) PAIRING
1.163E+00 9.882E+00 2.900E+00
5.994E+00 7.842E+00 1.430E+00
6.129E-01 9.136E+00 3.000E+00
2.463E+00 6.614E+00 1.430E+00
5.790E+00 8.381E+00 1.470E+00 |

35-BR- 80 1.318E+01 7.950E-01 1.882E+01 5.695E+00 0.0
35-BR- 81 1.290E+01 8.310E-01 3.275E+00 7.733E+00 1.570E+00
35-BR- 82 1.266E+01 6.900E-01 5.789E+00 3.665E+00 0.0
36-KR- 80 1.205E+01 8.350E-01 5.500E-01 8.257E+00 2.640E+00
36-KR- 81 1.503E+01 7.300E-01 6.057E+00 6.776E+00 1.170E+00
36-KR- 82 1.319E+01 7.810E-01 4.961E-01 8.191E+00 2.740E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
36-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
37-KR- 83
30-KR- 83 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00
31-60AFHN0L0GY, MITO, P.569 (1988)
2) MUGHA6HAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A*, ACADEMIC PRESS (1981).
31 GARASI, S. J. NUCL. SCI. TECHNOL. 12, 67 (1975).
41 IJIMA, S. AND KAWAI, M.: J. NUCL. PHYS. A337 (1987).
31 IJIMA, S. AND KAWAI, M.: J. NUCL. PHYS. A232, 381 (1974).
39 BECCHETTI, F.D. JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1951).
41 BERCHI, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
41 JIMA S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
31 GRUPPELAAR, H.: ECN-13 (1977).
31 ENSCHAT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
41 JIMA S., ET AL.: J. NUCL SCI. TECHNOL. 21, 10 (1984).
32 ENSCH. V. AND RAFFO, G.: CCDN-NW/10 (1969).
34 FORREST, R.A.: AD EXARCTIO
MAT number = 3640 36-KR- 83 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.272 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS : FOR JENDL-2, PARAMETERS WERE GIVEN FOR 2 POSITIVE AND A NEGATIVE RESONANCES ON THE BASIS OF THE DATA GIVEN BY MUGHABGHAB ET AL./3/ NEUTRON ORBITAL ANGULAR MOMENTUM L WERE ASSUMED TO BE 0. NEUTRON WIDTHS WERE MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 180+-30 BARNS AND THE NEUTRON RESONANCE CAPTURE INTEGRAL OF 183+-25 BARNS GIVEN BY MUGHABGHAB ET AL. RADIATION WIDTH OF 210 MEV FOR THE FIRST LEVEL/3/ WAS ADOPTED FOR THE OTHER RESONANCE LEVELS. HOWEVER, THE VALUES OF TOTAL SPIN J WERE UNKNOWN AND THE TARGET SPIN OF 4.5 WAS ADOPTED FOR ALL THE LEVELS. MF FOR JENDL-3, THE J-VALUES OF ALL RESONANCE LEVELS WERE TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. ACCORDING TO MODIFICATION OF THE J-VALUES, RESONANCE PARAMETERS WERE ALSO MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION AND THE NEUTRON RESONANCE CAPTURE INTEGRAL MENTIONED ABOVE. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. UNRESOLVED RESONANCE REGION : 0.272 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.580E\text{-}4, \ S1 = 2.920E\text{-}4, \ S2 = 0.650E\text{-}4, \ SG = 25.2E\text{-}4, \\ GG = 0.200 \ \text{EV}, \ R = 7.033 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 189.0 -ELASTIC 9.080 -CAPTURE 179.9 148 INTEGRALS (BARNS) F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY ILJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. MF /13/ MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). МΤ

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/.

| NO.
GR.
1
2
3
4
5
6
7
8
9
LEVELS AF | ENERGY(MEV)
0.0
0.0094
0.0416
0.5619
0.5711
0.6900
0.7983
1.0120
1.1028
1.1222
BOVE 1.21 MEV WERE A | SPIN-PARITY
9/2 +
7/2 +
1/2 -
5/2 -
3/2 -
3/2 +
5/2 +
11/2 +
9/2 +
13/2 +
SSUMED TO BE OVERLAPPING. |
|---|---|---|
| MT = 102 CAF
SPHERICAL (
CASTHY WAS
SECTIONS WE
AND REFFO/ | PTURE
OPTICAL AND STATISTI
ADOPTED. DIRECT AN
ERE ESTIMATED ACCORD
15/ AND NORMALIZED T | CAL MODEL CALCULATION WITH
D SEMI-DIRECT CAPTURE CROSS
ING TO THE PROCEDURE OF BENZI
O 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-I
REPRODUCE
KEV MEASURI | RAY STRENGTH FUNCTIO
THE CAPTURE CROSS SE
ED BY WALTER ET AL./ | N (25.9E-04) WAS ADJUSTED TO
CTION OF 272 MILLI-BARNS AT 30
16/ |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT = 32 (N,
MT = 103 (N,
MT = 104 (N,
MT = 104 (N,
MT = 106 (N,
MT = 106 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (N,
MT = 111 (| 2N) CROSS SECTION
3N) CROSS SECTION
N'A) CROSS SECTION
N'D) CROSS SECTION
P) CROSS SECTION
D) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
HE3) CROSS SECTION
ALPHA) CROSS SECTION
2P) CROSS SECTION
TION CROSS SECTIONS
RIUM AND MULTI-STEP | WERE CALCULATED WITH THE
EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH
FORMULA DEF
DENSITY PAF | H'S CONSTANT K (= 26
RIVED FROM KIKUCHI-K
RAMETERS. | 6.2) WAS ESTIMATED BY THE
AWAI'S FORMALISM/17/ AND LEVEL |
| FINALLY, TH
NORMALIZED
(N,P)
(N,ALPHA) | HE (N,P) AND (N,ALPH
TO THE FOLLOWING VA
14.00 MB (REC
) 5.28 MB (SYS | A) CROSS SECTIONS WERE
LUES AT 14.5 MEV:
OMMENDED BY FORREST/18/)
TEMATICS OF FORREST/18/) |
| MT = 251 MU
CALCULATED | -BAR
WITH CASTHY. | |
| MF = 4 ANGULAF
LEGENDRE POLY
GIVEN IN THE
TIC LEVELS, /
CALCULATED W
BUTIONS IN TH | R DISTRIBUTIONS OF S
YNOMIAL COEFFICIENTS
CENTER-OF-MASS SYST
AND IN THE LABORATOR
ITH CASTHY. FOR OTH
HE LABORATORY SYSTEM | ECONDARY NEUTRONS
FOR ANGULAR DISTRIBUTIONS ARE
EM FOR MT=2 AND DISCRETE INELAS-
Y SYSTEM FOR MT=91. THEY WERE
ER REACTIONS, ISOTROPIC DISTRI-
WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRON | DISTRIBUTIONS OF SE
IBUTIONS OF SECONDAR
INELASTIC SCATTERING
N EMITTING REACTIONS | CONDARY NEUTRONS
Y NEUTRONS WERE CALCULATED WITH
TO OVERLAPPING LEVELS AND FOR |
| TABLE 1 NEUTRO | ON OPTICAL POTENTIAL | PARAMETERS |
| V = 46
WS = 7
VSO= 7
THE FORM OF S | DEPTH (MEV)
6.0-0.25E
.0
.0
SURFACE ABSORPTION P | RADIUS(FM) DIFFUSENESS(FM) R0 = 5.7 A0 = 0.62 RS = 6.2 AS = 0.35 RS0= 5.7 AS0= 0.62 ART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL | DENSITY PARAMETERS | |
| NUCLIDE | A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) PAIRING |
| 34-SE- 79
34-SE- 80
34-SE- 81
34-SE- 82 | 1.412E+01 8.000E-01
1.334E+01 8.130E-01
1.368E+01 7.490E-01
1.259E+01 7.980E-01 | 5.994E+00 7.842E+00 1.430E+00
6.129E-01 9.136E+00 3.000E+00
2.463E+00 6.614E+00 1.430E+00
3.563E-01 8.246E+00 2.890E+00 |
| 35-BR- 80 | 1.318E+01 7.950E-01 | 1.882E+01 5.695E+00 0.0 |

35-BR- 81 1.290E+01 8.310E-01 3.275E+00 7.733E+00 1.570E+00 35-BR- 82 1.266E+01 6.900E+01 5.789E+00 3.665E+00 0.0 35-BR- 83 1.324E+01 7.830E+01 2.683E+00 6.978E+00 1.460E+00 36-KR- 81 1.503E+01 7.300E+01 4.961E+01 8.191E+00 2.740E+00 36-KR- 83 1.483E+01 6.700E+01 2.532E+00 5.89E+00 1.170E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 36-KR- 84 9.970E+00 9.600E+01 4.942E+01 8.590E+00 2.630E+00 37.00 APP0140 5.61E+00 5.61E+00 37.00 APP0140 5.61E+00 5.61E+00 37.00 APP0140 5.61E+00 5.61E+00 39.00 APP0140 5.61E+00 5.61E+00 30.00 APP0140 5.61E+00 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 5.61E+00 30.00 APP0140 30.00 APP0140 5.61E+00 30.00 APP0140 30.00 APP0140 AD AAEBER11, W.: NUCL PHYS. 29, 462 (1962). 30.10 AR, J.M. AND HAEBER11, W.: NUCL PHYS. 29, 462 (1962). 30.10 AR, J.M. AND HAEBER11, W.: NUCL PHYS. 4232, 381 (1974). 30.10 BECHET1, F.D., JR. AND GRENELES, G.W.: POLARIZATION 31.00 HER.J.M. AND HAEBER11, W.: NUCL PHYS. 4232, 381 (1974). 31.00 APP0140 APP140 APP140 APP140 31.00 APP140 AND HAEBER11, W.: NUCL PHYS. 43, 1446 31.00 APP140 AND HAEBER11, W.: NUCL PHYS. 43, 1446 31.00 APP140 AND HAEBER11, W.: NUCL PHYS. 43, 1446 31.00 APP140 APP140 APP140 APP140 APP140 31.00 APP140 APP140 APP140 APP140 31.00 APP140 APP140 APP140 APP140 31.00 APP140 APP140 APP140 31.00 APP140 APP140 APP140 3 MAT number = 3643 36-KR- 84 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.48 KEV EVALUATION OF JENDL-2 WAS PERFORMED AS FOLLOWS : NEUTRON WIDTHS AND AVERAGE RADIATION WIDTH FOR THE TWO POSITIVE LEVELS AT 519 AND 580 EV WERE TAKEN FROM THE DATA GIVEN BY MUGHABGHAB ET AL./3/ THE SIX RESONANCE LEVELS FROM 1.164 TO 2.12 KEV WERE ABANDONED, BECAUSE THEIR ISOTOPIC ASSIGNMENT WAS UNCERTAIN. THE VALUE OF AVERAGE RADIATION WIDTH WAS MODIFIED TO 121 MEV SO AS TO REPRODUCE THE NEUTRON RESONANCE CAPTURE INTEGRAL OF 2.43+-0.2 BARNS GIVEN BY MUGHABGHAB ET AL. THE VALUES OF NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J WERE ASSUMED TO BE 0 AND 0.5, RESPECTIVELY. SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED AT -150 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 0.110+-0.015 BARNS/3/. MF

FOR JENDL-3, ANY MODIFICATION WAS NOT MADE, BECAUSE NEW MEASUREMENTS HAVE NOT BEEN CARRIED OUT.

UNRESOLVED RESONANCE REGION : 2.48 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.580E-4, S1 = 2.920E-4, S2 = 0.650E-4, SG = 0.553E-4, GG = 0.200 EV, R = 7.061 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.269 -ELASTIC 6.159 -CAPTURE 0.1100 2.42

MF

CAPTURE 0.1100 2.42
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/6/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/7/
ALPHA = HUIZENGA AND IGO/8/
DEUTERON = LOHR AND HAEBERLI/9/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY ILJIMA ET AL./12/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/13/.

/13/.

MT = 1

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2

' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/.

NO. ENERGY(MEV) SPIN-PARITY GR. 0.0 0 + 1 0.8820 2 + 2 1.8340 0 + 3 1.9000 2 + 4 2.0860 4 + 5 2.3370 4 + 6 2.6260 2 + 7 2.7050 3 -8 2.7590 1 + 9 2.7750 2 + 10 3.0480 3 + 11 3.2250 1 -12 3.3350 2 -13 3.4770 1 -14 3.5700 3 -15 3.6500 5 -16 3.795 MEV WERE ASSUMED TO BE OVERLAPPING. ENERGY(MEV) NO. SPIN-PARITY T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BĔŇZI THE GAMMA-RAY STRENGTH FUNCTION (0.533E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 38.7 MILLI-BARNS AT 30 KEV MEASURED BY WALTER ET AL./16/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT = 17 MT = 22 MT = 28 MT = 103 МŤ MŤ MT THE KALBACH'S CONSTANT K (= 254.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 9.33 MB (SYSTEMATICS OF FORREST/18/) (N,ALPHA) 3.33 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY/4/. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) ------ - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 34 - SE - 80
 1.334E+01
 8.130E-01
 6.129E-01
 9.136E+00
 3.000E+00

 34 - SE - 81
 1.368E+01
 7.490E-01
 2.463E+00
 6.614E+00
 1.430E+00

 34 - SE - 82
 1.259E+01
 7.980E-01
 3.563E-01
 8.246E+00
 2.890E+00

 34 - SE - 83
 1.381E+01
 7.500E-01
 2.666E+00
 6.708E+00
 1.430E+00

1.290E+01 8.310E-01 3.275E+00 7.733E+00 1.570E+00 1.266E+01 6.900E-01 5.789E+00 3.665E+00 0.0 1.324E+01 7.830E-01 2.683E+00 6.978E+00 1.460E+00 * 1.302E+01 7.738E-01 1.393E+01 5.216E+00 0.0 35-BR- 81 35-BR- 82 35-BR- 83 35-BR-84 36-KR- 82 36-KR- 83 36-KR- 84 36-KR- 85 1.319E+01 7.810E-01 4.961E-01 8.191E+00 2.740E+00 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00 9.970E+00 9.600E-01 4.942E-01 8.590E+00 2.630E+00 1.024E+01 8.900E-01 1.570E+00 6.261E+00 1.170E+00 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.937 FOR KR- 84 AND 3.125 FOR KR- 85. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHIS., 43, 1440 (1965).
12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) WALTER, G., ET AL.: KFK-3652, 1 (1984).
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3646 36-KR- 85 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 1.0 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.580E-4, S1 = 2.920E-4, S2 = 0.650E-4, SG = 3.60E-4, GG = 0.200 EV, R = 7.056 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 7.916 ELASTIC 6.256 TOTAL ELASTIC CAPTURE 1.660 1.82 F = 3 NEUTRON CROSS SECTIONS BELOW 1.0 KEV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./4/, AND THE SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 6.7 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 1.0 KEV TO 100 KEV. MF = 3ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL /6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/. MT ENERGY(MEV) SPIN-PARITY NO. 9/2 + 1/2 - 3/2 - 5/2 +GR. 0.0 Ŏ. <u>3</u>049 1 2 3 1.1073 5/2 3/2 3/2 3/2 5/2 5/2 5/2 1.1666 45678 + 1.3427 1.4168 + 9 1.9389

| 10 2.0319 5/2 -
11 2.1374 3/2 -
12 2.4634 5/2 -
LEVELS ABOVE 2.7 MEV WERE ASSUMED TO BE OVERLAPPING. |
|--|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCTION (3.86E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.193 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (500 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 381.7) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 5.96 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 2.07 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 34-SE-82 1.259E+01 7.980E+01 3.563E+01 8.246E+00 2.890E+00 34-SE-83 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00 34-SE-84 * 8.736E+00 7.738E-01 6.479E-02 4.692E+00 2.360E+00 |
| 35-BR-821.266E+016.900E-015.789E+003.665E+000.035-BR-831.324E+017.830E-012.683E+006.978E+001.460E+0035-BR-84*1.302E+017.738E-011.393E+015.216E+000.035-BR-851.100E+017.000E-017.248E-013.841E+009.300E-01 |
| 36-KR-831.483E+016.700E-012.532E+005.589E+001.170E+0036-KR-849.970E+009.600E-014.942E-018.590E+002.630E+0036-KR-851.024E+018.900E-011.570E+006.261E+001.170E+0036-KR-869.052E+008.686E-012.185E-015.874E+002.100E+00SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.125 FOR KR- 85 AND 4.225 FOR KR- 86.

REFERENCES

- REFERENCES

 AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

- 7) 8 Í
- 9 10)
- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971)
- 11) ĠIĽBĖŔŤ, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 11) GILBERT, A. AND CAMERUN, A.G.W. CAN. S. THIO, 10, 11965).
 12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 13) GRUPPELAAR, H.: ECN-13 (1977).
 14) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3649 36-KR- 86 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 640 KEV EVALUATION OF RESONANCE ENERGIES, NEUTRON WIDTHS, NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J WAS BASED ON THE DATA MEASURED BY CARLTON ET AL./3/ AND BY RAMAN ET AL./4/ RADIATION WIDTHS FOR THE 12 RESONANCE LEVELS IN THE ENERGY RANGE FROM 19.238 TO 88.329 KEV WERE TAKEN FROM THE DATA BY RAMAN ET AL. THE VALUE OF AVERAGE RADIATION WIDTH WAS DETERMINED SO THAT THE AVERAGE CAPTURE CROSS SECTION AROUND 640 KEV MIGHT AGREE WITH THAT CALCULATED BY CASTHY/5/, AND THUS OBTAINED AVERAGE RADIATION WIDTH WAS ADOPTED FOR THE RESONANCE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL./6/ A NEGATIVE RESONANCE WAS ADDET AT -20 KEV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 3 MB GIVEN BY MUGHABGHAB ET AL. NO UNDECOUVED DECOMMONS DECION T A) ADDED

NO UNRESOLVED RESONANCE REGION

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.153 -ELASTIC 6.150 -0.0222 TOTAL ELASTIC CAPTURE 0.003000 0.0232

CAPIURE 0.003000 0.0232 MF = 3 NEUTRON CROSS SECTIONS BELOW 640 KEV, RESOLVED RESONANCE PARAMETERS WERE GIVEN. ABOVE 640 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/5/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF IIJIMA-KAWAI POTENTIAL/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/1/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/.

/15/.

MT

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

МΤ

* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/.

| NO.
GR.
2
3
4
5
6
7
8
9
10 | ENERGY(ME
0.0
1.5646
2.2480
2.3496
2.7330
2.8502
2.9262
3.0992
3.5420
3.8320
3.8320 | EV) | SPIN-P/
0 +
2 +
4 +
2 +
3 +
2 +
3 +
2 +
3 -
0 +
0 +
4 + | AR I T | ΓΥ | | |
|--|--|------|---|--------|----|----------|-----|
| LEVELS ABOVE | 3.9590
4.072 MEV | WERE | ASSUMED | то | ΒE | OVERLAPP | NG. |

T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = THE GAMMA-RAY STRENGTH FUNCTION (3.55E-6) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 2.5 MILLI-BARNS AT 100 KEV MEASURED BY WALTER/18/ MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS/7/. PEGASUS/7/ THE KALBACH'S CONSTANT K (= 352.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 8.00 MB (RECOMMENDED BY FORREST/20/) (N,ALPHA) 1.27 MB (SYSTEMATICS OF FORREST/20/) . CALCULATED WITH CASTHY. МТ F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) ----- - - -----TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 34-SE- 82 34-SE- 83 34-SE- 84 * 34-SE- 85 * 1.259E+01 7.980E-01 3.563E-01 8.246E+00 2.890E+00 1.381E+01 7.500E-01 2.666E+00 6.708E+00 1.430E+00 * 8.736E+00 7.738E-01 6.479E-02 4.692E+00 2.360E+00 * 9.605E+00 7.647E-01 3.056E-01 4.293E+00 1.430E+00 1.324E+01 7.830E-01 2.683E+00 6.978E+00 1.460E+00 * 1.302E+01 7.738E-01 1.393E+01 5.216E+00 0.0 1.100E+01 7.000E-01 7.248E-01 3.841E+00 9.300E-01 * 9.718E+00 7.558E-01 1.999E+00 2.830E+00 0.0 35-BR- 83 35-BR- 84 35-BR- 85 35-BR- 86 9.970E+00 9.600E-01 4.942E-01 8.590E+00 2.630E+00 1.024E+01 8.900E-01 1.570E+00 6.261E+00 1.170E+00 9.052E+00 8.686E-01 2.185E-01 5.874E+00 2.100E+00 9.400E+00 8.860E-01 8.826E-01 5.481E+00 1.170E+00 36-KR- 84 36-KR- 85 36-KR- 86 36-KR- 87 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.225 FOR KR- 86 AND 5.0 FOR KR- 87. REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC

| 2) | AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE |
|--|--|
| 3) | AND TECHNOLOGY, MITO, P. 569 (1988).
CARLTON, R.F., WINTERS, R.R., JOHNSON, C.H., HILL, N.W., AND |
| 4) | RAMAN, S., FOGELBERG, B., HARVEY, J.A., MACKLIN, R.L., AND
STELSON P.H. PHYS. REV. C. 28, 602 (1983) |
| 5)
6) | IGARAŠI, S.: J. NUČL. ŠČI. TEČHNOL. 12, 67 (1975).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A., AČADEMIC PRESS (1981). |
| 7)
8) | IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77
(1983) |
| 9)
10)
11)
12) | PEREY', F.G: PHYS. REV. 131, 745 (1963).
HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI). P. 682. THE UNIVERSITY OF WISCONSIN PRESS. |
| 13) | (1971)
GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 |
| 14)
15)
16)
17)
18)
19) | IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
GRUPPELAAR, H.: ECN-13 (1977)
MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
WALTER, G.: KFK-3706 (1984).
KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
MALTER AND MARKED AND (1900) |

REACTIONS", NORTH HOLLAND (1968). 20) FORREST, R.A.: AERE-R 12419 (1986). MAT number = 3725 37-RB- 85 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 8.468 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS : EVALUATION OF JENDL-2 WAS PERFORMED ON THE BASIS OF THE DATA MEASURED BY OHKUBO ET AL./3/ AMONG 138 LEVELS MEASURED IN THE ENERGY REGION UP TO 18.6 KEV, 116 RESONANCE LEVELS WERE ASSUMED TO BE S-WAVE, AND REMAINING 22 LEVELS WERE DESTIMATED TO BE P-WAVE. NEUTRON WIDTHS OF ALL LEVELS WERE DETERMINED FROM THE 2G*(NEUTRON WIDTH) MEASURED BY OHKUBO ET AL. HOWEVER, THE VALUE OF TOTAL SPIN J FOR EACH RESONANCE LEVEL WAS UNKNOWN EXCEPT 13 LEVELS ASSIGNED BY OHKUBO ET AL., AND THE TARGET SPIN OF 2.5 WAS ADOPTED AS J FOR J-UNKNOWN LEVELS. RADIATION WIDTHS WERE OBTAINED FOR 10 LEVELS BELOW 2.6 KEV FROM THE MEASUREMENT BY OHKUBO ET AL. AVERAGE RADIATION WIDTH WAS ALSO ESTIMATED TO BE 328+-18 MEV BY OHKUBO ET AL., AND WAS ADOPTED FOR THE OTHER LEVELS. A NEGATIVE RESONANCE WAS ADDED AT -943 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 480+-10 MB GIVEN BY MUGHABGHAB ET AL./4/ ŴIDTH WAS

FOR JENDL-3, THE TOTAL SPIN J OF 125 RESONANCE LEVELS WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS OF THESE LEVELS WERE MODIFIED ON THE BASIS OF THE ESTIMATED J VALUES. NEUTRON AND RADIATION WIDTHS OF THE NEGATIVE RESONANCE LEVEL WERE ALSO MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION ACCORDING TO THE ABOVE MODIFICATION OF THE NEUTRON WIDTHS. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET

UNRESOLVED RESONANCE REGION : 8.468 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTION, SO, WAS TAKEN FROM THE RECOMMENDATION IN REF./5/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.000E-4, S1 = 2.920E-4, S2 = 0.650E-4, SG = 21.4E-4, GG = 0.205 EV, R = 6.828 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)

| | 2200 M/S | RES. INTEG. |
|---------|----------|-------------|
| TOTAL | 6.334 | - |
| ELASTIC | 5.854 | - |
| CAPTURE | 0.4800 | 8.73 |
| | | |

CAPTURE 0.4800 8.73 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY ILJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/.

/15/.

T TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). МΤ = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. MT = 4NO. ENERGY(MEV) SPIN-PARITY 5/2 3/2 1/2 9/2 3/2 7/2 0.0 0.1513 GŔ. -1 2 0.2810 - $\begin{array}{c} 0.2010\\ 0.5140\\ 0.7350\\ 0.8685\\ 0.8830\\ \end{array}$ 3 + ă 5 1/2 5/2 6 7 0.9500 $\frac{1}{1750}$ $\frac{7}{2}$ + LEVELS ABOVE 1.294 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (22.0E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 335 MILLI-BARNS AT 25 KEV MEASURED BY LAKSHMANA ET AL./18/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =106 (N,HE3) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT MT МŤ МŤ ΜT ΜT MT =105 MT = 106MT THE KALBACH'S CONSTANT K (= 281.4) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1050.00 MB (RECOMMENDED BY BYCHKOV+/20/) (N,P) 17.40 MB (SYSTEMATICS OF FORREST/21/) (N,ALPHA) 6.65 MB (RECOMMENDED BY FORREST/21/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

1.290E+01 8.310E-01 3.275E+00 7.733E+00 1.570E+00 1.266E+01 6.900E-01 5.789E+00 3.665E+00 0.0 1.324E+01 7.830E-01 2.683E+00 6.978E+00 1.460E+00 * 1.302E+01 7.738E-01 1.393E+01 5.216E+00 0.0 35-BR- 81 35-BR- 82 35-BR- 83 35-BR-84 36-KR- 82 36-KR- 83 36-KR- 84 1.319E+01 7.810E-01 4.961E-01 8.191E+00 2.740E+00 1.483E+01 6.700E-01 2.532E+00 5.589E+00 1.170E+00 9.970E+00 9.600E-01 4.942E-01 8.590E+00 2.630E+00 1.024E+01 8.900E-01 1.570E+00 6.261E+00 1.170E+00 36-KR-85 37-RB- 83 37-RB- 84 37-RB- 85 37-RB- 86 1.400E+01 7.831E-01 3.730E+00 7.579E+00 1.570E+00 1.106E+01 8.060E-01 5.598E+00 4.438E+00 0.0 1.190E+01 8.690E-01 2.827E+00 7.561E+00 1.460E+00 1.002E+01 8.500E-01 3.954E+00 4.312E+00 0.0 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.75 FOR RB- 85 AND 5.0 FOR RB- 86. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
OHKUBO, M., MIŻUMOTO, M., AND KAWARASAKI, Y.: NUCL. SCI. TECH. 21, 254 (1984).

MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL. 1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1(1973).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). REFERENCES IIJIMA, S. AND RAWAL, W. S. M. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 9) 10) 11) 12) 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FILLS., 40, 1110 (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) LAKSHMANA, RAO, A. ET AL.: "PROC. SYMPOSIUM ON NUCLEAR PHYSICS, MADURAI, INDIA 1970", VOL.2, 19.
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
21) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3731 37-RB- 87 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 12.46 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS : EVALUATION OF JENDL-2 WAS PERFORMED ON THE BASIS OF THE DATA MEASURED BY OHKUBO ET AL./3/ AMONG 30 LEVELS MEASURED IN THE ENERGY REGION UP TO 49 KEV, 28 LEVELS WERE ASSUMED TO BE S-WAVE, AND REMAINING 2 LEVELS AT 267.1 AND 376.9 EV TO BE P-WAVE. NEUTRON WIDTHS WERE DETERMINED FROM THE 2G*(NEUTRON WIDTH) MEASURED BY OHKUBO ET AL. HOWEVER, THE VALUE OF TOTAL SPIN J FOR EACH RESONANCE LEVEL WAS UNKNOWN EXCEPT ONLY 6 LEVELS ASSIGNED BY OHKUBO ET AL. THE TARGET SPIN OF 1.5 WAS ADOPTED FOR THESE UNKNOWN LEVELS INSTEAD OF J. RADIATION WIDTH WAS OBTAINED TO BE 166+-8 MEV FOR ONLY ONE RESONANCE LEVEL AT 376.9 EV FROM THE MEASUREMENT BY OHKUBO ET AL. AVERAGE RADIATION WIDTH WAS ADOPTED FOR THE OTHER LEVELS. EOD JENDL 0 THE TOTAL ODEN ACCE OF OTHE OTHER LEVELS.

FOR JENDL-3, THE TOTAL SPIN J OF 24 RESONANCE LEVELS WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS OF THESE LEVELS WERE MODIFIED ON THE BASIS OF THE ESTIMATED J-VALUES. RADIATION WIDTH OF THE 2ND LEVEL AT 376.9 EV AND AVERAGE RADIATION WIDTH WERE ALSO MODIFIED TO 115.33 AND 115.0 MEV, RESPECTIVELY, SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 120+-30 MB GIVEN BY MUGHABGHAB ET AL./4/ SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 12.46 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTION, SO, WAS TAKEN FROM THE RECOMMENDATION IN REF./5/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF BNL-325 (3RD ED)/5/ (3RD ED.)/5/.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.600E-4, S1 = 2.920E-4, S2 = 0.650E-4, SG = 0.987E-4, GG = 0.290 EV, R = 6.423 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG.

| IUIAL | 4.479 | - |
|---------|--------|------|
| ELASTIC | 4.359 | - |
| CAPTURÉ | 0.1200 | 2.72 |
| | | |

2.72
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO, RS AND RSO OF ILJIMA-KAWAI POTENTIAL/8/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/9/
 ALPHA = HUIZENGA AND IGO/10/

PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (15/ /15/

MT = 1 TOTAL

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). * = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. SPIN-PARITY NO. ENERGY(MEV) 3/2 - 5/20.0 GR. 1 0.8458 3 1.4630 1.5785 4 4 1.5765 972 + 5 1.7410 5/2 -6 2.4150 7/2 + 7 2.5560 5/2 + LEVELS ABOVE 2.811 MEV WERE ASSUMED TO BE OVERLAPPING. T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (1.125E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 30 MILLI-BARNS AT 25 KEV MEASURED BY KONONOV ET AL./18/ FINALLY, THE CROSS SECTION WAS MODIFIED BY MULTIPLYING AN ENERGY-DEPENDENT FACTOR SO AS TO REPRODUCE THE EXPERIMENTAL DATA /19,20/ IN THE ENERGY RANGE FROM 100 KEV TO 10 MEV. THE KALBACH'S CONSTANT K (= 322.2) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/21/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1300.00 MB (RECOMMENDED BY BYCHKOV+/22/) (N,P) 11.80 MB (RECOMMENDED BY FORREST/23/) (N,ALPHA) 3.80 MB (RECOMMENDED BY FORREST) = 251 MU-BAR CALCULATED WITH CASTHY. МТ = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 35-BR-83
 1.324E+01 7.830E-01 2.683E+00 6.978E+00 1.460E+00

 35-BR-84
 * 1.302E+01 7.738E-01 1.393E+01 5.216E+00 0.0

 35-BR-85
 1.100E+01 7.000E-01 7.248E-01 3.841E+00 9.300E-01

 35-BR-86
 * 9.718E+00 7.558E-01 1.999E+00 2.830E+00 0.0

 9.970E+00 9.600E-01 4.942E-01 8.590E+00 2.630E+00 1.024E+01 8.900E-01 1.570E+00 6.261E+00 1.170E+00 9.052E+00 8.686E-01 2.185E-01 5.874E+00 2.100E+00 9.400E+00 8.860E-01 8.826E-01 5.481E+00 1.170E+00 36-KR- 84 36-KR- 85 36-KR- 86 36-KR-87 37-RB- 85 37-RB- 86 37-RB- 87 37-RB- 88 1.190E+01 8.690E-01 2.827E+00 7.561E+00 1.460E+00 1.002E+01 8.500E-01 3.954E+00 4.312E+00 0.0 8.806E+00 9.410E-01 1.125E+00 5.465E+00 9.300E-01 9.801E+00 8.185E-01 2.880E+00 3.704E+00 0.0 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.214 FOR RB- 87 AND 5.0 FOR RB- 88. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
OHKUBO, M., MIŻUMOTO, M., AND KAWARASAKI, Y.: NUCL. SCI. TECH. 21, 254 (1984).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL. 1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1(1973).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). REFERENCES IIJIMA, S. AND KANAL, W. S. M. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 9) 10) 11) 12) (1971) 13) ĢILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KONONOV, V.N., ET AL.: AT. ENERG, 5, 514 (1958).
19) DOVBENKO, A.G., ET AL.: ATOM. ENERGIJA, 23, 151 (1967).
20) DUDEY, N.D., ET AL.: J. NUCL ENERG., 24, 181 (1970).
21) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
22) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
23) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3831 38-SR- 86 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 37.12 KEV THE RESOLVED RESONANCE PARAMETERS FOR JENDL-3 WERE TAKEN FROM JENDL-2 WHICH WAS EVALUATED ON THE BASIS OF THE MEASURED DATA BY CAMARDA ET AL./3/ AND MUSGROVE ET AL./4/ THOSE OF THE FIRST RESONANCE LEVEL AT 588.4 EV WERE ADJUSTED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 1.04+-0.07 BARNS AT 0.0253 EV AND ITS RESONANCE INTEGRAL OF 4.79+-0.24 BARNS GIVEN BY MUGHABGHAB ET AL./5/ SCATTERING RADIUS WAS ALSO MODIFIED TO 7.25 FM ON THE BASIS OF THE GRAPH (FIG.1, PART A) OF REF./5/ MF UNRESOLVED RESONANCE REGION : 37.12 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.740E-4, S1 = 3.500E-4, S2 = 0.360E-4, SG = 1.23E-4, GG = 0.324 EV, R = 7.436 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 5.173 ELASTIC 4.133 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 4.82 1.040 CAPIURE1.0404.82F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILLIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/8/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/9/
ALPHA = HUIZENGA AND IGO/10/
DEUTERON = LOHR AND HAEBERLI/11/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/15/. MF = 3/15/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. MT ENERGY(MEV) SPIN-PARITY NO GŘ. 0 2 0.0 + 1.0786 + 1 2 3 1.8542 2.2297 2.4819 2.6423 24 + 3 2 4 5 2.6728 6 5

| 7 | 2.7880 | 2 + |
|--|--|---|
| 8 | 2.8569 | 6 + |
| 9 | 2.8783 | 3 + |
| 10 | 2.9555 | 8 + |
| 11 | 2.9973 | 5 - |
| 12 | 3.0557 | 5 - |
| 13 | 3.1852 | 3 - |
| LEVELS A | VBOVE 3.291 MEV WERE A | ASSUMED TO BE OVERLAPPING. |
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/ | NPTURE
OPTICAL AND STATISTIC
ADOPTED. DIRECT AND
VERE ESTIMATED ACCORDI
17/ AND NORMALIZED TO | CAL MODEL CALCULATION WITH
D SEMI-DIRECT CAPTURE CROSS
ING TO THE PROCEDURE OF BENZI
D 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA- | RAY STRENGTH FUNCTION | N (1.13E-04) WAS ADJUSTED TO |
| REPRODUCE | THE CAPTURE CROSS SEC | CTION OF 35 MILLI-BARNS AT 100 |
| KEV MEASUR | RED BY MUSGROVE ET AL. | ./4/ |
| MT = 16 (N,
MT = 22 (N,
MT = 28 (N,
MT =103 (N,
MT =104 (N,
MT =105 (N,
MT =107 (N,
MT =111 (N,
THESE REAC
PREEQUILIE
PEGASUS. | 2N) CROSS SECTION
N'A) CROSS SECTION
P) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
T) CROSS SECTION
ALPHA) CROSS SECTION
2P) CROSS SECTION
STION CROSS SECTIONS W
BRIUM AND MULTI-STEP E | WERE CALCULATED WITH THE
EVAPORATION MODEL CODE |
| THE KALBAC
Formula de
Density pa | CH'S CONSTANT K (= 268
ERIVED FROM KIKUCHI-KA
RAMETERS. | 8.2) WAS ESTIMATED BY THE
AWAI'S FORMALISM/18/ AND LEVEL |
| FINALLY, T | THE (N,P) AND (N,ALPHA | A) CROSS SECTIONS WERE |
| NORMALIZED | TO THE FOLLOWING VAL | LUES AT 14.5 MEV: |
| (N,P) | 44.00 MB (RECO | OMMENDED BY FORREST/19/) |
| (N,ALPHA |) 10.30 MB (SYST | TEMATICS OF FORREST/19/) |
| MT = 251 MU
CALCULATED | J-BAR
) WITH CASTHY. | |
| MF = 4 ANGULA | AR DISTRIBUTIONS OF SE | ECONDARY NEUTRONS |
| LEGENDRE POL | YNOMIAL COEFFICIENTS | FOR ANGULAR DISTRIBUTIONS ARE |
| GIVEN IN THE | CENTER-OF-MASS SYSTE | EM FOR MT=2 AND DISCRETE INELAS- |
| TIC LEVELS, | AND IN THE LABORATORY | Y SYSTEM FOR MT=91. THEY WERE |
| CALCULATED W | /ITH CASTHY. FOR OTHE | ER REACTIONS, ISOTROPIC DISTRI- |
| BUTIONS IN T | 'HE LABORATORY SYSTEM | WERE ASSUMED. |
| MF = 5 ENERGY | Z DISTRIBUTIONS OF SEC | CONDARY NEUTRONS |
| ENERGY DISTR | RIBUTIONS OF SECONDARY | Y NEUTRONS WERE CALCULATED WITH |
| PEGASUS FOR | INELASTIC SCATTERING | TO OVERLAPPING LEVELS AND FOR |
| OTHER NEUTRO | NN EMITTING REACTIONS. | |
| TABLE 1 NEUTR | CON OPTICAL POTENTIAL | PARAMETERS |
| V = 4
WS = 7
VSO= 7
THE FORM OF | 6.0-0.25E
R
O
SURFACE ABSORPTION PA | RADIUS(FM) DIFFUSENESS(FM)
RO = 5.893 AO = 0.62
RS = 6.393 AS = 0.35
RSO= 5.893 ASO= 0.62
ART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL | DENSITY PARAMETERS | |
| 36-KR- 82 | 1.319E+01 7.810E-01 | 4.961E-01 8.191E+00 2.740E+00 |
| 36-KR- 83 | 1.483E+01 6.700E-01 | 2.532E+00 5.589E+00 1.170E+00 |
| 36-KR- 84 | 9.970E+00 9.600E-01 | 4.942E-01 8.590E+00 2.630E+00 |
| 36-KR- 85 | 1.024E+01 8.900E-01 | 1.570E+00 6.261E+00 1.170E+00 |
| 37-RB- 83 * | 1.400E+01 7.831E-01 | 3.730E+00 7.579E+00 1.570E+00 |
| 37-RB- 84 | 1.106E+01 8.060E-01 | 5.598E+00 4.438E+00 0.0 |
| 37-RB- 85 | 1.190E+01 8.690E-01 | 2.827E+00 7.561E+00 1.460E+00 |
| 37-RB- 86 | 1.002E+01 8.500E-01 | 3.954E+00 4.312E+00 0.0 |
| 38-SR- 84 * | 1.417E+01 7.738E-01 | 7.392E-01 8.748E+00 2.810E+00 |
| 38-SR- 85 | 1.134E+01 9.100E-01 | 3.646E+00 7.608E+00 1.240E+00 |
| 38-SR- 86 | 1.120E+01 8.900E-01 | 5.328E-01 8.599E+00 2.700E+00 |
| 38-SR- 87 | 1.030E+01 8.610E-01 | 1.186E+00 5.938E+00 1.240E+00 |

SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 1.035 FOR SR- 86 AND 6.928 FOR SR- 87. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) CAMARDA, H., ET AL.: NCSAC-31, 40 (1970).
4) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
5) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
6) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
7) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
8) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 9) 10)11) iż) W. HAEBERLI), P. 682, THE UNIVERSITE OF WIGGONGLE ALLESS (1971). 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERI, A. AND GAMERON, A.G.M. C.M. C.M. (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KIUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3834 38-SR- 87 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

MT=45T COMMENTS AND DICTIONART F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 14.08 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS: EVALUATION OF JENDL-2 WAS PERFORMED ON THE BASIS OF THE MEASUREMENTS BY CAMARDA ET AL./3/ AND MUSGROVE ET AL./4/ NEUTRON WIDTHS WERE DERIVED FROM THE DATA OF 2G* (NEUTRON WIDTH) AND NEUTRON CAPTURE AREAS. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE O FOR ALL RESONANCE LEVELS EXCEPT THE 2ND LEVEL (L=1) AT 35.27 EV. HOWEVER, THE VALUES OF TOTAL SPIN J WERE UNKNOWN FOR ALL RESONANCE LEVELS. THUS, TARGET SPIN OF 4.5 WAS ADOPTED AS J VALUE. A VERAGE RADIATION WIDTH OF 180.4 MEV WAS OBTAINED BY AVERAGING THE GIVEN RADIATION WIDTHS. HOWEVER, THIS VALUE WAS REDUCED TO 110.72 MEV SO AS TO REPRODUCE THE NEUTRON CAPTURE RESONANCE INTEGRAL OF 118+-30 BARNS GIVEN BY MUGHABGHAB ET AL./5/ A NEGATIVE RESONANCE WAS ALSO ADDED AT -50 EV, AND THE PARAMETERS WERE ADJUSTED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 16+-3 BARNS GIVEN BY MUGHABGHAB ET AL./ EDD LENTLO THE VALUED OF TOTAL OPTINE CROSS SECTION OF 16+-3 BARNS GIVEN BY MUGHABGHAB ET AL.. EDD LENTLO THE VALUED OF TOTAL OPTINE AREAS WERE ADJUSTED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 16+-3 BARNS GIVEN BY MUGHABGHAB ET AL.

FOR JENDL-3, THE VALUES OF TOTAL SPIN J WERE TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS WERE MODIFIED ON THE BASIS OF THE ESTIMATED J-VALUES. RADIATION WIDTH OF THE NEGATIVE LEVEL WAS SLIGHTLY ADJUSTED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION ACCORDING TO THE MODIFICATION OF THE POSITIVE LEVELS. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET Τ̀Ο ΤΗΕ

UNRESOLVED RESONANCE REGION : 14.08 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.300E-4, S1 = 4.000E-4, S2 = 0.360E-4, SG = 4.72E-4, GG = 0.116 EV, R = 7.414 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEGRALS TOTAL 22.90 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 6.897 16.00 121

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF DETERMINED BY IIJIMA AND KAWAI/8/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELA /15/. MF WERE

USED ÍS DUE TÓ GRUPPELAAR /15/.

MT = 1

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/.

| | | NO.
GR.
2
3
4
5
6
7 | | ENE
0.
0.
1.
1.
1.
1. | RGY(1
0
3883
8730
2290
2570
7390
7710
9210 | MEV) | | SPIN
9/2
3/22
5/22
13/22
13/22
13/22
20 | I - PAF
+
-
+
-
+
+ | R Ι Τ Υ | | | | |
|----|---|---|---|--|--|---|--|--|--|--|----------------------------------|-------------------------------------|-------------------------------------|--------------------------------|
| | LEVE
MT = 102
SPHERI | LS A
CA
CAL | BOVE
PTURE
OPTIC | 1.99
AL A | 7 ME'
ND S' | V WE | RE A
STIC | SSUN | IED 1
IODEL | TO BE
L CAL | E OVI | ERLAP
ATION | PING.
WITH | |
| | ČASTHY
SECTIO
AND RE | WAS
NS W
FF0/ | ADOP
ERE E
17/ A | TED.
STIM
ND N | DÍI
ATED
ORMAI | RECT
ACC
LIZE | AND
ORDI
D TC | NG T | 11 - D
0 TH
11 L L | IRÉCT
HE PR
I-BAR | CA
ROCE
RN A | PTURE
DURE
T 14 | CROSS
OF BEN
MEV. | S
NZ I |
| | THE GA
REPROD
KEV ME | MMA-
UCE
ASUR | RAY S
THE C
ED BY | TREN
APTU
MUS | GTH
RE C
GROV | FUNC
ROSS
E ET | TION
SEC
AL. | (4.
TION
/4/ | 71E.
1 OF | -04)
42 N | WAS
IILL | ADJU
I-BAR | STED ⁻
NS AT | ГО
70 |
| | MT = 16
MT = 22
MT = 28
MT = 32
MT = 103
MT = 104
MT = 106
MT = 107
THESE | (N,
(N,
(N,
(N,
(N,
(N,
(N,
(N,
(N, | 2N) C
N'A)
N'P)
P) CR
D) CR
T) CR
HE3)
ALPHA
TION | ROSS
CROS
CROS
CROS
OSS
OSS
CROS
CROS | SECE
SSECT
SSSECT
SSSECTE
SSSSECTE
SSSSSSSSSS | TION
CTIO
CTIO
CTIO
ION
ION
CTIO
SECTO | N
N
N
I O N
N S W | FRF | CAL | CUL AT | -FD \ | NITH . | THF | |
| | PRĒĔQU
The ka | ILIB
LBAC | ŔĬŬM
H'S_C | AND
ONST | MUĽT
ANT I | Ĭ-ŠŤ
K (= | EP E
394 | VAPC
.6) | WAS | ION N
ESTI | IŌĎEI
MATI | Ë CÖDI
Ed By | É PEG/
THE | ASUS. |
| | FORMUL
DENSIT | A DE
Y PA | RIVED
RAMET | FRO
ERS. | MKI | KUCH | I - K A | WAI' | S F(| ORMAL | ISM | /18/ | AND LE | EVEL |
| | FINALL
NORMAL
(N,P
(N,A | Y, T
IŻED
)
LPHA | HE (N
To T
) | ,P)
HE F
20.
6. | AND
OLLO
60
81 | (N,A
WING
MB (
MB (| LPHA
VAL
SYST
SYST |) CR
UES
EMAT
EMAT | AT
AT
ICS
ICS | SECT
14.5
0F F
0F F | MEV
ORRI
ORRI | S WER
:
EST/1
EST) | E
9/) | |
| | MT = 251
CALCUL | MU.ATED | -BAR
WITH | CAS | THY. | | | | | | | | | |
| MF | E = 4 AN
LEGENDRE
GIVEN IN
TIC LEVE
CALCULAT
BUTIONS | GULA
POL
THE
LS,
ED W
IN T | R DIS
YNOMI
CENT
AND I
ITH C
HE LA | TRIB
AL C
ER-0
N TH
ASTH
BORA | UTIO
OEFF
F-MAS
E LAI
Y.
TORY | NS O
ICIE
SS S
BORA
FOR
SYS | F SE
NTS
YSTE
TORY
OTHE
TEM | COND
FOR
M FC
SYS
R RE
WERE | ARY
ANGU
R MI
STEM
ACTI
ASS | NEUT
JLAR
T=2 A
FOR
IONS,
SUMEC | RON
DIS
ND I
MT=9
IS | S
TRIBU
DISCR
91.
OTROP | TIONS
ETE IN
THEY V
IC DIS | ARE
NELAS-
VERE
STRI- |
| ΜF | = 5 EN
ENERGY D
PEGASUS
OTHER NE | ERGY
ISTR
FOR
UTRO | DIST
IBUTI
INELA
N EMI | RIBU
ONS
STIC
TTIN | TION
OF SI
SCA
G RE | S OF
ECON
TTER
ACTI | SEC
DARY
ING
ONS. | ONDA
NEU
TO C | ARY N
UTRON
UVERL | NEUTR
NS WE
LAPPI | RE (
NG | CALCU | LATED
S AND | WITH
FOR |
| ΤA | BLE 1 N | EUTR | ON OP | TICA | L PO | TENT | IAL | PARA | METE | ERS | | | | |

 $\begin{array}{c|cccc} & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & & \\$

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 36-KR- 83 | 1.483E+01 | 6.700E-01 | 2.532E+00 | 5.589E+00 | 1.170E+00 |
| 36-KR- 84 | 9.970E+00 | 9.600E-01 | 4.942E-01 | 8.590E+00 | 2.630E+00 |
| 36-KR- 85 | 1.024E+01 | 8.900E-01 | 1.570E+00 | 6.261E+00 | 1.170E+00 |
| 36-KR- 85 | 9.052E+00 | 8.686E-01 | 2.185E-01 | 5.874E+00 | 2.100E+00 |

1.106E+01 8.060E-01 5.598E+00 4.438E+00 0.0 1.190E+01 8.690E-01 2.827E+00 7.561E+00 1.460E+00 1.002E+01 8.500E-01 3.954E+00 4.312E+00 0.0 37-RB- 84 37-RB- 85 37-RB- 86 37 - RB -8.806E+00 9.410E-01 1.125E+00 5.465E+00 9.300E-01 87 1.134E+01 9.100E-01 3.646E+00 7.608E+00 1.240E+00 1.120E+01 8.900E-01 5.328E-01 8.599E+00 2.700E+00 1.030E+01 8.610E-01 1.186E+00 5.938E+00 1.240E+00 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+00 38-SR- 85 38-SR- 86 38-SR- 87 38-SR- 88 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.928 FOR SR- 87 AND 5.839 FOR SR- 88. REFERENCES REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND ÅPPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
CAMARDA, H., ET AL.: NCSAC-31, 40 (1970).
MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 9) 10) 11) 12) (1971). 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FHIS., 40, 1440 (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3837 38-SR- 88 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-0CT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=45T COMMENTS AND DICTIONART MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 300 KEV RESOLVED RESONANCE PARAMETERS FOR JENDL-3 WERE TAKEN FROM JENDL-2 WHICH WAS EVALUATED ON THE BASIS OF THE MEASUREMENTS BILPUCH ET AL./3/, CAMARDA ET AL./4/, MALAN ET AL./5/ AND BOLDEMAN ET AL./6/. FOR JENDL-3, RADIATION WIDTHS OF THE 1ST AND 5TH RESONANCE LEVELS (L=0) AT 2.78 AND 13.8 KEV WERE MODIFIED TO 190 AND 106 MEV, RESPECTIVELY, SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 5.8+-0.4 MB GIVEN BY ROY ET AL./7/ SCATTERING RADIUS OF 7.1 FM WAS TAKEN FROM MUGHABGHAB ET AL./8/ FOR JENDL-3.2, THESE RESONANCE PARAMETERS WERE MODIFIED SO AS TO REPRODUCE THE CAPTURE AREA DATA MEASURED AT ORNL, BY TAKING ACCOUNT OF THE CORRECTION FACTOR (1.0737) ANNOUNCED BY ALLEN ET AL./9/ NO UNRESOLVED RESONANCE REGION CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 5.436 ELASTIC 5.431 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 0.0633 0.0058 CAPTURE 0.0058 0.0033
F = 3 NEUTRON CROSS SECTIONS
BELOW 300 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 300 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY/10/, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/12/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/13/
 ALPHA = HUIZENGA AND IGO/14/
 DEUTERON = LOHR AND HAEBERLI/15/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/19/. MF /19/ MT = TOTAL SPHERICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./20/. ΜТ NO. SPIN-PARITY ENERGY(MEV) 0.0 1.8360 2.7341 3.1510 3.2185 GŔ. 02 + + ż 3 0 2 1 2 3 4 + 3.4865 3.5239 5 6 7 + 3.5846 5

| 8
9
10
11
12
13
14
15
16
17
18
19
20
20
21
LEVELS A | 3.6344
3.9526
3.9900
4.0355
4.1701
4.2240
4.2320
4.2693
4.2980
4.4137
4.4520
4.4437
4.4520
4.4137
4.4520
4.5139
4.6190
BOVE 4.636 MEV W | 3 +
4 +
3 -
2 +
4 -
3 +
4 +
3 +
4 +
3 +
4 +
3 +
4 +
2 -
ERE ASSUMED TO | BE OVERLAPPING. |
|--|--|--|--|
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/: | PTURE
OPTICAL AND STAT
ADOPTED. DIREC
ERE ESTIMATED AC
21/ AND NORMALIZ | ISTICAL MODEL
T AND SEMI-DIR
CORDING TO THE
ED TO 1 MILLI- | CALCULATION WITH
ECT CAPTURE CROSS
PROCEDURE OF BENZI
BARN AT 14 MEV. |
| THE GAMMA-
REPRODUCE
KEV MEASUR | RAY STRENGTH FUN
THE CAPTURE CROS
ED BY MUSGROVE E | CTION (0.0375E
S SECTION OF 2
T AL./22,9/ | -04) WAS ADJUSTED TO
.8 MILLI-BARNS AT 100 |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT = 103 (N,
MT = 104 (N,
MT = 105 (N,
MT = 107 (N,
THESE REAC
PREEQUILIB | 2N) CROSS SECTIO
3N) CROSS SECTIO
N'A) CROSS SECTI
N'P) CROSS SECTION
D) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
ALPHA) CROSS SECTION
TION CROSS SECTI
TION CROSS SECTION | N
ON
ON
TION
ONS WERE CALCU
TEP EVAPORATIC | LATED WITH THE
N MODEL CODE PEGASUS. |
| THE KALBAC
FORMULA DE
DENSITY PA | H'S CONSTANT K (
RIVED FROM KIKUC
RAMETERS. | = 380.2) WAS E
HI-KAWA1'S FOR | STIMATED BY THE
MALISM/23/ AND LEVEL |
| FINALLY, T
NORMALIZED
(N,P)
(N,ALPHA | HE (N,P) AND (N,
TO THE FOLLOWIN
15.00 MB
) 4.45 MB | ALPHA) CROSS S
G VALUES AT 14
(RECOMMENDED E
(SYSTEMATICS C | ECTIONS WERE
5 MEV:
Y FORREST/24/)
F FORREST/24/) |
| MT = 251 MU
CALCULATED | -BAR
WITH CASTHY. | | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED W
BUTIONS IN T | R DISTRIBUTIONS
YNOMIAL COEFFICI
CENTER-OF-MASS
AND IN THE LABOR
ITH CASTHY. FOR
HE LABORATORY SY | OF SECONDARY N
ENTS FOR ANGUL
SYSTEM FOR MT=
ATORY SYSTEM F
OTHER REACTIC
STEM WERE ASSU | EUTRONS
AR DISTRIBUTIONS ARE
22 AND DISCRETE INELAS-
OR MT=91. THEY WERE
NS, ISOTROPIC DISTRI-
MED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRO | DISTRIBUTIONS O
IBUTIONS OF SECO
INELASTIC SCATTE
N EMITTING REACT | F SECONDARY NE
NDARY NEUTRONS
RING TO OVERLA
IONS. | UTRONS
WERE CALCULATED WITH
PPING LEVELS AND FOR |
| TABLE 1 NEUTR | ON OPTICAL POTEN | TIAL PARAMETER
RADIUS(FM) | S |
| V = 4
WS = 7
VSO= 7
THE FORM OF | 6.0-0.25E
.0
SURFACE ABSORPTI | R0 = 5.893
RS = 6.393
RS0= 5.893
ON PART IS DEF | A0 = 0.62
AS = 0.35
AS0 = 0.62
AS0 = 0.62
WOODS-SAXON TYPE. |
| NUCLIDE | A(1/MEV) T(MEV | ERS
) C(1/MEV) | EX(MEV) PAIRING |
| 36-KR- 84
36-KR- 85
36-KR- 86
36-KR- 87 | 9.970E+00 9.600
1.024E+01 8.900
9.052E+00 8.686
9.400E+00 8.860 | E-01 4.942E-01
E-01 1.570E+00
E-01 2.185E-01
E-01 8.826E-01 | 8.590E+00 2.630E+00
6.261E+00 1.170E+00
5.874E+00 2.100E+00
5.481E+00 1.170E+00 |
| 37-RB- 85
37-RB- 86
37-RB- 87 | 1.190E+01 8.690
1.002E+01 8.500
8.806E+00 9.410 | E-01 2.827E+00
E-01 3.954E+00
E-01 1.125E+00 | 7.561E+00 1.460E+00
4.312E+00 0.0
5.465E+00 9.300E-01 |

9.801E+00 8.185E-01 2.880E+00 3.704E+00 0.0 37-RB- 88 1.120E+01 8.900E-01 5.328E-01 8.599E+00 2.700E+00 1.030E+01 8.610E-01 1.186E+00 5.938E+00 1.240E+00 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+00 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+00 38-SR- 86 38-SR- 87 38-SR- 88 38-SR- 89 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.839 FOR SR- 88 AND 5.818 FOR SR- 89. REFERENCES

AGRICE TO BE CLOUD TO BE (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 13) 14) 15) 16) (1971) 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
18) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
19) GRUPPELAAR, H.: ECN-13 (1977).
20) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
22) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3840 38-SR- 89 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 1.4 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/, AND S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL./3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.370E\text{-}4, \ S1 = 4.800E\text{-}4, \ S2 = 0.400E\text{-}4, \ SG = 0.551E\text{-}4, \\ GG = 0.170 \ \text{EV}, \ R = 7.047 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 6.120 -ELASTIC 5.700 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 0.414 0.4200 F = 3 NEUTRON CROSS SECTIONS BELOW 1.4 KEV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 6.7 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 1.4 KEV TO 100 KEV. MF ANGE FRUM 1.4 KEV 10 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/5/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA STRUCTURE SHEETS/14/ SPIN-PARITY 5/2 + 1/2 + 7/2 + 5/2 + 3/2 + 3/2 -ENERGY(MEV) NO. GŘ. 0.0 1.0320 1 2 3 1.4734 1.9402 2.0076 2.0574 4 5 2.0613 9/2 +6

2.0790 2.2801 2.4516 2.5701 2.6710 $\begin{array}{r} 11/2 & - \\ 5/2 & + \\ 3/2 & + \\ 3/2 & - \\ 7/2 & + \end{array}$ 7 8 9 10 11 LEVELS ABOVE 2.707 MĚV WERE ASSUMED TO BE OVERLAPPING. . = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = BENZI THE GAMMA-RAY STRENGTH FUNCTION (0.616E-04) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.17 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (2760 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. THE KALBACH'S CONSTANT K (= 330.4) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 8.85 MB (SYSTEMATICS OF FORREST/17/) (N,ALPHA) 2.86 MB (SYSTEMATICS OF FORREST) MT = 251MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) $\begin{array}{ccccccc} V &= 46.0 - 0.25E & R0 &= 5.893 & A0 &= 0.62 \\ WS &= 7.0 & RS &= 6.393 & AS &= 0.35 \\ VS0 &= 7.0 & RS0 &= 5.893 & AS0 &= 0.62 \\ THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. \end{array}$ TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.024E+01 8.900E-01 1.570E+00 6.261E+00 1.170E+00 9.052E+00 8.686E-01 2.185E-01 5.874E+00 2.100E+00 9.400E+00 8.860E-01 8.826E-01 5.481E+00 1.170E+00 1.074E+01 7.386E-01 2.319E-01 5.156E+00 1.890E+00 36-KR- 85 36-KR- 86 36-KR- 87 36-KR-* 88 1.002E+01 8.500E-01 3.954E+00 4.312E+00 0.0 8.806E+00 9.410E-01 1.125E+00 5.465E+00 9.300E-01 9.801E+00 8.185E-01 2.880E+00 3.704E+00 0.0 * 1.086E+01 7.303E-01 1.126E+00 3.949E+00 7.200E-01 37-RB- 86 37-RB- 87 37-RB- 88 37 - RB -89 38-SR- 87 38-SR- 88 38-SR- 89 38-SR- 90 1.030E+01 8.610E-01 1.186E+00 5.938E+00 1.240E+00 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+00 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+00 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+00

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.818 FOR SR- 89 AND 4.524 FOR SR- 90.

- REFERENCES
 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 3) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983)

 - 6) 7)
 - 8) 9)
- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071)
- W. HAEBERLIJ, F. 302, (1971). 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) ĜILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FILS., 40, 1440 (1965).
 11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 14) NUCLEAR DATA SHEETS, 16, 445 (1975).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

| MAT number = 3843
38-SR-90 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G.
DIST-SEP90 REV2-AUG93 |
|---|
| HISTORY
84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/
90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.
93-08 JENDL-3.2 WAS MADE BY JNDC FPND W.G. |
| ***** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| MF = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY |
| <pre>MF = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS</pre> |
| UNRESOLVED RESONANCE REGION : 6.0 KEV - 100 KEV
UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2.
THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED
WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING
WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULA-
TED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED
FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. |
| TYPICAL VALUES OF THE PARAMETERS AT 70 KEV:
S0 = 0.370E-4, S1 = 5.420E-4, S2 = 0.360E-4, SG = 0.190E-4,
GG = 0.205 EV, R = 6.796 FM. |
| CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)
2200 M/S RES. INTEG.
TOTAL 5.8187 -
ELASTIC 5.8037 -
CAPTURE 0.0150 0.0901 |
| <pre>MF = 3 NEUTRON CROSS SECTIONS
BELOW 6.0 KEV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS
WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE
CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./4/ AND
THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R
= 6.796 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE
ENRGY RANGE FROM 6.0 KEV TO 100 KEV. THE TOTAL CROSS SECTION
IS SUM OF THESE TWO CROSS SECTIONS.</pre> |
| ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/6/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS: |
| PROTON = PEREY/7/
ALPHA = HUIZENGA AND IGO/8/
DEUTERON = LOHR AND HAEBERLI/9/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY IJJIMA ET AL./12/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/13/. |
| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> |
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/.</pre> |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 0 +
1 0.8317 2 +
2 1.6559 4 +
3 1.8923 2 + |

 $\begin{array}{cccccccc} 4 & 2.2070 & 2 & + \\ 5 & 2.4973 & 2 & + \\ LEVELS ABOVE 2.528 & MEV & WERE & ASSUMED & TO & BE & OVERLAPPING. \end{array}$ T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN2 AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (1.70E-05) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.205 EV) AND AVERAGE S-WAVE RESONANCE LEVEL SPACING (12 KEV). T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MŤ MT = 22МŤ МΤ МΤ ŇТ МŤ MT PEGASUS. THE KALBACH'S CONSTANT K (= 259.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.79 MB (SYSTEMATICS OF FORREST/17/) (N,ALPHA) 1.82 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) ----V = 46.0-0.25E R0 = 5.893 A0 = 0.62 WS = 7.0 RS = 6.393 AS = 0.35 VS0= 7.0 RS0= 5.893 AS0= 0.62 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 9.052E+00 8.686E-01 2.185E-01 5.874E+00 2.100E+00 9.400E+00 8.860E-01 8.826E-01 5.481E+00 1.170E+00 1.074E+01 7.386E-01 2.319E-01 5.156E+00 1.890E+00 1.166E+01 7.303E-01 9.153E-01 4.874E+00 1.170E+00 36-KR- 86 36-KR- 87 36-KR- 88 * * 36-KR- 89 8.806E+00 9.410E-01 1.125E+00 5.465E+00 9.300E-01 9.801E+00 8.185E-01 2.880E+00 3.704E+00 0.0 1.086E+01 7.303E-01 1.126E+00 3.949E+00 7.200E-01 1.179E+01 7.220E-01 4.570E+00 3.659E+00 0.0 37-RB- 87 37-RB- 88 37-RB- 89 37-RB- 90 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+00 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+00 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+00 1.090E+01 8.100E-01 1.103E+00 5.625E+00 1.240E+00 38-SR- 88 38-SR- 89 38-SR- 90 38-SR- 91 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).

IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.524 FOR SR- 90 AND 5.0 FOR SR- 91.

- REFERENCES
 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
 3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 4) HARADA, H., ET AL.: JAERI-M 92-027, P.298 (1992).
 5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 - 7)
- IIJIMA, S. AND KAWAI, M. J. NUCL. Sol. HEGHNOL, 20, ... (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9) 10) . на 1971
- (1971). 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 11) GILBERI, A. AND GAMERON, A.G.M. C.M. C.M. (1965).
 12) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 13) GRUPPELAAR, H.: ECN-13 (1977).
 14) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 3925 39-Y - 89 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ***** (2,151) RESOLVED RESONANCE PARAMETERS = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1MI=451 COMMENTS AND DICTIONARY = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 48 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 AFTER SLIGHT MODIFICATION. FOR JENDL-2, RESONANCE ENERGIES WERE TAKEN FROM BOLDEMAN ET AL./3/ FOR THE LEVELS BELOW 47 KEV AND CAMARDA ET AL./4/ FOR THOSE ABOVE 50 KEV. FOR THE NEUTRON WIDTHS, ADOPTED WERE AVERAGE VALUES OF MORGENSTERN ET AL./5/, BOLDEMAN ET AL. AND CAMARDA ET AL. THE RADIATION WIDTHS WERE DERIVED FROM CAPTURE AREAS MEASURED BY BOLDEMAN ET AL. AVERAGE RADIATION WIDTH = 0.123 +- 0.027 EV FOR S-WAVE RES. 0.279 +- 0.127 EV FOR P-WAVE RES. THE SCATTERING RADIUS OF 6.7 FM WAS TAKEN FROM REF./6/. FOR JENDL-3, ONLY TOTAL SPIN J AND ANGULAR MOMENTUM L OF SOME RESONANCES WERE ESTIMATED WITH A RANDOM NUMBER METHOD AND A METHOD OF BOLLINGER AND THOMAS/7/, RESPECTIVELY. A NEGATIVE RESONANCE AT -251 EV WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./6/ MF = 2FOR JENDL-3.2, THE PARAMETERS FOR LEVELS MEASURED BY BOLDEMAN ET AL. IN THE ENERGY RANGE UP TO 46.07 KEV WERE REEVALUATED USING THEIR CAPTURE AREAS MULTIPLIED BY A FA OF 1.036 ACCORDING TO A CORRIGENDUM REPORTED BY ALLEN ET AT./8/ D BY Ä FACTOR ALLEN ET UNRESOLVED RESONANCE REGION : 48 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE ADOPTED FROM THE RECOMMENDATION IN REF./9/, AND WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/10/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.320E-4, S1 = 4.400E-4, S2 = 0.360E-4, SG = 0.626E-4, GG = 0.132 EV, R = 7.235 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 8.9900 7.7127 0.870 CAPIURE 1.2/73 0.870
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/12/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/13/
 ALPHA = HUIZENGA AND IGO/14/
 DEUTERON = LOHR AND HAEBERLI/15/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/19/. 1.2773 MF /19/.

| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> |
|--|
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./20/.</pre> |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 1/2 -
1 0.9091 9/2 +
2 1.5074 3/2 -
3 1.7445 5/2 -
4 2.2210 5/2 +
5 2.5299 7/2 +
6 2.5664 11/2 +
7 2.6222 9/2 +
8 2.8710 7/2 +
9 2.8820 3/2 -
10 3.0680 3/2 -
11 3.1060 5/2 -
12 3.1380 5/2 -
LEVELS ABOVE 3.502 MEV WERE ASSUMED TO BE OVERLAPPING. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (5.95E-05) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 13 MILLI-BARNS AT 70
KEV MEASURED BY MUSGROVE ET AL./22,8/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTION
THESE REACTION CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 299.5) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 980.00 MB (RECOMMENDED BY BYCHKOV+/24/)
(N,P) 25.00 MB (RECOMMENDED BY FORREST/25/)
(N,ALPHA) 5.50 MB (RECOMMENDED BY FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUC | CLIDE | SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|---|--|--|--|--|--|---|--|
| 37 -
37 -
37 -
37 -
37 - | RB - 8
RB - 8
RB - 8
RB - 8
RB - 8 | 5
6
7
8 | 1.190E+01
1.002E+01
8.806E+00
9.801E+00 | 8.690E-01
8.500E-01
9.410E-01
8.185E-01 | 2.827E+00
3.954E+00
1.125E+00
2.880E+00 | 7.561E+00
4.312E+00
5.465E+00
3.704E+00 | 1.460E+00
0.0
9.300E-01
0.0 |
| 38 -
38 -
38 -
38 -
38 - | - SR - 8
- SR - 8
- SR - 8
- SR - 8
- SR - 8 | 6
7
8
9 | 1.120E+01
1.030E+01
9.160E+00
9.380E+00 | 8.900E-01
8.610E-01
7.510E-01
8.200E-01 | 5.328E-01
1.186E+00
8.288E-02
5.043E-01 | 8.599E+00
5.938E+00
4.550E+00
4.642E+00 | 2.700E+00
1.240E+00
2.170E+00
1.240E+00 |
| 39 -
39 -
39 -
39 - | Y - 8
Y - 8
Y - 8
Y - 8
Y - 9 | 7 *
8
9
0 | 1.388E+01
1.109E+01
7.900E+00
1.027E+01 | 7.471E-01
7.450E-01
8.500E-01
6.770E-01 | 2.541E+00
3.738E+00
3.983E-01
1.716E+00 | 6.730E+00
3.570E+00
3.440E+00
2.209E+00 | 1.460E+00
0.0
9.300E-01
0.0 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. | | | | | | | |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.916 FOR Y - 89 AND 5.0 FOR Y - 90. | | | | | | | |
| REFERENCES | | | | | | | |
| 2)
3)
4)
5)
6) | AND A
KAWAI
BOLDE
CAMAR
MORGE
MUGHA
PART | PPLIED
, M. E
MAN, J
DA, H.
NSTERN
BGHAB,
A", AC | ALPRO
SCIENCE,
TAL.:J.
I.W., ETAL
S.: PHYS.
S.: PHYS.
S.F. ETA
S.F. ETA | SANTA FE.
NUCL. SCI
.: NUCL. S
REV., C16
AL.: NUCL.
AL.: NUCL.
AL.: "NEUTI
SS. (1981) | NF. ON NOCL
, VOL. 2, F
. TECHNOL.
SCI. ENG.,
1803 (197
PHYS., A12
RON CROSS S | EAR DATA 1
29, 195
64, 744 (
77).
23, 561 (198
564, 744 (
77).
23, 561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
561 (198).
571 (198).
571 (198).
571 (198).
571 | 069).
069). |
| 7)
8)
9) | BOLLI
ALLEN
MUGHA
VOL. | NGER,
, B.J.
BGHAB,
1, RES | L.M. AND T
, ET AL.:
S.F. AND
SONANCE PAF | THOMAS, G.I
NUCL. SCI
GARBER, D
RAMETERS", | E.: PHYS. F
. ENG., 82
.I.: "NEUTF
BNL 325, 3 | REV., 171,
230 (1982
RON CROSS S
BRD ED., VO | 1293(1968).
2).
SECTIONS,
DL. 1, |
| 10)
11)
12) | IGARA
IJJIM
IJJIM
(1983 | \$i, S.
A, S.
A, S.
). | AND FUKAH
ET AL.: JA
AND KAWAI, | HORI, T.: .
AERI-M 87-0
, M.: J. NI | JAERI 1321
025, P. 337
UCL. SCI. | (1991).
7 (1987).
FECHNOL., 2 | 20, 77 |
| 13)
14)
15)
16) | PEREY
HUIZE
LOHR,
BECCH
PHENO
W. HA | , F.G:
NGA, J
J.M.
ETTI,
MENA I
EBERLI | PHYS. REV
I.R. AND IC
AND HAEBER
F.D., JR.
N NUCLEAR
), P. 682, | /. 131, 745
GO, G.: NUG
RLI, W.: NU
AND GREEN
REACTIONS
, THE UNIV | 5 (1963).
CL. PHYS. 2
UCL. PHYS.
LEES, G.W.:
((EDS) H.F
ERSITY OF V | 29, 462 (19
A232, 381
POLARIZAT
A. BARSHALL
VISCONSIN F | 962).
(1974).
FION
AND
PRESS. |
| 17) | GILBE | Ŗİ, A. | AND CAMER | RON, A.G.W | .: CAN. J. | PHYS., 43 | , 1446 |
| 18)
19)
20)
21)
22) | IIJIM
GRUPP
MATSU
BENZI
MUSGR
PHYSI | A, S.,
ELAAR,
MOTO,
V. A
OVE, A
CS AND | ET AL.:
H.: ECN-1
J.: PRIVAT
ND REFFO,
.R. DE L.
NUCL DAT | J. NUCL. S(
13 (1977).
FE COMMUNI(
G.: CCDN-I
, ET AL.: 1 | CI. TECHNOL
CATION (198
NW/10 (1968
PROC. INT.
CTORS HARM | . 21, 10 (
31).
9).
CONF. ON N | (1984).
NEUTRON |
| 23) | KIKUC | HI, K.
IONS" | AND KAWAI | I, M.: "NU(| ČLĚAŘ MÁTTE | ËR AND NUCI | LEAR |
| 24)
25) | BYCHK | OV, V.
ST, R. | M. ET AL.:
A.: AERE-F | TNDC(CCP
12419 (19 |)-146/LJ (′
986). | 1980). | |
MAT number = 3931 39-Y - 91 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 380 EV - 100 KEV THE NEUTRON STRENGTH FUNCTION S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL./2/, AND S0 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.370E-4, S1 = 5.500E-4, S2 = 0.390E-4, SG = 2.81E-4, GG = 0.210 EV, R = 6.747 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S TOTAL 7.100 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 5.700 2.85 1.400 = 3 NEUTRON CROSS SECTIONS BELOW 380 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS ADOPTED FROM REF./2/ AND THE SCATTERING CROSS SECTION WAS CALCULATED FROM R = 6.7 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 380 EV TO 100 KEV. MF ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/5/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/ SPIN-PARITY 1/2 -ENERGY(MEV) NO. GŔ. 0.0 0.5556 0.6530 9/2 +1 3/2 5/2 7/2 5/2 2 3 0.9258 -4 1.1869 5 1.3054 + 3/26 1.4737

| 7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
LEVELS ABO | 1.5459
1.5480
1.5799
1.9804
2.0666
2.1291
2.1630
2.2067
2.2794
2.4740
2.5300
2.5700
2.5721
2.6890
2.7800
2.9600
2.9800
3.0450
3.1960
3.2270
3.2840
VE 3.32 MEV WERE A | 5/2 -
7/2 -
5/2 +
3/2 -
5/2 +
3/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
1/2 -
9/2 +
3/2 -
1/2 -
9/2 +
3/2 -
1/2 -
9/2 -
7/2 -
9/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 - | PPING. |
|---|---|---|---|
| MT = 102 CAPT
SPHERICAL OP
CASTHY WAS A
SECTIONS WER
AND REFFO/15 | URE
TICAL AND STATISTI
DOPTED. DIRECT AN
E ESTIMATED ACCORD
/ AND NORMALIZED T | CAL MODEL CALCULATI
D SEMI-DIRECT CAPTU
ING TO THE PROCEDUR
O 1 MILLI-BARN AT 1 | ON WITH
RE CROSS
E OF BENZI
4 MEV. |
| THE GAMMA-RA
THE SYSTEMAT
S-WAVE RESON
LEVEL DENSIT | Y STRENGTH FUNCTIO
ICS OF RADIATION W
ANCE LEVEL SPACING
Y PARAMETERS. | N (2.74E-04) WAS DE
IDTH (0.21 EV) AND
(769 EV) CALCULATE | TERMINED FROM
THE AVERAGE
D FROM THE |
| $\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$ |) CROSS SECTION
) CROSS SECTION
A) CROSS SECTION
P) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
PHA) CROSS SECTION
ON CROSS SECTIONS
UM AND MULTI-STEP | WERE CALCULATED WIT | H THE
Ode pegasus. |
| THE KALBACH'
FORMULA DERI
DENSITY PARA | S CONSTANT K (= 33
VED FROM KIKUCHI-K
METERS. | 4.4) WAS ESTIMATED
AWAI'S FORMALISM/16 | BY THE
/ AND LEVEL |
| FINALLY, THE
NORMALIZED T
(N,P)
(N,ALPHA) | (N,P) AND (N,ALPH
O THE FOLLOWING VA
10.70 MB (SYS
3.31 MB (SYS | A) CROSS SECTIONS W
LUES AT 14.5 MEV:
TEMATICS OF FORREST
TEMATICS OF FORREST | ERE
/17/)
) |
| MT = 251 MU-B
CALCULATED W | AR
ITH CASTHY. | | |
| MF = 4 ANGULAR
LEGENDRE POLYN
GIVEN IN THE C
TIC LEVELS, AN
CALCULATED WIT
BUTIONS IN THE | DISTRIBUTIONS OF S
OMIAL COEFFICIENTS
ENTER-OF-MASS SYST
D IN THE LABORATOR
H CASTHY. FOR OTH
LABORATORY SYSTEM | ECONDARY NEUTRONS
FOR ANGULAR DISTRI
EM FOR MT=2 AND DIS
Y SYSTEM FOR MT=91.
ER REACTIONS, ISOTR
WERE ASSUMED. | BUTIONS ARE
CRETE INELAS-
THEY WERE
OPIC DISTRI- |
| MF = 5 ENERGY D
ENERGY DISTRIB
PEGASUS FOR IN
OTHER NEUTRON | ISTRIBUTIONS OF SE
UTIONS OF SECONDAR
ELASTIC SCATTERING
EMITTING REACTIONS | CONDARY NEUTRONS
Y NEUTRONS WERE CAL
TO OVERLAPPING LEV | CULATED WITH
ELS AND FOR |
| TABLE 1 NEUTRON | OPTICAL POTENTIAL | PARAMETERS | |
| V = 46.
WS = 7.0
VSO= 7.0
THE FORM OF SU | DEPTH (MEV)
0-0.25E
RFACE ABSORPTION P | RADIUS(FM) DIFFU R0 = 5.893 A0 = RS = 6.393 AS = RS0= 5.893 AS0= ART IS DER. WOODS-S | SENESS(FM)
0.62
0.35
0.62
AXON TYPE. |

TABLE 2 LEVEL DENSITY PARAMETERS

| NU | CLIDE | SYS | ΤA | (1/ | /ME\ | /) | Τ(| ΜE | ۷) | | С | (1 | / M | EV) |) | ΕX | (M | EV |) | PA | IR | ING | |
|--|---|---|---|---|-------------------------------------|---|---|----------------------|--------------------------------------|--|---|-----------------------------|----------------------------|----------------------------------|--------------------------------|----------------------|---------------------------|------------------------------|-------------------------------|--------------------------------|----------------------|--|----------------------|
| 37
37
37
37
37 | - RB - 8
- RB - 8
- RB - 8
- RB - 8
- RB - 9 | 7
8
9 *
0 | 8
9
1
1 | .80
.80
.08
.17 |)6E+
)1E+
36E+
79E+ | +00
+00
+01
+01 | 9.
8.
7.
7. | 41
18
30
22 | 0E
5E
3E
0E | - 0 ⁻
- 0 ⁻
- 0 ⁻ | 1 1
1 2
1 1
1 4 | . 1
. 8
. 1
. 5 | 25
80
26
70 | E+(
E+(
E+(
E+(|)0
)0
)0
)0 | 5.
3.
3.
3. | 46
70
94
65 | 5E-
4E-
9E-
9E- | +00
+00
+00
+00 | 9.
0.
7.
0. | 30
0
20
0 |) E - (
0 E - (|)1
)1 |
| 38
38
38
38 | - SR - 8
- SR - 8
- SR - 9
- SR - 9 | 8
9
0
1 | 9
9
9
1 | .16
.38
.94
.09 | 60E+
30E+
40E+
90E+ | +00
+00
+00
+00 | 7.
8.
8.
8. | 51
20
53
10 | 0E
0E
0E
0E | - 0 ⁻
- 0 ⁻
- 0 ⁻ | 1 8
1 5
1 3
1 1 | . 2
. 0
. 7
. 1 | 88
43
95
03 | E - (
E - (
E - (
E + (|)2
)1
)1
)0 | 4.
4.
6.
5. | 55
64
25
62 | 0E-
2E-
2E-
5E- | +00
+00
+00
+00 | 2.
1.
1.
1. | 17
24
96
24 |) E + (
0 E + (
0 E + (
0 E + (| 00
00
00
00 |
| 39
39
39
39 | -Y - 8
-Y - 9
-Y - 9
-Y - 9
-Y - 9 | 9
0
1
2 | 7
1
1
1 | . 90
. 02
. 05
. 01 |)0E+
27E+
50E+
12E+ | +00
+01
+01
+01 | 8.
6.
7.
7. | 50
77
14
62 | 0E
0E
0E
9E | - 0 ⁻
- 0 ⁻
- 0 ⁻ | 1 3
1 1
1 8
1 2 | .9
.7
.3
.4 | 83
16
62
80 | E - (
E + (
E - (
E + (|)1
)0
)1
)0 | 3.
2.
3.
3. | 44
20
52
19 | 0E-
9E-
1E-
1E- | +00
+00
+00
+00 | 9.
0.
7.
0. | 30
0
20
0 |) E - (
0 E - (|)1
)1 |
| S | YST: | * = | LDP | ' S | WEF | RE | DET | ĒR | MI | NE |) F | RO | M | SYS | STE | ΜA | ΤĪ | cs. | | | | | |
| SP
IN
AS | IN CUT
THE C
SUMED | OFF
ASTH
TO B | PAR
Y C
E 5 | AME
Alc
.10 | ETER
CULA
D3 R | RS N
ATIO
FOR | VER
DN,
Y | E
- | CA
PI
91 | LCI
N (
Al | JLA
Cut
ND | TE
0F
5. | D
F
O | AS
FAC
FOF | 0.
CTO
Y | 14
RS
- | 6*
A
9 | SQF
T(
2. | RT(
D M | A)*
EV | A*
WE | *(2,
RE | /3). |
| REF
1)
2)
3)
4)
5) | ERENCE
KAWAI
AND T
MUGHA
PART
IGARA
IIJIM
IIJIM
(1983 | S M.
ÉCHN
BGHA
A",
SI,
S,
S,
S | ET
OLO
B,
AĊA
S.:
. E
. A | AL
GY,
S.F
DEN
J.
T.
ND |
- E
MIC
- NU

- KAV | PR(
ITO
ET /
PRE
JCL
: J/
VAI | DC.
AL.
ESS
AER
, M |
 -

 | NT
56
"N
19
M
J | 9
EU
81
TE(
87 | CON
(19
TRO
).
CHN
- 02
NUC | IF.
88
N
IOL
5, | OI
).
CR
· P
S | N N
OSS
12
ĊI | NUC
S S
2
337
. T | LE
EC
67
EC | AR
TI
19
HN | D/
ONS
197
87
0L | ATA
S,
75)
), | FC
VOL
20, |)R

7 | SCIE
I,
7 | ENCE |
| 6)
7)
8)
9) | PEREY
HUIZE
LOHR,
BECCH
PHENO
W. HA | , F.
NGA,
J.M
ETTI
MENA
EBER | G:
J.
A, F
IN
LI) | PH\
R.
ND
.D.
NU
, F | YS.
ANE
HAE
JĊLĔ | REV
D I (
EBEF
JR .
EAR
582 | /.
GO,
RLI
AN
RE
, T | 13
Ö
AC | 1,
W.
GR
TI | 74
NI
EEI
ONS
NI | 45
JCL
NUC
NLE
S (
/ER | (1
ES
(E
S I | 96
PH
P
DS
TY | 3).
YS.
HYS
G.V
OF | . 2
5.
V.:
H.H
= W | 9,
A2
P
is | 4
32
0L
BA
C0 | 62
ÅR
RSH
NS | (1
381
IZA
HAL
IN | 962
(1
TIC
L A
PRE | 97
97
ND
SS | 4). | |
| 10) | GILBE | ŔŤ, | Α. | AND | C C A | AMEF | RON | , | Α. | G.1 | N.: | С | ΑN | | J. | ΡH | YS | ., | 43 | , 1 | 44 | 6 | |
| 11)
12)
13)
14)
15)
16) | GRUPP
ENSDF
NUCLE
BENZI
KIKUC
REACT | Á, S
ELAA
: EV
AR D
, V.
HI,
IONS | Ŕ,
ALU
ATA
AN
K. | ET
H . :
ATE
SH
D F
AND
NOF | AL.
ED M
HEET
REFF
REFF | NUCI
NUCI
SO,
AWA
HOI | J.
13
_EA
31
G.
J,
LA | NL
(1
R
 | CL
97
ST
18
CC
:
(| 7)
RU(
1
DN
"N(
19(| SCI
CTU
(19
- NW
JCL
58) | RE
80
/1
EA | D
D
D
R | CHN
AT#
(19
MA1 | NOL
N F
969
FTE | IL
).
R | 21
E
AN | , ´
(Jl
D N | 10
JNE
NUC | (19
19
LEA |)84
)87
\R |).
). | |

17) FORREST, R.A.: AERE-R 12419 (1986).

EVAL-NOV88 M.SASAKI (MAPI) DIST-SEP89 REV2-APR94 HISTORY HISIORY 88-11 COMPILED BY T.ASAMI (JAERI) 94-04 JENDL-3.2 RESONANCE PARAMS OF ZR-90 MODIFIED BY M.KAWAI(TOSHIBA). GAMMA-RAY PRODUCTION DATA MODIFIED BY S.IGARASI(NEDAC). OTHER MODIFICATIONS WERE ADOPTED FROM JENDL FUSION FILE COMPILED BY T.NAKAGAWA (NDC/JAERI) $\begin{array}{c} \text{MAINLY TAKEN FROM JENDL FUSION FILE} \\ (4,16-91) & TAKEN FROM JENDL FUSION FILE \\ (5,16-91) & TAKEN FROM JENDL FUSION FILE \\ (12,102) \\ (13,3), (13,4), (13,103), (13,107) \\ (14,4), (14,103), (14,107) \\ (15,3), (15,102), (15,103), (15,107) \\ \end{array}$ JENDL FUSION FILE /1/ (AS OF APR. 1994) EVALUATED AND COMILED BY S.CHIBA (NDC/JAERI) THE DISCRETE INELASTIC SCATTERING CROSS SECTIONS AND THEIR ANGULAR DISTRIBUTIONS WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-II SYSTEM/2/ FOR EACH ISOTOPE. THE DATA OF NATURAL ZR WAS CONSTRUCTED FROM THESE ISOTOPE DATA. OTHER REACTION CROSS SECTIONS, I.E., THE CONTINUUM INELASTIC SCATTERING, (N,2N), (N,3N), (N,NA), (N,P) AND (N,ND) REACTION CROSS SECTIONS AND THEIR SECONDARY NEUTRON ENERGY SPECTRA, AND (N,P), (N,D), (N,T), (N,HE3) AND (N,A) CROSS SECTIONS WERE CALCULATED BY EGNASH2 IN THE SINCROS-II FOR EACH ISOTOPE. THE DATA FOR NATURAL ZR WAS CONSTRUCTED FROM THESE DATA. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMATICS /3/ USING F15TOB /1/. THE PRECOMPOUND TO COMPOUND RATIO WAS TAKEN FROM THE EGNASH2 CALCULATION. OTHER DATA WERE TAKEN FROM JENDI -3.1. DATA -OTHER DATA WERE TAKEN FROM JENDL-3.1. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY =2 RESONANCE PARAMETERS T=151 RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 171 KEV. UPPER BOUNDARIES OF THE RESOLVED RESONANCE REGIONS ARE: ZR-90: 171.0 KEV ZR-91: 30.16 KEV ZR-92: 71.0 KEV ZR-94: 53.5 KEV ZR-96: 100.0 KEV UNRESOLVED RESONANCE PARAMETERS WERE GIVEN UP TO 100 KEV FOR ZR-91, -92, -94. THE PARAMETERS WERE DETERMINED TO REPRODUCE EVALUATED CAPTURE AND TOTAL CROSS SECTIONS. DESCRIPTION ON EVALUATION IS GIVEN IN THE (1,451) OF EACH ISOTOPE. THE ABUNDANCE DATA WERE TAKEN FROM REF./5/ TO BE 0.5145, 0.1122, 0.1715, 0.1738 AND 0.0280 FOR ZR-90, -91, -92, -94 AND -96, RESPECTIVELY. MF=2MT=151 0.1715, 0.173 RESPECTIVELY. 2200 M/S CROSS SECTION(B) RES. INTEGRAL(B) 6.6026 6.4084 TOTAL ELASTIC CAPTURE 0.1943 1,203 MF=3 NEUTRON CROSS SECTIONS BELOW 100 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN. BE 100 AND 171 KEV, CONTRIBUTIONS FROM ZR-91, 92, 94 AND 96 GIVEN AS BACKGROUND CROSS SECTIONS TO TOTAL, ELASTIC AND CAPTURE. BETWEEN WERE FOR JENDL-3.2, THE ALL CROSS SECTION DATA EXCEPT FOR THE TOTAL WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS

MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/6/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

Q-VALUES OF THRESHOLD REACTIONS INCLUDING INELASTIC SCATTERING WERE SLIGHTLY CHANGED FROM CORRECT VALUES TO CONSISTENT ONES WITH THRESHOLD ENERGIES AND ATOMIC WEIGHT OF NATURAL ZR.

- MT=1 TOTAL MANY EXPERIMENTAL DATA ARE EXISTING. EVALUATED BASED ON THE EXPERIMENTAL DATA.

MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION.

MT=4, 51-89, 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./4/. THE DATA FOR SOME LEVELS WERE LUMPED AS FOLLOWS:

| MT | LEVEL ENERGY(MEV) | ZR-90 | ZR-91 | ZR-92 | ZR-94 | ZR-96 |
|----------|-------------------|----------|----------|-------------|----------|-----------|
| 51 | 0.918 | | | 54 | 51 | |
| 52
53 | 0.934
1.205 | | 51 | 51 | | |
| 54
55 | 1.300
1.383 | | | 52 | 52 | |
| 56
57 | 1.466 | | 52 | 53 | 53 | |
| 58 | 1.593 | | | 00 | E / | 51 |
| 59
60 | 1.750 | - / | | | 54 | 52 |
| 61
62 | 1.761
1.847 | 51 | | 54 | | |
| 63
64 | 1.882 | | 53
54 | | 55 | 53 |
| 65 | 2.067 | | 55 | 55 | 00 | 53 |
| 67 | 2.150 | | 50 | 56 | 56 | |
| 69 | 2.170 | 52 | 56 | | | |
| 70
71 | 2.201
2.225 | | 58 | | | 54 |
| 72
73 | 2.260 | | 59
60 | | | |
| 74
75 | 2.319 | 53 | 61 | 57 | 57 | 55 |
| 76 | 2.356 | | 62,63 | 57 | 58 | 55 |
| 77
78 | 2.395
2.439 | | 64 | 58 | | 56 |
| 79
80 | 2.486
2.507 | | | 59 | 59 | |
| 81
82 | 2.604 | | | | 60
61 | |
| 83 | 2.739 | 54,55 | | 60 | | F7 |
| 84
85 | 2.903 | | | 63,64 | 02-04 | 57 |
| 86
87 | 2.958
3.039 | | | 65
66,67 | | |
| 88
89 | 3.078 | 56
57 | | | | |
| 91
91 | 2.395 | 91 | 91 | 91 | 91 | 91 |

 $\mathsf{MT}=16,\ 22,\ 28,\ 103\ \mathsf{AND}\ 107\ (N,2N),\ (N,NA),\ (N,NP),\ (N,P)\ \mathsf{AND}\ (N,A)$ CONSTRUCTED FROM THE STATISTICAL-MODEL CALCULATIONS FOR EACH ISOTOPE.

MT = 102

■102 CAPTURE CONSTRUCTED FROM THE DATA OF EACH ISOTOPE, THEN MODIFIED BY MULTIPLING AN ENERGY DEPENDENT FACTOR TO REPRODUCE THE EXPERIMENTAL DATA OF STAVISSKIJ ET AL./7/ AND POENITZ /8/.

251 MU-BAR CALCULATED WITH OPTICAL MODEL. MT=251

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 ELASTIC SCATTERING CONSTRUCTED FROM THE STATISTICAL-MODEL/9/ CALCULATIONS FOR EACH ISOTOPE.

MT=51-89 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. CONSTRUCTED FROM THE DATA FOR EACH ISOTOPE. MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. DDX DATA IN MF6 WERE APPROXIMATELY TRANSFORMED TO MF4 AND MF5.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. DDX DATA IN MF6 WERE APPROXIMATELY TRANSFORMED TO MF4 AND MF5.

MF=12 PHOTON PRODUCTION MULTIPLICITIES $MT = \overline{1}02$

FRÔM ENERGY BALANCE.

MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 2 MEV) CONSTRUCTED FROM THE DATA FOR 5 ISOTOPES, USING MULTIPLICITIES CALCULATED WITH EGNASH /2/ AND CROSS SECTIONS. MT=4 (BELOW 2 MEV) CONSTRUCTED FROM LEVEL EXCITATION CROSS SECTIONS OF ISOTOPES AND TRANSITION PROBABILITIES TAKEN FROM ENSDF. MT=103, 107 (BELOW 2 MEV) MADE FROM THE DATA FOR ISOTOPES CALCULATED WITH EGNASH.

MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3, 4, 102, 103, 107 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MF=3 (ABOVE 2 MEV) CALCULATED WITH EGNASH.

MT=102 SPECTRA WERE CALCULATED WITH CASTHY FOR 5 ISOTOPES, REFERRING TO THE COMPILATION OF GAMMA-RAY SPECTRA FOR THERMAL NEUTRON BY LONE ET AL. /10/, AT 1.0E-5, 2.53E-2, 1.0, 1.0E+2, 1.0E+3, 1.0E+5, 5.0E+5, 1.0E+6, 1.5E+6 AND 2.0E+6 EV. PRIMARY TRANSITIONS WERE TAKEN INTO ACCOUNT FOR ZR-90, ZR-91 AND ZR-94. MF=103, 107 (BELOW 2 MEV) CALCULATED WITH EGNASH.

- REFERENCES

 CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
 YAMAMURO, N.: JAERI-M 90-006 (1990).
 KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
 HOLDEN, N.E., MARTIN, R.L. AND BARNES, I.L. : PURE & APPL. CHEM. 56, 675 (1984).
 ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 STAVISSKIJ JU.JA. ET AL.: AT. ENERGIJA, 15, 323 (1963). EXFOR 40679004.
 POENITZ W.P.: ANL-83-4, P.239 (1982). EXFOR 12832003.
 FU, C.Y. : ORNL/TM 7042 (1980).
 LONE M.A. ET AL.: AT. DATA AND NUCL. DATA TABLES, 26, 511 (1981).

| MAT number
40-ZR- 90 | = 4025
JNDC | EVAL - AUG89
DIST - SEP90 | JNDC FP NUCLE
REV2-NOV93 | AR DATA W.G. | |
|--|--|---|--|--|------------------------------------|
| HISTORY
84-10 EVALU
89-08 MODIE
90-10 MF=5 | JATION FOR
FICATION FO
SPECTRA A | JENDL-2 WAS
R JENDL-3 WA
T THRESHOLD | MADE BY JNDC
S MADE/2/.
ENERGIES WERE | FPND W.G./1/
MODIFIED. | |
| 93-11 JENDI
RES
OTH
COMP | SONANCE PAR
HER MODIFIC
ILED BY T.N | AMETERS MODI
ATIONS WERE
AKAGAWA (NDC | FIED BY M.KAV
ADOPTED FROM
/JAERI) | AI(TOSHIBA).
JENDL FUSION F | ILE. |
| *****
(2,15
(3,2) | MODIFIED
51) R
), (3,4), (| PARTS FOR J
ESOLVED RESO
3,32), (3,51
AKEN FROM JE | ENDL-3.2 **
NANCE PARAMET
-57), (3,91)
NDL FUSION FI | ERS
LE | * * * * |
| (4,)
(5, 10)
(5, 10) | 5,58-04).
5-91)
5-91)
T
5-91)
T | AKEN FROM JE
AKEN FROM JE | NDL FUSION FI
NDL FUSION FI | LE
LE
**** | * * * * |
| JENDI | - FUSION FI
EVALUATED | LE /3/ (AS
AND COMILED | OF NOV. 1993)
BY S. CHIBA | (NDC/JAERI) | |
| DATA
- TH
SE
S | WERE TAKEN
HE DISCRETE
ECTIONS WER
INCROS-II S | FROM JENDL-
AND CONTINU
E CALCULATED
YSTEM/4/ INC | 3.1 EXCEPT FC
UM INELASTIC
WITH CASTHY2
LUDING CONTRI | OR THE FOLLOWIN
SCATTERING CRO
Y AND DWUCKY I
BUTIONS FROM | G:
SS
N |
| D
- A1
C/
- TF | IRECT REACT
NGULAR DIST
ALCULATED W
HE (N,ND) R | IONS.
RIBUTIONS OF
ITH CASTHY2Y
EACTION CROS | DISCRETE INE
AND DWUCKY.
S_SECTION (MI | ELASTICS WERE A | LSO |
| - AI
RE
TH | L ENERGY D
EPLACED BY
HE CONTINUU
YSTEMATICS | ISTRIBUTIONS
THOSE CALCUL
M NEUTRONS W
/5/ USING FI | OF SECONDARY
ATED BY EGNAS
ERE CALCULATE
5TOB /3/. TH | NEUTRONS WERE
H2. THE DDX'S
D BY KUMABE'S
IE PRECOMPOUND | OF
TO |
| C)
- OF
TH
LE | YSTEM.
PTICAL-MODE
HE SINCROS-
EVEL SCHEME | L, LEVEL DEN
II CALCULATI
S WERE DETER | SITY AND OTHE
ON ARE DESCRI
MINED ON THE | ER PARAMETERS U
BED IN REF./4/
BASIS OF ENSDF | E
SED IN
/6/. |
| MF = 1 GEN
MT=451 CC | NERAL INFOR
DMMENTS AND | MATION
DICTIONARY | | | |
| MF = 2 RES
RESOLVED
RESO | SONANCE PAR
RESONANCE
DNANCE PARA | AMETERS
REGION (MLBW
METERS FOR J | FORMULA) : E
ENDL-3.1 WERE | BELOW 171 KEV
TAKEN FROM JE | NDL-2 |
| TAKEN F
WERE DE
THE PAF
SO AS T | JENDL-2, R
FROM THE DA
ERIVED FROM
RAMETERS OF
TO REPRODUC | ESONANCE ENE
TA OF MUSGRO
CAPTURE ARE
THE FIRST R
E THE CAPTUR | RGIES AND NEL
VE ET AL./7/
AS MEASURED E
ESONANCE WERE
E AND AND ELA | JTRON WIDTHS WE
RADIATION WI
BY BOLDEMAN ET
SLIGHTLY ADJU
STIC SCATTERING | RE
DTHS
AL./8/
STED
G |
| CROSS S
AVER/ | SECTIONS AT
AGE RADIATI | 0.0253 EV/9
ON WIDTH = 0
0
0 | /.
.190 +- 0.110
.270 +- 0.120
.280 +- 0.120 | D EV FOR S-WAVE
D EV FOR P-WAVE
D EV FOR D-WAVE | RES,
RES,
RES. |
| THE EFF
FOR
MODIFIE
THE THE
BY POME | FECTIVE SCA
JENDL-3, T
ED AND A NE
ERMAL CAPTU
ERANCE/10/, | TTERING RADI
HE PARAMETER
GATIVE RESON
RE CROSS SEC
AND THE RES | US OF 7.0 FM
S OF THREE D-
ANCE WAS ADDE
TION OF 0.104
ONANCE INTEGF | WAS ASSUMED.
WAVE RESONANCE
D SO AS TO REP
-0.07 BARN MEA
AL GIVEN BY | S WERE
RODUCE
SURED |
| MUGHAB(
FOR
BOLDEM/
REEVAL(
ACCORD)
NEGATI\
PARAMET
RESONAM | GHAB ET AL.
JENDL-3.2
AN ET AL. I
JATED USING
ING TO A CO
VE RESONANC
FERS REPROD
NCE INTEGRA | /9/
THE PARAMET
N THE ENERGY
THEIR CAPTU
RRIGENDUM RE
E WAS REMOVE
UCE WELL THE
L. | ERS FOR THE L
RANGE UP TO
RE AREA DATA
PORTED BY ALL
D BECAUSE THE
THERMAL CROS | EVELS MEASURED
192.9 KEV WERE
MULTIPLIED BY
EN ET AL./11/.
POSITIVE RESO
S SECTIONS/12/ | BY
0.967
THE
NANCE
AND |
| NO UNRESC | OLVED RESON | ANCE REGION | | | |
| CALCULATE
TOTAL
ELAS | ED 2200-M/S
FIC | CROSS SECTI
2200 M/S
5.376
5.365 | ONS AND RES.
RE | INTEGRALS (BAR
S. INTEG.
-
- | NS) |

MF = 3 NEUTRON CROSS SECTIONS BELOW 171 KEV, RESONANCE PARAMETERS WERE GIVEN.

IN THE EVALUATION FOR JENDL-3.1, ABOVE 171 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/13/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/14/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/15/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/16/ ALPHA = HUIZENGA AND IGO/17/ DEUTERON = LOHR AND HAEBERLI/18/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/19/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/20/ WERE EVALUATED BY IIJIMA ET AL./21/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /22/.

1221

FOR JENDL-3.2, DATA OF INELASTIC SCATTERING AND (N,ND) REAC-TION CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/23/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

" = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. MT = 4

| NO. | ENERGY(ME | EV) | SPIN- | PARI | TY (| (DIRECT | PROCES | SS) |
|--------------|-----------|------|--------|------|------|---------|--------|-----|
| GR. | 0.0 ` | , | 0 | + | | , | | |
| 1 | 1.7607 | | 0 | + | | * | | |
| 2 | 2.1865 | | 2 | + | | * | | |
| 3 | 2.3191 | | 5 | - | | | | |
| 4 | 2.7388 | | 4 | - | | | | |
| 5 | 2.7479 | | 3 | - | | * | | |
| 6 | 3.0772 | | 4 | + | | * | | |
| 7 | 3.3087 | | 2 | + | | | | |
| LEVELS ABOVE | 3.309 MEV | WERE | ASSUME | D TO | ΒE | OVERLAF | PING. | |

MT

= 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/24/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

THE GAMMA-RAY STRENGTH FUNCTION (1.41E-05) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 7.5 MILLI-BARNS AT 100 KEV MEASURED BY MUSGROVE ET AL./25/

T = 16 (N,2N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,HE3) CROSS SECTION T =106 (N,HE3) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION T =111 (N,2P) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT MT MT MT MT = 104MT =105 MT =106 MT =107 MT THE KALBACH'S CONSTANT K (= 301.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/26/ AND LEVEL DENSITY PARAMETERS.

FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE

NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 40.00 MB (RECOMMENDED BY FORREST/27/) (N,ALPHA) 10.00 MB (RECOMMENDED BY FORREST) THE (N.2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING TO THE EXPERIMENTAL DATA OF ZHAO WEN-RONG ET AL./28/, PAVLINK ET AL. /29/ AND MANY MEASURED DATA AROUND 14.5 MEV. MT = 32 (N,N'D) CROSS SECTION TAKEN FROM JENDL FUSION FILE. MT = 251 MU-BAR CALCULATED WITH CASTHY. = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS AT = 2 MF ΜT CALCULATED WITH CASTHY/13/. TAKEN FROM JENDL FUSION FILE WHICH WAS CALCULATED WITH CASTHY AND DWUCK/30/ (DWUCKY) IN THE SINCROS-II SYSTEM. = 16,17,22,28,32,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. MT MT F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16,17,22,28,32,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. << FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) DIFFUSENESS(FM) RADIUS(FM) ----------TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.120E+01 8.900E-01 5.328E-01 8.599E+00 2.700E+00 1.030E+01 8.610E-01 1.186E+00 5.938E+00 1.240E+00 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+00 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+00 38 - SR - 86 38 - SR - 87 38 - SR - 88 38 - SR - 88 38 - SR - 89 * 1.388E+01 7.471E-01 2.541E+00 6.730E+00 1.460E+00 1.109E+01 7.450E-01 3.738E+00 3.570E+00 0.0 7.900E+00 8.500E-01 3.983E-01 3.440E+00 9.300E-01 1.027E+01 6.770E-01 1.716E+00 2.209E+00 0.0 39-Y - 87 39-Y - 88 39-Y - 89 39-Y - 90 40-ZR- 88 40-ZR- 89 40-ZR- 90 40-ZR- 91 * 1.404E+01 7.386E-01 4.932E-01 7.870E+00 2.660E+00 1.095E+01 8.260E-01 1.379E+00 5.864E+00 1.200E+00 9.152E+00 8.222E-01 1.526E-01 5.383E+00 2.130E+00 1.036E+01 8.000E-01 7.822E-01 5.057E+00 1.200E+00 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 10.12 FOR ZR- 90 AND 12.04 FOR ZR- 91. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
3) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
4) YAMAMURO, N.: JAERI-M 90-006 (1990).
5) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
6) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
7) MUSGROVE, A.R. DE L. ET AL.: AUST. J. PHYS., 30, 379 (1977).
8) BOLDEMAN, J.W., ET AL.: NUCL. PHYS., A246, 1 (1975).
9) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
10) POMERANCE, H.: PHYS. REV., 88, 412 (1952).
11) ALLEN, B.J., ET AL.: NUCL. SCI. ENG., 82, 230 (1982).
12) LONE, M.A. AND BARTHOLOMEW, G.A.: PROC. 4TH INT. CONF. ON NEUTRON-CAPTURE GAMMA-RAY SPECTROSCOPY AND RELATED TOPICS, REFERENCES

- 13)
- 14)
- GRENOBLE, SEPT.1981, P.383 (1981). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 15)
- 16)
- 17)
- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 18) 19)
- (1971) 20) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 20) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 21) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 22) GRUPPELAAR, H.: ECN-13 (1977).
 23) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 24) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 25) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
 26) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 27) FORREST, R.A.: AERE-R 12419 (1986).
 28) ZHAO WEN-RONG, ET AL.: CHINESE J. NUCL. PHYS., 6, 80 (1984).
 29) PAVLINK, A., ET AL.: J. PHYS., G8, 1283 (1982).
 30) KUNZ, P.D.: PRIVATE COMMUNICATION.

| MAT number = 4028
40-ZR- 91 JNDC | EVAL-AUG89 JNDC FP NUCLI | EAR DATA W.G. |
|--|--|--|
| HISTORY
84-10 EVALUATION FOR J
89-08 MODIFICATION FOR
90-10 MF=5: SPECTRA AT
93-09 JENDL-3.2. | ENDL-2 WAS MADE BY JNDC
JENDL-3 WAS MADE/2/.
THRESHOLD ENERGIES WER | FPND W.G./1/
E MODIFIED. |
| COMPILED BY T.NA
***** MODIFIED
ALMOST ALL CROSS
(3,103) AND (3,1 | KAGAWA (NDC/JAERI)
PARTS FOR JENDL-3.2 *
SECTION DATA EXCEPT (3
07): | ************************************** |
| (3,4), (3,5)
(3,32), (3,1
(4,16-91)
(5,16-91)
THESE_DAT | -91), (3,105), (3,106)
A.WERE TAKEN FROM JENDL | , 22), (3,20), |
| JENDL FUSION FIL
EVALUATED | .E /3/ (AS OF SEP. 1993
AND COMILED BY S. CHIBA |)
(NDC/JAERI) |
| DATA WERE TAKEN
- THE DISCRETE
SECTIONS WERE
SINCROS-II SY | FROM JENDL-3.1 EXCEPT F(
AND CONTINUUM INELASTIC
CALCULATED WITH CASTHY
STEM/4/ INCLUDING CONTR | DR THE FOLLOWING:
SCATTERING CROSS
2Y AND DWUCKY IN
IBUTIONS FROM |
| DIRECT REACTI
- ANGULAR DISTR
CALCULATED WI
- THRESHOLD REA
104, 105 AND | ONS.
IBUTIONS OF DISCRETE INI
TH CASTHY2Y AND DWUCKY.
CTION CROSS SECTIONS (M
106) WERE REPLACED WITH | ELASTICS WERE ALSO
T=16, 17, 22, 28, 32,
THOSE CALCULATED BY |
| EGNASH2 IN TH
- ENERGY DISTRI
BY THOSE CALC
NUUM NEUTRONS
USING F15TOB | IE SINCROS-II.
BUTIONS OF SECONDARY NEI
ULATED BY EGNASH2. THE
WERE CALCULATED BY KUM.
/3/. THE PRECOMPOUND/C(| JTRONS WERE REPLACED
DDX'S OF THE CONTI-
ABE'S SYSTEMATICS/5/
DMPOUND RATIO WAS |
| CALCULATED BY
- OPTICAL-MODEL
THE SINCROS-I
LEVEL SCHEMES | ' THE SINCROS- II CODE S'
LEVEL DENSITY AND OTHI
I CALCULATION ARE DESCR
WERE DETERMINED ON THE | YSTEM.
ER PARAMETERS USED IN
IBED IN REF./4/.
BASIS OF ENSDF/6/. |
| MF = 1 GENERAL INFORM
MT=451 COMMENTS AND | IATION
DICTIONARY | |
| <pre>MF = 2 RESONANCE PARA
MT=151 RESOLVED AND
RESOLVED RESONANCE R
FOR JENDL-2, RESON
AL. /7/ WERE ADOPT
WERE OBTAINED BY A
AND OF BRUSEGAN ET
CAPTURE AREAS BY B
ACCOUNT. PARAMETE
FROM REF./7/. THE</pre> | METERS
UNRESOLVED RESONANCE PAI
EGION (MLBW FORMULA) : I
IANCE ENERGIES RECOMMENDI
ED. NEUTRON AND RADIAT
VERAGING THE DATA OF MUS
AL. /9/. FOR THE LEVE
OLDEMAN ET AL. /10/ WERI
RS OF A NEGATIVE RESONAI
EFFECTIVE SCATTERING R | RAMETERS
BELOW 30.16 KEV
ED BY MUGHABGHAB ET
IVE CAPTURE WIDTHS
SGROVE ET AL. /8/
LS ABOVE 20 KEV,
E ALSO TAKEN INTO
NCE WERE ADOPTED
ADIUS WAS ALSO TAKEN |
| FROM REF./7/
ASSUMED CAPTURE
FOR JENDL-3, THUS
ACCOUNT OF THE EVA
RADIATIVE WIDTHS W | WIDTH = 0.120 EV FOR S-
0.240 EV FOR P-V
EVALUATED PARAMETERS WEI
LUATION BY COCEVA/11/.
VERE DETERMINED SO AS TO | NAVE RES.
NAVE RES.
RE MODIFIED BY TAKING
AFTER MODIFICATION,
REPRODUCE CAPTURE |
| AREAS OF JENDL-2.
UNRESOLVED RESONANCE
THE NEUTRON STRENG
WITH OPTICAL MODEL
SPACING WAS DETERM
CALCULATED WITH CA
OBTAINED FROM FITT
AT 100 KEV. | REGION : 30.16 KEV - 10
TH FUNCTIONS, SO, S1 ANI
CODE CASTHY/12/. THE 0
INED TO REPRODUCE THE C/
STHY. THE EFFECTIVE SC/
ING TO THE CALCULATED TO | DO KEV
D S2 WERE CALCULATED
DBSERVED LEVEL
APTURE CROSS SECTION
ATTERING RADIUS WAS
DTAL CROSS SECTION |
| TYPICAL VALUES OF TH
S0 = 0.420E-4, S1
D0 = 660.4 EV, R | IE PARAMETERS AT 70 KEV:
= 5.700E-4, S2 = 0.360E
= 6.621 FM. | -4, GG = 0.205 EV |
| CALCULATED 2200-M/S
2
TOTAL 1
ELASTIC 1
CAPTURE | CROSS SECTIONS AND RES.
200 M/S RI
1.83
0.59
1.247 | INTEGRALS (BARNS)
ES. INTEG.
-
6.95 |

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/12/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/13/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/14/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/15/ ALPHA = HUIZENGA AND IGO/16/ DEUTERON = LOHR AND HAEBERLI/17/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/18/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT AND CAMERON/19/ WERE EVALUATED BY IIJIMA ET AL./20/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /21/. EOR JENDI 2 CO DATA COMPANY /21/. MF = 3FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/22/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAME-TERS OF SINCROS-II SYSTEM. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT T = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. SPIN-PA 5/2 + 1/2 + 5/2 + 7/2 + 9/2 + 11/2 -5/2 + 13/2 -13/2 -11/2 1/2 SPIN-PARITY (DIRECT PROCESS) NO ENERGY(MEV) 0.0 GŔ. 1234567890 10 2 1.4663 5/2 + * 3 1.8821 7/2 + * 4 2.0422 3/2 + * 5 2.1313 9/2 + * 6 2.1700 11/2 -7 2.1899 5/2 + 8 2.2007 7/2 + 9 2.2597 13/2 -10 2.2876 15/2 -11 2.3201 11/2 - * 12 2.3558 1/2 - * 13 2.3669 7/2 - * 14 2.3949 9/2 - * LEVELS ABOVE 2.395 MEV WERE ASSUMED TO BE OVERLAPPING. 1.4663 $\begin{array}{l} \textbf{F} = 16 & (N,2N) & CROSS & SECTION \\ \textbf{F} = 17 & (N,3N) & CROSS & SECTION \\ \textbf{F} = 22 & (N,N'A) & CROSS & SECTION \\ \textbf{F} = 28 & (N,N'P) & CROSS & SECTION \\ \textbf{F} = 32 & (N,N'D) & CROSS & SECTION \\ \textbf{F} = 104 & (N,D) & CROSS & SECTION \\ \textbf{F} = 105 & (N,T) & CROSS & SECTION \\ \textbf{F} = 106 & (N,HE3) & CROSS & SECTION \\ \textbf{DATA WERE ADOPTED FROM JENDL FUSION FILE. \\ \end{array}$ MT = 16MT ΜŤ ΜŤ MT = 32MT = 104MT =105 MT = 106CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY/12/ WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CRO SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. CROSS THE GAMMA-RAY STRENGTH FUNCTION (3.199E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 25 MILLI-BARNS AT 100 KEV MEASURED BY MUSGROVE ET AL./24/

MT =103 (N,P) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION

| PEGASUS/13/. | |
|--|---|
| THE KALBACH'S CONSTANT K (=269.1) WAS ESTIMATED BY THE FORM
DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/25/ AND LEVEL DENSIT
PARAMETERS. | ULA
Y |
| FINALLY, (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED
THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 29.00 MB (RECOMMENDATION BY FORREST/26/)
(N,ALPHA) 8.51 MB (SYSTEMATICS OF BY FORREST/26/) | Т0 |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY/12/. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS $MT = 2$ | |
| CALCULATED WITH CASTHY/12/.
MT = 51-54
TAKEN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH
CASTHY AND DWUCK/27/ (DWUCKY) IN THE SINCROS-II SYSTEM.
MT = 16,17,22,28,32,91
MT = 16,17,22,28,32,91 | |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT = 16,17,22,28,32,91
TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. | |
| <pre><<following and="" are="" calc.<="" casthy="" in="" parameters="" pegasus="" pre="" the="" used=""></following></pre> | ==
>>
== |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 46.0-0.25E R0 = 5.893 A0 = 0.62 WS = 7.0 RS = 6.393 AS = 0.35 WS0= 7.0 RS0= 5.893 AS0= 0.62 | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE A(/MEV) T(MEV) C(/MEV) EX(MEV) PAIRING 38-SP-87 1.030E+01.8 610E-01.1 1.86E+00.5 938E+00.1 2.40E+0 | 0 |
| 38-SR- 88 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+0 | |
| 38-SR-89 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+0 38-SR-90 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+0 | 0
0
0 |
| 38-SR-89 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+0 38-SR-90 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+0 39-Y 88 1.109E+01 7.450E-01 3.738E+00 3.570E+00 0.0 39-Y 89 7.900E+00 8.500E-01 3.983E-01 3.440E+00 9.300E-0 39-Y 90 1.027E+01 6.770E-01 1.716E+00 2.209E+00 0.0 39-Y 91 1.050E+01 7.140E-01 8.362E-01 3.521E+00 7.200E-0 | 0
0
0
1
1 |
| 38-SR-89 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+0 38-SR-90 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+0 39-Y 88 1.109E+01 7.450E-01 3.738E+00 3.570E+00 0.0 39-Y 89 7.900E+00 8.500E-01 3.983E-01 3.440E+00 9.300E-0 39-Y 90 1.027E+01 6.770E-01 1.716E+00 2.209E+00 0.0 39-Y 91 1.050E+01 7.140E-01 8.362E-01 3.521E+00 7.200E-0 40-ZR-89 1.095E+01 8.260E-01 1.379E+00 5.864E+00 1.200E+0 40-ZR-91 1.036E+01 8.200E-01 7.822E-01 5.057E+00 1.200E+0 40-ZR-92 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0 | 0
0
0
1
1
0
0
0
0 |
| 38-SR-89 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+0 38-SR-90 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+0 39-Y 88 1.109E+01 7.450E-01 3.738E+00 3.570E+00 0.0 39-Y 89 7.900E+00 8.500E-01 3.983E-01 3.440E+00 9.300E-0 39-Y 90 1.027E+01 6.770E-01 1.716E+00 2.209E+00 0.0 39-Y 91 1.050E+01 7.140E-01 8.362E-01 3.521E+00 7.200E-0 40-ZR-89 1.095E+01 8.260E-01 1.379E+00 5.864E+00 1.200E+0 40-ZR-90 9.152E+00 8.222E-01 1.526E-01 5.383E+00 2.130E+0 40-ZR-91 1.036E+01 8.000E-01 7.822E-01 5.057E+00 1.200E+0 40-ZR-92 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0 40-ZR-92 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0 40-ZR-92 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0 | 0
0
1
1
0
0
0
0 |
| 38-SR- 89 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+0 38-SR- 90 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+0 39-Y - 88 1.109E+01 7.450E-01 3.738E+00 3.570E+00 0.0 39-Y - 89 7.900E+00 8.500E-01 3.983E-01 3.440E+00 9.300E-0 39-Y - 90 1.027E+01 6.770E-01 1.716E+00 2.209E+00 0.0 39-Y - 91 1.050E+01 7.140E-01 8.362E-01 3.521E+00 7.200E-0 40-ZR- 89 4.095E+01 8.260E-01 1.379E+00 5.864E+00 1.200E+0 40-ZR- 91 4.036E+01 8.200E-01 7.822E-01 5.383E+00 2.130E+0 40-ZR- 91 4.036E+01 8.000E-01 7.822E-01 5.057E+00 1.200E+0 40-ZR- 92 4.038E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0 40-ZR- 92 4.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0 4.02E-01 7.100FF PARAMS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 12.04 FOR ZR- 91 AND 6.937 FOR ZR- 92. REFERENCES 1) AOKI T ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 3) CHIBA, S. ET AL.: JAERI-M 90-006 (1990). 6) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. 7) MUGHABGHAB, S.F. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). 6) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. 7) MUSGROVE, A.R. DE L., ET AL.: MUST, J. PHYS., 30, 391(1977) 9) BUSEGAN, A. ET AL.: "FROC. INT. CONF. ON NEUTRON PHYSICS NUCL DATA FOR REACTORS, HARWELL 1978", 706. | 000
1
1
0000
- |

- 13) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 14) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77

- 14) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. LECTINUL., 20, 77 (1983).
 15) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 16) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 17) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 18) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 19) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
- 19) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 20) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 21) GRUPPELAAR, H.: ECN-13 (1977).
 22) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 23) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 24) MUSGROVE, A.R. DE L. ET AL.: "PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978", 449.
 25) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 26) FORREST, R.A.: AERE-R 12419 (1986).
 27) KUNZ, P.D.: PRIVATE COMMUNICATION.

| MAT number = 4031
40-ZR- 92 JNDC | EVAL-AUG89 JND
DIST-SEP90 REV | C FP NUCLEAR DATA W.G.
2-APR94 |
|---|---|--|
| HISTORY
84-10 EVALUATION FOR
89-08 MODIFICATION FO
90-10 MF=5: SPECTRA A
94-04 JENDL-3.2: DADA | JENDL-2 WAS MAD
R JENDL-3 WAS M
T THRESHOLD ENE | E BY JNDC FPND W.G./1/
ADE/2/.
RGIES WERE MODIFIED. |
| OTHERS WERE MA
COMPILED BY T.N. | METERS BY M.KAW
INLY TAKEN FROM
AKAGAWA (NDC/JA | JENDL FUSION FILE
ERI) |
| ***** MODIFIED
(3,2), (3,4), (3
(4,16-91) | PARTS FOR JEND
3,51-91), (3,16 | L-3.2 ************************************ |
| (5,16-91)
ABOVE DA
(2,151) PARAI
******* | TA WERE TAKEN F
METERS OF A NEG | ROM JENDL FUSION FILE.
ATIVE RESONANCE
***** |
| JENDL FUSION FI
EVALUATED | LE /3/ (AS OF
AND COMILED BY | APR. 1994)
S. CHIBA (NDC/JAERI) |
| DATA WERE TAKEN
- THE DISCRETE
SECTIONS WER
SINCROS-LI S | FROM JENDL-3.1
AND CONTINUUM
E CALCULATED WI
YSTEM/4/ INCLUD | EXCEPT FOR THE FOLLOWING:
INELASTIC SCATTERING CROSS
TH CASTHY2Y AND DWUCKY IN
ING CONTRIBUTIONS FROM |
| - ANGULAR DIST
CALCULARTED W
- THRESHOLD RE.
REPLACED WIT | TUNS.
RIBUTIONS OF DI
ITH CASTHY2Y AN
ACTION CROSS SE
H THOSE CALCULA | SCRETE INELASTICS WERE ALSO
D DWUCKY.
CTIONS (MT=16, 17) WERE
TED BY EGNASH2 IN THE |
| - ENERGY DISTR
BY THOSE CAL
THE DDX'S OF
KUMABE'S SYS | IBUTIONS OF SEC
CULATED BY EGNA
THE CONTINUUM
TEMATICS /5/ US | ONDARY NEUTRONS WERE REPLACED
SH2 EXCEPT FOR MT=32 AND 33.
NEUTRONS WERE CALCULATED BY
ING F15TOB /3/THE |
| - OPTICAL-MODE
THE SINCROS
LEVEL SCHEME | EMPOUND RATIO
EM.
L. LEVEL DENSIT
II CALCULATION
S WERE DETERMIN | Y AND OTHER PARAMETERS USED IN
ARE DESCRIBED IN REF./4/.
ED ON THE BASIS OF ENSDF/6/. |
| MF = 1 GENERAL INFOR | MATION | |
| MT=431 COMMENTS AND
MF = 2 RESONANCE PAR
MT=151 RESOLVED AND
RESOLVED RESONANCE I
RESONANCE PARAMET
JENDL-2 WAS BASED
PARAMETERS OF A N
RADIUS WERE ADOPTI
AL./8/ AVERAGE R,
ASSUMED FOR S-WAV
JENDL-3.2, THE PA
MODIFIED TO REPRO
SECTION OF 7.1 B | AMETERS
UNRESOLVED RES
REGION (MLBW FO
ERS WERE TAKEN
ON THE MEASURE
EGATIVE RESONAN
ED FROM THE REC
ADIATION WIDTHS
E AND P-WAVE RE
RAMETERS OF THE
DUCE THE THERMA
OF ZR-92 AND 6. | ONANCE PARAMETERS
RMULA) : BELOW 71 KEV
FROM JENDL-2. EVALUATION FOR
D DATA BY BOLDEMAN ET AL./7/
CE AND EFFECTIVE SCATTERING
OMMENDATION OF MUGHABGHAB ET
OF 0.180 EV AND 0.270 WERE
SONANCES, RESPECTIVELY. FOR
NEGATIVE RESONANCE WERE
L ELASTIC SCATTERING CROSS
4 B/8/ OF NATURAL ZR. |
| UNRESOLVED RESONANC
THE NEUTRON STREM
COMPILATION OF MU
OPTICAL MODEL COD
DETERMINED TO REP
WITH CASTHY. THE
FROM FITTING TO T
THE RADIATION WID
COMPILATION OF MU | E REGION : 71 K
GTH FUNCTIONS S
GHABGHAB ET AL .
E CASTHY/9/. T
RODUCE THE CAPT
EFFECTIVE SCAT
HE CALCULATED T
THS GG(S) AND G
GHABGHAB ET AL. | EV - 100 KEV
O AND S1 WERE BASED ON THE
, AND S2 WAS CALCULATED WITH
HE OBSERVED LEVEL SPACING WAS
URE CROSS SECTION CALCULATED
TERING RADIUS WAS OBTAINED
OTAL CROSS SECTION AT 100 KEV.
G(P) WERE BASED ON THE |
| TYPICAL VALUES OF T
S0 = 0.500E-4, S1
SG(P) = 1.11E-4, | HE PARAMETERS A
= 7.000E-4, S2
GG(S)= 0.140EV, | T 80 KEV:
= 0.380E-4, SG(S)= 0.433E-4,
GG(P)= 0.360EV, R = 5.964FM. |
| CALCULATED 2200-M/S
TOTAL
ELASTIC
CAPTURE | CROSS SECTIONS
2200 M/S
7.339
7.110
0.2292 | AND RES. INTEGRALS (BARNS)
RES. INTEG.
-
0.714 |

= 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. MF = 3

FOR JENDL-3.1, ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/11/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/.

FOR JENDL-3.2, DATA OF INELASTIC, (N,2N) AND (N,3N) REACTION CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/19/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

' = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. МΤ

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | = ==.= | | | | | | | |
|---------------------------------------|--|--|--|---|--|--|------------------------------------|----------|
| LE | NO.
GR.
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
8
0
0
17
8
0
0
11
15
16
17
8
0
0
10
11
15
16
17
8
0
0
10
1
12
3
4
5
6
7
8
9
10
1
12
3
4
5
6
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
7
8
9
10
11
10
10
10
10
10
10
10
10
10
10
10 | ENERGY (M
0.0
0.9345
1.3828
1.4954
1.8473
2.0667
2.1500
2.3397
2.3983
2.4859
2.7435
2.8197
2.8640
2.9036
2.9095
2.9578
3.0397
3.0578 | EV)
WERE | SPIN-
02
04
22
23
45
42
24
03
62
22
ASSUME | PARITY
++++++++++++++++++++++++++++++++++++ | (DIRECT
*
*
*
*
E OVERLAF | PROCESS | S) |
| MT = 1
MT = 1
TAKE | 6 (N,2N
7 (N,3N
N FROM J |) CROSS SECT
) CROSS SECT
ENDL FUSION | ION
ION
FILE. | | | | | |
| MT = 1
SPHE
CAST
SECT
AND | 02 CAPT
RICAL OP
HY WAS A
IONS WER
REFF0/20 | URE
TICAL AND ST
DOPTED. DIR
E ESTIMATED
/ AND NORMAL | ATISTI
ECT AN
ACCORE
IZED T | CAL MO
ND SEMI
DING TO
TO 1 MI | DEL CAL
-DIREC
THE PI
LLI-BAL | LCULATION
T CAPTURE
ROCEDURE
RN AT 14 | N WITH
CROSS
OF BEN2
MEV. | ΖI |
| THE
REPR
KEV | GAMMA-RA
ODUCE TH
MEASURED | Y STRENGTH F
E CAPTURE CR
BY MUSGROVE | UNCTIO
OSS SE
ET AL |)N (8.9
CTION
/21/ | 99E-05)
OF 30 1 | WAS ADJU
MILLI-BAF | ISTED TO
RNS AT |)
100 |
| MT = 2
MT = 2
MT = 3
MT = 3 | 22 (N,N'
28 (N,N'
22 (N,N'
33 (N,N' | A) CROSS SEC
P) CROSS SEC
D) CROSS SEC
T) CROSS SEC | T I ON
T I ON
T I ON
T I ON
T I ON | | | | | |

Μ MT =103 (N,P) CROSS SECTION

| MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
|--|
| THE KALBACH'S CONSTANT K (= 163.7) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 22.00 MB (MEASURED BY IKEDA+/23/)
(N,ALPHA) 9.50 MB (AVERAGED VALUE OF QAIM+/24/
AND BAYHURST+/25/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT = 2 |
| CALCULATED WITH CASTHY/9/.
MT = 51-67
TAKEN EROM IENDI EUSION ELLE WHICH WAS CALCULATED WITH |
| CASTHY AND DWUCK/26/ (DWUCKY) IN THE SINCROS-II SYSTEM.
MT = 16,17,22,28,32,33,91
TRANSFORMED EROM ME-6 DATA (DDX) OF JENDI FUSION FILE |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS |
| MT = 16,17,22,28,91
TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE.
MT = 32,33
CALCULATED WITH PEGASUS. |
| < <following and="" are="" calc.="" casthy="" in="" parameters="" pegasus="" the="" used="">>
TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS</following> |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 46.0-0.25E R0 = 5.893 A0 = 0.62 WS = 7.0 RS = 6.393 AS = 0.35 VS0= 7.0 RS0= 5.893 AS0= 0.62 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 38-SR-88 9.160E+00 7.510E-01 8.288E-02 4.550E+00 2.170E+00 38-SR-89 9.380E+00 8.200E-01 5.043E-01 4.642E+00 1.240E+00 38-SR-90 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+00 38-SR-91 1.090E+01 8.100E-01 1.103E+00 5.625E+00 1.240E+00 |
| 39-Y897.900E+008.500E-013.983E-013.440E+009.300E-0139-Y-901.027E+016.770E-011.716E+002.209E+000.039-Y-911.050E+017.140E-018.362E-013.521E+007.200E-0139-Y-921.012E+017.629E-012.480E+003.191E+000.0 |
| 40-ZR-909.152E+008.222E-011.526E-015.383E+002.130E+0040-ZR-911.036E+018.000E-017.822E-015.057E+001.200E+0040-ZR-921.088E+018.192E-015.122E-016.429E+001.920E+0040-ZR-931.298E+017.000E-011.273E+005.183E+001.200E+00 |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3)
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.937 FOR ZR- 92 AND 6.100 FOR ZR- 93. |
| REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 3) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 4) YAMAMURO, N.: JAERI-M 90-006 (1990). 5) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). |
| 6) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/ŃNDC.
7) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986). |

8) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,

- 9) 10́)
- PART A", ACADEMIC PRESS (1981). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 11)
- 12)
- 13)
- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 14) 15)
- W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 16) GILBERT, A. AND CAMERON, A.G.W.. GAN. G. HILE, (1965).
 17) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 18) GRUPPELAAR, H.: ECN-13 (1977).
 19) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 21) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
 22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 23) IKEDA, Y. ÉT AL.: JAERI 1312 (1988).
 24) QAIM, S. M., ET AL.: EURATOM REPORT 5182E, 939 (1974).
 25) BAYHURST, B. P., ET AL.: J. INORG. NUCL. CHEM., 23, 173 (1961).

- (1961). 26) KUNZ, P.D.: PRIVATE COMMUNICATION.

MAT number = 4034 40-ZR- 93 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF T=45T COMMERTED AND DIGITIONAL
 = 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.7 KEV
 RESONANCE PARAMETERS WERE NEWLY EVALUATED AS FOLLOWS:
 RESONANCE ENERGIES, NEUTRON WIDTHS AND RADIATION WIDTHS WERE
 MAINLY TAKEN FROM THE MEASUREMENT OF MACKLIN/3/ UP TO 6.1 KEV.
 NEUTRON WIDTHS NOT MEASURED WERE DETERMINED FROM CAPTURE AREA
 DATA, AND TOTAL AND RADIATION WIDTHS OF MACKLIN ET AL./4/
 AVERAGE RADIATION WIDTHS WERE DEDUCED TO BE 0.145 EV FOR
 S-WAVE RESONANCES, AND 0.250 EV FOR P-WAVE RESONANCES. TOTAL
 SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A
 RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF
 SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND
 THOMAS/5/. SCATTERING RADIUS WAS BASED ON THE SYSTEMATICS OF
 MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE
 RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE
 CROSS SECTION GIVEN BY MUGHABGHAB ET AL./6/ MF ΪΚΈν. UNRESOLVED RESONANCE REGION : 1.7 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.370E\text{-}4, \ S1 = 5.480E\text{-}4, \ S2 = 0.360E\text{-}4, \ SG = 5.31E\text{-}4, \\ GG = 0.200 \ \text{EV}, \ R = 6.734 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL ELASTIC CAPTURE 7.892 5.653 18.2 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/9/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/. MF

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

ENERGY(MEV) 0.0

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/

SPIN-PARITY 5/2 + 3/2 +

/16/. MТ

MT = 2

1

TOTAL

NO. GR.

| 2 | 0.9490 | | 1/2 + | | |
|-----------|--------------|------|------------|----|--------------|
| 3 | 1.4231 | | 3/2 + | | |
| 4 | 1.4800 | | 7/2 + | | |
| 5 | 1.6000 | | 9/2 + | | |
| 6 | 1.6500 | | 5/2 + | | |
| 7 | 1.9200 | | 1/2 + | | |
| 8 | 2.0400 | | 11/2 - | | |
| 9 | 2.0800 | | 9/2 + | | |
| 10 | 2.1000 | | 1/2 + | | |
| LEVELS AB | 0VE 2.18 MEV | WERE | ASSUMED TO | ΒE | OVERLAPPING. |

MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

THE GAMMA-RAY STRENGTH FUNCTION (5.35E-04) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.20 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (374 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS.

| | MT = 16
MT = 17
MT = 22
MT = 28
MT = 32
MT = 33
MT = 103
MT = 104
MT = 107
THESE
PREEQ | (N,2
(N, N, N
(N, N, N
(N, N, N
(N, 1
(N, 1
(N, 1
(N, 2
(N, 2
(N, 2
(N, 2
(N, 2
(N, 2
(N, 2
(N, 2)))))))))))))))))))))))))))))))))))) | N) CRO
N) CRO
I'A) CR
I'P) CR
I'P) CR
I'P) CROS
I'P) CROSS
CROSS
ILPHA
ION CR
IUM AN | SS SEE
SSS SEE
SSS SEE
SSSS SEE
SSSS SEE
SSSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SEE
SSS SSS | TION
TION
CTION
CTION
CTION
TON
TON
TON
SECTIO
SECTIONS
T-STEP | N
WERE
EVAPO | CALCUL/
RATION | ATED WITH
MODEL CC | THE
DE PEGASU | S . |
|----|--|---|--|--|---|-------------------------------------|--|---|--------------------------------------|----------|
| | THE K
FORMU
DENSI | ALBACH
LA DER
TY PAR | I'S CON
IVED F
AMETER | STANT I
ROM KII
S. | < (= 1
<uchi-< td=""><td>78.4)
KAWA1'</td><td>WAS ES
S FORM</td><td>FIMATED B
ALISM/19/</td><td>Y THE
AND LEVE</td><td>L</td></uchi-<> | 78.4)
KAWA1' | WAS ES
S FORM | FIMATED B
ALISM/19/ | Y THE
AND LEVE | L |
| | FINAL
NORMA
(N,
(N, | LY, TH
LIŻED
P)
ALPHA) | IE (N,P
TO THE
1 |) AND
FOLLO
2.70
3.79 | (N,ALP
VING V
MB (SY
MB (SY | HA) CR
ALUES
STEMAT
STEMAT | AT 14.5
AT 14.5
ICS OF
ICS OF | CTIONS WE
5 MEV:
FORREST/
FORREST) | RE
20/) | |
| | MT = 25
CALCU | 1 MU-
LATED | BAR
WITH C | ASTHY. | | | | | | |
| MF | = 4 A
LEGENDR
GIVEN I
TIC LEV | NGULAR
E POLY
N THE
ELS, A | DISTR
NOMIAL
CENTER | IBUTIO
COEFF
- OF - MAS
THE IA | NS OF
ICIENT
SS SYS
BORATO | SECOND
S FOR
TEM FO
RY SYS | ARY NEU
ANGULAI
R MT=2 | JTRONS
R DISTRIB
AND DISC
R MT=91 | UTIONS ARI
RETE INELA
THEY WER | E
AS- |

CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| | | DEPTH (M | EV) | RADIUS(FM) | DIFFUSE | NESS(FM) |
|--|--------------------------------|--|--|--|--|--|
| THE F | V =
WS =
VSO=
FORM OF | 46.0-0.25E
7.0
7.0
SURFACE AB | SORPTION P | R0 = 5.893
RS = 6.393
RS0= 5.893
ART IS DER | A0 = 0
AS = 0
AS0= 0
WOODS-SA) | 62
35
62
(ON TYPE. |
| TABLE 2 | 2 LEVE | L DENSITY P | ARAMETERS | | | |
| NUCLI | DE SYS | T A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
| 38 - SR
38 - SR
38 - SR
38 - SR | - 89
- 90
- 91
- 92 * | 9.380E+00
9.940E+00
1.090E+01
1.288E+01 | 8.200E-01
8.530E-01
8.100E-01
7.065E-01 | 5.043E-01
3.795E-01
1.103E+00
2.515E-01 | 4.642E+00
6.252E+00
5.625E+00
6.391E+00 | 1.240E+00
1.960E+00
1.240E+00
2.360E+00 |
| 39-Y
39-Y
39-Y
39-Y
39-Y | - 90
- 91
- 92
- 93 | 1.027E+01
1.050E+01
1.012E+01
1.150E+01 | 6.770E-01
7.140E-01
7.629E-01
8.053E-01 | 1.716E+00
8.362E-01
2.480E+00
1.740E+00 | 2.209E+00
3.521E+00
3.191E+00
5.854E+00 | 0.0
7.200E-01
0.0
1.120E+00 |

| 40-ZR-911.036E+018.000E-017.822E-015.057E+001.200E+0040-ZR-921.088E+018.192E-015.122E-016.429E+001.920E+0040-ZR-931.298E+017.000E-011.273E+005.183E+001.200E+0040-ZR-941.275E+017.530E-014.411E-017.019E+002.320E+00 |
|---|
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.100 FOR ZR- 93 AND 5.524 FOR ZR- 94. |
| REFERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). MACKLIN, R.L. ET AL.: NUCL. SCI. ENG., 92, 525 (1986). MACKLIN, R.L. : ASTROPHYS. SPACE SCI., 115, 71 (1985). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 |
| 10) PEREY, F.G: PHYS. REV. 131, 745 (1963). 11) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 12) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 13) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. |
| 14) ĠİĽBĖRT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965) |
| 15) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 16) GRUPPELAAR, H.: ECN-13 (1977). 17) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). |
| 18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS". NORTH HOLLAND (1968). |

20) FORREST, R.A.: AERE-R 12419 (1988).

| MAT number
40-ZR- 94 | = 4037
JNDC | EVAL-AUG89 JNDC FP NUCLEAR DATA W.G.
DIST-SEP90 REV-SEP93 |
|---|---|---|
| 84-10 EVALU
89-08 MODIF
90-10 MF=5:
93-09 JENDL
COMPI | IATION FOR J
TCATION FOR
SPECTRA AT
-3.2.
LED BY T.NA | ENDL-2 WAS MADE BY JNDC FPND W.G./1/
2 JENDL-3 WAS MADE/2/.
3 THRESHOLD ENERGIES WERE MODIFIED.
3 KAGAWA (NDC/JAERI) |
| * * * * * *
(3,2)
(4,16 | MODIFIED
, (3,4), (3
;-91) | PARTS FOR JENDL-3.2 ************************************ |
| (5,16 | 5-91)
THESE DAT | A.WERE TAKEN FROM JENDL FUSION FILE. |
| JENDL | FUSION FIL
EVALUATED | .E /3/ (AS OF SEP. 1993)
AND COMILED BY S. CHIBA (NDC/JAERI) |
| DATA
- TH
SE
SI
DI | WERE TAKEN
IE DISCRETE
ICTIONS WERE
NCROS-II SY
RECT REACTI | FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
AND CONTINUUM INELASTIC SCATTERING CROSS
CALCULATED WITH CASTHY2Y AND DWUCKY IN
STEM/4/ INCLUDING CONTRIBUTIONS FROM
ONS. |
| CA
- TH
WE | LCULATED WI
IE (N,2N) AN
RE REPLACED | TH CASTHY2Y AND DWUCKY.
D (N,3N) REACTION CROSS SECTIONS (MT=16, 17)
WITH THOSE CALCULATED BY EGNASH2 IN THE |
| - EN
BY
NC
CC
T
R
OP
- OP | LERGY DISTRI
THOSE CALC
TTAKEN INT
NTINUUM NEU
CS /5/ USIN
TICAL-MODEL
E SINCROS-1 | BUTIONS OF SECONDARY NEUTRONS WERE REPLACED
ULATED BY EGNASH2 EXCEPT FOR MT=32 WHICH WAS
O ACCOUNT IN EGNASH2. THE DDX'S OF THE
ITRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
IG F15TOB /3/. THE PRECOMPOUND/COMPOUND
CULATED BY THE SINCROS- II CODE SYSTEM.
LEVEL DENSITY AND OTHER PARAMETERS USED IN
I CALCULATION ARE DESCRIBED IN REF./4/. |
| LE
 | VEL SCHEMES | WERE DETERMINED ON THE BASIS OF ENSUF767. |
| MF = 1 GEN MT = 451 CC | IERAL INFORM | IATION
DICTIONARY |
| MF = 2 KES
MT=151 RE
RESOLVED
RESOLVED
BOLDEMA
BOLDEMA
REPRODU
ELASTIC
AVERAGE
TO S-WA | SOLANCE PARA
SOLVED AND
RESONANCE R
ICE PARAMETE
METERS WERE
N ET AL./7/
ICE THE CAPT
CE THE CAPT
CE THE CAPT
RADIATION
RADIATION | MEIERS
UNRESOLVED RESONANCE PARAMETERS
EGION (MLBW FORMULA) : BELOW 53.5 KEV
RS WERE TAKEN FROM JENDL-2.
DETERMINED ON THE BASIS OF MEASURED DATA BY
A NEGATIVE RESONANCE WAS ADDED TO
URE CROSS SECTION OF 0.0499 BARN AND THE
G CROSS SECTION OF 6.1 BARN AT 0.0253 EV/8/.
WIDTHS OF 0.090 EV AND 0.175 EV WERE ADOPTED
VE RESONANCES, RESPECTIVELY. |
| UNRESOLVE
UNRESOL
THE NEU
WITH OP
WAS DET
CALCULA
OBTAINE
100 KEV | D RESONANCE
VED RESONAN
ITRON STRENG
TTICAL MODEL
ERMINED TO
TED WITH CA
D FROM FITT
'. | REGION : 53.5 KEV - 100 KEV
CE PARAMETERS WERE ADOPTED FROM JENDL-2.
TH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED
. CODE CASTHY/9/. THE OBSERVED LEVEL SPACING
REPRODUCE THE CAPTURE CROSS SECTION
.STHY. THE EFFECTIVE SCATTERING RADIUS WAS
ING TO THE CALCULATED TOTAL CROSS SECTION AT |
| TYPICAL V
S0 = 0.
GG = 0. | /ALUES OF TH
370E-4, S1
190 EV, R | IE PARAMETERS AT 70 KEV:
= 5.500E-4, S2 = 0.360E-4, SG = 0.534E-4,
= 6.704 FM. |
| CALCULATE
TOTAL
ELAST
CAPTU | ED 2200-M/S
2
IC
IRE | CROSS SECTIONS AND RES. INTEGRALS (BARNS)
200 M/S RES. INTEG.
6.202 -
6.152 -
0.04981 0.321 |
| MF = 3 NEU
BELOW 100
ABOVE 100
CALCULATI
COMPETING
WITH PEGA | UTRON CROSS
) KEV, RESON
) KEV, THE S
ON WAS PERF
3 REACTIONS,
SUS/10/ STA | SECTIONS
IANCE PARAMETERS WERE GIVEN.
PHERICAL OPTICAL AND STATISTICAL MODEL
ORMED WITH CASTHY, BY TAKING ACCOUNT OF
OF WHICH CROSS SECTIONS WERE CALCULATED
NDING ON A PREEQUILIBRIUM AND MULTI-STEP |

EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/11/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/. /18/. FOR JENDL-3.2, DATA OF INELASTIC, (N,2N) AND (N,3N) REACTION CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/19/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. ΜT TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. SPIN-PARITY (DIRECT PROCESS) NO. ENERGY(MEV) 0.0 ĠŔ. Ò + * 2 1234567890 10 1.3002 0 1.4696 4 3 1.4696 4 + 4 1.6714 2 + 5 2.0576 3 - * 6 2.1513 2 + 7 2.3302 4 + 9 2.5077 3 + * 10 2.6045 5 -11 2.6985 1 + 12 2.8260 2 + 13 2.8463 1 + 14 2.8606 4 + * LEVELS ABOVE 2.861 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION TAKEN FROM JENDL FUSION FILE. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (4.89E-05) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 19 MILLI-BARNS AT 100 KEV MEASURED BY MUSGROVE ET AL./21/ T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 22 MT = 28 MT = 32 MT = 103МŢ MT MT THE KALBACH'S CONSTANT K (= 161.8) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE

NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 10.00 MB (RECOMMENDED BY FORREST/23/) (N,ALPHA) 4.80 MB (MEASURED BY IKEDA+/24/) MT = 251 MU-BAR CALCULATED WITH CASTHY. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 51-64 TAKEN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH CASTHY AND DWUCK/25/ (DWUCKY) IN THE SINCROS-II SYSTEM. MT = 16,17,22,28,32,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. MT = 32 CALCULATED WITH PEGASUS. <<FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> _____ TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 9.940E+00 8.530E-01 3.795E-01 6.252E+00 1.960E+00 1.090E+01 8.100E-01 1.103E+00 5.625E+00 1.240E+00 * 1.288E+01 7.065E-01 2.515E-01 6.391E+00 2.360E+00 * 1.386E+01 6.989E-01 1.878E+00 5.664E+00 1.240E+00 38-SR- 90 38-SR- 91 38-SR- 92 38-SR- 93 1.050E+01 7.140E-01 8.362E-01 3.521E+00 7.200E-01 1.012E+01 7.629E-01 2.480E+00 3.191E+00 0.0 1.150E+01 8.053E-01 1.740E+00 5.854E+00 1.120E+00 9.149E+00 7.385E-01 1.378E+00 2.222E+00 0.0 39-Y - 91 39-Y - 92 39-Y - 93 39-Y - 94 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+00 1.298E+01 7.000E-01 1.273E+00 5.183E+00 1.200E+00 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00 1.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E+00 40-ZR- 92 40-ZR- 93 40-ZR- 94 40-ZR- 95 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.524 FOR ZR- 94 AND 5.652 FOR ZR- 95. REFERENCES REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMÚRO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NDC.
BOLDEMAN, J.W., ET AL.: NUCL. PHYS., A269, 31 (1976).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 10) 11) 1983). SERFY. F.G: PHYS. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 12) 13) 14) 15)

- (1971).
 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 17) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 18) GRUPPELAAR, H.: ECN-13 (1977).
 19) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 21) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL DATA FOR REACTORS, HARWELL 1978, 449.
 22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 23) FORREST, R.A.: AERE-R 12419 (1986).
 24) IKEDA, Y. ET AL.: JAERI 1312 (1988).
 25) KUNZ, P.D.: PRIVATE COMMUNICATION.

MAT number = 4040 40-ZR- 95 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 125 EV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.370E-4, S1 = 5.420E-4, S2 = 0.360E-4, SG = 8.03E-4, GG = 0.200 EV, R = 6.737 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 6.904 5.704 TOTAL ELASTIC CAPTURE 7.79 F = 3 NEUTRON CROSS SECTIONS BELOW 125 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMATICS FROM THE NEIGHBORING ZR ISOTOPES. THE SCATTERING CROSS SECTION WAS CALCULATED FROM R = 6.737 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 125 EV TO 100 KEV. 1.200 MF = 3ABOVE 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/5/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). * = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./13/ NO. ENERGY(MEV) SPIN-PARITY 0.0 0.9530 1.1730 1.3190 1.6180 5/2 + 1/2 + 3/2 + GR. 1 3/2 + 3/2 + 7/2 + 3/2 + 3/2 + 5/2 + 3/2 + 3 4 5 1.6180 6 7 1.7180 1.7890 8 1.8960

| 9 1.9400 5/2 +
10 2.0180 11/2 -
11 2.2520 3/2 +
12 2.2800 1/2 +
13 2.2910 3/2 +
14 2.3760 3/2 +
15 2.4500 7/2 +
16 2.6250 3/2 +
17 2.6250 3/2 +
17 2.6250 11/2 -
18 2.7240 7/2 +
19 2.8340 3/2 -
20 2.8340 11/2 -
21 2.9960 3/2 +
22 3.0620 3/2 +
23 .0620 3/2 +
23 .1170 11/2 -
LEVELS ABOVE 3.205 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCTION (8.00E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.2 EV) AND AVERAGE S-WAVE
RESONANCE LEVEL SPACING (250 EV). |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 171.2) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 5.68 MB (SYSTEMATICS OF FORREST/16/)
(N,ALPHA) 1.61 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $V = 46.0-0.25E \qquad R0 = 5.893 \qquad A0 = 0.62$
WS = 7.0 $RS = 6.393 \qquad AS = 0.35$
VS0 = 7.0 $RS = 5.893 \qquad AS = 0.62$
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.
TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 38-SR-911.090E+018.100E-011.103E+005.625E+001.240E+0038-SR-92*1.288E+017.065E-012.515E-016.391E+002.360E+0038-SR-93*1.386E+016.989E-011.878E+005.664E+001.240E+0038-SR-94*1.485E+016.915E-014.495E-017.333E+002.530E+00 |
| 39-Y - 92 1.012E+01 7.629E-01 2.480E+00 3.191E+00 0.0 |

39-Y - 93 1.150E+01 8.053E-01 1.740E+00 5.854E+00 1.120E+00 39-Y - 94 9.149E+00 7.385E-01 1.378E+00 2.222E+00 0.0 39-Y - 95 1.070E+01 8.306E-01 1.082E+00 5.839E+00 1.290E+00 40-ZR- 93 1.298E+01 7.000E-01 1.273E+00 5.183E+00 1.200E+00 40-ZR- 94 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00 40-ZR- 95 1.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E+00 40-ZR- 96 1.320E+01 7.000E-01 2.235E-01 6.589E+00 2.490E+00 40-ZR- 96 1.320E+01 7.000E-01 2.235E-01 6.589E+00 2.490E+00 5YST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS.
SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.652 FOR ZR- 95 AND 3.791 FOR ZR- 96.
REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2. P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
6) PEREY, F.G: PHYS. REV. 131, 745 (1963).
7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. A232. 381 (1974).
9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLKAIZATION W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
10 GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
11 GRUPPELAAR, H.: ECN-13 (1977).
11 JIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12 GRUPPELAAR, H.: ECN-13 (1977).
13 MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
14 BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
15) KINCHI, K. AND REFFO, G.: CCDN-NW/10 (1969).
16) FORREST, R.A.: AERE-R 12419 (1986).

| MAT number = 4043 | EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. |
|---|--|
| 40-ZR- 96 JNDC | DIST-SEP90 REV2-SEP93 |
| HISTORY
84-10 EVALUATION
89-08 MODIFICATIO
90-10 MF=5: SPECT
93-09 JENDL-3.2. | FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/
N FOR JENDL-3 WAS MADE/2/.
RA AT THRESHOLD ENERGIES WERE MODIFIED. |
| ***** NODI | |
| (3,2), (3,4
(4,16-91)
(5,16-91) |), $(3,16)$, $(3,17)$, $(3,51-91)$ |
| (3, 10-31)
THES | E DATA WERE TAKEN FROM JENDL FUSION FILE |
| JENDL FUSIO | N FILE /3/ (AS OF SEP. 1993) |
| EVALU | ATED AND COMILED BY S. CHIBA (NDC/JAERI) |
| DATA WERE T | AKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING: |
| - THE DISC | RETE AND CONTINUUM INELASTIC SCATTERING CROSS |
| SECTIONS | WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN |
| SINCROS- | LI SYSTEM/4/ INCLUDING CONTRIBUTIONS FROM |
| DIRECT R | EACTIONS. |
| - ANGULAR | DISTRIBUTIONS OF DISCRETE INELASTICS WERE ALSO |
| CALCULAT | ED WITH CASTHY2Y AND DWUCKY. |
| - THF (N 2 | N) AND (N 3N) REACTION CROSS SECTIONS (MT=16, 17) |
| WERE RÉP
SINCROS- | ĂCÊD WITH THOSE CALCULĂTĚD BY EGNASH2 ÎN THẢ |
| - ENERGY D | STRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED |
| BY THOSE | CALCULATED BY EGNASH2. THE DDX'S OF THE |
| CONTINUE | M NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA- |
| RATIO WA | S CALCULATED BY THE SINCROS- II CODE SYSTEM. |
| - OPTICAL | MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN |
| THE SINC | ROS-II CALCULATION ARE DESCRIBED IN REF./4/. |
| LEVEL SC | HEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. |
| | |
| MF = 1 GENERAL I | NFORMATION |
| MT=451 COMMENTS | AND DICTIONARY |
| MF = 2 RESONANCE | PARAMETERS |
| MT=151 RESOLVED | AND UNRESOLVED RESONANCE PARAMETERS |
| RESOLVED RESONA | NCE REGION (MLBW FORMULA) : BELOW 100 KEV |
| RESONANCE PAR | AMETERS WERE TAKEN FROM JENDL-2. |
| RESONANCE | ENERGIES AND NEUTRON WIDTHS WERE BASED ON THE |
| MEASURED VALU | ES BY COCEVA ET AL./7/ BELOW 41.5 KEV AND THOSE |
| BY MUSGROVE E | T AL./8/ ABOVE 41.5 KEV. THE NEUTRON WIDTHS OF |
| MUSGROVE ET A | WERE MULTIPLIED BY A FACTOR OF 1.79 SO AS TO |
| ADJUST TO THE | DATA OF COCEVA ET AL. THE RADIATION WIDTHS WERE |
| ADOPTED FROM | 3RUSEGAN ET AL./9/ THE PARAMETERS OF THE 301-EV |
| LEVEL WERE TA | (EN FROM SALAH ET AL./10/ PARAMETER OF A NEGA- |
| TIVE RESONANC | E WAS BASED ON THE RECOMMENDED PARAMETERS GIVEN |
| IN REF./11/, | AND THE RADIATION WIDTH WAS MODIFIED SO AS TO |
| REPRODUCE THE | CAPTURE CROSS SECTION OF 0.0229+-0.0010 BARNS AT |

0.0253 EV/11/. AVERAGE RADIATION WIDTHS OF 0.068+-0.010 EV AND 0.170+-0.130 EV WERE ADOPTED TO S-WAVE AND P-WAVE RESONANCES, RESPECTIVELY.

NO UNRESOLVED RESONANCE REGION

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.154 ELASTIC 6.131 CAPTURE 0.02280 5.87

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESOLVED RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/12/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/13/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/14/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/15/

ALPHA = HUIZENGA AND IGO/16/ DEUTERON = LOHR AND HAEBERLI/17/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/18/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/19/ WERE EVALUATED BY IIJIMA ET AL./20/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (21) /21/. FOR JENDL-3.2, DATA OF INELASTIC, (N,2N) AND (N,3N) REACTION CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/22/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). . = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. ENERGY(MEV) NO. SPIN-PARITY (DIRECT PROCESS) NO. ENERGY (MEV) SPIN-PARITY (DIRECT PROCES GR. 0.0 0 + 1 1.5940 0 + 2 1.7505 2 + * 3 1.8971 3 - * 4 2.2259 1 -5 2.3300 2 + 6 2.4400 1 -7 2.8574 3 -LEVELS ABOVE 2.857 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION DATA FOR JENDL FUSION FILE WERE ADOPTED. • = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT BĔŇZI THE GAMMA-RAY STRENGTH FUNCTION (1.40E-5) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 12 MILLI-BARNS AT 30 KEV MEASURED BY WYRICK/24/ [= 22 (N,N'A) CROSS SECTION = 28 (N,N'P) CROSS SECTION = 103 (N,P) CROSS SECTION = 104 (N,D) CROSS SECTION = 105 (N,T) CROSS SECTION = 107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 22MT = 28MT = 103MT = 104MT = 105 MT = 107 THE KALBACH'S CONSTANT K (= 203.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWA1'S FORMALISM/25/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1500.00 MB (MEASURED BY IKEDA+/26/) (N,P) 3.79 MB (SYSTEMATICS OF FORREST/27/) (N,ALPHA) 3.00 MB (RECOMMENDED BY FORREST/27/) (N,2N) (N,P) (N,ALPHA) MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS 0
MT = 2
...CALCULATED WITH CASTHY/12/. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS ΜT = 51 - 57TĀKĚN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH

CASTHY2Y AND DWUCK/28/ (DWUCKY) IN THE SINCROS-II SYSTEM. MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE.

<<FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> _____ TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - - - - -- - - - - - -V = 46.0-0.25E R0 = 5.893 A0 = 0.62 WS = 7.0 RS = 6.393 AS = 0.35 VS0= 7.0 RS0= 5.893 AS0= 0.62 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.288E+01 7.065E-01 2.515E-01 6.391E+00 2.360E+00 1.386E+01 6.989E-01 1.878E+00 5.664E+00 1.240E+00 1.485E+01 6.915E-01 4.495E-01 7.333E+00 2.530E+00 1.586E+01 6.842E-01 4.531E+00 6.411E+00 1.240E+00 38-SR-92 * 38-SR-93 * 38-SR-94 * 38-SR- 95 * 39-Y - 93 39-Y - 94 39-Y - 95 39-Y - 96 1.150E+01 8.053E-01 1.740E+00 5.854E+00 1.120E+00 9.149E+00 7.385E-01 1.378E+00 2.222E+00 0.0 1.070E+01 8.306E-01 1.082E+00 5.839E+00 1.290E+00 * 1.603E+01 6.771E-01 2.794E+01 5.117E+00 0.0 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00 1.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E+00 1.320E+01 7.000E-01 2.235E-01 6.589E+00 2.490E+00 1.259E+01 5.590E-01 2.497E-01 3.084E+00 1.200E+00 40-ZR- 94 40-ZR- 95 40-ZR- 96 40-ZR- 97 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.791 FOR ZR- 96 AND 5.0 FOR ZR- 97. ASSUMED TO BE 3.791 FOR ZR- 90 AND 5.0 FOR ZR- 91.
REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
COCEVA, C., ET AL.: "PROC. INT. CONF. ON NEUTRON CROSS SECTIONS FOR TECHNOLOGY, KNOXVILLE 1979", 319 (1980).
MUSGROVE, A.R. DE L., ET AL.: AAEC/E-415 (1977).
BRUSEGAN, A., ET AL.: "PROC. ATH INT. SYMP. ON NEUTRON-CAPTURE GAMMA-RAY SPECTROSCOPY AND RELATED TOPICS, GRENOBLE 1981", 406, THE INSTITUTE OF PHYSICS, LONDON (1982).
SALAH, M.M, ET AL.: "PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE 1985", VOL. 1, 593 (1986).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
ILJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 15)16) 18) (1971). (1971). 19) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 19) GILBERT, A. AND GAMELER, (1965).
20) ILJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
21) GRUPPELAAR, H.: ECN-13 (1977).
22) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
23) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).

24) WYRICK, J.M. AND POENITZ, W.P.: ANL-83-4, 196 (1982).
25) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
26) IKEDA, Y. ET AL.: JAERI 1312 (1988).
27) FORREST, R.A.: AERE-R 12419 (1986).
28) KUNZ, P.D.: PRIVATE COMMUNICATION.

MAT number = 4125 41-NB- 93 NAIG EVAL-NOV88 M.KAWAI, N.YAMAMURO DIST-SEP89 REV2-FEB94 HISTORY 82-10 EVALUATION OF RESONANCE PARAMETERS FOR JENDL-2 WAS MADE 82-10 EVALUATION OF RESONANCE FORMETERS FOR JENEL BY KAWAI. 88-10 EVALUATION WAS PERFORMED FOR JENDL-3. 88-10 COMPILED BY K.SHIBATA (JAERI). 94-02 JENDL-3.2 RESONANCE PARAMETERS MODIFIED BY M.KAWAI(TOSHIBA). GAMMA-RAY PRODUCTION DATA BY S.IGARASI(NEDAC). OTHER DATA WERE ADOPTED FROM JENDL FUSION FILE. COMPILED BY T.NAKAGAWA MODIFIED PARTS FOR JENDL-3.2 (2,151) RESOLVED RESONANCE PARAMETERS MODIFIED (3,1), (3,2), (3,4), (3,51-91) FROM JENDL FUSION FILE (4,16-91) TAKEN FROM JENDL FUSION FILE (5,16-91) TAKEN FROM JENDL FUSION FILE (5,16-91) TAKEN FROM JENDL FUSION FILE (12,102) BELOW 100 KEV (15,102) BELOW 100 KEV JENDL FUSION FILE /1/ (AS OF FEB. 1994) EVALUATED BY B.YU(CIAE) AND S.CHIBA (NDC/JAERI) COMPILED BY S.CHIBA. CROSS SECTIONS WERE MAINLY TAKEN FROM JENDL-3.1 EXCEPT FOR THE (N,2N) AND CONTINUUM INELASTIC SCATTERING CROSS SECTIONS WHICH WERE TAKEN FROM THE SINCROS-II/2/ CALCULATION. INTERPOLATION SCHEME OF THE DISCRETE INELASTIC SCATTERING CROSS SECTIONS WAS CHANGED FROM 3 TO 2. THE TOTAL CROSS SECTION AT 10 AND 15 KEV, WHICH IS THE BACKGROUND CROSS SECTION, WERE SET TO 0.0.
 ENERGY DISTRIBUTIONS WERE REPLACED WITH THE SINCROS-II CALCULATION.
 MF=6 WAS MADE BY THE F15TOB PROGRAM/1/. THE PRECOM-UND TO COMPOUND RATIO WAS TAKEN FROM OUTPUT OF THE SINCROS-II CALCULATION. KALBACH'S SYSTEMATICS/3/ WAS ADOPTED FOR DDX.
 OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1RESONANCE PARAMETERS MF=2 $M\bar{T} = 151$ RESOLVED RESONANCES: 1.0E-5 EV - 7 KEV PARAMETERS IN JENDL-3.1 WERE TAKEN FROM JENDL-2 BY MODIFING J VALUES. THE JENDL-2 PARAMETERS WERE EVALUATED ON THE BASIS OF FOLLOWING MEASUREMENTS: OF FOLLOWING MEASUREMENTS: TRANSMISSION BY GARG ET AL./5/, POITTEVIN ET AL./6/ AND ILIESCU ET AL./7/ SCATTERING BY ILIESCU ET AL./7/ CAPTURE BY MACKLIN /8/, LOPEZ ET AL./9/ AND ILIESCU ET AL./7/ J VALUES DETERMINED BY HASTE ET AL. /10/ WERE ADOPTED. AVERAGE RADIATIVE WIDTH WAS ASSUMED TO BE 0.172 EV (0.212 EV FOR DOUBLET), AND SCATTERING RADIUS TO BE 7.10 FM. THE J VALUES OF RESONANCES WITHOUT KNOWN J VALUES WERE RANDOMLY ASSIGNED. FOR JENDL-3.2, RE-ASSIGNMENT OF J AND MODIFICATION OF NEUTRON AND RADIATIVE WIDTHS WERE MADE TO REPRODUCE THE MEASURED CAPTURE AREA DATA/8/. UNRESOLVED RESONANCES: 7 KEV - 100 KEV DETERMINED WITH THE ASREP CODE/11/ SO AS TO REPRODUCE THE EVALUATED SIG-C AND SIG-T UP TO 100 KEV. TYPICAL PARAMETERS AT 70 KEV: S0= 0.4E-4, S1=6.68E-4, D-0BS=96.0 EV, R=6.477 FM, RADIATIVE WIDTH= 0.172 EV CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200-M/S RES. INTEG. ELASTIC 6.319 B

| C/
T(| APTURE
DTAL | 1.149 B
7.468 B | 9.445 B
- | |
|--|--|--|--|--|
| MF=3 | NEU | TRON CROSS SECTIO | NS | |
| MT=1 | TOTAL
BELOW 100
100 KEV TO | KEV : BACKGROU
O 20 MEV: SPLINE-
EXPERIM | ND CROSS SECTIONS GIVEN.
FUNCTION FITTING TO THE
ENTAL DATA/12/. | |
| MT=2 | ELAST
(TOTAL) - | IC SCATTERING
(REACTION CROSS | SECTION) | |
| MT=4,5 | 51-62,91 II
THE INELAS
WERE CALCO
/13/, CONS
WALTER-GUS
OF MT=53.
THE CROSS
GNASH CODE
MODIFICAT
TO JENDL-3 | NELASTIC SCATTERI
STIC SCATTERING C
ULATED WITH THE S
SIDERING LEVEL FL
SS POTENTIAL PARA
S OF THE DIRECT P
54, 56, 57, 58,
SECTION TO CONTI
E /15/ CONSIDERIN
ION MADE FOR JEND
3.2. | NG
ROSS SECTIONS TO DISCRETE LEVELS
TATISTICAL-MODEL CODE CASTHY
UCTUATION, USING MODIFIED
METERS FOR NEUTRONS. THE
ROCESS WERE ADDED TO THE LEVELS
60 BY USING THE DWUCK CODE /14/.
NUUM WAS CALCULATED WITH THE THE
G PRE-EQUILIBRIUM. THE
L FUSION FILE WAS ALSO ADOPTED | |
| | THE LEVEL
NO.
G.S
1.
2.
4.
5.
6.
7.
8.
9.
10.
11.
12.
LEVELS ABC | SCHEME IS GIVEN ENERGY (MEV) SPIN- 0.0 9/2 0.0304 1/2 0.6860 3/2 0.7440 7/2 0.8087 5/2 0.9791 11/2 1.0826 9/2 1.2974 9/2 1.3156 5/2 1.3351 17/2 OVE 1.34 MEV | AS FOLLOWS:
PARITY
-
-
-
+
+
+
+
+
+
+
+
+
+
+
+
+
ASSUMED TO BE OVERLAPPING. | |
| | OPTICAL-M0
V=52.56
VSYM=-16
R0=1.229
A0=0.688 | ODEL PARAMETERS A
-0.30*EN, WS=3.2
6.5 , WI=-0.
9 , RS=1.2
8 , B=0.51 | RE AS FOLLOWS:
33+0.271*EN, VS0=6.004-0.015*EN
963+0.153*EN, WS0=0.291-0.018*EN
82 , RI=1.42, RS0=1.103
2 , AI=0.509, AS0=0.56 | |
| | THE LEVEL
CALCULATIO | DENSITY PARAMETE | RS FOR GNASH AND CASTHY
S: | |
| | (1
NB-94
NB-93
NB-92
ZR-93
Y-90
Y-89
(1
Y-89
(1
Y-89
(1
Y-89) | A EX
/MEV) (MEV) (M
4.4 4.059 0.
3.0 5.884 0.
1.5 3.254 0.
1.0 5.461 0.
3.7 5.923 0.
1.9 6.284 0.
1.1 1.441 0.
0.7 2.946 0. | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| MT=16 | (N,2N)
BASED ON - | THE EXPERIMENTAL | DATA/16,17/. | |
| MT=17
(N) | ,22,28,103
D) AND (N
CALCULATEI
OPTICAL PC
AND DEUTEF
LEMOS/19/ | ,104,107 (N,3N),(
,A) CROSS SECTION
D WITH GNASH/15/.
OTENTIAL PARAMETE
RON WERE TAKEN FR
AND LOHR AND HAE | N,N'A),(N,N'P),(N,P)
S
RS FOR PROTON, ALPHA-PARTICLE
OM THE WORKS OF PEREY/18/,
VERLI/20/, RESPECTIVELY. | |
| MT=102 | 2 RADIA
1.0E-5 EV
100 KEV T(
T-G/
SIG | TIVE CAPTURE CROS
TO 100 KEV: RESC
0 20 MEV: CALCULA
AMMA=0.0109; DETE
-C=107MB AT 100 K | S SECTION
NANCE PARAMETERS GIVEN.
TED WITH THE CASTHY CODE/13/.
RMINED SO AS TO REPRODUCE
EV, MEASURED BY REFFO ET AL./21/ | |
| MT=251 MU-BAR
CALCULATED FROM FILE-4. | | | | |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-62 | | | | |

CALCULATED WITH CASTHY FOR EQUILIBRIUM PROCESS. THE COMPONENTS OF THE DIRECT PROCESS WERE ADDED TO THE LEVELS OF MT=53,54,56,57,58,60 BY USING THE DWUCK CODE /14/. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. E=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF = 5E=12 PHOTON PRODUCTION MULTIPLICITIES MT=16,17,22,28,52-62,91,103,104,107 CALCULATED WITH GNASH. MF = 12MT=102 FROM ENERGY BALANCE. =14 PHOTON ANGULAR DISTRIBUTIONS MT=16,17,22,28,52-62,91,102,103,104,107 ASSUMED TO BE ISOTROPIC. MF = 14F=15 PHOTON ENERGY DISTRIBUTIONS MT=16,17,22,28,91,103,104,107 CALCULATED WITH GNASH. MF = 15MT = 1022 CALCULATED WITH CASTHY, REFERRING TO THE COMPILATION OF GAMMA-RAY SPECTRA FOR THERMAL NEUTRON BY LONE ET AL./22/ PRIMARY TRANSITIONS WERE TAKEN INTO ACCOUNT AT 1.0E-5, 2.53E-2, 1.0E+1, 1.0E+3, 3.0E+4 AND 1.0E+5 EV. 2.53E-2, 1.0E+1, 1.0E+3, 3.UE+4 AND 1.UE+5 EV.
REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KALBACH, C.: PHYS. REV. C37, 2350 (1988).
ENDDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
GARG, J.B. ET AL.: PHYS. REV. B137, 547 (1965).
POITTEVIN, G.LE. ET AL.: NUCL. PHYS. 70, 497 (1965).
ILIESCU, N. ET AL.: NUCL. PHYS. 72, 298 (1965).
MACKLIN, R.L.: NUCL. SCI. ENG. 59, 12 (1976).
LOPEZ, W.M. ET AL.: NUCL. PHYS. A33, 340 (1967).
HASTE, T.J. AND THOMAS B.W.: J. PHYS. G1, 967 (1975).
KIKUCHI, Y.: UNPUBLISHED.
POENITZ, W.P. AND WHALEN, J.F.: ANL/NDM-80 (1983).
GARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
KUNZ, P.D.: UNIV. COLORADO (1974).
YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
FREHAUT, J. ET AL.: PHYS. REV. C16, 1792 (1977).
FREHAUT, J. ET AL.: PHYS. REV. C16, 1792 (1977).
FREHAUT, J. ET AL.: PHYS. REV. C16, 1792 (1977).
JEREY, F.G.: PHYS. REV. 131, 745 (1963).
JEREY, F.G.: PHYS. REV. 131, 745 (1963).
JEREY, F.G.: PHYS. REV. 131, 745 (1963).
LEMOS, O.F.: "DIFFUSION ELASTIQUE DE PARTICULES ALPHA DE 21 A 29.6 MEV SUR DES NOYAUX DE LA REGION TI-ZN", ORSAY REPORT, SERIES A., NO. 136, (1972).
DLOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
REFFO, G. ET AL.: NUCL. SCI. ENG., 80, 630 (1982).
LONE, M.A., LEAVITT, R.A. AND HARRISON D.A.: AT. DATA AND NUCL. DATA TABLES, 26, 511 (1981).

MAT number = 4128 41-NB- 94 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.028 KEV PARAMETERS WERE TAKEN FROM THE COMPILATION OF MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION (15.5 BARNS) GIVEN BY MUGHABGHAB ET AL./2/ SCATTERING RADIUS WAS ASSUMED TO BE 7.0 FM ACCORDING TO THE SYSTEMATICS OF MEASURED VALUES. MF MEÁSURED VALUES. UNRESOLVED RESONANCE REGION : 0.028 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS TAKEN FROM THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.400E-4, S1 = 5.500E-4, S2 = 0.400E-4, SG = 25.2E-4, GG = 0.188 EV, R = 6.696 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 22.22 -ELASTIC 6.453 -CAPTURE 15.77 126 CAPIURE15.77126MF = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/5/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/6/
ALPHA = HUIZENGA AND IGO/7/
DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/ ENERGY(MEV) NO. SPIN-PARITY GŘ. 0.0 6 3 + 0.0410 0.0587 1 + 23 47 0.0787 0.1134 0.1403 4 5 2 2 + 5 6 0.3016
| 7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24 | 0.3119
0.3342
0.3963
0.4502
0.6317
0.6409
0.6657
0.7849
0.7929
0.8178
0.8957
0.9240
0.9352
0.9586
0.9790
1.0077
1.0612
1.0857 | 4 + + + + + + + + + + + + + + + + + | |
|---|--|---|---|
| 236
27
28
29
LEVELS ABOVE | 1.1707
1.2020
1.2327
1.2569
1.264 MEV WERE | 3 +
0 +
2 +
0 +
ASSUMED TO BE | OVERLAPPING. |
| MT = 102 CAPTURE
SPHERICAL OPTIC
CASTHY WAS ADOP
SECTIONS WERE E
AND REFF0/15/ A | AL AND STATISTI
TED. DIRECT AN
STIMATED ACCORD
ND NORMALIZED T | CAL MODEL CALC
D SEMI-DIRECT
ING TO THE PRO
D 1 MILLI-BARN | ULATION WITH
CAPTURE CROSS
CEDURE OF BENZI
AT 14 MEV. |
| THE GAMMA-RAY S
THE SYSTEMATICS
S-WAVE RESONANC
LEVEL DENSITY P | TRENGTH FUNCTIO
OF RADIATION W
E LEVEL SPACING
ARAMETERS. | N (2.53E-03) W
IDTH (0.188 EV
(74.4 EV) CAL | AS DETERMINED FROM
) AND THE AVERAGE
CULATED FROM THE |
| $ \begin{array}{llllllllllllllllllllllllllllllllllll$ | ROSS SECTION
ROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
OSS SECTION
OSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTIONS
AND MULTI-STEP | WERE CALCULATE | D WITH THE
DEL CODE PEGASUS. |
| THE KALBACH'S C
FORMULA DERIVED
DENSITY PARAMET | ONSTANT K (= 183
FROM KIKUCHI-K
ERS. | 3.2) WAS ESTIM
AWAI'S FORMALI | ATED BY THE
SM/16/ AND LEVEL |
| FINALLY, THE (N
NORMALIZED TO T
(N,P)
(N,ALPHA) | ,P) AND (N,ALPH,
HE FOLLOWING VA
22.20 MB (SYS
6.42 MB (SYS | A) CROSS SECTI
LUES AT 14.5 M
TEMATICS OF FO
TEMATICS OF FO | ONS WERE
EV:
RREST/17/)
RREST) |
| MT = 251 MU-BAR
CALCULATED WITH | CASTHY. | | |
| MF = 4 ANGULAR DIS
LEGENDRE POLYNOMI
GIVEN IN THE CENT
TIC LEVELS, AND I
CALCULATED WITH C
BUTIONS IN THE LA | TRIBUTIONS OF S
AL COEFFICIENTS
ER-OF-MASS SYST
N THE LABORATOR
ASTHY. FOR OTH
BORATORY SYSTEM | ECONDARY NEUTR
FOR ANGULAR D
EM FOR MT=2 AN
Y SYSTEM FOR M
ER REACTIONS,
WERE ASSUMED. | ONS
ISTRIBUTIONS ARE
D DISCRETE INELAS-
T=91. THEY WERE
ISOTROPIC DISTRI- |
| MF = 5 ENERGY DIST
ENERGY DISTRIBUTI
PEGASUS FOR INELA
OTHER NEUTRON EMI | RIBUTIONS OF SE
ONS OF SECONDAR
STIC SCATTERING
TTING REACTIONS | CONDARY NEUTRO
Y NEUTRONS WER
TO OVERLAPPIN | NS
E CALCULATED WITH
G LEVELS AND FOR |
| TABLE 1 NEUTRON OP | TICAL POTENTIAL | PARAMETERS | |
| DEP
V = 46.0-0
WS = 7.0 | TH (MEV)
.25E | RADIUS(FM)
R0 = 5.893
RS = 6.393 | DIFFUSENESS(FM) $A0 = 0.62$ $AS = 0.35$ |
| VŠO= 7.0
THE FORM OF SURFA | CE ABSORPTION P | RŠO= 5.893
ART IS DER. WO | ÁŠO= Ŏ.62
ODS-SAXON TYPE. |

TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) PAIRING NUCLIDE A(1/MEV) T(MEV) 1.027E+01 6.770E-01 1.716E+00 2.209E+00 0.0 1.050E+01 7.140E-01 8.362E-01 3.521E+00 7.200E-01 1.012E+01 7.629E-01 2.480E+00 3.191E+00 0.0 1.150E+01 8.053E-01 1.740E+00 5.854E+00 1.120E+00 39-Y - 90 39-Y - 91 39-Y - 92 39-Ý - <u>93</u> 40-ZR- 91 40-ZR- 92 40-ZR- 93 40-ZR- 94 1.036E+01 8.000E-01 7.822E-01 5.057E+00 1.200E+00 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+00 1.298E+01 7.000E-01 1.273E+00 5.183E+00 1.200E+00 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00 1.040E+01 8.410E-01 4.607E+00 4.477E+00 0.0 1.250E+01 7.120E-01 2.205E+00 4.629E+00 7.200E-01 1.281E+01 7.230E-01 7.763E+00 4.250E+00 0.0 1.277E+01 7.500E-01 2.121E+00 5.782E+00 1.120E+00 41-NB- 92 41-NB- 93 41-NB- 94 41-NB- 95 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.400 FOR NB- 94 AND 3.625 FOR NB- 95. REFERENCES (FERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) <u>6</u>) 7١ <u>ٰ8</u> 9ý W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 44, 277 (1985).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4131 41-NB- 95 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 25 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATIC OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.370E-4, S1 = 5.500E-4, S2 = 0.360E-4, SG = 33.8E-4, GG = 0.160 EV, R = 6.700 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 12.70 5.700 7.000 TOTAL ELASTIC CAPTURE 41.8 F = 3 NEUTRON CROSS SECTIONS BELOW 25 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS ADOPTED FROM REF./3/ AND THE SCATTERING CROSS SECTION WAS CALCULATED FROM R = 6.7 FM UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 25 EV TO 100 KEV. MF = 3FM. ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/5/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT SHEETS/14/. SPIN-PARITY ENERGY(MEV) NO. 0.0 0.2357 0.7242 0.7280 GŔ. 1 9/2 + 1/2 -7/2 3/2 7/2 ż + 34 + 0.7567 + 0.7990 1/2 5/2 5 2 6 $\frac{7}{2}$ 7 1.0880

| 8 1.2230 1/2 -
9 1.2740 1/2 -
10 1.4190 7/2 -
11 1.5140 7/2 -
12 1.5900 3/2 +
13 1.6450 3/2 +
14 1.6910 3/2 +
15 1.8100 3/2 +
16 1.9130 3/2 +
17 1.9800 7/2 -
18 2.0700 3/2 +
19 2.1210 3/2 +
19 2.1210 3/2 +
LEVELS ABOVE 2.26 MEV WERE ASSUMED TO BE OVERLAPPING. |
|--|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (3.26E-03) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.16 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (49.1 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 167.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 15.00 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 4.32 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $V = 46.0-0.25E \qquad R0 = 5.893 \qquad A0 = 0.62$
WS = 7.0 $RS = 6.393 \qquad AS = 0.35$
VS0 = 7.0 $RS = 5.893 \qquad AS = 0.62$
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.
TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 39-Y911.050E+017.140E-018.362E-013.521E+007.200E-0139-Y921.012E+017.629E-012.480E+003.191E+000.039-Y931.150E+018.053E-011.740E+005.854E+001.120E+0039-Y949.149E+007.385E-011.378E+002.222E+000.0 |

40-ZR- 92 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+00
40-ZR- 93 1.298E+01 7.000E-01 1.273E+00 5.183E+00 1.200E+00
40-ZR- 94 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00
40-ZR- 95 1.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E+00
41-NB- 93 1.250E+01 7.120E-01 2.205E+00 4.629E+00 7.200E-01
41-NB- 94 1.281E+01 7.230E-01 7.763E+00 4.250E+00 0.0
41-NB- 95 1.277E+01 7.500E-01 2.121E+00 5.782E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 96 1.331E+01 5.880E-01 3.406E+00 2.530E+00 1.120E+00
41-NB- 4.220E+01 2.20E+01 2.120E+00
41-NB- 4.220E+01 2.120E+01
41-NB- 4.220E+01 2.120E+01
42-00E+01 2.120E+01 2.120E+01
42-00E+01 2.120E+01 2.120E+01
42-00E+01 2.120E+01 2.120E+01
42-00E+01 2.120E+01 2.120E+01
42-00E+01 2.120E+01 2.120E+01
42-00E+01 2.120E+01 2.120E+01<

MAT number = 4200 42-MO- 0 JNDC, JAERI EVAL-MAR89 JNDC FPND W.G., M.MIZUMOTO DIST-OCT89 REV2-FEB94 HISTORY 84-10 PHOTON PRODUCTION DATA WERE EVALUATED BY M.MIZUMOTO(JAERI). 89-03 FINAL DATA FOR JENDL-3 WERE COMPILED FROM ISOTOPE DATA. THE ISOTOPE DATA WERE EVALUATED BY JNDC FP NUCLEAR DATA WORKING 90-10 MF=5: SPECTRA AT THRESHOLD ENERGIES WERE MODIFIED. 94-02 JENDL-3.2. ČŌMPĪLĚĎ BY T.NAKAGAWA (NDC/JAERI) * * * * * (12,102) JENDL FUSION FILE /2/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) CROSS SECTIONS WERE CALCULATED WITH SINCROS-II SYSTEM/3/. THE OTHER CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 OF MT=16, 17, 22, 28 AND 91 WERE CREATED WITH F15TOB PROGRAM /2/ IN WHICH KUMABE'S SYSTEMATICS /4/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM/3/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./3/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/5/. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) EVALUATED BY KIKUCHI ET AL./6/ ON THE BASIS OF THE FOLLOWING EXPERIMENTS. MF XPERIMENTS. MO-92: BELOW 50 KEV TRANSMISSION : WASSON ET AL./7/ CAPTURE : WASSON ET AL./7/, WEIGMANN ET AL./8/, MUSGROVE ET AL./9/ MUSGROVE ET AL./9/ MO-94: BELOW 20 KEV CAPTURE : WEIGMANN ET AL./8/, MUSGROVE ET AL./9/ MO-95: BELOW 2 KEV TRANSMISSION : SHWE ET AL./10/ CAPTURE : WEIGMANN ET AL./8/ MO-96: BELOW 19 KEV CAPTURE : WEIGMANN ET AL./8/, MUSGROVE ET AL./9/ MO-97: BELOW 1.8 KEV TRANSMISSION : SHWE ET AL./10/ CAPTURE : WEIGMANN ET AL./8/ MO-98: BELOW 32 KEV TRANSMISSION : CHRIEN ET AL./11/ CAPTURE : WEIGMANN ET AL./8/, MUSGROVE ET AL./9/ MO-98: BELOW 26 KEV TRANSMISSION : WEIGMANN ET AL./11/ CAPTURE : WEIGMANN ET AL./12/ CAPTURE : WEIGMANN ET AL./8/, MUSGROVE ET AL./9/ MO-100: BELOW 26 KEV TRANSMISSION : WEIGMANN ET AL./8/, MUSGROVE ET AL./9/ MO-92 0.02 0.425 MO-94 0.135 0.175 MO-92 0.150 0.180 MO-96 0.114 0.136 MO-97 0.130 0.150 MO-98 0.085 0.12 MO-100 0.065 0.08 UNRESOLVED RESONANCE REGION : UP TO 100 KEV THE NEUTRON STRENGTH FUNCTIONS WERE CALCULATED WITH OPTICAL MODE CASTHY/13/. THE LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE AVERAGE PARAMETERS AT 70 KEV: TYPICAL VALUES OF THE AVERAGE PARAMETERS AT 70 KEV: S0 S1 S2 GG(EV) DC M0-92 0.369E-4 5.479E-4 0.364E-4 0.226 22 ĎÖ(EV) R(FM) 2252 6.746

| MO-94 0.369 |)E-4 5.479E-4 | 0.365E-4 0.230 | 1101 6.699 |
|-----------------------------|--------------------------------|----------------------------------|----------------------------|
| MO-95 0.369
MO-96 0.370 |)E-4 5.479E-4 | 0.365E-4 0.232 | 93.33 6.698 |
| MO-97 0.370 |)E-4 5.479E-4 | 0.365E-4 0.180 | 58.76 6.687 |
| MO-98 0.370
MO-100 0.370 |)E-4 5.479E-4
)E-4 5.479E-4 | 0.364E-4 0.133
0.365E-4 0.085 | 765.9 6.675
576 1 6.651 |
| | | | |
| CALCULATED 2200 |)-M/S_CROSS_SECT | IONS AND RES. IN | NTEGRALS (BARNS) |
| TOTAL | 8.066 | KES. | - INTEG. |
| ELASTIC | 5.483 | | |
| CAPIURE | 2.582 | 25 | 0.68 |

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.

WHICH Т0

FOR JENDL-3.1, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/13/ IN THE ENERGY RANGE ABOVE 100 KEV, BY TAKING ACCOUNT OF COMPETING REACTIONS OF WHICH CROSS SECTIONS WERE CALCULATED WITH A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS/14/. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA ET AL./15/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/16/ ALPHA = HUIZENGA AND IGO/17/ DEUTERON = LOHR AND HAEBERL1/18/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/19/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT AND CAMERON/20/ WERE EVALUATED BY IIJIMA ET AL./21/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. THE ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT (EX) IS DUE TO GRUPPELAAR/22/.

FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE THORETICAL CALCULATION WAS MADE WITH SINCROS-II SYSTEM/3/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/3/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/23/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

THE DATA FOR MT=1, 102, 103, 104, 105, 106, 107, 11 AND 251 ARE THE SAME AS JENDL-3.1.

MT = 1

= 1 TOTAL BELOW 500 KEV, SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. OMP IN TABLE 1 AND CASTHY WERE USED. ABOVE 500 KEV, SPLINE-FITTING TO THE DATA MEASURED BY FOSTER AND GLASGOW /24/, LAMBROPOULOS ET AL./25/ AND POENITZ AND WHALEN/26/ WAS MADE. MADE

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

T = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE INELASTIC SCATTERING CROSS SECTIONS FOR EACH ISOTOPE WERE GROUPED IN NATURAL MO DATA AS FOLLOWS:

| ΜŢ | -Q(MEV) | MO-92 | MO-94 | MO-95 | MO-96 | MO-97 | MO-98 | MO-100 |
|------------|---------|-------|-------|---------------|-------|-------|-------|--------|
| 51 | 0.2041 | - | - | 51 | - | - | - | - |
| 52 | 0.4809 | - | - | - | - | 51 | - | - |
| 53 | 0.5356 | - | - | - | - | - | - | 51 |
| 54 | 0.6579 | - | - | - | - | 52.53 | - | - |
| 55 | 0.6944 | - | - | - | - | - | - | 52 |
| 56 | 0.7192 | - | - | - | - | 54.55 | - | - |
| 57 | 0.7348 | - | - | - | - | | 51 | - |
| 58 | 0.7530 | - | - | 52 | - | 56 | - | - |
| Š 9 | 0.7820 | - | - | 53 | 51 | 57 | 52 | - |
| ĕŏ | 0.8206 | - | - | 54 | - | 58 | - | - |
| ĕ1 | 0 8711 | - | 51 | - | - | 59 | - | - |
| 62 | 0 9477 | - | - | 55 | - | ĕŏ | - | - |
| 63 | 1 0245 | - | - | 56 | - | ĕĭ | - | - |
| 64 | 1 0567 | - | - | 57 58 | - | 62 | - | 53 |
| 65 | 1 1168 | - | - | - | 52 | 63 | - | 54 |
| ăă | 1 3023 | - | - | 59 60 | - | - | - | - |
| 67 | 1 /257 | _ | _ | 61 | _ | _ | 53 | _ |
| 68 | 1 /077 | 51 | _ | - | 53 | _ | 54 | _ |
| 60 | 1 5409 | 51 | 52 | <u>ຣ</u> ວ ຣວ | 55 | - | 54 | - |
| 09 | 1.5400 | - | 52 | 02,03 | - | - | - | - |

| 70
71
72
73
75
76
77
78
80
81
82
83
84
85
86
87
889
0THERS | 1.6202
1.7425
1.8643
1.9650
2.2063
2.2826
2.3932
2.4810
2.5015
2.5339
2.5943
2.5943
2.7398
2.8702
2.9558
3.0641
3.3691
3.5420
3.6212
5.50
3.6212
5.50
5.50
5.50
5.50
5.50
5.50
5.50
5.5 | -
-
-
52
-
55
56
57
-
58
59,60
61
62,63
64-66
MMED UP | 53
54
55
56
57,58
59,60
62,63
64,65
66,67
68,69
TO MT= | 64,65
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
- | 54,55
56
57
58
59,60
61-63
64
65
66
67
-
-
-
- | | 55
56
57,58
59,62
63,64
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
- | |
|--|---|--|--|--|---|---|---|---------------------------|
| MT = 16
ADOPTE
WAS NC
YAMAMU | , 17, 22,
D FROM J
DT MADE B
JRO/27/ T | 28 (I
ENDL FUS
ECAUSE
O REPROI | N,2N),
SION FI
THE PAR
DUCE WE | (N,3N),
LE. NO
AMETERS
LL EXPE | (N,NA)
RMALIZAT
USED WE
RIMENTAL | AND (N
ION OF
RE DETI
DATA. | ,NP)
THE RE
ERMINED | SULTS
BY |
| MT = 102
SPHERI
CASTHY
SECTIC
AND RE
THE CA
THE CA
MO-
MO- | 2 CAPTUR
ICAL OPTI
Y/13/ WAS
DNS WERE
EFFO/28/
AMMA-RAY
APTURE CR
-92: 0.94
-96: 1.62
-100: 1.4 | E
CAL AND
ADOPTEI
ESTIMATI
AND NORI
STRENGTI
OSS SEC
1E-4, 1
3E-4, 1
32E-4, | STATIS
D. DIR
ED ACCO
WALIZED
H FUNCT
TION ME
WO-94:
WO-97: | TICAL M
ECT AND
RDING T
TO 1 M
IONS WE
ASURED
1.966E-
29.76E- | ODEL CAL
SEMI-DI
O THE PR
ILLI-BAR
RE ADJUS
BY MUSGR
4, MO-9
4, MO-9 | CULATIO
RECT C/
OCEDURI
N AT 14
TED TO
OVE ET
5: 29.
8: 1.62 | DN WITH
APTURE
E OF BE
4 MEV.
REPROD
AL./8/
76E-4,
23E-4, | CROSS
NZI
UCE |
| MT = 103
(N,
THESE
/14/.
DERIVE
PARAME
NORMAL
MEV. | 3,104,105
,P), (N,D
REACTION
THE KAL
ED FROM K
ETERS. T
IZED TO
FOR MORE | ,106,10
), (N,T
CROSS (
BACH'S (
IKUCHI-I
HE (N,P
THE EXPI
DETAIL(| 7,111
SECTION
CONSTAN
KAWAI'S
AND (
ERIMENT
S, SEE | E3), (N
S WERE
TS WERE
FORMAL
N,ALPHA
AL DATA
COMMENT | ,ALPHA)
CALCULAT
ESTIMA
ISM/29/
) CROSS
OR SYST
OF EACH | AND (N
ED WITH
TED BY
AND LE'
SECTION
EMATICS
ISOTON | ,2P)
H PEGAS
THE FO
VEL DEN
NS WERE
S AT 14
PE. | US
RMULA
SITY
.5 |
| $\begin{array}{rcl} MT &=& 251\\ CALCUL\\ MF &=& 4 & AN\\ MT &=& 2\\ CALCUL\\ MT &=& 51-\\ TAKEN\\ AND & DV\\ MT &=& 16,\\ TRANSF \end{array}$ | 1 MU-BAR
ATED WIT
NGULAR DI
ATED WIT
89
FROM JEN
VUCKY IN
17,22,28
CORMED FR | H CASTH'
STRIBUT
H CASTH'
DL FUSIC
THE SINC
91
OM MF=6 | Y/13/.
IONS OF
Y/13/ (
ON FILE
CROS-II
DATA (| SECOND
SAME AS
WHICH
SYSTEM
DDX) OF | ARY NEUT
JENDL-3
WAS CALC
JENDL F | RONS
.1).
ULATED
USION I | WITH C
FILE. | ASTHY |
| MF = 5 EN
MT = 16,
TRANSE | NERGY DIS
,17,22,28
FORMED FR | TRIBUTIO
,91
OM MF=6 | ONS OF
DATA (| SECONDA
DDX) OF | RY NEUTR
JENDL F | ONS
USION I | FILE. | |
| MF =12 PH
MT = 102
DETERN | HOTON PRO
2 (BELOW
MINED FRO | DUCTION
420 KEV
M ENERGY | MULTIP
)
Y BALAN | LICITIE
CE. | S | | | |
| MF = 13 PH
MT = 3 (
FITTEL
/30/ E | HOTON PRO
(ABOVE 42
) WITH TH
BASED ON | DUCTION
O KEV)
E EMPIR
THE EXPI | CROSS
ICAL FO
ERIMENT | SECTION
RMULA B
AL DATA | S
Y HOWERT
/31/. | ON AND | PLECHA | ТҮ |
| MF = 14 PH
MT = 3,1
ASSUME | HOTON ANG
102
ED TO BE | ULAR DIS | STRIBUT
IC. | IONS | | | | |
| MF = 15 CC
MT = 3
FITTEL
/30/E
EXPERI
MT = 102 | DWITH TH
BASED ON
IMENTAL D
2 | E EMPIR
THE EXPI
ATA MEAS | ENERGY
ICAL FO
ERIMENT
SURED B | SPECIR
RMULA B
AL DATA
Y YAMAM | A
Y HOWERT
/31/, AN
URO ÉT A | ON AND
D COMP/
L./32/ | PLECHA
ARED WI | TY
TH |

CALCULATED WITH CASTHY/13/ FOR EACH ISOTOPE AND CONSTRUCTED ACCORDING TO THEIR ABUNDANCES.

FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|----------------|------------|-----------------|
| V = 46.0-0.25E | R0 = 5.893 | A0 = 0.62 |
| WS = 7.0 | RS = 6.393 | AS = 0.35 |
| WS0= 7.0 | RS0= 5.893 | AS0= 0.62 |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCL. SYS | T A(/MEV) | T(MEV) | C(/MEV) | EX(MEV) | PAIRING |
|---|---|--|--|--|---|
| 40 - ZR - 88
40 - ZR - 89
40 - ZR - 90
40 - ZR - 91
40 - ZR - 92
40 - ZR - 93
40 - ZR - 93
40 - ZR - 95
40 - ZR - 96
40 - ZR - 96
40 - ZR - 98
40 - ZR - 98 | 1.404E+01
1.095E+01
9.152E+00
1.036E+01
1.088E+01
1.275E+01
1.331E+01
1.320E+01
1.225E+01
1.25E+01
1.725E+01
1.831E+01 | $\begin{array}{c} 7.386E-01\\ 8.260E-01\\ 8.222E-01\\ 8.192E-01\\ 7.000E-01\\ 7.530E-01\\ 7.530E-01\\ 7.000E-01\\ 5.590E-01\\ 6.633E-01\\ 6.633E-01\\ 6.566E-01 \end{array}$ | 4.932E-01
1.379E+00
1.526E-01
7.822E-01
5.122E-01
1.273E+00
4.411E-01
5.453E-01
2.235E-01
2.497E-01
1.790E+00
1.170E+01 | 7.870E+00
5.864E+00
5.383E+00
5.057E+00
6.429E+00
7.019E+00
3.985E+00
6.589E+00
3.084E+00
7.555E+00
6.957E+00 | 2.660E+00
1.200E+00
2.130E+00
1.920E+00
1.920E+00
2.320E+00
2.320E+00
2.490E+00
2.490E+00
2.140E+00
1.200E+00 |
| 41-NB- 89 *
41-NB- 90 *
41-NB- 91 *
41-NB- 92
41-NB- 93
41-NB- 94
41-NB- 95
41-NB- 96
41-NB- 97
41-NB- 98
41-NB- 99 *
41-NB- 100 * | 1.420E+01
1.395E+01
9.464E+00
1.040E+01
1.250E+01
1.287E+01
1.331E+01
1.337E+01
1.380E+01
1.742E+01
1.850E+01 | 7.303E-01
7.222E-01
7.143E-01
8.410E-01
7.120E-01
7.230E-01
7.500E-01
5.880E-01
6.710E-01
5.110E-01
6.566E-01
6.500E-01 | 2.467E+00
1.458E+01
3.924E-01
4.607E+00
2.205E+00
7.763E+00
2.121E+00
3.406E+00
9.771E-01
2.350E+00
1.085E+01
7.329E+01 | 6.611E+00
4.869E+00
3.082E+00
4.477E+00
4.629E+00
5.782E+00
5.782E+00
5.026E+00
1.731E+00
6.300E+00
5.699E+00 | 1.460E+00
0.0
9.300E-01
0.0
7.200E-01
0.0
1.120E+00
0.0
1.290E+00
0.0
9.400E-01
0.0 |
| 42-MO-90 *
42-MO-91
42-MO-92
42-MO-93
42-MO-94
42-MO-95
42-MO-96
42-MO-97
42-MO-97
42-MO-98
42-MO-98
42-MO-98
42-MO-100
42-MO-101 | 1.436E+01
1.168E+01
1.064E+01
1.301E+01
1.301E+01
1.403E+01
1.517E+01
1.594E+01
1.774E+01
1.780E+01
2.085E+01 | 7.222E-01
7.820E-01
7.770E-01
7.800E-01
6.850E-01
7.150E-01
7.410E-01
6.800E-01
6.900E-01
6.200E-01
6.000E-01
5.650E-01 | 4.129E-01
1.284E+00
2.062E-01
9.792E-01
3.417E-01
1.847E+00
6.991E-01
2.769E+00
7.358E-01
4.294E+00
6.702E-01
7.153E+00 | 7.834E+00
5.770E+00
5.938E+00
5.457E+00
5.835E+00
6.036E+00
6.058E+00
6.058E+00
6.645E+00
6.092E+00 | 2.740E+00
1.280E+00
2.210E+00
1.280E+00
2.000E+00
1.280E+00
2.400E+00
1.280E+00
2.570E+00
1.280E+00
2.220E+00
1.280E+00
1.280E+00 |
| SYST: * =
SPIN CUT-OF
REFERENCES
1) KAWAI, M.
2) CHIBA, S.
3) YAMAMURO,
4) KUMABE, I
5) ENSDF: EV
6) KIKUCHI,
7) WASSON, O
8) WEIGMANN,
9) MUSGROVE,
10) SHWE H.
11) CHRIEN, R,
12) WEIGMANN,
13) IGARASI,
14) IIJIMA, S
15) IIJIMA, S
16) PEREY, F.
17) HUIZENGA,
18) LOHR, J.M
19) BECCHETTI | LDP'S WERE DI
F PARAMS WERE
ET AL.: JAE
N.: JAERI-M
. ET AL.: NUC
ALUATED NUCLI
Y. ET AL.: JA
H. ET AL.: JA
H. ET AL.: JA
A. R.DE L. E
ND COTE R.E.
S. AND FUKAH
S. AND FUKAH
S. AND KAWAI,
G: PHYS. REV
J.R. AND IG
J.R. AND IG
J.R. AND IG
J.R. AND IG
J.R. AND IG
J.R. JR. | ETERMINED
E CALCULAT
NUCL. SCI.
90-006 (E
EAR STRUCT
AERI-M 86-
PHYS. REV.
1971 KONOS.
EAR STRUCT
ALL: NUC
PHYS. REV.
ORI, T. 87-C
M.: J. NUC
ERI-M 87-C
M.: J. NUC
AND GREENL | FROM SYSTE
ED AS 0.14
TECHNOL.,
7, P.35 (1
990).
NG., 104,
URE DATA F
030 (1986)
, C7, 1532
VILLE, 749
L. PHYS.,
AERI 1321
AERI 1321
AERI 1321
25, P.337
CL. SCI. T
(1963).
L. PHYS.2
CL. PHYS.2
CL. PHYS.2
CL. PHYS.2 | MATICS.
6*SQRT(A)
992).
280 (1990)
1LE, BNL/N
(1973).
(1971).
(1971).
(1976).
(1969).
(1969).
(1987).
(1987).
ECHNOL. 20
29, 462 (19
A232, 381
POLARIZAT | A**(2/3).
(1992).
(1976).
(1976).
(1976).
(1974). |

PHENOMENA IN NUCLEAR REACTIONS, P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
20) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43,1446(1965).
21) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
22) GRUPPELAAR, H.: ECN-13 (1977).
23) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
24) FOSTER JR.D.G. AND GLASGOW D.W.: PHYS. REV., C3, 576 (1971).
25) LAMBROPOULOS, P. ET AL.: NUCL. PHYS. A201, 1 (1973).
26) POENITZ, W.P. AND WHALEN, J.F.; ANL/NDM-80 (1983).
27) YAMAMURO, N.: NUCL. SCI. ENG., 109, 128 (1991).
28) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
29) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
30) HOWERTON, S.T. AND PLECHATY, E.F.: NUCL. SCI. ENG., 32, 178 (1968).
31) MORGAN, G. AND NEWMAN, N.: ORNL-TM-5097 (1975).
32) YAMAMURO, N. ET AL.: 1982 ANTWERP, 152 (1982).

MAT number = 4225 42-MO- 92 JNDC EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. DIST-OCT89 REV2-OCT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 89-08 MODIFICATION FOR JENDL-3 WAS MADE/2/. 90-10 MF=5: SPECTRA AT THRESHOLD ENERGIES WERE MODIFIED. 93-10 JENDL-3.2. (3,2), (3,4), (3,51-91), (3,16), (3,22), (3,28) (4,16-91) (5,16-91) ČOMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * * * THÉSE DATA WERE ADOPTED FROM JENDL FUSION FILE JENDL FUSION FILE /3/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO THE INELASTIC SCATTERING, (N,2N), (N,NP), (N,NA) CROSS SECTIONS WERE CALCULATED WITH SINCROS-II SYSTEM/4/. THE OTHER CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 OF MT=16, 22, 28 AND 91 WERE CREATED WITH F15TOB PROGRAM /3/ IN WHICH KUMABE'S SYSTEMATICS /5/ WAS USED. THE PRECOM-POUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM/4/ OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 50 KEV RESONANCE PARAMETERS WERE EVALUATED BY KIKUCHI ET AL./7/ ON THE BASIS OF THE FOLLOWING EXPERIMENTS. TRANSMISSION : WASSON ET AL./8/ CAPTURE : WASSON ET AL./8/ AVERAGE RADIATIVE WIDTHS OF 0.02 EV FOR S-WAVE RES. AND 0.425 EV FOR P-WAVE RES WERE ADOPTED. SCATTERING RADIUS WAS TAKEN FROM MUGHABGHAB ET AL./1/ UNRESOLVED RESONANCE REGION : 50 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/12/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.369E-4, S1 = 5.479E-4, S2 = 0.364 E-4, GG = 0.226 EV D0 = 2252 EV, R = 6.746 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 5.566 -ELASTIC 5.545 -CAPTURE 0.02075 0.968 INTEGRALS (BARNS) MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/12/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/13/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA ET AL./14/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: ĂS FOLLOWS: PROTON = PEREY/15/ ALPHA = HUIZENGA AND IGO/16/ DEUTERON = LOHR AND HAEBERLI/17/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/18/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT

AND CAMERON/19/ WERE EVALUATED BY IIJIMA ET AL./20/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. THE ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT (EX) IS DUE TO GRUPPELAAR/21/.

FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/22/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'.

| NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
LEVELS ABOVE | ENERGY(MEV)
0.0
1.5095
2.2826
2.5197
2.5271
2.6124
2.7604
2.8497
3.0070
3.0641
3.0913
3.3691
3.5420
3.5803
3.6212
3.6248
3.6280
3.6880
3.6880 WERE | SPIN-PARITY
0 +
2 + *
4 +
0 +
5 -
6 +
8 +
3 - *
5 -
4 -
2 + *
4 +
2 +
3 -
4 +
7 -
4 +
7 -
4 +
7 -
4 +
7 -
8 +
8 +
8 +
8 +
8 +
8 +
8 +
8 + | RLAPPING. |
|---|---|---|---|
| MT = 16, 22, 28
ADOPTED FROM J | (N,2N), (N,NA) A
ENDL FUSION FILE | ND (N,NP) CROSS S
· | ECTIONS |
| MT = 102 CAPTUR
SPHERICAL OPTI
CASTHY/12/ WAS
SECTIONS WERE
AND REFF0/23/ | E
CAL AND STATISTI
ADOPTED. DIREC
ESTIMATED ACCORD
AND NORMALIZED T | CAL MODEL CALCULA
T AND SEMI-DIRECT
ING TO THE PROCED
O 1 MILLI-BARN AT | TION WITH
CAPTURE CROSS
URE OF BENZI
14 MEV. |
| THE GAMMA-RAY
REPRODUCE THE
MUSGROVE ET AL | STRENGTH FUNCTIO
EXPERIMENTAL CAP
./9/. | N (9.406E-05) WAS
TURE CROSS SECTIO | ADJUSTED TO
N MEASURED BY |
| MT =103 (N,P) C
MT =104 (N,D) C
MT =105 (N,T) C
MT =106 (N,HE3)
MT =107 (N,ALPH
MT =111 (N,2P)
THESE REACTION
PREEQUILIBRIUM
PEGASUS/13/. | ROSS SECTION
ROSS SECTION
CROSS SECTION
CROSS SECTION
A) CROSS SECTION
CROSS SECTION
CROSS SECTIONS
AND MULTI-STEP | WERE CALCULATED W
EVAPORATION MODEL | ITH THE
CODE |
| THE KALBACH'S
FORMULA DERIVE
DENSITY PARAME | CONSTANT K (= 25
D FROM KIKUCHI-K
TERS. | 1.4) WAS ESTIMAT
AWAI'S FORMALISM/ | ED BY THE
24/ AND LEVEL |
| FINALLY, (N,P)
THE FOLLOWING
(N,P)
(N,ALPHA) | AND (N,ALPHA) C
VALUES AT 14.5 M
116 MB (SYSTEM
24 MB (MEASUR | ROSS SECTIONS WER
EV:
ATICS OF FORREST
ED BY IKEDA ET AL | E NORMALIZED TO
/25/)
./26/) |
| MT = 251 MU-BAR
CALCULATED WIT | H CASTHY/12/. | | |

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

MT = 2 CALCULATED WITH CASTHY/12/.

MT = 51-66 TAKEN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH CASTHY AND DWUCK/27/ IN THE SINCROS-II SYSTEM. MT = 16,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE.

MF

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
 MT = 16,22,28,91
 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE.

<<FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) R0 = 5.893 RS = 6.393 RS0= 5.893 A0 = 0.62AS = 0.35 V = 46.0-0.25E WS = 7.0 WSO= 7.0 ASO = 0.62TABLE 2 LEVEL DENSITY PARAMETERS SYST A(/MEV) T(MEV) C(/MEV) EX(MEV) PAIRING NUCL.

 40-ZR-88
 *
 1.404E+01
 7.386E-01
 4.932E-01
 7.870E+00
 2.660E+00

 40-ZR-89
 1.095E+01
 8.260E-01
 1.379E+00
 5.864E+00
 1.200E+00

 40-ZR-90
 9.152E+00
 8.222E-01
 1.526E-01
 5.383E+00
 2.130E+00

 40-ZR-91
 1.036E+01
 8.000E-01
 7.822E-01
 5.057E+00
 1.200E+00

 41-NB-89
 *
 1.420E+01
 7.303E-01
 2.467E+00
 6.611E+00
 1.460E+00

 41-NB-90
 *
 1.395E+01
 7.222E-01
 1.458E+01
 4.869E+00
 0.0

 41-NB-91
 *
 9.464E+00
 7.143E-01
 3.924E-01
 3.082E+00
 9.300E-01

 41-NB-92
 *
 1.040E+01
 8.410E-01
 4.607E+00
 4.477E+00
 0.0

 42-MO-90
 *
 1.436E+01
 7.222E-01
 4.129E-01
 7.834E+00
 2.740E+00

 42-MO-91
 1.168E+01
 7.820E-01
 1.284E+00
 5.770E+00
 1.280E+00

 42-MO-92
 1.064E+01
 7.770E-01
 2.062E-01
 5.938E+00
 2.210E+00

 42-MO-93
 1.125E+01
 7.800E-01
 9.792E-01
 5.457E+00
 1.280E+00

 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUT-OFF PARAMS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALUCULATION, SPIN CUT-OFF FACTORS AT 0 MEV WERE ASSUMED TO BE 13.13 FOR MO-92 AND 5.000 FOR MO-93. ERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL. 29, 195 (1992). CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO, N.: JAERI-M 90-006 (1990). KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986). WASSON, O.A. ET AL.: JAERI-M 86-030 (1986). WASSON, O.A. ET AL.: 1971 KONOXVILLE, 749 (1971). MUSGROVE, A.R.DE L. ET AL.: NUCL. PHYS., A270, 108 (1976). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). REFERENCES 1) 3 4) 5) 6 7 8) 9) 10) 11) 13) 14) (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 15) 16) 17) 18) (1971) 19) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERI, A. AND CAMERON, ACCURENCE, (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984) GRUPPELAAR, H.: ECN-13 (1977). ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). 20) SCI. TECHNOL. 21, 10 (1984). 21) 22) 23 24)

25) FORREST, R.A.: AERE-R 12419 (1986). 26) IKEDA, Y. ET AL.: JAERI 1312 (1987). 27) KUNZ, P.D.: PRIVATE COMMUNICATION.

| MA
4 | T numbe
2-M0- 9 | 94 | = 42
JNDC | 31 | | EV | AL-
ST- | AU | 689
789 | 9 J
A R | | C
2- | FP
0C | NI
T93 | JCL | .EA | R | DA | ТΑ | W. | G. | | |
|----------------------------|---|--|--|--|--|--|---|--|--|---|--|---|---|---|---|--|--------------------------------------|--|---|--|---|--|--------------------------------------|
| HI
84
89
90
93 | STORY
-10 EV/
-08 MOI
-10 MF=
-10 JEN
COM | ALU
DIF
=5:
NDL
MPI | ATIO
ICAT
SPE
-3.2
LED | N F
ION
CTR
BY | OR
FOI
A A
T.N/ | JEN
R J
T T
AKA | DL-
ENC
HRE
GAW | 2
)L -
SH
/A | WAS
3 V
OLI
(NI | S N
NAS
D E
DC/ | IAD
MENE | E
AD
RG
ER | BY
E/
IE | JN
2/
S | NDC
Ver | C F | PN
MO | D \
DII | W.G | 3./
ED. | 1 / | | |
| | * * * *
(3
(4 | * *
, 2)
, 16 | MO
, (3
-91) | DIF
,4) | IED
, (: | РА
3,5 | R T S
1 - S | 5 F
91) | OR
, | JE
(3, | ND
16 | L-
), | 3.
(| 2
3, ´ | 17) | * * * | * *
(3 | * * ;
, 22 | ***
2), | (| * * * *
3 , 28 | ***
}) | * * |
| | (5
(3) | ,16
,32 | -91)
THE
)
**** | SE
* * * | DAT/
DI | A W
ELE | ERE
TEC | A
)
* * | D0F
* * * | ΡΤΕ
* * * | D | F R
* * | OM
* * | J [
* * * | ENC
* * * |)L
. * * | FU
* * | SI(
* * * | 0N
* * * | FI | LE
* * * * | : * * 1 | * * |
| | JEI | NDL
EVA
COM | FUS
LUAT
PILE | ED
ED
ED B | FII
BY
Y K |
LE
K.K
.KO | /3/
05/
SAK | ,
КО
(0 | (A S
(N E | S C
E D A |)F
(C) | OC
A | T.
ND | 19
S | 993
. CH |
3)
11 E | A |
(NI | DC/ | 'JA |
ERI) | | |
| | (
[
[
[
[| T
CRO
THE
OF
OF
THE
S
I
N
LE
V | HE I
SS STH
MT=1
GRAM
PRES
PRES
PTIC
THE S | NEL
ECT
IER
6,
COM
COM
SIN
SIN
CCHE | AST
ION
CRO
17,
I
POUI
COI
MODI
CRO
MES | IC
SS22
ND/
DE,I
S-I
WE | SCA
ERE
SEC2
HICON
SCA
EC2
SEC2
SEC2
SEC2
SEC2
SEC2
SEC2
SEC2 | TTC
TTC
TTC
TTC
TTC
TTC
TTC
TTC
TTC
TTC | ER
ALC
ONS
AND
KUN
UND
M/2
CUL
TEF | ING
CUL
SOMAES
MAES
AER
 | AT
ER
E
AT
ISI
NE | (NEEWE
SIO
TND | , 2
W
RE
SY
A
A
R
O
N | N)
ITI
KEN
CF
STE
AS
ND
E TI | , H SEAA
EMAA
CA
OES | N,
RCATE
ATE
ATE
CRATE
BA | 3N
CR
D
CS
UL
R
IB |)
JEI
VI
ATE
PAR
S (| (N
NDL
TH
ZD
RAN
OF | I,N
F1
VAS
BY
IET
I
EN | P)
YSTE
5TOE
USE
THE
ERS
EF./
SDF/ | (N
M/2
D
USE
(4/
(6/ | ,NA)
4/.
=6 |
| MF | = 1 (
MT=451 | GEN
CO | ERAL
MMEN | IN
ITS | FORI
AND | MAT
DI | 10N
CT1 | I
ON | AR۱ | ŕ | | | | | | | | | | | | | |
| MF | = 2 F
MT=151
RESOLVE
EVALU
FOLLG
AVER
EV FC
UNRESOI
THE T
WITH
SPAC
CALCU
OBTA
AT 10 | RESE
D
D
D
D
D
D
D
D
D
D
D
D
D
D
D
D
D
D | ONAN
SOLSO
E :DG :CO
NRER WA
SD RO
TT WAD
F
V
E
F
V
C
SD
TT
T
C
SD
TT
T
C
SD
TT
T
C
SD
TT
SD
TT
SD
SD
SD
SD
SD
SD
SD
SD
SD
SD
SD
SD
SD | ICE
VAN
WASE
VAS
VAS
VAS
VAS
VAS
VAS
VAS
VAS
VAS
VAS | PAR
AND
CEAI
RIGM
IGE
IVD
ANCI
ANCI
RODER
FIT | A RDEANUE EGLMAT | TESN
TEOY
DAETEN
DUAGE
DDY
T | SOL (I KIAA
ISE NCCO
INCCO | VEL
MLE
KUC
L.
RES
TIC
AST
THE | RENCES 2000 | ASN
ASN
ASN
ASN
ASN
ASN
ASN
ASN
ASN
ASN | ORT UUESO/UECU | ANUL
AL
SG
SME
S,
ETI | CE
A)
D
D
T
C
S
T
H
E
V
E
T
E
I | PA
;
7/
ESF
AN
HE
SC
DO
T | RAEN TEECE | MEOT
A OI
SEUU
A L | TEF
WE
HE
VEI
RVE
RVE
RE
CF | RS
20
84
79/
35
LY .
ERE
CF
NG
S | KE
SI
EV
LES
RAS | V
S OF
ANE
ALCU
VEL
S SE
S ECT | - TH
) 0.
JLA
JLA
S W/
FION | HE
. 175
FED
I ON
S
N |
| | TYPICAL
SO =
DO = | V
0.
11 | ALUE
369E
01 | S 0
-4,
EV, | F TI
S1
R | HE
=
= | PAR
5.4
6.6 | AM
79
999 | ETE
E-4
FM | ERS
4,
1. | S A
S2 | T
= | 70
0 | KE
.36 | EV:
55 | E - | 4, | G | G = | = 0 | . 230 |) E\ | / |
| | CALCUL/
TO ⁻
EL/
CAF | ATE
TAL
AST
PTU | D 22 | 200- | M/S | CR
220
6.
5.
0. | 0SS
0 M
011
998
013 | S S
1/S
311 | ECT | ГІС | NS | A | ND | RE | ES.
R | RES | NT
-
1. | EG <u>F</u>
IN
40 | RAL
TEG | _S | (BAF | (NS) |) |
| MF | = 3
BELOW
THE SPH
PERFORM
REACTIC
PEGASUS
EVAPORM
DETERM
OF THE
AS FOLL
PRO | NEU
HEDS
MEDS
MEDS
MEDS
MEDS
MEDS
MEDS
MEDS
M | TRON
KEV
ICAL
WIT, OF
1/ S
ON M
D BY
TAL
S: = | CR
CP
CP
CP
CP
CP
CP
CR
CP
CP
CP
CP
CP
CP
CP
CP
CP
CP
CP
CP
CP | OSS
ESOI
TICA
ASTI
DIN
L.
JIM
SS
REY | SE
NAN
AL
CR
G TH
G TH
SEC
/ 13 | CTI
CE
10/
SS
A
C
S
A
C
A
C
A
T
T
I
C
/ | ON
PA
S
S
P
N
N
N
N | S
RAN
BY
ECT
REE
'S
/12 | MET
TA
TA
EQU
EQU
EQU
EQU | ER
KI
NS
IL
R
TO | S
NG
B
NB
NB
NB
NB
NB
NB
NB
NB
NB
NB
NB
NB
N | WE
ER
RI
UT
EP | RE
MOI
CCC
EC
UM
ROI
F(| GI
DEL
DUN
CAL
AN
OUC
DR | | N.
OF
LA
MU
EN
AR | CUI
CC
TEI
LT
SYS
GEI | ABC
LAT
OMF
D W
I - S
N T
S
T E
D F | VE
IO
PET
VITI
STE
AB
MA | 100
N WA
ING
H
P
LE 1
TIC
TICL |) KE
(S
TRE
LES | EV,
ERE
ND
ARE |
| | ALPI
DEU
HEL
PARAME
CAMERON
DETERM | HA
TER
IUM
TER
N/1
INA | 0N =
-3 A
S FO
7/ W
TION | HU
LO
ND
R T
ERE
AN | IZEI
HR
TRI
HE
EV
D M | NGA
AND
TON
COM
ALU
ODI | AN
HA
POS
ATE
FIC | | IGO
ERL
CCH
EL
BY
ION | D/1
_I/
HET
_EV
II
N W | 4/
15
TI
EL
JI | A
D
MA | ND
EN
E
MA | GF
SIT
T A
DE | REE
Fy
AL. | ENL
FC
/1 | EE
RM
8/ | S / ^
U L /
·
P I | 16/
A C
MC
RES |)F
)RE
SEN | GIRE
EXT
T WC | SER
ENS | Γ-
SIVE |

TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. THE ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT (EX) IS DUE TO GRUPPELAAR/19/.

FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/20/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAME-TERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4

F = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'.

ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) ΝΟ. 0.0 0.8711 1.5737 1.7425 GŔ. 0 2 4 1 + 3 1.7425 0 + 4 1.8643 2 + 5 2.0674 2 + 6 2.2952 4 + 7 2.3932 2 + 8 2.4235 6 + 9 2.5339 3 - * 10 2.5668 4 + 11 2.6115 5 -12 2.7398 1 + 13 2.7681 4 + 14 2.8058 2 + 15 2.8359 3 + 16 2.8702 2 + 17 2.8724 6 + 18 2.9558 8 + 19 2.9651 2 + LEVELS ABOVE 2.965 MEV WERE ASSUMED TO BE OVERLAPPING. 3456789011234 11234 0 2 2 (N,2N) CROSS SECTION (N,3N) CROSS SECTION (N,N'A) CROSS SECTION (N,N'P) CROSS SECTION FROM JENDL FUSION FILE. MT = 16 MT = 17 MT = 22 MT = 28 ADOPTED T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY/10/ WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT THE GAMMA-RAY STRENGTH FUNCTION (=1.966E-4) WAS ADJUSTED TO REPRODUCE THE EXPERIMENTAL CAPTURE CROSS SECTION OF 54.5 MILLI-BARNS AT 100 KEV MEASURED BY MUSGROVE ET AL./9/. MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =106 (N,HE3) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION MT =111 (N,2P) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PRE-EQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS /11/ /11/. THE KALBACH'S CONSTANT K (= 151.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS. FINALLY, (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 55.10 MB (SYSTEMATICS OF FORREST/23/) (N,ALPHA) 17.50 MB (RECOMMENDED BY FORREST/23/)

| MT = 251 MU-BAR
CALCULATED WITH CASTHY/10/. | |
|--|--|
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEU MT = 2 | JTRONS |
| MT_=_51-69 | |
| TAKEN FROM JENDL FUSION FILE DATA WHICH WA
CASTHY AND DWUCK/24/ IN THE SINCROS-II SYS | AS CALCULATED WITH |
| TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL | FUSION FILE. |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUT
MT = 16,17,22,28,91
MT = 16,17,22,28,91
MT = 0,17,22,18,91
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT = 0,17,191
MT | TRONS |
| TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL | FUSION FILE. |
| <pre><<following are="" casthy<="" in="" parameters="" pre="" the="" used=""></following></pre> | AND PEGASUS CALC.>> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) | DIFFUSENESS(FM) |
| V = 46.0-0.25E R0 = 5.893
WS = 7.0 RS = 6.393
WS0-7.0 RS0-5.893 | A0 = 0.62
AS = 0.35
ASO = 0.62 |
| TABLE 2 LEVEL DENSITY PARAMETERS | A30- 0.02 |
| NUCL. SYST A(/MEV) T(MEV) C(/MEV) E | EX(MEV) PAIRING |
| 40-ZR-90 9.152E+00 8.222E-01 1.526E-01 5
40-ZR-91 1.036E+01 8.000E-01 7.822E-01 5 | 5.383E+00 2.130E+00
5.057E+00 1.200E+00 |
| 40-ZR- 92 1.088E+01 8.192E-01 5.122E-01 6 40-ZR- 93 1.298E+01 7.000E-01 1.273E+00 5 | 5.429E+00 1.920E+00
5.183E+00 1.200E+00 |
| 41-NB-91 * 9.464E+00 7.143E-01 3.924E-01 3
41-NB-92 1.040E+01 8.410E-01 4.607E+00 4 | 3.082E+00 9.300E-01
4.477E+00 0.0 |
| 41-NB-93 1.250E+01 7.120E-01 2.205E+00 4 41-NB-94 1.281E+01 7.230E-01 7.763E+00 4 | 4.629E+00 7.200E-01
4.250E+00 0.0 |
| 42-MO-92 1.064E+01 7.770E-01 2.062E-01 5
42-MO-93 1.125E+01 7.800E-01 9.792E-01 5 | 5.938E+00 2.210E+00
5.457E+00 1.280E+00 |
| 42-MÖ- 94 1.301E+01 6.850E-01 3.417E-01 5
42-MO- 95 1.360E+01 7.150E-01 1.847E+00 5 | 5.770E+00 2.000E+00
5.835E+00 1.280E+00 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEM | MATICS. |
| SPIN CUT-OFF PARAMS WERE CALCULATED AS 0.146 | S*SQRT(A)*A**(2/3).
CTORS_AT 0 MEV WERE |
| ASSUMED TO BE 7.761 FOR MO-94 AND 6.184 FOR | MO-95. |
| 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLE
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P. | AR DATA FOR BASIC
1627 (1985). |
| 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL.,
3) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (19 | 29, 195 (1992).
992). |
| 5) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 2
6) FNSDF: EVALUATED NUCLFAR STRUCTURE DATA FI | 280 (1990).
LE BNI/NNDC |
| 7) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
8) WEIGMANN H. ET AL.: 1971 KNOXVILLE, 749 (1 | 971). |
| 9) MUSGROVE A.R.DE L.: NUCL. PHYS., A270, 108
10) IGARASI, S. AND FUKAHORI, T.: JAERI 1321
11) ILLINA, S. END FUKAHORI, T.: JAERI 1321 | 3 (1976).
(1991). |
| 12) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TE
(1983). | ECHNOL., 20, 77 |
| 13) PEREY, F.G. PHYS. REV. 131, 745 (1963).
14) HULZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29 | 9, 462 (1962). |
| 16) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A 16) BECCHETTI, F.D., JR. AND GREENLEES, G.W.:
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H H | POLARIZATION
BARSHALL AND |
| W. HAEBERLI), P. 682, THE UNIVERSITY OF WI | SCONSIN PRESS. |
| 17) GILBERI, A. AND CAMERON, A.G.W.: CAN. J. F
(1965).
18) LILMA S. ET AL C. I. NUCL SCI. TECHNOL | 21 10 (1984) |
| 19) GRUPPELAAR, H.: ECN-13 (1977).
20) ARTHUR, E.D. AND YOUNG. P.G.: LA-8626-MS (| (1980). |
| 21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969)
22) KIKUCHI. K. AND KAWAI. M.: "NUCLEAR MATTER | AND NUCLEAR |

| | REACTIONS", | NORTH | HOLLAND (1 | 968). |
|-----|-------------|---------|------------|---------|
| 231 | FORREST R | Δ · ΔΕΡ | F-R 12/10 | (1026) |
| 231 | | | | (+300). |

24) KUNZ, P.D.: PRIVATE COMMUNICATION.

MAT number = 4234 42-MO- 95 JNDC EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. DIST-OCT89 REV2-OCT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 89-08 MODIFICATION FOR JENDL-3 WAS MADE/2/. 90-10 MF=5: SPECTRA AT THRESHOLD ENERGIES WERE MODIFIED. 93-10 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) (3,10° SHESE DATA WERE ADOPTED FROM JENDL FUSION FILE (3,32) DELETED JENDL FUSION FILE /3/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) CROSS SECTIONS WERE CALCULATED WITH SINCROS-II SYSTEM/4/. THE OTHER CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 OF MT=16, 17, 22, 28 AND 91 WERE CREATED WITH F15TOB PROGRAM /3/ IN WHICH KUMABE'S SYSTEMATICS /5/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS- II CODE SYSTEM/4/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2 KEV
EVALUATION WAS MADE BY KIKUCHI ET AL./7/ ON THE BASIS OF
THE FOLLOWING EXPERIMENTAL DATA.
 TRANSMISSION : SHWE ET AL./8/
 CAPTURE : WEIGMANN ET AL./9/
 ASSUMED GAM-G : 0.150 EV FOR S-WAVE AND 0.180 EV FOR
 P-WAVE RESONANCE.
 A NEGATIVE RESONANCE WAS ADDED AT -20 EV. VALUES OF TOTAL
 SPIN J WERE ASSUMED ARBITRARILY FOR LEVELS WHOSE J HAS NOT
 BEEN DETERMINED.
UNRESOLVED RESONANCE REGION : 2 KEV - 100 KEV
 THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED
 WITH OPTICAL MODEL CODE CASTHY/10/. THE OBSERVED LEVEL
 SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION
 CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS
 OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT
 100 KEV. MF = 2100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.369E-4, S1 = 5.479E-4, S2 = 0.365 E-4, GG = 0.232 EV D0 = 76.12 EV, R = 6.680 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 19.560 -ELASTIC 5.566 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 13.99 119 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/6/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA ET AL./12/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PEREY/13/ MF PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/

HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /19/.

FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/20/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAME-TERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | LEVELS | NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
8
ABOV | ENERG
0.0
0.20
0.76
0.78
0.94
1.03
1.05
1.07
1.30
1.30
1.36
1.55
1.62
1.64
2.1.645 | Y(MEV)
41
58
62
06
77
92
67
97
97
57
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
08
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
77
97
70
97
70
97
70
97
70
97
97
97
97
97
97
97
97
97
97
97
97
97 | SPIN-P
3/2 +
7/2 +
1/2 +
3/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
3/2 +
1/2 +
3/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
3/2 +
1/2 +
1/2 +
3/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 + | ARITY
TO BE | (DIRECT
*
*
*
* | PROCESS) | |
|----------------|---|--|---|--|--|--------------------------------------|--|--|----|
| МТ
МТ
МТ | = 16 (
= 17 (
= 22 (
= 28 (
ADOPTED | (N,2N)
(N,3N)
(N,N'A
(N,N'P
FROM | CROSS S
CROSS S
CROSS
CROSS
CROSS
CROSS
JENDL FU | ECTION
ECTION
SECTION
SECTION
SION FIL | Ε. | | | | |
| ΜТ | = 102
SPHERICA
CASTHY/1
SECTIONS
AND REFE | CAPTU
AL OPT
10/ WA
3 WERE
50/21/ | RE
ICAL AND
S ADOPTE
ESTIMAT
AND NOR | STATIST
D. DIRE
ED ACCOR
MALIZED | ICAL MOD
CT AND S
DING TO
TO 1 MIL | EL CAL
EMI-DI
THE PR
LI-BAR | CULATION
RECT CAF
OCEDURE
N AT 14 | N WITH
PTURE CROS
OF BENZI
MEV. | S |
| | THE GAMM
REPRODUC
AT 30 KE | MA-RAY
CE THE
EV MEA | STRENGT
EXPERIM
SURED BY | H FUNCTI
ENTAL CA
MUSGROV | ON (2.97
PTURE CR
E ET AL. | 6E-03)
0SS SE
/22/ | WAS AD.
ECTION OF | JUSTED TO
- 0.4 BARN | |
| МТ
МТ
МТ | =103 (
=104 (
=105 (
=106 (
=107 (
THESE RE
PREEQUIL
PEGASUS / | (N,P)
(N,D)
(N,T)
(N,HE3
(N,ALP
EACTIC
LIBRIU
(11/. | CROSS SE
CROSS SE
CROSS SE
) CROSS
HA) CROSS
N CROSS
M AND MU | CTION
CTION
CTION
SECTION
S SECTIO
SECTIONS
LTI-STEP | N
WERE CA
EVAPORA | LCULAT
TION M | ED WITH | THE
DE | |
| | THE KALE
FORMULA
DENSITY | BACH'S
DERIV
PARAM | CONSTAN
ED FROM
ETERS. | T K (= 1
KIKUCHI- | 42.6) W.
KAWAI'S | AS EST
FORMAL | IMATED E
ISM/23/ | BY THE
AND LEVEL | |
| | FINALLY,
THE FOLL
(N,P)
(N,ALF | , (N,P
_OWING
PHA) | C) AND (N
VALUES
38.00
13.50 | ,ALPHA)
AT 14.5
MB (RE
MB (RE | CROSS SE
MEV:
COMMENDE
COMMENDE | CTIONS
D BY F
D BY F | SWERE NO
ORREST/2
ORREST/2 | DRMALIZED
24/)
24/) | то |
| МΤ | = 251 | MU-BA | R | | | | | | |

CALCULATED WITH CASTHY/10/.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 2CALCULATED WITH CASTHY/10/. MT = 51-65 TAKEN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH CASTHY AND DWUCK/25/ IN THE SINCROS-II SYSTEM. MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. <<FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 46.0-0.25E WS = 7.0 WS0= 7.0 R0 = 5.893- - - - - - - - - - -A0 = 0.62RS = 6.393RSO = 5.893AS = 0.35ASO= 0.62 TABLE 2 LEVEL DENSITY PARAMETERS C(/MEV) EX(MEV) PAIRING NUCLIDE A(/MEV) T(MEV) - - - - - -_ _ _ _ 1.036E+01 8.000E-01 7.822E-01 5.057E+00 1.200E+00 1.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+00 1.298E+01 7.000E-01 1.273E+00 5.183E+00 1.200E+00 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00 40-ZR- 91 40-ZR- 92 40-ZR- 93 40-ZR- 94 1.040E+01 8.410E-01 4.607E+00 4.477E+00 0.0 1.250E+01 7.120E-01 2.205E+00 4.629E+00 7.200E-01 1.281E+01 7.230E-01 7.763E+00 4.250E+00 0.0 1.277E+01 7.500E-01 2.121E+00 5.782E+00 1.120E+00 41-NB- 92 41-NB- 93 41-NB- 94 41-NB- 95 1.125E+01 7.800E-01 9.792E-01 5.457E+00 1.280E+00 1.301E+01 6.850E-01 3.417E-01 5.770E+00 2.000E+00 1.360E+01 7.150E-01 1.847E+00 5.835E+00 1.280E+00 1.403E+01 7.410E-01 6.991E-01 7.645E+00 2.400E+00 42-MO- 93 42-MO- 94 42-MO- 95 42-MO- 96 SPIN CUT-OFF PARAMS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALUCULATION, SPIN CUT-OFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.184 FOR MO-95 AND 7.696 FOR MO-96. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
CHIBA, S. ET AL.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
KUMABE, I. ET AL.: JAERI-M 86-030 (1986).
SHWE H. AND COTE R.E.: PHYS. REV. 179, 1148 (1969).
SHWE I. AND COTE R.E.: PHYS. REV. 179, 1148 (1969).
WEIGMANN H. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). IIJIMA, S. AND NOWAL, W. S. M. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 13) 141 15 Ì (1971). 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND GAMERON, (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MUSGROVE A.R.DE L. ET AL.: NUCL. PHYS., A270, 108 (1976). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR 18) 19) 20) 21) 22) 231

| | REACTIONS", | NORTH H | HOLLAND (′ | 1968). |
|-------|-------------|----------|------------|---------|
| 24) | FORREST, RÍ | A.: AERI | E-R 12419 | (1986). |
| 0 r (| , ס`ס דואוע | | | |

25) KUNZ, P.D.: PRIVATE COMMUNICATION.

| MA
4 | T number
2-MO- 96 | = 4237
JNDC | EVAL-AUG89 JNDC FP NUCLEAR DATA W.G.
DIST-OCT89 REV2-OCT93 | |
|----------------------------|---|---|--|------------------|
| HI
84
89
90
93 | -10 EVALU
-08 MODIF
-10 MF=5
-10 JENDU
COMP | JATION
FICATIO
: SPECT
-3.2
ILED BY | OR JENDL-2 WAS MADE BY JNDC FPND W.G./1/
FOR JENDL-3 WAS MADE/2/
A AT THRESHOLD ENERGIES WERE MODIFIED.
T.NAKAGAWA (NDC/JAERI) | |
| | (3,2)
(4,16 | MODI
), (3,4
5-91) | IED PARTS FOR JENDL-3.2 ************************************ | |
| | (5,16
(3,32 | 5-91)
THESE
2)
****** | DATA WERE ADOPTED FROM JENDL FUSION FILE
DELETED | |
| | JENDI
EV/
COM | - FUSIO
ALUATED
MPILED | FILE /3/ (AS OF OCT. 1993)
BY K.KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI)
Y K.KOSAKO | |
| | | THE INE
DSS SEC
OTHER,
DGRAM /
PRECO
NCROS-I
OPTICAL
THE SCH | ASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA
IONS WERE CALCULATED WITH SINCROS-II SYSTEM /4/
CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6
17, 22, 28 AND 91 WERE CREATED WITH F15TOB
/ IN WHICH KUMABE'S SYSTEMATICS /5/ WAS USED.
POUND/COMPOUND RATIO WAS CALCULATED BY THE
CODE SYSTEM/4/.
WODEL, LEVEL DENSITY AND OTHER PARAMETERS USED
CROS-II CALCULATION ARE DESCRIBED IN REF./4/.
MES WERE DETERMINED ON THE BASIS OF ENSDE/6/ | ()
;
;; |
| MF | = 1 GEN | NERAL I | FORMATION | |
| ME | MT=451 C | OMMENTS
SONANCE | AND DICTIONARY
PARAMETERS | |
| VII | T=151 RE
RESOLVED
EVALUAT
AVERAGE
EV FOR
UNRESOLVE
THE NEU
WITHCING
CALCULA
OBTAINE
100 KEV | SOLVED
RESONA
JRE : WAVE
E RADIA
S-WAVE
ED RESO
JTRON S
JTRON S
JTRON S
JTRON S
G WAS D
ATED WI
ED FROM | AND UNRESOLVED RESONANCE PARAMETERS
CE REGION (MLBW FORMULA) : BELOW 19 KEV
MADE BY KIKUCHI ET AL./7/
IGMANN ET AL./8/, MUSGROVE ET AL./9/
IVE WIDTHS WERE ASSUMED TO BE 0.114 EV AND 0.13
AND P-WAVE RESONANCES, RESPECTIVELY.
ANCE REGION : 19 KEV - 100 KEV
RENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED
ODEL CODE CASTHY/10/. THE OBSERVED LEVEL
TERMINED TO REPRODUCE THE CAPTURE CROSS SECTION
H CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS
FITTING TO THE CALCULATED TOTAL CROSS SECTION A | 36
)

 |
| | TYPICAL
S0 = 0
D0 = 93 | /ALUES
.370E-4
3.33 EV | F THE PARAMETERS AT 70 KEV:
S1 = 5.480E-4, S2 = 0.365E-4, GG = 0.162 EV
R = 6.698 FM. | |
| | CALCULATE
TOTAL
ELAS
CAPTU | ED 2200
FIC
JRE | M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)
2200 M/S RES. INTEG.
5.322 -
4.727 -
0.5954 17.5 | |
| MF | = 3 NEU
BELOW 100
THE SPHEF
PERFORMET
REACTIONS
PEGASUS/7
EVAPORAT
DETERMINE
OF THE TO | JTRON C
KICAL O
WITH
S, OF W
11/ STA
ION MOD
ED BY I
NTAL CR | OSS SECTIONS
ESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV,
TICAL AND STATISTICAL MODEL CALCULATION WAS
ASTHY/10/, BY TAKING ACCOUNT OF COMPETING
ICH CROSS SECTIONS WERE CALCULATED WITH
DING ON A PREEQUILIBRIUM AND MULTI-STEP
L. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
JIMA ET AL./12/ TO REPRODUCE A SYSTEMATIC TREND
SS SECTION. THE OMP'S FOR CHARGED PARTICLES AR | E
E |
| | ALPHA
DEUTEF
HELIUM
PARAMETEF
AND CAMEF
EXTENSIVE
PRESENT V | N = P
= H
RON = L
M-3 AND
RS FOR
RON/17/
E DETER
VORK. | REY/13/
IZENGA AND IGO/14/
HR AND HAEBERLI/15/
TRITON = BECCHETTI AND GREENLEES/16/
HE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT
WERE EVALUATED BY IIJIMA ET AL./18/. MORE
INATION AND MODIFICATION WERE MADE IN THE
ABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED | |

IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /19/.

FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/20/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAME-TERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | ľ | NO.
SR.
2
3
4
5 | ENERGY(
0.0
0.7782
1.1479
1.4977
1.6259
1.6281 | MEV) | SPIN-PAF
0 +
2 +
0 +
2 +
2 +
2 +
4 + | RITY (DI | RECT P
* | ROCESS) | |
|----|---|--|---|---|--|--|-------------------------------------|------------------------------------|----|
| | LEVELS | 6
7
8
9
10
11
12
13
14
15
16
17
8
ABOVE | 1.8695
1.9784
2.2193
2.2193
2.2345
2.4261
2.4384
2.4406
2.4406
2.4406
2.5045
2.5943
E 2.594 | V WERE | 4 + +
3 2 + +
3 3 + +
5 6 2 + +
1 3 + +
ASSUMED | TO BE OV | *
ERLAPP | ING. | |
| | MT = 16
MT = 17
MT = 22
MT = 28
ADOPTED | (N,2N)
(N,3N)
(N,N'A)
(N,N'P)
FROM | CROSS SEC
CROSS SEC
CROSS SE
CROSS SE
CROSS SE
JENDL FUSI | TION
TION
CTION
CTION
CTION
ON FIL | Ε. | | | | |
| | MT = 102
SPHERIC/
CASTHY/7
SECTIONS
AND REF | CAPTUF
AL OPTI
10/ WAS
3 WERE
50/21/ | RE
ICAL AND S
S ADOPTED.
ESTIMATED
AND NORMA | STATIST
DIRE
ACCOR | ICAL MODEL
CT AND SEM
DING TO TH
TO 1 MILL | L CALCUL
MI-DIREC
HE PROCE
I-BARN A | ATION
T CAPT
DURE O
T 14 M | WITH
URE CROS
F BENZI
EV. | S |
| | THE GAMM
REPRODUC
MEASUREI | MA-RAY
CE THE
D BY MU | STRENGTH
EXPERIMEN
JSGROVE ET | FUNCTI
TAL CA
AL./9 | ON (1.6238
PTURE CROS
/ | E-04) WA
SS SECTI | S ADJU
ON | STED TO | |
| | MT =103
MT =104
MT =105
MT =107
THESE RE
PREEQUII
PEGASUS | (N,P) (
(N,D) (
(N,T) (
(N,ALPH
ACTION
IBRIUN
/11/. | CROSS SECT
CROSS SECT
CROSS SECT
AA) CROSS
N CROSS SE
M AND MULT | ION
ION
SECTIO
CTIONS
I-STEP | N
WERE CAL(
EVAPORAT | CULATED
ION MODE | WITH T
L CODE | HE | |
| | THE KALE
FORMULA
DENSITY | BACH'S
DERIVE
PARAME | CONSTANT
D FROM KI
TERS. | K (=11
KUCHI- | 6.4) WAS
KAWAI'S FO | ESTIMAT
DRMALISM | ED BY
/22/ A | THE
ND LEVEL | |
| | FINALLY
THE FOLI
(N,P)
(N,ALF | , (N,P)
_OWING
PHA) |) AND (N,A
VALUES AT
23.00
10.00 | LPHA)
14.5
MB (ME
MB (RE | CROSS SEC ⁻
MEV:
ASURED BY
COMMENDED | TIONS WE
IKEDA E
BY FORR | RE NOR
T AL./
EST/24 | MALIZED
23/)
/) | ТO |
| | MT = 251
CALCULAT | MU-BAF
FED WIT | R
TH CASTHY/ | 10/. | | | | | |
| ΜF | = 4 ANGU
MT = 2 | JLAR DI | ISTRIBUTIO | NS OF | SECONDARY | NEUTRON | S | | |

CALCULATED WITH CASTHY/10/. MT = 51-67 TAKEN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH CASTHY AND DWUCK/25/ IN THE SINCROS-II SYSTEM. MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. MF <<FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) ·---- - - - - - - - -- - - - -- - - - - - - - - - -V = 46.0-0.25E WS = 7.0 WS0= 7.0 R0 = 5.893A0 = 0.62RS = 6.393RSO = 5.893AS = 0.35AS0= 0.62TABLE 2 LEVEL DENSITY PARAMETERS C(/MEV) EX(MEV) PAIRING NUCLIDE A(/MEV) T(MEV) . - - - - - - -40-ZR-921.088E+01 8.192E-01 5.122E-01 6.429E+00 1.920E+0040-ZR-931.298E+01 7.000E-01 1.273E+00 5.183E+00 1.200E+0040-ZR-941.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+0040-ZR-951.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E+00 1.250E+01 7.120E-01 2.205E+00 4.629E+00 7.200E-01 1.281E+01 7.230E-01 7.763E+00 4.250E+00 0.0 1.277E+01 7.500E-01 2.121E+00 5.782E+00 1.120E+00 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0 41-NB- 93 41-NB- 94 41-NB- 95 41-NB-96 1.301E+01 6.850E-01 3.417E-01 5.770E+00 2.000E+00 1.360E+01 7.150E-01 1.847E+00 5.835E+00 1.280E+00 1.403E+01 7.410E-01 6.991E-01 7.645E+00 2.400E+00 1.517E+01 6.800E-01 2.769E+00 6.036E+00 1.280E+00 42-MO- 94 42-MO- 95 42-MO- 96 42-MO- 97 SPIN CUT-OFF PARAMS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALUCULATION, SPIN CUT-OFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.696 FOR MO- 96 AND 7.075 FOR MO- 97. REFERENCES ERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO, N.: JAERI-M 90-006 (1990). KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986). WEIGMANN H. ET AL.: 1971 KNOXVILLE, 749 (1971). MUSGROVE A.R.DE L.: NUCL. PHYS., A270, 108 (1976). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 1) 3 4) 5 Ì 6 7 8) 9) 10) (11)125 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 13) 14) 15 Ì 16)(1971) 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). IKEDA, Y. ET AL.: JAERI 1312 (1988). FORREST, R.A.: AERE-R 12419 (1986). KUNZ, P.D.: PRIVATE COMMUNICATION. 18) 19) 20) 21) 22) 23) 24)

MAT number = 4240 42-MO- 97 JNDC EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. DIST-DEC89 REV2-0CT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 89-08 MODIFICATION FOR JENDL-3 WAS MADE/2/. 90-10 MF=5: SPECTRA AT THRESHOLD ENERGIES WERE MODIFIED. 93-10 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) (3,2), (3,4), (3,51-91), (3,16), (3,17), (3,22), (3,28) (4,16-91) (5,16-91) (3,10° SHESE DATA WERE ADOPTED FROM JENDL FUSION FILE (3,32) DELETED JENDL FUSION FILE /3/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) CROSS SECTIONS WERE CALCULATED WITH SINCROS-II SYSTEM /4/. THE OTHER CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 OF MT=16, 17, 22, 28 AND 91 WERE CREATED WITH F15TOB PROGRAM /3/ IN WHICH KUMABE'S SYSTEMATICS /5/ WAS USED. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM/4/. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.8 KEV EVALUATION WAS MADE BY KIKUCHI ET AL./7/ ON THE BASIS OF THE FOLLOWING EXPERIMENTAL DATA. TRANSMISSION : SHWE ET AL./8/ CAPTURE : WEIGMANN ET AL./9/ ASSUMED GAMMA-G : 0.130 EV FOR S-WAVE AND 0.150 EV FOR P-WAVE RESONANCES. A NEGATIVE RESONANCE ADDED AT -20 EV. VALUES OF TOTAL SPIN J WERE ASSUMED ARBITRARILY FOR LEVELS WHOSE J HAS NOT BEEN DETERMINED. UNRESOLVED RESONANCE REGION : 1.8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS S0 S1 AND S0 WERE ACCOUNTS THE NEUTRON STRENGTH FUNCTIONS S0 S1 AND S0 WERE ACCOUNTS THE NEUTRON STRENGTH FUNCTIONS S0 S1 AND S0 WERE ACCOUNTS A NEGATIVE RESONANCE REGION : 1.8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS S0 S1 AND S0 WERE ACCOUNTS THE NE MF = 2DETERMINED. JRESOLVED RESONANCE REGION : 1.8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/10/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.370E-4, S1 = 5.479E-4, S2 = 0.365E-4, GG = 0.180 EV D0 = 58.76 EV, R = 6.687 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 7.957 ELASTIC 5.857 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 17.1 2.100 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/10/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA ET AL./12/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PERFY/13/ MF PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/

HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /19/.

FOR JENDL-3.2, DATA OF NEUTRON EMITTING REACTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/20/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAME-TERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | LEVEI | NO
GR
234567890
1123
1123
LS | -
-
ABOVE | | NERG
) . 485
) . 485
) . 67
) . 71
) . 725
) . 79
) . 848
) . 999
1 . 091
1 . 11
1 . 11 | Y(M
09
992
030
992
030
992
030
992
030
992
030
992
030
992
030
90
81
0
92
83
0
92
83
0
92
83
0
92
83
0
92
83
0
92
83
0
92
83
0
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
92
83
80
80
83
80
80
80
80
80
80
80
80
80
80
80
80
80 | EV) | RE | S FUSITION AS | PIN
5/2
5/2
5/2
5/2
5/2
5/2
5/2
5/2
5/2
5/2 | - PA
+ + + + + + + + + + + + + + + + + + + | NRI'
TO | ΤΥ
ΒΕ | (D
E 0 | VER | LAP | PRO | NG. | 8) | |
|----------------------|--|--|--|--|--|---|---------------------------------------|--------------------------|-----------------------------|---|---|-------------------|-------------------------|-----------------|------------------------|------------------------|---------------------------|----------------------|-----------|----|
| МТ
МТ
МТ
МТ | = 16
= 17
= 22
= 28
ADOPTEI | (N
(N
(N
(N
(N
(N | ,2N)
,3N)
,N'A)
,N'P)
,OM J | CROS
CROS
CRO
CRO
ENDI | SS S
SS S
SSS
SSS
SSS
- FU | ECT
ECT
SEC
SEC
SIO | O N
 O N
T C
T C
N F |

 | Ξ. | | | | | | | | | | | |
| ΜТ | = 102
SPHERIC
CASTHY
SECTION
AND REP | CAL
/10/
NS V
FF0/ | APTUR
OPTI
/ WAS
VERE
/21/ | E
CAL
AD
EST
AND | AND
DPTE
IMAT
NOR | ST
D.
ED
MAL | ATI
DI
ACC
IZE | STI
REC
ORE
D 1 | CAL
CT A
DINC | AND
G T
I M | ODE
SE
O T
I L L | L
MI
HE | CAL
-DI
PR
BAR | | LAT
CT
EDU
AT | ION
CAP
RE
14 | I WI
PTUF
OF
ME\ | ITH
RE CF
BENZ | ROS
ZI | S |
| | THE GAN
REPRODU
MEASURE | MMA-
JCE
ED E | -RAY
THE
BY MU | STRI
EXPI
ISGR(| ENGT
ERIM
DVE | H F
ENT
ET | UNC
AL
AL. | CAF
CAF
/22 |)N (
PTUF
2/ | (2.
{E | 976
CRC | SE -
SS | 03)
SE | W.
CT | AS
ION | ADJ | UST | TED 1 | ГО | |
| MT
MT
MT
MT | =103
=104
=105
=106
=107
THESE F
PREEQU
PEGASUS | (N
(N
(N
(N
REAC
ILIE
S/11 | , P) C
, D) C
, T) C
, HE3)
, ALPH
CTION
3RIUM
1/. | ROS
ROS
CROS
CROS
I
CRO
I
CRO
I
CRO
I
ANI | S SE
SE
SE
SS
SS
SS
SS
SS
SS
SS
SS
SS
SS
S | CTI
CTI
SEC
S S
SEC
LTI | ON
ON
TIC
ECT
TIC
- ST | N
ION
NS
EP | N
Wef
EV <i>i</i> | RE | CAL
RAT | CU | LAT
N M | ED
10D | WI
EL (| TH
COD | THE
De | Ē | | |
| | THE KAI
FORMUL/
DENSIT | LBAC
A De
Y P <i>i</i> | CH ' S
ER I VE
ARAME | CONS
D FI
TERS | STAN
ROM
S. | т к
кік | (=
UCH | =103
 - | 3.4
(AW <i>A</i> | \)
\ ' | WAS
S F | S E
OR | STI
MAL | MA
IS | TED
M/2: | ВҮ
3/ | ά τι
ΑΝΕ | HE
D LE\ | /EL | |
| | FINALLY
THE FOU
(N,P
(N,AI | Y, (
LLOV
)
LPH <i>A</i> | (N,P)
VING
A) | ANI
VALU
1 | D (N
JES
7.00
7.50 | ÅT
M | РНА
14.
В (
В (|) (
5 M
MEA
REC | CROS
MEV:
SUF
COMM | SS
RED
MEN | SEC
BY
DEC | CTI
/ I
D B | ONS
KED
Y F | S W
DA
OR | ERE
ET
RES | NO
AL.
T/2 | RMA
/24
25/) | ALIZE
4 /)
) | ΞD | то |
| ΜТ | = 251
CALCUL/ | ATE[| J-BAR
D WIT | н сл | ∖ѕтн | Y/1 | 0/. | | | | | | | | | | | | | |

| MF MT
MT
MT | 4
= 2
ALC
= 5
AKE | ANGU
CULAT
51-63
N FR | LAR
ED V
OM | DIS
NITH
JEND
DWUC | TRII
CA:
L FI
K/20 | BUT
STH
USI
6/ | I ON
Y / 1
ON
I N | S O
0/.
FIL
THE | F S
E C
S I | EC(| ONE
A V
ROS |) A R
/ H I
3 - I | Y N
CH
I S | EUT
WAS
YST | RO
S C | NS
Al(| CUL | ATE | D W | ITH | |
|---|--|--|---|---|--|---|---|---|--|---|---------------------------------------|--|--|---|--|---|--|--------------------------------|-------------------------------|--|--------|
| MF =
MF _
T | = 1
RAN
5
= 1
RAN | ENER
16,17
16,17
18 | ,22
MED
GY [
,22
MED | ,28,
FRÓ
DIST
,28,
FRÓ | 91
M MI
RIBI
91
M MI | F=6
UT1
F=6 | DA
ONS
DA | TA
OF
TA | (DC
Se
(DC |)
2001
201
201 | 0F
ND <i>A</i>
0F | : J
(RY
: J | END
NE
END | L F
UTR
L F | US
RON
TUS | 101
S
101 | NF
NF | I LE
I LE | | | |
| =====
< <fol< td=""><td>LOV</td><td>VING</td><td>ARE</td><td>====
PAR
====</td><td>===:
AME
===:</td><td>TER</td><td>===
S U
===</td><td>===
SED
===</td><td>===
 N
===</td><td>===
 T </td><td>= = =
HE
= = =</td><td>ĊA</td><td>===
STH
====</td><td>===
Y A
===</td><td>ND</td><td>===
PE
===</td><td>EGA</td><td>===
SUS
===</td><td></td><td>LC.>></td><td>=
></td></fol<> | LOV | VING | ARE | ====
PAR
==== | ===:
AME
===: | TER | ===
S U
=== | ===
SED
=== | ===
 N
=== | ===
 T | = = =
HE
= = = | ĊA | ===
STH
==== | ===
Y A
=== | ND | ===
PE
=== | EGA | ===
SUS
=== | | LC.>> | =
> |
| TABLE | E 1 | NEU | TRO | N OP | тісл | AL | РОТ | ENT | IAL | . P/ | AR A | ME | TER | S | | | | | | | |
| | | V =
WS =
WSO= | 46
7.(
7.(| DEP
.0-0 | TH
.251 | (ME)
E | V)
 | | | RAI
RO
RS
RS(| DIU
=
=
D= | S (
5 .
6 .
5 . | FM)
893
393
893 | | D
-
A
A
A | IFF
0 =
S =
S0= | = US
= 0
= 0
= 0 | ENE
. 62
. 35
. 62 | SS(F | FM)
 | |
| TABLE | 2 | LEV | EL [| DENS | ΙΤΥ | PA | RAM | ETE | RS | | | | | | | | | _ | | | |
| NUCL
40-Z
40-Z
40-Z
40-Z | _ I DE
ZR -
ZR -
ZR -
ZR -
ZR - | 93
94
95
96 | | A(/M
1.29
1.27
1.33
1.32 | EV)
8E+(
5E+(
1E+(
0E+(| 01
01
01
01
01 | T (M
7 . 0
7 . 5
6 . 0
7 . 0 | EV)
00E
30E
70E
00E | - 01
- 01
- 01
- 01 | C
1
4
5
2 | (/ N
. 27
. 41
. 45
. 23 | 1EV
3E
1E
3E
53E |)
+00
-01
-01
-01 | EX
5.
7.
3.
6. | 18
01
98
58 | EV
3E-
9E-
5E-
9E- |)
+00
+00
+00
+00 | PA
1.
2.
1.
2. | 2008
3208
2008
4908 | NG
E+00
E+00
E+00
E+00
E+00 | |
| 41 - N
41 - N
41 - N
41 - N | IB -
IB -
IB -
IB - | 94
95
96
97 | | 1.28
1.27
1.33
1.33 | 1E+(
7E+(
1E+(
7E+(| 01
01
01
01 | 7.2
7.5
5.8
6.7 | 30E
00E
80E
10E | - 01
- 01
- 01
- 01 | 7
2
3
9 | . 76
. 12
. 40
. 77 | 63E
1E
6E
1E | +00
+00
+00
-01 | 4.
5.
2.
5. | 25
78
53
02 | 0E-
2E-
0E-
6E- | +00
+00
+00
+00 | 0.
1.
0.
1. | 0
1208
0
2908 | E+00
E+00 | |
| 42-N
42-N
42-N
42-N | 10 -
10 -
10 -
10 - | 95
96
97
98 | ,
,
,
,
, | 1.36
1.40
1.51
1.59 | 0E+(
3E+(
7E+(
4E+(| 01
01
01
01 | 7.1
7.4
6.8
6.9 | 50E
10E
00E
00E | - 01
- 01
- 01
- 01 | 1
6
2
7 | . 84
. 99
. 76
. 35 | 7E
1E
9E
8E | +00
-01
+00
-01 | 5.
7.
6.
7. | 83
64
03
88 | 5E-
5E-
6E-
8E- | +00
+00
+00
+00 | 1.
2.
1.
2. | 280
400
280
570 | E+00
E+00
E+00
E+00
E+00 | |
| SPI
IN
ASS | N C
The
Sume | CUTOF
CAS
D TO | F P/
THY
BE | ARAM
CAL
7.0 | S WI
CUL <i>I</i>
75 I | ERE
ATI
FOR | CA
ON,
MŎ | LCU
SP
- 9 | LAT
IN
7 A | ED
CU
ND | АЗ
ТОР
5. | 5 0
F
29 | .14
FAC
1 F | 6 * S
TOR
OR | QR
S
MO | T(/
AT
- 9 | A)*/
0 1
98. | Ą**
MEV | (2/3
WEF | 3).
RE | |
| REFER
2) K
3) C
4) K
5) K
6) E
7) K
9) W
10) I
11) I
(| RENC
AND
AND
AND
ANA
ANA
COMA
COMA
COMA
COMA
COMA
COMA
COMA
COM | CES
APPL
AI, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, SO
ABE, S | ET
IED
N
I.E
VALU
YALU
AND
H.S.E
S.E
S.E | AL.
SCI
T ALJ
T ALJ
ET TE
ET T
ET A
ET A | : PI
ENCI
AER: I
DAL R
EAL VI
EAL VI
KAW | ROC
J.
JAE
JAE
I-M
UCL
: E
: E
KAH
JA
AI, | SAUC-0.
R 9LRR 9CEAE
9ORR 9
EAE
9ORR 1. | NT.
TA
90CT
STM
HYSN
HYSN
J | CC
FEI
SC-C
FSC-C
FSC-C
C
SC-C
SC-C
SC-C
SC-C | NF
199
27
199
ETUE
200
21
21
21
21
21
21
21
21
21
21 | . VOL
VT, 993R3 . LER, . | ON
CHN
DA
DA
79
71
P.C | NUC
2,
0L.
5 (
04,
986,
49
321
321
1. | LEA
P.1299
FIL
SFIL
(199
(199
(199
(199
(199
(199
(199
(19 | R
62
99
2)
80
E,
97
199
219
219
219
219 | DA1
7 (
19
(19
8
19
0
1)
2
0
1) | TA
(19)
95
990
NL/1
69) | FOR
85)
(19
).
NND | BAS
92)
C.
77 | SIC | |
| 13) Ĥ
14) H
15) L
16) B
F | | Ý, F
ZENGA
J
CHETT
NOMEN
HAEBE | .G:
,J
M./
I, F
A IN
RLI | PHY
.R.
AND
F.D.
NU
), P | S. I
AND
HAEI
JI
ČLE
. 63 | REV
IG
BER
R.
AR
82, | . 1
Ö,
Lİ,
AND
REA
TH | 31,
G.:
W.
GR
CTI
E U | 74
NU
EEN
ONS
NIV | 5
ICL
IUCI
ILEI
S (
ERS | (19
. F
ES,
(EC
S I 1 | 963
PHY
PH
G
S)
Y |).
S.
YS.
.W.
H.
OF | 29,
A2
:
H.
NIS | 4
232
P0
BA
SC0 | 62
LAF
RSF
NS | (19
381
RIZ
HAL
IN | 962
(1
ATI
L A
PRE |).
974)
ON
ND
SS. |). | |
| 17) (| 31LE
196 | BERT,
35). | Α. | AND | CAI | MER | ON, | Α. | G.W | 1.: | CA | Ν. | J. | PH | IYS | ., | 43 | , 1 | 446 | | |
| 18) 1
19) 0
20) A
21) E
22) M
23) K
F
24) 1 | RUF
BENZ
MUSC
KEAC | IMÂ,
PPELA
IUR,
ZI, V
SRÔVE
JCHI,
CTION
DA, Y | S.,
AR,
E.D
, A1
, A
, K
, S
, E | ET
H.:
ND R
ND R
.R.D
AND
NOR
T AL | AL.
ECI
DY(
EFF(
EL
KA\
THI | : J
N-1:
OUN
O, E
WAI
HOL
JAE | . N
G, (
G.:A
T A
LAN
RI | UCL
197
P.G
CC
L.:
D (
131 | | LA
NW
ICL
ICL
ICL
ICL
ICL
ICL
ICL
ICL
I
198 | . 7
- 86
/ 10
. F
E A F | EC
526
9 (
9 HY
8 M | HNO
- MS
196
S
A†† | L.
(1
9).
ER | 21
98
270
AN | ,
0)
Ů N | 10
108
NUC | (19
(1
LEA | 84)
976)
R |). | |

25) FORREST, R.A.: AERE-R 12419 (1986). 26) KUNZ, P.D.: PRIVATE COMMUNICATION.

| MAT number = 4243 | EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. |
|--|---|
| 42-MO- 98 JNDC | DIST-SEP90 REV2-OCT93 |
| HISTORY
84-10 EVALUATION FOR J
89-08 MODIFICATION FOR
90-02 (N,ALPHA) CROSS | ENDL-2 WAS MADE BY JNDC FPND W.G./1/
JENDL-3 WAS MADE/2/.
SECTION WAS MODIFIED. |
| 90-10 MF=5: SPECTRA AT
93-10 JENDL-3.2.
COMPILED BY T.NA | THRESHOLD ENERGIES WERE MODIFIED.
KAGAWA (NDC/JAERI) |
| ***** MODIFIED
(2,151) UN
(3,1) CA
(3,4), (3,51-91)
TA
(3,32) DE | PARTS FOR JENDL-3.2 ************************************ |
| (4,10-91) IA | KEN FROM JENDL FUSION FILE |
| (5,16-91) TA | KEN FROM JENDL FUSION FILE |
| ***************** | ******** |
| JENDL FUSION FIL | E /3/ (AS OF OCT. 1993) |
| EVALUATED BY K | .KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI) |
| COMPILED BY K. | KOSAKO |
| THE INELASTI | C SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) |
| CROSS SECTIONS | WERE CALCULATED WITH SINCROS-II SYSTEM /4/. |
| THE OTHER CROS | S SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 |
| OF MT=16, 17, | 22, 28 AND 91 WERE CREATED WITH F15TOB |
| PROGRAM /3/ IN | WHICH KUMABE'S SYSTEMATICS /5/ WAS USED. |
| THE PRECOMPOUN | D/COMPOUND RATIO WAS CALCULATED BY THE |
| SINCROS-UL COD | SYSTEM/// |
| OPTICAL-MODE | L, LEVEL DENSITY AND OTHER PARAMETERS USED |
| IN THE SINCROS | -II CALCULATION ARE DESCRIBED IN REF./4/. |
| LEVEL SCHEMES | WERE DETERMINED ON THE BASIS OF ENSDF/6/. |
| MF = 1 GENERAL INFORM. | ATION |
| MT=451 COMMENTS AND | DICTIONARY |
| MF = 2 RESONANCE PARA | METERS |
| MT=151 RESOLVED AND | UNRESOLVED RESONANCE PARAMETERS |
| RESOLVED RESONANCE R | EGION (MLBW FORMULA) : BELOW 32 KEV |
| PARAMETERS WERE TA | KEN FROM JENDL-2 WHICH WAS EVALUATED BY |
| KIKUCHI ET AL./7/ | ON THE BASIS OF THE FOLLOWING EXPERIMENTAL |
| TRANSMISSION : | CHRIEN ET AL./8/ |
| CAPTURE : | WEIGMANN ET AL./9/, MUSGROVE ET AL./10/ |
| AVERAGE RADIATION | WIDTHS OF 0.085 EV AND 0.12 EV WERE ADOPTED |
| TO S-WAVE AND P-WA | VE RESONANCES, RESPECTIVELY. A NEGATIVE |
| RESONANCE WAS ADDE | D AT -980 EV SO AS TO REPRODUCE THE THERMAL |
| CAPTURE CROSS SECT | ION GIVEN IN REF./11/. SCATTERING RADIUS |
| WAS TAKEN FROM THE | COMPILATION BY MUGHABGHAB ET AL./11/ |
| UNRESOLVED RESONANCE
THE NEUTRON STRENG
WITH OPTICAL MODEL
SPACING WAS DETERM
CALCULATED WITH CA
OBTAINED FROM FITT
100 KEV. | REGION : 32 KEV - 100 KEV
TH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED
CODE CASTHY/12/. THE OBSERVED LEVEL
INED TO REPRODUCE THE CAPTURE CROSS SECTION
STHY. THE EFFECTIVE SCATTERING RADIUS WAS
ING TO THE CALCULATED TOTAL CROSS SECTION AT |
| TYPICAL VALUES OF TH | E PARAMETERS AT 70 KEV: |
| S0 = 0.370E-4, S1 | = 5.48E-4, S2 = 0.365E-4, SG = 1.74E-4, |
| GG = 0.133 EV, R | = 6.631 FM. |
| CALCULATED 2200-M/S
TOTAL
ELASTIC
CAPTURE | CROSS SECTIONS AND RES. INTEGRALS (BARNS)
200 M/S RES. INTEG.
5.772 -
5.642 -
0.1300 6.56 |
| MF = 3 NEUTRON CROSS | SECTIONS |
| BELOW 100 KEV, RESON | ANCE PARAMETERS WERE GIVEN. |
| ABOVE 100 KEV, THE S | PHERICAL OPTICAL AND STATISTICAL MODEL |
| CALCULATION WAS PERF | ORMED WITH CASTHY, BY TAKING ACCOUNT OF |
| COMPETING REACTIONS, | OF WHICH CROSS SECTIONS WERE CALCULATED |
| WITH PEGASUS/13/ STA | NDING ON A PREEQUILIBRIUM AND MULTI-STEP |
| EVAPORATION MODEL. | THE OMP'S FOR NEUTRON GIVEN IN TABLE 1(A) |
| WERE DETERMINED BY | IJIMA AND KAWAI/14/ TO REPRODUCE A SYSTEMA- |

TIC TREND OF THE TOTAL CROSS SECTION. THIS SET WAS USED FOR CALCULATION OF THE CAPTURE CROSS SECTION WITH CASTHY AND THE PEGASUS CALCULATION, AND ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS. ANOTHER SET OF PARAMETERS IN TABLE 1 (B) WAS DETEMINED BY WATANABE/15/ TO FIT BETTER THE MEASUED TOTAL CROSS SECTION, AND WAS USED FOR THE TOTAL CROSS SECTION CALCULATION FOR JENDL-3.2. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/16/ ALPHA = HUIZENGA AND IGO/17/ DEUTERON = LOHR AND HAEBERLI/18/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/19/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/20/ WERE EVALUATED BY IIJIMA ET AL./21/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /22/. /22/. FOR JENDL-3.2, THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/23/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES A STANDARD LEVEL DENSITY PARAME- TERS OF SINCROS-II SYSTEM. ĀND ' = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. OPTICAL POTENTIAL PARAMETERS ARE GIVEN IN TABLE 1(B). MT = 1. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). ΜT F = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. MT NO. SPIN-PARITY (DIRECT PROCESS) ENERGY(MEV) 0.0 0.7348 0.7874 GR. 0 0 2 1 + * 1.4323 1.5100 1.7585 3456789 10 2 4 2 4 1.8809 1.9650 2.0175 2.0376 2.1048 2.2063 4 3 + * 0 2 2 2.2238 2.3334 2.3436 12 13 4 2 14 6 LEVELS ABOVE 2.344 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION ADOPTED FROM JENDL FUSION FILE. T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. OPTICAL POTENTIAL PARAMETERS ARE LISTED IN TABLE 1(A). DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/24/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT THE GAMMA-RAY STRENGTH FUNCTION (1.62E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MUSGROVE ET AL./10 T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT =103 MT =104 MT =105 MT =107 THESE THE KALBACH'S CONSTANT K (=77.4) WAS ESTIMATED BY THE FORMULA

DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/25/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.80 MB (MEASURED BY IKEDA ET AL./26/) (N,ALPHA) 5.70 MB (MEASURED BY IKEDA ET AL.) THE (N,ALPHA) CROSS SECTION WAS MODIFIED A LITTLE BY EYE-GUIDING THE EXPERIMENTAL DATA OF RAHMAN ET AL./27/ AND OF IKEDA ET AL./26/ MT = 251 MU-BAR CALCULATED WITH CASTHY. = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 2MF ΜT CALCULATED WITH CASTHY/12/ AND OMP IN TABLE 1(A). TAKEN FROM JENDL FUSION FILE DATA WHICH WAS CALCULATED WITH CASTHY AND DWUCK/28/ IN THE SINCROS-II SYSTEM. = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. MT MT F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16,17,22,28,91 TRANSFORMED FROM MF=6 DATA (DDX) OF JENDL FUSION FILE. << FOLLOWING ARE PARAMETERS USED IN THE CASTHY AND PEGASUS CALC.>> TABLE 1(A) NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) DIFFUSENESS(FM) RADIUS(FM) ---------V = 46.0-0.25E R0 = 5.893 A0 = 0.62 WS = 7.0 RS = 6.393 AS = 0.35 VS0= 7.0 RS0= 5.893 AS0= 0.62 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 1(B) NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) * DIFFUSENESS(FM) DEPTH (MEV) V = 49.29-0.5266E R0 = 1.270 A0 = 0.664 WS = 6.574+0.5038E RS = 1.264 AS = 0.538 VSO= 9.0 RSO= 1.201 ASO= 0.367 * COEFFICIENTS OF A**(1/3) THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. - - - -TABLE 2 LEVEL DENSITY PARAMETERS A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING NUCLIDE 1.275E+01 7.530E-01 4.411E-01 7.019E+00 2.320E+00 1.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E+00 1.320E+01 7.000E-01 2.235E-01 6.589E+00 2.490E+00 1.259E+01 5.590E-01 2.497E-01 3.084E+00 1.200E+00 40-ZR- 94 40-ZR- 95 40-ZR- 96 40-ZR- 97 1.277E+01 7.500E-01 2.121E+00 5.782E+00 1.120E+00 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0 1.337E+01 6.710E-01 9.771E-01 5.026E+00 1.290E+00 1.380E+01 5.110E-01 2.350E+00 1.731E+00 0.0 41-NB- 95 41-NB- 96 41-NB- 97 41-NB- 98 42-MO-961.403E+01 7.410E-01 6.991E-01 7.645E+00 2.400E+0042-MO-971.517E+01 6.800E-01 2.769E+00 6.036E+00 1.280E+0042-MO-981.594E+01 6.900E-01 7.358E-01 7.888E+00 2.570E+0042-MO-991.774E+01 6.200E-01 4.294E+00 6.058E+00 1.280E+00 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.291 FOR MO- 98 AND 2.875 FOR MO- 99. REFERENCES REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 3) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 4) YAMAMURO, N.: JAERI-M 90-006 (1990). 5) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).

- ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986). CHRIEN, R.E. ET AL.: PHYS. REV., C13, 578 (1976). WEIGMANN, H. ET AL.: 1971 KNOXVILLE, 749 (1971). MUSGROVE A.R.DE L. ET AL.: NUCL. PHYS., A270, 108 (1976). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). <u>6</u>) 7 8) 9) 10) 11) 12) 13) 14) (1983). WATANABE, T.: PRIVALE COMMUNICATION (1993). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 15) 16) 17) 18) 19) 1971 (1971). 20) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERON, A.G.W. CARL G. H.C., (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). IKEDA, Y. ET AL.: JAERI 1312 (1988). RAHMAN, M.M., ET AL.: NUCL. PHYS., A435, 43 (1985). KUNZ, P.D.: PRIVATE COMMUNICATION. 21) 22) 23) 24) 25)
- 26) 27)
- 28)

MAT number = 4246 42-MO- 99 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 24 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.370E-4, S1 = 5.400E-4, S2 = 0.340E-4, SG = 26.5E-4, GG = 0.120 EV, R = 6.699 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 13.70 5.700 TOTAL ELASTIC CAPTURE 8.000 41.6 F = 3 NEUTRON CROSS SECTIONS BELOW 24 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMATICS FROM THE NEIGHBORING MO ISOTOPES. THE SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 6.7 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 24 EV TO 100 KEV. MF = 3ABOVE 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/3/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IIJIMA AND KAWAI/4/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/5/ ALPHA = HUIZENGA AND IGO/6/ DEUTERON = LOHR AND HAEBERLI/7/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/8/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/9/ WERE EVALUATED BY IIJIMA ET AL./10/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /11/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/12/ AND NUCLEAR DATA STRUCTUKE ∟ SHEETS/13/. SPIN-PARITY 1/2 + ENERGY(MEV) NO GŘ. 0.0 $\begin{array}{c} 0.0\\ 0.0980\\ 0.2355\\ 0.3520\\ 0.5255\\ 0.5490\\ \end{array}$ 3/2 7/2 3/2 1/2 3/2 1 + 2 3 + + 4 5 + 3/2 +6 0.6150

| 7 0.6870 9/2 -
8 0.7535 5/2 -
9 0.7930 3/2 +
10 0.8895 3/2 +
11 0.9050 1/2 +
12 0.9130 1/2 +
13 0.9450 3/2 +
14 0.9520 5/2 -
15 1.0330 1/2 -
16 1.1500 1/2 -
LEVELS ABOVE 1.199 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|-------------------------------|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN
AND REFFO/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. | ZI |
| THE GAMMA-RAY STRENGTH FUNCTION (2.48E-03) WAS DETERMINED
THE SYSTEMATICS OF RADIATION WIDTH (0.12 EV) AND THE AVER
S-WAVE RESONANCE LEVEL SPACING (48.3 EV) CALCULATED FROM
LEVEL DENSITY PARAMETERS. | FROM
AGE
THE |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGA</pre> | .SUS. |
| THE KALBACH'S CONSTANT K (= 78.9) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LE
DENSITY PARAMETERS. | VEL |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 8.23 MB (SYSTEMATICS OF FORREST/16/)
(N,ALPHA) 2.18 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE IN
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY W
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DIS
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | ARE
ELAS-
ERE
TRI- |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND
OTHER NEUTRON EMITTING REACTIONS. | WITH
FOR |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{ccccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(F)} \\ V &= 46.0 - 0.25E & \text{R0} = 5.893 & \text{A0} = 0.62 \\ WS &= 7.0 & \text{RS} = 6.393 & \text{AS} = 0.35 \\ VS0 &= 7.0 & \text{RS0} = 5.893 & \text{AS0} = 0.62 \\ \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYP} \end{array}$ | M)

PE. |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYSI A(1/MEV) I(MEV) C(1/MEV) EX(MEV) PAIRIN 40-ZR-95 1.331E+01 6.070E-01 5.453E-01 3.985E+00 1.200E 40-ZR-96 1.320E+01 7.000E-01 2.235E-01 6.589E+00 2.490E 40-ZR-97 1.259E+01 5.590E-01 2.497E-01 3.084E+00 1.200E 40-ZR-98 * 1.725E+01 6.633E-01 1.790E+00 7.555E+00 2.140E | G
+00
+00
+00
+00 |
| 41-NB-961.331E+015.880E-013.406E+002.530E+000.041-NB-971.337E+016.710E-019.771E-015.026E+001.290E41-NB-981.380E+015.110E-012.350E+001.731E+000.041-NB-99*1.742E+016.566E-011.085E+016.300E+009.400E | +00
-01 |

| 42-M0-97 1.517E+01 6.800E-01 2.769E+00 6 42-M0-98 1.594E+01 6.900E-01 7.358E-01 7 42-M0-99 1.774E+01 6.200E-01 4.294E+00 6 42-M0-100 1.780E+01 6.000E-01 6.702E-01 6 | 6.036E+00 1.280E+00
7.888E+00 2.570E+00
5.058E+00 1.280E+00
5.645E+00 2.220E+00 |
|--|--|
| SYST: * = LDP'S WERE DETERMINED FROM SYSTE | MATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.1
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTOF
ASSUMED TO BE 2.875 FOR MO- 99 AND 5.125 FOR | 146*SQRT(A)*A**(2/3).
RS AT 0 MEV WERE
MO-100. |
| REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCL
AND TECHNOLOGY, MITO, P. 569 (1988).
2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 6
3) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337
4) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TE | LEAR DATA FOR SCIENCE
67 (1975).
(1987).
ECHNOL., 20, 77 |
| 5) PEREY, F.G: PHYS. REV. 131, 745 (1963). 6) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29 7) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A 8) BECCHETTI, F.D., JR. AND GREENLEES, G.W.:
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H.
W. HAEBERLI), P. 682, THE UNIVERSITY OF WI | 9, 462 (1962).
A232, 381 (1974).
POLARIZATION
BARSHALL AND
ISCONSIN PRESS. |
| 9) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. F | PHYS., 43, 1446 |
| 10) IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 11) GRUPPELAAR, H.: ECN-13 (1977). 12) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FI 13) NUCLEAR DATA SHEETS, 48, 663 (1986). 14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969) 15) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER REACTIONS" NORTH HOLLAND (1968) | . 21, 10 (1984).
ILE (JUNE 1987).
AND NUCLEAR |

16) FORREST, R.A.: AERE-R 12419 (1988).
| MAT number = 4249 | EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. |
|---|--|
| 42-MO-100 JNDC | DIST-MAY90 REV2-NOV93 |
| HISTORY
84-10 EVALUATION
89-08 MODIFICATIO
90-10 MF=5: SPECT
93-11 JENDL-3.2.
COMPILED BY | FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/
N FOR JENDL-3 WAS MADE/2/.
RA AT THRESHOLD ENERGIES WERE MODIFIED.
T.NAKAGAWA (NDC/JAERI) |
| ***** MODI
(2,151)
(3,1)
(3,4), (3,5
(3,32) | FIED PARTS FOR JENDL-3.2 ************************************ |
| (4,16-91)
(5,16-91)
******** | TAKEN FROM JENDL FUSION FILE
TAKEN FROM JENDL FUSION FILE |
| JENDL FUSIC | N FILE /3/ (AS OF OCT. 1993) |
| EVALUATED | BY K.KOSAKO(NEDAC) AND S.CHIBA (NDC/JAERI) |
| COMPILED | BY K.KOSAKO |
| THE INE | LASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) |
| CROSS SEC | TIONS WERE CALCULATED WITH SINCROS-II SYSTEM /4/. |
| THE OTHER | CROSS SECTIONS WERE TAKEN FROM JENDL-3.1. MF=6 |
| OF MT=16, | 17, 22, 28 AND 91 WERE CREATED WITH F15TOB |
| PROGRAM / | 3/ IN WHICH KUMABE'S SYSTEMATICS /5/ WAS USED. |
| THE PRECC | MPOUND/COMPOUND RATIO WAS CALCULATED BY THE |
| SINCROS-1 | I CODE SYSTEM/4/. |
| OPTICAL | -MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED |
| IN THE SI | NCROS-II CALCULATION ARE DESCRIBED IN REF./4/. |
| LEVEL SCH | EMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. |
| MF = 1 GENERAL I | NFORMATION |
| MT=451 COMMENTS | AND DICTIONARY |
| MF = 2 RESONANCE | PARAMETERS |
| MT=151 RESOLVED | AND UNRESOLVED RESONANCE PARAMETERS |
| RESOLVED RESONA | NCE REGION (MLBW FORMULA) : BELOW 26 KEV |
| PARAMETERS WE | RE TAKEN FROM JENDL-2 WHICH WAS EVALUATED BY |
| KIKUCHI ET AL | /7/ ON THE BASIS OF THE FOLLOWING EXPERIMENTAL |
| AVERAGE RADIA | ON : WEIGMANN ET AL./8/ |
| CAPTURE | : WEIGMANN ET AL./9/, MUSGROVE ET AL./10/ |
| AVERAGE RADIA | TION WIDTHS OF 0.065 EV AND 0.08 EV WERE ADOPTED |
| TO S-WAVE AND | P-WAVE RESONANCES, RESPECTIVELY. A NEGATIVE |
| RESONANCE WAS | ADDED AT -172 EV SO AS TO REPRODUCE THE THERMAL |
| CAPTURE CROSS | SECTION GIVEN BY MUGHABGHAB ET AL./11/ |
| SCATTERING RA | DIUS WAS TAKEN FROM REF./11/. |
| UNRESOLVED RESC
THE NEUTRON S
WITH OPTICAL
SPACING WAS D
CALCULATED WI
OBTAINED FROM
100 KEV. | NANCE REGION : 26 KEV - 100 KEV
TRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED
MODEL CODE CASTHY/12/. THE OBSERVED LEVEL
ETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION
TH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS
FITTING TO THE CALCULATED TOTAL CROSS SECTION AT |
| TYPICAL VALUES | OF THE PARAMETERS AT 50 KEV: |
| S0 = 0.370E-4 | , S1 = 5.479E-4, S2 = 0.365E-4, SG = 1.58E-4, |
| GG = 0.085 EV | , R = 6.308 FM. |
| CALCULATED 2200
TOTAL
ELASTIC
CAPTURE | -M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)
2200 M/S RES. INTEG.
5.499 -
5.300 -
0.1990 3.91 |
| MF = 3 NEUTRON C | ROSS SECTIONS |
| BELOW 100 KEV, | RESONANCE PARAMETERS WERE GIVEN. |
| ABOVE 100 KEV, | THE SPHERICAL OPTICAL AND STATISTICAL MODEL |
| CALCULATION WAS | PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF |
| COMPETING REACT | IONS, OF WHICH CROSS SECTIONS WERE CALCULATED |
| WITH PEGASUS/13 | / STANDING ON A PREEQUILIBRIUM AND MULTI-STEP |
| EVAPORATION MOD | EL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1(A) |
| WERE DETERMINED | BY IIJIMA AND KAWAI/14/ TO REPRODUCE A SYSTEMA- |
| TIC TREND OF TH | E TOTAL CROSS SECTION. THIS SET WAS USED FOR |

CALCULATION OF THE CAPTURE CROSS SECTION WITH CASTHY AND THE PEGASUS CALCULATION, AND ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS. ANOTHER SET OF PARAMETERS IN TABLE 1 (B) WAS DETEMINED BY WATANABE/15/ TO FIT BETTER THE MEASUED TOTAL CROSS SECTION, AND WAS USED FOR THE TOTAL CROSS SECTION CALCULATION FOR JENDL-3.2. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/16/ ALPHA = HUIZENGA AND IGO/17/ DEUTERON = LOHR AND HAEBERLI/18/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/19/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/20/ WERE EVALUATED BY IIJIMA ET AL./21/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /22/. 1221 FOR JENDL-3.2, THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP), (N,NA) CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTIG WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/23/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAME- TERS OF SINCROS-II SYSTEM. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. OPTICAL
POTENTIAL PARAMETERS ARE GIVEN IN TABLE 1(B). ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./6/ CNTRIBUTIONS OF THE DIRECT PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. SPIN-PARITY (DIRECT PROCESS) NO. ENERGY(MEV) 0.0 0.5356 0.6944 1.0637 GR. 0 2 + 1 2 + 02 + 3 4 1.1361 4 + LEVELS ABOVE 1.136 MEV WERE ASSUMED TO BE OVERLAPPING. T = 16 (N,2N) CROSS SECTION = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION THESE CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THE (N,2N) CROSS SECTION CALCULATED WITH SINCROS-II WAS MULTIPLIED BY 1.08. MT = 16MŤ MŤ MT T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. OPTICAL POTENTIAL PARAMETERS ARE LISTED IN TABLE 1(A). DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/24/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = 102THE GAMMA-RAY STRENGTH FUNCTION (1.43E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MUSGROVE ET MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (=50.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/25/ AND LEVEL DENSITY PARAMETERS. FINALLY, (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 2.50 MB (RECOMMENDED BY FORREST/26/) (N,ALPHA) 2.80 MB (MEASURED BY IKEDA ET AL./27/) MT = 251 MU-BAR

CALCULATED WITH CASTHY.

| MF | л
ТМ | 4 | 2 | AN | GU | LA | R | DI | STI | RI | BUT | ГІС |)NS | S C | F | SE | CO | ND | AR | Υ | NE | UT | RO | NS | | | | | | | |
|-------------|----------------------------|-------------------------|-------------------|-----------------|---------------|----------------|----------------------|----------------|------------------|----------------|------------------|--------------------|-----------------|-------------|-------------|-------------------|---------------|----------|--------------|--------------|----------------|---------------|---------------|---------------|-----------------|------------|-----------|-------------------|------------|------------|---|
| | ".
мт | | _C | UL
1- | AT
54 | ED | W | IT | H (| CA | STH | HY/ | 12 | 2/ | AN | D | OM | P | ΙN | T | AΒ | LE | 1 | (A |). | | | | | | |
| | - | TAK
Cas | ΚĒ
ST | N
HY | FR
A | O M
N D | J
D | EN
WU | DL
CK | F
/ 2 | US
8/ | | F
 T | E I L
He | ES | D A
I N | TA | W
OS | H I
- I | СН | W
S Y | AS
ST | C
E M | AL | CUI | LA | ΤE | D١ | NIT | Η | |
| | MT_ | TR/ | 1
\N | 6,
Sŕ | 17
0R | ,2
ME | 2,
D | 28
FR | ,9
ÓM | 1
M | F=6 | 6 C |) A T | Ā | (D | DX |) | 0F | J | EN | DL | F | US | 10 | NI | FII | LE | | | | |
| MF | ,= | 5 | 1 | ΕN | ER | GY | D | ١S | TR | I B | UT | 101 | IS | 0F | S | ΕC | ON | DA | RY | Ν | EU | ΤR | ΟN | S | | | | | | | |
| I | ··· · | TR/ | ١N | Sŕ | ÓŔ | ,г
МЕ | D, | FR | ΟM | M | F=6 | 6 C |) A T | A | (D | DX |) | 0F | J | EN | DL | F | US | 10 | NI | FII | LE | | | | |
| ==: | ==: | === | ==: | == | == | ==: | == | == | ==: | == | === | | :== | :== | == | == | == | == | == | ==: | == | == | == | == | ==: | ==: | ==: | ==: | === | === | |
| <<
== | F01 | LL(
=== |) W
= = : | I N
= = | G
== | A R
= = | E
= = | РА
== | RAI
==: | ME
== | TEF
=== | RS
=== | US
=== | SED
=== |
== | N
== | ΤH
== | E
== | СА
== | ST
==: | HY
== | A
== | ND
== | P
== | E G / | ASI
=== | US
== | دC
=== | ALC
=== | .>>
=== | |
| ΤA | BLI | E 1 | 1 (| A) | | NE | UT | RO | N (| 0 P | TIC | CAL | . F | 0T | ΈN | ΤI | AL | . P | AR | AM | ΕT | ER | S | | | | | | | | |
| | | | | _ | | | | DE | РТI
 | Η | (M E | EV) | | | | R | AD | 10 | S (| FΜ |) | _ | D | I F | FU | SEI | NE | SS | (FM |) | |
| | | | 1 | V
NS | = | 4
7 | 6.
.0 | 0 - | 0.2 | 25 | E | | | | | R | 0
S | =
= | 5.
6. | 89
39 | 3
3 | | A
A | 0
S | = (| 0.0 | 62
35 | | | | |
| | ТН | ΕF | =0 | VS
RM | 0=
0 | F ⁷ | .0
SU | RF | ACI | E. | ABS | SOF | PT | | N | R
P A | SC
RT | !=
 | 5.
S | 89:
DE | 3
R. | W | А
00 | SO
DS | = (
- S/ | 0.0
AX(| 62
)N | T | YPE | | |
| ΤA | BLI | E 1 | 1 (| B) | | NE | UT | RO | N (| 0 P | TI(| CAL | . F | 70' | ΈN | ΤI | AL | . P | AR | AM | ΕT | ER | S | | | | | | | | |
| | | | | _ | | | | DE | РТI
 | Η | (M E | EV) | | | | R | AD | 10 | S (| FΜ |) | _ | D | I F | FU | SEI | NE | SS | (FM |) | |
| | | | 1 | V
NS | = | 4
6 | 9.
.5 | 29
74 | - 0
+0 | . 5
. 5 | 266
038 | 3E
BE | | | | R | 0
S | =
= | 1.
1. | 27
26 | 0
4 | | A
A | 0
S | = (| 0.0 | 66
53 | 4
8 | | | |
| | . | | | VS | 0= | 9 | .0 | | | _ | | | | | | R | Ş0 | ,
co | 1.
EF | 20
F I | 1
C I | ΕŅ | ТS | SO | F (| 0.:
A* | 36
* (| 7
1 <u>/</u> : | 3)_ | | |
| тл | | | -0 | K M | 0 | F : | 50
ח | | ACI
SI | E.
TV | AB: | | | ТС
:тс | | PA | RI | I | S | DE | К. | W | 00 | DS | - 57 | AX(| JN | Ι | YPE | • | |
| N | | |)
F | L | L ∨
SY | ST | A | (1 | / MI | EV |) | чк <i>г</i>
Т (| ME | :v) | | | C (| 1/ | ME | V) | | FΧ | (M | ΕV |) | I | ΡA | IR | ING | | |
| -
4 | 0 - 2 | ZR - | - |
96 | | | 1 | .3 |
20 |
E + | <u>-</u> .
01 | 7. | 00 |)0E | - 0 | 1 | 2. | 23 | 5E | - 0 |
1 |
6 . | 58 | 9E |
+0(| 0 2 |
2 | 49 | 0E+ | 00 | |
| 4 | 0 - 2 | ZR ·
ZR · | - | 97 | | * | 1 | .2 | 59
25 | E+
E+ | 01 | 5. | 59 | 00E
33E | - 0
- 0 | 1 | 2. | 49 | 7E
0E | -0
+0 | 1 | 3.
7. | 08
55 | 4E
5E | +00+00 | | 1. | 20 | 0E+
0E+ | 00 | |
| 4 | 0 - 4
1 - 1 | ∠R·
NR- | | 99
97 | | | 1 | . ð
3 | 37 | E + 1
F + 1 | 01 | ю.
6 | 50
71 | | :-0
:-0 | 1 | ٦.
٩ | 77 | 0E
1F | +0 | 1 | ю.
5 | 95
02 | 7 E
6 F | +00 | 0. | 1.
1 | 201
291 | 0E+ | 00 | |
| 4 | 1 -
1 - | NB-
NB- | - | 98
99 | | * | 1 | .3 | 80
42 | E+
E+ | 01
01 | 5. | 11 | 0E
66 | - 0
- 0 | 1 | 2.
1. | 35 | 0Ē
5E | +0+0+0 | 0
1 | 1.
6. | 73
30 | 1E
0E | +0(+0) | 0 (
0 9 | 0.
9. | 0
40 | 0E- | 01 | |
| 4 | 1 - 1 | NB- | - 1 | 00 | | * | 1 | . 8 | 50 | E+ | 01 | 6. | 50 |)0E | - 0 | 1 | 7. | 32 | 9E | +0 | 1 | 5. | 69 | 9E | +00 | 0 (| 0. | 0 | | | |
| 4 | 2 - 1
2 - 1 | 40 -
10 -
10 - | - | 98 | | | 1 | .5 | 94
74 | E+
E+ | 01 | 6. | 90 |)0E | - 0 | 1 | 7.4. | 35 | 8E
4E | -0
+0 | 1 | 7.
6. | 88 | 8E | +00 | | 2. | 57
28 | 0E+
0E+ | 00 | |
| 4 | 2 - 1
2 - 1 | 40.
40. | - 1 | 01 | | | 2 | .0 | 80 | E +
E + | 01 | б.
5. | 65 | 50E | - 0 | 1 | б.
7. | 15 | 3E | +0 | 0 | б.
6. | 09 | 2E | +0(| 0 | 1. | 28 | 0E+
0E+ | 00 | |
| | SYS | ST: | | * | = | L | DP | ' S | W | ER | E | DET | ĒF | RMI | NE | D | FR | 01 | S | YS | ΤE | MA | ΤI | CS | • | | | | | | |
| S
I
A | P I <u>I</u>
N
S S I | N (
The
Jme | D | TO
CA
T | FF
ST
0 | P.
HY
BE | AR
C
5 | AM
AL
.1 | ETI
CUI
25 | ER
LA
F | S V
TIC
OR | VEF
DN,
MC | E
ع
) - 1 | CA
SPI | N
N
A | U L
C U
N D | AT
TO
5 | ED
FF | A
F
00 | S
AC
F | 0.
TO
OR | 14
RS
M | 6*
A
0- | SQ
T
10 | RT
0
1. | (A
ME |)*.
V | A*
WEI | * (2
RE | /3) | • |
| RE
1 | FEF
) / | R E M
A O M | ۱C
۲ / | ES | т. | E | т | AL | . : | Р | ROO | С. | IN | IT. | С | 0 | F. | 0 | N | NU | CL | ΕA | R | DA | ТА | F | OR | B | ASI | С | |
| 2 |)
) | ANE
Kav |)
VA | ÁΡ
Ι, | PL | I E | D
E T | SC | IEI
L. | NC
: | Е,
Ј. | SA
NL | N T
I C L | A | FESC | i. | _V
_T | OL
EC | ΗN | 2,
0Ľ | P
ب: | .1 | 62
9, | 7
1 | (19
95 | 98
(| 5)
19 | 92 |). | | |
| 3 | | YAN | I B. | Ą,
MŲ | R0 | 1 | ΕΙ
Ν _Ε | A
÷ | JĂI | ĖŖ | JAL
I-N | = R I
M _ S | - N
90 - | | 12 -
16 | 02 | 99 | 0) | '.3
'. | 5 | (1 | 99
20 | 2) | | | <u>_</u> | | | | | |
| 5
6
7 | | | SD
SD | ВЕ
F:
СН | ļΕ | VÅ | LŪ | AT
FT | AL
ED | Ň | UCI | | Ŕ | ST | RU
RU | CT
6- | | Ė, | DA
(1 | TA
S | ،
F
۶۱ | 28
I L | Ĕ, | B | NL | / NI | ŇD | С. | | | |
| 8
9 | { i | NE I
NE I | G | MA
MA | ŇŃ
NN | , | н.
Н. | Ë | Ţ | ĂĹ | . :
: : | PF
19 | IY S
971 | З.
К | RĔ | Ϋ́. | 'İL | Č2 | ò, | 1
74 | 15
9 | (1 | 19
97 | 69
1) |). | | | | | | |
| 10
11 |) | NUS | SGI
S <u>H</u> | R O
A B | VE
GH | ÅŖ | A. | R.
S. | DE
F | E | . E | ΞΤ
ΑL. | AL
: | | N | U C
Ţ R | L.
ON | P
C | HY
RO | S.
SS | 's | Á2
EC | 70
T I | ΟŇ | 108
S, | 8
V (| (1
)L | 97) | 6).
I, | | |
| 12 | \rangle | - A F
I G /
I I I | <
\ R. | A
A S
M A | Ϊ, | A
S | СА
Г | DE
AN
T | MI
DI
AI | FU | KAL | | > (
? , | 19
T | 181
- 9 |). | AE | RΙ | _1 | 32 | 1 | (1 | 99 | 1) | i | | | | | | |
| 14 | 5 | 11.
(19 |)

 | ИА
3) | ,
, | Š. | Ā | ΝD | Ϊĸ | ÀŴ. | ΑĬ | , N | ì.: | IVI | | NŬ | ĆĹ | | śċ | Ι. | Ť | ЕÇ | ΗŇ | ŏĹ |).
., | 2(| Ο, | 7 | 7 | | |

- 15) 16) 17)
- WATANABE, T.: PRIVALE COMMUNICATION (1993). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 18) 19)
- W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 20) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 21) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 22) GRUPPELAAR, H.: ECN-13 (1977).
 23) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 24) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 25) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 26) FORREST, R.A.: AERE-R 12419 (1986).
 27) IKEDA, Y. ET AL.: JAERI 1312 (1988).
 28) KUNZ, P.D.: PRIVATE COMMUNICATION.

MAT number = 4331 43-TC- 99 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA): BELOW 4.219 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 WITH SLIGHT MODIFICATION. EVALUATION FOR JENDL-2 WAS MADE BY KIKUCHI /3/. PARAMETERS OF THE 1ST AND 2ND RESONANCES WERE ADOPTED FROM RECOMMENDED VALUES OF FISCHER ET AL./4/, AND SLIGHTLY ADJUSTED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 20+-1 BARNS AT 0.0253 EV AND THE RESONANCE INTEGRAL OF 340+-20 BARNS /5/. PARAMETERS OF LEVELS BETWEEN 40 EV AND 1.5 KEV WERE EVALUATED ON THE BASIS OF DATA MEASURED BY ADAMCHUK ET AL. /6/ AND BY LITTLE AND BLOCK/7/. IN THE ENERGY RANGE FROM 1.0 TO 2.6 KEV, ARTIFICIAL LEVELS WERE GENERATED WITH STAT /8/ BY ASSUMING D=0.04 EV, S0= 0.17E-4, S1=11.12E-4 AND THE AVERAGE RADIATION WIDTH OF 0.17 EV. FOR THE RESONANCES OF WHICH ENERGY WAS ONLY MEASURED BY LITTLE AND BLOCK, THEIR PARAMETERS WERE ALSO ESTIMATED WITH STAT. ABOVE 2.66 KEV, EVALUATION WAS BASED ON THE CAPTURE AREAS MEASURED BY MACKLIN /9/. SCATTERING RADIUS WAS TAKEN FROM THE COMPILATION OF MUGHABGHAB ET AL./5/ FOR JENDL-3, TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVE-LY ESTIMATED WITH A RANDOM NUMBER METHOD. IN THIS PROCEDURE, NEUTRON WIDTHS FOR RESONANCES ABOVE 2.66 KEV WERE DETERMINED TO REPRODUCE THE CAPTURE AREAS MEASURED BY MACKLIN/9/. FOR JENDL-3, POTAL SPIN J OF SOME RESONANCES WAS TENTATIVE-LY ESTIMATED WITH A RANDOM ON RADIATIVE CAPTURE WIDTHS FOR LEVELS BETWEEN 111 EV AND 754 EV WERE MODIFIED SO AS TO REPRODUCE THE CAPTURE AREAS MEASURED BY LITTLE AND BLOCK/7/. UNRESOLVED RESONANCE REGION : 4.219 KEV - 100 KEV UNRESOLVED RESONANCE REGION : 4.219 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MACKLIN /9/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.414E-4, S1 = 4.241E-4, S2 = 0.488 E-4, SG = 90.4E-4, GG = 0.186 EV, R = 6.215 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. 10TAL 23.063 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 3.422 312 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/10/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/12/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /19/.

| /19/. | |
|---|--|
| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> | |
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> | |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./20/</pre> | |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 9/2 +
1 0.1405 7/2 +
2 0.1426 1/2 -
3 0.1811 5/2 +
4 0.5091 3/2 -
5 0.5343 5/2 -
6 0.6254 7/2 +
7 0.6715 5/2 -
8 0.7263 11/2 +
9 0.7616 5/2 +
10 0.7620 13/2 +
LEVELS ABOVE 0.9 MEV WERE ASSUMED TO BE OVERLAPPING. | |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (8.37E-03) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 380 MILLI-BARNS AT 100
KEV MEASURED BY MACKLIN/22/. | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 101.5) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1230.00 MB (RECOMMENDED BY BYCHKOV ET AL./24/)
(N,P) 14.00 MB (RECOMMENDED BY FORREST/25/)
(N,ALPHA) 7.00 MB (RECOMMENDED BY FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| V = 47.5 $R0 = 5.972$ $A0 = 0.62$ $WS = 9.74$ $RS = 6.594$ $AS = 0.35$ $VS0 = 7.0$ $RS0 = 5.97$ $AS0 = 0.62$ | |

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) PAIRING NUCLIDE A(1/MEV) T(MEV) - - - -- - - - - -1.277E+01 7.500E-01 2.121E+00 5.782E+00 1.120E+00 1.331E+01 5.880E-01 3.406E+00 2.530E+00 0.0 1.337E+01 6.710E-01 9.771E-01 5.026E+00 1.290E+00 1.380E+01 5.110E-01 2.350E+00 1.731E+00 0.0 41-NB- 95 41-NB- 96 41-NB- 97 41-NB- 98 1.403E+01 7.410E-01 6.991E-01 7.645E+00 2.400E+00 1.517E+01 6.800E-01 2.769E+00 6.036E+00 1.280E+00 1.594E+01 6.900E-01 7.358E-01 7.888E+00 2.570E+00 1.774E+01 6.200E-01 4.294E+00 6.058E+00 1.280E+00 42-MO- 96 42-M0- 97 42-M0- 98 42-MÖ- 99 1.600E+01 6.700E-01 4.756E+00 6.089E+00 1.120E+00 1.659E+01 6.120E-01 1.776E+01 4.176E+00 0.0 1.600E+01 6.550E-01 2.973E+00 5.984E+00 1.290E+00 1.637E+01 5.850E-01 1.189E+01 3.635E+00 0.0 43-TC- 97 43-TC- 98 43-TC- 99 43-TC-100 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.899 FOR TC- 99 AND 5.0 FOR TC-100. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
FISCHER, P., ET AL.: "PROC. INT. CONF. ON NEUTRON PHYS. AND NUCL. DATA FOR REACTORS AND OTHER APPLIED PURPOSES, HARWELL 1978", 718.
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A". ACADEMIC PRESS (1981).
ADAMCHUK, JU.V., ET AL.: IAE-2335 (1973).
LITTLE, R.C., BLOCK, R.L.: TRANS. AM. NUCL. SOC., 26, 574 (1977). LITTLE, N.G., DECL., (1977). KIKUCHI, Y.: JAERI-M 6248 (1975). MACKLIN, R.L.: NUCL. SCI. ENG., 81, 520 (1982). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 8) 9) 10) 11) 121 IJIMA, S. AND KAWAI, M. J. NUCL. Sol. Legingli, 20, 1. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 13) 14) 15) 16) W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSTRAINESS. (1971). 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 17) GILBERT, A. AND CAMERON, A.G.W. CARL G. L.G., (1965).
18) I JIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984)
19) GRUPPELAAR, H.: ECN-13 (1977).
20) MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978).
21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
22) MACKLIN, R.L.: NUCL. SCI. ENG. 81, 520 (1982).
23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
24) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
25) FORREST, R.A.: AERE-R 12419 (1986). SCI. TECHNOL. 21, 10 (1984).

MAT number = 4425 44-RU- 96 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 200 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.440E-4, S1 = 4.300E-4, S2 = 0.630E-4, SG = 5.71E-4, GG = 0.150 EV, R = 6.211 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 5.390 5.100 TOTAL ELASTIC CAPTURE 7.30 0.2900 F = 3 NEUTRON CROSS SECTIONS BELOW 200 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 6.3 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 200 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). - = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT SHEETS/14/. SPIN-PARITY ENERGY(MEV) NO. DWBA CAL. 0.0 0.8326 GR. 02 + 1 * + 1.5180 1.9311 2.1487 2.2839 ż 4 2 0 3 4 + 5 + 6 2 2 6 + 2.4621 7 +

| 8
9
10
11 | 2.5247
2.5290
2.5762
2.5882 | 2 +
2 +
2 +
5 - | |
|--|--|---|--|
| 12
13
LEVELS A | 2.6513
2.7399
BOVE 2.76 MEV WER | 2 +
1 +
E ASSUMED TO BI | E OVERLAPPING. |
| FOR THE LE
INELASTIC
DWUCK-4 CO
BASED ON T | VELS WITH AN ASTE
SCATTERING CROSS
DE/15/. DEFORMAT
HE DATA COMPILED | RISK, THE CONT
SECTIONS WAS C,
ION PARAMETER
BY RAMAN ET AL | RIBUTION OF DIRECT
ALCULATED BY THE
(BETA2 = 0.158) WAS
./16/ |
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/ | PTURE
OPTICAL AND STATI
ADOPTED. DIRECT
ERE ESTIMATED ACC
17/ AND NORMALIZE | STICAL MODEL CA
AND SEMI-DIRE
ORDING TO THE
D TO 1 MILLI-BA | ALCULATION WITH
CT CAPTURE CROSS
PROCEDURE OF BENZI
ARN AT 14 MEV. |
| THE GAMMA-
REPRODUCE
KEV MEASUR | RAY STRENGTH FUNC
THE CAPTURE CROSS
ED BY SRIRAMACHAN | TION (5.43E-04
SECTION OF 31
DRA ET AL./18/ |) WAS ADJUSTED TO
5 MILLI-BARNS AT 25 |
| MT = 16 (N,
MT = 22 (N,
MT = 28 (N,
MT = 32 (N,
MT = 103 (N,
MT = 104 (N,
MT = 105 (N,
MT = 106 (N,
MT = 107 (N,
MT = 111 (N.
THESE REAC
PREEQUILIB | 2N) CROSS SECTION
N'A) CROSS SECTIO
N'P) CROSS SECTIO
P) CROSS SECTION
D) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
HE3) CROSS SECTIO
ALPHA) CROSS SECTIO
ALPHA) CROSS SECTIO
TION CROSS SECTIO
RIUM AND MULTI-ST | N
N
TON
NS WERE CALCUL
EP EVAPORATION | ATED WITH THE
MODEL CODE PEGASUS. |
| THE KALBAC
FORMULA DE
DENSITY PA | H'S CONSTANT K (=
RIVED FROM KIKUCH
RAMETERS. | 118.0) WAS ES
I-KAWAI'S FORM | TIMATED BY THE
ALISM/19/ AND LEVEL |
| FINALLY, T
NORMALIZED
(N,P)
(N,ALPHA
THE (N,2N)
THE DATA M | HE (N,P) AND (N,A
TO THE FOLLOWING
150.00 MB (
31.90 MB (
CROSS SECTION WA
EASURED BY BORMAN | LPHA) CROSS SE
VALUES AT 14.
RECOMMENDED BY
SYSTEMATICS OF
S DETERMINED B'
N ET AL./21/ | CTIONS WERE
5 MEV:
FORREST/20/)
FORREST/20/)
Y EYE-GUIDING OF |
| MT = 251 MU
CALCULATED | -BAR
WITH CASTHY/2/. | | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED W
SCATTERING W
ISOTROPIC DI | R DISTRIBUTIONS C
YNOMIAL COEFFICIE
CENTER-OF-MASS S
AND IN THE LABORA
ITH CASTHY. CONT
AS CALCULATED WIT
STRIBUTIONS IN TH | F SECONDARY NE
NTS FOR ANGULA
YSTEM FOR MT=2
TORY SYSTEM FO
RIBUTION OF DI
H DWUCK-4. FO
E LABORATORY S | UTRONS
R DISTRIBUTIONS ARE
AND DISCRETE INELAS-
R MT=91. THEY WERE
RECT INELASTIC
R OTHER REACTIONS,
YSTEM WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRO | DISTRIBUTIONS OF
IBUTIONS OF SECON
INELASTIC SCATTER
N EMITTING REACTI | SECONDARY NEU
DARY NEUTRONS
ING TO OVERLAP
ONS. | TRONS
WERE CALCULATED WITH
PING LEVELS AND FOR |
| TABLE 1 NEUTR | ON OPTICAL POTENT | IAL PARAMETERS | |
| V = 4
WS = 9
VSO= 7
THE FORM OF | DEPTH (MEV)
7.5
.74
.0
SURFACE ABSORPTIC | RADIUS(FM)
RO = 5.972
RS = 6.594
RSO= 5.97
N PART IS DER. | DIFFUSENESS(FM)
A0 = 0.62
AS = 0.35
ASO= 0.62
WOODS-SAXON TYPE. |
| TABLE 2 LEVEL | DENSITY PARAMETE | RS | |
| 42-MO- 92 | 1.064E+01 7.770E | -01 2.062E-01 | 5.938E+00 2.210E+00 |
| 42-M0- 93
42-M0- 94
42-M0- 95 | 1.301E+01 7.800E
1.360E+01 6.850E
1.360E+01 7.150E | -01 9.792E-01
-01 3.417E-01
-01 1.847E+00 | 5.457E+00 1.280E+00
5.770E+00 2.000E+00
5.835E+00 1.280E+00 |

43-TC- 93 * 9.672E+00 6.989E-01 3.869E-01 3.036E+00 9.300E-01

* 1.062E+01 6.915E-01 2.121E+00 2.589E+00 0.0 * 1.159E+01 6.842E-01 1.101E+00 3.745E+00 7.200E-01 1.741E+01 5.640E-01 1.503E+01 3.650E+00 0.0 43-TC- 94 43-TC- 95 43-TC- 96 9.776E+00 6.915E-01 6.034E-02 4.294E+00 2.210E+00 1.358E+01 6.720E-01 1.120E+00 5.133E+00 1.280E+00 1.343E+01 6.680E-01 3.373E-01 5.719E+00 2.000E+00 1.510E+01 6.390E-01 1.567E+00 5.300E+00 1.280E+00 44-RU- 94 44-RU- 95 44-RU- 96 44-RU- 97 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.586 FOR RU- 96 AND 5.0 FOR RU- 97. REFERENCES REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
3) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
6) PEREY, F.G. PHYS. REV. 131, 745 (1963).
7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965) GILBERI, A. AND CAMERON, A.G.W.. CAN. J. FILLO, 40, 1440 (1965). ILJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). NUCLEAR DATA SHEETS, 35, 281 (1982). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). SRIRAMACHANDRA MURTY, M. ET AL.: J. PHYS. SOC. JAPAN, 35, 8 (1973). (11)12) 13) 14) 15) 16) 17)18) (1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
(1973).
<

MAT number = 4431 44-RU- 98 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 140 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.440E-4, S1 = 4.300E-4, S2 = 0.610E-4, SG = 4.88E-4, GG = 0.130 EV, R = 6.187 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 13.10 5.100 TOTAL ELASTIC CAPTURE 8.000 11.5 F = 3 NEUTRON CROSS SECTIONS BELOW 140 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 6.3 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 140 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). - = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT SHEETS/14/. SPIN-PARITY ENERGY(MEV) NO. DWBA CAL. 0.0 0.6524 GR. 02 + 1 * + 1.3211 1.3978 1.4146 ż ō + 3 4 4 2 3 1 + 1.7972 5 + 6 1.8169 + 7 2.0133 3 +

| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
|---|
| LEVELS ABOVE 2.671 MEV WERE ASSUMED TO BE OVERLAPPING.
FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/15/. DEFORMATION PARAMETER (BETA2 = 0.1947) WAS
BASED ON THE DATA COMPILED BY RAMAN ET AL./16/ |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (4.61E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.13 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (282 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 96.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1050.00 MB (RECOMMENDED BY BYCHKOV+/19/)
(N,P) 70.70 MB (SYSTEMATICS OF FORREST/20/)
(N,ALPHA) 17.20 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{cccc} & \text{DEPTH (MEV)} & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & V &= 47.5 & \text{RO} = 5.972 & \text{AO} = 0.62 \\ & \text{WS} &= 9.74 & \text{RS} = 6.594 & \text{AS} = 0.35 \\ & \text{VSO} &= 7.0 & \text{RSO} = 5.97 & \text{ASO} = 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 42-M0-94 1.301E+01 6.850E-01 3.41/E-01 5.770E+00 2.000E+00 42-M0-95 1.360E+01 7.150E-01 1.847E+00 5.835E+00 1.280E+00 42-M0-96 1.403E+01 7.410E-01 6.991E-01 7.645E+00 2.400E+00 42-M0-97 1.517E+01 6.800E-01 2.769E+00 6.036E+00 1.280E+00 |

1.159E+01 6.842E-01 1.101E+00 3.745E+00 7.200E-01 1.741E+01 5.640E-01 1.503E+01 3.650E+00 0.0 1.600E+01 6.700E-01 4.756E+00 6.089E+00 1.120E+00 1.659E+01 6.120E-01 1.776E+01 4.176E+00 0.0 43-TC- 95 43-TC- 96 43-TC- 97 43-TC-98 44-RU- 96 44-RU- 97 44-RU- 98 44-RU- 99 1.343E+01 6.680E-01 3.373E-01 5.719E+00 2.000E+00 1.510E+01 6.390E-01 1.567E+00 5.300E+00 1.280E+00 1.382E+01 7.400E-01 6.070E-01 7.507E+00 2.400E+00 1.650E+01 6.570E-01 4.016E+00 6.235E+00 1.280E+00 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.894 FOR RU- 98 AND 12.66 FOR RU- 99. REFERENCES (EFERENCES)
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SC AND TECHNOLOGY, MITO, P. 569 (1988).
2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
3) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) ON NUCLEAR DATA FOR SCIENCE IIJIMA, S. AND NOWAL, MARKING, MARKING, MARKING, MARKING, S. AND NOWAL, MARKING, PEREY, F.G. PHYS. REV. 131, 745 (1963). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1074) 6) 8) 9) (1971) 10) ĢILBĒRT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) ĜILBEŔT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
11) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 39, 467 (1983).
15) KUNZ, P.D.: PRIVATE COMMUNICATION.
16) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4434 44-RU- 99 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-0CT93

HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

* * * * * ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

MF = 2

= 4 of commented and brothonned # = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1 KEV RESONANCE PARAMETERS WERE EVALUATED AS FOLLOWS: RESONANCE ENERGIES, NEUTRON AND RADIATION WIDTHS WERE TAKEN FROM THE MEASUREMENT OF POPOV ET AL./2/ AS FOR LOWEST TWO LEVES, THE PARAMETERS WERE TAKEN FROM THE COMPILATION OF MUGHABGHAB ET AL./3/. TOTAL SPIN J FOR RESONANCES MEASURED BY POPOV ET AL. WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/4/. AVERAGE RADIATION WIDTH OF 199 MEV WAS DEDUCED AND ADOPTED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS OF 6.1 FM WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

FOR JENDL-3.2, TOTAL SPIN J WAS DETERMINED BASED ON THE MEASUREMENTS OF COCEVA ET AL./5/ AND WITH A RANDUM NUMBER METHOD.

UNRESOLVED RESONANCE REGION : 1 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./3/

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.440E\text{-}4, \ S1 = 4.200E\text{-}4, \ S2 = 0.600E\text{-}4, \ SG = 79.2E\text{-}4, \\ GG = 0.195 \ \text{EV}, \ R = 6.224 \ \text{FM}. \end{array}$

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. 10.985 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 3.6767.309 171

MF

CAPIURE 7.309 171 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RS0 OF IIJIMA-KAWAI POTENTIAL/8/. THE
OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/9/
ALPHA = HUIZENGA AND IGO/10/
DEUTERON = LOHR AND HAEBERLI/11/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/15/. /15/

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. МΤ SPIN-PARITY NO. ENERGY(MEV) 5/2 + 3/2 + 5/2 + 7/2 + 7/2 +GR. 0.0 0.0894 1 2 3 0.3221 0.3404 3/2 5/2 7/2 9/2 11/2 11/2 0.4420 0.5755 0.6180 456789 0.7192 1.0480 1.0700 1.3130 1.4960 + + 10 13/2 15/2 11 12 + 12 1.5720 15/2 -LEVELS ABOVE 1.7 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (7.80E-03) WAS DETERMINED FROM THE RADIATION WIDTH (0.195+-0.020 EV) AND AVERAGE S-WAVE RESONANCE LEVEL SPACING (25+-2 EV/3/). $\begin{array}{l} r = 16 & (N,2N) \ CROSS \ SECTION \\ r = 17 & (N,3N) \ CROSS \ SECTION \\ r = 22 & (N,N'A) \ CROSS \ SECTION \\ r = 28 & (N,N'P) \ CROSS \ SECTION \\ r = 32 & (N,N'D) \ CROSS \ SECTION \\ r = 103 & (N,P) \ CROSS \ SECTION \\ r = 104 & (N,D) \ CROSS \ SECTION \\ r = 105 & (N,T) \ CROSS \ SECTION \\ r = 106 & (N,HE3) \ CROSS \ SECTION \\ r = 107 & (N,ALPHA) \ CROSS \ SECTION \\ r = 107 & (N,ALPHA) \ CROSS \ SECTION \\ r = REACTION \ CROSS \ SECTION \\ r = REQUILIBRIUM \ AND \ MULTI-STEP \ EVAPORATION \ MODEL \ CODE \ PEGASUS. \\ \end{array}$ MT = MT = 10 MT = 17 MT = 22 MT = 28 MT = 32 ΜŤ ΜT ΜT MT MT THE KALBACH'S CONSTANT K (= 126.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 49.40 MB (SYSTEMATICS OF FORREST/19/) (N,ALPHA) 12.30 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY/6/. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DIFFUSENESS(FM) DEPTH (MEV) RADIUS(FM) $\begin{array}{ccccccc} V &= 47.5 & R0 = 5.972 & A0 = 0.62 \\ WS &= 9.74 & RS = 6.594 & AS = 0.35 \\ VS0 = 7.0 & RS0 = 5.97 & AS0 = 0.62 \\ THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. \end{array}$ TABLE 2 LEVEL DENSITY PARAMETERS A(1/MEV) T(MEV) NUCLIDE C(1/MEV) EX(MEV) PAIRING 42-MO-95 1.360E+01 7.150E-01 1.847E+00 5.835E+00 1.280E+00 42-MO-96 1.403E+01 7.410E-01 6.991E-01 7.645E+00 2.400E+00

42-MO- 97 42-MO- 98 1.517E+01 6.800E-01 2.769E+00 6.036E+00 1.280E+00 1.594E+01 6.900E-01 7.358E-01 7.888E+00 2.570E+00 43-TC- 96 43-TC- 97 43-TC- 98 43-TC- 99 1.741E+01 5.640E-01 1.503E+01 3.650E+00 0.0 1.600E+01 6.700E-01 4.756E+00 6.089E+00 1.120E+00 1.659E+01 6.120E-01 1.776E+01 4.176E+00 0.0 1.600E+01 6.550E-01 2.973E+00 5.984E+00 1.290E+00 1.510E+01 6.390E-01 1.567E+00 5.300E+00 1.280E+00 1.382E+01 7.400E-01 6.070E-01 7.507E+00 2.400E+00 1.650E+01 6.570E-01 4.016E+00 6.235E+00 1.280E+00 1.520E+01 7.200E-01 7.835E-01 8.078E+00 2.570E+00 44-RU- 97 44-RU- 98 44-RU- 99 44-RU-100 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 12.66 FOR RU- 99 AND 4.062 FOR RU-100. REFERENCES ERENCES KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). POPOV, JU.P., ET AL.: YAD. FIZ., 29, 561 (1979). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). COCEVA, C., ET AL.: NUCL. PHYS., A 117, 586 (1968). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 1) 2) ŝί 4) 5) 6) 7) 81 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 9) 10) 11) 12) (1971) 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERUN, A.G.W.. GAN. S. FILLO, I.G., I.G., (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4437 44-RU-100 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 11.89 KEV
RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 EXCEPT FOR THOSE
OF NEGATIVE AND HYPOTHETICAL RESONANCES, ANGULAR MOMENTUM FOR
SOME LEVELS AND SCATTERING RADIUS.
FOR JENDL-2, THE 228.5-EV RESONANCE WAS ADOPTED FROM
PRIESMEYER AND JUNG/3/. RESONANCES ABOVE 2679.7 EV WERE
MAINLY BASED ON THE EXPERIMENTAL DATA OF MACKLIN AND HALPERIN
/4/. RESONANCES AT 120 EV AND BETWEEN 336 AND 2497 EV WERE
HYPOTHETICAL LEVELS GENERATED BY ASSUMING SO=0.43E-4, DO=340
EV, S1=4.1E-4, D1=110 EV. THE AVERAGE RADIATION WIDTH OF 0.124
+-0.017 EV WAS DEDUCED AND ADOPTED TO THE LEVELS WHOSE
RADIATION WIDTH WAS UNKNOWN. TWO NEGATIVE RESONANCES WERE
ADDED, AND PARAMETERS OF THE 120-EV LEVEL WERE ADJUSTED SO AS
TO REPRODUCE THE CAPTURE CROSS SECTION OF 5.0+-0.6 BARNS AT
0.0253 EV AND THE CAPTURE RESONANCE INTEGRAL OF 11.2+-1.1
BARNS/5/.
FOR JENDL-3, THE REDUCED NEUTRON WIDTH WAS DECREASED FROM
43 MEV TO 23 MEV. SCATTERING RADIUS WAS CHANGED TO 6.1 FM
ACCORDING TO THE SYSTEMATICS OF MEASURED VALUES. NUMBER OF
NEGATIVE RESONANCES WAS REDUCED TO ONE AND ITS PARAMETERS WERE
REEVALUATED. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME
RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS
/6/. MF /6/ UNRESOLVED RESONANCE REGION : 11.89 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.450E-4, S1 = 6.500E-4, S2 = 0.530E-4, SG = 3.91E-4, GG = 0.125 EV, R = 4.971 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 11.49 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 6.465 5.022 11.2 CAPIURE 5.022 11.2 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/9/. THE
OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/10/
 ALPHA = HUIZENGA AND IGO/11/
 DEUTERON = LOHR AND HAEBERLI/12/
 HEIUW-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. MF /16/ MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2

T = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/.

| NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
LEVELS ABOVE | ENERGY(MEV)
0.0
0.5396
1.1304
1.2265
1.3621
1.7407
1.8653
1.8812
2.0517
2.0639
2.0777
2.0993
2.1673
2.2406
2.3872
2.4694
2.5168
2.613 MEV WERE | SPIN-PARITY
0 +
2 +
0 +
4 +
2 +
0 +
1 +
3 +
0 +
3 -
6 +
2 -
2 -
1 +
0 +
2 -
2 -
ASSUMED TO BE OV | DWBA CAL.
*
*
ERLAPPING. |
|---|--|--|---|
| FOR THE LEVELS
INELASTIC SCAT
DWUCK-4 CODE/1
BETA3 = 0.116)
AL./19/ AND SP | WITH AN ASTERIS
TERING CROSS SEC
8/. DEFORMATION
WERE BASED ON
EAR/20/, RESPEC | SK, THE CONTRIBUT
CTIONS WAS CALCUL
N PARAMETERS (BET
THE DATA COMPILED
TIVELY. | ION OF DIRECT
ATED BY THE
A2 = 0.2172 AND
BY RAMAN ET |
| MT = 102 CAPTUR
SPHERICAL OPTI
CASTHY WAS ADC
SECTIONS WERE
AND REFF0/21/ | E
CAL AND STATIST
PTED. DIRECT AN
ESTIMATED ACCORI
AND NORMALIZED | ICAL MODEL CALCUL
ND SEMI-DIRECT CA
DING TO THE PROCE
TO 1 MILLI-BARN A | ATION WITH
PTURE CROSS
DURE OF BENZI
T 14 MEV. |
| THE GAMMA-RAY
REPRODUCE THE
KEV MEASURED B | STRENGTH FUNCTIO
CAPTURE CROSS SI
Y MACKLIN ET AL | DN (3.79E-04) WAS
ECTION OF 120 MIL
./22,23/ | ADJUSTED TO
LI-BARNS AT 70 |
| MT = 16 (N,2N)
MT = 17 (N,3N)
MT = 22 (N,N'A)
MT = 28 (N,N'P)
MT = 32 (N,N'D)
MT = 103 (N,P) C
MT = 104 (N,D) C
MT = 105 (N,T) C
MT = 107 (N,ALPH
THESE REACTION
PREEQUILIBRIUM | CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
ROSS SECTION
ROSS SECTION
A) CROSS SECTION
A) CROSS SECTIONS
AND MULTI-STEP | N
WERE CALCULATED
EVAPORATION MODE | WITH THE
L CODE PEGASUS. |
| THE KALBACH'S
FORMULA DERIVE
DENSITY PARAME | CONSTANT K (= 8
D FROM KIKUCHI-
TERS. | 89.2) WAS ESTIMAT
KAWAI'S FORMALISM | ED BY THE
/24/ AND LEVEL |
| FINALLY, THE (
NORMALIZED TO
(N,P)
(N,ALPHA) | N,P) AND (N,ALP)
THE FOLLOWING V/
15.00 MB (REC
8.70 MB (SY) | HA) CROSS SECTION
ALUES AT 14.5 MEV
COMMENDED BY FORR
STEMATICS OF FORR | S WERE
:
ÉST/25/)
EST/25/) |
| MT = 251 MU-BAR
CALCULATED WIT | H CASTHY. | | |
| MF = 4 ANGULAR DI
LEGENDRE POLYNOW
GIVEN IN THE CEN
TIC LEVELS, AND
CALCULATED WITH
SCATTERING WAS C
ISOTROPIC DISTRI | STRIBUTIONS OF S
IAL COEFFICIENTS
TER-OF-MASS SYS
IN THE LABORATOP
CASTHY. CONTRIB
ALCULATED WITH I
BUTIONS IN THE I | SECONDARY NEUTRON
S FOR ANGULAR DIS
TEM FOR MT=2 AND
RY SYSTEM FOR MT=
BUTION OF DIRECT
DWUCK-4. FOR OTH
LABORATORY SYSTEM | S
TRIBUTIONS ARE
DISCRETE INELAS-
91. THEY WERE
INELASTIC
ER REACTIONS,
WERE ASSUMED. |
| MF = 5 ENERGY DIS
ENERGY DISTRIBUT
PEGASUS FOR INEL
OTHER NEUTRON EM | TRIBUTIONS OF SI
IONS OF SECONDAI
ASTIC SCATTERING
ITTING REACTION | ECONDARY NEUTRONS
RY NEUTRONS WERE
G TO OVERLAPPING
S. | CALCULATED WITH
LEVELS AND FOR |
| TABLE 1 NEUTRON C | PTICAL POTENTIAI
PTH (MEV) | L PARAMETERS | FFUSENESS(FM) |
| | ····· | | |

| Τŀ | V = 47
WS = 9
VSO= 7
HE FORM OF S | 7.5
.74
.0
Surface Absorp [:] | TION F | R0 = 5.972 A0 = 0.62
RS = 6.594 AS = 0.35
RS0= 5.97 AS0= 0.62
PART IS DER. WOODS-SAXON TYPE. |
|---------------------------------|---|--|---|---|
| TABL | E 2 LEVEL | DENSITY PARAM | ETERS | |
| NUC | CLIDE | A(1/MEV) T(M | EV) | C(1/MEV) EX(MEV) PAIRING |
| 42 -
42 -
42 -
42 - | -MO- 96
-MO- 97
-MO- 98
-MO- 99 | 1.403E+01 7.4
1.517E+01 6.8
1.594E+01 6.9
1.774E+01 6.2 | 10E-01
00E-01
00E-01
00E-01
00E-01 | 1 6.991E-01 7.645E+00 2.400E+00
1 2.769E+00 6.036E+00 1.280E+00
1 7.358E-01 7.888E+00 2.570E+00
1 4.294E+00 6.058E+00 1.280E+00 |
| 43 -
43 -
43 -
43 - | TC- 97
TC- 98
TC- 99
TC- 99
TC-100 | 1.600E+01 6.70
1.659E+01 6.12
1.600E+01 6.59
1.637E+01 5.89 | 00E - 01
20E - 01
50E - 01
50E - 01 | 1 4.756E+00 6.089E+00 1.120E+00
1 1.776E+01 4.176E+00 0.0
1 2.973E+00 5.984E+00 1.290E+00
1 1.189E+01 3.635E+00 0.0 |
| 44 -
44 -
44 -
44 - | RU- 98
RU- 99
RU-100
RU-101 | 1.382E+01 7.4
1.650E+01 6.5
1.520E+01 7.20
1.726E+01 6.7 | 00E - 01
70E - 01
00E - 01
00E - 01 | 1 6.070E-01 7.507E+00 2.400E+00
1 4.016E+00 6.235E+00 1.280E+00
1 7.835E-01 8.078E+00 2.570E+00
1 7.228E+00 6.836E+00 1.280E+00 |
| SPI
IN
ASS | IN CUTOFF P/
THE CASTHY
SUMED TO BE | ARAMETERS WERE
CALCULATION,
4.062 FOR RU- | CALCU
SPIN C
100 AN | ULATED AS 0.146*SQRT(A)*A**(2/3).
CUTOFF FACTORS AT 0 MEV WERE
ND 14.30 FOR RU-101. |
| REFE
1)
2)
3) | ERENCES
AOKI, T. E
AND APPLIE
KAWAI, M. E
AND TECHNOI
PRIESMEYER | T AL.: PROC. II
D SCIENCE, SAN
ET AL.: PROC.
LOGY, MITO, P.
, H.G., JUNG, N | NT. CC
TA FE.
INT. C
569 (
H.H.: | ONF. ON NUCLEAR DATA FOR BASIC
., VOL. 2, P.1627 (1985).
CONF. ON NUCLEAR DATA FOR SCIENCE
(1988).
ATOMKERNENERGIE, 19, 111 (1972). |
| 5)
6)
7)
8)
9) | MUGHABGHAB
PART A", A(
BOLLINGÈR,
IGARASI, S
IIJIMA, S.
IIJIMA, S. | L.S.F. ET AL.:
CADEMIC PRESS
L.M. AND THOM
.: J. NUCL. SC
ET AL.: JAERI
AND KAWAI, M. | "NEUT
(1981)
AS, G.
I. TEC
-M 87-
: J. N | TRON CROSS SECTIONS, VOL. I,
).
E.: PHYS. REV., 171,1293(1968).
CHNOL., 12, 67 (1975).
-025, P. 337 (1987).
NUCL. SCI. TECHNOL., 20, 77 |
| 10)
11)
12)
13) | (1983).
PEREY, F.G
HUIZENGA,
LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERL | : PHYS. REV. 1;
J.R. AND IGO,
AND HAEBERLI,
F.D. JR. AND
IN NUCLEAR REA(
I), P. 682, TH | 31, 74
G.: NU
W.: N
GREEN
CTIONS
E UNIV | 45 (1963).
UCL. PHYS. 29, 462 (1962).
NUCL. PHYS. A232, 381 (1974).
NLEES, G.W.: POLARIZATION
S ((EDS) H.H. BARSHALL AND
VERSITY OF WISCONSIN PRESS. |
| 14) | (1971).
GILBERT, A | . AND CAMERON, | A.G.W | W.: CAN. J. PHYS., 43, 1446 |
| 15)
16)
17)
18)
19) | (1965).
IIJIMA, S.
GRUPPELAAR
MATSUMOTO,
KUNZ, P.D.
RAMAN, S., | , ET AL.: J. NI
, H.: ECN-13 (
J.: PRIVATE COMMI
: PRIVATE COMMI
ET AL.: ATOM. | UCL. S
1977).
OMMUNI
UNICAT
DATA | SCI. TECHNOL. 21, 10 (1984).
İCATION (1981).
TION.
AND NUCL. DATA TABLES 36, 1 |
| 20)
21)
22) | SPEAR, R.H
BENZI, V. /
MACKLIN, R
CROSS SECT | .: ATOM. DATA A
AND REFFO, G.:
L., ET AL.: PI
IONS OF FISSIO | AND NU
CCDN-
ROC. S
N PROD | UCL. DATA TABLE, 42, 55 (1989).
-NW/10 (1969).
SPECIALISTS' MEETING ON NEUTRON
DUCTS, BOLOGNA 1979, NEANDC(E) |
| 23)
24)
25) | MAČKLIN, R
KIKUCHI, K
REACTIONS"
FORREST, R | .L., WINTERS, I
. AND KAWAI, M
, NORTH HOLLANI
.A.: AERE-R 124 | R.R.:
.: "NU
D (196
419 (1 | NUCL. SCI. ENG., 78, 110(1981).
UCLEAR MATTER AND NUCLEAR
68).
1986). |

MAT number = 4440 44-RU-101 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-0CT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. LEVEL SCHEME FOR INELASTIC SCATTERING CROSS SECTIONS WERE REPLACED. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.06 KEV
RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED ACCORDING TO NEW
EXPERIMENTAL DATA.
FOR JENDL-2, PARAMETERS WERE DETERMINED FROM THE EXPERIMENTAL DATA OF PRIESMEYER AND JUNG/3/ AND POPOV ET AL./4/
VALUES OF SPIN J WERE BASED ON THE DATA OF COCEVA ET AL./5/
A NEGATIVE RESONANCE WAS ADDED AT -20 EV TO REPRODUCE THE
CAPTURE CROSS SECTION OF 3.4+-0.9 BARNS AT 0.0253 EV/6/.
AVERAGE RADIATION WIDTH OF 0.180+-0.022 EV WAS DEDUCED, AND
ADOPTED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN.
FOR JENDL-3, PARAMETERS OF 40 LEVELS WERE REEVALUATED ON
THE BASIS OF THE NEW EXPERIMENTAL DATA OF ANUFRIEV/7/ FOR
NEUTRON WIDTHS. RADIATION WIDTHS AND TOTAL SPIN J OF
SEVERAL LEVELS WERE ALSO REVISED ACCORDING TO ANUFRIEV'S
DATA. SCATTERING RADIUS WAS MODIFIED TO 6.1 FM. TOTAL SPIN
J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM
NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME
RESONANCES WAS DETERMINED WITH A METHOD OF BOLLINGER AND
THOMAS/8/. MF THOMAS/8/ UNRESOLVED RESONANCE REGION : 1.06 KEV - 100 KEV THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MACKLIN ET AL./9,10/ THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.59E-4, S1 = 6.10E-4, S2 = 0.54E-4, SG = 105.E-4, GG = 0.173 EV, R = 5.062 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 7.100 -TOTAL ELASTIC CAPTURE 3.741 3.359 100 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/11/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/12/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGEN RSO OF IIJIMA-KAWAI POTENTIAL/13/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/14/ ALPHA = HUIZENGA AND IGO/15/ DEUTERON = LOHR AND HAEBERLI/16/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/17/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/18/ WERE EVALUATED BY IIJIMA ET AL./19/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAF /20/. MF NCE OF SPIN CUT-OFF IS DUE TO GRUPPELAAR /20/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./21/. NQ. ENERGY(MEV) SPIN-PARITY 0.0 0.12723 0.30685 0.31133 GŠ 5/2 + 1234567890 112 + + + 3 0.31133 5/2 + 4 0.32480 1/2 + 5 0.42230 3/2 + 6 0.52750 11/2 -7 0.53500 5/2 + 9 0.59830 5/2 -10 0.61630 3/2 + 11 0.62300 3/2 + 12 0.62350 1/2 + 13 0.68400 3/2 + 14 0.71800 1/2 -15 0.72000 9/2 + 16 0.82300 3/2 + 17 0.84278 7/2 + 18 0.90800 1/2 -19 0.92700 3/2 + 20 0.92872 9/2 + 21 0.93847 7/2 + 22 0.97340 5/2 + 23 1.0012 11/2 + 24 1.0410 3/2 + 25 1.0510 7/2 + 26 1.0980 1/2 + 27 1.1100 1/2 + 28 1.1690 3/2 + LEVELS ABOVE 1.2068 MEV WERE ASSUMED TO BE OVERLAPPING. 0.32480 + MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (1.16E-02) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 500 MILLI-BARNS AT 100 KEV MEASURED BY MACKLIN ET AL./9,10/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T = 103 (N,P) CROSS SECTION T = 104 (N,D) CROSS SECTION T = 105 (N,T) CROSS SECTION T = 106 (N,HE3) CROSS SECTION T = 107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16МŤ ΜT MŤ MŤ МТ ΜŤ ŇТ ΜT MT THE KALBACH'S CONSTANT K (= 106.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 24.00 MB (SYSTEMATICS OF FORREST/24/) (N,ALPHA) 6.07 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | ł |
|---|---------|
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) | |
| V = 47.5
WS = 0.74
R0 = 5.972
R0 = 0.62
R0 = 0.62 | |
| $W_{3} = 9.74$
$V_{3} = 0.594$
$V_{3} = 0.62$
THE FORM OF SUPERCE APSORPTION DAPT IS DEP WOODS SAYON TYPE | |
| TABLE 2. LEVEL DENSITY DADAMETERS | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE A (1/MEV) I (MEV) C (1/MEV) EX (MEV) PATRING | |
| 42-M0- 97 1.517E+01 6.800E-01 2.769E+00 6.036E+00 1.280E+00
42-M0- 98 1.594E+01 6.900E-01 7.358E-01 7.888E+00 2.570E+00 | |
| 42-M0-99 1.774E+01 6.200E-01 4.294E+00 6.058E+00 1.280E+00 42-M0-100 1.780E+01 6.000E-01 6.702E-01 6.645E+00 2.220E+00 | |
| 43-TC- 98 1.659E+01 6.120E-01 1.776E+01 4.176E+00 0.0 | |
| 43-TC-99 1.600E+01 6.550E-01 2.973E+00 5.984E+00 1.290E+00
43-TC-100 1.637E+01 5.850E-01 1.189E+01 3.635E+00 0.0 | |
| 43-1C-101 1.675E+01 6.440E-01 6.361E+00 5.761E+00 9.400E-01 | |
| 44-RU-99 1.650E+01 6.570E-01 4.016E+00 6.235E+00 1.280E+00
44-RU-100 1.520E+01 7.200E-01 7.835E-01 8.078E+00 2.570E+00 | |
| 44-RU-101 1.726E+01 6.700E-01 7.228E+00 6.836E+00 1.280E+00 44-RU-102 1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 | |
| | |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3)
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE |). |
| ASSUMED TO BE 14.30 FOR RU-101 AND 7.654 FOR RU-102. | |
| 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC | |
| AND APPLIED SCIENCE, SANIA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET.AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). | |
| 3) PRIESMEYER, H.G., JUNG, H.H.: ATOMKERNENERGIE, 19, 111 (1972).
4) POPOV, JU.P., ET.AL.: YAD. FIZ., 29, 561 (1979). | • |
| 5) COCEVA, C., ET AL.: NUCL. PHYS., A 117, 586 (1968).
6) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, | |
| PART A", ACADEMIC PRESS (1981).
7) ANUFRIEV, V.A. ET AL.: ATOM. ENERGIYA, 58, 279 (1985). | |
| BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). MACKLIN, R.L., ET AL.: "PROC. SPECIALISTS' MEETING ON NEUTRON | ۰.
۱ |
| CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979", NEANDC(E) 209L, 103. | |
| 10) MACKLIN, R.L., WINTERS, R.R.: NUCL. SCI. ENG., 78, 110(1981).
11) IGARASI, S. AND FUKAHORI, T. JAERI 1321 (1991). | • |
| 12) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
13) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 | |
| (1983).
14) PEREY, F.G: PHYS. REV. 131, 745 (1963). | |
| 15) HUIZEŃGA, J.R. AND IGO, G.: NUCL. PHYŚ. 29, 462 (1962).
16) LOHR. J.M. AND HAEBERLI. W.: NUCL. PHYŚ. A232. 381 (1974). | |
| 17) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND | |
| W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). | |
| 18) ĠIĹBEŔŤ, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). | |
| 19) ÌIJĪMĂ, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
20) GRUPPELAAR. H.: ECN-13 (1977) | |
| ŽÍ ĚŇŠDF EVALUATED ŇUCLĚAŘ ŠTŘÚCTURE DATA FILE (OCT. 1993).
22) BENZL V AND REEC G CCDN-NW/10 (1969) | |
| 23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS" NORTH HOLIAND (1968) | |
| 24) FORREST, R.A.: AERE-R 12419 (1986). | |

MAT number = 4443 44-RU-102 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 13.4 KEV RESONANCE PARAMETERS OF JENDL-2/1/ WERE MODIFIED ACCORDING TO NEW EXPERIMENTAL DATA. FOR JENDL-2, RESONANCE ENERGIES BELOW 2.5 KEV WERE TAKEN FROM THE DATA OF PRIESMEYER AND JUNG/3/ AND SHAW ET AL./4/, AND THE OTHER RESONANCES ABOVE 2.7 KEV FROM MACKLIN AND HALPERIN/5/. THE NEUTRON AND RADIATION WIDTHS OF LARGE RESONANCES WERE TAKEN FROM PRIESMEYER AND JUNG/3/ AND MACKLIN AND HALPERIN/5/. FOR OTHERS, THE AVERAGE RADIATION WIDTH OF 0.112+-0.027 EV WAS ADOPTED. FOR LEVELS OBSERVED BY SHAW ET AL. AND FOR THREE FICTITIOUS LEVELS AT 2.467, 2.556 AND 2.645 KEV, THE PARAMETERS WERE DETERMINED BY ASSUMING SO=0.43E-4, DO=340 EV, S1=4.1E-4 AND D1=110 EV. PARAMETERS OF THE NEGATIVE LEVEL ADDED AT -146 EV AND THE FIRST POSITIVE LEVEL WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 1.21 +-0.07 BARNS AT 0.0253 EV AND ITS RESONANCE INTEGRAL OF 4.2 +-0.1 BARNS/6/. MF +-0.07 BARNS AT 0.0253 EV AND ITS RESONANCE INTEGRAL OF 4.2 +-0.1 BARNS/6/. FOR JENDL-3, NEUTRON AND RADIATION WIDTHS OF 14 RESONANCES WERE REEVALUATED ON THE BASIS OF THE EXPERIMENTAL DATA OF ANUFRIEV ET AL./7/ FOR THE RESONANCES OBSERVED BY SHAW ET AL., REDUCED NEUTRON WIDTHS WERE GIVEN AS 6.5 MEV AND 65 MEV FOR S-WAVE AND P-WAVE RESONANCES, RESPECTIVELY. PARAMETERS OF THE NEGATIVE RESONANCE WERE ALSO REVISE. SCATTERING RADIUS WAS MODIFIED FROM 6.35 FM TO 6.1 FM BASED ON THE SYSTEMATICS. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/8/. UNRESOLVED RESONANCE REGION : 13.4 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.450E-4, S1 = 5.000E-4, S2 = 0.530E-4, SG = 3.61E-4, GG = 0.115 EV, R = 5.756 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 6.791 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 5.561 4.32 GAPTURE 1.229 4.32 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF ILJIMA-KAWAI POTENTIAL/11/. THE
OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/12/
 ALPHA = HUIZENGA AND IGO/13/
 DEUTERON = LOHR AND HAEBERLI/14/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/16/ WERE EVALUATED BY ILJIMA ET AL./17/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WARE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELA
/18/. MF WERE USED

NCE OF SPIN CUT-OFF IS DUE TO GRUPPELAAR /18/.

MT =

T = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/. NO. ENERGY(MEV) SPIN-PARITY DWBA CAL GŘ. 0.0 Ò + 0.4751 0.9437 * ž 1 2 3 0 2 4 1.1032 456789 10112 1.1064 1.5217 1.5806 1.6027 1.7987 1.8371 3 2 4 4 0 9 1.8737 0 + 10 1.8732 6 + 11 2.0369 2 + 12 2.0442 3 - * 13 2.2192 5 + 14 2.2612 2 + 15 2.3720 5 -16 2.4211 4 + 17 2.4419 4 + LEVELS ABOVE 2.5 MEV WERE ASSUMED TO BE OVERLAPPING. FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/20/. DEFORMATION PARAMETERS (BETA2 = 0.2443 A BETA3 = 0.196) WERE BASED ON THE DATA COMPILED BY RAMAN ET AL./21/ AND SPEAR/22/, RESPECTIVELY. AND . = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT BENZI THE GAMMA-RAY STRENGTH FUNCTION (3.44E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 110 MILLI-BARNS AT 70 KEV MEASURED BY MACKLIN ET AL./24,25/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT = 17 MT = 22 MT = 28ΜТ ΜŤ МŤ MT THE KALBACH'S CONSTANT K (= 72.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/26/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 16.70 MB (SYSTEMATICS OF FORREST/27/) (N,ALPHA) 6.20 MB (RECOMMENDED BY FORREST/27/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) ------ - - - - - - - - -- - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.594E+01 6.900E-01 7.358E-01 7.888E+00 2.570E+00 1.774E+01 6.200E-01 4.294E+00 6.058E+00 1.280E+00 1.780E+01 6.000E-01 6.702E-01 6.645E+00 2.220E+00 2.085E+01 5.650E-01 7.153E+00 6.092E+00 1.280E+00 42-MO- 98 42-MO- 99 42-MO-100 42-MÖ-101 1.600E+01 6.550E-01 2.973E+00 5.984E+00 1.290E+00 1.637E+01 5.850E-01 1.189E+01 3.635E+00 0.0 1.675E+01 6.440E-01 6.361E+00 5.761E+00 9.400E-01 1.761E+01 5.400E-01 1.217E+01 3.317E+00 0.0 43-TC- 99 43-TC-100 43-TC-101 43-TC-102 1.520E+01 7.200E-01 7.835E-01 8.078E+00 2.570E+00 1.726E+01 6.700E-01 7.228E+00 6.836E+00 1.280E+00 1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 44-RU-100 44 - RU - 101 44 - RU - 102 44-RU-103 1.890E+01 6.480E-01 1.210E+01 7.110E+00 1.280E+00 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.654 FOR RU-102 AND 5.045 FOR RU-103. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) PRIESMEYER, H.G., JUNG, H.H.: ATOMKERNENERGIE, 19,111 (1972).
4) SHAW, R.A., ET AL.: BULL. AMER. PHYS. SOC., 20, 560 (1975).
5) MACKLIN, R.L. AND HALPERIN, J.: NUCL. SCI. ENG., 73, 174 (1980) MACKLIN, N.L. //// (1980). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981). ANUFRIEV, V.A. ET AL.: ATOM. ENERGIYA, 58, 279 (1985). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). DEV. 131 745 (1963). 20. 462 (1962). 6) 7) 8) 9) 10) 11) (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 12) 13) 14) 15) (1971) 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERUN, A.G.W., GAN, G. H.G., H., (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MACKLIN, R.L., ET AL.: PROC. SPECIALISTS' MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979, NEANDC(E) 209L, 103. MACKLIN, R.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110 17) 18) 19) 20) 21) 22) 23) 24) 25) MACKLIN, R.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110 26) MACKLIN, KLE, AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
27) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4446 44-RU-103 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 11.05 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.450E-4, S1 = 6.000E-4, S2 = 0.530E-4, SG = 76.7E-4, GG = 0.170 EV, R = 5.590 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 13.10 5.100 8.000 TOTAL ELASTIC CAPTURE -91.3 MF = 3 NEUTRON CROSS SECTIONS BELOW 11.05 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THERMAL CAPTURE CROSS SECTION WAS DETERMINED BY THE SYSTEMATICS FROM THE NEIGHBORING RU ISOTOPES. THE SCATTERING CROSS SECTION WAS CALCULATED FROM R = 6.3 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 11.05 EV TO 100 KEV. ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./13/. MT ENERGY(MEV) SPIN-PARITY NO. 3/2 + 5/2 + 5/2 + 1/2 +GR. 0.0 0.0027 1 2 3 0.1360 0.1742 0.2134 0.2380 0.2877 0.2974 0.3465 $\dot{7}/2$ 45678 + 11/2 1/2 7/2 5/2 + + 3/2 +9 0.4056

10 0.4319 1/2 + 11 0.4990 5/2 + LEVELS ABOVE 0.511 MEV WERE ASSUMED TO BE OVERLAPPING. T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENJ AND REFFO/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = BENZI THE GAMMA-RAY STRENGTH FUNCTION (7.69E-03) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.170 EV) AND AVERAGE S-WAVE RESONANCE LEVEL SPACING (22.1 EV). THE KALBACH'S CONSTANT K (= 111.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 11.60 MB (SYSTEMATICS OF FORREST/16/) (N,ALPHA) 2.86 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - -- - - - -- - - - - - - - -V = 47.5 WS = 9.74 VSO = 7.0 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS C(1/MEV) EX(MEV) NUCLIDE SYST A(1/MEV) T(MEV) PAIRING 1.774E+01 6.200E-01 4.294E+00 6.058E+00 1.280E+00 1.780E+01 6.000E-01 6.702E-01 6.645E+00 2.220E+00 2.085E+01 5.650E-01 7.153E+00 6.092E+00 1.280E+00 * 1.856E+01 6.452E-01 1.419E+00 8.145E+00 2.520E+00 -----42-MO- 99 42-M0-100 42-M0-101 42-M0-102 43-TC-100 43-TC-101 43-TC-102 43-TC-103 1.637E+01 5.850E-01 1.189E+01 3.635E+00 0.0 1.675E+01 6.440E-01 6.361E+00 5.761E+00 9.400E-01 1.761E+01 5.400E-01 1.217E+01 3.317E+00 0.0 1.810E+01 6.310E-01 6.436E+00 6.379E+00 1.240E+00 1.726E+01 6.700E-01 7.228E+00 6.836E+00 1.280E+00 1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 1.890E+01 6.480E-01 1.210E+01 7.110E+00 1.280E+00 1.650E+01 6.780E-01 8.593E-01 7.878E+00 2.520E+00 44 - <u>RU</u> - 101 44 - RU - 102 44 - RU - 103 44-RU-104 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE

ASSUMED TO BE 5.045 FOR RU-103 AND 4.524 FOR RU-104.

- REFERENCES

 AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 6) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
- 10) GILBERI, A. AND CAMERON, A.G.M. C.M. C.M. (1965).
 (1965).
 11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
 14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 15) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 16) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4449 44-RU-104 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 11.12 KEV
RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 EXCEPT THOSE OF
THE 1ST POSITIVE AND NEGATIVE RESONANCES.
 PARAMETERS FOR JENDL-2 WERE EVALUATED AS FOLLOWS:
 RESONANCE ENERGIES BELOW 2 KEV WERE TAKEN FROM THE EXPERIMENTAL DATA BY PRIESMEYER AND JUNG/3/ AND SHAW ET AL./4/, OTHER
RESONANCES ABOVE 2.7 KEV WERE DETERMINED FROM MACKLIN AND
HALPERIN/5/. THE NEUTRON WIDTHS WERE EVALUATED ON THE BASIS
OF THE DATA OF PRIESMEYER AND JUNG, AND OF MACKLIN AND
HALPERIN. THE RADIATION WIDTHS OF LARGE RESONANCES WERE TAKEN
FROM REF./5/ FOR THE OTHERS, THE AVERAGE RADIATION WIDTH OF
0.103+-0.018 EV WAS DEDUCED, AND ADOPTED TO THE LEVELS WHOSE
RADIATION WIDTH WAS UNKNOWN. SEVEN HYPOTHETICAL RESONANCES
WERE GENERATED IN THE ENERGY RANGE FROM 2 TO 2.7 KEV. FOR THE
LEVELS OBSERVED BY SHAW ET AL. AND THE HYPOTHETICAL ONES,
REDUCED NEUTRON WIDTHS OF 12 AND 38 MEV WERE GIVEN FOR S-WAVE
AND P-WAVE RESONANCES, RESPECTIVELY. A NEGATIVE RESONANCE WAS
ADDED AT -941 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION
OF 0.32+-0.02 BARNS AT 0.0253 EV/6/.
FOR JENDL-3, PARAMETERS OF THE FIRST POSITIVE AND NEGATIVE
RESONANCES WERE MODIFIED SO AS TO REPRODUCE THE RESONANCE
INTEGRAL RECOMMENDED BY WORA ABCHARE ATAL./6/ SCATTERING
RADIUS WAS REDUCED FROM 6.35 FM TO 6.1 FM ON THE BASIS OF THE
SYSTEMATICS.
UNRESOLVED RESONANCE REGION - 11 12 KEV F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF MF TAKEN FOR THE `wās UNRESOLVED RESONANCE REGION : 11.12 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/, AND S1 WAS BASED ON THE THE COMPILATION OF MUGHABGHAB ET AL./6/ THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.450E-4, S1 = 5.700E-4, S2 = 0.530E-4, SG = 2.95E-4, GG = 0.110 EV, R = 5.366 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.558 -ELASTIC 5.236 -CAPTURE 0.3226 6.57 CAPIURE 0.3226 6.57
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/9/. THE
OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/10/
ALPHA = HUIZENGA AND IGO/11/
DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. /16/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING

CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/.

| NO. | ENERGY(MEV) | SPIN-PARITY | DWBA CAL. |
|--------------|--------------|---------------|--------------|
| GR. | 0.0 | 0 + | |
| 1 | 0.3580 | 2 + | * |
| 2 | 0.8885 | 4 + | |
| 3 | 0.8930 | 2 + | |
| 4 | 0.9881 | 0 + | |
| 5 | 1.2423 | 3 + | |
| LEVELS ABOVE | 1.5 MEV WERE | ASSUMED TO BE | OVERLAPPING. |

FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/18/. DEFORMATION PARAMETER (BETA2 = 0.2742) WAS BASED ON THE DATA COMPILED BY RAMAN ET AL./19/

* = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

THE GAMMA-RAY STRENGTH FUNCTION (2.85E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 95 MILLI-BARNS AT 70 KEV MEASURED BY MACKLIN ET AL./21,22/

| I = 16 (N,2N) CROSS SECTION
T = 17 (N,3N) CROSS SECTION
T = 22 (N,N'A) CROSS SECTION
T = 28 (N,N'P) CROSS SECTION
T =103 (N,P) CROSS SECTION
T =104 (N,D) CROSS SECTION
T =105 (N,T) CROSS SECTION
T =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
|---|
| THE KALBACH'S CONSTANT K (= 62.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N.P) 7.00 MB (RECOMMENDED BY FORREST/24/) |

(N,ALPHA) 2.60 MB (RECOMMENDED BY FORREST)

MT = 251 MU-BAR CALCULATED WITH CASTHY.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH | (MEV) | RADIUS(FM) | DIFFU | SENESS(FM) |
|-----------------------------------|------------|---------------------------------------|----------------------|----------------------|
| V = 47.5
WS = 9.74
VS0= 7.0 | | R0 = 5.972
RS = 6.594
RS0= 5.97 | A0 =
AS =
AS0= | 0.62
0.35
0.62 |
| THE FORM OF SURFACE | ABSORPTION | PART IS DER. | WOODS-S | AXON TYPE. |
| TABLE 2 LEVEL DENSITY | PARAMETERS | 6 | | |
| NUCLIDE SYST A(1/ME) | /) T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |

 42-M0-100
 1.780E+01
 6.000E-01
 6.702E-01
 6.645E+00
 2.220E+00

 42-M0-101
 2.085E+01
 5.650E-01
 7.153E+00
 6.092E+00
 1.280E+00

 42-M0-102
 *
 1.856E+01
 6.452E-01
 1.419E+00
 8.145E+00
 2.520E+00

2.175E+01 5.300E-01 5.321E+00 5.655E+00 1.280E+00 42-M0-103 1.675E+01 6.440E-01 6.361E+00 5.761E+00 9.400E-01 1.761E+01 5.400E-01 1.217E+01 3.317E+00 0.0 1.810E+01 6.310E-01 6.436E+00 6.379E+00 1.240E+00 1.600E+01 5.500E-01 7.030E+00 2.960E+00 0.0 43-TC-101 43-TC-102 43-TC-103 43-TC-104 1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 1.890E+01 6.480E-01 1.210E+01 7.110E+00 1.280E+00 1.650E+01 6.780E-01 8.593E-01 7.878E+00 2.520E+00 2.025E+01 6.060E-01 1.144E+01 6.747E+00 1.280E+00 44 - RU - 102 44 - RU - 103 44 - RU - 104 44-RU-105 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.524 FOR RU-104 AND 5.0 FOR RU-105. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
PRIESMEYER, H.G., JUNG, H.H.: ATOMKERNENERGIE, 19,111 (1972).
SHAW, R.A., ET AL.: BULL. AMER. PHYS. SOC., 20, 560 (1975).
MACKLIN, R.L., HALPERIN, J.: NUCL. SCI. ENG. 73, 174 (1980).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). REFERENCES . Н 197 14) ĠIĽBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1007) 15)16) 17) 18) 19) (1987)
20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
21) MACKLIN, R.L., ET AL.: PROC. SPECIALISTS' MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979, NEANDC(E) 209L, 103.
22) MACKLIN, R.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110 (1981).
(23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
(24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4455 44-RU-106 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 500 EV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.450E-4, S1 = 6.000E-4, S2 = 0.530E-4, SG = 1.59E-4, GG = 0.150 EV, R = 5.157 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. INTEGRALS (BARNS) 3.488 TOTAL ELASTIC CAPTURE 2.01 0.1460 F = 3 NEUTRON CROSS SECTIONS BELOW 500 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE THERMAL CAPTURE CROSS SECTION WAS ADOPTED FROM REF./4/. THE SCATTERING CROSS SECTION WAS CALCULATED FROM R = 5.1566 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 500 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/. MT ENERGY(MEV) SPIN-PARITY NO. GR. 0.0 0 + ŏ.2703 2 + 1 42 0.7140 0.7927 + 3 4 0.9910 0 + LEVELS ABOVE 1.092 MEV WERE ASSUMED TO BE OVERLAPPING. - = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS MΤ

| SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. |
|---|
| THE GAMMA-RAY STRENGTH FUNCTION (1.50E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.15 EV) AND AVERAGE
S-WAVE RESONANCE LEVEL SPACING (1.0 KEV). |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 65.2) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 3.87 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 0.86 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{ccccc} & \text{DEPTH (MEV)} & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & \text{V} &= 47.5 & \text{RO} &= 5.972 & \text{AO} &= 0.62 \\ & \text{WS} &= 9.74 & \text{RS} &= 6.594 & \text{AS} &= 0.35 \\ & \text{VSO} &= 7.0 & \text{RSO} &= 5.97 & \text{ASO} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 42-M0-102 1.856E+01 6.452E-01 1.419E+00 8.145E+00 2.520E+00 42-M0-103 2.175E+01 5.300E-01 5.321E+00 5.655E+00 1.280E+00 42-M0-104 * 1.825E+01 6.403E-01 1.076E+00 7.922E+00 2.530E+00 42-M0-105 * 1.809E+01 6.379E-01 6.674E+00 6.554E+00 1.280E+00 |
| 43-TC-1031.810E+016.310E-016.436E+006.379E+001.240E+0043-TC-1041.600E+015.500E-017.030E+002.960E+000.043-TC-105*1.843E+016.379E-018.330E+006.667E+001.250E+0043-TC-106*1.826E+016.355E-015.237E+015.297E+000.0 |
| 44-RU-1041.650E+016.780E-018.593E-017.878E+002.520E+0044-RU-1052.025E+016.060E-011.144E+016.747E+001.280E+0044-RU-1061.870E+016.300E-011.097E+007.896E+002.530E+0044-RU-1072.030E+016.000E-011.043E+016.637E+001.280E+00SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 4.125 FOR RU-106 AND 5.0 FOR RU-107. |
| REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY. MITO. P. 569 (1988). |

AND TECHNOLOGY, MITO, P. 569 (1988). 3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).

- 4) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77

- 6) IIJIMA, S. AND KAMAL, (1983).
 7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
 8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
- W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

MAT number = 4525 45-RH-103 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-FEB94 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 94-02 JENDL-3.2 WAS MADE BY JNDC FPND W.G. CROSS SECTION WAS MADE. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 3.58 KEV
RESONANCE PARAMETERS WERE MAINLY TAKEN FROM JENDL-2.
EVALUATION PROCEDURE OF JENDL-2 IS AS FOLLOWS:
RESONANCE ENERGIES AND NEUTRON WIDTHS WERE DETERMINED FROM THE
EXPERIMENTAL DATA OF RIBON ET AL./3/ AND FRICKE AND CARLSON
/4/. TOTAL SPINJ JWAS TAKEN FROM HASTE AND THOMAS/5/ BELOW
1.2 KEV, RIBON ET AL. UP TO 2.63 KEV, AND MACKLIN AND
HALPERIN/6/ ABOVE 2.65 KEV. RADIATION WIDTHS WERE EVALUATED
FROM THE DATA OF RIBON ET AL. AND OF FRICKE AND CARLSON BELOW
2.65 KEV. ABOVE 2.65 KEV, RADIATION WIDTH WAS DETERMINED SO
AS TO REPRODUCE THE CAPTURE AREAS OF MACKLIN AND HALPERIN/6/
CORRECTED ACOCORDING TO A CORRIGENDUM /7/. FOR LEVELS WHOSE
RADIATION WIDTH BECAME NEGATIVE. NEUTRON WIDTH WAS CALCULATED
FROM THE CAPTURE AREAS OF MACKLIN AND HALPERIN, ASSUMING THE
RADIATION WIDTH OF 0.16 EV/8/. AVERAGE RADIATION WIDTH OF
0.160+-0.013 EV/8/ WAS ASSUMED FOR THE LEVELS HAVING NO DATA
ON RADIATION WIDTH. THE EFFECTIVE SCATTERING RADIUS OF 6.2 FM
WAS TAKEN FROM REF./8/.
FOR JENDL-3. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. ABOVE 2.65 KEV.
NEUTRON WIDTHS WERE RE-ADJUSTED TO REPRODUCE THE CAPTURE ÅREA
DATA OF MACKIN AND HALPERIN/6/.
FOR JENDL-3.2, RADIATION WIDTH WAS RE-ADJUSTED SO AS TO
REPRODUCE THE CAPTURE AREA DATA.
UNRESOLVED RESONANCE REGION : 3.58 KEV - 100 KEV MF = 2UNRESOLVED RESONANCE REGION : 3.58 KEV - 100 KEV THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY/9/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CRO SECTION AT 100 KEV. TOTAL CROSS TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.440E-4, S1 = 4.100E-4, S2 = 0.530E-4, SG = 71.8E-4, GG = 0.230 EV, R = 6.521 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. 149.858 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 3.260 146.598 1040 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP MF EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1(A) WERE DETERMINED TO REPRODUCE THE MEASURED TOTAL CROSS SECTIONS, AND USED IN THE PEGASUS CACULATION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: POLLOWS: PROTON = PEREY/11/ ALPHA = HUIZENGA AND IGO/12/ DEUTERON = LOHR AND HAEBERLI/13/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE

EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /17/. ANOTHER SET OF OMP OF NEUTRONS GIVEN IN TABLE 1(B) WAS DETER-MINED FOR JENDL-3.2 SO AS TO REPRODUCE BETTER THE TOTAL CROSS SECTION. THIS SET OF OMP WAS USED IN CASTHY CALCULATION FOR JENDL-3.2. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WITH OMP IN TABLE 1(B)
WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY AND OMP IN TABLE 1(B) WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. MT = 4SPIN-PARITY 1/2 -7/2 + 9/2 + 3/2 -5/2 -5/2 + 7/2 + 3/2 + 3/2 -3/2 -7/2 -5/2 -9/2 -NO. ENERGY(MEV) GŔ. 0.0 $\begin{array}{c} 0.0\\ 0.0397\\ 0.0930\\ 0.2950\\ 0.3575\\ 0.5368\\ 0.6076\\ 0.6501 \end{array}$ 1 2 3 45678 6 0.6076 7/2 + 7 0.6501 7/2 + 8 0.6518 3/2 + 9 0.8036 3/2 -10 0.8477 7/2 -11 0.8804 5/2 -12 0.9200 9/2 -LEVELS ABOVE 0.96 MEV WERE ASSUMED TO BE OVERLAPPING. CAPTURE MT = 102SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY AND THE OMP IN TABLE 1(B) WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/19/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (6.67E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 295 MILLI-BARNS AT 250 KEV MEASURED BY MACKLIN ET AL./20,7/ THE PRESENT RESULTS ARE SLIGHTLY LARGER THAN DATA OF WISSHAK ET AL./21/ AT THE ENERGIES FROM 20 TO 200 KEV. $\begin{array}{l} T = 16 & (N,2N) \ CROSS \ SECTION \\ T = 17 & (N,3N) \ CROSS \ SECTION \\ T = 22 & (N,N'A) \ CROSS \ SECTION \\ T = 28 & (N,N'P) \ CROSS \ SECTION \\ T = 33 & (N,N'T) \ CROSS \ SECTION \\ T = 103 & (N,P) \ CROSS \ SECTION \\ T = 104 & (N,P) \ CROSS \ SECTION \\ T = 104 & (N,T) \ CROSS \ SECTION \\ T = 105 & (N,T) \ CROSS \ SECTION \\ T = 106 & (N,HE3) \ CROSS \ SECTION \\ T = 107 & (N,ALPHA) \ CROSS \ SECTION \\ THESE \ REACTION \ CROSS \ SECTIONS \ WERE \ CALCULATED \ WITH \ THE \\ PREEQUILIBRIUM \ AND \ MULTI-STEP \ EVAPORATION \ MODEL \ CODE \ PEGASUS. \\ \end{array}$ MT = MT MT MT MT МŤ ΜT MT MŤ МŤ МŤ THE KALBACH'S CONSTANT K (= 111.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 17.00 MB (RECOMMENDED BY FORREST/23/) (N,ALPHA) 11.00 MB (RECOMMENDED BY FORREST) THE (N,2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF THE DATA MEASURED BY FREHAUT ET AL./24/ AND VEESER ET AL./25/ MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE MF = 4
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1(A) NEUTRON OPTICAL POTENTIAL PARAMETERS

| | | · / | | | - | - | | | | | | | | | | | | | | | | - | | | | | | | | |
|--|--|---|----------------------------|-----------------------------------|--|--|---|--|-------------------------------------|---|---------------------------|-------------------------------|----------------------------------|---------------------|---|----------------------------------|------------------------------|---|-----------------------------------|-------------------------------------|------------------------------|----------------------------------|--|---|--------------------------|---------------------------------------|----------------------------------|--------------------------|--------------------------|------------------|
| ТН | E F | V
WS
VS
ORM |
=
0=
0 | 47
9
7
F \$ | 7.5
.74
.0
SUF |)EF | PTH
 | Η (

Ξ μ | (M E | EV) |)

R P ⁻ |
T I | -
0N | I F | R
R
R
R | AD

S
SO
RT |

 =
 = | S (
565S | 9
5
9
D | M)
72
94
7
ER | | NO | DII
AO
AS
AS(
OD; | F F
=
=
0=
S - | US
0
0
0
SA | EN
- 6
- 3
- 6
X0 | ES
2
2
5
2
N | S (F

T Y F | ́М)
 | |
| TABL | E 1 | (B) | | NEL | JTF | 201 | |)
P1 | | CAL | _ | ΡO | ΤE | N | ΓΙ, | AL | . F | PAF | RAI | NE- | ΓE | RS | F |) R | J | ΕN | DL | -3. | 2 | |
| TH
RA | E F(
DIUS | V
WS
VS
ORM
S P |
=
0=
0
AR | 48
8
5
F
AME | 8.8
.10
.63
SUR
ETE |)EF
31-
36-
33
8F/
ER S | PTH
- 0 .
+ 0 .
A C E
S / | H (
43
48
48
ARE | (ME
396
362
ABS | |)

E F |
T
F | -
0 N
C I | I F | R
R
R
R
R
R | AD

SO
SO
RT
S |

 | IS (
1
1
S | (FI
2;
4;
2;
2;
2; | M)
34
21
41
ER | i /: | W0
3) | AO
AS
AS
ODS
TI | F F
= =
= =
= =
= = =
= = = | US
0
0
SA
MS | EN
- 6
- 3
- 5
X0
- X0 | ES
65
77
0
N | S (F | ́М)
РЕ. | |
| TABL | E 2 | L | ΕV | EL | DE | EN S | 517 | ΓY | PA | AR/ | ۹M | ΕT | ER | S | | | | | | | | | | | | | | | | |
| NUC | | Ξ | SY | ST | A (| 1 | / M E | EV) |) | T | (M | E V
 |) | | (| C (| 1/ | ME | V |) | _E) | X (| ME' | /) | | P | A I | RIN | IG | - |
| 43-
43-
43-
43- | TC -
TC -
TC -
TC -
TC - | 99
100
101
102 | | | 1 .
1 .
1 .
1 . | 60
61
61
76 | 00E
37E
75E
51E | +(
+(
+(|)1
)1
)1
)1 | 6565 | 5
8
4
4 | 50
50
40
00 | E -
E -
E -
E - | 0 | | 2.
1.
6.
1. | 97
18
36
21 | 3E
9E
1E
7E | +(
+(
+(| 00
01
00
01 | 53
53
53 | .9
.6
.7
.3 | 84
35
61
17 | +++++++++++++++++++++++++++++++++++++++ | 00
00
00
00 | 1
0
9
0 | . 2
. 0
. 4
. 0 | 90E
00E | +0(
-0 | 0
1 |
| 44 -
44 -
44 -
44 - | RU - ⁻
RU - ⁻
RU - ⁻
RU - ⁻ | 100
101
102
103 | | | 1 .
1 .
1 .
1 . | 52
72
64 | 20E
26E
43E
90E | +(
+(
+(|)1
)1
)1
)1 | 7
6
6 | 2
7
5
4 | 00
00
50
80 | E -
E -
E -
E - | 0 | | 7.
7.
8.
1. | 83
22
87
21 | 5
8
2
2
0 | - (
+ (
- (
+ (|)1
)0
)1
)1 | 8
6
7
7 | . 0
. 8
. 1
. 1 | 78
36
06
10 | +++++++++++++++++++++++++++++++++++++++ | 00
00
00
00 | 2
1
2
1 | . 5
. 2
. 2
. 2 | 70E
80E
20E
80E | +0(
+0(
+0(
+0(| 0
0
0
0 |
| 45 -
45 -
45 -
45 - | RH - ⁻
RH - ⁻
RH - ⁻
RH - ⁻ | 101
102
103
104 | | * | 1 .
1 .
1 .
1 . | 59
70
57
7 | 96E
03E
70E
14E | +(
+(
+(|)1
)1
)1
)1 | 6
6
6
5 | 4
4
5
9 | 76
52
50
10 | E -
E -
E - | 0 | | 2.
3.
4.
1. | 60
19
29
77 | 8
7
8
8
1 | +(
+(
+(| 00
01
00
01 | 5
4
5
4 | . 8
. 9
. 4
. 0 | 32
66
99
18 | +++++++++++++++++++++++++++++++++++++++ | 00
00
00
00 | 1
0
9
0 | . 2
. 0
. 4
. 0 | 90E
00E | +0(
-0 | 0
1 |
| SY | ST: | * | = | L |) P ' | S | WE | ERE | | DET | ΓE | RM | ĪN | IEC | | FR | 01 | 1 8 | SY: | STE | ΞM | ΑT | I C S | S. | | | | | | - |
| SPI
IN
ASS | N CI
THE
UMEI | UTO
CA
D T | FF
ST
0 | P/
HY
BE | ARA
CA
6. | ME
L(
37 | ETE
Cui
75 | ERS
AT
F(| S V
FIC
DR | VEF
DN
RH | ЯЕ
,
Н- | С
SР
10 | AL
IN
3 | .Cl
1 (
AN | | A T
T O
5 | ED
FF |) /
F
F | AS
A
OI | 0
СТ(
Я Р | . 1
) R
? H | 46
S
- 1 | * S(
AT
04 | 2R
0 | Т(
М | A)
EV | *A
W | * * (
ERE | 2/3 | 3) |
| REFE
1)
2)
3)
4)
5)
6)
7) | REN
AOK
AND
KAW/
RIB
FRI
HAS
MACI
MACI
198 | CES
AP,
AI,
CE,
CE,
KLI
(1) | T.
PL
P
, T
N, | IEI
. I
M.
. L
R
R | T A
S S
E T
E T
, C
. L . | AL
CAL
CAL
TH | | PF
NCE
SON
MAS | ROC
J.NU
J.NU
J.NU
J.NU | S
NU
JCI
A
B
RIN | I
JC
W
N | NTA
L.
G.
J
S, | · F
S
HY
UL
J
· R | | DNI
i .
PI
NU(| F ·
T
A
T -
HY
CL | OL
EC
A -
S .
NU | | NI
2
10
7 | JCI
, F
130
39
1
. E | | AR
16
29
(19
,
G. | 27
97(
71
98 | AT
(19)):1
73
3. | A
19
5
(| F0
85
(1
19
17
78 | R
99:
75
4 | BAS
2).
).
(19 | 80) |). |
| 8)
9)
10)
11)
12)
13)
14) | MUGI
PAR
IGAI
IJ
PERI
HUIZ
LOHI
BECC
PHEI
W. I | HAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA | GH
,
GA
JTEBE | AB
S.
G
M.
AL | , CAD
. ET
. ET
J.R
J.R
F.
IN, | | AL
AL
AL
AL
AL
AL
AL
AL
AL
AL
AL
AL
AL
A | E T
F U F
N D F
J F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E F
A E | | ALS
ESE
AEF
AEF
AEF
AEF
AEF | | (1
- M
30 .
WGT
E | | | FR(
).
J/
J/
J/
J/
J/
J/
J/
J/
J/
J/
J/
J/
J/ | ON
AE5
L.LE
EE(
RS | RI
19
S
EC | R (
P :
963
PH
PH
(
S)
Y | | S S
21
337
 | SE
7
29
A
1
1 | CT
19
(1
23
PO
BC | 101
91
98
462
2,
1 Å I
A R
3
0 N | NS
)
7)
2
3
3
1
5
1
5
1 | ,
(1
81
AL
N | V0
96
TI
PR | L.
2)
19
ON
AN
ES | 74)
S. | | |
| 15) | (19)
GILI | 71)
BER | †, | А | . A | N |) (| CAN | ΛEF | 107 | ١, | A | . G | G.V | ۷. | : | CA | N. | | J. | P | ΗY | S. | , | 43 | , | 14 | 46 | | |
| 16)
17)
18)
19)
20) | (190
IIJ
GRUI
MAT
BEN
MACI | 55)
IMA
PPE
SUM
ZI,
KLI | LA
OT
V
N, | S.
AR
O,
R | , E
, F
J.
ANC
. L. | T
 .
) | AL
E
REF
E1 | ËĊN
F A
F F (| | J.
13
G. | N
(
) | UC
19
AE
C | L.
77
RI
CD
RC | /) /
- N
)N · | SC
//
- N\ | I.
77
\// | 34
10
PE | EC | (19
(19
(19 | 978
978 | 3)
3)
31 | 2
Š' | 1,
Mi | 1
EE | 0
T I | (1
NG | 98-
0 | 4).
N | | |

- NEUTRON CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979", NEANDC(E) 209L, 103.
 21) WISSHAK, K. ET AL.: PHYS. REV., C42, 1731 (1990).
 22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 23) FORREST, R.A.: AERE-R 12419 (1986).
 24) FREHAUT, J., ET AL.: SYMP. ON NEUTRON CROSS SECTIONS FROM 10-50MEV, BNL, P.399 (1980)
 25) VEESER,L.R., ET AL.: PHYS. REV., C16, 1792 (1977)

MAT number = 4531 45-RH-105 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW FORMULA) : BELOW 7.5 EV PSEUDO RESONANCES WERE GIVEN AT -5 EV AND 5 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION AND RESONANCE INTEGRAL GIVEN BY MUGHABGHAB ET AL./2/ MF UNRESOLVED RESONANCE REGION : 7.5 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.440E-4, S1 = 4.100E-4, S2 = 0.560E-4, SG = 103.E-4, GG = 0.150 EV, R = 6.208 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 24820 -TOTAL ELASTIC CAPTURE 8991 15830 17000 CAPIURE 15830 17000
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE
OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/6/
ALPHA = HUIZENGA AND IGO/7/
DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/. MF = 3/12/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/. МΤ ENERGY(MEV) SPIN-PARITY 0.0 0.1296 7/2 + 1/2 -GŔ. 1 0.1492 0.3925 0.4555 9/2 3/2 5/2 2 + 345678 5/2 -3/2 + 9/2 + 5/2 + 7/2 + 5/2 + 5/2 + 3/2 + 0.4693 0.4740 0.4992 0.6386 0.7243 ġ 10 0.7620

| 11 0.7830 1/2 -
12 0.7858 5/2 -
13 0.8058 3/2 +
LEVELS ABOVE 0.817 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (9.93E-03) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.15 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (15.1 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 107.9) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 13.60 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 3.24 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV)
V = 47.5
WS = 9.74
VSO= 7.0
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE A(1/MEV) I(MEV) C(1/MEV) EX(MEV) PAIRING |
| 43-TC-102 1.761E+01 5.400E-01 1.217E+01 3.317E+00 0.0 43-TC-103 1.810E+01 6.310E-01 6.436E+00 6.379E+00 1.240E+00 43-TC-104 1.600E+01 5.500E-01 7.030E+00 2.960E+00 0.0 |
| 44-RU-1021.643E+016.550E-018.872E-017.106E+002.220E+0044-RU-1031.890E+016.480E-011.210E+017.110E+001.280E+0044-RU-1041.650E+016.780E-018.593E-017.878E+002.520E+0044-RU-1052.025E+016.060E-011.144E+016.747E+001.280E+00 |
| 45-RH-1031.570E+016.550E-014.298E+005.499E+009.400E-0145-RH-1041.714E+015.910E-011.771E+014.018E+000.045-RH-1051.637E+017.110E-018.434E+007.191E+001.240E+0045-RH-1061.700E+015.300E-018.449E+002.973E+000.0 |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.615 FOR RH-105 AND 5.0 FOR RH-106.

REFERENCES

- CEFERENCES
 AWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IJJMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

- 6) Ź١
- IIJIMA, S. AND NOWAL, W. S. M. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 8) 9)
- (1971) 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 10) GILBERI, A. AND CAMERON, A.C. SCI. COMP. C. (1965).
 11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 14) NUCLEAR DATA SHEETS, 47, 261 (1986).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4625 46-PD-102 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 E 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.25 KEV
 RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ MF UNRESOLVED RESONANCE REGION : 0.25 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION S1 WAS BASED ON THE SYSTEMATICS OF MUGHABGHAB ET AL., AND S0 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.800E-4, S1 = 5.000E-4, S2 = 1.000E-4, SG = 9.09E-4, GG = 0.150 EV, R = 4.951 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 8.387 -TOTAL ELASTIC CAPTURE 5.024 19.5 3.363 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/5/, POENITZ AND WHALEN/6/ AND SO ON, AND APPLIED TO PD ISOTOPES ALSO. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IJJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. ΜT ENERGY(MEV) SPIN-PARITY 0.0 0.5565 1.2760 1.5346 1.5930 GR. 0 2 1 2 4 2 0 3456789 + 1.6582 06326 + 1.9190 1.9444 2.1115 + +

2.1118

3 +

10

2.1381 2.2487 2.2947 2.3014 2.3430 2.3912 2.4316 2.4745 42 11 12 + 13 4 4 3 1 14 + 15 16 17 3 18 2.4745 5 -LEVELS ABOVE 2.48 MEV WERE ASSUMED TO BE OVERLAPPING. " = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. МΤ BENZI THE GAMMA-RAY STRENGTH FUNCTION (9.55E-04) WAS DETERMINED FROM THE SYSTEMATICS. MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT = 32 (N,N'D) CROSS SECTION MT = 104 (N,D) CROSS SECTION MT = 104 (N,D) CROSS SECTION MT = 105 (N,T) CROSS SECTION MT = 106 (N,HE3) CROSS SECTION MT = 107 (N,ALPHA) CROSS SECTION MT = 111 (N,2P) CROSS SECTION MT = 111 (N,2P) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 93.4) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 93.60 MB (RECOMMENDED BY FORREST/18/) (N,ALPHA) 19.60 MB (SYSTEMATICS OF FORREST/18/) MT = 251 MU - BARCALCULATED WITH CASTHY. ^E = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 50.01-0.5528E WS = 8.165 VS0= 5.261 A0 = 0.56 AS = 0.44 AS0 = 0.267R0 = 5.972WS = 8.165 VS0= 5.261 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.382E+01 7.400E-01 6.070E-01 7.507E+00 2.400E+00 1.650E+01 6.570E-01 4.016E+00 6.235E+00 1.280E+00 1.520E+01 7.200E-01 7.835E-01 8.078E+00 2.570E+00 1.726E+01 6.700E-01 7.228E+00 6.836E+00 1.280E+00 44-RU- 98 44-RU- 99 44-RU-100 44-RU-101 * 1.386E+01 6.566E-01 1.354E+00 4.866E+00 1.120E+00 * 1.490E+01 6.500E-01 1.162E+01 4.114E+00 0.0 * 1.596E+01 6.476E-01 2.608E+00 5.832E+00 1.290E+00 * 1.703E+01 6.452E-01 3.197E+01 4.966E+00 0.0 45-RH- 99 45 - RH - 100 45 - RH - 101 45-RH-102 1.400E+01 6.500E-01 1.679E-01 6.179E+00 2.470E+00 1.689E+01 6.410E-01 3.454E+00 6.175E+00 1.350E+00 46-PD-100 46-PD-101

46-PD-102 1.831E+01 6.210E-01 6.406E-01 7.665E+00 2.640E+00 1.733E+01 6.550E-01 5.327E+00 6.637E+00 1.350E+00
SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS.
SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.569 FOR PD-102 AND 5.0 FOR PD-103.
REFERENCES 1) KAWAL M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL. 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971).
6) POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983).
7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND GLASCOW, D. WUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS (105S) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
12) IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GREFT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEET 35, 443 (1982).
16) BENZI, V. AND REFFÓ G.: CCDN-NW/10 (1969).
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1986).
18) FORREST, R'A.: AERE-R 12419 (1986). **MAT number = 4631** 46-PD-104 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW FORMULA) : BELOW 279 EV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2; PARAMETERS OF 182.3-EV RESONANCE WERE TAKEN FROM THE DATA MEASURED BY POPOV ET AL./3/ MF UNRESOLVED RESONANCE REGION : 279 EV - 100 KEV THE NEUTRON STRENGTH FUNCTION S1 WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./4/, AND SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.810E-4, S1 = 5.300E-4, S2 = 1.000E-4, SG = 6.18E-4, GG = 0.160 EV, R = 4.725 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 5.440 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 4.917 0.5231 21.9 CAPTURE0.523121.9F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/7/, POENITZ AND WHALEN/8/ AND
SO ON, AND APPLIED TO PD ISOTOPES TOO. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/9/
ALPHA = HUIZENGA AND IGO/10/
DEUTERON = LOHR AND HAEBERLI/11/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/13/ WERE EVALUATED BY IJIMA ET AL./14/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPEL/
/15/. WERE USED TO GRUPPELAAR /15/.T TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2. = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. МΤ NO. SPIN-PARITY ENERGY(MEV) DWBA-CAL GR. 0.0 0.5558 0 2 1 + $\begin{array}{c} 1.3236\\ 1.3336\\ 1.3417\\ 1.7929\\ 1.7938\\ 1.7938\\ \end{array}$ 2 4 0 2 3 4 + 5 0 2 3 67 1.8207 8 1.9416 5 + 9 2.0824 4 + LEVELS ABOVE 2.2 MEV WERE ASSUMED TO BE OVERLAPPING.

FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/17/. DEFORMATION PARAMETER (BETA2 = 0.209) WA BASED ON THE DATA COMPILED BY RAMAN ET AL./18/ WAS CAPTURE MT = 102= 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY/5/ WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/19/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (6.50E-4) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 220 MILLI-BARNS AT 50 KEV MEASURED BY CORNELIS ET AL./20/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =106 (N,HE3) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT = 10 MT = 17 MT = 22 MT = 28 MT = 32 MT = 103 MT =104 MT =105 ŇТ MΤ THE KALBACH'S CONSTANT K (= 89.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/21/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 58.00 MB (RECOMMENDED BY FORREST/22/) (N,ALPHA) 10.40 MB (SYSTEMATICS OF FORREST/22/) = 251 MU-BAR CALCULATED WITH CASTHY. MT F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.520E+01 7.200E-01 7.835E-01 8.078E+00 2.570E+00 1.726E+01 6.700E-01 7.228E+00 6.836E+00 1.280E+00 1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 1.890E+01 6.480E-01 1.210E+01 7.110E+00 1.280E+00 44-RU-100 44 - RU - 101 44 - RU - 102 44-RU-103 * 1.596E+01 6.476E-01 2.608E+00 5.832E+00 1.290E+00 * 1.703E+01 6.452E-01 3.197E+01 4.966E+00 0.0 1.570E+01 6.550E-01 4.298E+00 5.499E+00 9.400E-01 1.714E+01 5.910E-01 1.771E+01 4.018E+00 0.0 45-RH-101 45 - RH - 102 45 - RH - 103 45-RH-104 1.831E+01 6.210E-01 6.406E-01 7.665E+00 2.640E+00 1.733E+01 6.550E-01 5.327E+00 6.637E+00 1.350E+00 1.630E+01 6.650E-01 8.743E-01 7.305E+00 2.290E+00 1.791E+01 6.700E-01 9.137E+00 7.207E+00 1.350E+00 46-PD-102 46-PD-103 46-PD-104 46-PD-105

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.680 FOR PD-104 AND 6.279 FOR PD-105. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) POPOV, JU. P., ET AL.: JINR-P3-11013 (1977).
4) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
5) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
6) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
7) FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). FUSIER, D.G. JR. AND GLASGOW, D. W.L. FINCL M.L., C., C., (1971). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9) 10) 11) 121 (1971) 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1440 (1965).
14) IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978).
17) KUNZ, P.D.: PRIVATE COMMUNICATION.
18) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
19) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
20) CORNELIS, E., ET AL.: PROC. INT. CONF. NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, ANTWERP 1982, P.222 (1982).
21) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
22) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4634 46-PD-105 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 REV1-AUG91

HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 91-08 TOTAL SPIN OF RESONANCES WAS MODIFIED.

- 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.0485 KEV RESONANCE PARAMETERS WERE MAINLY TAKEN FROM JENDL-2. EVALUATION FOR JENDL-2 WAS MADE ON THE BASIS OF DATA MEASURED BY STAVELOZ ET AL./3/ DATA BY BOLLINGER ET AL./4/ AND BY COCEVA ET AL./5/ WERE ALSO TAKEN INTO ACCOUNT TO DETERMINE THE ANGULAR MOMENTUM L AND THE SPIN J. THE AVERAGE RADIATION WIDTH OF 0.15 EV WAS ASSUMED FOR S-WAVE LEVELS. TWO NEGATIVE RESONANCES WERE ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./6/ TWO AL./6/

AL.707 FOR JENDL-3, TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVE-LY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/7/.

UNRESOLVED RESONANCE REGION : 2.0485 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. T 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.600E-4, S1 = 5.800E-4, S2 = 0.980E-4, SG = 155.E-4, GG = 0.145 EV, R = 4.600 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 25.36 ELASTIC 5.116 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 20.25 96.8

CAPIURE 20.25 96.8 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/10/, POENITZ AND WHALEN/11/ AND SO ON, AND APPLIED TO PD ISOTOPES. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/. MF

/18/

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/.

NO ENERGY(MEV) SPIN-PARITY

| G
1
1
1
1
1
1
1
1
1
1
1
2
2
2
2
2
2
2
2 | R. 0
0
0
0
0
0
0
0
0
0
0
0
0
0 | .0
.2805
.3063
.3192
.4422
.4422
.4891
.5608
.6445
.6445
.6445
.6507
.6732
.6940
.7272
.7870
.9294
.9390
.9624
.9790
.0118
.0722
.0750
.0879
.0984
.1410
5 MEV WERE | 5/2 +
3/2 +
7/2 +
5/2 +
1/2 +
1/2 -
5/2 +
1/2 +
7/2 +
1/2 +
7/2 +
5/2 +
1/2 +
7/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 -
5/2 +
1/2 +
5/2 +
1/2 -
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/ | DVERLAPPING. |
|--|---|---|--|---|
| MT = 102
SPHERICA
CASTHY W
SECTIONS
AND REFF
THE GAMM | CAPTURE
L OPTICAL
AS ADOPTED
WERE ESTI
0/20/ AND
A-RAY STRE | AND STATIST
DIRECT A
MATED ACCOR
NORMALIZED | ICAL MODEL CAL(
ND SEMI-DIRECT
DING TO THE PR(
TO 1 MILLI-BARI
ON (1.86E-02) \ | CULATION WITH
CAPTURE CROSS
DCEDURE OF BENZI
N AT 14 MEV.
WAS ADJUSTED TO |
| REPRODUC
KEV MEAS | E THE CAPT
URED BY MA | URE CROSS S
CKLIN ET AL | ĔĊŦÌŎŇŎĔ 680 i
./21,22/ | MILLI-BARNS AT 100 |
| MT = 16
MT = 17
MT = 22
MT = 32
MT = 103
MT = 104
MT = 106
MT = 106
MT = 107
THESE RE
PREEQUIL | N,2N) CROS
N,3N) CROS
N,N'A) CROS
N,N'P) CRO
N,P) CRO
N,P) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,T) CROSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS
N,TLOSS | S SECTION
S SECTION
SS SECTION
SS SECTION
SECTION
SECTION
SECTION
SS SECTION
ROSS SECTION
SS SECTIONS
MULTI-STEP | N
WERE CALCULATE
EVAPORATION MO | ED WITH THE
DDEL CODE PEGASUS. |
| THE KALB
FORMULA
DENSITY | ACH'S CONS
DERIVED FR
PARAMETERS | TANT K (= 1
OM KIKUCHI-
· | 04.7) WAS ESTIN
KAWAI'S FORMAL | MATED BY THE
ISM/23/ AND LEVEL |
| FINALLY,
NORMALIZ
(N,P)
(N,ALP | THE (N,P)
ED TO THE
32
HA) 7 | AND (N,ALP
FOLLOWING V
.00 MB (RE
.39 MB (SY | HA) CROSS SECT
ALUES AT 14.5 N
COMMENDED BY FO
STEMATICS OF FO | IONS WERE
MEV:
DRREST/24/)
DRREST/24/) |
| MT = 251
CALCULAT | MU-BAR
ED WITH CA | STHY. | | |
| MF = 4 ANGU
LEGENDRE P
GIVEN IN T
TIC LEVELS
CALCULATED
BUTIONS IN | LAR DISTRI
OLYNOMIAL
HE CENTER-
, AND IN T
WITH CAST
THE LABOR | BUTIONS OF
COEFFICIENT
OF-MASS SYS
HE LABORATO
HY. FOR OT
ATORY SYSTE | SECONDARY NEUTH
S FOR ANGULAR I
TEM FOR MT=2 AN
RY SYSTEM FOR N
HER REACTIONS,
M WERE ASSUMED | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
MT=91. THEY WERE
ISOTROPIC DISTRI- |
| MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT | GY DISTRIB
TRIBUTIONS
R INELASTI
RON EMITTI | UTIONS OF S
OF SECONDA
C SCATTERIN
NG REACTION | ECONDARY NEUTRO
RY NEUTRONS WEI
G FROM OVERLAPI
S. | ONS
RE CALCULATED WITH
PING LEVELS AND FOR |
| TABLE 1 NEU | TRON OPTIC | AL POTENTIA | L PARAMETERS | DIFFUSENESS(FM) |
| V =
WS =
VSO= | 50.01-0.5
8.165
5.261 | 528E | R0 = 5.972
RS = 6.594
RS0= 5.97 | A0 = 0.56
AS = 0.44
AS0= 0.267 |

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) NUCLIDE SYST A(1/MEV) T(MEV) PAIRING - - - -1.726E+01 6.700E-01 7.228E+00 6.836E+00 1.280E+00 1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 1.890E+01 6.480E-01 1.210E+01 7.110E+00 1.280E+00 1.650E+01 6.780E-01 8.593E-01 7.878E+00 2.520E+00 44-RU-101 44 - RÚ - 102 44 - RU - 103 44-RU-104 45 - RH - 102 45 - RH - 103 45 - RH - 104 1.703E+01 6.452E-01 3.197E+01 4.966E+00 0.0 1.570E+01 6.550E-01 4.298E+00 5.499E+00 9.400E-01 1.714E+01 5.910E-01 1.771E+01 4.018E+00 0.0 1.637E+01 7.110E-01 8.434E+00 7.191E+00 1.240E+00 45-RH-105 1.733E+01 6.550E-01 5.327E+00 6.637E+00 1.350E+00 1.630E+01 6.650E-01 8.743E-01 7.305E+00 2.290E+00 1.791E+01 6.700E-01 9.137E+00 7.207E+00 1.350E+00 1.717E+01 6.660E-01 8.922E-01 8.024E+00 2.590E+00 46-PD-103 46 - PD - 104 46 - PD - 105 46-PD-106 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.279 FOR PD-105 AND 6.429 FOR PD-106. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
STAVELOZ, P., ET AL.: "PROC. SPECIALIST'S MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCT NUCLEI, BOLOGNA 1979", NEANDC(E)209L, 53 (1979).
BOLLINGER, L.M., ET AL.: "PROC. CONGRES INTERNATIONAL DE PHYSIQUE NUCLEAIRE, PARIS 1964", VOL.2, 673 (1964).
COCEVA, C., ET AL.: PHYS. LETT., 16, 159 (1965).
MUGHABGHAB', S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).

FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). REFERENCES 10) FOSIER, D.G. JR. AND WHALEN, J.F.: ANL-NDM-80 (1983). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) (11)12) 13) 141 15) 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MACKLIN, R.L., ET AL.: PROC. SPECIALISTS' MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979, NEANDC(E) 2091 103. 17) 18) 19) 20) 21) 22) MACKLIN, R.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110 (1981). KIKUCHI, 23) KİKÜCHİ, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4637 46-PD-106 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW FORMULA) : BELOW 423 EV PARAMETERS OF A POSITIVE LEVEL WERE TAKEN FROM JENDL-2 WHICH WERE EVALUATED ON THE BASIS OF MEASURED DATA BY POPOV ET AL. /3/ A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS AT 0.0253 EV GIVEN BY MUGHABGHAB ET AL./4/ SCATTERING RADIUS OF 6.5 FM WAS ADOPTED. MF UNRESOLVED RESONANCE REGION : 423 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./4/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.340 \text{E-}4, \\ GG = 0.177 \end{array}$ S1 = 5.200E-4, S2 = 0.970E-4, SG = 6.33E-4, \\ GG = 0.177 \hspace{1mm}\text{EV}, \end{array} R = 5.280 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.304 -ELASTIC 5.001 -CAPTURE 0.3030 9.31 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/7/, POENITZ AND WHALEN/8/ AND SO ON, AND APPLIED TO PD ISOTOPES. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IJJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/. /15/MT = TOTAL SPHERICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. МΤ NO. SPIN-PARITY ENERGY(MEV) DWBA CAL. GR. 0.0 0 2 + * + 1.1280 ż 2 3 4 04 1.2292 + 1.5580 3 2 + 5 6 7 + 0 1.7061 +

8 1.9104 2 + 9 1.9323 4 + 10 2.0012 0 + 11 2.0761 6 + 12 2.0774 4 + 13 2.0843 3 - * 14 2.2424 2 + 15 2.2780 0 + 16 2.2829 4 + 17 2.3060 4 -18 2.3086 2 + 19 2.3508 4 + 20 2.3660 4 + 20 2.3660 4 + 21 2.3973 5 -22 2.4014 3 -23 2.4386 2 + LEVELS ABOVE 2.5 MEV WERE ASSUMED TO BE OVERLAPPING. FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/17/. DEFORMATION PARAMETERS (BETA2 = 0.229 AN BETA3 = 0.170) WERE BASED ON THE DATA COMPILED BY RAMAN ET AL./18/ AND SPEAR/19/, RESPECTIVELY. AND MT = 102CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (6.32E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 308 MILLI-BARNS AT 30 KEV MEASURED BY MACKLIN ET AL./21,22/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MΤ МŤ МŤ ΜT МΤ MŤ МŤ МŤ THE KALBACH'S CONSTANT K (= 77.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 23.00 MB (RECOMMENDED BY FORREST/24/) (N,ALPHA) 5.60 MB (RECOMMENDED BY FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) - - - - - - - - - -- - - - - - - $\begin{array}{ccccccc} V &= 50.01 \text{-} 0.5528E & \text{RO} &= 5.972 & \text{AO} &= 0.56\\ \text{WS} &= 8.165 & \text{RS} &= 6.594 & \text{AS} &= 0.44\\ \text{VSO} &= 5.261 & \text{RSO} &= 5.97 & \text{ASO} &= 0.267\\ \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON} \end{array}$ A0 = 0.56 AS = 0.44 AS0 = 0.267. TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

1.643E+01 6.550E-01 8.872E-01 7.106E+00 2.220E+00 1.890E+01 6.480E-01 1.210E+01 7.110E+00 1.280E+00 1.650E+01 6.780E-01 8.593E-01 7.878E+00 2.520E+00 2.025E+01 6.060E-01 1.144E+01 6.747E+00 1.280E+00 44-RU-102 44 - RU - 103 44 - RU - 104 44-RU-105 1.570E+01 6.550E-01 4.298E+00 5.499E+00 9.400E-01 1.714E+01 5.910E-01 1.771E+01 4.018E+00 0.0 1.637E+01 7.110E-01 8.434E+00 7.191E+00 1.240E+00 1.700E+01 5.300E-01 8.449E+00 2.973E+00 0.0 45-RH-103 45 - RH - 104 45 - RH - 105 45-RH-106 1.630E+01 6.650E-01 8.743E-01 7.305E+00 2.290E+00 1.791E+01 6.700E-01 9.137E+00 7.207E+00 1.350E+00 1.717E+01 6.660E-01 8.922E-01 8.024E+00 2.590E+00 1.916E+01 6.110E-01 6.467E+00 6.507E+00 1.350E+00 46-PD-104 46-PD-105 46-PD-106 46-PD-107 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.429 FOR PD-106 AND 4.350 FOR PD-107. REFERENCES REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND ÅPPLIED SCIENCE, SANTA FE. VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
POPOV, JU. P., ET AL.: JINR-P3-11013 (1977).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971) (1971); POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9) 10) 11) 121 W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 ĠIĹBEŔT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MACKLIN, R.L., ET AL.: PROC. SPECIALISTS' MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979, NEANDC(E) 209L, 103. 14)15) 16) 17) 18) 19) 20S 209L, 103.
22) MACKLIN, R.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110(1981).
23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
24) FORREST, R.A.: AERE-R 12419 (1986). Ř.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110

MAT number = 4640 46-PD-107 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93

HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

(2,151)

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 1

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.0 KEV RESONANCE PARAMETERS OF JENDL-2 WERE REEVALUATED AS FOLLOWS: FOR JENDL-2, RESONANCE ENERGIES WERE BASED ON THE DATA BY MACKLIN/3/. NEUTRON WIDTHS WERE TAKEN FROM EXPERIMENTAL DAT/ OF SINGH ET AL./4/ AND MACKLIN/3/. THE AVERAGE RADIATION WIDTH OF 0.125 EV/4/ WAS ASSUMED. FOR JENDL-3, THE RESONANCE ENERGIES WERE ADOPTED FROM JENDL-2. NEUTRON WIDTHS WERE TAKEN FROM THE MEASUREMENT OF ANUFRIEV ET AL./5/ OR DETERMINED FROM THE CAPTURE AREA DATA MEASURED BY MACKLIN/6/ AND AN AVERAGED RADIATION WIDTH OF 131+-69 MEV. RADIATION WIDTHS OF RESONANCES WHOSE NEUTRON WIDTH WAS MEASURED BY ANUFRIEV ET AL./5/ WERE DETERMINED FROM THE DATA OF THE CAPTURE AREA MEASURED BY MACKLIN/6/ AND THE NEUTRON WIDTH/5/. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/7/. DATA UNRESOLVED RESONANCE REGION : 1.000 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.810E-4, S1 = 3.030E-4, S2 = 0.960E-4, SG = 220.E-4, GG = 0.125 EV, R = 6.025 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.326 ELASTIC 3.318 CAPTURE 2.008 112

CAPTURE 2.008 112 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/10/, POENITZ AND WHALEN/11/ AND
SO ON, AND APPLIED TO PD ISOTOPES. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/12/
 ALPHA = HUIZENGA AND IGO/13/
 DEUTERON = LOHR AND HAEBERLI/14/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/18/.

/18/.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/. ΜT SPIN-PARITY 5/2 + 1/2 + NO. ENERGY(MEV) GR. 0.0 1 $1^{1}_{5/2}$ $7^{1}_{2/2}$ 7^{1 0.2140 0.3028 0.3122 ż 3 4 $\begin{array}{c} 0.3122\\ 0.3482\\ 0.3660\\ 0.3819\\ 0.3924\\ 0.4120\\ 0.4712\\ 0.5677\\ 0.6701\\ 0.6850\\ 0.6980\\ 0.7590\\ 0.7810\\ 0.8060\\ \end{array}$ 5 6 7 8 9 10 11 12 13 14 15 16 17 0.8060 18 0.8090 5/2 + 19 0.8890 1/2 + 20 1.0230 3/2 + LEVELS ABOVE 1.03 MEV WERE ASSUMED TO BE OVERLAPPING. F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = BENZI THE GAMMA-RAY STRENGTH FUNCTION (2.17E-02) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 750 MILLI-BARNS AT KEV MEASURED BY MACKLIN ET AL./21/ Т0 100 $\begin{array}{l} \mathsf{MT} = 16 & (\mathsf{N}, 2\mathsf{N}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 17 & (\mathsf{N}, 3\mathsf{N}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 22 & (\mathsf{N}, \mathsf{N}'\mathsf{A}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 28 & (\mathsf{N}, \mathsf{N}'\mathsf{P}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 32 & (\mathsf{N}, \mathsf{N}'\mathsf{D}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 103 & (\mathsf{N}, \mathsf{P}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 104 & (\mathsf{N}, \mathsf{D}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 105 & (\mathsf{N}, \mathsf{T}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 105 & (\mathsf{N}, \mathsf{T}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{MT} = 107 & (\mathsf{N}, \mathsf{ALPHA}) \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \\ \mathsf{THESE} \ \mathsf{REACTION} \ \mathsf{CROSS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{COS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{COS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{SECTION} \ \mathsf{TOS} \ \mathsf{SECS} \ \mathsf{COS} \ \mathsf{SECS} \ \mathsf{SECS} \ \mathsf{SECS} \ \mathsf{SECS} \ \mathsf{COS} \ \mathsf{SECS} \ \mathsf{S$ THE KALBACH'S CONSTANT K (= 97.8) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWA1'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 15.90 MB (SYSTEMATICS OF FORREST/23/) (N,ALPHA) 3.64 MB (SYSTEMATICS OF FORREST) = 251 MU-BAR CALCULATED WITH CASTHY. МT F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) - - - -V = 50.01-0.5528E R0 = 5.972 A0 = 0.56

| WS = 8.165
VSO= 5.261
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
|---|
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 44-RU-1031.890E+016.480E-011.210E+017.110E+001.280E+0044-RU-1041.650E+016.780E-018.593E-017.878E+002.520E+0044-RU-1052.025E+016.060E-011.144E+016.747E+001.280E+0044-RU-1061.870E+016.300E-011.097E+007.896E+002.530E+00 |
| 45-RH-1041.714E+015.910E-011.771E+014.018E+000.045-RH-1051.637E+017.110E-018.434E+007.191E+001.240E+0045-RH-1061.700E+015.300E-018.449E+002.973E+000.045-RH-1071.963E+015.480E-013.151E+005.336E+001.250E+00 |
| 46-PD-1051.791E+016.700E-019.137E+007.207E+001.350E+0046-PD-1061.717E+016.660E-018.922E-018.024E+002.590E+0046-PD-1071.916E+016.110E-016.467E+006.507E+001.350E+0046-PD-1081.790E+016.460E-018.844E-017.957E+002.600E+00 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3)
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 4.350 FOR PD-107 AND 5.875 FOR PD-108. |
| REFERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). MACKLIN, R.L.: PRIVATE COMMUNICATION (1984). SINGH, U.N., ET AL.: NUCL. SCI. ENG., 67, 54 (1978). ANUFRIEV, V.A. ET AL.: PROC FIFTH ALL UNION CONF ON NEUTRON
PHYSICS, KIEV, SEPT. 1980, VOL. 2, 159 (1980). MACKLIN, R.L.: NUCL. SCI. ENG., 89, 79 (1985). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJJMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576
(1971). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS (EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). IIJMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). |
| 18 GRUPPELAR, H.: ECN-13 (1977). 19) MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978). 20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 21) MACKLIN, R.L., ET AL.: PROC. SPECIALISTS' MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979, NEANDC(E) |
| 22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS", NORTH HOLLAND (1968).
23) FORREST, R.A.: AERE-R 12419 (1986). |

MAT number = 4643 46-PD-108 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 9 KEV RESONANCE PARAMETERS ARE THE SAME AS JENDL-2 WHICH WERE MAINLY TAKEN FROM THE RECOMMENDATION BY MUGHABGHAB ET AL./3/ THE AVERAGE RADIATION WIDTH OF 0.077 EV/3/ WAS ASSUMED. MF RESOLVED RESONANCE REGION : 9 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./3/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL UNRESOLVED OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.780E\text{-}4, \ S1 = 4.400E\text{-}4, \ S2 = 0.950E\text{-}4, \ SG = 5.00E\text{-}4, \\ GG = 0.077 \ \text{EV}, \ R = 5.256 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 10.42 -ELASTIC 1.921 -CAPTURE 8.504 252 INTEGRALS (BARNS) CAPIURE8.504252F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/6/, POENITZ AND WHALEN/7/ AND
SO ON, AND APPLIED TO PD ISOTOPES. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/8/
ALPHA = HUIZENGA AND IGO/9/
DEUTERON = LOHR AND HAEBERLI/10/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPEL/
/14/. WERE USED TO GRUPPELAAR /14/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2. = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/. МΤ NO. SPIN-PARITY ENERGY(MEV) DWBA CAL. 0.0 0.4340 GŔ. 02240 1 + 0.9312 1.0483 1.0528 2 3456789 +

1.3142

1.4411 1.5400 1.7710

2.0460

10

0321 +

6 +

3

| 11
12
13
14
15
16
LEVELS | 2.1
2.2
2.3
2.3
2.3
ABOVE 2.44 | 410
140
825
180
620
920
MEV WERE | 0 +
2 +
5 +
5 -
2 +
2 +
ASSUMED TO | BE OVERLAPP | ING. |
|--|--|---|--|---|---|
| FOR THE LI
INELASTIC
DWUCK-4 C(
BETA3 = 0
AL./17/ AI | EVELS WITH
SCATTERING
DDE/16/. D
.150) WERE
ND SPEAR/18 | AN ASTERI
CROSS SE
EFORMATIC
BASED ON
/, RESPEC | SK, THE CON
ECTIONS WAS
ON PARAMETER
THE DATA CO
CTIVELY. | TRIBUTION O
CALCULATED
S (BETA2 =
MPILED BY R | F DIRECT
BY THE
0.243 AND
AMAN ET |
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS A
AND REFFO | APTURE
OPTICAL AN
S ADOPTED.
NERE ESTIMA
/19/ AND NO | D STATIST
DIRECT A
TED ACCOP
RMALIZED | TICAL MODEL
ND SEMI-DIR
DING TO THE
TO 1 MILLI- | CALCULATION
ECT CAPTURE
PROCEDURE
BARN AT 14 | WITH
CROSS
OF BENZI
MEV. |
| THE GAMMA
REPRODUCE
KEV MEASUI | -RAY STRENG
THE CAPTUR
RED BY MACK | TH FUNCTI
E CROSS S
LIN ET AL | ON (4.98E-0
SECTION OF 2
/20,21/ | 4) WAS ADJU
58 MILLI-BA | STED TO
RNS AT 30 |
| MT = 16 (N
MT = 17 (N
MT = 22 (N
MT = 28 (N
MT =103 (N
MT =104 (N
MT =105 (N
MT =107 (N
THESE REAC
PREEQUILIN | ,2N) CROSS
,3N) CROSS
,N'A) CROSS
,P) CROSS S
,P) CROSS S
,D) CROSS S
,T) CROSS S
,ALPHA) CRO
CTION CROSS
3RIUM AND M | SECTION
SECTION
SECTION
ECTION
ECTION
ECTION
SS SECTION
SECTION
ULTI-STEF | N
S WERE CALCU
P EVAPORATIO | LATED WITH
N MODEL COD | THE
E PEGASUS. |
| THE KALBAC
FORMULA DI
DENSITY P | CH'S CONSTA
ERIVED FROM
ARAMETERS. | NT K (=
KIKUCHI- | 64.9) WAS E
KAWAI'S FOR | STIMATED BY
MALISM/22/ | THE
AND LEVEL |
| FINALLY,
NORMALIŽEI
(N,P)
(N,ALPH) | THE (N,P) A
D TO THE FO
11.2
A) 2.6 | ND (N,ALF
LLOWING V
O MB (SY
O MB (RE | PHA) CROSS S
(ALUES AT 14
(STEMATICS O
ECOMMENDED B | ECTIONS WER
.5 MEV:
F FORREST/2
Y FORREST/2 | E
3/)
3/) |
| MT = 251 MU
CALCULATE | J-BAR
D WITH CAST | HY. | | | |
| MF = 4 ANGUL/
LEGENDRE POI
GIVEN IN THI
TIC LEVELS,
CALCULATED \
SCATTERING \
ISOTROPIC D | AR DISTRIBU
LYNOMIAL CO
E CENTER-OF
AND IN THE
WITH CASTHY
WAS CALCULA
ISTRIBUTION | TIONS OF
EFFICIENT
-MASS SYS
LABORATC
. CONTRI
TED WITH
S IN THE | SECONDARY N
SFOR ANGUL
STEM FOR MT=
DRY SYSTEM F
BUTION OF D
DWUCK-4. F
LABORATORY | EUTRONS
AR DISTRIBU
2 AND DISCR
OR MT=91.
IRECT INELA
OR OTHER RE
SYSTEM WERE | TIONS ARE
ETE INELAS-
THEY WERE
STIC
ACTIONS,
ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTI
PEGASUS FOR
OTHER NEUTRO | Y DISTRIBUT
RIBUTIONS O
INELASTIC
ON EMITTING | IONS OF S
F SECONDA
SCATTERIN
REACTION | ECONDARY NE
RY NEUTRONS
IG FROM OVER
IS. | UTRONS
WERE CALCU
LAPPING LEV | LATED WITH
ELS AND FOR |
| TABLE 1 NEUT | RON OPTICAL | POTENTIA | | S | |
| V = 9
WS = 9
VSO=
THE FORM OF | 50.01-0.552
3.165
5.261
SURFACE AB | 8E
SORPTION | R0 = 5.972
RS = 6.594
RS0= 5.97
PART IS DER | A0 = 0.
AS = 0.
AS0= 0.
AS0= 0.
. WOODS-SAX | 56
44
267
ON TYPE. |
| TABLE 2 LEVEI
NUCLIDE SYS ⁻ | L DENSITY P
T A(1/MEV) | ARAMETERS
T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
| 44 - RU - 104
44 - RU - 105
44 - RU - 106
44 - RU - 107 | 1.650E+01
2.025E+01
1.870E+01
2.030E+01 | 6.780E-0
6.060E-0
6.300E-0
6.000E-0 | 01 8.593E-01
01 1.144E+01
01 1.097E+00
01 1.043E+01 | 7.878E+00
6.747E+00
7.896E+00
6.637E+00 | 2.520E+00
1.280E+00
2.530E+00
1.280E+00 |
| 45 - RH - 105
45 - RH - 106
45 - RH - 107
45 - RH - 108 * | 1.637E+01
1.700E+01
1.963E+01
1.861E+01 | 7.110E-0
5.300E-0
5.480E-0
6.306E-0 | 01 8.434E+00
01 8.449E+00
01 3.151E+00
01 5.818E+01 | 7.191E+00
2.973E+00
5.336E+00
5.341E+00 | 1.240E+00
0.0
1.250E+00
0.0 |
| | | | | | |

| 46-PD-106 1.717E+01 6.660E-01 8.922E-01 8.024E+00 2.590E+00
46-PD-107 1.916E+01 6.110E-01 6.467E+00 6.507E+00 1.350E+00
46-PD-108 1.790E+01 6.460E-01 8.844E-01 7.957E+00 2.600E+00
46-PD-109 2.071E+01 6.030E-01 1.194E+01 6.925E+00 1.350E+00
SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
|--|
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 5.875 FOR PD-108 AND 5.0 FOR PD-109. |
| REFERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 |
| (1971). 7) POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). 8) PEREY, F.G: PHYS. REV. 131, 745 (1963). 9) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 10) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 11) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). |
| 12) ĠIĹBEŔT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). 13) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 14) GRUPPELAAR, H.: ECN-13 (1977). 15) MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978). 16) KUNZ, P.D.: PRIVATE COMMUNICATION. 17) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 |
| (1987)
18) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
19) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
20) MACKLIN, R.L., ET AL.: PROC. SPECIALISTS' MEETING ON NEUTRON
CROSS SECTIONS OF FISSION PRODUCTS, BOLOGNA 1979, NEANDC(E) |
| 209L, 103.
21) MACKLIN, R.L. AND WINTERS, R.R.: NUCL. SCI. ENG., 78, 110
(1981).
22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS". NORTH HOLLAND (1968). |

23) FORREST, R.A.: AERE-R 12419 (1988).

MAT number = 4649 46-PD-110 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 8 KEV RESONANCE PARAMETERS ARE THE SAME AS JENDL-2 WHICH WERE MAINLY TAKEN FROM THE RECOMMENDATION BY MUGHABGHAB ET AL./3/ AVERAGE RADIATION WIDTH OF 0.06 EV/3/ WAS ASSUMED. A NEGATIVE RESONANCE WAS ADDED AT -20 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION S1 WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./3/, AND S0 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.810E-4, S1 = 6.000E-4, S2 = 0.950E-4, SG = 2.64E-4, GG = 0.060 EV, R = 4.124 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.222 ELASTIC 4.995 TOTAL ELASTIC CAPTURE CAPTURE 0.2270 2.82 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/4/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/6/, POENITZ AND WHALEN/7/ AND SO ON, AND APPLIED TO PD ISOTOPES. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. 2.82 0.2270 MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). * = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/. SPIN-PARITY NO. ENERGY(MEV) DWBA CAL 0.0 0.3738 0.8138 0 2 2 GR. + 1 + 0.9205 4 3 4 5 000 1.1710 + 6 7 1.2124 3 2 + + 8 1.3980 Δ +

| 9 1.4701 1 +
10 1.5739 6 +
LEVELS ABOVE 1.67 MEV WERE ASSUMED TO BE OVERLAPPING. |
|--|
| FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/16/. DEFORMATION PARAMETER (BETA2 = 257) WAS
BASED ON THE DATA COMPILED BY RAMAN ET AL./17/ |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY/4/ WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (2.65E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 80.0 MILLI-BARNS AT 100
KEV MEASURED BY MACKLIN ET AL./19,20/ AND CORNELIS ET AL.
/21/ |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 61.9) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 5.57 MB (SYSTEMATICS OF FORREST/23/)
(N,ALPHA) 1.17 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM)
V = 50.01-0.5528E R0 = 5.972 A0 = 0.56
WS = 8.165 RS = 6.594 AS = 0.44
VS0= 5.261 RS0= 5.97 AS0= 0.267
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDESYST A(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING44-RU-1061.870E+016.300E-011.097E+007.896E+002.530E+0044-RU-1072.030E+016.000E-011.043E+016.637E+001.280E+0044-RU-108*1.826E+016.306E-011.050E+007.617E+002.420E+0044-RU-109*1.807E+016.282E-015.592E+006.353E+001.280E+00 |
| 45-RH-1071.963E+015.480E-013.151E+005.336E+001.250E+0045-RH-108*1.861E+016.306E-015.818E+015.341E+000.045-RH-1091.608E+016.270E-012.572E+005.371E+001.140E+0045-RH-110*1.824E+016.258E-014.505E+015.092E+000.0 |
| 46-PD-1081.790E+016.460E-018.844E-017.957E+002.600E+0046-PD-1092.071E+016.030E-011.194E+016.925E+001.350E+0046-PD-1101.880E+016.300E-011.215E+007.897E+002.490E+00 |

| 46- | PD-11 | 1 | 2. | 143E· | +01 : | 5.610 | DE - 01 | 7.37 | '6E+00 | 06.2 | 67E+00 | 0 1.350 | E+00 |
|--|---|--|---|---|---|---|--|--|---|--|--|--|--------------------|
| SY | ST: | * = | LDP ' | S WEI | RE DI | ETER | MINEC | FROM | I SYS | ГЕМАТ | ICS. | | |
| SPI
IN
ASS | N CUT
THE C
UMED | OFF
ASTH
TO B | PARA
Y CA
E 5. | METEL
LCUL
824 | RS WI
ATIOI
FOR I | ERE (
N, SI
PD-1 | CALCU
PIN C
10 AN | ULATED
UTOFF
ID 5.0 | AS (
FAC
FOR | D.146
FORS
PD-1 | *SQRT(
AT 0 N
11. | (A)*A**
NEV WERI | (2/3).
E |
| REFE
1)
2)
3)
4)
5)
6) | RENCE,
AOKI,
AND A
KAWAI
AND T
MUGHA
PART
IGARA
IJJIM
FOSTE
(1971 | S T.I.
PPLI.
ÉCHNA
SI, S
AR, D | ET A
ED S
ET OLOG
B. ACAC
S.:
. ET
. G. | L.:
GCIEN(
AL.:
GY, M
G.F.
DEMIC
J. NI
JR. / | PROC
PRO
ITO,
PRE
JCL.
JCL.
AND | . IN ⁻
SANT/
C. II
SS (/
SCI
ERI-I
GLAS(| T. CC
A FE.
NT. C
569 (
"NEUT
1981)
. TEC
M 87-
GOW, | ONF. C
ONF.
1988)
RON C
CHNOL.
025,
D. W. | ON NU(
ON NU
ROSS
, 12
P. 3
: PH | CLEAR
P.16
JCLEA
SECT
, 67
37 (1
YS. R | DATA
27 (19
R DATA
IONS,
(1975)
987).
EV., C | FOR BA
385)
VOL. I
0.
C3, 576 | SIC
CIENCE
, |
| 7)
8)
9)
10)
11) | POENI
PEREY
HUIZE
LOHR,
BECCH
PHENO
W. HA | ΤŻ,
ŇGA,
J.M
ETTI
MENA
ĘBER | W.P.
G: P
J.R
I. AN
, F.
I.N | AND
PHYS.
ANI
ID HAI
D.
NUCLI
P. | WHAI
REV
DIG
EBERI
JR.
JR.
S82, | LEN,
. 13
D, G
LI, \
AND Q
REAC
THE | J.F.
1, 74
.: NU
W.: N
GREEN
GREEN
TIONS
UNIV | : ANL
15 (19
JCL: F
JUCL:
JLEES,
6 ((EC
(ERSIT | - NDM
963) .
PHYS .
PHYS
G.W
OS) H
Y OF | -80 (
29,
. A23
.: P0
.H. B
WISC | 1983).
462 (1
2, 381
LARIZA
ARSHAL
ONSIN | 962).
(1974)
TION
L AND
PRESS. |). |
| 12) | GILBE | ŔŤ, | Α. Α | ND C | AMER | ON, / | A.G.W | 1.: CA | N.J | . PHY | S., 43 | 3, 1446 | |
| 13)
14)
15)
16)
17) | GRUPP
MATSU
KUNZ,
RAMAN | /.
A, S
ELAA
MOTO
P.D
, S. | R, F
R, J
, J
, ET | ET AL
I.: E(
ET
PRIVA
AL. | .: J
CN-1:
AL.
FE C(
: AT(| . NU(
3 (19
: JAE
OMMUI
OM. E | CL.S
977).
ERI-N
NICAT
DATA | SCI. T
1 7734
10N.
AND N | ECHN(
(197)
UCL. | DL. 2
78).
DATA | 1, 10
TABLE | (1984)
S 36, | 1 |
| 18)
19) | BENZI | / V.
IN,
SÉC | AND
R.L.
TION | REFI
ET
IS OF | =0, (
AL.
FIS: | G.: (
: PR(
SION | CCDN-
CC-S
PROD | NW/10
SPECIA
OUCTS, |) (196
(LIST)
BOL(| 69).
S' Me
DGNA | ETING
1979, | ON NEU
NEANDC | TRON
(E) |
| 20) | MACKL | | Ŕ.L. | AND | WIN | TERS | , R.F | R.: NU | UCL. S | SCI. | ENG., | 78, 11 | 0 |
| 21)
22) | CORNE
SCIEN
KIKUC | UIS,
CE Å | E.
ND T
K. A | ET / | AL.:
DLOG
AWAI | PRO
Y, AI | C. IN
NTWER
: "NU | IT. CC
RP 198
ICLEAR |)NF. 1
82, P
8 MAT | NUCLE
.222
TER A | AR DAT
(1982)
ND NU(| TA FOR
LEAR | |
| | KEACI | IUNS | Ξ, N | IUKIH | HUL | LAND | (196 | 58). | | | | | |

23) FORREST, R.A.: AERE-R 12419 (1988).

MAT number = 4700 47-AG- 0 JAERI EVAL-MAR87 LIU T.J., T.NAKAGAWA, K.SHIBATA DIST-SEP89 REV2-FEB94 HISTORY 87-03 NEW EVALUATION FOR JENDL-3/1/ 87-07 COMPILED BY K.SHIBATA 94-02 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2
(2,151)
 RESOLVED RESONANCE PARAMETERS
(3,2), (3,3), (3,4), (3,51-62), (3,64-71), (3,73-79)
 CURVES OF INELASTIC SCATTERING CROSS SECTIONS
 WERE SMOOTHED BY ADDING INTERPOLATED VALUES AT
 SEVERAL ENERGY POINTS.
(3,102)
 ONLY Q-VALUE WAS MODIFIED.

MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY.

MT=451 COMMENTS AND DICTIONARY. F=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS THIS FILE WAS MADE OF AG-107 AND AG-109 DATA. RESOLVED RESONANCE PARAMETERS (BELOW 7.0095 KEV) OF JENDL-3.1 ARE THE SAME AS THOSE OF JENDL-2, WHICH WERE MADE BY NAKAJIMA /2/ ON THE BASIS OF EXPERIMENTAL DATA BY MOXON AND RAE /3/, GARG ET AL./4/, ASGHAR ET AL./5/, PATTENDEN /6/, MURADJAN AND ADAMCHUK /7/, DE BARROS ET AL./8/, PATTENDEN AND JOLLY /9/, MACKLIN /10/ AND MIZUMOTO ET AL./11/. THERE ARE NO NEW EXPERIMENTAL DATA AVAILABLE SINCE THE JENDL-2 EVALUATION. TOTLA SPIN J AND ANGULAR MOMENTUM L OF SOME RESONANCES WERE ESTIMATED WITH A RANDOM NUMBER METHOD AND A METHODOF BOLLINGER AND THOMAS/12/, RESPECTIVELY. THE CAPTURE CROSS SECTION OF JENDL-3.1 BETWEEN 1.3 AND 2.6 KEV IS TOO LOW COMPARED WITH INTERPOLATED VALUES FROM THE LOWER AND HIGHER ENERGY REGIONS. TO COMPENSATE THE LOWER ADD ENTRY REGIONS. TO COMPENSATE THE LOWER CAPTURE CROSS SECTION, HYPOTHETICAL P-WAVE RESONANCES WERE ADDED. THE OTHER DATA ARE THE SAME AS JENDL-3.1, EXCEPT FOR NEUTRON WIDTH WHICH WAS MODIFIED SO AS TO REPRODUCE THE CAPTURE AREA MEASURED BY MACKLIN/10/. UNRESOLVED RESONANCE PARAMETERS (7.0095 - 100 KEV) THE PARAMETERS WERE DETERMINED WITH THE CODE ASREP /13/ TO REPRODUCE THE CAPTURE AND TOTAL CROSS SECTIONS. WHICH WERE BASED ON EXPERIMENTAL DATA /14,15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA OF THE NATURAL ELEMENT AND ITS ISOTOPES. MF=2

ISOTOPES.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S TOTAL 68.805 S. INTEGRALS (BARNS): RES. INTEG. TOTAL ELASTIC CAPTURE 5.180 63.625 762 9

MF=3 NEUTRON CROSS SECTIONS

MT=1,102 TOTAL, CAPTURE BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. NO BACKGROUND CROSS SECTIONS ARE ADOPTED. ABOVE 100 KEV, CROSS SECTIONS WERE EVALUATED ON THE BASIS OF EXPERIMENTAL DATA AND THEORETICAL CALCULATIONS. THE MAIN DATA WERE TAKEN FROM THE WORKS OF POENITZ AND WHALEN /14/, FOSTER AND GLASGOW /16/ FOR TOTAL CROSS SECTOIN AND MIZUMOTO ET AL. /15/, POENITZ/17/ FOR CAPTURE CROSS SECTION. THE DATA WERE FITTED WITH SPLINE FUNCTION /18/, AND WERE ADJUSTED FOR CONSISTENCE BETWEEN THE NATURAL ELEMENT AND ITS ISOTOPES. MT=2 ELASTIC ELASTIC = TOTAL - NONELASTIC MT=3 NONELASTIC SUM OF MT=4,16,17,22,28,102,103,107

MT=3 NONELASTIC SUM OF MT=4,16,17,22,28,102,103,107 MT=4 TOTAL INELASTIC SUM OF MT=51-80,91 MT=16,17,22,28,51-80,91,103,107 (N,2N),(N,3N),(N,NA),(N,NP), INELASTIC,(N,P),(N,A) THEY WERE MADE OF AG-107 AND AG-109 DATA. FOR THESE TWO ISOTOPES, THE CROSS SECTIONS WERE CALCULATED WITH THE MULTISTEP HAUSER-FESHBACH CODE TNG /19, 20/. AT FIRST, THE OPTICAL MODEL AND LEVEL DENSITY PARAMETERS WERE TAKEN FROM THE WORKS OF SMITH ET AL. /21/ AND IIJIMA ET AL. /22/, RESPECTIVELY AND THEN THEY WERE ADJUSTED TO REPRODUCE AVAILABLE EXPERIMENTAL DATA.

FOR JENDL-3.2, INELASTIC SCATTERING CROSS SECTIONS AT THRESHOLD ENERGIES OF OTHER LEVELS WERE INSERTED BY INTERPOLATING THE CALUCULATED VALUES WITH AKIMA'S METHOD.

| THE OPTICAL MODE | L PARAMET | ERS ARE | : | | | |
|--|---|--|--|--|---|---|
| DEP | TH (MEV) | R | ADIUS(FM) | DIFFU | SENESS(| FM) |
| NEUTRON V = 4
WS = 8 | 8.25-0.3E
.501-0.15 | R
E R | 0 = 1.249
S = 1.270 | A0 =
AS = | 0.603
0.575 | |
| VSO= 6
PROTON V = 6
WS = 1 | .0
6.061-0.5
2.50-0.10 | 50E R
E R | SO = 1.249
0 = 1.150
S = 1.250 | AŠO=
AO =
AS = | 0.603
0.650
0.470 | |
| ALPHA V = 1
WS = 2 | 93.0-0.15
1.00+0.25 | E R
E R
E R | C = 1.150
0 = 1.370
S = 1.370
C = 1.370 | A0 =
AS = | 0.560
0.560 | |
| THE LEVEL DENSITY | PARAMETE | RS ARE: | | | | |
| ECUT(MEV)
RH-103 0.990
RH-104 0.230
RH-105 0.770
RH-106 0.150
PD-106 2.380
PD-107 0.700
PD-107 0.700
PD-109 0.360
AG-105 1.230
AG-105 1.230
AG-106 0.4400
AG-107 1.420
AG-108 0.270
AG-109 1.180
AG-110 0.320 | EJO(MEV)
5.409
4.351
5.700
3.869
8.004
7.693
7.957
7.380
5.830
3.549
5.918
3.014
6.112
3.150 | T(MEV)
0.655
0.650
0.575
0.660
0.769
0.646
0.687
0.609
0.563
0.593
0.593
0.576
0.705
0.454 | A (1/MEV)
15.50
15.43
16.80
17.50
17.17
14.98
17.90
17.50
18.57
17.16
14.55
15.04
14.50
17.01 | C(MEV)
3.884
17.72
4.000
17.18
0.920
6.956
0.884
9.479
2.750
12.92
2.412
6.004
2.666
2.513 | CSPIN
49.725
54.591
57.230
56.147
49.293
59.268
59.268
59.268
58.301
60.343
56.110
47.878
49.799
48.306
57.015 | EPAIR
0.90
1.24
0.00
2.595
2.355
0.94
0.00
1.25
0.94
0.00
1.25
0.00 |
| THE LEVEL SCHEME | IS GIVEN | AS FOL | LOWS: | | | |
| AG-107: | ENERGY | MEV) | SPIN-PAR | ΙΤΥ | | |
| GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16 | $\begin{array}{c} 0.0\\ 0.0930\\ 0.1260\\ 0.3250\\ 0.4230\\ 0.7730\\ 0.9220\\ 0.9500\\ 0.9730\\ 0.9910\\ 1.0610\\ 1.1420\\ 1.1470\\ 1.2230\\ 1.2590\\ 1.3260\\ \end{array}$ | | $\begin{array}{c} 1/2 & - \\ 7/2 & + \\ (9/2) + \\ 3/2 & - \\ 5/2 & - \\ (11/2) + \\ 3/2 & - \\ 5/2 & + \\ (7/2) - \\ (13/2) + \\ (1/2 & -) \\ 1/2 & + \\ 7/2 & - \\ 5/2 & + \\ (3/2) + \\ (3/2) + \end{array}$ | | | |
| NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
MT-251 | ENERGY (
0.0
0.0880
0.1330
0.3110
0.7020
0.7070
0.7240
0.7360
0.8630
0.8700
0.9110
0.9120
1.0910
1.0990 | MEV) | SPIN-PAR
1/2 -
7/2 +
9/2 +
3/2 -
5/2 -
3/2 -
3/2 +
(3/2) +
5/2 -
(5/2) +
7/2 -
9/2 -
(5/2) +
7/2 -
9/2 -
(5/2) + | ΙΤΥ | | |
| CALCULATED FROM | MF=4, MT=2 | | | | | |
| MF=4 ANGULAR DIST | RIBUTIONS | OF SEC | ONDARY NEU | JTRONS | | |
| CALCULATED WITH
MT=51-80
CALCULATED WITH | TNG. | Y CODE | /23/. | | | |

MT=16,17,22,28,91 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. IF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 CALCULATED WITH TNG. MF = 5MF=12,14,15 GAMMA-PRODUCTION DATA MT=4,16,17,22,28,102,103,107 CALCULATED WITH TNG. REFERENCES

LIU, T. ET, AL., JAERI-M. 91-011 (1991).
NAKAJIMA, Y., TO BE PUBLISHED.
MOXON, M.C., RAE, E.R., "PROC. EANDC CONF. ON TIME-OF-FLIGHT METHODS, SACLAY, 1961", 439.
GARG, J.B., ET, AL., PHYS. REV., B137, 547(1965).
ASGHAR, M., ET, AL., "PROC. INT. CONF. ON THE STUDY OF NUCLEAR STRUCTURE WITH NEUTRONS, ANTWERP 1965", 65.
PATTENDEN N.J., IBID., 532.
MURADJAN, G.V., ADAMCHUK, JU. V., JADERNO-FIZICHESKIE ISSLEDOVANIJA, 6 64 (1968).
DE BARROS, S., ET, AL., NUCL. PHYS., A131, 305(1969).
PATTENDEN, N.J., JOLLY, J.E., AERE-PR/NP-16(1969).
MACKLIN, R.L., NUCL. SCI. ENG., 82, 400(1982).
MIZUMOTO, M., ET, AL., J. NUCL. SCI. TECHNOL., 20, 883(1983).
BOLLINGER, L.M. AND THOMAS, G.E., PHYS. REV., 171,1293(1968).
KIKUCHI Y., PRIVATE COMMUNICATION.
POENITZ, W.P., WHALEN, J.F., ANL-NDM-80(1983).
MIZUMOTO, M., ET AL., "PROC. INTER. CONF. ON NUCL.DATA FOR SCIENCE AND TECHNOLOGY", ANTWERP, P.226 (1982).
FOSTER, JR., D.G., AND GLASGOW, D.W., PHYS. REV., C3, 576 (1971).
POENITZ, W.P., ANL-83-4,239(1982).
NAKAGAWA, T., J. AT. ENE. SOC. JAPAN, 22, 559 (1980).
FU, C.Y., ORNL/TM-7042(1980).
SHIBATA, K., FU, C.Y., ORNL/TM-10093 (1986).
SHIBATA, K., FU, C.Y., ORNL/TM-10093 (1986).
SHIBATA, K., FU, C.Y., ORNL/TM-10093 (1986).
SHIBATA, K., FU, C.Y., ORNL/TM-10093 (1986).
SHIBATA, S., ET AL, J. NUCL. SCI. TECHNOL., 21, 10 (1984).
IGARASI, S. AND FUKAFORI, T., JAERTI 1321 (1991). REFERENCES

MAT number = 4725 47-AG-107 JAERI EVAL-MAR87 LIU T.J.,T.NAKAGAWA.,K.SHIBATA DIST-SEP89 REV2-FEB94 HISTORY 87-03 NEW EVALUATION FOR JENDL-3/1/ 87-07 COMPILED BY K.SHIBATA 94-02 JENDL-3.2 WAS MADE BY JNDC FPND W.G. (2,151) (3,2), (3,3), * * * * * * * * * * * * * * F=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF=2 RE MT=151 RESONANCE PARAMETERS H=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS (BELOW 7.0095 KEV) RESOLVED RESONANCE PARAMETERS (BELOW 7.0095KEV) FOR JENDL-3.1 ARE THE SAME AS THOSE OF JENDL-2, WHICH WERE MADE BY NAKAJIMA /2/ ON THE BASIS OF EXPERIMENTAL DATA BY MOXON AND RAE /3/, GARG ET AL./4/, ASGHAR ET AL./5/, MURADJAN AND ADAMCHUK /6/, DE BARROS ET AL./7/, PATTENDEN AND JOLLY /8/, MACKLIN /9/ AND MIZUMOTO ET AL./10/. THERE WERE NO NEW EXPERIMENTAL DATA AVAILABLE SINCE JENDL-2 EVALUATION. ONLY TOTAL SPIN J AND ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A RANDOM NUMBER METHOD AND A METHOD OF BOLLINGER AND THOMAS/11/, RESPECTIVELY. THE CAPTURE CROSS SECTION OF JENDL-3.1 BETWEEN 1.3 AND 2.6 KEV IS TOO LOW COMPARED WITH INTERPOLATED VALUES FROM THE LOWER AND HIGHER ENERGY REGIONS. TO COMPENSATE THE LOWER CAPTURE CROSS SECTION, P-WAVE RESONANCES WITH A CAPTURE AREA OF 0.04 EV WERE ADDED EVERY 40 EV BETWEEN 1.28 AND 2.04 KEV, AND EVERY 15 EV BETWEEN 2.04 AND 2.64 KEV. THE OTHER DATA ARE THE SAME AS JENDL-3.1, EXCEPT FOR NEUTRON WIDTH WHICH WAS MODIFIED SO AS TO REPRODUCE THE CAPTURE AREA MEASURED BY MACKLIN/9/.

UNRESOLVED RESONANCE PARAMETERS (7.0095 - 100 KEV) THE PARAMETERS WERE DETERMINED WITH THE ASREP CODE /12/ TO REPRODUCE THE CAPTURE AND TOTAL CROSS SECTIONS, WHICH WERE BASED ON EXPERIMENTAL DATA /13, 14/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA OF THE NATURAL ELEMENT AND ITS ISOTOPES. THE TYPICAL PARAMETERS ARE :

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS): 2200 M/S RES. INTEG. TOT 1

104

| LUIAL | 46.310 | |
|---------|--------|--|
| ELASIIC | 7.687 | |
| CAPIURE | 38.623 | |
| | | |

MF=3 NEUTRON CROSS SECTIONS

MF=3 NEUTRON CROSS SECTIONS MT=1,102 TOTAL, CAPTURE BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. NO BACKGROUND CROSS SECTIONS ARE ADOPTED. ABOVE 100 KEV, CROSS SECTIONS WERE EVALUATED ON THE BASIS OF EXPERIMENTAL DATA AND THEORETICAL CALCULATIONS. THE MAIN DATA WERE TAKEN FROM THE WORKS OF DUKEREVICH ET AL. /15/, SMITH ET AL. /16/ FOR TOTAL CROSS SECTOIN AND MIZUMOTO ET AL. /12/, MACKLIN ET AL. /9/ FOR CAPTURE CROSS SECTION. THE DATA WERE FITTED WITH SPLINE FUNCTION /17/, AND WERE ADJUSTED FOR CONSISTENCE BETWEEN THE NATURAL ELEMENT AND ITS ISOTOPES. MT=2 ELASTIC ELASTIC = TOTAL - NONELASTIC MT=4 TOTAL INELASTIC SUM OF MT=51-66,91 MT=16,17,22,28,51-66,91,103,107 (N,2N),(N,3N),(N,NA),(N,NP), INELASTIC,(N,P),(N,A) FOR THESE REACTIONS THE CROSS SECTIONS WERE CALCULATED WITH THE MULTI-STEP HAUSER-FESHBACH CODE TNG /18, 19/. AT FIRST, THE OPTICAL MODEL AND LEVEL DENSITY PARAMETERS WERE TAKEN FROM THE

WORKS OF SMITH ET AL./20/ AND IIJIMA ET AL./21/, RESPECTIVELY AND THEN THEY WERE ADJUSTED TO REPRODUCE THE AVAILABLE EXPERIMENTAL DATA.

FOR JENDL-3.2, INELASTIC SCATTERING CROSS SECTIONS AT THRESHOLD ENERGIES OF OTHER LEVELS WERE INSERTED BY INTERPOLATING THE CALUCULATED VALUES WITH AKIMA'S METHOD.

THE OPTICAL MODEL PARAMETERS ARE:

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|--|---|---|
| NEUTRON V = 48.25-0.3E
WS = 8.501-0.15E | R0 = 1.249
RS = 1.270 | A0 = 0.603
AS = 0.575 |
| PROTON V = 66.061-0.550E
WS = 12.50-0.10E | RSU = 1.249
RO = 1.150
RS = 1.250
RC = 1.150 | ASO = 0.803
AO = 0.650
AS = 0.470 |
| ALPHA V = 193.0-0.15E
WS = 21.00+0.25E | RO = 1.370
RS = 1.370
RC = 1.370
RC = 1.370 | A0 = 0.560
AS = 0.560 |

THE LEVEL DENSITY PARAMETERS ARE:

| | ECUT(MEV) | EJO(MEV) | T(MEV) | A(1/MEV) | C(MEV) | CSPIN | EPAIR |
|----------|-----------|----------|--------|----------|--------|--------|-------|
| RH-103 | 0.990 í | 5.409 ′ | 0.655 | `15.50´ | 3.884 | 49.725 | 0.94 |
| RH-104 | 0.230 | 4.351 | 0.650 | 15.43 | 17.72 | 49.820 | 0.00 |
| PD-106 | 2.380 | 8.004 | 0.666 | 17.17 | 0.920 | 56.147 | 2.59 |
| PD-107 | 0.700 | 7.693 | 0.769 | 14.98 | 6.956 | 49.293 | 1.35 |
| AG-105 | 1.230 | 5.830 | 0.609 | 18.57 | 2.750 | 60.343 | 0.94 |
| AG-106 | 0.400 | 3.549 | 0.563 | 17.16 | 12.92 | 56.110 | 0.00 |
| AG - 107 | 1.420 | 5.918 | 0.693 | 14.55 | 2.412 | 47.878 | 1.24 |
| AG-108 | 0.270 | 3.014 | 0.576 | 15.04 | 6.004 | 49.799 | 0.00 |

THE LEVEL SCHEME IS GIVEN AS FOLLOWS:

| NO.
GR.
12
34
56
7
89
10
11
12
13
14
15
16 | ENERGY(MEV)
0.0
0.0930
0.1260
0.3250
0.4230
0.7730
0.7870
0.9500
0.9500
0.9910
1.0610
1.1420
1.1420
1.2230
1.22590
1.3260 | SPIN-PARITY
1/2 -
7/2 +
(9/2)+
3/2 -
5/2 -
(11/2)+
3/2 -
5/2 +
5/2 -
(7/2)-
(13/2)+
(1/2 -)
1/2 +
7/2 -
5/2 +
(3/2)+
(3/2)+
(3/2)+ | |
|---|---|--|----|
| CONTINUUM LEVELS | WERE ASSUMED | ABOVE 1.42 ME | ۷. |

MT=251 CALCULATED FROM MF=4,MT=2.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH THE CASTHY CODE /22/. MT=51-66 CALCULATED WITH THE TNG CODE. MT=16,17,22,28,91 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 CALCULATED WITH TNG.

MF=12,14,15 GAMMA-PRODUCTION DATA MT=4,16,17,22,28,102,103,107 CALCULATED WITH TNG.

- REFERENCES
 1) LIU., T. ET AL.: JAERI-M 91-011 (1991).
 2) NAKAJIMA, Y., TO BE PUBLISHED.
 3) MOXON, M.C., RAE, E.R., "PROC. EANDC CONF. ON TIME-OF-FLIGHT METHODS, SACLAY, 1961",439.
 4) GARG, J.B., ET AL., PHYS. REV., B137, 547(1965).
 5) ASGHAR, M., ET AL., "PROC. INT. CONF. ON THE STUDY OF NUCLEAR

STRUCTURE WITH NEUTRONS, ANTWERP 1965",(65). MURADJAN, G.V., ADAMCHUK, JU. V., JADERNO-FIZICHESKIE ISSLEDOVANIJA, 6, 64 (1968). DE BARROS, S., ET AL., NUCL. PHYS., A131, 305(1969). PATTENDEN, N.J., JOLLY, J.E., AERE-PR/NP-16(1969). MACKLIN, R.L., NUCL. SCI. ENG., 82, 400(1982). MIZUMOTO, M., ET AL. J. NUCL. SCI. TECHNOL., 20, 883(1983). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). KIKUCHI, Y., PRIVATE COMMUNICATION. POENITZ, W.P., WHALEN, J.F., ANL-NDM-80(1983). MIZUMOTO, M., ET AL., "PROC. INT. CONF. ON NUCL. DATA FOR SCIENCE. AND TECHNOLOGY", ANTWERP, P.226 (1982). DUKAREVICH, JU.V., ET AL., NUCL. PHYS., A92, 433(1967). SMITH, A., ET AL., NUCL. PHYS., A32, 297 (1979). NAKAGAWA, T., J. AT. ENE. SOC. JAPAN, 22, 559 (1980). FU, C.Y., ORNL/TM-7042(1980). SHIBATA, K., FU, C.Y., ORNL/TM-10093(1986). SMITH, A., ET AL., NUCL. PHYS., A415, 1 (1984). IIJIMA, S., ET AL., J. NUCL. SCI. TECHNOL., 21, 10 (1984). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). 6) 7) 8) 9) 10) 11) 12) 13) 14) 15) 16) 17) 18) 19) 20) 21)

22)

MAT number = 4731 47-AG-109 JAERI EVAL-MAR87 LIU T.J., T.NAKAGAWA, K.SHIBATA DIST-SEP89 REV2-FEB94 HISTORY

87-03 NEW EVALUATION FOR JENDL-3/1/ 87-07 COMPILED BY K.SHIBATA 94-02 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

MODIFIED PARTS FOR JENDL-3.2 ***** RESOLVED RESONANCE PARAMETERS (2,151) (3,2), (3,3), RESOLVED RESONANCE PARAMETERS (3,4), (3,51-64) CURVES OF INELASTIC SCATTERING CROSS SECTIONS WERE SMOOTHED BY ADDING INTERPOLATED VALUES AT SEVERAL ENERGY POINTS. ONLY Q-VALUE WAS MODIFIED. CROSS SECTION OF 0.0 INSERTED AT 1 MEV.

(3,102) (3,107)

MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY.

MT=451 COMMENTS AND DICTIONARY. MF=2 RESOLVED PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS (BELOW 7.0095KEV) OF JENDL-3.1 ARE THE SAME AS THOSE OF JENDL-2, WHICH WERE MADE BY NAKAJIMA /2/ ON THE BASIS OF EXPERIMENTAL DATA BY MOXON AND RAE/3/, GARG ET AL./4/, ASGHAR ET AL./5/, PATTENDEN/6/, MURADJAN AND ADAMCHUK /7/, DE BARROS ET AL./8/, PATTENDEN AND JOLLY/9/, MACKLIN/10/ AND MIZUMOTO ET AL./11/. THERE WAS NO NEW EXPERIMENTAL DATA AVAILABLE SINCE THE JENDL-2 EVALUATION. TOTAL SPIN J AND ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A RANDOM NUMBER METHOD AND A METHOD OF BOLLINGER AND THOMAS/12/, RESPECTIVELY. THE CAPTURE CROSS SECTION OF JENDL-3.1 IS TOO LOW BETWEEN 1.3 KEV AND 2.6 KEV COMPARED WITH INTERPOLATED VALUES FROM THE HIGHER AND LOWER ENERGY REGIONS. TO COMPENSATE THE LOW CAPTURE CROSS SECTION, P-WAVE RESONANCES WITH CAPTURE AREA OF 0.020 EV WERE ADDED EVERY 20 EV BETWEEN 1.25 AND 1.59 KEV, AND EVERY 40 EV BETWEEN 1.59 AND 2.59 KEV. THE OTHER DATA ARE THE SAME AS JENDL-3.1, EXCEPT FOR NEUTRON WIDTH WHICH WAS MODIFIED SO AS TO REPRODUCE THE CAPTURE AREA DATA MEASURED BY MACKLIN. UNRESOLVED RESONANCE PARAMETERS (7.0095 - 100 KEV) THE PARAMETERS WERE DETERMINED WITH CODE ASREP /13/ TO REPRODUCE THE CAPTURE AND TOTAL CROSS SECTIONS, WHICH WERE BASED ON EXPERIMENTAL DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA /14, 15/ AND ADJUSTED FOR CONSISTENCE BETWEEN THE DATA OF THE NATURAL ELEMENT AND ITS ISOTOPES. THE TYPICAL PARAMETERS ARE : S0 = (0.315-0.540)E-4, S1 = (3.61-4.34)E-4, S2= 0.53E-4,

1470

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS): 2200 M/S RES. INTEG.

| TOTAL | 93.018 |
|---------|--------|
| ELASTIC | 2.483 |
| CAPTURE | 90.536 |
| | |

MF=3 NEUTRON CROSS SECTIONS

MT=1.102 TOTAL, CAPTURE BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. NO BACKGROUND CROSS SECTIONS ARE ADOPTED. ABOVE 100 KEV, CROSS SECTIONS WERE EVALUATED ON THE BASIS OF EXPERIMENTAL DATA AND THEORETICAL CALCULATIONS. THE MAIN DATA WERE TAKEN FROM THE WORKS OF MIZUMOTO ET AL. /15/, MACKLIN /10/ FOR CAPTURE CROSS SECTION. THE DATA WERE FITTED WITH SPLINE FUNCTION /16/,AND WERE ADJUSTE FOR CONSISTENCE BETWEEN THE NATURAL ELEMENT AND ITS ISOTOPES. MT=2 ELASTIC = TOTAL - NONELASTIC MT=1,102 _ADJUSTED MT=2

MT=2 ELASTIC ELASTIC = TOTAL - NONELASTIC MT=3 NONELASTIC SUM OF MT=4,16,17,22,28,102,103,107 MT=4 TOTAL INELASTIC SUM OF MT=51-64,91 MT=16,17,22,28,51-64,91,103,107 (N,2N),(N,3N),(N,NA),(N,NP), INELASTIC,(N,P),(N,A) FOR THESE REACTIONS THE CROSS SECTIONS WERE CALCULATED WITH THE MULTISTEP HAUSER-FESHBACH CODE TNG /17,18/. AT FIRST, THE OPTICAL MODEL AND LEVEL DENSITY PARAMETERS WERE TAKEN FROM THE WORKS OF SMITH ET AL./19/ AND IIJIMA ET AL./20/, RESPECTIVELY AND THEN THEY WERE ADJUSTED TO REPRODUCE THE AVAILABLE

EXPERIMENTAL DATA.

FOR JENDL-3.2, INELASTIC SCATTERING CROSS SECTIONS AT THRESHOLD ENERGIES OF OTHER LEVELS WERE INSERTED BY INTERPOLATING THE CALUCULATED VALUES WITH AKIMA'S METHOD.

THE OPTICAL MODEL PARAMETERS ARE:

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|--|--|---|
| NEUTRON V = 48.25-0.3E
WS = 8.501-0.15E
VS0= 6.0 | R0 = 1.249
RS = 1.270
RS0= 1.249 | A0 = 0.603
AS = 0.575
AS0 = 0.603 |
| PROTON V = 66.061-0.550E
WS = 12.50-0.10E | RO = 1.150
RS = 1.250
RS = 1.250 | A0 = 0.650
AS = 0.470 |
| ALPHA V = 193.0-0.15E
WS = 21.00+0.25E | RC = 1.150
RO = 1.370
RS = 1.370
RC = 1.370 | A0 = 0.560
AS = 0.560 |

THE LEVEL DENSITY PARAMETERS ARE:

| RH - 105
RH - 106
PD - 108
PD - 109
AG - 107
AG - 108
AG - 109 | ECUT(MEV)
0.770
0.150
1.900
0.360
1.420
0.270
1.180 | EJO(MEV)
5.700
3.869
7.957
7.380
5.918
3.014
6.112 | T(MEV)
0.630
0.575
0.646
0.687
0.693
0.576
0.705 | A (1/MEV)
16.80
17.50
17.90
17.50
14.55
15.04
14.50 | C(MEV)
4.000
17.18
0.884
9.479
2.412
6.004
2.666
2.666 | CSPIN
54.591
57.230
59.268
58.301
47.878
49.799
48.306 | EPAIR
1.24
0.00
2.60
1.35
1.24
0.00
1.25 |
|--|--|---|---|--|--|---|---|
| AG - 110 | 0.320 | 3.150 | 0.454 | 17.01 | 2.513 | 57.015 | 0.00 |

THE LEVEL SCHEME USED IS GIVEN AS FOLLOWS:

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 | 1/2 - |
| 1 | 0.0880 | 7/2 + |
| 2 | 0.1330 | 9/2 + |
| 3 | 0.3110 | 3/2 - |
| 4 | 0.4150 | 5/2 - |
| 5 | 0.7020 | 3/2 - |
| 6 | 0.7070 | 3/2 + |
| 7 | 0.7240 | (3/2)+ |
| 8 | 0.7360 | `5/2´+ |
| 9 | 0.8630 | 5/2 - |
| 10 | 0.8700 | (5/2)+ |
| 11 | 0.9110 | `7/2´+ |
| 12 | 0.9120 | 7/2 - |
| 13 | 1.0910 | 9/2 - |
| 4 4 | 4 0000 | |

CONTINUUM LEVELS WERE ASSUMED ABOVE 1.18 MEV.

MT=251 CALCULATED FROM MF=4,MT=2.

 $\mathsf{MF}{=}4$ Angular distributions of secondary neutrons $\mathsf{MT}{=}2$

CALCULATED WITH THE CASTHY CODE /21/.

MT=51-64 CALCULATED WITH TNG. MT=16,17,22,28,91 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 CALCULATED WITH TNG.

MF=12,14,15 GAMMA-PRODUCTION DATA MT=4,16,17,22,28,102,103,107 CALCULATED WITH TNG.

- REFERENCES

 LIU, T. ET AL., JAERI-M 91-011 (1991).
 NAKAJIMA, Y., TO BE PUBLISHED.
 MOXON, M.C., RAE, E.R., "PROC. EANDC CONF. ON TIME-OF-FLIGHT METHODS, SACLAY, 1961", 439.
 GARG, J.B., ET AL., PHYS. REV., B137, 547(1965).
 ASGHAR, M., ET AL., "PROC. INT. CONF. ON THE STUDY OF NUCLEAR STRUCTURE WITH NEUTRONS, ANTWERP 1965", 65.
 PATTENDEN N.J., IBID., 532.
 MURADJAN, G.V., ADAMCHUK, JU. V., JADERNO-FIZICHESKIE ISSLEDOVANIJA, 6, 64(1968).

8) DE BARROS, S., ET AL., NUCL. PHYS., A131, 305(1969).
9) PATTENDEN, N.J., JOLLY, J.E., AERE-PR/NP-16(1969).
10) MACKLIN, R.L., NUCL. SCI. ENG., 82, 400(1982).
11) MIZUMOTO, M., ET AL., J. NUCL. SCI. TECHNOL., 20, 883(1983).
12) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
13) KIKUCHI, Y., PRIVATE COMMUNICATION.
14) POENITZ, W.P., WHALEN, J.F., ANL-NDM-80(1983).
15) MIZUMOTO, M., ÉT AL., "PROC. INTER.CONF. ON NUCL.DATA FOR SCIENCE AND TECHNOLOGY", ANTWERP, P.226 (1982).
16) NAKAGAWA, T., J. AT.ENE. SOC. JAPAN,22,559(1980).
17) FU C.Y., ORNL/TM-7042(1980).
18) SHIBATA,K., FU, C.Y., ORNL/TM-10093(1986).
19) SMITH,A., ÉT AL., J. NUCL. SCI. TECHNOL., 21, 10(1984).
20) ILJIMA, S., ET AL., J. NUCL. SCI. TECHNOL., 21, 10(1984).
21) IGARASI, S. ANF FUKAHORI, T.: JAERI 1321 (1991).

MAT number = 4735 47 - AG - 110MJNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.125 KEV MOST PARAMETERS WERE BASED ON THE EXPERIMENTS BY ANUFRIEV ET AL./2/ AVERAGE RADIATION WIDTH OF 148 MEV/2/ WAS ADOPTED. TOTAL SPIN J WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS /3/. A NEGATIVE RESONANCE AT -2 EV WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./4/ MF UNRESOLVED RESONANCE REGION : 0.125 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.810E-4, S1 = 2.970E-4, S2 = 0.930E-4, SG = 1720.E-4, GG = 0.148 EV, R = 6.032 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 88.47 -ELASTIC 6.468 -CAPTURE 82.00 94.1 INTEGRALS (BARNS) MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/7/, POENITZ AND WHALEN/8/ AND SO ON, AND APPLIED TO AG-110M. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IJJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/. /15/MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA SHEETS/17/. ΜТ NO ENERGY(MEV) SPIN-PARITY 0.0 -0.1176 -0.1066 GŔ. 6 + 1233 1 + 0.0011 0.0736 0.0740 3 + 4 + 5 2 +
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{c} .0811\\ .1193\\ .1194\\ .1496\\ .1514\\ .1539\\ .1841\\ .1869\\ .2213\\ .2430\\ .2604\\ .2636\\ .2944\\ .3071\\ .3148\\ .3389\\ .3493\\ .3513\\ .3536\\ .3664\\ .3682\\ .3793\\ .4081\\ \end{array}$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
|---|--|---|---|
| LEVELS ABOVE 0.4
MT = 102 CAPTURE
SPHERICAL OPTICAL | AND STATISTI | CAL MODEL CAL | OVERLAPPING. |
| SECTIONS WERE ESTI
AND REFFO/18/ AND | MATED ACCORD | ID SEMI-DIREC
ING TO THE PR
O 1 MILLI-BAR | ROCEDURE OF BENZI
RN AT 14 MEV. |
| THE GAMMA-RAY STRE
THE SYSTEMATICS OF
S-WAVE RESONANCE L
LEVEL DENSITY PARA | NGTH FUNCTIC
RADIATION W
EVEL SPACING
METERS. |)N (1.88E-01)
/IDTH (0.13 EV
6 (0.693 EV) (| WAS DETERMINED FROM
/) AND THE AVERAGE
CALCULATED FROM THE |
| MT = 16 (N,2N) CROS
MT = 17 (N,3N) CROS
MT = 22 (N,N'A) CRO
MT = 28 (N,N'P) CRO
MT = 32 (N,N'D) CRO
MT = 33 (N,N'T) CROS
MT = 103 (N,P) CROSS
MT = 104 (N,D) CROSS
MT = 106 (N,HE3) CRO
MT = 107 (N,ALPHA) C
THESE REACTION CRO
PREEQUILIBRIUM AND | S SECTION
S SECTION
SS SECTION
SS SECTION
SS SECTION
SECTION
SECTION
SECTION
SECTION
SS SECTION
ROSS SECTION
S SECTIONS
MULTI-STEP | I
WERE CALCULA
EVAPORATION N | TED WITH THE
MODEL CODE PEGASUS. |
| THE KALBACH'S CONS
FORMULA DERIVED FR
DENSITY PARAMETERS | TANT K (= 8
OM KIKUCHI-K | 31.5) WAS EST
(AWAI'S FORMAI | IMATED BY THE
ISM/19/ AND LEVEL |
| FINALLY, THE (N,P)
NORMALIŻED TO THE
(N,P) 13
(N,ALPHA) 2 | AND (N,ALPH
FOLLOWING VA
.10 MB (SYS
.84 MB (SYS | A) CROSS SEC
LUES AT 14.5
TEMATICS OF I
TEMATICS OF I | TIONS WERE
MEV:
FORREST/20/)
FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CA | STHY. | | |
| MF = 4 ANGULAR DISTRI
LEGENDRE POLYNOMIAL
GIVEN IN THE CENTER-
TIC LEVELS, AND IN T
CALCULATED WITH CAST
BUTIONS IN THE LABOR | BUTIONS OF S
COEFFICIENTS
OF-MASS SYST
HE LABORATOR
HY. FOR OTH
ATORY SYSTEM | ECONDARY NEUT
FOR ANGULAR
EM FOR MT=2 /
SYSTEM FOR
IER REACTIONS
I WERE ASSUME | FRONS
DISTRIBUTIONS ARE
AND DISCRETE INELAS-
MT=91. THEY WERE
ISOTROPIC DISTRI-
). |
| MF = 5 ENERGY DISTRIB
ENERGY DISTRIBUTIONS
PEGASUS FOR INELASTI
OTHER NEUTRON EMITTI | UTIONS OF SE
OF SECONDAR
C SCATTERING
NG REACTIONS | CONDARY NEUTR
Y NEUTRONS WE
FROM OVERLAP | RONS
ERE CALCULATED WITH
PPING LEVELS AND FOR |
| TABLE 1 NEUTRON OPTIC | AL POTENTIAL | PARAMETERS | |
| $V_{\rm M} = 50.01 - 0.5$ | (MEV)
528E | $R_{0} = 5.972$ | AQ = Q.56 |
| WS = 8.165
VSO= 5.261 | | к5 = 6.594
RSO= 5.97 | AS = 0.44
ASO= 0.267 |

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) PAIRING NUCLIDE SYST A(1/MEV) T(MEV) - - - -1.700E+01 5.300E-01 8.449E+00 2.973E+00 0.0 1.963E+01 5.480E-01 3.151E+00 5.336E+00 1.250E+00 1.861E+01 6.306E-01 5.818E+01 5.341E+00 0.0 1.608E+01 6.270E-01 2.572E+00 5.371E+00 1.140E+00 45-RH-106 45 - RH - 107 45 - RH - 108 45-RH-109 1.916E+01 6.110E-01 6.467E+00 6.507E+00 1.350E+00 1.790E+01 6.460E-01 8.844E-01 7.957E+00 2.600E+00 2.071E+01 6.030E-01 1.194E+01 6.925E+00 1.350E+00 1.880E+01 6.300E-01 1.215E+00 7.897E+00 2.490E+00 46-PD-107 46-PD-108 46-PD-109 46-PD-110 1.671E+01 5.760E-01 1.221E+01 3.609E+00 0.0 1.650E+01 6.300E-01 2.761E+00 5.709E+00 1.250E+00 1.791E+01 5.900E-01 2.444E+01 4.282E+00 0.0 1.955E+01 5.810E-01 6.505E+00 5.835E+00 1.140E+00 47 - AG - 108 47 - AG - 109 47 - AG - 110 47-AG-111 - - - - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 2.711 FOR AG-110 AND 5.0 FOR AG-111. REFERENCES REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
ANUFRIEV, V.A. ET AL., ATOM. ENERGIYA, 53, 29 (1982)
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971) (1971)
8) POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983).
9) PEREY, F.G: PHYS. REV. 131, 745 (1963).
10) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
11) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
12) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) и. ни 1971 13) ĠIĽBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERI, A. AND CAMERON, A.C.M. C.M. L. (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
17) NUCLEAR DATA SHEETS, 38, 545 (1983).
18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
19) KIUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4800 48-CD- 0 JNDC EVAL-MAR89 JNDC FP ND W.G., N.YAMAMURO DIST-OCT89 REV2-DEC93 HISTORY 89-03 EVALUATION OF CD ISOTOPES FOR JENDL-3 WAS MADE BY JNDC FP NUCLEAR DATA W.G./1/, AND DATA FOR NATURAL CD WERE CONSTRUCTED FROM THEM BY T.NAKAGAWA(JAERI). 89-03 PHOTON_PRODUCTION DATA WERE CALCULATED BY N.YAMAMURO (DATA ENGINEERING) 93-12 JENDL-3.2 GAMMA-RAY PRODUCTION DATA : BY S. IGARASI (NDEAC) RESONANCE PARAMETERS: BY Y. NAKAJIMA, T.NAKAGAWA(JAERI) COMPILED BY T.NAKAGAWA (NDI/JAERI) MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) EVALUATION WAS MADE ON THE BASIS OF THE FOLLOWING DATA FOR EACH ISOTOPE. CD-106 : BELOW 0.7 KEV MUGHABGHAB ET AL./2/ ASSUMED CAPTURE WIDTH = 0.153 EV CD-108 : BELOW 0.38 KEV ANUFRIEV ET AL./3/ ASSUMED CAPTURE WIDTH = 0.110 EV CD-110 : BELOW 7.0 KEV LIOU ET AL./4/, MUSGROVE ET AL./5/, ALFIMENKOV ET AL./6/. MF = 2CD-110 : BELOW ... LIOU ET AL./4/, MUSCINE... ET AL./6/. ASSUMED CAPTURE WIDTH = 0.102 EV CD-111 : BELOW 1.8 KEV LIOU ET AL./4/, WASSON AND ALLEN/7/ ASSUMED CAPTURE WIDTH = 0.102 EV CD-112 : BELOW 7.0 KEV LIOU ET AL./4/, MUSGROVE ET AL./5/. ASSUMED CAPTURE WIDTH = 0.1 EV/4/ BELOW 2.0 KEV, AND 0.077 EV ABOVE 2.0 KEV FOR S-WAVE RES. 0.096 EV/5/ FOR P-WAVE RES. ASSUMED C... O.096 L.. CD-113 : BELOW 2.0 KEV LIOU ET AL./4/. ASSUMED CAPTURE WIDTH = 0.101 EV/4/ CD-114 : BELOW 8.0 KEV LIOU ET AL./1/, MUSGROVE ET AL./5/. ASSUMED CAPTURE WIDTH = 0.11 EV /4/ BELOW 2.0 KEV, AND 0.053 EV ABOVE 2.0 KEV FOR S-WAVE RES. 0.082 EV/5/ FOR P-WAVE RES. O.082 EV/5/ FOR P-WAVE RES. AND D.053 EV ABOVE_ET AL./5/. FOR S-WAVE RES. AND D.053 EV ABOVE_ET AL./5/. FOR S-WAVE RES. AND D.053 EV ABOVE_ET AL./5/. FOR S-WAVE RES. AND D.053 EV ABOVE_ET AL./5/. CD-116 : BELOW 9.0 KEV LIOU ET AL./4/, MUSGROVE ET AL./5/. ASSUMED CAPTURE WIDTH = 0.047 EV FOR S-WAVE RES. AND 0.085 EV FOR P-WAVE RES/5/. IN ORDER TO REPRODUCE WELL MEASURED TOTAL CROSS SECTIONS, EFFECTIVE SCATTERING RADIUS OF 6.2 FM WAS ASSUMED FOR THE ALL EFFECTIVE SCATTERING RADIUS OF 6.2 FM WAS ASSUMED FOR THE ALL ISOTOPES. UNRESOLVED RESONANCE REGION : UP TO 100 KEV THE NEUTRON STRENGTH FUNCTIONS FOR L=0 AND 1 WERE TAKEN FROM MUGHABGHAB ET AL./2/, AND THOSE FOR L=2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/8/. AVERAGE RADIATIVE CAPTURE WIDTHS WERE ALSO TAKEN FROM REF./2/. THE OBSERVED LEVEL SPACINGS WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTIONS CALCULATED WITH CASTHY FOR CD-110, CD-112, CD-113, CD-114 AND CD-116, AND THE CAPTURE CROSS SECTIONS DETERMINED FROM EXPERIMENTAL DATA FOR THE OTHER ISOTOPES. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. FINALLY, BACKGROUND CROSS

SECTION WAS GIVEN TO THE CAPTURE TO REPRODUCE THE EXPERIMENTAL DATA/9.10/

UNRESOLVED RESONANCE PARAMETERS (AT 70 KEV)

| NUCLIDE
CD-106
CD-108
CD-110
CD-111
CD-112
CD-113
CD-114
CD-116 | S0
1.00E-4
1.20E-4
0.44E-4
0.45E-4
0.31E-4
0.64E-4
0.16E-4 | S1
5.00E-4
4.80E-4
3.00E-4
3.90E-4
4.40E-4
2.20E-4
3.50E-4
2.80E-4 | S2
0.97E-4
0.95E-4
0.93E-4
0.53E-4
0.91E-4
0.90E-4
0.89E-4
0.87E-4 | GG(S,D)
(EV)
0.155
0.071
0.071
0.160
0.077
0.160
0.053
0.047 | GG(P)
(EV)
0.175
0.125
0.080
0.160
0.090
0.160
0.070
0.070 | D-OBS
(EV)
131
147
155
15.8
212
27.4
250
432 | R
(FM)
4.70
4.59
6.25
5.76
5.76
5.44
6.74
6.49 |
|---|---|--|--|---|---|---|---|
| CALCULATED | 2200-M/S | CROSS SE | CTIONS AN | ID RES. | | ALS (BAR | NS) |
| TOTAL | | 2535.9 | | N E · | - INTE | _0. | |
| | | 7.649 | | | - | | |
| | - 4 | | | | | | |

MF = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY/8/, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WER
DETERMINED TO REPRODUCE THE CD-111 TOTAL CROSS SECTION. THE
OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/12/
ALPHA = HUIZENGA AND 1G0/13/ WERE

PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (18/ /18/

TOTAL MT = 1

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. IN THE ENERGY REGION FROM 100 KEV TO 2.5 MEV, CROSS SECTION WAS DETERMINED FROM THE DATA MEASURED BY WHALEN ET AL./19/, ET AL./20/ AND POENITZ AND WHALEN/21/. GREEN

MT =

' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 3 NON-ELASTIC SCATTERING SUM OF PARTIAL CROSS SECTIONS EXCEPT MT=2.

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEMES WERE TAKEN FROM REF./22/ FOR CD-106 AND 108, REF./23/ FOR CD-110, 111, 112 1ND 113, AND REF./24/ FOR CD-114 AND 116. THE DIRECT CROSS SECTION WAS CALCULATED WITH DWUCK-4/25/ TO 2+ AND 3- LEVELS OF EVEN-MASS ISOTOPES WHICH ARE MARKED WITH '*' IN THE FOLLOWING TABLE. THE CROSS SECTIONS WERE GROUPED AS FOLLOWS:

| $MT \cap (MEV)$ | 106 | 100 | 110 | 111 | 112 | 112 | 111 | 116 |
|-----------------|-----|-----|-----|-------|-----|-------|-----|-------|
| | 100 | 100 | 110 | | 112 | 113 | 114 | 110 |
| 51 -0.2454 | - | - | - | 51 | - | 51 | - | - |
| 52 -0.2986 | - | - | - | - | - | 52,53 | - | - |
| 53 -0.3419 | - | - | - | 52,53 | - | - | - | - |
| 54 -0.4166 | - | - | - | 54 | - | 54,55 | - | - |
| 55 -0.5131 | - | - | - | - | - | 56 | - | 51* |
| 56 -0.5583 | - | - | - | - | - | 57 | 51* | - |
| 57 -0.6174 | 51* | 51* | - | 55 | 51* | - | - | - |
| 58 -0.6577 | - | - | 51* | 56 | - | 58,59 | - | - |
| 59 -0.754 | - | - | - | 57 | - | - | - | - |
| 60 -0.8553 | - | - | - | 58 | - | 60 | - | - |
| 61 -0.8836 | - | - | - | - | - | 61 | - | - |
| 62 -0.9884 | - | - | - | - | - | 62,63 | - | - |
| 63 -1.02 | - | - | - | 59 | - | - | - | - |
| 64 -1.1261 | - | - | - | 60 | - | 64 | - | - |
| 65 -1.1342 | - | - | - | - | - | - | 52 | - |
| 66 -1.19 | - | - | - | 61 | - | 65 | - | - |
| 67 -1.2093 | - | - | - | - | - | - | 53 | 52,53 |
| 68 -1.223 | - | - | - | - | 52 | - | - | - |

| 69 -1.283
70 -1.3052 | - | - | - | 2 | -
53 | - | 54
55 | 54 |
|---|--|---|--|--|---|--|---|--|
| 71 -1.361
72 -1.3639 | - | - | - | : | 54 | - | -
56 | 55 |
| 73 -1.4317
74 -1.4732 | 52 | 52 5 | 2,53 | - 5
- | 5,56
- | 2 | 2 | - |
| 75 -1.5424
76 -1.7318 | 53 5
- | 3,54 | 54
55 | 2 | - | -
- 5 | -
57,58 | - |
| 77 -1.7833
78 -1.971 | -
- 5 | - 5
5,56 | 6,57
- | : | -
57 | - | - | - |
| 79 -1.971
80 -2.0788 | 54 | - 5 | 58
9*,60 | - 5
- | 8*,59
- | - | - | - |
| 81 -2.1627
82 -2.22 | - 5
55 <u>-</u> 57 | 7,58*
59 | 61
62 | - | - | - | - | - |
| 83 -2.355
84 -2.4641 | 58*
59-61 | 60
61 6 | 63
4,65 | - | - | - | - | - |
| 85 -2.538
86 -2.5612 | - 6 | 62
3-69 | 66 | - | - | - | - | - |
| 88 -2.868 | 7 | 1 - 6 | 9,70 | - | - | - | - | - |
| 91 -1.1948 | 91 / | 91 | 91 | 91 | 91 | 91 | 91 | 91 |
| MT = 102 CA
SPHERICAL
CASTHY/8/
SECTIONS V
AND REFFO/
THE GAMMA-
THE FOLLOV
NUCLI
CD-10
CD-11
CD-11
CD-11
CD-11 | APTURE
OPTICAL
WAS ADON
VERE EST
/26/ AND
/26/ AND
CAP
VING CAP
IDE CR
06 0.
08 0.
10 0.
11 0.
11 0.
11 0.
13 0.
13 0.
14 0.
14 0. | AND S
PTATEDA
NOTH
ENGRE CE
S34 AT
2245 AT
2245 AT
2245 AT
2245 AT
2245 AT
2245 AT
2245 AT
2245 AT
220 AT
220 AT | TATISTI
DIRECT
ACCORT
LIZEDTIC
ROSS SE
TO KEV
30 KEV
30 KEV
30 KEV
30 KEV
30 KEV | CAL M
AND
DING T
ONS WE
CCTION
CCTION
CCTION | IODEL C
SEMI-D
O THE
ILLI-B
IRE ADJ
IS.
TRENGT
14
8.
4.
103
4.
4.
2. | ALCULA
IRECT
PROCEE
ARN AT
JSTED
.2E-4
65E-4
.2E-4
.2E-4
.2E-4
.5E-4
.50E-4
.50E-4 | TION W
CAPTUR
DURE OF
14 ME
TO REP
CTION | ITH
E CROSS
BENZI
V.
RODUCE |
| AT THẾ ÈN
TO WELL F
/10/. BY
REGIÓN AN
KEV. | NËRGIES
REPRODUC
ADOPTIN
ND MULTI | BĚLOW
E THE
G BACK
PLING | 10 MEV,
DATA ME
GROUND
AN ENER | THE
ASURE
DATA
CGY DE | CROSS
D BY K
IN THE
PENDEN | ŠĖČTIC
OMPE/S
UNRES
T FACT | ON WAS
0/ AND
OLVED
OR ABO | MODIFIED
POENITZ
RESONANCE
VE 100 |
| Q-VALUE V | NAS SET | TO 7.2 | 33 MEV | ΟΒΤΑΙ | NED BY | WEIGH | ITING A' | VERAGE. |
| MI = 16, 17,
(N, 2N),
(N, 2N),
THESE REAC
EQUILIBRIU
/11/. THE
DERIVED FF
PARAMETERS
WERE NORMA
WERE NORMA
NUCLI
CD-10
CD-11
CD-11
CD-11
CD-11
CD-11
CD-11
CD-11
CD-11 | , 22, 28,
, (N, HE3)
CTION CR
UM AND M
E KALBAC
ROM KIKU
S. THE (
ALIZED T
IDE (
06
08
10
11 (
12 (
13 (
14 (
VALUES I
VALUES I
) SYSTEM | , 32,
N, A
OSS SE
ULTI-S
CAL
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
CHI-S
C | VERE CA
WERE CA
WERE CA
WERE CA
WERE CA
OF DATA
OF WEN | 14, N' P)
ND (N
WERE
PORMAT
WERE
CORMA (
NG) /2
SORMA (
NG) /2
SORMA (
NG) /2
SORMA (
NG) /2
SORMA (
NG) /2
SORMA (
NG) /2
SO
SO
SO
SO
SO
SO
SO
SO
SO
SO
SO
SO
SO | N, ALPH
CALCUL
ION MO
E ESTIM
ISM/27
N, ALPH
LUES(M
9/ (N
URED B
U ET A | TOT CONTRACT TO TOT CONTRACT TO TO TO TO TO TO TO TO TO TO TO TO TO | N,P),
SECTIONS
FECTIONS
FECTIONS
FECTIONS
FECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIONS
SECTIO | (N,D),
S
E PRE-
ASUS
FORMULA
DENSITY
TIONS
EV:
ALIZED).
AL./30/ |
| MT = 251 MU
CALCULATED | U-BAR
D FROM (| MF=4, | MT=2). | | | | | |
| MF = 4 ANGULA
DISTRIBUTION
CALCULATED V
LEVELS WERE
CENTER-OF-MA
ISOTROPIC DI | AR DISTR
NS OF EL
NITH CAS
GROUPED
ASS SYST
ISTRIBUT | IBUTIO
ASTIC
THY/8/
INTO
EM WER
IONS I | NS OF S
AND INE
. IN T
1 LEVEL
E ASSUM
N THE L | ECOND
LASTI
HE CA
, ISC
IÉD.
ABORA | ARY NE
C SCAT
SE WHE
TROPIC
FOR OT
TORY S | UTRONS
TERING
RE MOF
DISTR
HER RE
YSTEM | RE THAN
RE THAN
IBUTIO
ACTION
WERE A | ONS WERE
2
NS IN THE
SSUMED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS/11/ | Y DISTRI
RIBUTION
FOR INE | BUTION
S OF S
LASTIC | S OF SE
ECONDAR
SCATTE | CONDA
Y NEU
RING | RY NEU
TRONS
FROM 0 | TRONS
WERE C
VERLAF | ALCULA
PING L | TED WITH
EVELS |

| AND FOR OTHER NEUTRON EMITTING REACTIONS. |
|--|
| MF = 12 PHOTON PRODUCTION MULTIPLICITIES
MT = 3 (ABOVE 100 KEV)
CALCULATED WITH GNASH/32/ MODIFIED BY YAMAMURO/33/
MT = 102 (BELOW 100 KEV)
CALCULATED FROM ENERGY BALANCE. |
| MF = 14 PHOTON ANGULAR DISTRIBUTIONS
MT = 3, 102
ISOTROPIC DISTRIBUTIONS WERE ASSUMED. |
| <pre>MF = 15 PHOTON ENERGY DISTRIBUTIONS
MT = 3 (ABOVE 100KEV)
CALCULATED WITH GNASH/32/ MODIFIED BY YAMAMURO/33/
MT = 102 (BELOW 100 KEV)
SPECTRA WERE CALCULATED WITH CASTHY FOR 8 ISOTOPES, REFERRING
TO THE COMPILATION OF GAMMA-RAY SPECTRA FOR THERMAL NEUTRON
BY M.A.LONE ET AL./34/, AT 1.0E-5, 2.53E-2, 1.0E+0, 1.0E+2,
1.0E+3 AND 1.0E+4 EV. PRIMARY TRANSITIONS WERE TAKEN INTO
ACCOUNT FOR CD-111, CD-112, CD-113, CD-114 AND CD-116.</pre> |
| TABLE 1NEUTRON OPTICAL POTENTIAL PARAMETERS
DEPTH (MEV)DIFFUSENESS(FM)V= 50.01-0.5528ER0 = 5.972A0 = 0.56WS = 8.165RS = 6.594AS = 0.44WS0= 5.261RS0= 5.97AS0= 0.267 |
| TABLE 2 LEVEL DENSITY PARAMETERS OF CD ISOTOPES
NUCLIDE SYST A(/MEV) T(MEV) C(/MEV) EX(MEV) PAIRING |
| 48-CD-104 * 1.643E+01 6.403E-01 3.532E-01 7.266E+00 2.650E+00 48-CD-105 1.600E+01 6.850E-01 4.000E+00 6.612E+00 1.360E+00 48-CD-106 1.468E+01 6.950E-01 5.785E-01 7.078E+00 2.300E+00 48-CD-106 1.468E+01 6.950E-01 5.785E-01 7.078E+00 2.300E+00 48-CD-107 1.647E+01 6.740E-01 4.374E+00 6.626E+00 1.360E+00 48-CD-108 1.541E+01 6.900E-01 5.114E-01 7.655E+00 2.600E+00 48-CD-109 1.812E+01 6.120E-01 3.856E+00 6.132E+00 1.360E+00 48-CD-110 1.750E+01 6.300E-01 5.212E-01 7.482E+00 2.610E+00 48-CD-111 1.874E+01 5.930E-01 3.762E+00 6.000E+00 1.360E+00 48-CD-112 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00 48-CD-113 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 48-CD-114 1.910E+01 6.010E-01 5.651E-01 7.266E+00 1.360E+00 |
| REFERENCES KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1,
PART A", ACADEMIC PRESS (1981). ANUFRIEV ET AL.: SOV. AT. ENERGY, 57, 502 (1985). LIOU, H.I. ET AL.: PHYS. REV., C10, 709 (1974). MUSGROVE, A.R. DE L., ET AL.: J. PHYS. G, 4, 771 (1978). ALFIMENKOV ET AL.: NUCL. PHYS., A398, 93 (1983). WASSON, O.A. ALLEN, B.J.: PHYS. REV., C7, 780 (1973). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). KOMPE, D.: NUCL. PHYS., A133, 513 (1969). POENITZ, W.P.: ANL-83-4, 239 (1982). HIJJMA, S. ET AL.: JAERI-M 87-025 P. 337 (1987). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). HULZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). HULZENGA, J.R. AND HAEBERLI, W.: NUCL. PHYS. 29, 462 (1962). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS (IEDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GRUPPELAAR, H.: ECN-13 (1977). WHALEN, J.F. ET AL.: JAL. ANL-7210, 16 (1966). GRUPPELAAR, H.: ECN-13 (1977). POENITZ, W.P. AND WFALEN, J.F.: ANL/NDM-080 (1983). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). MALEN, J.F. ET AL.: MULARS (ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). KUNZ, P.D.: PRIVATE COMMUNICATION. |
| |

- 26) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 27) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 28) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
 29) FORREST, R.A.: AERE-R 12419 (1986).
 30) BORMANN, M. ET AL.: NUCL. PHYS., A115, 309 (1968).
 31) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
 32) YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977).
 33) YMAMAMURO, N.: JAERI-M 88-140 (1988).
 34) LONE, M.A. ET AL.: AT. DATA AND NUCL. TABLES, 26, 511 (1981).

MAT number = 4825 48-CD-106 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 F = 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 700 EV
 RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/
 NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS
 ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGE
 RADIATION WIDTH OF 0.153 EV WAS DETERMINED FROM THE EXPERIMENTAL DATA OF MUSGROVE ET AL./4/ ABOVE 2.6 KEV. SCATTERING
 RADIUS OF 6.5 FM WAS ADOPTED FROM THE SYSTEMATICS OF MEASURED
 VALUES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE
 THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 700 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MUSGROVE ET AL./6,7/ THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTHS, GG(S) AND GG(P), WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.000E-4, S1 = 5.000E-4, S2 = 0.970E-4, SG(S)= 11.8E-4, SG(P)= 13.3E-4, GG(S)= 0.155 EV, GG(P)= 0.175 EV, R= 4.699 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 6.492 ELASTIC 5.522 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 10.7 0.9695 CAPTURE0.969510.7F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/9/, POENITZ AND WHALEN/10/ AND
SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/11/
ALPHA = HUIZENGA AND IGO/12/
DEUTERON = LOHR AND HAEBERLI/13/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/17/. MF = 3/17/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/18/ AND NUCLEAR DATA SHEETS/19/. ENERGY(MEV) SPIN-PARITY NO. DWBA CAL. 0.0 GŘ. 0 2 4 2 + * 1 + 1.4938

+

+

Δ +

2

3

4

2.1045

| 5 2.3050 4 +
6 2.3306 5 +
7 2.3386 4 +
8 2.3705 3 - *
9 2.4856 4 +
10 2.4917 6 +
11 2.5031 6 +
LEVELS ABOVE 2.522 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/20/. DEFORMATION PARAMETERS (BETA2 = 0.1732 AND
BETA3 = 0.194) WERE BASED ON THE DATA COMPILED BY RAMAN ET
AL./21/ AND SPEAR/22/, RESPECTIVELY. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.42E-03) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 340 MILLI-BARNS AT 70
KEV MEASURED BY MUSGROVE ET AL./6,7/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
MT =111 (N,2P) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 122.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/24/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 900.00 MB (RECOMMENDED BY BYCHKOV+/25/)
(N,ALPHA) 100.00 MB (RECOMMENDED BY FORREST/26/)
THE (N,P) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF THE
DATA MEASURED BY BORMANN ET AL./27/ |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 50.01-0.5528E R0 = 5.972 A0 = 0.56 WS = 8.165 RS = 6.594 AS = 0.44 VS0= 5.261 RS0= 5.97 AS0= 0.267 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2LEVEL DENSITY PARAMETERSNUCLIDESYST A(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING46-PD-1021.831E+016.210E-016.406E-017.665E+002.640E+0046-PD-1031.733E+016.550E-015.327E+006.637E+001.350E+0046-PD-1041.630E+016.650E-018.743E-017.305E+002.290E+00 |

1.791E+01 6.700E-01 9.137E+00 7.207E+00 1.350E+00 46-PD-105

 47-AG-103
 *
 1.627E+01
 6.427E-01
 2.835E+00
 5.882E+00
 1.290E+00

 47-AG-104
 *
 1.737E+01
 6.403E-01
 3.551E+01
 5.016E+00
 0.0

 47-AG-105
 *
 1.848E+01
 6.379E-01
 1.390E+01
 6.378E+00
 9.400E-01

 47-AG-106
 *
 1.839E+01
 5.480E-01
 1.824E+01
 3.696E+00
 0.0

 1.643E+01 6.403E-01 3.532E-01 7.266E+00 2.650E+00 1.600E+01 6.850E-01 4.000E+00 6.612E+00 1.360E+00 1.468E+01 6.950E-01 5.785E-01 7.078E+00 2.300E+00 1.647E+01 6.740E-01 4.374E+00 6.626E+00 1.360E+00 48-CD-104 48-CD-105 48-CD-106 48-CD-107 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 1.094 FOR CD-106 AND 5.0 FOR CD-107. REFERENCES REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
MUSGROVE, A.R. DE L., ET AL.: J. PHSICS PT G, 4, 771 (1978).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
MUSGROVE, A.R. DE L., ET AL.: PROC. OF INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, P.449
ALLEN, B.J., ET AL.: NUCL. SCI. ENG., 82, 230 (1982).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). FUSIER, D.G. JR. AND GLAGGON, D. H.L. H.C. H.L., H. (1971). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 10) 11) 12) 13) 14) 1971 15) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERON, A.G.W.: CAN. J. FILG., 40, 1400 (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). NUCLEAR DATA SHEETS, 30, 305 (1980). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). KIKUCHI, K. AND REFFO, G.: CCDN-NW/10 (1969). BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980). FORREST, R.A.: AERE-R 12419 (1986). BORMANN, M., ET AL.: NUCL. PHYS., A115, 309 (1968). 16) 17) 18) 19) 20) 21) 22) 23) 24) 25) 26) 27)

MAT number = 4831 48-CD-108 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 380 EV RESONANCE PARAMETERS WERE BASED ON THE EXPERIMENTAL DATA OF ANUFRIEV ET AL./2/ NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. SCATTERING RADIUS OF 6.5 FM WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL./4/ MF UNRESOLVED RESONANCE REGION : 0.380 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./4/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MUSGROVE ET AL./6,7/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTHS, GG(S) AND GG(P), WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.200E-4, S1 = 4.800E-4, S2 = 0.950E-4, SG(S)= 7.15E-4, SG(P)= 8.51E-4, GG(S)= 0.105 EV, GG(P)= 0.125 EV, R= 4.590 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 6.619 -ELASTIC 5.533 -CAPTURE 1.087 27.2 INTEGRALS (BARNS) F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/9/, POENITZ AND WHALEN/10/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/11/ ALPHA = HUIZENGA AND IGO/12/ DEUTERON = LOHR AND HAEBERLI/13/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /17/. MF /17/ MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2STRUCTURE DATA FILE (1987 VERSION)/18/ AND NUCLEAR DATA SHEETS /19/. ΜТ NO ENERGY(MEV) SPIN-PARITY DWBA CAL. 0.0 0.6330 1.5084 0 2 4 GŔ. + 1 1.6017 2 0 3 + 45 + 1.9132 2 +

| 6
7
8
9
10
11
12
13
14
15
16
17
18
20
21
22
23
24
25
26
27
LEVELS A | 1.9380
2.1627
2.2023
2.2393
2.5655
2.5000
2.5413
2.6649
2.6015
2.6750
2.6817
2.6750
2.6817
2.7069
2.7400
2.7400
2.7400
2.9953
2.9941
3.0467
3.0574
3.0574
3.0574
3.0760
3.1105
3.1380
ABOVE 3.17 MEV WER | 0 +
2 -
3 -
2 +
2 +
0 +
6 +
5 +
5 -
2 +
0 -
2 +
5 -
0 +
5 +
6 -
6 +
2 +
7 -
0 +
6 +
0 +
6 +
2 +
7 -
0 +
6 +
5 +
5 -
5 -
2 +
2 +
0 +
6 +
5 -
2 +
2 +
0 -
2 +
2 +
2 +
0 +
6 +
5 -
2 +
2 +
0 -
2 +
2 +
2 +
0 +
6 +
5 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
2 +
0 -
0 -
2 +
0 -
2 +
0 -
2 +
0 -
0 -
2 +
0 -
2 +
0 -
0 -
2 +
0 -
0 -
2 +
0 -
0 -
0 -
0 -
0 -
0 -
0 -
0 -
0 -
0 - | *
ERLAPPING. |
|---|--|--|---|
| FOR THE LE
INELASTIC
DWUCK-4 CC
BASED ON T
0.207 WAS | EVELS WITH AN ASTE
SCATTERING CROSS
DE/20/. DEFORMAT
THE DATA COMPILED I
PRESENTLY DETERMIN | RISK, THE CONTRIBU
SECTIONS WAS CALCUI
ION PARAMETER (BET/
BY RAMAN ET AL./21,
NED. | TION OF DIRECT
LATED BY THE
A2 = 0.1752) WAS
/ AND BETA3 = |
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/ | APTURE
OPTICAL AND STATIS
ADOPTED. DIRECT
VERE ESTIMATED ACCO
22/ AND NORMALIZED | STICAL MODEL CALCU
AND SEMI-DIRECT CA
DRDING TO THE PROCI
D TO 1 MILLI-BARN A | LATION WITH
APTURE CROSS
EDURE OF BENZI
AT 14 MEV. |
| THE GAMMA-
REPRODUCE
KEV MEASUR | RAY STRENGTH FUNC
THE CAPTURE CROSS
ED BY MUSGROVE ET | TION (8.63E-04) WAS
SECTION OF 230 MII
AL./6,7/ | S ADJUSTED TO
LLI-BARNS AT 70 |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT = 32 (N,
MT =103 (N,
MT =104 (N,
MT =105 (N,
MT =106 (N,
MT =107 (N,
MT =111 (N,
THESE REAC
PREEQUILIE | 2N) CROSS SECTION
3N) CROSS SECTION
N'A) CROSS SECTION
N'D) CROSS SECTION
P) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
T) CROSS SECTION
HE3) CROSS SECTION
ALPHA) CROSS SECTION
ALPHA) CROSS SECTION
2TION CROSS SECTION
3RIUM AND MULTI-ST | N
N
ION
NS WERE CALCULATED
EP EVAPORATION MODI | WITH THE
EL CODE PEGASUS. |
| THE KALBAC
FORMULA DE
DENSITY PA | CH'S CONSTANT K (=
ERIVED FROM KIKUCH
ARAMETERS. | 97.0) WAS ESTIMA
I-KAWAI'S FORMALISI | TED BY THE
M/23/ AND LEVEL |
| FINALLY, T
NORMALIZED
(N,2N)
(N,P)
(N,ALPHA | THE (N,2N), (N,P),
D TO THE FOLLOWING
1000.00 MB (1
57.60 MB (1
A) 12.10 MB (3 | AND (N,ALPHA) CROS
VALUES AT 14.5 MEV
RECOMMENDED BY BYCI
SYSTEMATICS OF FOR
SYSTEMATICS OF FOR | S SECTIONS WERE
V:
HKOV+/24/)
REST/25/)
REST) |
| MT = 251 MU
CALCULATED | J-BAR
) WITH CASTHY. | | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED W
SCATTERING W
ISOTROPIC DI | AR DISTRIBUTIONS OF
LYNOMIAL COEFFICIES
E CENTER-OF-MASS S
AND IN THE LABORA
WITH CASTHY. CONTI
VAS CALCULATED WITH
STRIBUTIONS IN TH | F SECONDARY NEUTROI
NTS FOR ANGULAR DIS
YSTEM FOR MT=2 AND
TORY SYSTEM FOR MT:
RIBUTION OF DIRECT
H DWUCK-4. FOR OTI
E LABORATORY SYSTE | NS
STRIBUTIONS ARE
DISCRETE INELAS-
=91. THEY WERE
INELASTIC
HER REACTIONS,
M WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRO | C DISTRIBUTIONS OF
RIBUTIONS OF SECON
INELASTIC SCATTER
N EMITTING REACTIO | SECONDARY NEUTRON
DARY NEUTRONS WERE
ING FROM OVERLAPPII
DNS. | S
CALCULATED WITH
NG LEVELS AND FOR |
| TABLE 1 NEUTR | RON OPTICAL POTENT | IAL PARAMETERS | |

RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) - - - - - - - - -AS = 0.44ASO = 0.267TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.630E+01 6.650E-01 8.743E-01 7.305E+00 2.290E+00 1.791E+01 6.700E-01 9.137E+00 7.207E+00 1.350E+00 1.717E+01 6.660E-01 8.922E-01 8.024E+00 2.590E+00 1.916E+01 6.110E-01 6.467E+00 6.507E+00 1.350E+00 46-PD-104 46-PD-105 46-PD-106 46-PD-107

 47-AG-105
 *
 1.848E+01
 6.379E-01
 1.390E+01
 6.378E+00
 9.400E-01

 47-AG-106
 1.839E+01
 5.480E-01
 1.824E+01
 3.696E+00
 0.0

 47-AG-107
 1.650E+01
 6.300E-01
 2.823E+00
 5.699E+00
 1.240E+00

 47-AG-108
 1.671E+01
 5.760E-01
 1.221E+01
 3.609E+00
 0.0

 1.468E+01 6.950E-01 5.785E-01 7.078E+00 2.300E+00 1.647E+01 6.740E-01 4.374E+00 6.626E+00 1.360E+00 1.541E+01 6.900E-01 5.114E-01 7.655E+00 2.600E+00 1.812E+01 6.120E-01 3.856E+00 6.132E+00 1.360E+00 48-CD-106 48-CD-107 48-CD-108 48-CD-109 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.088 FOR CD-108 AND 5.0 FOR CD-109. REFERENCES REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
ANUFRIEV, V.A. ET AL.: ATOMNAYA ENERGIYA, 57, 59 (1984).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
MUSGROVE, A.R. DE L., ET AL: PROC. OF INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, P.449.
ALLEN, B.J., ET AL.: NUCL. SCI. ENG., 82, 230 (1982).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). (1971). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 10) 11) 12) 13) 14) . НА 1971 15) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 15) GILBERT, A. AND CAMERUN, A.G.W.. CAN. J. THIO., TO, T.G. (1965).
16) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
17) GRUPPELAAR, H.: ECN-13 (1977).
18) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
19) NUCLEAR DATA SHEETS, 37, 289 (1982).
20) KUNZ, P.D.: PRIVATE COMMUNICATION.
21) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
22) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
24) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
25) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4837 48-CD-110 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-12 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 7 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2, AND SLIGHTLY MODIFIED FOR JENDL-3.2. FOR JENDL-2, EVALUATION WAS MADE ON THE BASIS OF EXPERI-MENTAL DATA OF LIOU ET AL./3/ AND MUSGROVE ET AL./4/ THE AVERAGE RADIATION WIDTH WAS ASSUMED TO BE 0.1 EV/3/ BELOW 3.1 KEV, AND TO BE 0.071 EV FOR S-WAVE LEVELS AND 0.084 EV FOR P-WAVE ONES/4/ ABOVE 3.1 KEV. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND TOTAL CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./5/ FOR JENDL-3.2, THE PARAMETERS OF THE NEGATIVE RESONANCE WERE ADJUSTED TO DECREASE THE ELASTIC SCATTERING CROSS SECTION IN THE ENERGY REGION BELOW ABOUT 1 KEV. THIS MODIFICATION WAS NEEDED TO IMPROVE THE TOTAL CROSS SECTION OF NATURAL CD AROUND 10 EV. MF = 210 ΕV UNRESOLVED RESONANCE REGION : 7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./5/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTHS, GG(S) AND GG(P), WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.440E-4, S1 = 3.000E-4, S2 = 0.930E-4, SG(S)= 4.57E-4, SG(P)= 5.15E-4, GG(S)= 0.071 EV, GG(P)= 0.080 EV, R= 6.251 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 16.928 ELASTIC 5.874 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 11.054 39.3 CAPIURE 11.054 39.3 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/8/, POENITZ AND WHALEN/9/ AND
SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/10/
 ALPHA = HUIZENGA AND IGO/11/
 DEUTERON = LOHR AND HAEBERLI/12/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. MF = 3/16/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/.

| NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
LEVELS ABC | ENERGY(MEV)
0.0
0.6577
1.4732
1.4757
1.5424
1.7833
1.8092
2.0042
2.0788
2.1245
2.1627
2.2200
2.3550
2.4641
2.4798
2.5380
2.5612
2.7864
2.8680
2.8780
2.9266
DVE 2.974 MEV WERE | SPIN-PARITY
0 +
2 +
0 +
2 +
3 +
1 +
3 +
5 -
3 -
5 -
3 +
4 +
3 +
5 -
3 +
4 +
3 +
5 -
5 -
4 +
2 +
7 -
4 +
7 -
5 -
ASSUMED TO B | DWBA CAL.
*
* |
|--|--|--|---|
| FOR THE LEVE
INELASTIC SC
DWUCK-4 CODE
BETA3 = 0.16
AL./19/ AND | ELS WITH AN ASTERI
CATTERING CROSS SE
7/18/. DEFORMATIO
88) WERE BASED ON
SPEAR/20/, RESPEC | SK. THE CONTR
CTIONS WAS CA
N PARAMETERS
THE DATA COMP
TIVELY. | IBUTION OF DIRECT
LCULATED BY THE
(BETA2 = 0.1771 AND
ILED BY RAMAN ET |
| MT = 102 CAPT
SPHERICAL OF
CASTHY WAS A
SECTIONS WEF
AND REFF0/21 | TURE
PTICAL AND STATIST
ADOPTED. DIRECT A
RE ESTIMATED ACCOR
I/ AND NORMALIZED | ICAL MODEL CA
ND SEMI-DIREC
DING TO THE P
TO 1 MILLI-BA | LCULATION WITH
T CAPTURE CROSS
ROCEDURE OF BENZI
RN AT 14 MEV. |
| THE GAMMA-RA
REPRODUCE TH
KEV MEASURED | AY STRENGTH FUNCTI
HE CAPTURE CROSS S
D BY MUSGROVE ET A | ON (4.65E-04)
ECTION OF 245
L./22/ | WAS ADJUSTED TO
MILLI-BARNS AT 30 |
| MT = 16 (N,2M
MT = 17 (N,3M
MT = 22 (N,N
MT = 28 (N,N
MT = 103 (N,P)
MT = 104 (N,D)
MT = 105 (N,T)
MT = 107 (N,AL
THESE REACT
PREEQUILIBR | N) CROSS SECTION
N) CROSS SECTION
P) CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
PHA) CROSS SECTION
ON CROSS SECTION
ON CROSS SECTIONS | N
WERE CALCULA
EVAPORATION | TED WITH THE
MODEL CODE PEGASUS. |
| THE KALBACH'
FORMULA DERI
DENSITY PARA | 'S CONSTANT K (=
IVED FROM KIKUCHI-
AMETERS. | 92.5) WAS EST
KAWAI'S FORMA | IMATED BY THE
LISM/23/ AND LEVEL |
| FINALLY, THE
NORMALIZED T
(N,2N)
(N,P)
(N,ALPHA) | E (N,2N), (N,P) AN
TO THE FOLLOWING V
1170.00 MB (SY
29.70 MB (SY
6.34 MB (SY | D (N,ALPHA) C
ALUES AT 14.5
STEMATICS OF
STEMATICS OF
STEMATICS OF
STEMATICS OF | ROSS SECTIONS WERE
MEV:
WEN DEN LU+/24/)
FORREST/25/)
FORREST) |
| MT = 251 MU-E
CALCULATED V | BAR
VITH CASTHY. | | |
| F = 4 ANGULAR
LEGENDRE POLYN
GIVEN IN THE (
TIC LEVELS, AN
CALCULATED WIT
SCATTERING WAS
ISOTROPIC DIST | DISTRIBUTIONS OF
NOMIAL COEFFICIENT
CENTER-OF-MASS SYS
ND IN THE LABORATO
TH CASTHY. CONTRI
S CALCULATED WITH
FRIBUTIONS IN THE | SECONDARY NEU
S FOR ANGULAR
TEM FOR MT=2
RY SYSTEM FOR
BUTION OF DIR
DWUCK-4. FOR
LABORATORY SY | TRONS
DISTRIBUTIONS ARE
AND DISCRETE INELAS-
MT=91. THEY WERE
ECT INELASTIC
OTHER REACTIONS,
STEM WERE ASSUMED. |

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

MF

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| | | | | | DE | PΤ | H (| (ME | EV) | | | | R | AD |) (| JS | (F | M) | | | DI | F | FUS | SEN | ١E | SS | (F | M) | | |
|--|--|---|---|--|--|-----------------------------|--|--|---------------------------|-----------------------------------|--------------------------------|------------------------------|------------------------------------|--|------------------------|---|---|------------------------------|----------------------------------|--|--|--|------------------------------------|------------------------------|----------------------|----------------------|--------------------------|--------------------------|-----|--|
| Tł | HE F | V
W
V
FOR | =
S =
S0=
M 0 | 50
8.
5.
F S | .01
165
261
URF | -0
-0 | .5
.5 | 528
ABS | SOR |
РТ | 10 | N | -
R
R
P A | 0
S
SC
RT | =
=
)= | 5
6
5
1 S | .9
.5
.9
D | 72
94
7
ER | | WC | A (
A (
A (
A (
A (
A ())) | | (
= ()
= ()
- SA |).5
).2
).2 | 56
44
26
20 |
7
T | YP | Е. | | |
| TABL | _E 2 | 2 | LEV | EL | DEN | SI | TΥ | PA | RA | МE | ΤE | RS | 5 | | | | | | | | | | | | | | | | | |
| NUC | | DE | | | A (1 | / M | EV |) | Т(| ΜE | V) | | | C (| 1, | / M | ΕV | ') | Е | Х (| ME | V |) | F | PA | I R | IN | G | | |
| 46
46
46
46 | - PD -
PD -
PD -
PD - | - 10
- 10
- 10
- 10 | 6
7
8
9 | | 1.7
1.9
1.7
2.0 | 17
16
90
71 | E+(
E+(
E+(
E+(|)1
)1
)1
)1 | 6.
6.
6. | 66
11
46
03 | 0E
0E
0E
0E | - 0
- 0
- 0 |)1
)1
)1
)1 | 8.
6.
8.
1. | 92
46
84
19 | 22
57
44
94 | E -
E +
E -
E + | 01
00
01
01 | 8
6
7
6 | . 0.500 |)24
507
57 | | +0(
+0(
+0(
+0(| | 2.
 .
2. | 59
35
60
35 | 0E
0E
0E
0E | +0(
+0(
+0(
+0(| | |
| 47 -
47 -
47 -
47 - | - AG -
- AG -
- AG -
- AG - | - 10
- 10
- 10
- 11 | 7
8
9
0 | | 1.6
1.6
1.6
1.7 | 50
71
50
91 | E+(
E+(
E+(
E+(|)1
)1
)1
)1 | 6.
5.
6.
5. | 30
76
30
90 | 0E
0E
0E
0E | - 0
- 0
- 0
- 0 |)1
)1
)1
)1 | 2.
1.
2.
2. | 82
22
76
44 | 23
21
51
44 | E+
E+
E+
E+ | 00
01
00
01 | 5
3
5
4 | . 6 | 999
999
999
999
999 |)E·
)E·
2E· | +00
+00
+00
+00 | | .
).
 .
). | 24
0
25
0 | 0E
0E | +0(
+0(|) | |
| 48
48
48
48 | - CD -
CD -
CD -
CD - | - 10
- 10
- 11
- 11 | 8
9
0
1 | | 1.5
1.8
1.7
1.8 | 41
12
50
74 | E+(
E+(
E+(
E+(|)1
)1
)1
)1 | 6.
6.
6.
5. | 90
12
30
93 | 0 E
0 E
0 E
0 E | - 0
- 0
- 0
- 0 |)1
)1
)1
)1 | 5.
3.
5.
3. | 1
85
2
76 | 14
56
12
52 | E -
E +
E -
E + | 01
00
01
00 | 7
6
7
6 | . 6
. 1
. 4 | 32
32
82 | | +00
+00
+00
+00 | | 2. | 60
36
61
36 | 0 E
0 E
0 E
0 E | +0(
+0(
+0(
+0(| | |
| SP
IN
ASS | IN (
The
Sume | CUT
C
D | OFF
ASTI
TO | PA
HY
BE | RAM
CAL
9.0 | IET
CU
77 | ERS
LAT | S W
TIC
DR | /ER
)N,
CD | E
S
- 1 | CA
PI
10 | LC
N
A | UL
CU
ND | AT
ITC | ED
FF | 2
 | AS
FA
6 | 0
CT
F0 | .1
ÖR
R | 46
S
C[| 5 * 5
A 1
) - 1 | SQ
 1 | RT(
0 M
1. | (A)
//E\ |)* | A*
WE | * (
RE | 2/3 | 3). | |
| REFE
1)
2)
3)
4)
5)
6)
7)
8) | AOF
AOF
ANI
KAV
LIC
MUC
PAF
IGA | NCE
A
VAI
SGHA
SGHA
JIE
SGTA
JIE | ST.
PPL
H.E
BGH
SI,
R
R | ET
IED
I. Å
ÅB,
ÅB,
S.
S.
D.G | AL
SCA
ET A
ADE
ADE
ET J | F I
ID
ID
ID
IC | PF
NCE
E
E
F
U
F
U
F | ROC
J.
F.
PRE
AF
JA
ND | SAUYE .SRR | IN
CL
ST: (,
I,- | T.
A
AL
19
M
GO | FEC
EU
81:37
W, | ON
i,
JTR
)J
JTR
)J | IF.
T
C
I
N
I
A
E
D
2
5 | (OI
E(
21(
PH | ON
CHI
CR
CR
I
P
. : | N
2
N
7
S
7
1
3
7 | UC
09
6
33
HY | LE
P .
' (
S E
7 S . | AF
19
29
4
7
19
7
19
7 | 27
527
77
77
77
71
991
98 |) A ⁻
19
77
) N
27
) N
27
) N
27
) N | TA
(19
95
1 (
S,
). | F(
985
(1
(19
V(|)
7
97
97 | B
92
8) | АЅ
).
і,
6 | IC | | |
| 9)
10)
11)
12)
13) | POE
PEF
HU
LOF
BEC
PHE
W.
(19 | ENI
REY
IZE
IZE,
CCH
ENO
A
971 | ϯż,
, ϝ
J.I
ETT
MEN.
EBE
). | W.
.G:
J.
M.
I,
A. I
RLI | P.
PH
.R.
AND
F.D
N N
), | AN
IYS
A
IÚĊ
P. | D V
ND
AEE
JF
LEA | NHA
REV
BER
R.
AR
B2, | LE
GÖ
AN
RE
T | N,
13
G
Å
A
H
E | J
1,
W.
GR
TI
U | . F
7
E
0
N
1 | 45
IUC
NU
NU
NU
NU | A
L
L
L
L
L
L
L
L
L
L
L
L
L
L
L
L
L
L
L | NI
19
S | -
96
P
P
OS | ND
3)
YS
G.
)
0 |)M -
S.
W.
H.
DF | 80
29 | (
23
PC
SC | 19
46
2
0
L
A
F | 82
82
83
85
85 | 3).
381
IZ/
HAL
IN | 196
1 (
1 T
PF | 62
(1
A
RE |).
97
ND
SS | 4) | | | |
| 14) | G
(19 | _BE | ŔТ,
). | Α. | AN | ID
• | | MER | RON
I | ,
NI I I | A. | G. | W. | : | C/ | 4 N
T E / | сп | J. | P
I | ΗY | ′S. | · , | 43
10 | 3, | 1 | 44
01 | 6 | | | |
| 16)
17)
18)
19) | GRU
MAT
KUN
RAN | JPP
TSU
NZ,
MAN | ELA
MOTO
P.I
S | AR,
O,
D.: | J.:
PR
ET | P
IV
AL | ËĊŇ
RI\
ATE | 1
V - 1
V A T
E C
A T | 3
E
O M
O M | (1
CO
MU | 97
MM
NI
DA | 7)
UN
CA
TA | | AT
ON | - I (
 .
) | |)
(
CL | 19 | 81
DA |).
(
T <i>A</i> | .,
, 1 | ΓA Ι | BLE | ES | 3 | 6, | ,.
1 | | | |
| 20)
21)
22) | SPE
BEN
MUS
PH | EAR
NZI
SGR
YSI | , R
V
OVE
CS | .H.
. A
, A | : A
ND
.R.
NU | TO
RE
D | M.
FFC
E L | DA
D,
DĂŤ | G
G
A | A
Ť
F0 | ND
CC
AL
R | DN
RE | IUC
I - N
AC | L.
IW/
PR | 10
200
200 | ΟΑ΄
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο
Ο | TA
(1
 | 96
96
NT | AB
9)
₩E | LE
ĊC
LL |) N F | 42 | 2,
01
781 | 55
N N | 5
NE
4 | (1
UT
49 | 98
R0 | 9).
N | - | |
| 23)
24)
25 | KIK
REA
WEN | | HI,
ION
EN
ST | K.
S",
LU
R | AÑ
NO
AND
A | ID
RT
F | KAV
H H
INP | VAI
HOL
K, | ĽA
R. | M.
ND
W.
24 | :
(
19 | "N
19
PH | 1UC
68
1YS | LÉ
). | RE | R Í I
E V | МА
., | LTT
C | ER
4, | A
1 | NE
17 |)
73 | NU(
(1 | CÉE
197 | EA
71 | R
). | | | | |

25) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4840 48-CD-111 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-12 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONART MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.8 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED FOR JENDL-3. FOR JENDL-2, EVALUATION WAS MADE ON THE BASIS OF EXPERIMEN-TAL DATA OF LIOU ET AL./3/ AND WASSON AND ALLEN/4/. THE AVERAGE RADIATION WIDTH WAS ASSUMED TO BE 0.102 EV/3/. SCATTERING RADIUS OF 6.5 FM WAS ASSUMED ON THE BASIS OF SYSTEMATICS OF MEASURED VALUES. FOR JENDL-3, THE LOWEST TWO P-WAVE RESONANCES WERE ADDED ACCORDING TO THE DATA BY ALFIMENKOV ET AL./5/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. PARAMETERS OF A NEGATIVE RESONANCE WERE MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./6/ FOR JENDL-3.2, THE CAPTURE DATA MEASURED AT ORERA OF ORNL WERE RENORMALIZED (FACTOR=1.208)/7/. THE NEUTRON AND/OR RADIATION WIDTH WERE REVISED TO REPRODUCE THE NORMALIZED CAPTURE AREA FOR EACH RESONANCE ABOVE 2.76 EV. WURDECONVED DECONMENTED DECONVERTING THE OF OF ON THE PACE OF OR DECONVERTING CROSS SECTIONS (ADVENT) WINDECONVED DECONMENT (A 9 KEV 100 KEV WURDECONVED DECONMENT (A 9 KEV 100 KEV WERE RENORMALIZED (FACTOR) (A 9 KEV 100 KEV WERE AREA FOR EACH RESONANCE ABOVE 2.76 EV. UNRESOLVED RESONANCE REGION : 1.8 KEV - 100 KEV THE SAME PARAMETER VALUES AS JENDL-2 WERE USED AS INITIAL VALUES. THEN THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY /8/ (SEE MF=3, MT=102) ABOVE 15 KEV AND THOSE MEASURED BY MUSGROVE ET AL./9/ BELOW 15 KEV. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.450E-4, S1 = 3.900E-4, S2 = 0.530E-4, SG = 101.E-4, GG = 0.160 EV, R = 5.763 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S TOTAL 29.013 ELASTIC 5.074 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 23.939 49.9 CAPTURE 23.939 49.9 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/8/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/11/, POENITZ AND WHALEN/12/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /19/. /19/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./20/.

| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 1/2 +
1 0.2454 5/2 +
2 0.3419 3/2 +
3 0.3960 11/2 -
4 0.4166 7/2 +
5 0.6200 5/2 +
6 0.7000 3/2 +
7 0.7540 5/2 +
8 0.8665 3/2 +
9 1.0200 1/2 +
10 1.1300 5/2 +
10 1.1300 5/2 +
11 1.1900 1/2 +
LEVELS ABOVE 1.33 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|---------|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (1.032E-02) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 664 MILLI-BARNS AT 90
KEV MEASURED BY MUSGROVE ET AL./9/ |) |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS</pre> | 5. |
| THE KALBACH'S CONSTANT K (= 107.8) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL
DENSITY PARAMETERS. | - |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 50.00 MB (RECOMMENDED BY FORREST/23/)
(N,ALPHA) 4.52 MB (SYSTEMATICS OF FORREST/23/) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELA
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | S - |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WIT
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND F
OTHER NEUTRON EMITTING REACTIONS.</pre> | H
OR |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 50.01-0.5528E R0 = 5.972 A0 = 0.56 WS = 8.165 RS = 6.594 AS = 0.44 VS0= 5.261 RS0= 5.97 AS0= 0.267 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING | - |

46-PD-108 46-PD-109 1.790E+01 6.460E-01 8.844E-01 7.957E+00 2.600E+00 2.071E+01 6.030E-01 1.194E+01 6.925E+00 1.350E+00 1.880E+01 6.300E-01 1.215E+00 7.897E+00 2.490E+00 46-PD-110 1.671E+01 5.760E-01 1.221E+01 3.609E+00 0.0 1.650E+01 6.300E-01 2.761E+00 5.709E+00 1.250E+00 1.791E+01 5.900E-01 2.444E+01 4.282E+00 0.0 1.955E+01 5.810E-01 6.505E+00 5.835E+00 1.140E+00 47 - AG - 108 47 - AG - 109 47 - AG - 110 47-AG-111 1.812E+01 6.120E-01 3.856E+00 6.132E+00 1.360E+00 1.750E+01 6.300E-01 5.212E-01 7.482E+00 2.610E+00 1.874E+01 5.930E-01 3.762E+00 6.000E+00 1.360E+00 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00 48-CD-109 48-CD-110 48-CD-111 48-CD-112 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.636 FOR CD-111 AND 3.236 FOR CD-112. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
LIOU, H.I., ET AL.: PHYS. REV., C10, 709 (1974).
WASSON, O.A., ALLEN, B.J.: PHYS. REV., C7, 780 (1973).
ALFIMENKOV ET AL.: NUCL. PHYS. REV., C7, 780 (1973).
ALFIMENKOV ET AL.: NUCL. PHYS. REV., C7, 780 (1973).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
ALLEN, B.J. ET AL.: NUCL. SCI. ENG., 82, 230 (1982).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
MUSGROVE, A.R. DE L., ET AL.: "PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978", 449P.
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). FUSIER, D.G. JR. AND GENESSI, L. (1971). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 12) 13) 14) 15) 16) (1971). (1971). 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 17) GILBERI, A. AND CAMERON, A.G.W., GAN. J. THIO., 40, 1410 (1965).
18) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
19) GRUPPELAAR, H.: ECN-13 (1977).
20) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
23) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4843 48-CD-112 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 7 KEV. PARAMETERS WERE TAKEN FROM JENDL-2. FOR JENDL-2, EVALUATION WAS MADE ON THE BASIS OF EXPERIMENTAL DATA OF LIOU ET AL./3/ AND MUSGROVE ET AL./4/ THE AVERAGE RADIATION WIDTH OF S-WAVE RESONANCES WAS ASSUMED TO BE 0.1 EV/3/ BELOW 2.0 KEV, AND TO BE 0.077 EV ABOVE 2.0 KEV. FOR P-WAVE ONES, THE AVERAGE WIDTH OF 0.096 EV/4/ WAS ASSUMED. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./5/ MF UNRESOLVED RESONANCE REGION : 7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./5/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTHS, GG(S) AND GG(P), WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.500E-4, S1 = 4.400E-4, S2 = 0.910E-4, SG(S)= 3.63E-4, SG(P)= 4.24E-4, GG(S)= 0.077 EV, GG(P)= 0.090 EV, R= 5.439 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 9.211 ELASTIC 7.019 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 13.4 2.192 CAPIURE2.19213.4F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILLIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/8/, POENITZ AND WHALEN/9/ AND
SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/10/
ALPHA = HUIZENGA AND IGO/11/
DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. MF = 3/16/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. MT SPIN-PARITY ENERGY(MEV) NO DWBA CAL. GŘ. 0 2 0.0 + 0.6174 * + 1 2 3 1.2230 1.3116 0 2 4 1.4142 4 Ò 5 + 6 1.4682 2 +

| LEVELS | 7
8
9
ABOVE 2. | 1.8697
1.9710
2.0038
047 MEV WERE | 0 +
3 -
2 -
ASSUMED TO 1 | *
BE OVERLAPPING. |
|---|--|---|---|--|
| FOR THE
INELASTI
DWUCK-4
BETA3 =
AL./19/ | LEVELS WI
C SCATTER
CODE/18/.
0.162) WE
AND SPEAR | TH AN ASTERI
ING CROSS SE
DEFORMATIC
RE BASED ON
/20/, RESPEC | SK, THE CONTI
ECTIONS WAS CA
DN PARAMETERS
THE DATA COM
CTIVELY. | RIBUTION OF DIRECT
ALCULATED BY THE
(BETA2 = 0.1863 AND
PILED BY RAMAN ET |
| MT = 102
SPHERICA
CASTHY W
SECTIONS
AND REFF | CAPTURE
L OPTICAL
AS ADOPTE
WERE EST
0/21/ AND | AND STATIST
D. DIRECT A
IMATED ACCOP
NORMALIZED | TICAL MODEL CAND SEMI-DIRE
ND SEMI-DIRE
DING TO THE
TO 1 MILLI-BA | ALCULATION WITH
CT CAPTURE CROSS
PROCEDURE OF BENZI
ARN AT 14 MEV. |
| THE GAMM
REPRODUC
KEV MEAS | A-RAY STR
E THE CAP
URED BY N | ENGTH FUNCTI
TURE CROSS S
USGROVE ET A | ON (4.04E-04
SECTION OF 220
AL./22/ |) WAS ADJUSTED TO
D MILLI-BARNS AT 30 |
| MT = 16 (
MT = 17 (
MT = 22 (
MT = 28 (
MT =103 (
MT =104 (
MT =107 (
THESE RE
PREEQUIL | N,2N) CRC
N,3N) CRC
N,N'A) CR
N,P) CR
N,P) CROS
N,P) CROS
N,T) CROS
N,T) CROS
N,ALPHA)
ACTION CR
IBRIUM AN | SS SECTION
SS SECTION
OSS SECTION
SS SECTION
SSECTION
SSECTION
CROSS SECTION
CROSS SECTION
D MULTI-STEF |)N
3 WERE CALCUL
9 EVAPORATION | ATED WITH THE
MODEL CODE PEGASUS. |
| THE KALB
FORMULA
DENSITY | ACH'S CON
DERIVED F
PARAMETER | ISTANT K (=
ROM KIKUCHI-
IS. | 83.6) WAS ES
KAWAI'S FORM | TIMATED BY THE
ALISM/23/ AND LEVEL |
| FINALLY,
NORMALIŻ
(N,P)
(N,ALP | THE (N,P
ED TO THE
HA) | 2) AND (N,ALF
FOLLOWING \
6.00 MB (RE
3.10 MB (RE | PHA) CROSS SE
(ALUES AT 14.5
COMMENDED BY
COMMENDED BY | CTIONS WERE
5 MEV:
FORREST/24/)
FORREST) |
| MT = 251
CALCULAT | MU-BAR
ED WITH C | ASTHY. | | |
| MF = 4 ANGU
LEGENDRE P
GIVEN IN T
TIC LEVELS
CALCULATED
SCATTERING
ISOTROPIC | LAR DISTR
OLYNOMIAL
HE CENTER
, AND IN
WITH CAS
WAS CALC
DISTRIBUT | IBUTIONS OF
COEFFICIENT
-OF-MASS SYS
THE LABORATO
THY. CONTRI
ULATED WITH
IONS IN THE | SECONDARY NE
S FOR ANGULA
TEM FOR MT=2
RY SYSTEM FO
BUTION OF DI
DWUCK-4. FO
LABORATORY S | UTRONS
R DISTRIBUTIONS ARE
AND DISCRETE INELAS-
R MT=91. THEY WERE
RECT INELASTIC
R OTHER REACTIONS,
YSTEM WERE ASSUMED. |
| MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT | GY DISTRI
TRIBUTION
R INELAST
RON EMITT | BUTIONS OF S
S OF SECONDA
IC SCATTERIN
ING REACTION | ECONDARY NEU
RY NEUTRONS
IG FROM OVERL
IS. | TRONS
WERE CALCULATED WITH
APPING LEVELS AND FOR |
| TABLE 1 NEU | TRON OPTI | CAL POTENTIA | L PARAMETERS | |
| V =
WS =
VSO=
THE FORM O | 50.01-0.
8.165
5.261
F SURFACE | 5528E
ABSORPTION | RO = 5.972
RS = 6.594
RSO= 5.97
PART IS DER. | A0 = 0.56
AS = 0.44
AS0= 0.267
WOODS-SAXON TYPE. |
| TABLE 2 LEV | EL DENSIT | Y PARAMETERS | 3 | |
| NUCLIDE SY | ST A(1/ME | V) T(MEV) | C(1/MEV) | EX(MEV) PAIRING |
| 46 - PD - 108
46 - PD - 109
46 - PD - 110
46 - PD - 111 | 1.790E
2.071E
1.880E
2.143E | +01 6.460E-0
+01 6.030E-0
+01 6.300E-0
+01 5.610E-0 | 01 8.844E-01
01 1.194E+01
01 1.215E+00
01 7.376E+00 | 7.957E+00 2.600E+00
6.925E+00 1.350E+00
7.897E+00 2.490E+00
6.267E+00 1.350E+00 |
| 47 - AG - 109
47 - AG - 110
47 - AG - 111
47 - AG - 112 | 1.650E
1.791E
1.955E
* 1.857E | +01 6.300E-0
+01 5.900E-0
+01 5.810E-0
+01 6.210E-0 | 01 2.761E+00
01 2.444E+01
01 6.505E+00
01 4.959E+01 | 5.709E+00 1.250E+00
4.282E+00 0.0
5.835E+00 1.140E+00
5.129E+00 0.0 |
| 48-CD-110
48-CD-111 | 1.750E
1.874E | +01 6.300E-0 |)1 5.212E-01
)1 3.762E+00 (| 7.482E+00 2.610E+00
6.000E+00 1.360E+00 |

| 48-CD-112 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00
48-CD-113 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 |
|--|
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 3.236 FOR CD-112 AND 5.733 FOR CD-113. |
| REFERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). LIOU, H.I., ET AL.: PHYS. REV., C10, 709 (1974). MUSGROVE, A.R. DE L., ET AL.: J. PHYS. G, 4, 771 (1978). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 |
| 9) POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). 10) PEREY, F.G: PHYS. REV. 131, 745 (1963). 11) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 12) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 13) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971) |
| 14) GILBERI, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). |
| IIJIMA, S., ELAL.: J. NUCL. SCI. LECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J.: PRIVATE COMMUNICATION (1981). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 |
| 20) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989). 21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 22) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978. 449. |
| 23) KIKUCHI, K. AND_KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR |

REACTIONS", NORTH HOLLAND (1968).
 FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4846 48-CD-113 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-AUG93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-08 JENDL-3.2 WAS MADE BY JNDC FPND W.G. (2,151) F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.0 KEV FOR JENDL-2, EVALUATION WAS MADE ON THE BASIS OF THE DATA MEASURED BY LIOU ET AL./3/ THE AVERAGE RADIATION WIDTH OF 0.101 EV/3/ WAS ASSUMED FOR S-WAVE LEVELS. FOR JENDL-3, TO SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. TOTAL UNRESOLVED RESONANCE REGION : 1 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./4/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY ABOVE 10 KEV. BELOW 10 KEV, THE SAME PARAMETERS AS 10 KEV WERE ADOPTED. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.310E-4, S1 = 2.200E-4, S2 = 0.900E-4, SG = 58.4E-4, GG = 0.160 EV, R = 6.739 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL ELASTIC CAPTURE 20670 25.47 20650 395 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/7/, POENITZ AND WHALEN/8/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ WFRF PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (15/. /15/. ΜТ TOTAL 1 SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. NO. GR. SPIN-PARITY 1/2 -11/2 -ENERGY(MEV) 0.0

0.2986 0.3163 0.4596 0.5223 0.5840 0.6810 0.7085 0.8853 0.8836 0.9884 1.008023456789011 11 + + + + 12 13 14 1.1261 15 LEVELS ABOVE 1.195 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (4.63E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 720 MILLI-BARNS AT KEV MEASURED BY MUSGROVE ET AL./18/ 30 T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16 MT = 17 MT = 22 MT = 28 MT = 32 ΜT MT MT MΤ THE KALBACH'S CONSTANT K (= 94.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 10.90 MB (SYSTEMATICS OF FORREST/20/) (N,ALPHA) 2.23 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. ⁼ = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF =MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 50.01-0.5528E R0 = 5.972 A0 = 0.56 WS = 8.165 RS = 6.594 AS = 0.44 VS0= 5.261 RS0= 5.97 AS0= 0.267 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON AS = 0.44ASO = 0.267. TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING - - - -2.071E+01 6.030E-01 1.194E+01 6.925E+00 1.350E+00 1.880E+01 6.300E-01 1.215E+00 7.897E+00 2.490E+00 2.143E+01 5.610E-01 7.376E+00 6.267E+00 1.350E+00 1.821E+01 6.210E-01 5.620E-01 7.654E+00 2.670E+00 46-PD-109 46-PD-110 46-PD-111 46-PD-112 47 - AG - 110 47 - AG - 111 1.791E+01 5.900E-01 2.444E+01 4.282E+00 0.0 1.955E+01 5.810E-01 6.505E+00 5.835E+00 1.140E+00

47-AG-112 * 1.857E+01 6.210E-01 4.959E+01 5.129E+00 0.0 47-AG-113 * 1.837E+01 6.185E-01 5.132E+00 6.321E+00 1.320E+00 1.874E+01 5.930E-01 3.762E+00 6.000E+00 1.360E+00 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 1.910E+01 6.010E-01 5.651E-01 7.611E+00 2.680E+00 48-CD-111 48-CD-112 48-CD-113 48-CD-114 . SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.733 FOR CD-113 AND 3.875 FOR CD-114. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
3) LIOU, H.I., ET AL.: PHYS. REV., C10, 709 (1974).
4) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
5) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
6) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
7) FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). (1971). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9) 10) (11)125 (1971) 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERON, A.G.W.. CAN. J. THIS., 43, 1443 (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) MUSGROVE, A.R. DE L., ET AL.: "PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978", 449.
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4849 48-CD-114 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 8 KEV FOR JENDL-2, EVALUATION WAS MADE ON THE BASIS OF EXPERIMEN-TAL DATA OF LIOU ET AL./3/ AND MUSGROVE ET AL./4/ THE AVERAGE RADIATION WIDTH OF S-WAVE RESONANCES WAS ASSUMED TO BE 0.11 EV/3/ BELOW 2.0 KEV, AND TO BE 0.053 EV ABOVE 2.0 KEV. FOR P-WAVE ONES, THE AVERAGE WIDTH OF 0.082 EV/4/ WAS ASSUMED. FOR JENDL-3, PARAMETERS OF A NEGATIVE RESONANCE AND SCATTERING RADIUS WERE MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./5/ MF UNRESOLVED RESONANCE REGION : 8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./5/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTHS, GG(S) AND GG(P), WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.640E-4, S1 = 3.500E-4, S2 = 0.890E-4, SG(S)= 2.12E-4, SG(P)= 2.80E-4, GG(S)= 0.053 EV, GG(P)= 0.070 EV, R= 5.804 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.240 -TOTAL ELASTIC CAPTURE 5.900 0.3404 17.0 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/8/, POENITZ AND WHALEN/9/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/. /16/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. NO. ENERGY(MEV) SPIN-PARITY DWBA CAL. 0.0 GŔ. 0 2 0 + 1 1.1342 1.2093 3 2 4 + 4 5 + 1.3052 0 +

| 6 1.3639 2 +
7 1.7318 4 +
8 1.7571 1 +
LEVELS ABOVE 1.776 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/18/. DEFORMATION PARAMETER (BETA2 = 0.1912) WAS
BASED ON THE DATA COMPILED BY RAMAN ET AL./19/ |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (2.50E-04) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 150 MILLI-BARNS AT 30
KEV MEASURED BY MUSGROVE ET AL./21/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 76.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 10.00 MB (RECOMMENDED BY FORREST/23/)
(N,ALPHA) 0.70 MB (RECOMMENDED BY FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{ccccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & \text{V} &= 50.01\text{-}0.5528E & \text{RO} &= 5.972 & \text{AO} &= 0.56 \\ & \text{WS} &= 8.165 & \text{RS} &= 6.594 & \text{AS} &= 0.44 \\ & \text{VSO} &= 5.261 & \text{RSO} &= 5.97 & \text{ASO} &= 0.267 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 46-PD-110 1.880E+01 6.300E-01 1.215E+00 7.897E+00 2.490E+00 46-PD-111 2.143E+01 5.610E-01 7.376E+00 6.267E+00 1.350E+00 46-PD-112 * 1.802E+01 6.210E-01 5.620E-01 7.654E+00 2.670E+00 46-PD-113 * 1.800E+01 6.185E-01 4.082E+00 6.206E+00 1.350E+00 |
| 47-AG-111 1.955E+01 5.810E-01 6.505E+00 5.835E+00 1.140E+00 47-AG-112 * 1.857E+01 6.210E-01 4.959E+01 5.129E+00 0.0 47-AG-113 * 1.837E+01 6.185E-01 5.132E+00 6.321E+00 1.320E+00 47-AG-114 * 1.816E+01 6.161E-01 3.785E+01 4.871E+00 0.0 |
| 48-CD-1121.797E+016.190E-016.327E-017.351E+002.500E+0048-CD-1131.973E+015.760E-014.397E+006.018E+001.360E+0048-CD-1141.910E+016.010E-015.651E-017.611E+002.680E+00 |

48-CD-115 2.072E+01 5.570E-01 4.805E+00 5.966E+00 1.360E+00 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.875 FOR CD-114 AND 5.0 FOR CD-115. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) LIOU, H.I., ET AL.: PHYS. REV., C10, 709 (1974).
4) MUSGROVE, A.R. DE L., ET AL.: J. PHYS. G. 4, 771 (1978).
5) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
6) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
7) IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
8) FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971). (1971) (1971). POENITŻ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 9) 10) 11) 13) (1971). 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 14) GIBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
15) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
16) GRUPPELAAR, H.: ECN-13 (1977).
17) LEDERER, C.M., ET AL.: TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
18) KUNZ, P.D.: PRIVATE COMMUNICATION.
19) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
21) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
23) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4855 48-CD-116 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 9 KEV PARAMETERS WERE TAKEN FROM JENDL-2. EVALUATION FOR JENDL-2 WAS MADE ON THE BASIS OF EXPERIMENTAL DATA OF LIOU ET AL./3/ AND MUSGROVE ET AL./4/ THE AVERAGE RADIATIVE CAPTURE WIDTH WAS ASSUMED TO BE 0.047 EV FOR S-WAVE LEVELS AND 0.085 EV FOR P-WAVE ONES/4/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./5/ MF UNRESOLVED RESONANCE REGION : 9 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV THE RADIATION WIDTHS, GG(S) AND GG(P), WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.160E-4, S1 = 2.800E-4, S2 = 0.870E-4, SG(S)= 1.09E-4, SG(P)= 1.62E-4, GG(S)= 0.047 EV, GG(P)= 0.070 EV, R= 6.488 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 6.058 -ELASTIC 5.983 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 0.07484 1.75 CAPIURE 0.07484 1.75
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF
DETERMINED TO REPRODUCE THE CD-NATURAL TOTAL CROSS SECTIONS
MEASURED BY FOSTER AND GLASGOW/8/, POENITZ AND WHALEN/9/ AND
SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/10/
ALPHA = HUIZENGA AND IGO/11/
DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELA
/16/. MF 1 WERE AMÉTÉRS USED SPIN CUT-OFF TO GRUPPELAAR /16/. MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2. = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. ΜТ NO. SPIN-PARITY ENERGY(MEV) DWBA CAL. GR. 0.0 0 2 + 1 + 1.2130 2 2 + 1.2190 3 4 2 4 5 1.3610 0 + LEVELS ABOVE 1.644 MEV WERE ASSUMED TO BE OVERLAPPING.

FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/18/. DEFORMATION PARAMETER (BETA2 = 0.1907) WAS BASED ON THE DATA COMPILED BY RAMAN ET AL./19/ . = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BĔŇZI THE GAMMA-RAY STRENGTH FUNCTION (1.35E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 90 MILLI-BARNS AT 3 KEV MEASURED BY MUSGROVE ET AL./21/ 30 T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT = 17MT = 22MT = 28MT =103 MT =104 MT =105 MT =107 THESE THE KALBACH'S CONSTANT K (= 76.2) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) CROSS SECTION WAS NORMALIZED TO THE FOLLOWING VALUE AT 14.5 MEV: (N,P) 2.50 MB (RECOMMENDED BY FORREST/23/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - -- - -- - - - - - - -R0 = 5.972V = 50.01-0.5528E A0 = 0.56WS = 8.165 VS0= 5.261 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON AS = 0.44ASO = 0.267TYPE. TABLE 2 LEVEL DENSITY PARAMETERS C(1/MEV) EX(MEV) NUCLIDE SYST A(1/MEV) T(MEV) PAIRING 46-PD-112 * 1. 46-PD-113 * 1 1.821E+01 6.210E-01 5.620E-01 7.654E+00 2.670E+00 1.800E+01 6.185E-01 4.082E+00 6.206E+00 1.350E+00 1.779E+01 6.161E-01 5.463E-01 7.226E+00 2.500E+00 1.758E+01 6.137E-01 3.052E+00 5.945E+00 1.350E+00 46-PD-113 * 46-PD-114 * 46-PD-115 * 1.837E+01 6.185E-01 5.132E+00 6.321E+00 1.320E+00 * 1.816E+01 6.161E-01 3.785E+01 4.871E+00 0.0 * 1.795E+01 6.137E-01 5.063E+00 5.891E+00 1.150E+00 * 1.773E+01 6.113E-01 2.869E+01 4.609E+00 0.0 47 - AG - 113 47 - AG - 114 47-AG-115 47-AG-116 1.910E+01 6.010E-01 5.651E-01 7.611E+00 2.680E+00 2.072E+01 5.570E-01 4.805E+00 5.966E+00 1.360E+00 1.990E+01 5.750E-01 6.265E-01 7.206E+00 2.510E+00 2.107E+01 5.620E-01 6.164E+00 6.181E+00 1.360E+00 48-CD-114 48-CD-115 48-CD-116 48-CD-117 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE

ASSUMED TO BE 3.925 FOR CD-116 AND 5.0 FOR CD-117.

- REFERENCES

 AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 LIOU, H.I., ET AL.: PHYS. REV., C10, 709 (1974).
 MUSGROVE, A.R. DE L., ET AL.: J. PHYS. G, 4, 771 (1978).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 FOSTER, D.G. JR. AND GLASGOW, D. W.: PHYS. REV., C3, 576 (1971).
- 9) 10)
- 11) 12) 13)
- (1971). POENITZ, W.P. AND WHALEN, J.F.: ANL-NDM-80 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
- (1971) 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 15) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 16) GRUPPELAAR, H.: ECN-13 (1977).
 17) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
 18) KUNZ, P.D.: PRIVATE COMMUNICATION.
 19) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987).
 20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 21) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
 22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 23) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4925 49-IN-113 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 830 EV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH AND SCATTERING RADIUS WERE TAKEN FROM MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 830 EV - 100 KEV THE NEUTRON STRENGTH FUNCTION, SO, WAS BASED ON MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING AND SO WERE ADJUSTED TO REPRODUCE THE CAPTURE AND TOTAL CROSS SECTIONS CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.840E-4, S1 = 2.700E-4, S2 = 0.770E-4, SG = 126.E-4, GG = 0.075 EV, R = 5.496 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 15.75 ELASTIC 3.679 TOTAL ELASTIC CAPTURE 12.07 325 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. MF /13/ MT = TOTAL SPHERICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. МТ NO ENERGY(MEV) SPIN-PARITY 9/2 + 1/2 -3/2 -0.0 0.3917 0.6468 GŔ. 1 1.0242 5/2 1/2 3 4 + 3/2 +5 1.0642

1.1064 5/2 5/2 17/2 13/2 13/2 2/2 1/2 2/2 1/2 2/267 89 10 11 12 13 14 5 1.1004 1.1315 1.1731 1.1911 1.3448 1.3510 1.3807 + + + + + - $\begin{array}{c} 1.3007\\ 1.4718\\ 1.5094\\ 1.5361\\ 1.5670\\ 1.5695\\ 1.6305\\ 1.6305\end{array}$ + 16 17 + 18 19 20 21 22 1.6882 1.7000 1.7070 1.7580 + + + 23 24 1.7680 LEVELS ABOVE 1.836 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (125.E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 290 MILLI-BARNS AT 500 KEV MEASURED BY GRENCH AND MENLOVE/17/. MT = MT MT MT MT МŤ ΜT МΤ MŤ МŤ МŤ THE KALBACH'S CONSTANT K (= 151.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1600.00 MB (RECOMMENDED BY BYCHKOV+/19/) (N,P) 24.50 MB (SYSTEMATICS OF FORREST/20/) (N,ALPHA) 4.99 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY/4/. ^E = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - - - - -- - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 47-AG-109
 1.650E+01
 6.300E-01
 2.761E+00
 5.709E+00
 1.250E+00

 47-AG-110
 1.791E+01
 5.900E-01
 2.444E+01
 4.282E+00
 0.0

 47-AG-111
 1.955E+01
 5.810E-01
 6.505E+00
 5.835E+00
 1.140E+00

 * 1.857E+01 6.210E-01 4.959E+01 5.129E+00 0.0 47 - AG - 112 1.750E+01 6.300E-01 5.212E-01 7.482E+00 2.610E+00 1.874E+01 5.930E-01 3.762E+00 6.000E+00 1.360E+00 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 48-CD-110 48-CD-111 48-CD-112 48-ČD-113 1.948E+01 6.234E-01 1.096E+01 6.793E+00 1.250E+00 1.743E+01 5.090E-01 7.808E+00 2.779E+00 0.0 1.885E+01 5.070E-01 1.371E+00 4.280E+00 1.140E+00 1.632E+01 5.290E-01 6.292E+00 2.752E+00 0.0 49-IN-111 49-IN-112 49-IN-113 49-IN-114 - - - - - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.604 FOR IN-113 AND 5.0 FOR IN-114. REFERENCES REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 7) ۶ì 9) 10) 11) ĠİĽBĖŔŤ, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IIJIMA, (1965).
12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEETS, 33, 1 (1981).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) GRENCH, H.A. AND MENLOVE, H.O.: PHYS. REV., 165, 1298 (1968).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 4931 49-IN-115 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MODIFIED PARTS FOR JENDL-3.2
(2,151)
UNRESOLVED RESONANCE PARAMETERS RE-ADJUSTED
SO AS TO REPRODUCE THE RE-NORMALIZED CAPTURE
CROSS SECTION.
(3,102)
RE-NORMALIZATION.
(3,2), (3,4), (3,51-91) AND ANGULAR DISTRIBUTIONS
SMALL EFFECTS OF THE RE-NORMALIZATION OF
CAPTURE CROSS SECTION. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS: FOR JENDL-2, PARAMETERS WERE TAKEN FROM THE EXPERIMENT BY HACKEN ET AL./3/ ANGULAR MOMENTUM L AND SPIN J WERE BASED ON THE MEASUREMENT OF CORVI AND STEFANON/4/. THE AVERAGE RADIATION WIDTH OF 0.085 EV WAS DEDUCED /3/ AND APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. FOR JENDL-3, TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVE-LY ESTIMATED WITH A RANDOM NUMBER METHOD. UNRESOLVED RESONANCE REGION : 2 KEV - 100 KEV PARAMETERS WERE TAKEN FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./6/ TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.760E-4, S1 = 2.700E-4, S2 = 0.760E-4, SG = 95.0E-4, GG = 0.077 EV, R = 5.539 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES 6. INTEGRALS (BARNS) RES. INTEG. 203.5 2.526 TOTAL ELASTIC CAPTURE CAPTURE 201.0 3210 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAARR /15/. 201.0 3210 MF = 3TOTAL MT SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. T = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. MT = ADOPTED. NO. ENERGY(MEV) SPIN-PARITY 9/2 + 1/2 - 3/2 + 3/2 + 1/20.0 GŔ. 1 0.3362 0.5970 0.8284 0.8640 0.9336 0.9412 1.0780 2 3 4 1/2 7/2 5/2 11/2 13/2 9/2 9/2 9/2 56789 7 1.0780 5/2 + 8 1.1325 11/2 + 9 1.2905 13/2 + 10 1.4180 9/2 + 11 1.4487 9/2 + 12 1.4625 7/2 + 13 1.4858 9/2 + LEVELS ABOVE 1.5 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (9.37E-03) WAS ADJUSTED TO REPRODUCE THE NATURAL IN CAPTURE CROSS SECTION OF 460 MILLI-BARNS AT 80 KEV MEASURED BY KOMPE /18/, SHORIN ET AL./19/ AND KONONOV ET AL./20/ THE KALBACH'S CONSTANT K (= 138.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/21/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 8.00 MB (RECOMMENDED BY FORREST/22/) (N,ALPHA) 2.40 MB (RECOMMENDED BY FORREST) THE (N,2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF THE DATA MEASURED BY SANTRY ET AL./23/ MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. ME = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - -TABLE 2 LEVEL DENSITY PARAMETERS
NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 47-AG-111
 1.955E+01
 5.810E-01
 6.505E+00
 5.835E+00
 1.140E+00

 47-AG-112
 *
 1.857E+01
 6.210E-01
 4.959E+01
 5.129E+00
 0.0

 47-AG-113
 *
 1.837E+01
 6.185E-01
 5.132E+00
 6.321E+00
 1.320E+00

 47-AG-114
 *
 1.816E+01
 6.161E-01
 3.785E+01
 4.871E+00
 0.0

 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 1.910E+01 6.010E-01 5.651E-01 7.611E+00 2.680E+00 2.072E+01 5.570E-01 4.805E+00 5.966E+00 1.360E+00 48-CD-112 48-CD-113 48-CD-114 48-CD-115 1.885E+01 5.070E-01 1.371E+00 4.280E+00 1.140E+00 1.632E+01 5.290E-01 6.292E+00 2.752E+00 0.0 1.600E+01 6.510E-01 2.555E+00 5.941E+00 1.320E+00 1.710E+01 5.650E-01 1.250E+01 3.562E+00 0.0 49-IN-113 49-IN-114 49-IN-115 49-IN-116 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.461 FOR IN-115 AND 5.0 FOR IN-116. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
3) HACKEN, G., ET AL.: PHYS. REV., C10, 1910 (1974).
4) CORVI, F. AND STEFANON, M.: NUCL. PHYS. A233, 185 (1974).
5) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
6) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
7) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
8) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 8) IIJIMA, S. AND NAWAI, W. J. HOLL C. (1983).
9) PEREY, F.G. PHYS. REV. 131, 745 (1963).
10) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
11) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
12) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 13) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FILLS., 40, 110 (1965).
14) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KOMPE, D.: NUCL. PYS., A133, 513 (1969).
19) SHORIN, V.S., ET AL.: YADERNYA FIZIKA, 19, 5 (1974).
20) KONONOV, V.N. ET AL.: YADERNYA KONSTANTY, 22, 29 (1977).
21) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
22) FORREST, R.A.: AERE-R 12419 (1986).
23) SANTRY, D.C., ET AL.: CAN. J. PHYS., 54, 757 (1976)

MAT number = 5025 50-SN-112 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.5 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGE RADIATION WIDTH WAS 110 MEV/2/. SCATTERING RADIUS OF 6.3 FM WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 1.5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.300E-4, S1 = 2.700E-4, S2 = 0.780E-4, SG = 4.11E-4, GG = 0.110 EV, R = 5.896 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 5.597 ELASTIC 4.588 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 30.5 1.009 CAPIURE1.00930.5F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY/4/, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S
FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/7/
ALPHA = HUIZENGA AND IGO/8/
DEUTERON = LOHR AND HAEBERLI/9/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/13/. MF = 3/13/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). " = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. ENERGY(MEV) SPIN-PARITY NO. 0.0 1.2570 GŘ. 022 + + 2.1513 2.1909 +

ō

4 +

+

3

4

2.2479

2.3550 2.4762 2.5214 2.5214 2.5560 2.5566 2.6180 2.9136 2.9264 2.9264 2.9460 2.9460 2.9460 3.2485 3.2780 3.2780 3.28655678900 1011234567 11234567 11234567 11234567 11234577 11234577 11234577 11234577 11234577 11234577 11234577 1 32 + 4 6722244 + + 6 422422 2Õ 21 22 23 42 LEVELS ABOVE 3.292 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (3.79E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 220 MILLI-BARNS AT 25 KEV MEASURED BY BRADLEY ET AL./17/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =106 (N,HE3) CROSS SECTION T =106 (N,ALPHA) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION T =111 (N,2P) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = MT MT MT MT МŤ ΜT МΤ MŤ MT THE KALBACH'S CONSTANT K (= 146.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1200.00 MB (RECOMMENDED BY BYCHKOV+/19/) (N,P) 30.00 MB (RECOMMENDED BY FORREST/20/) (N,ALPHA) 13.90 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) $\begin{array}{ccccccc} V &= 47.64 \text{-}0.473\text{E} & \text{R0} &= 6.256 & \text{A0} &= 0.62 \\ \text{WS} &= 9.744 & \text{RS} &= 6.469 & \text{AS} &= 0.35 \\ \text{VS0} &= 7.0 & \text{RS0} &= 6.241 & \text{AS0} &= 0.62 \\ \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

1.541E+01 6.900E-01 5.114E-01 7.655E+00 2.600E+00 1.812E+01 6.120E-01 3.856E+00 6.132E+00 1.360E+00 1.750E+01 6.300E-01 5.212E-01 7.482E+00 2.610E+00 1.874E+01 5.930E-01 3.762E+00 6.000E+00 1.360E+00 48-CD-108 48-CD-109 48-CD-110 48-CD-111 * 1.984E+01 6.282E-01 1.463E+01 7.031E+00 1.240E+00 * 1.966E+01 6.258E-01 9.269E+01 5.668E+00 0.0 * 1.948E+01 6.234E-01 1.096E+01 6.793E+00 1.250E+00 1.743E+01 5.090E-01 7.808E+00 2.779E+00 0.0 49-IN-109 49-IN-110 49-IN-111 49-IN-112 2.002E+01 6.258E-01 2.291E+00 8.241E+00 2.430E+00 1.496E+01 6.610E-01 2.129E+00 5.516E+00 1.190E+00 1.463E+01 6.680E-01 3.016E-01 6.730E+00 2.440E+00 1.635E+01 5.980E-01 1.778E+00 5.033E+00 1.190E+00 50-SN-110 50-SN-111 50-SN-112 50-SN-113 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.907 FOR SN-112 AND 5.0 FOR SN-113. REFERENCES (EFERENCES)
(AWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
(2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
(3) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
(4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
(5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
(6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
7) PEREY, F.G. PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 11) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. PHYS., 43, 1440 (1965).
12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEETS, 29, 587 (1980).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) BRADLEY, T., ET AL.: PROC. INT. CONF. NUCLEAR CROSS SECTIONS FOR TECHNOLOGY, KNOXVILLE 1979, P.344 (1980).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) BYCHKOV, V.M. ET AL.: AERE-R 12419 (1986).

MAT number = 5031 50-SN-114 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.5 KEV RESONANCE PARAMETERS WERE MAINLY BASED ON MUGHABGHAB ET AL./2/ THE LEVELS WHOSE NEUTRON WIDTH WAS UNKNOWN WERE ASSUMED TO BE P-WAVE RESONANCES, AND A REDUCED NEUTRON WIDTH OF 0.082 EV WAS TENTATIVELY GIVEN FOR THOSE LEVELS. AVERAGE RADIATION WIDTH OF 0.090 EV AND SCATTERING RADIUS OF 6.3 FM WERE TAKEN FROM MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 2.5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.200E\text{-}4, \ S1 = 2.700E\text{-}4, \ S2 = 0.760E\text{-}4, \ SG = 3.00E\text{-}4, \\ GG = 0.090 \ \text{EV}, \ R = 5.953 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 4.671 -ELASTIC 4.546 -CAPTURE 0.1253 6.67 CAPTURE 0.1253 6.67 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HEIIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA STŘUCTUKE SHEETS/14/ ENERGY(MEV) NO. SPIN-PARITY 0.0 GŘ. 0 2 + + 1 2 3 1.9532 2.1550 2.1875 2.2392 2.2747 ō Õ + 42 4 5 + 6 3

| 7 2.4220 8 2.4543 9 2.5147 10 2.57650 11 2.6143 12 2.7656 13 2.8151 14 2.8599 15 2.9051 16 2.9140 17 2.9435 18 3.0270 19 3.1840 22 3.1884 23 3.1903 24 3.2040 25 3.2078 26 3.2259 LEVELS ABOVE 3.244 | 0 +
2 +
2 +
2 +
2 +
3 4 +
2 +
5 -
4 +
2 +
5 -
4 +
2 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
0 +
2 +
2 +
0 +
0 +
0 +
0 +
0 +
0 +
0 +
0 |
|--|---|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND S
CASTHY WAS ADOPTED. DI
SECTIONS WERE ESTIMATED
AND REFF0/15/ AND NORMA | TATISTICAL MODEL CALCULATION WITH
RECT AND SEMI-DIRECT CAPTURE CROSS
ACCORDING TO THE PROCEDURE OF BENZI
LIZED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH
THE RADIATION WIDTH (O.
RESONANCE LEVEL SPACING
DENSITY PARAMETERS. | FUNCTION (2.71E-04) WAS DETERMINED FROM
09+-0.03 EV/2/) AND THE AVERAGE S-WAVE
G (330 EV) CALCULATED FROM THE LEVEL |
| $\begin{array}{llllllllllllllllllllllllllllllllllll$ | TION
TION
CTION
CTION
TION
TON
TON
SECTION
SECTION
SECTION
SECTIONS WERE CALCULATED WITH THE
T-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT
FORMULA DERIVED FROM KI
DENSITY PARAMETERS. | K (= 175.9) WAS ESTIMATED BY THE
KUCHI-KAWAI'S FORMALISM/16/ AND LEVEL |
| FINALLY, THE (N,P) AND
NORMALIZED TO THE FOLLO
(N,P) 38.50
(N,ALPHA) 7.55 | (N,ALPHA) CROSS SECTIONS WERE
WING VALUES AT 14.5 MEV:
MB (SYSTEMATICS OF FORREST/17/)
MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIO
LEGENDRE POLYNOMIAL COEFF
GIVEN IN THE CENTER-OF-MA
TIC LEVELS, AND IN THE LA
CALCULATED WITH CASTHY.
BUTIONS IN THE LABORATORY | DNS OF SECONDARY NEUTRONS
FICIENTS FOR ANGULAR DISTRIBUTIONS ARE
ASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
BORATORY SYSTEM FOR MT=91. THEY WERE
FOR OTHER REACTIONS, ISOTROPIC DISTRI-
Y SYSTEM WERE ASSUMED. |
| MF = 5 ENERGY DISTRIBUTION
ENERGY DISTRIBUTIONS OF S
PEGASUS FOR INELASTIC SCA
OTHER NEUTRON EMITTING RE | IS OF SECONDARY NEUTRONS
SECONDARY NEUTRONS WERE CALCULATED WITH
ITTERING TO OVERLAPPING LEVELS AND FOR
ACTIONS. |
| TABLE 1 NEUTRON OPTICAL PO | TENTIAL PARAMETERS |
| DEPTH (MEV) $V = 47.64-0.473E$ $WS = 9.744$ $VSO = 7.0$ $THE FORM OF SURFACE ABSOR$ $TABLE 2 I EVEL DENSITY PARA$ | RADIUS(FM) DIFFUSENESS(FM)
R0 = 6.256 A0 = 0.62
RS = 6.469 AS = 0.35
RS0= 6.241 AS0= 0.62
RTION PART IS DER. WOODS-SAXON TYPE. |
| NUCLIDE SYST A(1/MEV) T(| MEV) C(1/MEV) EX(MEV) PAIRING |

1.750E+01 6.300E-01 5.212E-01 7.482E+00 2.610E+00 1.874E+01 5.930E-01 3.762E+00 6.000E+00 1.360E+00 1.797E+01 6.190E-01 6.327E-01 7.351E+00 2.500E+00 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 48-CD-110 48-CD-111 48-CD-112 48-CD-113 49-IN-111 49-IN-112 49-IN-113 49-IN-114 1.948E+01 6.234E-01 1.096E+01 6.793E+00 1.250E+00 1.743E+01 5.090E-01 7.808E+00 2.779E+00 0.0 1.885E+01 5.070E-01 1.371E+00 4.280E+00 1.140E+00 1.632E+01 5.290E-01 6.292E+00 2.752E+00 0.0 1.463E+01 6.680E-01 3.016E-01 6.730E+00 2.440E+00 1.635E+01 5.980E-01 1.778E+00 5.033E+00 1.190E+00 1.515E+01 6.270E-01 2.438E-01 6.175E+00 2.330E+00 1.567E+01 5.540E-01 7.229E-01 4.100E+00 1.190E+00 50-SN-112 50-SN-113 50-SN-114 50-SN-115 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.548 FOR SN-114 AND 7.437 FOR SN-115. REFERENCES (EFERENCES)
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 6) 8) 9) W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) GILBERT, A. AND CAMERUN, A.G.W.. CAN. S. THOO, 10, 1965).
11) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 35, 375 (1982).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5034 50-SN-115 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.95 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAI SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. AVERAGED RADIATION WIDTH OF 85 MEV AND SCATTERING RADIUS OF 6.3 FM WERE ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. MF TOTAL

UNRESOLVED RESONANCE REGION : 0.95 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./2/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.300E-4, S1 = 2.700E-4, S2 = 0.750E-4, SG = 22.6E-4, GG = 0.085 EV, R = 5.873 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 38.22 ELASTIC 8.370 CAPTURE 29.85 13.8

MF

CAPTURE 29.85 13.8 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/6/
ALPHA = HUIZENGA AND IGO/7/
DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/. MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/.

/12/

MT = TOTAL

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2

' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MТ

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 1/2 + |
| 1 | 0.4973 | 3/2 + |
| 2 | 0.6128 | 7/2 + |
| 3 | 0.7134 | 11/2 - |
| 4 | 0.9865 | 5/2 + |
| 5 | 1.2801 | 3/2 + |

| 6 1.4168 5/2 +
7 1.6338 3/2 +
8 1.7339 5/2 +
9 1.7856 7/2 -
10 1.8250 3/2 +
11 1.8575 7/2 +
12 1.9440 11/2 -
13 1.9640 1/2 +
14 1.9738 1/2 +
15 2.0246 15/2 -
16 2.0601 5/2 +
LEVELS ABOVE 2.084 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (20.9E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 200 MILLI-BARNS AT 100
KEV MEASURED BY TIMOKHOV ET AL./16/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 194.4) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 28.00 MB (SYSTEMATICS OF FORREST/18/)
(N,ALPHA) 5.49 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV)
V = 47.64-0.473E
WS = 9.744
VSO = 7.0
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDEA(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING48-CD-1111.874E+015.930E-013.762E+006.000E+001.360E+0048-CD-1121.797E+016.190E-016.327E-017.351E+002.500E+0048-CD-1131.973E+015.760E-014.397E+006.018E+001.360E+0048-CD-1141.910E+016.010E-015.651E-017.611E+002.680E+00 |
| 49-IN-1121.743E+015.090E-017.808E+002.779E+000.049-IN-1131.885E+015.070E-011.371E+004.280E+001.140E+0049-IN-1141.632E+015.290E-016.292E+002.752E+000.049-IN-1151.600E+016.510E-012.555E+005.941E+001.320E+00 |

| 50
50
50 | - SN - 113
- SN - 114
- SN - 115
- SN - 116 | 1.635E+01 5.980E-01 1.778E+00 5.033E+00 1.190E+00
1.515E+01 6.270E-01 2.438E-01 6.175E+00 2.330E+00
1.567E+01 5.540E-01 7.229E-01 4.100E+00 1.190E+00
1.529E+01 6.680E-01 3.763E-01 7.111E+00 2.510E+00 |
|--|---|--|
| SP
IN
ASS | IN CUTOFF
THE CASTH
SUMED TO B | PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
Y CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
E 7.437 FOR SN-115 AND 6.125 FOR SN-116. |
| REFI
1)
2)
3)
4)
5) | ERENCES
KAWAI, M.
AND TECHN
MUGHABGHA
PART A",
IGARASI,
IJJIMA, S
IJJIMA, S
(1983) | ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
OLOGY, MITO, P. 569 (1988).
B, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
ACADEMIC PRESS (1981).
S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
. ET AL.: JAERI-M 87-025, P. 337 (1987).
. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 |
| 6)
7)
8)
9) | LOHR, J.M
BECCHETTI
PHENOMENA
W. HAEBER
(1971). | G: PHYS. REV. 131, 745 (1963).
J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
LI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. |
| 10) | GILBERT,
(1965). | A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 |
| 11)
12)
13)
14)
15)
16)
17)
18) | IIJIMA, S
GRUPPELAA
ENSDF: EV
NUCLEAR D
BENZI, V.
TIMOKHOV,
KIKUCHI,
REACTIONS
FORREST, | ., EI AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
R, H.: ECN-13 (1977).
ALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
ATA SHEETS, 30, 413 (1980).
AND REFFO, G.: CCDN-NW/10 (1969).
V.M., ET AL.: FEI-1921 (1988).
K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
", NORTH HOLLAND (1968).
R.A.: AERE-R 12419 (1986). |

MAT number = 5037 50-SN-116 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2 KEV RESONANCE PARAMETERS AND SCATTERING RADIUS WERE BASED ON MUGHABGHAB ET AL./2/ THE LEVEL AT 779 EV WHOSE NEUTRON WIDTH WAS UNKNOWN WAS ASSUMED TO BE A P-WAVE RESONANCE, AND A REDUCED NEUTRON WIDTH OF 160 MEV WAS TENTATIVELY GIVEN FOR THIS LEVEL. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS /3/. AVERAGE RADIATION WIDTH OF 80 MEV WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLEI. MF UNRESOLVED RESONANCE REGION : 2 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED GG FOR NEIGHBORING NUCLIDES. MEASURED GG FOR NEIGHBORING NUCLIDES TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.740E-4, S1 = 2.700E-4, S2 = 0.740E-4, SG = 1.79E-4, GG = 0.080 EV, R = 5.567 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 4.439 ELASTIC 4.312 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 0.1277 12.4 CAPTURE 0.1277 12.4 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. MF /13/ MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS /15/. ΜТ NO ENERGY(MEV) SPIN-PARITY 0.0 1.2935 1.7568 GŔ. 0 2 0 + 1 + 2.0273 3 + 022 4 + 2.2253 5 +

| 6 2.2661 3 -
7 2.3659 5 -
8 2.3908 4 +
9 2.3922 4 +
10 2.5291 4 +
LEVELS ABOVE 2.546 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.66E-04) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 85 MILLI-BARNS AT 40
KEV MEASURED BY MACKLIN AND GIBBONS/17/ |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 179.7) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 20.40 MB (SYSTEMATICS OF FORREST/19/)
(N,ALPHA) 3.95 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{ccccc} V &= 47.64 - 0.473E & R0 &= 6.256 & A0 &= 0.62 \\ WS &= 9.744 & RS &= 6.469 & AS &= 0.35 \\ VS0 &= 7.0 & RS0 &= 6.241 & AS0 &= 0.62 \\ THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. \end{array}$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| A A |
| 49-IN-1131.885E+015.070E-011.371E+004.280E+001.140E+0049-IN-1141.632E+015.290E-016.292E+002.752E+000.049-IN-1151.600E+016.510E-012.555E+005.941E+001.320E+0049-IN-1161.710E+015.650E-011.250E+013.562E+000.0 |
| 50-\$N-1141.515E+016.270E-012.438E-016.175E+002.330E+0050-\$N-1151.567E+015.540E-017.229E-014.100E+001.190E+0050-\$N-1161.529E+016.680E-013.763E-017.111E+002.510E+0050-\$N-1171.583E+015.960E-011.352E+004.804E+001.190E+00 |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). |

IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.125 FOR SN-116 AND 5.375 FOR SN-117. REFERENCES 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). 2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). 3) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). 4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). 5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 7) PEREY, F.G: PHYS. REV. 131, 745 (1963). 8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. 29, 462 (1962). 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. 29, 462 (1962). 10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 12) IIJIMA, S. ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 13) GRUPPELAAR, H.: ECN-13 (1977). 14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). 15) NUCLEAR DATA SHEEFS, 32. 287 (1981). 16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 17) MACKLIN, R.L. AND GBEONS, J.H.: TAKEN FROM EXFORT1981(1964). 18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). 19) FORREST, R.A.: AERE-R 12419 (1986). MAT number = 5040 50-SN-117 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MODIFIED PARTS FOR JENDL-3.2
(2,151)
UNRESOLVED RESONANCE PARAMETERS RE-ADJUSTED
SO AS TO REPRODUCE THE RE-NORMALIZED CAPTURE
CROSS SECTION.
(3,102)
RE-NORMALIZATION.
(3,2), (3,4), (3,51-91) AND ANGULAR DISRIBUTIONS
SMALL EFFECTS OF THE RE-NORMALIZATION OF
CAPTURE CROSS SECTION. * * * * * MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.35 KEV RESONANCE PARAMETERS WERE MAINLY BASED ON MUGHABGHAB ET AL. /2/ NEW DATA MEASURED BY ALFIMENKOV ET AL./3/ WERE ALSO CONSIDERED. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/4/. AVERAGED RADIATION WIDTH OF 74 MEV WAS DEDUCED AND APPLIED TO THE LEVELS WHOSE RADIA-TION WIDTH WAS UNKNOWN. SCATTERING RADIUS OF 6.1 FM WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBOR-ING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. MF = 2

UNRESOLVED RESONANCE REGION : 2.35 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION S1 WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING AND S0 WERE DETERMINED TO REPRODUCE THE CAPTURE AND TOTAL CROSS SECTIONS CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.499E-4, S1 = 3.000E-4, S2 = 0.730E-4, SG = 15.6E-4, GG = 0.080 EV, R = 5.582 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEGRALS INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 5.104 2.173 18.2

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF ILJIMA-KAWAI POTENTIAL/7/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY ILJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. MF

/14/.

MT = 1

T = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/15/ AND NUCLEAR DATA SHEETS /16/.

| | LEVEL | NO.
GR.
234
567
89
10
11
12
S AI | BOVE | EN
00
00
11
11
11
11
11
11 | ERG
. 0
. 15
. 31
. 71
. 00
. 41
. 49
. 57
. 66
. 77
48 | Y(M
86
46
45
996
43
672
880
00
MEV | EV)
WE | RE | S
1
AS | P1/22/22/22/22/22/22/22/22/22/22/22/22/22 | I - P + + + + + + + + + + + + + + + + + + | PAR | О В | Е (| DVE | RLAF | PPII | NG. | | |
|---|--|---|---|--|--|---|---|---------------------------------|--------------------------------------|---|---|----------------------------|---------------------------------------|------------------------------|---|-------------------------------------|------------------------------------|------------------------|-------------------------------------|-----------|
| MT =
SF
C/
SF | = 102
PHERIC
ASTHY
ECTION
ND REF | CAL
WAS
IS WI
FO/ | PTURE
OPTIC
ADOF
ERE E
17/ A | AL
TED
STI | AND
MAT
NOR | ST
DIR
ED
MAL | ATI
ECT
ACC
IZE | ST
Al
ORI
D | ICA
ND
DIN
TO | L N
SEN
G T
1 N | 10D
11 -
0
11 L | DEL
DI
TH | CA
REC
E P
- BA | LCI
T (
RO(
RN | JLA
CAP
CEDU
AT | TION
TURN
JRE
14 | N W
E CI
OF
ME | ITH
ROS
BE
V. | S
NZ I | |
| T I
R I
K I | HE GAN
EPRODU
EV MEA | IMA - <u>I</u>
ICE
SURI | RAY S
THE C
ED BY | STRE
CAPT
(TI | NGT
URE
MOK | H F
CR
HOV | UNC
OSS
ET | TI(
SI
AI | ON
ECT
L./ | (1.
ION
18/ | 50
 0 |)4E
)F | -3)
167 | W A
M I | AS /
ILL | ADJI
I-B/ | JSTI
ARN: | ED
S A | T0
T 90 |) |
| MT =
MT =
MT =
MT =
MT =
MT =
MT =
T
PF | = 16
= 17
= 22
= 28
= 32
= 103
= 104
= 105
= 107
HESE F
REEQUI | (N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;
(N, ;)))))))))))))))))))))))))))))))))))) | 2N) C
3N) C
N'A)
N'P)
P) C
P) C
F
D) C
F
ALPHA
TION
RIUM | CROSS
CROCOSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CCROSS
CC | S S S S S S S S S S S S S S S S S S S | ECT
SECC
SECC
CTI
SEC
CTI
SEC
LTI | I ON
I ON
T I O
T I O
ON
ON
ECTO
T I O
S
T I O | N
N
N
N
S
E
P | N
WE
EV | RE | C A
DR A | | ULA
ON | TED |) W
DEL | ITH
COI | THI
DE I | EPEG | ASUS | δ. |
| TI
F(
DI | HE KAL
DRMULA
ENSITY | BACI
DEI
PAI | H'S C
RIVED
RAMET | CONS
) FR
TERS | TAN
OM | Т К
КІК | (=
UCH | 16
 - | 67.
KAW | 9)
Al' | W A
S | S
F0 | EST
RMA | IMA
LIS | ATEI
SM/ |) В`
19/ | Y TI
ANI | HE
D L | EVEL | - |
| F
N(| INALLY
DRMALI
(N,P)
(N,AL | ŹED
PHA | HE (N
To T
) | N,P)
THE
14
2 | AN
FOL
.00 | D (
LOW
M | N,A
ING
B (
B (| LPH
V/
ME/
SYS | HA)
ALU
ASU
STE | CF
ES
RED
MAT | AT
AT
B | S
Y
S | SEC
4.5
IKE
OF | TIC
ME
DA+
FOF | ONS
EV:
F/2(
RRES | WEF
(/)
ST/2 | RE
21/ |) | | |
| MT =
C/ | = 251
Alcula | MU | -BAR
WITH | I CA | STH | Υ. | | | | | | | | | | | | | | |
| MF = 4
LEGE
GIVE
TIC
CALC
BUT | 4 ANG
ENDRE
EN IN
LEVEL
CULATE
IONS I | ULAI
POL
THE
S, J
D W
N TI | R DIS
YNOMI
CENT
AND I
ITH C
HE LA | STRI
AL
ER-
N
CAST
ABOR | BUT
COE
OF -
HE
HY
ATO | ION
FFI
MAS
LAB
F
RY | S O
CIE
S S
ORA
OR
SYS | F
NTS
YS
TOF
OTF | SEC
SF
TEM
RY
HER
W W | OND
OR
FC
SYS
RE
ERE | AR
AN
R
TE
AC | Y
IGU
MT
TI
SS | NEU
LAR
=2
FOR
ONS
UME | TRC
DI
ANE
M1
D. |) NS
 ST
) D
 9
 SO | RIBI
ISCI
1.
TROI | JTI(
RETI
THI
PIC | ONS
E I
EY
DI | ARE
NEL <i>A</i>
WERE
STRI | \S-
 - |
| MF =
ENEF
PEG/
OTHE | 5 ENE
RGY DI
ASUS F
ER NEU | RGY
STR
OR
JTROI | DIST
IBUTI
INELA
N EMI | RIB
ONS
STI
TTI | UTI
OF
CS
NG | ONS
SE
CAT
REA | OF
CON
TER
CTI | SI
DAI
IN
ONS | ECO
RY
G T
S. | NDA
NEL
O C | RY
JTR
VE | ON
RL | EUT
S W
APP | RON
Ere
Inc | NS
E C/
E LI | ALCI
EVEI | JLA ⁻
LS / | TED
AND | WIT
FOF | CH
S |
| TABLE | 1 NE | UTR | ON OF | тіс | AL | POT | ENT | IAI | LΡ | ARA | ME | TE | RS | | | | | | | |
| THE | V
WS
VSC
FORM | = 4
= 9
)= 7
0F | DEF
7.64-
.744
.0
SURFA | РТН

-0.4
АСЕ | (ME
73E
ABS | V)

ORP ⁻ |
TIO | N | RA
RO
RS
RS
PAR | DIU
=
0=
T I | S (
6.
6.
6.
8. | FM
25
46
24
DE |)

9
1
R. | ם
-
4
4
WOO | 0 F
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 =
\0 = | = USE
= 0
= 0
= 0
- SA) | ENE
. 62
. 35
. 62
XON | SS(

TY | FM)

PE. | |
| TABLE | 2 LE | VEL | DENS | віту | ΡA | RAM | ете | RS | | | | | | | | | | | | |

NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.973E+01 5.760E-01 4.397E+00 6.018E+00 1.360E+00 1.910E+01 6.010E-01 5.651E-01 7.611E+00 2.680E+00 2.072E+01 5.570E-01 4.805E+00 5.966E+00 1.360E+00 1.990E+01 5.750E-01 6.265E-01 7.206E+00 2.510E+00 48-CD-113 48 - CD - 114 48 - CD - 115 48 - CD - 115 1.632E+01 5.290E-01 6.292E+00 2.752E+00 0.0 1.600E+01 6.510E-01 2.555E+00 5.941E+00 1.320E+00 1.710E+01 5.650E-01 1.250E+01 3.562E+00 0.0 1.678E+01 6.010E-01 2.387E+00 5.208E+00 1.150E+00 49-IN-114 49-IN-115 49-IN-116 49-IN-117 1.567E+01 5.540E-01 7.229E-01 4.100E+00 1.190E+00 1.529E+01 6.680E-01 3.763E-01 7.111E+00 2.510E+00 1.583E+01 5.960E-01 1.352E+00 4.804E+00 1.190E+00 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 50-SN-115 50-SN-116 50-SN-117 50-SN-118 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.375 FOR SN-117 AND 5.410 FOR SN-118. REFERENCES

KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
ALFIMENKOV, V.P. ET AL.: NUCL. PHYS. A398, 93 (1983).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(19
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 93 (1983). V., 171,1293(1968). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9) 10) 11) (1971). 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 12) GILBERI, A. AND CAMERUN, A.G.W. GAR. G. THEO, A., (1965).
13) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
14) GRUPPELAAR, H.: ECN-13 (1977).
15) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
16) NUCLEAR DATA SHEETS, 50, 63 (1987).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) TIMOKHOV ET AL.: ????
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) IKEDA, Y. ÉT AL.: JAERI 1312 (1988).
21) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5043 50-SN-118 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 4.8 KEV
 RESONANCE PARAMETERS AND SCATTERING RADIUS WERE BASED ON
 MUGHABGHAB ET AL./2/ THE LEVELS WHOSE NEUTRON WIDTH WAS
 UNKNOWN WERE ASSUMED TO BE P-WAVE RESONANCES, AND A REDUCED
 NEUTRON WIDTH OF 250 MEV WAS TENTATIVELY GIVEN FOR THESE
 LEVELS. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES
 WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/.
 AVERAGE RADIATION WIDTH WAS ASSUMED TO BE 85 MEV ACCORDING TO
 THE SYSTEMATICS FROM THE NEIGHBORING NUCLIDES. A NEGATIVE
 RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND
 SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 4.8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.460E-4, S1 = 2.600E-4, S2 = 0.730E-4, SG = 0.976E-4, GG = 0.085 EV, R = 5.803 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG TOTAL 4.440 -ELASTIC 4.222 -CAPTURE 0.2178 5.35 INTEGRALS (BARNS)

CAPTURE 0.2178 5.35
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S
FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/7/
 ALPHA = HUIZENGA AND IGO/8/
 DEUTERON = LOHR AND HAEBERLI/9/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/. MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/13/.

/13/.

MT =

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

МΤ

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 | 0 + |
| 1 | 1.2296 | 2 + |
| 2 | 1.7578 | 0 + |

2.0431 2.0565 2.2803 2.3100 2.3211 3 2 ++ ă ō 5 Ã + 6 3 LEVELS ABOVE 2.326 MEV WERE ASSUMED TO BE OVERLAPPING. * = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = BENZI THE GAMMA-RAY STRENGTH FUNCTION (8.96E-05) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 52 MILLI-BARNS AT 40 KEV MEASURED BY MACKLIN AND GIBBONS/17/. T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT = 17 MT = 22 MT = 28 MT = 103 MT =103 MT =104 MT =105 MT =107 THESE THE KALBACH'S CONSTANT K (= 171.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) CROSS SECTION WAS NORMALIZED TO THE FOLLOWING VALUE AT 14.5 MEV: (N,P) 7.00 MB (RECOMMENDED BY FORREST/19/) MT = 251MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) ----- - - - - - - - - - - - -V = 47.64-0.473E R0 = 6.256 A0 = 0.62 WS = 9.744 RS = 6.469 AS = 0.35 VSO= 7.0 RSO= 6.241 ASO= 0.62 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.910E+01 6.010E-01 5.651E-01 7.611E+00 2.680E+00 2.072E+01 5.570E-01 4.805E+00 5.966E+00 1.360E+00 1.990E+01 5.750E-01 6.265E-01 7.206E+00 2.510E+00 2.107E+01 5.620E-01 6.164E+00 6.181E+00 1.360E+00 48-CD-114 48-CD-115 48-CD-116 48-CD-117 1.600E+01 6.510E-01 2.555E+00 5.941E+00 1.320E+00 1.710E+01 5.650E-01 1.250E+01 3.562E+00 0.0 1.678E+01 6.010E-01 2.387E+00 5.208E+00 1.150E+00 * 1.804E+01 6.064E-01 3.111E+01 4.636E+00 0.0 49-IN-115 49 - IN - 116 49 - IN - 117 49-IN-118 1.529E+01 6.680E-01 3.763E-01 7.111E+00 2.510E+00 1.583E+01 5.960E-01 1.352E+00 4.804E+00 1.190E+00 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 1.635E+01 5.990E-01 1.772E+00 5.050E+00 1.190E+00 50 - SN - 116 50 - SN - 117 50 - SN - 118 50-SN-119 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).

IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.410 FOR SN-118 AND 3.524 FOR SN-119.
REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
PEREY, F.G. PHYS. REV. 131, 745 (1963).
HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).

BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
GRUPPELAAR, H.: ECN-13 (1977).
BEDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
NUCLEAR DATA SHEETS, 51, 329 (1987).
NUCLEAR DATA SHEETS, 51, 329 (1987).
BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
MACKLIN, R.L. AND GABONS, J.H.: TAKEN FROM EXFORT1981(1964).
KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
FORREST, R.A.: AERE-R 12419 (1986). MAT number = 5046 50-SN-119 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

= 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.3 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGE RADIATION WIDTH OF 90 MEV AND SCATTERING RADIUS OF 6.0 FM WERE ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. MF

UNRESOLVED RESONANCE REGION : 1.3 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION S1 WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND SO AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.740E-4, S1 = 3.800E-4, S2 = 0.720E-4, SG = 12.7E-4, GG = 0.090 EV, R = 4.970 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.852 -TOTAL ELASTIC CAPTURE 4.676 5.33

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| ENERGY(MEV) | SPIN-PARITY |
|-------------|--|
| 0.0 ` ´ | 1/2 + |
| 0.0239 | 3/2 + |
| 0.0895 | 11/2 - |
| 0.7870 | 7/2 + |
| | ENERGY(MEV)
0.0
0.0239
0.0895
0.7870 |

0.9205 0.9214 1.0624 1.0894 4567890 101123 + + 1.0894 1.1877 1.2497 1.3549 1.5544 1.5716 1.6173 1.6310 1.7184 1.7747 + + + + + 14 15 16 1.7747 1.7897 17 . 1.9050 1.9296 1.9388 18 + 19 20 LEVELS ABOVE 1.983 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (12.9E-4) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 80 MILLI-BARNS AT 100 KEV MEASURED BY TIMOKHOV ET AL./17/ THE KALBACH'S CONSTANT K (= 189.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.50 MB (RECOMMENDED BY FORREST/19/) (N,ALPHA) 1.40 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) ------ - - - - - - - - -- - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 2.072E+01 5.570E-01 4.805E+00 5.966E+00 1.360E+00 1.990E+01 5.750E-01 6.265E-01 7.206E+00 2.510E+00 2.107E+01 5.620E-01 6.164E+00 6.181E+00 1.360E+00 1.766E+01 6.064E-01 3.562E-01 7.089E+00 2.600E+00 48-CD-115 48-CD-116 48-CD-117 48-CD-118 *

1.710E+01 5.650E-01 1.250E+01 3.562E+00 0.0 1.678E+01 6.010E-01 2.387E+00 5.208E+00 1.150E+00 1.804E+01 6.064E-01 3.111E+01 4.636E+00 0.0 1.940E+01 5.340E-01 2.195E+00 4.999E+00 1.240E+00 49-IN-116 49-IN-117 49-IN-118 49-IN-119 1.583E+01 5.960E-01 1.352E+00 4.804E+00 1.190E+00 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 1.635E+01 5.990E-01 1.772E+00 5.050E+00 1.190E+00 1.595E+01 6.540E-01 4.691E-01 7.083E+00 2.430E+00 50-SN-117 50 - SN - 118 50 - SN - 119 50 - SN - 120 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.524 FOR SN-119 AND 6.5 FOR SN-120. REFERENCES REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 7) 8) 9) 10) W. HAEBERLI), P. 682, THE UNIVERSITE OF WISCONSTRUCTED. (1971). 11) GLEERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 11) GILBERI, A. AND CAMERUN, A.G.W.. CAN. J. THIO., TO, TTO (1965).
12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEETS, 26, 207 (1979).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) TIMOKHOV, V.M., ET AL.: FEI-1921 (1988).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5049 50-SN-120 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 70 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF J-UNKNOWN P-WAVE RESONANCES WAS ASSUMED TO BE 1/2. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGE RADIATION WIDTH OF 120 MEV WAS DEDUCED AND APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS OF 6.0 FM WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 70 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.140E-4, S1 = 2.100E-4, S2 = 0.710E-4, SG = 0.507E-4, GG = 0.120 EV, R = 6.267 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEGRALS TOTAL 5.479 -ELASTIC 5.340 -CAPTURE 0.1392 1.22 INTEGRALS (BARNS)

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/.

/13/.

MT =

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

МΤ

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 | 0 + |
| 1 | 1.1715 | 2 + |
| 2 | 1.8750 | 0 + |

| LEVELS | 3
4
5
6
7
8
9
0
12
13
14
5
6
ABOVE 2 | 2.0975
2.1598
2.2846
2.2900
2.3556
2.3997
2.4211
2.4661
2.4820
2.5868
2.6427
2.6972
2.7213
.76 MEV WER | 2
0
4
5
0
2
3
1
4
7
0
4
4
2
2
8
8
5
0
2
3
1
4
7
0
4
4
2
8
5 | +
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+ | _APPING. |
|--|--|---|--|---|---|
| MT = 102
SPHERICA
CASTHY V
SECTIONS
AND REFE | CAPTURE
AL OPTICA
VAS ADOPT
S WERE ES
FO/16/ AN | L AND STATI
ED. DIRECT
TIMATED ACC
D NORMALIZE | STICAL MC
AND SEMI
ORDING TC
D TO 1 MI | DDEL CALCULA
I-DIRECT CAP
) THE PROCEDI
ILLI-BARN AT | TION WITH
TURE CROSS
JRE OF BENZI
14 MEV. |
| THE GAMM
REPRODUC
KEV MEAS | MA-RAY ST
CE THE CA
SURED BY | RENGTH FUNC
PTURE CROSS
TIMOKHOV ET | TION (0.4
SECTION
AL./17/ | 455E-4) WAS /
OF 21 MILLI | ADJUSTED TO
-BARNS AT 100 |
| MT = 16
MT = 17
MT = 22
MT = 28
MT =103
MT =104
MT =105
MT =105
THESE RE
PREEQUIL | (N,2N) CR
(N,3N) CR
(N,N'A) C
(N,P) CRO
(N,P) CRO
(N,T) CRO
(N,T) CRO
(N,ALPHA)
EACTION C
LIBRIUM A | OSS SECTION
OSS SECTION
ROSS SECTIO
ROSS SECTIO
SS SECTION
SS SECTION
CROSS SECTIO
ROSS SECTIO
ND MULTI-ST | N
N
ION
NS WERE C
EP EVAPOF | CALCULATED W | ITH THE
CODE PEGASUS. |
| THE KALE
FORMULA
DENSITY | BACH'S CO
DERIVED
PARAMETE | NSTANT K (=
FROM KIKUCH
RS. | 182.1) W
I-KAWAI'S | VAS ESTIMATE
S FORMALISM/ | D BY THE
18/ AND LEVEL |
| FINALLY
NORMALIZ
(N,P)
(N,ALF | , THE (N,
ZED TO TH
PHA) | P) AND (N,A
E FOLLOWING
4.50 MB (
0.40 MB (| LPHA) CRC
VALUES A
RECOMMEND
RECOMMEND | OSS SECTIONS
AT 14.5 MEV:
DED BY FORRES
DED BY IKEDA | WERE
ST/19/)
+/20/) |
| MT = 251
CALCULAT | MU-BAR
FED WITH | CASTHY. | | | |
| MF = 4 ANGU
LEGENDRE F
GIVEN IN T
TIC LEVELS
CALCULATED
BUTIONS IN | JLAR DIST
POLYNOMIA
THE CENTE
S, AND IN
D WITH CA
N THE LAB | RIBUTIONS O
L COEFFICIE
R-OF-MASS S
THE LABORA
STHY. FOR
ORATORY SYS | F SECONDA
NTS FOR A
YSTEM FOF
TORY SYST
OTHER REA
TEM WERE | ARY NEUTRONS
ANGULAR DIST
3 MT=2 AND D
FEM FOR MT=9
ACTIONS, ISO
ASSUMED. | RIBUTIONS ARE
ISCRETE INELAS-
1. THEY WERE
TROPIC DISTRI- |
| MF = 5 ENEF
ENERGY DIS
PEGASUS FO
OTHER NEUT | RGY DISTR
STRIBUTIO
DR INELAS
FRON EMIT | IBUTIONS OF
NS OF SECON
TIC SCATTER
TING REACTI | SECONDAF
DARY NEUT
ING TO OV
ONS. | RY NEUTRONS
FRONS WERE CA
/ERLAPPING LI | ALCULATED WITH
EVELS AND FOR |
| TABLE 1 NEU | JTRON OPT | ICAL POTENT | IAL PARAN | METERS | |
| V =
WS =
VSO=
THE FORM (| DEP1
= 47.64-0
= 9.744
= 7.0
)F SURFAC | .473E
E ABSORPTIO | RADIOS
RO = 6
RS = 6
RSO= 6
N PART IS | 5.256 A0 =
5.469 AS =
5.241 ASO=
5.241 ASO=
5.241 WOODS | = 0.62
= 0.35
= 0.62
-SAXON TYPE. |
| TABLE 2 LE | /EL DENSI | TY PARAMETE | RS | | |
| NUCLIDE S)
48-CD-116
48-CD-117
48-CD-118
48-CD-119 | (ST A(1/M
1.990
2.107
* 1.766
* 1.742 | E+01 5.750E
E+01 5.620E
E+01 6.064E
E+01 6.040E | C(1/M
-01 6.265
-01 6.164
-01 3.562
-01 2.363 | MEV) EX(MEV
5E-01 7.206E
4E+00 6.181E
2E-01 7.089E
3E+00 5.715E |) PAIRING
+00 2.510E+00
+00 1.360E+00
+00 2.600E+00
+00 1.360E+00 |
| 49 - IN - 117
49 - IN - 118
49 - IN - 119 | 1.678
* 1.804
1.940 | E+01 6.010E
E+01 6.064E
E+01 5.340E | -01 2.387
-01 3.111
-01 2.195 | 7E+00 5.208E
1E+01 4.636E
5E+00 4.999E | +00 1.150E+00
+00 0.0
+00 1.240E+00 |

49-IN-120 * 1.757E+01 6.016E-01 2.330E+01 4.366E+00 0.0 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 1.635E+01 5.990E-01 1.772E+00 5.050E+00 1.190E+00 1.595E+01 6.540E-01 4.691E-01 7.083E+00 2.430E+00 1.630E+01 6.100E-01 2.010E+00 5.217E+00 1.190E+00 50-SN-118 50-SN-119 50-SN-120 50-SN-121 - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.5 FOR SN-120 AND 5.0 FOR SN-121. REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 7) ġ) 9) 10) 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

MAT number = 5055 50-SN-122 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 29 KEV RESONANCE PARAMETERS WERE EVALUATED AS FOLLOWS: RESONANCE ENERGIES AND NEUTRON WIDTHS WERE BASED ON MAINLY THE DATA MEASURED BY NAKAJIMA ET AL./2/ AND PARTIALLY THOSE GIVEN BY MUGHABGHAB ET AL./3/ NEUTRON ONBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/4/. AVERAGED RADIATION WIDTH OF 130 MEV WAS ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. SCATTERING RADIUS WAS TAKEN AS 5.7 FM /3/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 29 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.740E-4, S1 = 2.600E-4, S2 = 0.700E-4, SG = 0.297E-4, GG = 0.130 EV, R = 5.564 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 3.979 -TOTAL ELASTIC CAPTURE 3.795 0.1837 0.933 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/7/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/15/ AND NUCLEAR DATA SHEETS/16/. ENERGY(MEV) SPIN-PARITY 0.0 GR. 020 + 1.1402 2.0900 1 + + 2.1450 3 4 +

2.1530 2.2490 2.3360 2.4000 2.4150 2.4920 45 5 4 7 6 7 + 8 23 + 9 $\overline{2.4920}$ $\overline{3}$ -LEVELS ABOVE 2.556 MEV WERE ASSUMED TO BE OVERLAPPING. F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = THE GAMMA-RAY STRENGTH FUNCTION (2.75E-5) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 23 MILLI-BARNS AT 30 KEV MEASURED BY MACKLIN ET AL./18/ F = 16 (N,2N) CROSS SECTION F = 17 (N,3N) CROSS SECTION F = 22 (N,N'A) CROSS SECTION F = 28 (N,N'P) CROSS SECTION F =103 (N,P) CROSS SECTION F =104 (N,D) CROSS SECTION F =105 (N,T) CROSS SECTION F =105 (N,T) CROSS SECTION F =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT = 17 MT = 22 MT = 28 MT = 103MT = 104ŇТ MΤ THE KALBACH'S CONSTANT K (= 241.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. MT = 251 MU-BAR CALCULATED WITH CASTHY/5/. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. E = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) . - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 48-CD-118
 *
 1.766E+01
 6.064E-01
 3.562E-01
 7.089E+00
 2.600E+00

 48-CD-119
 *
 1.742E+01
 6.040E-01
 2.363E+00
 5.715E+00
 1.360E+00

 48-CD-120
 *
 1.718E+01
 6.016E-01
 1.880E-01
 7.009E+00
 2.790E+00

 48-CD-121
 *
 1.693E+01
 5.992E-01
 1.734E+00
 5.442E+00
 1.360E+00

 49-IN-119
 1.940E+01
 5.340E-01
 2.195E+00
 4.999E+00
 1.240E+00

 49-IN-120
 *
 1.757E+01
 6.016E-01
 2.330E+01
 4.366E+00
 0.0

 49-IN-121
 *
 1.601E+01
 6.060E-01
 1.119E+00
 5.277E+00
 1.430E+00

 49-IN-122
 *
 1.707E+01
 5.968E-01
 1.737E+01
 4.092E+00
 0.0

 1.595E+01 6.540E-01 4.691E-01 7.083E+00 2.430E+00 1.630E+01 6.100E-01 2.010E+00 5.217E+00 1.190E+00 1.434E+01 7.060E-01 3.423E-01 7.416E+00 2.620E+00 1.509E+01 6.870E-01 3.062E+00 6.032E+00 1.190E+00 50-SN-120 50 - SN - 121 50 - SN - 122 50 - SN - 123 SYST: * = LDP'S WERE DETERMINED FORM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.569 FOR SN-122 AND 4.541 FOR SN-123.

REFERENCES

- REFERENCES

 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 NAKAJIMA, Y. ET AL.: ANN. NUCL. ENERGY, 17, 95 (1990).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IJJMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 8)

- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 9) 10) 11)
- (1971). 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 13)
- 14) 15) 16)
- 17)
- 18) 19)

MAT number = 5058 50-SN-123 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 22 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.740E-4, S1 = 2.600E-4, S2 = 0.690E-4, SG = 30.1E-4, GG = 0.140 EV, R = 5.548 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 7.000 -ELASTIC 4.000 -TOTAL ELASTIC CAPTURE 3.000 62.6 F = 3 NEUTRON CROSS SECTIONS BELOW 22 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. TH CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMATICS FROM NEIGHBORING SN ISOTOPES. THE ELASTIC SCATTE-RING CROSS SECTION WAS ESTIMATED FROM R = 5.4 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 22 EV MF = 3THF TO 100 KEV ABOVE 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/3/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/4/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/5/ ALPHA = HUIZENGA AND IGO/6/ DEUTERON = LOHR AND HAEBERLI/7/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/8/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/9/ WERE EVALUATED BY IIJIMA ET AL./10/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /11/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/12/ AND NUCLEAR DATA STRUCTUKE ∟ SHEETS/13/. SPIN-PARITY 11/2 -ENERGY(MEV) NO GŘ. 0.0 3/2 1/2 9/2 3/2 5/2 Ŏ.Ŏ246 + 1 2 3 0.1504 + 0.6188 0.8702 0.8990 4 5 + 3/2 +6 0.9198

| 7 0.9314 7/2 -
8 1.0443 7/2 +
9 1.0721 3/2 +
10 1.1359 1/2 +
11 1.1550 7/2 +
12 1.1944 5/2 +
LEVELS ABOVE 1.301 MEV WERE ASSUMED | TO BE OVERLAPPING. |
|---|--|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MOD
CASTHY WAS ADOPTED. DIRECT AND SEMI-
SECTIONS WERE ESTIMATED ACCORDING TO
AND REFFO/14/ AND NORMALIZED TO 1 MIL</pre> | EL CALCULATION WITH
DIRECT CAPTURE CROSS
THE PROCEDURE OF BENZI
LI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCTION (2.97)
THE SYSTEMATICS OF RADIATION WIDTH (O
S-WAVE RESONANCE LEVEL SPACING (43.8)
LEVEL DENSITY PARAMETERS. | E-03) WAS DETERMINED FROM
.13 EV) AND AVERAGE
EV) OBTAINED FROM THE |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CAL
PREFQUILIBRIUM AND MULTI-STEP EVAPORAL</pre> | LCULATED WITH THE
TION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 206.8) WA
FORMULA DERIVED FROM KIKUCHI-KAWAI'S | S ESTIMATED BY THE
FORMALISM/15/ AND LEVEL |
| DENSITY PARAMETERS.
FINALLY, THE (N.P.) CROSS SECTION WAS I | NORMALIZED TO THE |
| FOLLOWING VALUE AT 14.5 MEV:
(N,P) 2.15 MB (SYSTEMATIC | S OF FORREST/16/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDAR
LEGENDRE POLYNOMIAL COEFFICIENTS FOR AN
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR
TIC LEVELS, AND IN THE LABORATORY SYSTE
CALCULATED WITH CASTHY. FOR OTHER REAC
BUTIONS IN THE LABORATORY SYSTEM WERE A | Y NEUTRONS
GULAR DISTRIBUTIONS ARE
MT=2 AND DISCRETE INELAS-
M FOR MT=91. THEY WERE
TIONS, ISOTROPIC DISTRI-
SSUMED. |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRO
PEGASUS FOR INELASTIC SCATTERING TO OVE
OTHER NEUTRON EMITTING REACTIONS. | NEUTRONS
ONS WERE CALCULATED WITH
RLAPPING LEVELS AND FOR |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAME | TERS |
| DEPTH (MEV) RADIUS(V = 47.64-0.473E R0 = 6.1 WS = 9.744 RS = 6.1 VS0= 7.0 RS0= 6.1 THE FORM OF SURFACE ABSORPTION PART IS | FM) DIFFUSENESS(FM)
256 A0 = 0.62
469 AS = 0.35
241 ASO= 0.62
DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(17MEV) T(MEV) C(17ME 48-CD-119 * 1.742E+01 6.040E-01 2.363E 48-CD-120 * 1.718E+01 6.016E-01 1.880E 48-CD-121 * 1.693E+01 5.992E-01 1.734E 48-CD-122 * 1.667E+01 5.968E-01 2.388E | V) EX(MEV) PATRING +00 5.715E+00 1.360E+00 -01 7.009E+00 2.790E+00 +00 5.442E+00 1.360E+00 -01 6.394E+00 2.450E+00 |
| 49-IN-120 * 1.757E+01 6.016E-01 2.330E 49-IN-121 1.601E+01 6.060E-01 1.119E 49-IN-122 * 1.707E+01 5.968E-01 1.737E 49-IN-123 1.470E+01 6.100E-01 1.34E | +01 4.366E+00 0.0
+00 5.277E+00 1.430E+00
+01 4.092E+00 0.0
+00 4.483E+00 1.090E+00 |
| 50-SN-121 1.630E+01 6.100E-01 2.010E 50-SN-122 1.434E+01 7.060E-01 3.423E 50-SN-123 1.509E+01 6.870E-01 3.062E 50-SN-124 1.601E+01 6.160E-01 3.224E SYST: * = LDP'S WERE DETERMINED FROM S | +00 5.217E+00 1.190E+00
-01 7.416E+00 2.620E+00
+00 6.032E+00 1.190E+00
-01 6.294E+00 2.280E+00
YSTEMATICS. |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.541 FOR SN-123 AND 7.975 FOR SN-124.

REFERENCES MALL M.

(1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
(2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
(3) IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
(4) IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

5)

- IIJIMA, S. AND KAWAI, M. J. NUCL. Sol. Legendel, 20, ... (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 6) 7) 8)
- . на 1971
- (1971). 9) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 9) GILBERI, A. AND CAMERON, A.G.M. C.M. C. M. C. (1965).
 10) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 11) GRUPPELAAR, H.: ECN-13 (1977).
 12) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 13) NUCLEAR DATA SHEETS, 29, 453 (1980).
 14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 15) KIUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 16) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5061 50-SN-124 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-MAR93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-03 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT = 151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 10.7 KEV RESONANCE PARAMETERS AND SCATTERING RADIUS WERE BASED ON MUGHABGHAB ET AL./2/ THE LEVELS WHOSE NEUTRON WIDTH WAS UNKNOWN WERE ASSUMED TO BE P-WAVE RESONANCES, AND A REDUCED NEUTRON WIDTH OF 830 MEV WAS TENTATIVELY GIVEN FOR THESE LEVELS. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH OF 140 MEV WAS DERIVED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. UNRESOLVED RESONANCE REGION : 10.7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.150E-4, S1 = 2.600E-4, S2 = 0.680E-4, SG = 0.144E-4, GG = 0.140 EV, R = 5.979 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S TOTAL 4.535 ELASTIC 4.400 0 2200 M/S INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 7.86 0.1355 CAPIURE 0.1355 7.86 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| | UNLETO, | | | | | | | | | |
|----|---|--|---|---|--|--|--|---|--|---------------------------------|
| | LEVEL | NO.
GR.
2
3
4
5
6
7
8
9
10
11
13
14
15
17
18
19
20
S
ABOVE | ENE
0
2
2
2
2
2
2
2
2
2 | RGY (ME
01316
1016
1294
1294
1294
1294
2045
3249
33664
4469
56024
56024
56024
56024
56024
56024
56024
56024
56024
56024
56024
56023
5751
87783
WEV
WE | V)
RE AS | SPIN
0
2
4
0
2
2
5
2
7
2
2
8
6
2
3
0
1
4
2
2
2
5
2
7
2
2
8
5
2
7
2
2
8
6
2
3
0
1
4
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
5
2
7
7
2
2
2
2 | -PARITY
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+ | ,
OVERLA | PPING. | |
| | MT = 102
SPHERIC
CASTHY
SECTION
AND REF | CAPTUF
AL OPT
WAS ADO
S WERE
F0/16/ | RE
ICAL A
OPTED.
ESTIM
AND N | ND STA
DIRE
ATED A
ORMALI | TISTI
CT AN
CCORD
ZED T | CAL MO
D SEM
ING TO
O 1 M | DEL CA
I-DIREC
D THE F
ILLI-BA | LCULAT
CAPT
ROCEDU
RN AT | ION WITH
URE CROSS
RE OF BEN
14 MEV. | S
NZ I |
| | THE GAM
REPRODU
KEV MEA | MA-RAY
CE THE
SURED E | STREN
CAPTU
BY TIM | GTH FU
RE CRO
OKHOV | NCTIO
SS SE
ET AL | N (0.7
CTION
./17/ | 1286-4)
OF 8.3 | WAS A
MILLI | DJUSTED 1
-BARNS A1 | 0
5 90 |
| | MT = 16
MT = 17
MT = 22
MT = 28
MT =103
MT =104
MT =105
MT =105
MT =107
THESE R
PREEQUI | (N,2N)
(N,3N)
(N,N'A)
(N,P)
(N,P)
(N,D)
(N,T)
(N,ALPH
EACTION
LIBRIUM | CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
A) CROS
A AND | SECTI
SECTI
SECT
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECT
SECT
WULTI- | ON
ON
ION
ION
N
CTION
STEP | WERE (
EVAPOF | CALCULA | TED WI
MODEL | TH THE
CODE PEGA | ASUS. |
| | THE KAL
FORMULA
DENSITY | BACH'S
DERIVE
PARAME | CONST
D FRO
TERS. | ANT K
M KIKU | (= 21
CHI-K | 5.9) V
AWAI'S | VAS EST
S FORMA | IMATED | BY THE
8/ AND LE | VEL |
| | FINALLY
FOLLOWI
(N,P) | , THE (
NG VALU | (N,P)
JE AT
1. | CROSS
14.5 M
56 MB | SECTI
EV:
(SYS | ON WAS | S NORMA
ICS OF | LIZED
FORRES | TO THE
T/19/) | |
| | MT = 251
CALCULA | MU-BAF
TED WIT | R
TH CAS | THY. | | | | | | |
| MF | = 4 ANG
LEGENDRE
GIVEN IN
TIC LEVEL
CALCULATE
BUTIONS I | ULAR D
POLYNOM
THE CEN
S, AND
D WITH
N THE L | ISTRIB
MIAL C
NTER-O
IN TH
CASTH
ABORA | UTIONS
DEFFIC
F-MASS
E LABO
Y. FO
TORY S | OF S
IENTS
SYST
RATOR
R OTH
YSTEM | ECONDA
FOR A
EM FOF
Y SYS
ER REA
WERE | ARY NEU
ANGULAR
AMT=2
FEM FOR
ACTIONS
ASSUME | TRONS
DISTR
AND DI
MT=91
, ISOT | IBUTIONS
SCRETE IN
. THEY V
ROPIC DIS | ARE
NELAS -
VERE
STRI- |
| MF | = 5 ENE
ENERGY DI
PEGASUS F
OTHER NEU | RGY DIS
STRIBUT
OR INEL
TRON EN | STRIBU
FIONS
ASTIC | TIONS
DF SEC
SCATT
G REAC | OF SE
ONDAR
ERING
TIONS | CONDAP
Y NEU
TO OV | RY NEUT
FRONS W
/ERLAPF | RONS
VERE CA
VING LE | LCULATED
VELS AND | WITH
FOR |
| ΤA | BLE 1 NE | UTRON (| OPTICA | L POTE | NTIAL | PARAM | IETERS | | | |
| | v | DE
 | PTH (1
4-0.47 | MEV)
3E | | RADIUS
RO = 6 | 6(FM)
6.256 | DIFF

A0 = | USENESS(F
0.62 | |

| WS = 9.744
VSO= 7.0
THE FORM OF SURFACE ABSORPTION | RS = 6.469 AS = 0.35
RSO= 6.241 ASO= 0.62
PART IS DER. WOODS-SAXON TYPE. |
|--|---|
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) PAIRING |
| 48-CD-120 * 1.718E+01 6.016E-0
48-CD-121 * 1.693E+01 5.992E-0
48-CD-122 * 1.667E+01 5.968E-0
48-CD-123 * 1.641E+01 5.943E-0 | 1 1.880E-01 7.009E+00 2.790E+00
1 1.734E+00 5.442E+00 1.360E+00
1 2.388E-01 6.394E+00 2.450E+00
1 1.268E+00 5.165E+00 1.360E+00 |
| 49-IN-121 1.601E+01 6.060E-0 49-IN-122 * 1.707E+01 5.968E-0 49-IN-123 1.470E+01 6.100E-0 49-IN-124 1.655E+01 5.240E-0 | 1 1.119E+00 5.277E+00 1.430E+00
1 1.737E+01 4.092E+00 0.0
1 1.134E+00 4.483E+00 1.090E+00
1 6.345E+00 2.747E+00 0.0 |
| 50 - SN - 122 1.434E+01 7.060E-0 50 - SN - 123 1.509E+01 6.870E-0 50 - SN - 124 1.601E+01 6.160E-0 50 - SN - 125 1.591E+01 6.210E-0 | 1 3.423E-01 7.416E+00 2.620E+00
1 3.062E+00 6.032E+00 1.190E+00
1 3.224E-01 6.294E+00 2.280E+00
1 1.927E+00 5.249E+00 1.190E+00 |
| SYST: * = LDP'S WERE DETERMINE | D FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALC
IN THE CASTHY CALCULATION, SPIN
ASSUMED TO BE 7.975 FOR SN-124 A | ULATED AS 0.146*SQRT(A)*A**(2/3).
CUTOFF FACTORS AT 0 MEV WERE
ND 5.0 FOR SN-125. |
| <pre>REFERENCES 1) KAWAI, M. ET AL.: J. NUCL. SC 2) MUGHABGHAB, S.F. ET AL.: "NEU PART A", ACADEMIC PRESS (1981 3) BOLLINGÉR, L.M. AND THOMAS, G 4) IGARASI, S. AND FUKAHORI, T.: 5) IJJIMA, S. ET AL.: JAERI-M 87 6) IJJIMA, S. AND KAWAI, M.: J. (1983). 7) PEREY, F.G: PHYS. REV. 131, 7 8) HUIZENGA, J.R. AND IGO, G.: N 9) LOHR, J.M. AND HAEBERLI, W.: 10) BECCHETTI, F.D., JR. AND GREE PHENOMENA IN NUCLEAR REACTION W. HAEBERLI), P. 682, THE UNI (1971). 11) GILBERT, A. AND CAMERON, A.G. (1965). 12) IJJIMA, S., ET AL.: J. NUCL. 13) GRUPPELAAR, H.: ECN-13 (1977) 14) ENSDF: EVALUATED NUCLEAR STRU 15) NUCLEAR DATA SHEETS, 41, 413 16) BENZI, V. AND REFFO, G.: CCDN 17) TIMOKHOV,V.M., ET AL.:??? 18) KIKUCHI, K. AND KAWAI, M.: "N REACTIONS", NORTH HOLLAND (19 9) FORREST, R.A.: AERE-R 12419 (</pre> | I. TECHNOL., 29, 195 (1992).
TRON CROSS SECTIONS, VOL. I,
):
.E.: PHYS. REV., 171,1293(1968).
JAERI 1321 (1991).
-025, P. 337 (1987).
NUCL. SCI. TECHNOL., 20, 77
45 (1963).
UCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. 43, 1446
SCI. TECHNOL. 21, 10 (1984).
:
:
:
:
:
:
:
:
:
:
:
:
: |

MAT number = 5067 50-SN-126 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 2 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATON WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.750E-4, S1 = 2.500E-4, S2 = 0.670E-4, SG = 0.107E-4, GG = 0.150 EV, R = 5.582 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 4.090 TOTAL ELASTIC CAPTURE 0.09000 0.150 F = 3 NEUTRON CROSS SECTIONS BELOW 2 KEV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. TH CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMATICS FROM NEIGHBORING NUCLIDES, AND SCATTERING CROSS SECTION FROM R = 5.4 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 2 KEV TO 100 KEV. MF = 3THF ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/3/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/4/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/5/ ALPHA = HUIZENGA AND IGO/6/ DEUTERON = LOHR AND HAEBERLI/7/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/8/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/9/ WERE EVALUATED BY IIJIMA ET AL./10/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /11/. /11/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/12/ AND NUCLEAR DATA MT SHEETS/13/. ENERGY(MEV) SPIN-PARITY NO. 0.0 1.1411 2.0497 2.1108 2.1301 2.1615 2.1942 2.2180 GR. 02 + 1 + ż 4 2 4 + 34 + 5 5 4 7 6 + 2.2189 7

LEVELS ABOVE 2.25 MEV WERE ASSUMED TO BE OVERLAPPING.

MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (9.55E-06) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 5 MILLI-BARNS AT 300 KEV, WHICH WAS ESTIMATED FROM THE DATA OF NEIGHBORING KEV, WHIC NUCLIDES.

MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.

THE KALBACH'S CONSTANT K (= 232.5) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LEVEL DENSITY PARAMETERS.

MT = 251 MU-BAR CALCULATED WITH CASTHY.

F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) | | |
|--|-----------------------------|-------------------------------|--|--|
| V = 47.64-0.473E | R0 = 6.256 | A0 = 0.62 | | |
| WS = 9.744 | RS = 6.469 | AS = 0.35 | | |
| VSU= 7.0
The form of surface absorption | RSU= 6.241
PART IS DER V | ASU= 0.62
NOODS-SAXON TYPE | | |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE | SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING | |
|--|-------------------|--|--|--|--|--|--|
| 48-CD-122
48-CD-123
48-CD-124
48-CD-125 | 2 *
3 *
1 * | 1.667E+01
1.641E+01
1.614E+01
1.587E+01 | 5.968E-01
5.943E-01
5.919E-01
5.895E-01 | 2.388E-01
1.268E+00
1.426E-01
9.238E-01 | 6.394E+00
5.165E+00
6.225E+00
4.884E+00 | 2.450E+00
1.360E+00
2.560E+00
1.360E+00 | |
| 49 - IN - 123
49 - IN - 124
49 - IN - 125
49 - IN - 126 | 3
1
5
* | 1.470E+01
1.655E+01
1.627E+01
1.600E+01 | 6.100E-01
5.240E-01
5.895E-01
5.160E-01 | 1.134E+00
6.345E+00
1.449E+00
4.768E+00 | 4.483E+00
2.747E+00
4.874E+00
2.470E+00 | 1.090E+00
0.0
1.200E+00
0.0 | |
| 50 - SN - 124
50 - SN - 125
50 - SN - 126
50 - SN - 127 | | 1.601E+01
1.591E+01
1.646E+01
1.577E+01 | 6.160E-01
6.210E-01
6.270E-01
6.140E-01 | 3.224E-01
1.927E+00
4.012E-01
1.633E+00 | 6.294E+00
5.249E+00
6.778E+00
5.075E+00 | 2.280E+00
1.190E+00
2.390E+00
1.190E+00 | |
| SYST: ' | ' = LI | DP'S WERE [| DETERMINED | FROM SYSTE | MATICS. | | |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3) | | | | | | | |

ÎN THẾ CÁSTHY CALCULATION, SPIN CUTOFF FÁCTORS AT O MEÝ WERÈ ASSUMED TO BE 1.141 FOR SN-126 AND 5.0 FOR SN-127.

REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988).
2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
3) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
- 4) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 5) PEREY, F.G: PHYS. REV. 131, 745 (1963).
 6) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 7) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 8) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 9) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

9) GILBERT, A. AND CAMERON, A.G.W. COMM. C. 1965).
10) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
11) GRUPPELAAR, H.: ECN-13 (1977).
12) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
13) NUCLEAR DATA SHEETS, 36, 227 (1982).
14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
15) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).

| MAT number = 5100
51-SB- 0 JNDC | EVAL-MAR89 JNDC FP NUCLE
DIST-OCT89 REV2-FEB94 | AR DATA W.G. |
|---|--|--|
| 89-03 DATA WERE CONSTR
WERE EVALUATED B
90-07 UNRESOLVED RESON
MODIFIED | UCTED WITH THOSE FOR SB-
Y JNDC FP NUCLEAR DATA W
ANCE PARAMETERS AND MF=3 | 121 AND SB-123 WHICH
/.G./1/.
8, MT=251 WERE |
| 94-02 JENDL-3.2
CAPTURE CROSS SE
OTHER DATA WERE
COMPILED BY T.NA | CTION MODIFIED BY JNDC F
ADOPTED FROM JENDL FUSIC
KAGAWA | FPND WG.
DN FILE. |
| ***** MODIFIED
ALL CROSS SECTIO
(3.32) AND (
ALL ANGULAR DIST
ALL ENERGY DISTR
**** | PARTS FOR JENDL-3.2 **
NS EXCEPT (3,105).
3,33) WERE DELETED.
RIBUTIONS EXCEPT FOR (4,
IBUTIONS. | 2).
***** |
| JENDL FUSION FIL
EVALUATED
COMPILED | E /2/ (AS OF FEB. 1994)
BY K.KOSAKO (NEDAC) AND
BY K.KOSAKO. | S. CHIBA (NDC/JAERI) |
| - THE INELASTIC
DISTRIBUTIONS
CONTINUUM INE
DWUCKY IN SIN
FROM DIRECT R
- THE (N,2N), (
(N,A) REACTIO
104, 107) WER
- THE (N,T) REA
AND ANG. DIST
WERE TAKEN FR
- ENERGY DISTRI
BY THOSE CALC
CONTINUUM NEU
TICS /4/ USIN
RATIO WAS CAL
- OPTICAL-MODEL
THE SINCROS-I
LEVEL SCHEMES | SCATTERING CROSS SECTIO
OF INELASTICALLY SCATTE
LASTIC) WERE CALCULATED
CROS-II SYSTEM/3/ INCLUE
EACTIONS.
N,3N), (N,NA), (N,NP), (
N CROSS SECTIONS (MT=16,
E CALCULATED BY EGNASH2
CTION CROSS SECTION, RES
RIBUTIONS OF ELASTICALLY
OM JENDL-3.1.
BUTIONS OF SECONDARY NEL
ULATED BY EGNASH2. THE
TRONS WERE CALCULATED BY
G F15TOB /2/. THE PRECC
CULATED BY THE SINCROS-
, LEVEL DENSITY AND OTHE
I CALCULATION ARE DESCRI
WERE DETERMINED ON THE | NS AND ANGULAR
RED NEUTRONS (EXCEPT
WITH CASTHY2Y AND
DING CONTRIBUTIONS
(N,P), (N,D) AND
17, 22, 28, 103,
IN THE SINCROS-II.
SONANCE PARAMETERS
'SCATTERED NEUTRONS
UTRONS WERE REPLACED
DDX'S OF THE
'KUMABE'S SYSTEMA-
DMPOUND/COMPOUND
II CODE SYSTEM.
R PARAMETERS USED IN
BED IN REF./3/.
BASIS OF ENSDF/5/. |
| MF = 1 GENERAL INFORM
MT=451 COMMENTS AND | ATION
DICTIONARY | |
| <pre>MF = 2 RESONANCE PARA
MT=151 RESOLVED AND
RESOLVED RESONANCE P
1) SB-121 : BELOW 2
EVALUATION WAS
OHKUBO ET AT./6
AL./9/, MURADJA
ANGULAR MOMENTU
BELYAEV ET AL./
THE AVERAGE RAD
ASSUMED.
2) SB-123 : BELOW 2.</pre> | METERS
UNRESOLVED RESONANCE PAF
ARAMETERS (MLBW FORMULA)
KEV
MADE ON THE BASIS OF DAT
7/. BOLOTIN AND CHRIEN/
N ET AL./10/ AND ADAMCHL
M L AND SPIN J WERE BASE
12/. BAHT ET AL./13/ ANE
IATIVE CAPTURE WIDTH OF
5. KEV | AMETERS
A MEASURED BY
8/, WYNCHANK ET
JK ET AL./11/.
D ON THE DATA BY
O CAUVIN ET AL./14/.
0.089 EV WAS |
| EVALUATION WAS
OHKUBO ET AL./6
CHRIEN/8/, WYNC
ADAMCHUK ET AL.
BASED ON THE DA
THE AVERAGE RAD
ASSUMED | MADE ON THE BASIS OF THE
,15/, STOLVY AND HARVEY,
HANK ET AL./9/, MURADJAN
/11/. ANGULAR MOMENTUM
TA BY BAHT ET AL./13/ AN
IATIVE CAPTURE WIDTH OF | 16/, BOLOTIN AND
16/, BOLOTIN AND
1 ET AL./10/ AND
L AND SPIN J WERE
D CAUVIN ET AL./14/.
0.098 EV WAS |
| UNRESOLVED RESONANCE
THE NEUTRON STRENG
WITH OPTICAL MODEL
SPACING WAS DETERM
CALCULATED WITH CA
OBTAINED FROM FITT
100 KEV. | REGION : UP TO 100 KEV
TH FUNCTIONS, SO, S1 AND
CODE CASTHY/17/. THE C
INED TO REPRODUCE THE CA
STHY. THE EFFECTIVE SCA
ING TO THE CALCULATED TO | O S2 WERE CALCULATED
DBSERVED LEVEL
APTURE CROSS SECTION
ATTERING RADIUS WAS
DTAL CROSS SECTION AT |
| CALCULATED 2200-M/S
TOTAL
ELASTIC
CAPTURE | CROSS SECTIONS AND RES.
200 M/S RE
8.943
3.722
5.221 | INTEGRALS (BARNS)
S. INTEG.
-
175 |

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. FOR JENDL-3.1, ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/17/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/18/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/19/ BY MODIFYING RADIUS PARAMETER OF THE SPIN-ORBIT TERM. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/20/ ALPHA = HUIZENGA AND IGO/21/ DEUTERON = LOHR AND HAEBERLI/22/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/23/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GIRBERT AND CAMERON/24/ WERE EVALUATED BY IIJIMA ET AL./25/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /26/. /26/. FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE ELASTIC SCATTERING, CAPTURE AND (N,T) WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/3/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/3/ FOR NEUTRON, PEREY OMP /27/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/28/ FOR ALPHA, LOHR-HAEBERLI OMP/29/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/30/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. ' = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED IN THE ENERGY RANGES BELOW 500 KEV. BETWEEN 500 KEV AND 11.5 MEV, SPLINE FITTING TO THE EXPERIMENTAL DATA /31,32/ WAS PERFORMED. ABOVI THIS, EXPERIMENTAL DATA WERE CONNECTED BY EYE-GUIDING. MT = 1ÂBOVE MT = 2' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./5/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'. NO. MT ENERGY(MEV) NO. MT ENERGY(MEV) . MT ENERGY(MEV) J-PARITY NO. MT ENERGY(MEV) J-PARITY 0.0 5/2 + GR. 0.0 7/2 + 51 0.0371 7/2 + * 1 52 0.1603 5/2 + * 53 0.5076 3/2 + * 2 54 0.5418 3/2 + * 55 0.5731 1/2 + * 3 56 0.7128 1/2 + 57 0.9470 9/2 + * 4 59 1.0302 9/2 + * 58 1.0240 7/2 + * 5 61 1.0886 9/2 + * 60 1.0354 9/2 + 6 64 1.1813 7/2 + * 62 1.1393 11/2 + 7 65 1.2609 5/2 + * 63 1.1447 9/2 + * 8 66 1.3374 7/2 + * 63 1.1447 9/2 + * 8 66 1.3374 7/2 + * 64 1.4075 5/2 + 69 1.4105 7/2 + 70 1.4272 9/2 + * 71 1.4480 1/2 -OVERLAPPING LEVELS WERE ASSUMED ABOVE 1.449 MEV FOR SB-121 AND ABOVE 1.338 MEV FOR SB-123. J-PARITY J-PARITY GR. 1 3 4 5 6 7 8 9 10 11 12 13 F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY/17/ WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/33/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = THE GAMMA-RAY STRENGTH FUNCTIONS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTIONS. CROSS SECTION (1 MEV) STRENGTH FUNCTION SB-121 0.110 BARN 54.5E-4 SB-123 0.084 BARN 24.2E-4 MT = 16, 17, 22, 28, 103, 104, 107 (N,2N), (N,3N), (N,N'A), (N,N'P), (N,P), (N,D) AND (N,ALPHA) CROSS SECTIONS ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS

MADE WITH SINCROS-II FOR EACH ISOTOPES, AND THE RESULTS WERE NORMALIZED TO EXPERIMENTAL DATA.

MT = 105 (N,T) CROSS SECTIONS CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS/18/.

THE KALBACH'S CONSTANTS WERE ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/34/ AND LEVEL DENSITY PARAMETERS. SB-121: 145.3, SB-123: 174.0

MT = 251 MU-BAR CALCULATED WITH CASTHY/17/.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2

CALCULATED WITH THE CASTHY CODE/17/. MT=16, 17, 22, 28, 51-91 TAKEN FROM JENDL FUSION FILE.

MF_= 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 51-91 TAKEN FROM JENDL FUSION FILE.

<< THE PARAMETERS USED IN THE CASTHY AND PEGASUS CALCULATIONS.>> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|------------------|------------|-----------------|
| V = 47.64-0.473E | R0 = 6.256 | A0 = 0.62 |
| WS = 9.744 | RS = 6.469 | AS = 0.35 |
| WS0= 7.0 | RS0= 6.241 | AS0= 0.62 |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE | SYST | A(/MEV) | T(MEV) | C(/MEV) | EX(MEV) | PAIRING |
|--|---|--|---|---|--|--|
| 49 - IN - 11
49 - IN - 11
49 - IN - 11
49 - IN - 12
49 - IN - 12
49 - IN - 12
49 - IN - 12 | 7
8 *
9
0 *
1
2 * | 1.678E+01
1.804E+01
1.940E+01
1.757E+01
1.601E+01
1.707E+01 | 6.010E-01
6.064E-01
5.340E-01
6.016E-01
6.060E-01
5.968E-01 | 2.387E+00
3.111E+01
2.195E+00
2.330E+01
1.119E+00
1.737E+01 | 5.208E+00
4.636E+00
4.999E+00
4.366E+00
5.277E+00
4.092E+00 | 1.150E+00
0.0
1.240E+00
0.0
1.430E+00
0.0 |
| 50 - SN - 11
50 - SN - 11
50 - SN - 12
50 - SN - 12
50 - SN - 12
50 - SN - 12
50 - SN - 12 | 8
9
0
1
2
3 | 1.633E+01
1.635E+01
1.595E+01
1.630E+01
1.434E+01
1.509E+01 | 6.140E-01
5.990E-01
6.540E-01
6.100E-01
7.060E-01
6.870E-01 | 3.341E-01
1.772E+00
4.691E-01
2.010E+00
3.423E-01
3.062E+00 | 6.448E+00
5.050E+00
7.083E+00
5.217E+00
7.416E+00
6.032E+00 | 2.340E+00
1.190E+00
2.430E+00
1.190E+00
2.620E+00
1.190E+00 |
| 51 - SB - 11
51 - SB - 12
51 - SB - 12
51 - SB - 12
51 - SB - 12
51 - SB - 12
51 - SB - 12 | 9 *
0 *
1
2
3
4 | 1.858E+01
1.834E+01
1.730E+01
1.772E+01
1.585E+01
1.696E+01 | 6.040E-01
6.016E-01
5.740E-01
5.500E-01
6.213E-01
5.600E-01 | 5.801E+00
3.366E+01
1.715E+00
1.346E+01
1.285E+00
1.090E+01 | 5.944E+00
4.659E+00
5.022E+00
3.517E+00
5.469E+00
3.433E+00 | 1.150E+00
0.0
1.240E+00
0.0
1.430E+00
0.0 |
| SYST:
REFERENCE
1) KAWAI
2) CHIBA
3) YAMAM
4) KUMAB
5) ENSDF
6) OHKUB
7) OHKUB
8) BOLOT | * = LI
S
, M. I
URO, I
E, I.
C, M.
O, M.
URO, M. | DP'S WERE
ET AL.: J.
ET AL.: JA
N.: JAERI-
ET AL.: N
LUATED NUC
ET AL.: J
ET AL.: J
ADD CHRI | DETERMINED
NUCL. SCI
ERI-M 92-0
M 90-006 (
UCL. SCI.
LEAR STRUC
AERI-M 93-
. PHYS. S
FN. R.F. | FROM SYST
. TECHNOL.
27, P.35 (
1990).
ENG., 104,
TURE DATA
012 (1993)
OC. JAPAN,
NUCL PHYS | EMATICS.
29, 195
1992).
280 (1990
FILE, BNL/I
33, 1185
42, 676 | (1992).
).
NNDC.
(1972).
(1963). |

8) BOLOTIN, H. AND CHRTEN, R.E.: NUCL. PHYS., 42, 676 (1963).
9) WYNCHANK, S., ET AL.: PHYS. REV., 166, 1234 (1968).
10) MURADJAN, G.V., ET AL.: JADERNO-FIZICHESKIE ISSLEDOVANIJA, 6, 64 (1968).
11) ADAMCHUK, JU.V., ET AL.: IAE-2108 (1971).
12) BELYAEV, F.N. ET AL.: "PROC. 6TH ALL UNION CONF. ON NEUTRON PHYSICS, KIEV 1983", VOL. 2, 366 (1983).
13) BAHT, M.R., ET AL.: "PROC. 3RD CONF. ON NEUTRON CROSS SECTIONS AND TECHNOL., KNOXVILLE 1971", VOL. 2, 785 (1971).
15) OHKUBO, M. ET AL.: J. PHYS. SOC. JAPAN, 33, 1185 (1972).

- 16) STOLVY, A. AND HARVEY, J.A.: PHYS. REV., 108, 353 (1957).
 17) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
 18) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 19) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77

- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 20) 21) 22) 23)
- W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 24) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 24) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 25) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 26) GRUPPELAAR, H.: ECN-13 (1977).
 27) PEREY, F.G.: PHYS. REV., 131, 745 (1963).
 28) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 29) LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
 30) BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971)
- PHENOMENA IN NUCL. REACTIONS, "UNIV. WISCONSIN PRESS, P.682 (1971).
 31) FOSTER JR.D.G. AND GLASGOW D.W.: PHYS. REV., C3, 576 (1971).
 32) SMITH, A.B. ET AL.: NUCL. PHYS., A415, 1 (1984).
 33) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 34) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).

MAT number = 5125 51-SB-121 JNDC EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-FEB94 HISTORY HISTORT 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 89-08 MODIFICATION FOR JENDL-3 WAS MADE/2/. 94-02 JENDL-3.2 CAPTURE CROSS SECTION MODIFIED BY JNDC FPND WG. OTHER DATA WERE ADOPTED FROM JENDL FUSION FILE. COMPILED BY T.NAKAGAWA ALL CROSS SECTIONS EXCEPT (3,105). (3,32) AND (3,33) WERE DELETED. ALL ANGULAR DISTRIBUTIONS EXCEPT FOR (4,2). ALL ANGULAR DISTRIBUTIONS. ALL ENERGY DISTRIBUTIONS. JENDL FUSION FILE /3/ (AS OF FEB. 1994) EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-II SYSTEM/4/ INCLUDING CONTRIBUTIONS FROM DIRECT REACTIONS. THE (N,2N), (N,3N), (N,NA), (N,NP), (N,P), (N,D) AND (N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103, 104, 107) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. THE (N,T) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103, 104, 107) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. THE (N,T) REACTION CROSS SECTION, RESONANCE PARAMETERS AND ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS WERE TAKEN FROM JENDL-3.1. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /5/ USING F15TOB /3/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS- II CODE SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2 KEV
RESONANCE PARAMETERS OF JENDL-2/1/ WERE REVISED EXCEPT FOR
RADIATION WIDTHS.
 EVALUATION OF JENDL-2 WAS MADE ON THE BASIS OF THE DATA
MEASURED BY BOLOTIN AND CHRIEN/7/, WYNCHANK ET AL./8/,
MURADJAN ET AL./9/, ADAMCHUK ET AL./10/ AND OHKUBO ET AL.
/11/ NEUTRON ORBITAL ANGULAR MOMENTUM L AND TOTAL SPIN J
WERE BASED ON THE DATA BY BHAT ET AL./12/ AND CAUVIN ET AL.
/13/ THE AVERAGE RADIATION WIDTH OF 0.089 EV WAS DEDUCED AND
APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN.
AFTER THAT, NEW EXPERIMENTAL DATA FOR NEUTRON WIDTHS AND
TOTAL SPIN J WERE PUBLISHED BY OHKUBO ET AL./14/ AND BELIAEV
ET AL./15/, RESPECTIVELY.
 EVALUATION OF JENDL-3 WAS PERFORMED ON THE BASIS OF THE
NEW DATA FOR THE NEUTRON WIDTHS AND SPIN J AND JENDL-2 FOR
THE RADIATION WIDTHS. TOTAL SPIN J OF SOME RESONANCES WAS
TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON
ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF
BOLLINGER AND THOMAS/16/. SCATTERING RADIUS OF 6.0 FM WAS
ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR
NEIGHBORING NUCLIDES.
UNRESOLVED PESONANCE PEGLON : 2 KEV = 100 KEV UNRESOLVED RESONANCE REGION : 2 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./17/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/18/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB FT AL FT AI

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV:

 $\ensuremath{\texttt{S0}}\xspace = 0.300\ensuremath{\texttt{E}}\xspace - 4\,,\ \ensuremath{\texttt{S1}}\xspace = 2.700\ensuremath{\texttt{E}}\xspace - 4\,,\ \ensuremath{\texttt{S2}}\xspace = 0.760\ensuremath{\texttt{E}}\xspace - 4\,,\ \ensuremath{\texttt{SG}}\xspace = 5.838\,\ensuremath{\texttt{FM}}\xspace.$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 9.582 -ELASTIC 3.590 -INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.

5.991

214

BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. FOR JENDL-3.1, ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SÉCTIONS WERE CALCULATED WITH PEGASUS/19/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/20/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/21/ ALPHA = HUIZENGA AND IGO/22/ DEUTERON = LOHR AND HAEBERLI/23/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/24/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/25/ WERE EVALUATED BY IIJIMA ET AL./26/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /27/.

FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE ELASTIC SCATTERING, CAPTURE AND (N,T) WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRON, PEREY OMP /28/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/29/ FOR ALPHA, LOHR-HAEBERLI OMP/30/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/31/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT

 $^{\circ}$ = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WITH THE MODIFIED WALTER-GUSS OMP/4/ WAS ADOPTED.

' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

. = 4, 51 - 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

| NO. | ENERGY(ME | V) SPIN-PARIT | Y (DIR | ECT | PROCESS) |
|--------|---------------|------------------------------|--------|--------|----------|
| GŖ. | 0.0 | $\frac{5}{2} +$ | | | |
| 1 | 0.0371 | 7/2 + | | * | |
| 2 | 0.5076 | 3/2 + | | ×
+ | |
| 3 | 0.5/31 | 1/2 + | | т
х | |
| 4 | 0.9470 | $\frac{9}{2} +$ | | * | |
| 5 | 1.0240 | 7/2 + | | ^ | |
| 6 | 1.0354 | 9/2 + | | | |
| 1 | 1.1393 | $\frac{11}{2} + \frac{7}{2}$ | | * | |
| õ | 1.1447 | 1/2 + | | | |
| 10 | 1.3002 | 9/2 +
5/2 - | | | |
| 10 | 1.4075 | J/2 +
7/2 - | | | |
| 12 | 1 4772 | $\frac{7}{2} + \frac{1}{2}$ | | * | |
| 13 | 1 4480 | 1/2 - | | | |
| LEVELS | ABOVE 1 449 M | EV WERE ASSUMED . | TO BE | OVER | LAPPING |

F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/32/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (54.5E-4) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 110 MILLI-BARNS AT 1 MEV WHICH WAS AN AVERAGE VALUE OF EXPERIMENTAL DATA OF TROFIMOV/33/ AND OUR PREVIOUS EVALUATION NORMALIZED TO 150 MB AT 500 KEV/34/.

AT = 16 (N,2N) CROSS SECTION AT = 17 (N,3N) CROSS SECTION AT = 22 (N,N'A) CROSS SECTION AT = 28 (N,N'P) CROSS SECTION AT =103 (N,P) CROSS SECTION AT =104 (N,D) CROSS SECTION AT =104 (N,D) CROSS SECTION AT =107 (N,ALPHA) CROSS SECTION ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO $MT = 16 \\ MT = 17 \\ MT = 22 \\ MT =$ MT = 28MT = 103MT = 104MT = 107(N,D)+(N,NP) 0.00415 B AT 14.5 MEV (SYSTEMATICS OF FORREST/35/), (N,A) 0.0036 B AT 14.9 MEV (SYSTEMATICS OF KONNO+/36/). AND THE (N,2N) CROSS SECTION WAS ADJUSTED TO THE ENERGY DISTRIBUTIONS OF EMITTED NEUTRONS (A FACTOR OF 1.27 WAS APPLIED). '=105 (N.T) CROSS SECTION THIS REACTION CROSS SECTION WAS CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. МΤ THE KALBACH'S CONSTANT K (= 145.3) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/37/ AND LEVEL DENSITY PARAMETERS. MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2CALCULATED WITH THE CASTHY CODE/20/. MT=16, 17, 22, 28, 51-91 TAKEN FROM JENDL FUSION FILE. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. << THE PARAMETERS USED IN THE CASTHY AND PEGASUS CALCULATIONS. >> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.678E+01 6.010E-01 2.387E+00 5.208E+00 1.150E+00 * 1.804E+01 6.064E-01 3.111E+01 4.636E+00 0.0 1.940E+01 5.340E-01 2.195E+00 4.999E+00 1.240E+00 * 1.757E+01 6.016E-01 2.330E+01 4.366E+00 0.0 49-IN-117 49 - IN - 118 49 - IN - 119 * 49-IN-120 50 - SN - 118 50 - SN - 119 50 - SN - 120 50 - SN - 121 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 1.635E+01 5.990E-01 1.772E+00 5.050E+00 1.190E+00 1.595E+01 6.540E-01 4.691E-01 7.083E+00 2.430E+00 1.630E+01 6.100E-01 2.010E+00 5.217E+00 1.190E+00

 51-SB-119
 *
 1.858E+01
 6.040E-01
 5.801E+00
 5.944E+00
 1.150E+00

 51-SB-120
 *
 1.834E+01
 6.016E-01
 3.366E+01
 4.659E+00
 0.0

 51-SB-121
 1.730E+01
 5.740E-01
 1.715E+00
 5.022E+00
 1.240E+00

 51-SB-122
 1.772E+01
 5.500E-01
 1.346E+01
 3.517E+00
 0.0

 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 9.25 FOR SB-121 AND 5.0 FOR SB-122. REFERENCES REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 3) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 4) YAMAMURO, N.: JAERI-M 90-006 (1990). 5) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).

| 6)
7)
8)
9) | ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
BOLOTIN, H., CHRIEN, R.E.: NUCL. PHYS., 42, 676 (1963).
WYNCHANK, S., ET AL.: PHYS. REV., 166, 1234 (1968).
MURADJAN, G.V., ET AL.: JADERNO-FIZICHESKIE ISSLEDOVANIJA, |
|--|--|
| 10)
11)
12)
13) | ADAMCHUK, JU.V., ET AL.: IAE-2108 (1971).
ADAMCHUK, JU.V., ET AL.: IAE-2108 (1971).
OHKUBO, M.,ET AL.: J. PHYS. SOC. JAPAN, 33, 1185 (1972).
BHAT, M.R., ET AL.: PHYS. REV., C2, 1115 (1970).
CAUVIN, B., ET AL.: "PROC. 3RD CONF. ON NEUTRON CROSS
SECTIONS AMO TECHNOL KNOXVILLE 1971" VOL 2 785 (1971) |
| 14)
15)
16) | OHKUBO, M. ET AL.: JAERI-M 93-012 (1993).
BELIAEV F.N. ET AL.: PROC. OF 6TH ALL UNION CONF. ON NEUTRON
PHYSICS, KIEV, OCTOBER 1983, VOL. 2, 366 (1983)
BOLLINGER L M AND THOMAS G. E. PHYS. REV. 171 1293(1968) |
| 17 | MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). |
| 19)
20) | I JIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1997).
I JIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
I JIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 |
| 21)
22)
23)
24) | (1983).
PEREY, F.G: PHYS. REV. 131, 745 (1963).
HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. |
| 25) | (1971).
GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965) |
| 26)
27)
28)
29)
30)
31) | IJJNA,
GRUPPELAAR, H.: ECN-13 (1977).
PEREY, F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION
PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 |
| 32)
33) | (1971).
BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
TROFIMOV, YU.N.: PROC. 1ST INT. CONF. NEUTRON PHYSICS, KIEF
1987 VOL 3 P 331 (1987) |
| 34)
35) | TOLSTIKOV, V.A., ET AL.: ATOMNAYA ENERGIYA, 24, 576 (1968).
FORREST, R.A.: AERE-R 12419 (1986). |

- 36) KÖNNÖ, C. ET AL.: JAERI 1329 (1993).
 37) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).

MAT number = 5131 51-SB-123 JNDC EVAL-AUG89 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-FEB94 HISTORY HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 89-08 MODIFICATION FOR JENDL-3 WAS MADE/2/. 94-02 JENDL-3.2 CAPTURE CROSS SECTION MODIFIED BY JNDC FPND WG. OTHER DATA WERE ADOPTED FROM JENDL FUSION FILE. COMPILED BY T.NAKAGAWA ALL ENERGY DISTRIBUTIONS JENDL FUSION FILE /3/ (AS OF FEB. 1994) EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-II SYSTEM/4/ INCLUDING CONTRIBUTIONS FROM DIRECT REACTIONS. THE (N,2N), (N,3N), (N,NA), (N,NP), (N,P), (N,D) AND (N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103, 104, 107) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. THE (N,T) REACTION CROSS SECTION, RESONANCE PARAMETERS AND ANG. DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS WERE TAKEN FROM JENDL-3.1. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /5/ USING F15TOB /3/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS- II CODE SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./4/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/6/. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.5 KEV
RESONANCE PARAMETERS OF JENDL-2/1/ WERE REVISED EXCEPT FOR
RADIATION WIDTHS.
EVALUATION FOR JENDL-2 WAS MADE ON THE BASIS OF THE DATA
MEASURED BY STOLVY AND HARVEY/7/, BOLOTIN AND CHRIEN/8/,
WYNCHANK ET AL./9/, MURADJAN ET AL./10/, ADAMCHUK ET AL./11/,
OHKUBO ET AL./12/ AND OHKUBO/13/. ANGULAR MOMENTUM L AND SPIN
J WERE BASED ON THE DATA BY BHAT ET AL./14/ AND CAUVIN ET AL.
/15/. THE AVERAGE RADIATION WIDTH OF 0.098 EV WAS DEDUCED AND
APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN.
NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL
CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL./16/
AFTER THE EVALUATION FOR JENDL-2. NEW EXPERIMENTAL DATA OF
NEUTRON WIDTHS WERE PUBLISHED BY OHKUBO ET AL./17/ EVALUATION
OF JENDL-3 WAS MADE ON THE BASIS OF THE NEW EXPERIMENTAL DATA AFOR THE NEUTRON WIDTHS AND PREVIOUS ONES FOR THE RADIATION
WITHDS AND TOTAL SPIN J. TOTAL SPIN J OF SOME RESONANCES WAS
TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON
WIGHER AND THOMAS/18/. SCATTERING RADIUS OF 6.0 FM WAS
ASSUMED FROM THE STEMATICS OF MEASURED VALUES FOR NEIGHBOR-ING NUCLIDES. PARAMETERS OF A NEGATIVE RESONANCE WAS
ASSUMED FROM THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBOR-ING NUCLIDES. PARAMETERS OF A NEGATIVE RESONANCE WERE
ALSO
MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS
SECTION/16/.
UNRESOLVED RESONANCE REGION : 2.5 KEV - 100 KEV

UNRESOLVED RESONANCE REGION : 2.5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./16/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/19/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB

| LI AL. | | | | | | |
|--|---|---|--|--|--|---|
| TYPICAL VA
S0 = 0.2
GG = 0.1 | LUES OF TH
50E-4, S1
00 EV, R | IE PARAMETI
= 2.700E-4
= 5.857 FI | ERS AT 70
4, S2 = 0
M. | KEV:
.760E-4, S | G = 26.6E-4 | 1, |
| CALCULATED
TOTAL
ELASTI
CAPTUR | 2200-M/S
2
C
E | CROSS SEC
200 M/S
8.086
3.899
4.187 | TIONS AND | RES. INTE
RES. I
-
123 | GRALS (BARI
NTEG. | NS) |
| MF = 3 NEUT
BELOW 100 | RON CROSS
Kev, reson | SECTIONS
IANCE PARAI | METERS WE | RE GIVEN. | | |
| FOR JENDL-
STATISTICA
TAKING ACC
WERE CALCU
AND MULTI-
IN TABLE 1
OF THE TOT
POTENTIAL/
PROTON
ALPHA
DEUTERO
HELIUM-
PARAMETERS
AND CAMERO
EXTENSIVE
PRESENT WO
IN THE PRE
PARAMETER
/28/. | 3.1, ABOVE
L MODEL CA
OUNT OF CC
LATED WITH
STEP EVAPC
WERE DETE
AL CROSS S
21/. THE
= HUIZE
N = LOHR A
3 AND TRIT
FOR THE C
N/26/ WERE
N/26/ WERE
N/26/ WERE
SENT CALCU
IN THE ENE | 100 KEV,
ALCULATION
MPETING RI
PRATION MOI
RATION BO
RATION BY
OMP'S FOR
22/
IGA AND IG
ON = BECCI
COMPOSITE
EVALUATED
ION AND M
2 SHOWS
ILATION. | THE SPHE
WAS PERF
EACTIONS,
20/ STAND
DEL. THE
AS TO CHANGING
CHARGED
D/23/
1/24/
HETTI AND
EVEL DEN
DIFICATI
THE LEVEL
ENERGY DE
BELOW E- | RICAL OPTI
ORMED WITH
OF WHICH
ING ON A P
OMP'S FOR
PRODUCE A
RSO OF II
PARTICLES
GREENLEES
GREENLEES
GREENLEES
SITY FORMU
MA ET AL./
ON WERE MA
DENSITY P
PENDENCE O
JOINT IS D | CAL AND
CASTHY B'
CROSS SECT
REEQUILIBR
NEUTRON G
SYSTEMATIC
JIMA-KAWAI
ARE AS FOLI
/25/
LA OF GILBI
27/ MORE
DE IN THE
ARAMETERS U
F SPIN CUT
UE TO GRUPI | Y
IONS
IVEN
TREND
LOWS:
ERT
JSED
OFF
PELAAR |

FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE ELASTIC SCATTERING, CAPTURE AND (N,T) WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/4/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/4/ FOR NEUTRON, PEREY OMP /29/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/30/ FOR ALPHA, LOHR-HAEBERLI OMP/31/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/32/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WITH THE MODIFIED WALTERGUSS OMP?4/ WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./6/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

| NO. | ENERGY(ME | V) | SPIN-PA | ARITY | (DIRECT | PROCESS) |
|---------------------------|---------------------|------|---|-------|---------|----------|
| GR.
1 | 0.0 | | 1/2 +
5/2 + | | * | |
| 2 | 0.5418 | | 3/2 + 3/2 + | | * | |
| 3 | 0.7128 | | 1/2 + | | | |
| 4 | 1.0302 | | 9/2 + | | * | |
| 5 | 1.0886 | | $\frac{9}{2} +$ | | * | |
| 6 | 1.1813 | | //2 + | | * | |
| / | 1.2609 | | $\frac{5}{2} + \frac{5}{2} + \frac{5}{2}$ | | * | |
| LEVELS ⁸ ABOVE | 1.3374
1.338 MEV | WERE | ASSUMED | TO BE | OVERLAF | PPING. |
| | _ | | | | | |

T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/33/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (24.2E-4) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 84 MB AT 1.0 MEV WHICH WAS AN AVERAGE VALUE OF EXPERIMENTAL DATA OF TROFIMOV/34/ AND OUR PREVIOUS EVALUATION NORMALIZED TO 100 MB AT 500 KEV/35/.

MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION

MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO MT = 22 MT = 28 MT =103 MT =104 MT =107 ΜT (N,D)+(N,NP) 0.00201 B AT 14.5 MEV (SYSTEMATICS OF FORREST/36/), (N,P) 0.0078 B AT 14.9 MEV (SYSTEMATICS OF KONNO+/37/). (N,A) 0.00225 B AT 14.9 MEV (SYSTEMATICS OF KONNO+/37/). AND THE (N,2N) CROSS SECTION WAS ADJUSTED TO THE ENERGY DISTRIBUTIONS OF EMITTED NEUTRONS (A FACTOR OF 1.16 WAS APPLIED). MT =105 (N,T) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 174.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/38/ AND LEVEL DENSITY PARAMETERS. MT = 251MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2CALCULATED WITH THE CASTHY CODE/21/. MT=16, 17, 22, 28, 51-91 TAKEN FROM JENDL FUSION FILE. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT = 16<< THE PARAMETERS USED IN THE CASTHY AND PEGASUS CALCULATIONS. >> TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 49-IN-119
 1.940E+01
 5.340E-01
 2.195E+00
 4.999E+00
 1.240E+00

 49-IN-120
 *
 1.757E+01
 6.016E-01
 2.330E+01
 4.366E+00
 0.0

 49-IN-121
 1.601E+01
 6.060E-01
 1.119E+00
 5.277E+00
 1.430E+00

 49-IN-122
 *
 1.707E+01
 5.968E-01
 1.737E+01
 4.092E+00
 0.0

 1.595E+01 6.540E-01 4.691E-01 7.083E+00 2.430E+00 1.630E+01 6.100E-01 2.010E+00 5.217E+00 1.190E+00 1.434E+01 7.060E-01 3.423E-01 7.416E+00 2.620E+00 1.509E+01 6.870E-01 3.062E+00 6.032E+00 1.190E+00 50 - SN - 120 50 - SN - 121 50 - SN - 122 50-SN-123 1.730E+01 5.740E-01 1.715E+00 5.022E+00 1.240E+00 1.772E+01 5.500E-01 1.346E+01 3.517E+00 0.0 1.585E+01 6.213E-01 1.285E+00 5.469E+00 1.430E+00 1.696E+01 5.600E-01 1.090E+01 3.433E+00 0.0 51-SB-121 51 - SB - 122 51 - SB - 123 51-SB-124 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.399 FOR SB-123 AND 5.0 FOR SB-124. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
3) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
4) YAMAMURO, N.: JAERI-M 90-006 (1990).
5) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
6) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.

| 7
8
9
10 |) STOLVY, A. AND HARVEY, J.A.: PHYS. REV., 108, 353 (1957).
) BOLOTIN, H. AND CHRIEN, R.E.: NUCL. PHYS., 42, 676 (1963).
) WYNCHANK, S., ET AL.: PHYS. REV., 166, 1234 (1968).
) MURADJAN, G.V., ET AL.: JADERNO-FIZICHESKIE ISSLEDOVANIJA, 6, |
|--|---|
| 11)
12)
13)
14) | 64 (1968).
) ADAMCHUK, JU.V., ET AL.: IAE-2108 (1971).
) OHKUBO, M., ET AL.: J. PHYS. SOC. JAPAN, 33, 1185 (1972).
) OHKUBO, M.: PRIVATE COMMUNICATION (1982).
) BHAT, M.R., ET AL.: PHYS. REV., C2, 1115.(1970). |
| 15)
16)
17) |) CAUVIN, B., ELAL.: "PROC. 3RD CONF. ON NEUTRON CROSS
SECTIONS AND TECHNOL., KNOXVILLE 1971", VOL. 2, 785 (1971).
) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). |
| 18
19
20
21 |) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
) IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
) JIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 |
| 22)
23)
24)
25) | (1983).
) PEREY, F.G: PHYS. REV. 131, 745 (1963).
) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS_((EDS)_H.HBARSHALL_AND |
| 26) | W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971).
) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965) |
| 27)
28)
29)
30)
31)
32) | (1903).
(IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
(GRUPPELAAR, H.: ECN-13 (1977).
PEREY, F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR, J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BECCHETTI, F.D. JR. AND GREENLEES G.W.: "POLARIZATION
PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 |
| 33)
34)
35)
36)
37)
38) | (1971).
) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
) TROFIMOV, YU.N.: PROC. 1ST INT. CONF. NEUTRON PHYSICS, KIEF
1987, VOL. 3, P.331 (1987).
) TOLSTIKOV, V.A., ET AL.: ATOMNAYA ENERGIYA, 24, 576 (1968).
) FORREST, R.A.: AERE-R 12419 (1986).
) FORREST, R.A.: AERE-R 12419 (1986).
) KONNO, C. ET AL.: JAERI 1329 (1993).
) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR |
| | REACTIONS, NORTH HULLAND (1900). |

MAT number = 5134 51-SB-124 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 2.54 EV - 100 KEV THE NEUTRON STRENGTH FUNCTION, SO, WAS ESTIMATED FROM THOSE OF OTHER SB ISOTOPES, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY AT 100 KEV. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.300E-4, S1 = 2.700E-4, S2 = 0.760E-4, SG = 211.E-4, GG = 0.100 EV, R = 5.700 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 21.16 -ELASTIC 3.760 -CAPTURE 17.40 156 F = 3 NEUTRON CROSS SECTIONS BELOW 2.54 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM THE COMPILATION BY MUGHABGHAB ET AL./4/ UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 2.54 EV TO 100 KEV. MF = 3KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/. MT ΝΟ. ENERGY(MEV) SPIN-PARITY GR. 0.0 3 -1 0.0107 5 + LEVELS ABOVE 0.041 MEV WERE ASSUMED TO BE OVERLAPPING. CAPTURE МТ 102 = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

| THE GAMMA-RAY STRENGTH FUNCTION (1.97E-02) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.1 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (5.08 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
|---|
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 176.9) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 3.53 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 1.91 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV)
V = 47.64-0.473E
WS = 9.744
VSO = 7.0
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 49-IN-120 * 1.757E+01 6.016E-01 2.330E+01 4.366E+00 0.0 49-IN-121 1.601E+01 6.060E-01 1.119E+00 5.277E+00 1.430E+00 49-IN-122 * 1.707E+01 5.968E-01 1.737E+01 4.092E+00 0.0 49-IN-123 1.470E+01 6.100E-01 1.134E+00 4.483E+00 1.090E+00 |
| 50-SN-1211.630E+016.100E-012.010E+005.217E+001.190E+0050-SN-1221.434E+017.060E-013.423E-017.416E+002.620E+0050-SN-1231.509E+016.870E-013.062E+006.032E+001.190E+0050-SN-1241.601E+016.160E-013.224E-016.294E+002.280E+00 |
| 51-SB-1221.772E+015.500E-011.346E+013.517E+000.051-SB-1231.585E+016.213E-011.285E+005.469E+001.430E+0051-SB-1241.696E+015.600E-011.090E+013.433E+000.051-SB-1251.700E+015.120E-017.883E-013.792E+001.090E+00 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 5.0 FOR SB-124 AND 7.267 FOR SB-125. |
| REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE |

AND TECHNOLOGY, MITO, P. 569 (1988). 3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).

- 4) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77

- 6) IIJIMA, S. AND KAMAL, (1983).
 7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
 8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
- W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 11) GILBERI, A. AND CAMERON, A.G.W. C.M. C. (1965).
 12) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 13) GRUPPELAAR, H.: ECN-13 (1977).
 14) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5137 51-SB-125 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 14 EV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS DETERMINED WITH THE LOCAL SYSTEMATICS/2/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED AT 100 KEV WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.300E\text{-}4, \ S1 = 2.500E\text{-}4, \ S2 = 0.680E\text{-}4, \ SG = 61.2E\text{-}4, \\ GG = 0.150 \ \text{EV}, \ R = 5.908 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S TOTAL 9.000 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 4.000 5.000 55.7 F = 3 NEUTRON CROSS SECTIONS BELOW 14 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THI CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMTICS FROM NEIGHBORING NUCLIDES. THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 5.4 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 14 EV TO 100 KEV. MF THF ABOVE 100 KEV. ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/ MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/. МТ NO. ENERGY(MEV) SPIN-PARITY 7/2 + 5/2 + 3/2 + 1/2 + 9/2 + 9/2 + 9/2 + 9/2 + 9/2 + 1/2 + 9/2 + 1/20.0 0.3321 0.6429 GŔ. 1 0.9216 3 4 11/2 +5 1.0892

| 10
11
12
13
14
15
15
17
17
17
17
17
17
17
17
17
17
17
17
17 | 5 1.3495
7 1.4197
3 1.4839
9 1.5914
0 1.7356
1 .8000
2 1.8063
3 1.8895
4 1.9472
5 1.9826
5 2.0018
7 2.1130
3 2.2007
9 2.2405
0 2.2531
1 2.2754
2 2.2880
3 2.2990
4 2.5150
5 2.6700
7 2.6780
3 2.7100
ABOVE 2.78 MEV WER | 7/2 +
9/2 +
3/2 +
7/2 +
3/2 +
1/2 +
9/2 +
11/2 -
9/2 +
11/2 -
9/2 +
9/2 +
9/2 +
9/2 +
9/2 +
9/2 +
9/2 +
1/2 -
1/2 -
1/2 -
1/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 +
5/2 +
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 -
1/2 +
1/2 +
1/2 -
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 +
1/2 + | PING. |
|--|--|--|--|
| MT = 102 (
SPHERICAL
CASTHY WA
SECTIONS
AND REFF(| CAPTURE
_ OPTICAL AND STATI
AS ADOPTED. DIRECT
WERE ESTIMATED ACC
D/15/ AND NORMALIZE | STICAL MODEL CALCULATIC
AND SEMI-DIRECT CAPTUR
ORDING TO THE PROCEDURE
D TO 1 MILLI-BARN AT 14 | DN WITH
RE CROSS
OF BENZI
MEV. |
| THE GAMMA
THE SYSTE
S-WAVE RE
LEVEL DEM | A-RAY STRENGTH FUNC
EMATICS OF RADIATIO
ESONANCE LEVEL SPAC
NSITY PARAMETERS. | TION (5.25E-03) WAS DET
N WIDTH (0.15 EV) AND T
ING (28.6 EV) CALCULATE | ERMINED FROM
HE AVERAGE
D FROM THE |
| MT = 16 (M
MT = 17 (M
MT = 28 (M
MT = 32 (M
MT = 33 (M
MT = 103 (M
MT = 104 (M
MT = 107 (M
THESE REA
PREEQUIL | N,2N) CROSS SECTION
N,3N) CROSS SECTION
N,N'A) CROSS SECTIO
N,N'P) CROSS SECTIO
N,N'D) CROSS SECTIO
N,P) CROSS SECTION
N,P) CROSS SECTION
N,P) CROSS SECTION
N,T) CROSS SECTION
N,T) CROSS SECTION
N,ALPHA) CROSS SECT
ACTION CROSS SECTIO
IBRIUM AND MULTI-ST | N
N
N
N
NS WERE CALCULATED WITH
EP EVAPORATION MODEL CO | I THE
DE PEGASUS. |
| THE KALBA
FORMULA D
DENSITY F | ACH'S CONSTANT K (=
DERIVED FROM KIKUCH
PARAMETERS. | 181.2) WAS ESTIMATED E
I-KAWAI'S FORMALISM/16/ | BY THE
AND LEVEL |
| FINALLY,
NORMALIŻE
(N,P)
(N,ALPH | THE (N,P) AND (N,A
ED TO THE FOLLOWING
2.58 MB (
1A) 1.45 MB (| LPHA) CROSS SECTIONS WE
VALUES AT 14.5 MEV:
SYSTEMATICS OF FORREST/
SYSTEMATICS OF FORREST) | ERE
(17/) |
| MT = 251 M
CALCULATE | MU-BAR
ED WITH CASTHY. | | |
| MF = 4 ANGUL
LEGENDRE PC
GIVEN IN TH
TIC LEVELS,
CALCULATED
BUTIONS IN | LAR DISTRIBUTIONS O
DLYNOMIAL COEFFICIE
HE CENTER-OF-MASS S
, AND IN THE LABORA
WITH CASTHY. FOR
THE LABORATORY SYS | F SECONDARY NEUTRONS
NTS FOR ANGULAR DISTRIE
YSTEM FOR MT=2 AND DISC
TORY SYSTEM FOR MT=91.
OTHER REACTIONS, ISOTRO
TEM WERE ASSUMED. | BUTIONS ARE
RETE INELAS-
THEY WERE
OPIC DISTRI- |
| MF = 5 ENERC
ENERGY DIST
PEGASUS FOF
OTHER NEUTF | BY DISTRIBUTIONS OF
TRIBUTIONS OF SECON
R INELASTIC SCATTER
RON EMITTING REACTI | SECONDARY NEUTRONS
DARY NEUTRONS WERE CALC
ING TO OVERLAPPING LEVE
ONS. | ULATED WITH |
| TABLE 1 NEUT | FRON OPTICAL POTENT | IAL PARAMETERS | |
| V =
WS =
VSO=
THE FORM OF | DEPTH (MEV)
47.64-0.473E
9.744
7.0
SURFACE ABSORPTIO | RADIUS(FM) DIFFUS
R0 = 6.256 A0 = C
RS = 6.469 AS = C
RS0= 6.241 AS0= C
N PART IS DER. WOODS-SA | SENESS(FM)
0.62
0.35
0.62
0.62
0.00 TYPE. |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLID | E SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|--|--|---|---|--|--|--|
| 49 - IN -
49 - IN -
49 - IN -
49 - IN - | 121
122 *
123
124 | 1.601E+01
1.707E+01
1.470E+01
1.655E+01 | 6.060E-01
5.968E-01
6.100E-01
5.240E-01 | 1.119E+00
1.737E+01
1.134E+00
6.345E+00 | 5.277E+00
4.092E+00
4.483E+00
2.747E+00 | 1.430E+00
0.0
1.090E+00
0.0 |
| 50 - SN -
50 - SN -
50 - SN -
50 - SN -
50 - SN - | 122
123
124
125 | 1.434E+01
1.509E+01
1.601E+01
1.591E+01 | 7.060E-01
6.870E-01
6.160E-01
6.210E-01 | 3.423E-01
3.062E+00
3.224E-01
1.927E+00 | 7.416E+00
6.032E+00
6.294E+00
5.249E+00 | 2.620E+00
1.190E+00
2.280E+00
1.190E+00 |
| 51 - SB -
51 - SB -
51 - SB -
51 - SB -
51 - SB - | 123
124
125
126 | 1.585E+01
1.696E+01
1.700E+01
1.700E+01 | 6.213E-01
5.600E-01
5.120E-01
5.250E-01 | 1.285E+00
1.090E+01
7.883E-01
7.566E+00 | 5.469E+00
3.433E+00
3.792E+00
2.897E+00 | 1.430E+00
0.0
1.090E+00
0.0 |
| SYST: | * = LI | DP'S WERE | DETERMINED | FROM SYSTE | MATICS. | |
| SPIN C
IN THE
ASSUME | UTOFF P
CASTHY
D TO BE | ARAMETERS
CALCULATI
7.267 FOR | NERE CALCUI
DN, SPIN CU
SB-125 ANI | ATED AS 0.
JTOFF FACTO
5.0 FOR S | .146*SQRT(#
)RS AT 0 ME
SB-126. | A)*A**(2/3).
EV WERE |
| REFEREN
1) KAW,
AND
2) MUG
PAR
3) IGA
4) IIJ
5) IIJ | CES
AI, M.
TECHNO
HABGHAB
T A", A(
RASI, S
IMA, S.
IMA, S.
83) | ET AL.: PRO
LOGY, MITO
S F ET
CADEMIC PRO
: J. NUCL
ET AL.: J,
AND KAWAI | DC. INT. C(
, P. 569 (7
AL.: "NEUTF
ESS (1981)
SCI. TECH
AERI-M 87-(
, M.: J. NI | DNF. ON NUC
1988)
Ron Cross s
Inol., 12,
225, P. 337
JCL. SCI. 1 | CLEAR DATA
SECTIONS, V
67 (1975)
(1987),
FECHNOL., 2 | FOR SCIENCE
/OL. I,
20, 77 |
| 6) PER
7) HUI
8) LOH
9) BEC
PHE
W. | ĚÝ, F.G
ZENGA,
R, J.M.
CHETTI,
NOMENA
HAEBERL | : PHYS. RE'
J.R. AND I
AND HAEBE
F.D., JR.
IN NUCLEAR
I), P. 682 | V. 131, 748
GO, G.: NUC
RLI, W.: NU
AND GREENI
REACTIONS
, THE UNIVE | 5 (1963).
CL. PHYS. 2
JCL. PHYS.
LEES, G.W.:
((EDS) H.H
ERSITY OF V | 29, 462 (19
A232, 381
POLARIZAT
BARSHALL
VISCONSIN F | 962).
(1974).
[ION
AND
PRESS. |
| 10) GIL | BERT, A | . AND CAME | RON, A.G.W. | .: CAN. J. | PHYS., 43 | , 1446 |
| 11) IIJ
12) GRU
13) ENS
14) NUC
15) BEN
16) KIK
REA | IMA, S.
PPELAAR
DF: EVA
LEAR DA
ZI, V.
UCHI, K
CTIONS" | , ET AL.: ,
H.: ECN-
LUATED NUC
TA SHEETS,
AND REFFO,
. AND KAWÅ
, NORTH HO | J. NUCL. S(
13 (1977).
LEAR STRUC
32, 497 (1
G.: CCDN-1
G.: CCDN-1
I, M.: "NU(
LLAND (1968 | CI. TECHNOL
TURE DATA F
1981).
WW/10 (1969
CLEAR MATTE
3). | 21, 10
FILE (JUNE
9).
ER AND NUCL | (1984).
1987).
_EAR |

17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5225 52-TE-120 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 68 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.970E-4, S1 = 1.700E-4, S2 = 1.100E-4, SG = 7.72E-4, GG = 0.100 EV, R = 5.376 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 5.980 TOTAL ELASTIC CAPTURE 2.340 22.5 F = 3 NEUTRON CROSS SECTIONS BELOW 68 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. TH CAPTURE CROSS SECTION AT 0.0253 WAS ADOPTED FROM REF./3/ AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 5.4 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 68 EV TO 100 KEV. MF = 3THE 5.4 ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL /5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). - = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT SHEETS/14/. ENERGY(MEV) SPIN-PARITY NO. GŔ. 0.0 02 + + 1.1031 ż ō + 3 4 4 2 6 3 1.2017 + 1.7762 5 + 6 1.8635 + 7 2.0834 3

8 2.1085 1 + LEVELS ABOVE 2.202 MEV WERE ASSUMED TO BE OVERLAPPING. ΜT 102 CAPTURE = = 102 CAPTORE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (7.41E-04) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.1 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (135 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =106 (N,HE3) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MT MT = 22MT = 28MT = 32МΤ ŇТ ŇТ ΜT MT THE KALBACH'S CONSTANT K (= 135.2) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 26.60 MB (SYSTEMATICS OF FORREST/17/) (N,ALPHA) 12.30 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BARCALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - - - -- - - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.529E+01 6.680E-01 3.763E-01 7.111E+00 2.510E+00 1.583E+01 5.960E-01 1.352E+00 4.804E+00 1.190E+00 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 1.635E+01 5.990E-01 1.772E+00 5.050E+00 1.190E+00 50-SN-116 50-SN-117 50-SN-118 50-SN-119 * 1.902E+01 6.089E-01 5.934E+00 6.380E+00 1.320E+00 * 1.880E+01 6.064E-01 4.497E+01 4.927E+00 0.0 * 1.858E+01 6.040E-01 5.801E+00 5.944E+00 1.150E+00 * 1.834E+01 6.016E-01 3.366E+01 4.659E+00 0.0 51-SB-117 51 - SB - 118 51 - SB - 119 51 - SB - 120 1.918E+01 6.064E-01 9.376E-01 7.533E+00 2.460E+00 1.819E+01 6.210E-01 6.418E+00 6.117E+00 1.140E+00 1.700E+01 5.940E-01 3.471E-01 6.309E+00 2.290E+00 1.800E+01 6.200E-01 5.720E+00 6.022E+00 1.140E+00 52 - TE - 118 52 - TE - 119 52 - TE - 120 52-TE-121 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).

IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.375 FOR TE-120 AND 5.0 FOR TE-121.

REFERENCES

- (EFERENCES)
 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 3) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

- 6)
- 7)
- IIJIMA, S. AND KAWAI, M.. J. NUCL. SCI. LEGINGEL, 20, ... (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9)
- . на 1971 (1971). 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) GILBERI, A. AND CAMERON, A.G.M. C.M. C. M. C. (1965).
 11) IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 14) NUCLEAR DATA SHEETS, 17, 39 (1976).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KINUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5231 52-TE-122 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY # = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 11 KEV RESONANCE PARAMETERS IN THE ENERGY REGION BELOW 2.7 KEV WERE TAKEN FROM JENDL-3.1 WITH SLIGHT MODIFICATION AND THOSE ABOVE 2.7 KEV WERE NEWLY EVALUATED FOR JENDL-3.2. FOR JENDL-3.1, RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ THE LEVELS ONLY WHOSE RESONANCE ENERGY WAS REPORTED WERE ASSUMED TO BE P-WAVE RESONANCES AND A REDUCED NEUTRON WIDTH OF 23 MEV WAS TENTATIVELY GIVEN FOR THOSE LEVELS. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH WAS DEDUCED TO BE 154 MEV, AND APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL. MF AL. FOR JENDL-3.2, NEUTRON AND RADIATION WIDTH WERE DETERMINED FROM THE NEUTRON WIDTHS MEASURED BY TELLIER ET AL./4/ AND THE CAPTURE AREA DATA BY MACKLIN AND WINTERS/5/ IN THE ENERGY RANGE ABOVE 2.7 KEV. THE AVERAGE RADIATION WIDTH OF 0.073 EV GIVEN BY MACKLIN AND WINTERS WAS APPLIED TO THE LEVELS WHOSE RADIATION WIDTH HAD NOT BEEN DETERMINED FROM THE EXPERIMENTS. THE AVERAGE VALUE OF 0.154 EV OF JENDL-3.1 WAS REPLACED WITH AL. 0.0733 EV. UNRESOLVED RESONANCE REGION : 5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY/6/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.830E-4, S1 = 1.700E-4, S2 = 1.100E-4, SG = 6.67E-4, GG = 0.140 EV, R = 5.490 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.980 -ELASTIC 2.605 -CAPTURE 3.375 80.2 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE . WERE

PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA SHEETS/17/.

| NO.
GR. | ENERGY(ME
0.0 | V) | SPIN-P/
0 + | RIT | ΓY | |
|--------------|------------------|------|----------------|-----|----|-------------|
| 1 2 | 0.5640 | | 2 + | | | |
| 3 | 1.2568 | | 2 + | | | |
| 5 | 1.7500 | | 6 + | | | |
| LEVELS ABOVE | 1.753 MEV | WERE | ASSUMED | 10 | ВE | OVERLAPPING |

MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

THE GAMMA-RAY STRENGTH FUNCTION (6.36E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 155 MILLI-BARNS AT 90 KEV MEASURED BY MACKLIN AND WINTERS/5/.

| | $\begin{array}{rrrr} MT &= \\ MT &= \\ MT &= \\ MT &= 1 \\ MT &= 1 \\ MT &= 1 \\ MT &= 1 \\ MT &= 1 \\ THE \\ PRE \end{array}$ | 16
17
22
03
04
05
06
07
SE
U | (N
(N
(N
(N
(N
(N
(N
(N
(N
(N
(N)
(N)
(N | , 2N)
, 3N)
, N'A
, P)
, T)
, T
, ALP
CTIO
BRIU | CRO
CRO
CROS
CROS
CROS
CROS
CROS
CROS
CR | SS
SSS
SSS
SSS
SSS
SSS
SSS
SSS
SSS
SSS | SECT
SECT
SECT
SECTI
ECTI
ECTI
SS
SS
SEC
ULTI | ION
TIC
ON
ON
EECT
C | N
N
N
N
N
N
N
N
S
N
S
N
S
N
S | N
WER
EVA | E (
POF | CALC | CULA | TED | WI ⁻ | TH T
CODE | HE
PEG | ASUS. |
|-----|--|---|--|---|--|---|--|--|---|---|---------------------------------|---|---|--------------------------------|---------------------------------|-----------------------------|-----------------------------|--------------------------------|
| | THE
FOR
DEN | KAI
MUL/
ISIT | LBA(
A DI
Y P/ | CH'S
ERIV
ARAM | CON
ED F
ETER | STAI
ROM
S. | NT K
KIK | (=
UCH | = 12
 - | 25.8
(AWA | 5) V
(1'5 | VAS
6 FC | EST
)RMA | IMA
LISM | ΓED
//19 | BY
9/ A | THE
ND L | EVEL |
| | FIN
NOR
(| IALL`
MAL
N,P
N,AI | Y -
IŻEI
)
LPH/ | THE
D To
A) | (N,P
THE
1 |) Al
FO
0.5
6.7 | ND (
LLOW
D N
6 N | N, A
INC
IB (
IB (| LPH
VA
(REC
(SYS | HA)
ALUE
COMM
STEM | CRC
S A
IENE
IAT I |)SS
AT 1
)ED
 CS | SEC
4.5
BY
OF | TION
ME
FORF
FORF | NS N
/:
REST
REST | WERE
T/20
T/20 |)/)
)/) | |
| | MT =
CAL | 251
CUL/ | ATEI | J-BA
D WI | R
TH C | AST | HY. | | | | | | | | | | | |
| M F | E = 4
LEGEN
GIVEN
TIC L
CALCU
BUTIC | AN(
IDRE
I IN
EVEI
ILATI
NS | GUL/
POI
THI
LS,
ED <u>\</u>
IN | AR D
LYNO
E CE
AND
WITH
THE | ISTR
MIAL
NTER
IN
CAS
LABO | I BU
COI
- OF
THE
THY
RAT | TION
EFFI
- MAS
LAE
ORY | IS
CIE
S
OR
OR
S
Y S | OF
ENTS
SYST
ATOF
OTH
STEN | SECO
FO
EM
RY S
HER
M WE | NDA
FOF
SYST
REA
RE | ARY
ANGL
MT
FEM
ACTI
ASS | NEU
JLAR
=2
FOR
ONS
SUME | TRON
DIS
AND
MT=
D | NS
5TR
DIS
=91
50TF | I BUT
SCRE
T
ROP I | TONS
TE I
HEY
C DI | ARE
NELAS-
WERE
STRI- |
| MF | = 5
ENERG
PEGAS
OTHER | ENI
Y D
US I
NEI | ERG`
ISTI
FOR
UTR(| Y DI
RIBU
INE
ON E | STRI
TION
LAST
MITT | BUT
SOI
IC
ING | IONS
F SE
SCAT
REA | OF
CON
TEF | SE
NDAF
RING | CON
Y N
TO | IDAF
IEUT
) O\ | RY N
TRON
/ERL | IEUT
IS W
APP | RONS
ERE
ING | CAI
LE | LCUL | ATED
AND | WITH
FOR |

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|---|--|---|
| V = 45.97 - 0.199E
WS = 6.502
VSO = 7.0
THE FORM OF SUPERCE ABSORDTION | R0 = 6.481
RS = 6.926
RS0 = 6.49
RS0 = 1000 | A0 = 0.62
AS = 0.35
AS0= 0.62
WOODS SAYON TYPE |
| THE FORM OF SURFACE ADSORFITON | FART IS DER. | WOODS-SAXON TIPE. |

TABLE 2 LEVEL DENSITY PARAMETERS

NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.633E+01 6.140E-01 3.341E-01 6.448E+00 2.340E+00 1.635E+01 5.990E-01 1.772E+00 5.050E+00 1.190E+00 1.595E+01 6.540E-01 4.691E-01 7.083E+00 2.430E+00 1.630E+01 6.100E-01 2.010E+00 5.217E+00 1.190E+00 50-SN-118 50 - SN - 119 50 - SN - 120 50 - SN - 121

 51-SB-119
 *
 1.858E+01
 6.040E-01
 5.801E+00
 5.944E+00
 1.150E+00

 51-SB-120
 *
 1.834E+01
 6.016E-01
 3.366E+01
 4.659E+00
 0.0

 51-SB-121
 1.730E+01
 5.740E-01
 1.715E+00
 5.022E+00
 1.240E+00

 51-SB-122
 1.772E+01
 5.500E-01
 1.346E+01
 3.517E+00
 0.0

 1.700E+01 5.940E-01 3.471E-01 6.309E+00 2.290E+00 1.800E+01 6.200E-01 5.720E+00 6.022E+00 1.140E+00 1.705E+01 6.350E-01 6.339E-01 7.160E+00 2.380E+00 1.874E+01 5.850E-01 4.619E+00 5.627E+00 1.140E+00 52 - TE - 120 52 - TE - 121 52 - TE - 122 52-TE-123 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.524 FOR TE-122 AND 4.266 FOR TE-123. REFERENCES (FFERENCES)
(AWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
(AWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981).
(ACADEMIC PRESS (1981). Μ. ,<u>1</u>29<u>3(</u>1968). MACKLIN, R.L. AND WINTERS, R.R.: ORNL-6561 (1988). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 5) 6) 8) IIJIMA, S. AND NAWAI, W.. G. NOCL. 1 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 9) 10) 11) 12) (1971) 13) ĢILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND GAMERUN, A.G.W.. GAN. J. THIG., 40, 1110 (1965).
14) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
17) NUCLEAR DATA SHEETS, 49, 315 (1986).
18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5234 52-TE-123 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-SEP93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-09 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 700 EV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH WAS DEDUCED TO BE 107 MEV, AND APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. THE SCATTERING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL. UNRESOLVED RESONANCE REGION : 0.7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTIONS CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.790E\text{-}4, \ S1 = 1.700E\text{-}4, \ S2 = 1.100E\text{-}4, \ SG = 80.9E\text{-}4, \\ GG = 0.124 \ \text{EV}, \ R = 5.519 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 418.7 -ELASTIC 0.5894 -CAPTURE 418.1 5650 (N,ALPHA) 4.6E-05 INTEGRALS (BARNS) (N,ALPTA) 4.0E-U5 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. TOTAL MT = 1SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING

SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| LEV | NO.
GR.
2
34
5
6
7
8
9
10
11
12
12
14
15
A
/ELS A | BOVE | ENE
0.
0.
0.
0.
0.
0.
0.
0.
0.
0.
1.
1.
1.
21 | RGY(
01590244007
244007
5599805
568975
568975
6697636
6697636
78946
6697636
78946
669763
669763
669763
669763
66976
89966
66200
89966
6200
89966
6200
89966
8990
89966
8000
8000
8000
8000 | WEV) | E AS | SPI
3/
13/
5/
3/
3/
3/
3/
SUW | P+++++++++++++++++++++++++++++++++++++ | ARIT
TO E | Υ
8Ε Ο | VER | LAPF | PING. | | |
|--|--|---|---|--|--|--|---|--|--|--|---------------------------------|-------------------------------------|---|-------------------------------|---------------------------|
| MT = 10
SPHEF
CASTF
SECT
AND F |)2 CA
RICAL
HY WAS
IONS W
REFFO/ | PTURE
OPTIC
ADOP
ERE E
16/ A | AL A
TED.
STIM | ND S
DI
ATED
ORMA | TATI
RECT
ACC
LIZE | STIC
AND
ORDI
D TC | CAL
DSE
ING
D1 | MOD
MI-
TO
MIL | EL C
DIRE
THE
LI-E | ALC
CT
PRO
BARN | ULA
CAP
CED
AT | TION
TURE
URE
14 | N WIT
CRC
OF E
MEV. | H
SS
SENZ | I |
| THE C
REPRO
KEV M | GAMMA-
DDUCE
MEASUR | RAY S
THE C
ED BY | TREN
APTU
MAC | GTH
RE C
KLIN | FUNC
ROSS
ET | TION
SEC
AL./ | N (7
CTIC
/17/ | .93
N 0 | E-03
F 55 | 8) W
53 M | AS
ILL | ADJL
I-BA | USTED
ARNS | AT T | 70 |
| MT = 16
MT = 17
MT = 22
MT = 22
MT = 32
MT = 103
MT = 104
MT = 106
MT = 106
MT = 107
THESE
PREE | 6 (N,,
23 (N,,
23 (N,,
23 (N,,
23 (N,,
23 (N,,
24 (N,,
24 (N,,
25 (N,,
26 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,,
27 (N,)))))))))))))))))))))))))))))))))))) | 2N) CC
3N) CC
N'A)
N'P)
D) CR
D) CR
T) CR
ALPHA
TION
FRIUM | CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS | SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS | TION
TION
CTIO
CTIO
ION
ION
CTIO
SECT
CTIO
CTIO | N
N
I ON
NS
EP | VERE | CA | LCUL | ATE
I MO | D W
DEL | I TH
COE | THE
DE PE | GASI | US. |
| THE FORMU
DENS | (ALBAC
JLA DE
ITY PA | H'S C
RIVED
RAMET | ONST
FRO
ERS. | ANT
M KI | K (=
KUCH | 149
I-K/ | 9.5)
AWA1 | WA
S | S ES
FORM | STIM
IALI | ATE
SM/ | D BY
18/ | ′THE
AND | LEVI | EL |
| FINAL
NORMA
(N
(N | _LY, T
ALIŻED
,P)
,ALPHA | ΉΕ (Ν
ΤΟ Τ
λ) | I,P)
HE F
10.
5. | AND
OLLO
60
05 | (N,A
WING
MB (
MB (| LPH/
VAL
SYS1
SYS1 | A) C
_UES
FEMA
FEMA | ROS
AT
TIC
TIC | S SE
14.
S OF
S OF | CTI
5 M
F0
F0 | ONS
EV:
RRE
RRE | WEF
ST/1
ST) | RE
9/) | | |
| THE
RESON
1.15E
THE
ABOVE
PEGAS | (N,ALP
NANCE
-8 EV
CROSS
0.7
SUS CA | HA) C
PARAN
SECTI
KEV,
LCULA | ROSS
ETER
S TO
ON W
THE
TION | SEC
S, B
REP
AS A
CROS | TION
YAS
RODU
VERA
SSE | BEL
SUMI
CE 1
GED
CTIC | -OW
ING
THE
IN
DN W | 0.7
A M
THE
SUI
AS | KEV
EAN
RMAL
TABL
CONN | / WA
ALP
CR
E E
IECT | S C
HA
OSS
NER
ED | ALCU
WIDT
SEC
GY I
SMOC | JLATE
H OF
CTION
NTER
OTHLY | D FI | ROM
Š
ŤHE |
| MT = 25
CALCU | 51 MU
JLATED | -BAR
WITH | I CAS | THY. | | | | | | | | | | | |
| MF = 4 A
LEGENDF
GIVEN
TIC LEV
CALCULA
BUTIONS | ANGULA
RE POL
IN THE
/ELS,
ATED W
S IN T | R DIS
YNOMI
CENT
AND I
ITH C
HE LA | AL C
ER-O
N TH
ASTH
BORA | UTIO
OEFF
F-MA
E LA
Y
TORY | NS O
ICIE
SS S
BORA
FOR
SYS | F SE
NTS
YSTE
TORN
OTHE
TEM | ECON
FOR
M F
Y SY
ER R
WER | DAR
OR
STE
EAC
E A | Y NE
GULA
MT=2
M FC
TION
SSUN | UTR
R D
AN
R M
IS,
IED. | ONS
IST
D D
T=9
ISO | RIBU
ISCF
1.
TROF | UTION
RETE
THEY
PIC D | IS AI
INEI
WEI
DISTI | RE
LAS -
RE
RI - |
| MF = 5 E
ENERGY
PEGASUS
OTHER N | ENERGY
DISTR
FOR
NEUTRO | Í DIST
IBUTI
INELA
N EMI | RIBU
ONS
STIC
TTIN | TION
OF S
SCA
G RE | S OF
ECON
TTER
ACTI | SEC
DARY
ING
ONS | COND
Y NE
TO | ARY
UTR
OVE | NEU
ONS
RLAF | UTRO
WER
PPIN | NS
E C
G L | ALCU
EVEL | JLATE
S AN | D W
ID F(| ITH
OR |
| TABLE 1 | NEUTR | ON OF | TICA | L PO | TENT | IAL | PAR | AME | | 5 | חור | | NESS | | \ |
| | | UCP | | ₩EV) | | г
- | · | | | | | | . NE 33 | | / |

| Т | HE | V
W
V
FOR | S =
S0=
M 0 | 4 4
6
7
9 F | 5.9
.50
.0
SUF | 97 -
)2
RFA | 0.
CE | 199
AB | E
SOF | RP1 | .10 | n f | R(
RS
RS
PAF |) :
30:
77 | = (
= (
= (| 6.4
6.9
6.4 | 481
926
49
DER | ; | WO | AO
AS
AS(
OD; | =
=
0=
S - 3 | 0
0
0
SA) | 62
35
62
(0N | Т | YPE | Ξ. | |
|-----------------------|--------------------------------------|---|--|----------------------|-------------------------------------|-----------------------------|--------------------------|--------------------------------|-------------------------------------|----------------------------------|-----------------------|------------------------------|--------------------------------|---|-------------------------------|------------------------------------|------------------------------------|------------------------|--------------------------|------------------------------|-----------------------------------|--------------------------------|-----------------------|----------------------|---------------------------------|----------|----|
| ТАВ | LE | 2 | LEV | EL | DE | INS | ١T | ΥP | ARA | ΛMΕ | TE | RS | | | | | | | | | | | | | | | |
| NU | CLI | DE | SY | ST | A (| (1/ | ME | /) | Т(| ME | V) | | (| C (' | 1/1 | ME' | V) | E | X (| ME | V) | | PA | IR | ING | ;
 | |
| 50
50
50
50 | - SN
- SN
- SN
- SN | - 11
- 12
- 12
- 12 | 9
0
1
2 | | 1 .
1 .
1 .
1 . | 63
59
63
43 | 5E-
5E-
0E-
4E- | ⊦01
⊦01
⊦01
⊦01 | 5.
6.
6.
7. | 99
54
10 | 0E
0E
0E
0E | - 01
- 01
- 01
- 01 | | 1.
4.(
2.(
3.4 | 772
69
01(
423 | 2 E ·
1 E
0 E ·
3 E | +00
-01
+00
-01 |) 5
7
5
7 | . 0
. 0
. 2
. 4 | 50
83
17
16 | E+(
E+(
E+(
E+(| 00
00
00
00 | 1.
2.
1.
2. | 19
43
19
62 | 0E+
0E+
0E+
0E+ | 00 | |
| 51
51
51
51 | - SB
- SB
- SB
- SB | - 12
- 12
- 12
- 12 | 0
1
2
3 | * | 1.
1.
1.
1. | 83
73
77
58 | 4E-
0E-
2E-
5E- | ⊦01
⊦01
⊦01
⊦01 | 6.
5.
5. | 01
74
50
21 | 6E
0E
0E
3E | - 01
- 01
- 01
- 01 | | 3 . ;
1 . ;
1 . ; | 360
719
340
289 | 6 E ·
5 E ·
6 E · | +01
+00
+01
+00 | 4
5
3
5 | . 6
. 0
. 5
. 4 | 59
22
17
69 | E+(
E+(
E+(
E+(| 00
00
00
00 | 0.
1.
0.
1. | 0
24
0
43 | 0E+
0E+ | 00
00 | |
| 52
52
52
52 | - TE
- TE
- TE
- TE
- TE | - 12
- 12
- 12
- 12 | 1
2
3
4 | | 1 .
1 .
1 .
1 . | 80
70
87
78 | 0E-
5E-
4E-
4E- | ⊦01
⊦01
⊦01
⊦01 | 6.
6.
5. | 20
35
85
74 | 0E
0E
0E
0E | - 01
- 01
- 01
- 01 | | 5.
5.
4.
1. | 72(
339
619
452 | 0 E ·
9 E ·
9 E · | +00
-01
+00
+00 |) 6
7
) 5
) 8 | . 0
. 1
. 6
. 4 | 22
60
27
79 | E+(
E+(
E+(
E+(| 00
00
00
00 | 1.
2.
1.
2. | 14
38
14
57 | 0E+
0E+
0E+
0E+
0E+ | 00 | |
| S | YST | : | * = | L | DP' | S | WE | RE | DET | EF | MI | NED | D | R | ЭМ | S | YST | EM | ΑT | I C | s . | | | | | | |
| SP
IN
AS | IN
TH
SUM | CUT
E C
ED | OFF
AST
TO | Ρ/
ΗΥ
ΒΕ | ARA
CA
4. | ME
LC
26 | TEI
UL/
6 I | RS
ATI
FOR | WEF
ON,
TE | RE
5
- 1 | CA
5 P I
2 3 | LCL
N (
AN | JL/
CU
ND | ATI
FOI
3 | ED
FF
.99 | A
F
91 | S C
ACT
FC | 0 R
0 R | 46
S
TE | * S(
AT
- 12 | QR ⁻
0
24 | Т(/
Ме | \)*
V | A*
WE | * (2
RE | 2/3 |). |
| REF
1)
2) | ERE
KA
MU
PA | NCE
WAI
GHA
RT | S
, M
BGH
A", | I.I
AB
A(| ET
Sad | AL
G.F
DEM | ic ⁱ | J.
ET
PR | NL
AL.
ESS | | "N
19 | SC
EU
81) | I.
FR(| TI
DN | ECI | HN(
ROS | OL.
SS | ŚΕ | 29
CT | i oi | 19:
NS | 5 (
, \ | (19
/0L | 92 |).
1, | | |
| 3)
4)
5)
6) | B0
 G
 | LLI
ARA
JIM
JIM | NGÉ
SI,
A,
A, | R
S
S
S | L.
- 4
ET
AN | M.
ND
AND
A
ND | AI
Fl
L.
KA | ND
JKA
: J
VAI | THC
HOF
AEF
, N |) M A
R I ,
R I -
M . : | ∖S
†
M
J | G
87-
87 | . E
J/
- 02 | 1
2
5
2
5
2
5
2
5
2
5 | PI
RI
, I | HY:
1:
SC | S.
321
33
I. | RE
(
7
TE | V.
19
(1
CH | 91
98
NO | 17 ⁻
).
7)
L. | 1,1
,
, 2 | 129
20, | 3(
7 | 196
7 | 58) | • |
| 7)
8)
9)
10) | PE
HU
LO
BE
PH
W. | HR
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F | / · F
NGA
J ·
ETT
MEN
EBE | G
M.
I,
RL | : F
J.F
AN
F.
IN
I), | PHY
ND
D.
NU
NU | S.
ANI
HAI
ĊLÌ | RE
BE
JR .
EAR
882 | V.
GO,
RLI
AN
RE
, T | 13
O
NĎ
EAC | 31,
W.
GR
TI | 74
NI
EEN
ONS | 45
JCI
NU(
NLE
/EF | ()
EE()
(() | 190
Pl
S,
ED;
I T | 63
HY
9
H
G
S)
Y |).
S.
YŠ.
.W.
H.
OF | 29
:
H.
WI | 23
P0
B
SC | 462
2,
LÅI
AR
0N | 2
812
SH/
STI | (19
81
ZAT
ALL
N F | 962
(1
10
RE |).
97
ND
SS | 4). | | |

(1971).
(1971).
(1965).
(1965).
(1965).
(1965).
(1965).
(1965).
(1965).
(1967).
(1967).
(1970).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1971).
(1984).
(1984).
(1987).
(1987).
(1987).
(1987).
(1987).
(1987).
(1987).
(1987).
(1987).
(1987).
(1988).
(1988).
(1988).
(1988).
(1988).
(1988).
(1988).
(1988).
(1988).

MAT number = 5237 52-TE-124 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 7 KEV RESONANCE PARAMETERS IN THE ENERGY REGION BELOW 2.7 KEV WERE TAKEN FROM JENDL-3.1 WITH SLIGHT MODIFICATION AND THOSE ABOVE 2.7 KEV WERE NEWLY EVALUATED FOR JENDL-3.2. FOR JENDL-3.1, RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH OF 0.1 EV AND SCATTERING RADIUS OF 5.8 FM WERE TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. FOR JENDL-3.2, NEUTRON AND RADIATION WIDTH WERE DETERMINED FROM THE NEUTRON WIDTHS MEASURED BY TELLIER ET AL./4/ AND THE CAPTURE AREA DATA BY MACKLIN AND WINTERS/5/ IN THE ENERGY RANGE ABOVE 2.7 KEV. THE AVERAGE RADIATION WIDTH OF 0.0635 EV GIVEN BY MACKLIN AND WINTERS WAS APPLIED TO THE LEVELS WHOSE RADIATION WIDTH HAD NOT BEEN DETERMINED FROM THE EXPERIMENTS. THE AVERAGE VALUE OF 0.11 EV OF JENDL-3.1 WAS REPLACED WITH 0.0635 EV. 0.0635 EV. UNRESOLVED RESONANCE REGION : 7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./2/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.630E-4, S1 = 1.700E-4, S2 = 1.100E-4, SG = 2.79E-4, GG = 0.110 EV, R = 5.648 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. 10.437 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 3.653 6.785 5.62 CAPTURE 6.785 5.62
 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.
MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).
MT = 4,51,-91,010ELASTIC SCATTERING
MT = 4,51,-91,010ELASTIC SCATTERING

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA SHEETS/17/.

| LEV | NO.
GR.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
ELS ABOV | ENERGY
0.0
1.156
1.248
1.325
1.656
1.736
1.746
1.746
1.747
1.882
2.020
2.039
2.031
2.153
2.182 | (MEV)
7566557752240090036645577552244009003664556V WERE | SPIN-PAF
0 +
2 +
0 +
4 +
2 +
0 +
1 +
6 +
2 +
0 +
4 +
0 +
2 +
0 +
4 +
0 +
2 +
0 +
1 -
ASSUMED T | RITY
FO BE OVERLAP | PING. |
|--|---|---|--|--|---|---|
| MT = 10
SPHER
CASTH
SECTI
AND R | 2 CAPTU
ICAL OPT
Y WAS AD
ONS WERE
EFF0/18/ | RE
ICAL AND
OPTED. D
ESTIMATE
AND NORM | STATIST
IRECT AI
D ACCORI
IALIZED | ICAL MODEL
ND SEMI-DI
DING TO TH
TO 1 MILLI | _ CALCULATION
IRECT CAPTURE
HE PROCEDURE
I-BARN AT 14 | WITH
CROSS
OF BENZI
MEV. |
| THE G
REPRO
KEV M | AMMA-RAY
DUCE THE
EASURED | STRENGTH
CAPTURE
BY MACKLI | FUNCTIO
CROSS SI
N AND W | ON (2.59E-
ECTION OF
INTERS/5/. | -04) WAS ADJU
83.2 MILLI-B | STED TO
ARNS AT 90 |
| MT = 16
MT = 17
MT = 22
MT = 28
MT =103
MT =104
MT =105
MT =107
THESE
PREEQ | (N,2N)
(N,3N)
(N,N'P
(N,P)
(N,P)
(N,T)
(N,ALP
REACTIO
UILIBRIU | CROSS SE
CROSS SE
) CROSS S
CROSS SEC
CROSS SEC
CROSS SEC
CROSS SEC
HA) CROSS
N CROSS S
M AND MUL | CTION
CTION
ECTION
TION
TION
SECTION
ECTIONS
TIONS
TI-STEP | N
WERE CALC
EVAPORATI | CULATED WITH | THE
E PEGASUS. |
| THE K
FORMU
DENSI | ALBACH'S
LA DERIV
TY PARAM | CONSTANT
ED FROM K
ETERS. | K (= 1
IKUCHI-I | 10.0) WAS
KAWAI'S FO | ESTIMATED BY
DRMALISM/19/ | THE
AND LEVEL |
| FINAL
NORMA
(N,
(N, | LY, THE
LIŻED TO
P)
ALPHA) | (N,P) AND
THE FOLL
9.00
3.79 | (N,ALPI
.OWING V
MB (REC
MB (SY: | HA) CROSS
ALUES AT 1
COMMENDED
STEMATICS | SECTIONS WER
14.5 MEV:
BY FORREST/2
OF FORREST/2 | E
0/)
0/) |
| MT = 25
CALCU | 1 MU-BA
LATED WI | R
TH CASTHY | <i>.</i> | | | |
| MF = 4 A
LEGENDR
GIVEN I
TIC LEV
CALCULA
BUTIONS | NGULAR D
E POLYNO
N THE CE
ELS, AND
TED WITH
IN THE | ISTRIBUTI
MIAL COEF
NTER-OF-M
IN THE L
CASTHY.
LABORATOR | ONS OF
FICIENT
ASS SYS
ABORATO
FOR OT
Y SYSTE | SECONDARY
S FOR ANGL
TEM FOR MT
RY SYSTEM
HER REACTI
W WERE ASS | NEUTRONS
JLAR DISTRIBU
F=2 AND DISCR
FOR MT=91.
IONS, ISOTROP
SUMED. | TIONS ARE
ETE INELAS-
THEY WERE
IC DISTRI- |
| MF = 5 E
ENERGY
PEGASUS
OTHER N | NERGY DI
DISTRIBU
FOR INE
EUTRON E | STRIBUTIO
TIONS OF
LASTIC SC
MITTING R | NS OF SI
SECONDAI
ATTERING
EACTION | ECONDARY N
RY NEUTRON
G TO OVERL
S. | NEUTRONS
NS WERE CALCU
LAPPING LEVEL | LATED WITH
S AND FOR |
| TABLE 1 | NEUTRON | OPTICAL P | OTENTIA | L PARAMETE | ERS | |

DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM)

| V = 45.97-0.199E R0 = 6.2
WS = 6.502 RS = 6.2
VS0= 7.0 RS0= 6.2
THE FORM OF SURFACE ABSORPTION PART IS D | 481 A0 = 0.62
926 AS = 0.35
49 ASO= 0.62
DER. WOODS-SAXON TYPE. |
|--|---|
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV | /) EX(MEV) PAIRING |
| 50-SN-120 1.595E+01 6.540E-01 4.691E 50-SN-121 1.630E+01 6.100E-01 2.010E 50-SN-122 1.434E+01 7.060E-01 3.423E 50-SN-123 1.509E+01 6.870E-01 3.062E | -01 7.083E+00 2.430E+00
+00 5.217E+00 1.190E+00
-01 7.416E+00 2.620E+00
+00 6.032E+00 1.190E+00 |
| 51-SB-121 1.730E+01 5.740E-01 1.715E- 51-SB-122 1.772E+01 5.500E-01 1.346E- 51-SB-123 1.585E+01 6.213E-01 1.285E- 51-SB-124 1.696E+01 5.600E-01 1.090E- | +00 5.022E+00 1.240E+00
+01 3.517E+00 0.0
+00 5.469E+00 1.430E+00
+01 3.433E+00 0.0 |
| 52-TE-122 1.705E+01 6.350E-01 6.339E 52-TE-123 1.874E+01 5.850E-01 4.619E 52-TE-124 1.784E+01 6.740E-01 1.452E 52-TE-125 1.992E+01 5.590E-01 5.035E | -01 7.160E+00 2.380E+00
+00 5.627E+00 1.140E+00
+00 8.479E+00 2.570E+00
+00 5.527E+00 1.140E+00 |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS
IN THE CASTHY CALCULATION, SPIN CUTOFF F
ASSUMED TO BE 3.991 FOR TE-124 AND 10.14 | S 0.146*SQRT(A)*A**(2/3).
ACTORS AT 0 MEV WERE
FOR TE-125. |
| REFERENCES 1) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNO 2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROS
PART A", ACADEMIC PRESS (1981). 3) BOLLINGER, L.M. AND THOMAS, G.E.: PHYS 4) TELLIER, H. AND NEWSTEDD, C.M.: PROC.
NEUTRON CROSS SECTIONS AND TECHNOL., F
P.680 (1971). | DL., 29, 195 (1992).
SS SECTIONS, VOL. I,
S. REV., 171,1293(1968).
3RD INT. CONF. ON
(OXVILL, MARCH 1971, |
| 5) MAČKLIN, R.L. AND WINTERS, R.R.: ORNL
6) IGARASI, S. AND FUKAHORI, T.: JAERI 13
7) IIJIMA, S. ET AL.: JAERI-M 87-025, P.
8) IIJIMA, S. AND KAWAI, M.: J. NUCL. SC
(1983) | -6561 (1988).
321 (1991).
337 (1987).
I. TECHNOL., 20, 77 |
| 9) PEREY, F.G: PHYS. REV. 131, 745 (1963) 10) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS 11) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS 12) BECCHETTI, F.D., JR. AND GREENLEES, G PHENOMENA IN NUCLEAR REACTIONS ((EDS)
W. HAEBERLI), P. 682, THE UNIVERSITY (|).
5. 29, 462 (1962).
7S. A232, 381 (1974).
.W.: POLARIZATION
H.H. BARSHALL AND
DF WISCONSIN PRESS. |
| 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. | J. PHYS., 43, 1446 |
| (1903). 14) IIJIMA, S., ET AL.: J. NUCL. SCI. TECH 15) GRUPPELAAR, H.: ECN-13 (1977). 16) ENSDF: EVALUATED NUCLEAR STRUCTURE DAT 17) NUCLEAR DATA SHEETS, 41, 413 (1984). 18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (2000) 19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MARACTIONS", NORTH HOLLAND (1968). 20) FORREST, R.A.: AERE-R 12419 (1986). | HNOL. 21, 10 (1984).
FA FILE (JUNE 1987).
1969).
ATTER AND NUCLEAR |

MAT number = 5240 52-TE-125 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93

HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

* * * * * ***** MODIFIED PARTS FOR JENDL-3.2 **** (2,151) RESOLVED RESONACE PARAMETERS *

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 3 KEV
 RESONANCE PARAMETERS IN THE ENERGY REGION BELOW 2.7 KEV
WERE TAKEN FROM JENDL-3.1 WITH SLIGHT MODIFICATION AND THOSE
ABOVE 2.7 KEV WERE NEWLY EVALUATED FOR JENDL-3.2.
 FOR JENDL-3.1, RESONANCE PARAMETERS WERE BASED ON
MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON
ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF
BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH WAS DEDUCED
TO BE 150 MEV, AND APPLIED TO THE LEVELS WHOSE RADIATION WIDTH
WAS UNKNOWN. A NEGATIVE RESONANCE WAS ADDED AND ITS PARAMETERS WERE ADJUSTED TOGETHER WITH SCATTERING RADIUS (6.0 FM) SO
AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS
SECTIONS GIVEN BY MUGHABGHAB ET AL.
 FOR JENDL-3.2, NEUTRON AND RADIATION WIDTH WERE DETERMINED
FROM THE NEUTRON WIDTHS MEASURED BY TELLIER ET AL./4/ AND THE
CAPTURE AREA DATA BY MACKLIN AND WINTERS/5/ IN THE ENERGY
RANGE ABOVE 2.7 KEV. THE AVERAGE RADIATION WIDTH OF 0.1075 EV
GIVEN BY MACKLIN AND WINTERS WAS APPLIED TO THE LEVELS WHOSE
RADIATION WIDTH HAD NOT BEEN DETERMINED FROM THE EXPERIMENTS.
 THE AVERAGE VALUE OF 0.15 EV OF JENDL-3.1 WAS REPLACED WITH
 0.1075 EV.

UNRESOLVED RESONANCE REGION : 3 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.480E-4, S1 = 1.700E-4, S2 = 1.000E-4, SG = 33.9E-4, GG = 0.157 EV, R = 5.761 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 4.940 3.420 TOTAL ELASTIC CAPTURE

21.9

CAPIURE 1.520 21.9 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/8/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/9/
 ALPHA = HUIZENGA AND IGO/10/
 DEUTERON = LOHR AND HAEBERLI/11/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/15/. MF = 3

1.520

/15/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = - 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA MT SHEETS/17/. SPIN-PARITY 1/2 + 3/2 + NO. ENERGY(MEV) GR. 1 $\begin{array}{c} 0.0\\ 0.0355\\ 0.1448\\ 0.3211\\ 0.4435\\ 0.4624\\ \end{array}$ ⁻ = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. МΤ BENZI THE GAMMA-RAY STRENGTH FUNCTION (3.28E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 600 MILLI-BARNS AT 20 KEV MEASURED BY BERGMAN AND ROMANOV/19/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16 MT = 17 MT = 22 MT = 28 MT = 32 MT = 103MT = 104МŤ MT THE KALBACH'S CONSTANT K (= 179.3) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/20/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.70 MB (SYSTEMATICS OF FORREST/21/) (N,ALPHA) 2.86 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 50-SN-1211.630E+016.100E-012.010E+005.217E+001.190E+0050-SN-1221.434E+017.060E-013.423E-017.416E+002.620E+0050-SN-1231.509E+016.870E-013.062E+006.032E+001.190E+0050-SN-1241.601E+016.160E-013.224E-016.294E+002.280E+00 1.772E+01 5.500E-01 1.346E+01 3.517E+00 0.0 1.585E+01 6.213E-01 1.285E+00 5.469E+00 1.430E+00 1.696E+01 5.600E-01 1.090E+01 3.433E+00 0.0 1.700E+01 5.120E-01 7.883E-01 3.792E+00 1.090E+00 51 - SB - 122 51 - SB - 123 51 - SB - 124 51-SB-125 1.874E+01 5.850E-01 4.619E+00 5.627E+00 1.140E+00 1.784E+01 6.740E-01 1.452E+00 8.479E+00 2.570E+00 1.992E+01 5.590E-01 5.035E+00 5.527E+00 1.140E+00 1.706E+01 6.100E-01 5.154E-01 6.554E+00 2.230E+00 52-TE-123 52 - TE - 124 52 - TE - 125 52-TE-126 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 10.14 FOR TE-125 AND 7.509 FOR TE-126. REFERENCES REFERENCES

KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
TELLIER, H. AND NEWSTEDD, C.M.: PROC. 3RD INT. CONF. ON NEUTRON CROSS SECTIONS AND TECHNOL., KOXVILL, MARCH 1971, P.680 (1971).
MACKLIN, R.L. AND WINTERS, R.R.: ORNL-6561 (1988).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 9) 10) $11) \\ 12)$ W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). NUCLEAR DATA SHEETS, 32, 497 (1981). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). BERGMAN, A.A. AND ROMANOV, S.A.: YADERNAYA FIZIKA, 20, 252 (1974). 14) 15) 16) 17) 18) 19) (1974).
20) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
21) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5243 52-TE-126 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93

HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

* * * * * ***** MODIFIED PARTS FOR JENDL-3.2 **** (2,151) RESOLVED RESONACE PARAMETERS * * * * * * * * * * * * * * * * * * *

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

MF = 2

UNRESOLVED RESONANCE REGION : 14.7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./2/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.280E-4, S1 = 1.700E-4, S2 = 1.000E-4, SG = 1.41E-4, GG = 0.150 EV, R = 5.891 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. _ _ _ . .

| IOTAL | 4.572 | - |
|---------|-------|------|
| ELASTIC | 3.537 | - |
| CAPTURE | 1.035 | 8.15 |
| | | |

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR MF

/15/.

| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> |
|---|
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR
STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA
SHEETS/17/.</pre> |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 0 +
1 0.6663 2 +
2 1.3613 4 +
3 1.4202 2 +
4 1.7755 6 +
5 1.8735 0 +
6 2.0133 4 +
7 2.0453 2 +
8 2.1816 1 -
9 2.2176 5 -
10 2.3094 2 +
11 2.3861 3 -
12 2.3960 5 +
13 2.4213 3 -
LEVELS ABOVE 2.44 MEV WERE ASSUMED TO BE OVERLAPPING. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.26E-04) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 68 MILLI-BARNS AT 40
KEV MEASURED BY BERGMAN AND ROMANOV/19/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 113.3) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/20/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 5.00 MB (RECOMMENDED BY FORREST/21/)
(N,ALPHA) 2.30 MB (RECOMMENDED BY FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| V = 45.97 - 0.199F R0 = 6.481 A0 = 0.62 |
VSO= 7.0 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.

TABLE 2 LEVEL DENSITY PARAMETERS

| N | UCL | ID | E | | А | (1 | / M E | EV) | Т | (M E | EV) | | | C (| 1/ | ME | () | Е | Х (| ΜE | V) | | PA | IR | ING | ; | |
|--|----------------------------------|--|---|---|-----------------------------------|--------------------------------|---|--|--|---|--|--------------------------------------|-----------------------------------|---------------------------------------|----------------------------|-------------------------------------|------------------------------------|--------------------------|----------------------------|----------------------------|----------------------|-------------------------------|--------------------------------|----------------------------|--------------------------|----------------|----|
| -55555 | 0 - 3
0 - 3
0 - 3
0 - 3 | SN -
SN -
SN -
SN - | 122
123
124
125 | | 1
1
1 | .4
.5
.6 | 34E
09E
01E
91E | +0
+0
+0
+0 | 1 7
1 6
1 6
1 6 | .06
.87
.16
.2 | 50E
70E
50E | - 0
- 0
- 0
- 0 |
1
1
1 | 3.
3.
3.
3. | 42
06
22
92 | 3E
2E
4E
7E | - 01
+00
- 01
+00 | 7
6
6
5 | . 4
. 0
. 2
. 2 | 16
32
94
49 | E+
E+
E+
E+ | -00
-00
-00
-00 | 2.
1.
2.
1. | 62
19
28
19 | 0E+
0E+
0E+
0E+ | 00
00
00 | |
| 5
5
5
5
5 | 1 - 5
1 - 5
1 - 5
1 - 5 | 68 -
68 -
68 -
68 - | 123
124
125
126 | | 1
1
1 | .5
.6
.7
.7 | 85E
96E
00E
00E | +0
+0
+0
+0 | 1 6
1 5
1 5
1 5 | . 2
. 6(
. 12
. 2 | 13E
20E
20E
50E | - 0
- 0
- 0
- 0 | 1
1
1 | 1.
1.
7.
7. | 28
09
88
56 | 5E-
0E-
3E-
6E- | +00
+01
-01
+00 |) 5
3
3
2 | .4
.4
.7
.8 | 69
33
92
97 | E+
E+
E+
E+ | -00
-00
-00 | 1.
0.
1.
0. | 43
0
09
0 | 0E+
0E+ | 00
00 | |
| 5555 | 2 - 1
2 - 1
2 - 1
2 - 1 | ΓΕ -
ΓΕ -
ΓΕ -
ΓΕ - | 124
125
126
127 | | 1
1
2 | .7
.9
.7
.0 | 84E
92E
06E
04E | +0
+0
+0
+0 | 1 6
1 5
1 6
1 5 | .74
.59
.10 | 40E
90E
90E
90E | - 0
- 0
- 0
- 0 | 1
1
1 | 1.
5.
5.
3. | 45
03
15
63 | 2E-
5E-
4E-
3E- | +00
+00
-01
+00 | 8
5
6
5 | .4
.5
.5
.1 | 79
27
54
65 | E+
E+
E+
E+ | -00
-00
-00 | 2.
1.
2.
1. | 57
14
23
14 | 0E+
0E+
0E+
0E+ | 00 | |
| SI
II
A | PIN
N T
SSI | N C
THE
JME | UTOI
CAS
D T(| FFP
STHY
DBE | AR
C | AM
AL
.5 | ETE
CUL
09 | RS
AT
FOI | WE
ION
R T | RE
² | CA
SPI
126 | LC
N
A | U L
C U
N D | AT
T0
6 | ED
FF | A
F
66 | S O
ACT
FC | 0.1
0R
0R | 46
S
TE | * S
AT
- 1 | Q R
0
27 | RT (/
) MI | A)*
EV | A*
WE | * (2
RE | 2/3 |). |
| RE
1
2
3
4 | FEF
)
)

 | REN
AUG
AR
BOL
TEL | CES
AI,
HAB(
T A
LIN(
LIEF
TROP | M.
GHAB
GER,
A
GER,
H | ET
ĊA
L | A
S.
DE
.M
AN
S | L.:
F.
MIC
D N
SEC | ET
ET
ND
NEWS
TT | . N
AL
TH
STE
ONS | UCI
S
OM/
DD
AN | - " N
(19
AS,
, C
ND | SC
EU
81
G
M | I.
TŘ
).
. É.
ĊH | T
0N
.:
P
NO | PI
PI
PI
PI
PI | HN(
ROS
HYS
C.
, I | DL.
SS
S.
3R
KOX | SE
RE
D | 29
CT
V.
IN
LL | ỉ0
†. | 19
NS
17
MA | 25
S,
X1,
XRCI | (19
VOL
129
F.
H 1 | 992

93(
0N
97 |);
1;
196
1, | 68) | |
| 5
6
7
8 | | /AC
 GA
 IJ
 IJ | 80
KLIN
RAS
IMA
IMA | (197
N, R
I, S
, S.
, S. | 1)
. L
E [:]
Al | ÀN
T
ND | ANE
DF
AL.
KA | UK/ | INT
AHO
JAE
I, | ERS
RI
RI
M. | З,
, т
-м
: Ј | R :
87 | R.
J
- 0
NU | :
AE
25
CL | OR
RI | NL
1:
P.
SC | -65
321
33
1. | 61
(
7
TE | (
19
(1
CH | 19
91
98
N0 | 88
).
7)
L. | 3).
, 2 | 20, | 7 | 7 | | |
| 9
10
11
12 | | | EY,
ZEN(
R,
CHE
NOME
HAEE | F.G
GA,
J.M.
TTI,
ENA
BERL | :
J.
F
IN
I) | PH
R.
ND
.D
.N | YS.
AN
HA
ŪĊL
P. | RI
ND
JR
JR
682 | EV
IGO
ERL
A
R
R
R | 13
i,
ND
EAC
THE | 31,
W.
GR
CTI | 7
N
EE
ON | 45
UC
NU
NL
S
VE | (
CL
EE(
RS | 19
S,
ED | 63
HYS
PH
G
S)
Y (|).
S.
YS.
.W.
H.
DF | 29
A
:
H.
WI | 23
P0
B
SC | 46
2,
LÁ
AR
ON | 2
81
SH
SI | (19
881
ZA
IALI
N | 962
(1
TIC
L A
PRE | 97
97
ND
SS | 4). | | |
| 13 |) (| 19
11
19 | 71)
BER
65) | Г, Α | | AN | DC | CAM | ERO | N, | Α. | G. | W. | : | CA | Ν. | J. | Ρ | ΗY | S. | , | 43 | , 1 | 44 | 6 | | |
| 14
15
16
17
18
19
20 | | I J
RUS
NUC
NER
SER
SER
SER
SER
SER
SER
SER
SER
SER
S | IMA
PPEI
DF:
LEAF
GMAN
UCH
CTI
RES | , S.
-AAR
EVA
V DA
V, A
N, A
I, K
DNS"
F, R | ,
LU
TA
AN
. A | ET
H
S
D
AN
NO | AL
ED
HEE
REF
AND
D H
RTH
AE | CN
NU
TS
FO
NU
(AW)
A
H
(AW) | J.
-13
CLE
, G
OMA
OMA
AI,
OLL
- R | N
A
R
6
N
O
N
O
N
O
N
O
N
O
N
O
N
O
N
O
N
O
N | JCL
197
22
CC
/,
:
(
19 | 7)
RU
7
DN
S.
19
(| SC
(1
- N
A.
UC
68 | I.
98
W/
:
LE
).
86 | T
2)
10
YA
AR | ECI
DA ⁻
DEI
M/ | HNC
TA
196
RNA
ATT | FI
(9)
(YA
ER | 2
LE
·F
A | 1 ,
(
I Z
N D | 1
JU
IK
N | 0
INE
(A,
IUCI | (19
19
20
LEA |)84
)87
), : |).
).
252 | 2 | |
| | - | | | | | | | | | | | • | | | | | | | | | | | | | | | |

MAT number = 5247 52-TE-127MJNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 5.3 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.700E-4, S2 = 1.000E-4, SG = 130.E-4, GG = 0.150 EV, R = 5.352 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 3384 3.630 TOTAL ELASTIC CAPTURE 338Õ 1340 F = 3 NEUTRON CROSS SECTIONS BELOW 5.3 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 5.3 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELA/ /12/. WERE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT = SHEETS/14/. NO. ENERGY(MEV) SPIN-PARITY 0.0 -.08826 -.02714 11/2 -3/2 + 1/2 + GR. 1 9/2 5/2 3/2 7/2 1/2 0.2518 0.3850 0.4146 34 5 + 0.5426 0.5477 67 + 5/2 +8 0.5972

| 9
10
11
12
13
14
15
LEVELS A | 0.6
0.6
0.8
0.9
1.0
1.0
BOVE 1.088 | 754
951
969
359
887
526
671
MEV WERE | 3/2 +
5/2 +
9/2 -
7/2 +
5/2 +
5/2 +
5/2 +
ASSUMED TO | BE OVERLAF | PPING. |
|---|--|--|---|---|--|
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/ | PTURE
OPTICAL AN
ADOPTED.
ERE ESTIMA
15/ AND NO | D STATIST
DIRECT AN
TED ACCORE
RMALIZED T | ICAL MODEL (
ND SEMI-DIRE
DING TO THE
FO 1 MILLI-E | CALCULATION
ECT CAPTURE
PROCEDURE
BARN AT 14 | N WITH
CROSS
OF BENZI
MEV. |
| THE GAMMA-
THE SYSTEM
S-WAVE RES
LEVEL DENS | RAY STRENG
ATICS OF R
ONANCE LEV
ITY PARAME | TH FUNCTIO
ADIATION V
EL SPACINO
TERS. | DN (1.32E-02
VIDTH (0.14
G (10.6 EV) | 2) WAS DETE
EV) AND TH
CALCULATED | ERMINED FROM
HE AVERAGE
FROM THE |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT = 32 (N,
MT = 103 (N,
MT = 104 (N,
MT = 105 (N,
MT = 105 (N,
THESE REAC | 2N) CROSS
3N) CROSS
N'A) CROSS
N'P) CROSS
N'D) CROSS
P) CROSS S
D) CROSS S
D) CROSS S
T) CROSS S
ALPHA) CRO
TION CAD | SECTION
SECTION
SECTION
SECTION
ECTION
ECTION
ECTION
SS SECTION
SS SECTION | WERE CALCUL | | THE |
| THE KALBAC
FORMULA DE
DENSITY PA | H'S CONSTA
RIVED FROM
RAMETERS. | NT K (= 16
KIKUCHI-F | SO.O) WAS ES
(AWA1'S FORM | STIMATED BY
MALISM/16/ | THE
AND LEVEL |
| FINALLY, T
NORMALIŻED
(N,P)
(N,ALPHA | HE (N,P) A
TO THE FO
3.0
) 1.6 | ND (N,ALPH
LLOWING VA
7 MB (SYS
5 MB (SYS | HA) CROSS SE
ALUES AT 14
STEMATICS OF
STEMATICS OF | ECTIONS WEF
5 MEV:
F FORREST/7
F FORREST) | RE
17/) |
| MT = 251 MU
CALCULATED | -BAR
WITH CAST | ΉY/2/. | | | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED W
BUTIONS IN T | R DISTRIBU
YNOMIAL CO
CENTER-OF
AND IN THE
ITH CASTHY
HE LABORAT | TIONS OF S
EFFICIENTS
-MASS SYST
LABORATOF
FOR OTH
ORY SYSTEM | SECONDARY NE
FOR ANGULA
TEM FOR MT=2
Y SYSTEM FO
HER REACTION
WERE ASSUM | EUTRONS
AR DISTRIBL
2 AND DISCF
DR MT=91.
NS, ISOTROF
MED. | JTIONS ARE
RETE INELAS-
THEY WERE
PIC DISTR1- |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRO | DISTRIBUT
IBUTIONS O
INELASTIC
N EMITTING | IONS OF SE
F SECONDAF
SCATTERING
REACTIONS | ECONDARY NEU
RY NEUTRONS
TO OVERLAP | JTRONS
WERE CALCU
PPING LEVEL | JLATED WITH
S AND FOR |
| TABLE 1 NEUTR | ON OPTICAL | POTENTIAL | PARAMETERS | 3 | |
| V = 4
WS = 6
VSO= 7
THE FORM OF | 5.97-0.199
.502
.0
SURFACE AB | SORPTION F | RADIUS(FM)
R0 = 6.481
RS = 6.926
RS0= 6.49
PART IS DER | A0 = 0
AS = 0
AS0= 0
W00DS-SA) | 62
.35
.62
.0N TYPE. |
| TABLE 2 LEVEL | DENSITY P | ARAMETERS | 0 (4 (ME) /) | | |
| 50 - SN - 123
50 - SN - 124
50 - SN - 125
50 - SN - 126 | 1.509E+01
1.601E+01
1.591E+01
1.646E+01 | 6.870E-01
6.160E-01
6.210E-01
6.270E-01 | G(17MEV)
3.062E+00
3.224E-01
1.927E+00
4.012E-01 | 6.032E+00
6.294E+00
5.249E+00
6.778E+00 | 1.190E+00
2.280E+00
1.190E+00
2.390E+00 |
| 51 - SB - 124
51 - SB - 125
51 - SB - 126
51 - SB - 127 | 1.696E+01
1.700E+01
1.700E+01
1.700E+01
1.700E+01 | 5.600E-01
5.120E-01
5.250E-01
5.120E-01 | 1.090E+01
7.883E-01
7.566E+00
6.326E-01 | 3.433E+00
3.792E+00
2.897E+00
3.902E+00 | 0.0
1.090E+00
0.0
1.200E+00 |
| 52 - TE - 125
52 - TE - 126
52 - TE - 127 | 1.992E+01
1.706E+01
2.004E+01 | 5.590E-01
6.100E-01
5.380E-01 | 5.035E+00
5.154E-01
3.633E+00 | 5.527E+00
6.554E+00
5.165E+00 | 1.140E+00
2.230E+00
1.140E+00 |
| | | | | | |

1.800E+01 6.090E-01 6.586E-01 7.010E+00 2.340E+00 52-TE-128

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.066 FOR TE-127 AND 7.680 FOR TE-128.

- REFERENCES

 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

 - 6) 7)

 - 8) 9)
- (1971) 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 10) GILBERT, A. AND GAMEKUN, A.G.W.. GAN. J. THO., 10, 111 (1965).
 11) IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 14) NUCLEAR DATA SHEETS, 35, 181 (1982).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5249 52-TE-128 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 8 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2./1/ EVALUATION FOR JENDL-2 WAS MADE BY KIKUCHI/3/. NEUTRON WIDTHS WERE ADOPTED FROM EXPERIMENTAL DATA OF TELLIER ET AL./4/, AND RADIATIVE CAPTURE WIDTHS FROM CAPTURE AREAS MEASURED BY BROWNE AND BERMAN/5/. FOR THE RESONANCES ABOVE 7 KEV, THE AVERAGE RADIATION WIDTH OF 0.048+-0.025 EV WAS ASSUMED. A NEGATIVE RESONANCE WAS ADDED AT -600 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 0.215+-0.008 BARNS/6/. THE EFFECTIVE SCATTERING RADIUS OF 5.5 FM WAS TAKEN FROM REF./6/. MF UNRESOLVED RESONANCE REGION : 8 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL./6/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.250E-4, S1 = 1.700E-4, S2 = 1.000E-4, SG = 0.540E-4, GG = 0.150 EV, R = 5.897 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 4.313 -TOTAL ELASTIC CAPTURE 4.099 0.2140 1.31 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF ILJIMA-KAWAI POTENTIAL/9/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY ILJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/. /16/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. NO. ENERGY(MEV) SPIN-PARITY 0.0 0.7432 GŔ. 0 + 24 1 1.4971 1.5232 3 2 6 + 4 5 + 1.9722 2 +

6 7 8 1.9822 0 + 4 2 2.0300 2.1320 2.1335 + + ğ LEVELS ABOVE 2.197 MEV WERE ASSUMED TO BE OVERLAPPING. CAPTURE MT = 102= 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (4.85E-05) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 48 MILLI-BARNS AT 20 KEV MEASURED BY BERGMAN AND ROMANOV/19/. MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 116.8) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/20/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 2.40 MB (RECOMMENDED BY FORREST/21/) (N,ALPHA) 0.95 MB (RECOMMENDED BY FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY/7/. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) ----- - - - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS A(1/MEV) T(MEV) NUCLIDE C(1/MEV) EX(MEV) PAIRING

 50-SN-124
 1.601E+01
 6.160E-01
 3.224E-01
 6.294E+00
 2.280E+00

 50-SN-125
 1.591E+01
 6.210E-01
 1.927E+00
 5.249E+00
 1.190E+00

 50-SN-126
 1.646E+01
 6.270E-01
 4.012E-01
 6.778E+00
 2.390E+00

 50-SN-127
 1.577E+01
 6.140E-01
 1.633E+00
 5.075E+00
 1.190E+00

 1.700E+01 5.120E-01 7.883E-01 3.792E+00 1.090E+00 1.700E+01 5.250E-01 7.566E+00 2.897E+00 0.0 1.700E+01 5.120E-01 6.326E-01 3.902E+00 1.200E+00 1.468E+01 5.600E-01 4.264E+00 2.658E+00 0.0 51-SB-125 51 - SB - 126 51 - SB - 127 51 - SB - 128 1.706E+01 6.100E-01 5.154E-01 6.554E+00 2.230E+00 2.004E+01 5.380E-01 3.633E+00 5.165E+00 1.140E+00 1.800E+01 6.090E-01 6.586E-01 7.010E+00 2.340E+00 2.015E+01 5.350E-01 3.588E+00 5.141E+00 1.140E+00 52 - TE - 126 52 - TE - 127 52 - TE - 128 52-TE-129 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE

ASSUMED TO BE 7.680 FOR TE-128 AND 5.913 FOR TE-129.

- REFERENCES

 AOUNTLY TO LET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
 TELLIER, H., ET AL.: CEA-N-1268 (1970).
 BROWNE, J.C., BERMAN, B.L.: PHYS. REV., C8, 2405 (1973).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 11) 12) 13)
- (1971) 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 14) GILBERT, A. AND GAMERON, A.G.M. GARL G. LINCL, 10, 114 (1965).
 15) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 16) GRUPPELAAR, H.: ECN-13 (1977).
 17) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
 18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 19) BERGMAN, A.A. AND ROMANOV, S.A.: YADERNAYA FIZIKA, 20, 252 (1974) (1974).
 20) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 21) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5253 52-TE-129MJNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 7.2 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.600E-4, S2 = 1.000E-4, SG = 99.2E-4, GG = 0.140 EV, R = 5.407 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 1605 3.400 TOTAL ELASTIC CAPTURE 1600 752 F = 3 NEUTRON CROSS SECTIONS BELOW 7.2 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMATICS FROM NEIGHBORING TE ISOTOPES. THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 5.2 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 7.2 EV TO 100 KEV. MF = 3ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/2/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/3/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/4/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/5/ ALPHA = HUIZENGA AND IGO/6/ DEUTERON = LOHR AND HAEBERLI/7/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/8/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/9/ WERE EVALUATED BY IIJIMA ET AL./10/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /11/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/12/ AND NUCLEAR DATA STRUCTUKE ∟ SHEETS/13/. SPIN-PARITY 11/2 -ENERGY(MEV) NO GŘ. 0.0 3/2 1/2 9/2 5/2 5/2 7/2 -0.1055 1 + 23 + 0.3595 + 0.4392 0.5284 4 5 + 6 0.6546

0.7073 0.7705 0.8610 1.0495 7/2 5/2 5/2 1/2 7/2 5/2 5/2 5/2 5/2 5/2 5/2 7 8 9 10 + + 1.1045 1.1227 1.1753 11 12 13 14 15 16 + + 1.1965 1.2120 1.2295 1.4525 1.4525 1.4932 1.5275 1.5485 + + + 3/2 1/2 9/2 1/2 5/2 9/2 5/2 17 18 19 20 21 22 + 21 1.5491 5/2 + 22 1.6218 9/2 + 23 1.6469 5/2 + LEVELS ABOVE 1.675 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (9.71E-03) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.14 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (14.4 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. $\begin{array}{l} r = 16 & (N,2N) \ CROSS \ SECTION \\ r = 17 & (N,3N) \ CROSS \ SECTION \\ r = 22 & (N,N'A) \ CROSS \ SECTION \\ r = 28 & (N,N'P) \ CROSS \ SECTION \\ r = 32 & (N,N'D) \ CROSS \ SECTION \\ r = 103 & (N,P) \ CROSS \ SECTION \\ r = 104 & (N,D) \ CROSS \ SECTION \\ r = 105 & (N,T) \ CROSS \ SECTION \\ r = 107 & (N,ALPHA) \ CROSS \ SECTION \\ r = 107 & (N,ALPHA) \ CROSS \ SECTION \\ r = REACTION \ CROSS \ SECTION \\ r = REQUILIBRIUM \ AND \ MULTI-STEP \ EVAPORATION \ MODEL \ CODE \ PEGASUS. \\ \end{array}$ MT = 16ΜT MŤ MT MT МŤ ΜŤ ΜT МТ THE KALBACH'S CONSTANT K (= 167.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 1.66 MB (SYSTEMATICS OF FORREST/16/) (N,ALPHA) 0.96 MB (SYSTEMATICS OF FORREST) - = 251 MU-BAR CALCULATED WITH CASTHY. MT = 251 F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - **`** - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 50-SN-125 50-SN-126 1.591E+01 6.210E-01 1.927E+00 5.249E+00 1.190E+00 1.646E+01 6.270E-01 4.012E-01 6.778E+00 2.390E+00 1.577E+01 6.140E-01 1.633E+00 5.075E+00 1.190E+00 50-SN-127

50-SN-128 * 1.584E+01 5.822E-01 1.831E-01 5.627E+00 2.230E+00 1.700E+01 5.250E-01 7.566E+00 2.897E+00 0.0 1.700E+01 5.120E-01 6.326E-01 3.902E+00 1.200E+00 1.468E+01 5.600E-01 4.264E+00 2.658E+00 0.0 1.596E+01 5.040E-01 5.308E-01 3.333E+00 1.040E+00 51 - SB - 126 51 - SB - 127 51 - SB - 128 51-SB-129 2.004E+01 5.380E-01 3.633E+00 5.165E+00 1.140E+00 1.800E+01 6.090E-01 6.586E-01 7.010E+00 2.340E+00 2.015E+01 5.350E-01 3.588E+00 5.141E+00 1.140E+00 1.800E+01 5.470E-01 2.657E-01 5.735E+00 2.180E+00 52 - TE - 127 52 - TE - 128 52 - TE - 129 52-TE-130 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.913 FOR TE-129 AND 12.98 FOR TE-130. REFERENCES EFFERENCES 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). 2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). 3) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 4) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) IIJIMA, S. AND NORMA, MARKING, MARKING, MARKING, MARKING, S. AND NORMA, MARKING, S. AND NORMA, MARKING, PEREY, F.G. PHYS. REV. 131, 745 (1963). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 5) 6) 7) 8) (1971) 9) ĢILBĒRT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
10) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
11) GRUPPELAAR, H.: ECN-13 (1977).
12) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
13) NUCLEAR DATA SHEETS, 39, 551 (1983).
14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
15) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
16) FORREST, R.A.: AERE-R 12419 (1986). (1965). IIJIMA, S

MAT number = 5255 52-TE-130 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 30.5 KEV RESONANCE PARAMETERS WERE MAINLY BASED ON MUGHABGHAB ET AL./2/ SOME RADIATION WIDTHS WERE DERIVED FROM THE DATA OF CAPTURE AREA AND NEUTRON WIDTH GIVEN BY MUGHABGHAB ET AL. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AVERAGED RADIATION WIDTH WAS DEDUCED TO BE 107 MEV, AND APPLIED TO THE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. THE SCATTERING RADIUS OF 7.4 FM WAS TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 30.5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.160E-4, S1 = 1.600E-4, S2 = 0.990E-4, SG = 0.157E-4, GG = 0.130 EV, R = 6.013 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEGRALS TOTAL 4.106 -ELASTIC 3.836 -CAPTURE 0.2700 0.285 INTEGRALS (BARNS)

CAPTURE 0.2700 0.285
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/6/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/7/
ALPHA = HUIZENGA AND IGO/8/
DEUTERON = LOHR AND HAEBERLI/9/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELA/
/13/. WERE

TÖ GRÜPPELAAR /13/.

MT =

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

ΜT

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 | 0 + |
| 1 | 0.8394 | 2 + |
| 2 | 1.5880 | 2 + |

| 3 1.6328 4 +
4 1.8150 6 +
5 1.9814 4 +
6 2.1008 5 -
7 2.1460 7 -
LEVELS ABOVE 2.191 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCTION (1.41E-05) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 11 MILLI-BARNS AT 60
KEV MEASURED BY BERGMAN AND ROMANOV/17/. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE
PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 159.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) CROSS SECTIONS WAS NORMALIZED TO THE
FOLLOWING VALUE AT 14.5 MEV:
(N,P) 1.80 MB (RECOMMENDED BY FORREST/19/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{rcl} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & \text{V} &= 45.97 \cdot 0.199E & \text{RO} &= 6.481 & \text{AO} &= 0.62 \\ & \text{WS} &= 6.502 & \text{RS} &= 6.926 & \text{AS} &= 0.35 \\ & \text{VSO} &= 7.0 & \text{RSO} &= 6.49 & \text{ASO} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NOCLIDE SYST A(17MEV) T(MEV) C(17MEV) EX(MEV) PATRING 50-SN-126 1.646E+01 6.270E-01 4.012E-01 6.778E+00 2.390E+00 50-SN-127 1.577E+01 6.140E-01 1.633E+00 5.075E+00 1.190E+00 50-SN-128 * 1.584E+01 5.822E-01 1.831E-01 5.627E+00 2.230E+00 50-SN-129 * 1.554E+01 5.798E-01 9.299E-01 4.443E+00 1.190E+00 |
| 51-\$B-1271.700E+015.120E-016.326E-013.902E+001.200E+0051-\$B-1281.468E+015.600E-014.264E+002.658E+000.051-\$B-1291.596E+015.040E-015.308E-013.333E+001.040E+0051-\$B-1301.566E+015.000E-013.630E+002.154E+000.0 |
| 52-TE-1281.800E+01 6.090E-01 6.586E-01 7.010E+00 2.340E+0052-TE-1292.015E+01 5.350E-01 3.588E+00 5.141E+00 1.140E+0052-TE-1301.800E+01 5.470E-01 2.657E-01 5.735E+00 2.180E+0052-TE-1311.846E+01 5.360E-01 1.800E+00 4.651E+00 1.140E+00SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 12.98 FOR TE-130 AND 5.0 FOR TE-131.

REFERENCES

ERENCES KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) 1) 2)

3)

4)

5) 6)

6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965)

12) [IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEETS, 13, 133 (1974).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) BERGMAN, A.A. AND ROMANOV, S.A.: YADERNAYA FIZIKA, 20, 252 (1974).

17) DERGMAN, A.A. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5325 53-I -127 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-APR93

HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-09 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.0 KEV
RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS:
EVALUATION FOR JENDL-2 WAS CARRIED OUT ON THE BASIS OF THE
MEASUREMENTS BY GARG ET AL./3/, CAUVIN ET AL./4/, ROHR ET
AL./5/, AND MACKLIN/6/. RESONANCE ENERGIES WERE BASED ON THE
DATA BY GARG ET AL. (64 LEVELS), BY ROHR ET AL. (190 LEVELS),
AND BY MACKLIN (119 LEVELS). NEUTRON WIDTHS WERE DERIVED FROM
THE DATA OF 2G* (REDUCED NEUTRON WIDTH) BY GARG ET AL., THOSE
OF 2G* (NEUTRON WIDTH) BY ROHR ET AL., AND THOSE OF G* (NEUTRON
WIDTH) AND NEUTRON CAPTURE AREAS BY MACKLIN. RADIATION WIDTHS
WERE DERIVED FROM THE DATA OF 2G* (RADIATION WIDTH) BY ROHR ET
AL. AND FROM THOSE OF (72/37)*G* (RADIATION WIDTH) BY MACKLIN.
AVERAGE RADIATION WIDTH OF 83.24 MEV OBTAINED BY AVERAGING THE
DATA BY ROHR ET AL., AND THAT OF 110 MEV GIVEN BY MACKLIN WERE
ADOPTED IN THE ENERGY REGIONS BELOW AND ABOVE 2650 EV,
RESPECTIVELY. THE DATA OF TOTAL SPIN J MEASURED BY CAUVIN ET
AL. WERE AVAILABLE FOR THE 13 RESONANCE LEVELS BELOW 240 EV.
AS FOR THE REMAINING 360 LEVELS, TARGET SPIN OF 2.5 WAS
ADOPTED AS TOTAL SPIN. TWO NEGATIVE RESONANCES WERE ADDED SO
AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS
SECTIONS OF 6.2+-0.2 AND 3.54+-0.03 BARNS/7/, RESPECTIVELY.
SCATTERING RADIUS WAS ALSO TAKEN FROM MUGHABGHAB ET AL./7/
EOR JENDI-3 THE VALUES OF TOTAL SPIN J EOR THE 360 RESONANCE FOR JENDL-3, THE VALUES OF TOTAL SPIN J FOR THE 360 RESONANCE LEVELS MENTIONED ABOVE WERE TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON AND RADIATION WIDTHS WERE MODIFIED ON THE BASIS OF THE ESTIMATED J-VALUES. A RESONANCE LEVEL MEASURED BY POPOV AND TSHETSYAK/8/ WAS ADDED AT 137.0 EV, AND AVERAGE RADIATION WIDTHS OF THE 20.41-, 65.93- AND 174.22-EV LEVELS WERE REPLACED BY THE NEW DATA MEASURED BY THEM. RESONANCE PARAMETERS OF THE TWO NEGATIVE LEVELS WERE ALSO MODIFIED SO AS TO REPRODUCE THE ABOVE-MENTIONED THERMAL CAPTURE AND SCATTERING CROSS SECTIONS ACCORDING TO THE MODIFICATION OF THE POSITIVE LEVELS. UNRESOLVED RESONANCE REGION : 2 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE PARAMETERS WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY /9/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.760E-4, S1 = 1.580E-4, S2 = 0.990E-4, SG = 88.5E-4, GG = 0.1175EV, R = 5.605 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 9.740 -ELASTIC 3.540 -CAPTURE 6.200 148 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/11/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ WERE

ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (18/ /18/

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 5/2 + |
| 1 | 0.0576 | 7/2 + |
| 2 | 0.2028 | 3/2 + |
| 3 | 0.3750 | 1/2 + |
| 4 | 0.4179 | 5/2 + |
| 5 | 0.6184 | 3/2 + |
| 6 | 0.6286 | 7/2 + |
| 7 | 0.6510 | 9/2 + |
| 8 | 0.7165 | 11/2 + |
| 9 | 0.7446 | 9/2 + |
| 10 | 0.9910 | 3/2 + |
| | | |

LEVELS ABOVE 1.1 MEV WERE ASSUMED TO BE OVERLAPPING.

F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (8.29E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 760 MILLI-BARNS AT 25 KEV MEASURED BY YAMAMURO ET AL./21/

| MT
MT
MT
MT
MT
MT | = 16
= 17
= 22
= 32
= 33
= 103
= 104
= 105
= 106
= 107
THESEQU | (N,
(N,
(N,
(N,
(N,
(N,
(N,
(N,
(N,
(N, | 2N)
N'A)
N'D)
N'D)
P)
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC | CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
ROSSS
CROSSS
CROSS
CNO
CROSS
CNO
CROSSS
CNO
CROSSS
CNO
CROSSS
CNO
CROSSS
CNO
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROS
CRO | SS
SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS | TION
TION
CTIC
CCTIC
CCTIC
ION
CTIC
SECTIC
SECTIC
I - ST | N
WERE
EVAF | E CA
PORA | LCUL
TION | ATEC
MOD |) WI
DEL | TH T
CODE | HE
PEG | ASUS. |
|----------------------------------|--|--|---|---|---|---|-------------------|--------------|--------------|-------------|-------------|--------------|-----------|-------|
| | | | | ~ ~ · · ~ - | | |
 | | ~ - ~ | | | | | |

THE KALBACH'S CONSTANT K (= 185.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS.

FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1800.00 MB (RECOMMENDED BY BYCHKOV+/23/) (N,P) 16.00 MB (RECOMMENDED BY FORREST/24/) (N,ALPHA) 1.50 MB (RECOMMENDED BY FORREST)

MT = 251 MU-BAR CALCULATED WITH CASTHY.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR

OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) DIFFUSENESS(FM) |
|---|--|
| V = 45.97-0.199E
WS = 6.502
VSO= 7.0
THE FORM OF SURFACE ABSORPTION | R0 = 6.481 A0 = 0.62
RS = 6.926 AS = 0.35
RS0= 6.49 AS0= 0.62
PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) PAIRING |
| 51-SB-123 1.585E+01 6.213E-0 51-SB-124 1.696E+01 5.600E-0 51-SB-125 1.700E+01 5.120E-0 51-SB-126 1.700E+01 5.250E-0 | 1 1.285E+00 5.469E+00 1.430E+00
1 1.090E+01 3.433E+00 0.0
1 7.883E-01 3.792E+00 1.090E+00
1 7.566E+00 2.897E+00 0.0 |
| 52-TE-124 1.784E+01 6.740E-0 52-TE-125 1.992E+01 5.590E-0 52-TE-126 1.706E+01 6.100E-0 52-TE-127 2.004E+01 5.380E-0 | 1 1.452E+00 8.479E+00 2.570E+00
1 5.035E+00 5.527E+00 1.140E+00
1 5.154E-01 6.554E+00 2.230E+00
1 3.633E+00 5.165E+00 1.140E+00 |
| 53-I -125 * 1.789E+01 5.895E-0 53-I -126 * 1.763E+01 5.871E-0 53-I -127 1.717E+01 6.263E-0 53-I -128 1.715E+01 6.200E-0 | 1 2.042E+00 5.696E+00 1.430E+00
1 1.981E+01 4.127E+00 0.0
1 4.458E+00 5.757E+00 1.090E+00
1 2.329E+01 4.542E+00 0.0 |
| SYST: * = LDP'S WERE DETERMINE | D FROM SYSTEMATICS. |
| IN THE CASTHY CALCULATION, SPIN
ASSUMED TO BE 7.0 FOR I -127 AND | CUTOFF FACTORS AT 0 MEV WERE
5.0 FOR I -128. |
| REFERENCES | ONE ON NUCLEAR DATA FOR BASIC |
| AND APPLIED SCIENCE, SANTA FE
2) KAWAI, M. ET_AL.: J. NUCL. SC | i. TECHNOL., 29, 195 (1992). |
| 3) GARG, J.B., ET AL.: PHYS. REV 4) CAUVIN, B., ET AL.: "PROC. 3R 4) CAUPTECHNOL 4) CAUPTECHNOL | , B137, 547 (1965).
D CONF, ON NEUTRON CROSS-SECTIONS |
| 5) ROHR, G., ET AL.: NEANDC(E)17
6) MACKLIN. R.L.: NUCL. SCI. ENG | 2U, VOL.3, 8 (1976).
. 85. 350 (1983). |
| 7) MUGHABGHAB, S.F. ÉT AL.: "NEU
PART_A", ACADEMIC PRESS (1981 | TRÔŇ´CRÔŠS`SECTÍONS, VOL. I,
). |
| ACADEMIC PRESS (1984).
8) POPOV, A.B. AND TSHETSYAK, K. | : JINR-P3-81-721 (1981). |
| 10) IIJIMA, S. ET AL.: JAERI-M 87
11) IIJIMA, S. AND KAWAI, M.: J. | -025, P. 337 (1987).
NUCL. SCI. TECHNOL., 20, 77 |
| (1983)
12) PEREY, F.G: PHYS. REV. 131, 7 | 45 (1963) |
| 14) LOHR, J.M. AND HAEBERLI, W.:
15) RECCHETTI E D. IR AND GREE | NUCL. PHYS. 29, 462 (1962).
NUCL. PHYS. A232, 381 (1974).
NIFES G W - POLARIZATION |
| W. HAEBERLI), P. 682, THE UNI | S ((EDS) H.H. BARSHALL AND
VERSITY OF WISCONSIN PRESS. |
| (1971)
16) GILBERT, A. AND CAMERON, A.G. | W.: CAN. J. PHYS., 43, 1446 |
| (1905).
17) IJJIMA, S., ET AL.: J. NUCL.
18) GRUPPELAAR H · ECN-13 (1977) | SCI. TECHNOL. 21, 10 (1984). |
| 19) MATSUMOTO, J., ET AL.: JAERI-
20) BENZI, V. AND REFFO, G.: CCDN | 7734 (1978).
-NW/10 (1969). |
| 21) YAMAMURO, N., ET AL.: J. NUCL
22) KIKUCHI, K. AND KAWAI, M.: "N
NOBLU DALE AND (42) | . SCI. TECHNOL., 17, 582 (1980).
UCLEAR MATTER AND NUCLEAR |
| 23) BYCHKOV, V.M. ET AL.: INDC(CC | P)-146/LJ (1980). |

24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5331 53-1 -129 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

MI=451 CUMMENIS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 3.391 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS : EVALUATION FOR JENDL-2 WAS CARRIED OUT ON THE BASIS OF THE DATA MEASURED BY MACKLIN/3/. RESONANCE ENERGIES FOR 125 LEVELS WERE BASED ON THE MEASUREMENT BY MACKLIN EXCEPT THE 1ST LEVEL. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE O FOR ALL RESONANCE LEVELS. RADIATION WIDTH FOR EACH RESONANCE LEVEL WAS NOT GIVEN BY MACKLIN. THEREFORE, AVERAGE RADIATION WIDTH OF 120 MEV WAS ASSUMED BY TAKING ACCOUNT OF THE MAXIMUM VALUE (58.5 MEV) OF NEUTRON CAPTURE AREAS MEASURED BY MACKLIN. NEUTRON WIDTHS WERE DERIVED FROM THE NEUTRON CAPTURE AREAS AND THE AVERAGE RADIATION WIDTH. SINCE THE VALUES OF TOTAL SPIN FOR ALL RESONANCE LEVELS WERE UNKNOWN, THE TARGET SPIN OF 3.5 WAS ADOPTED AS THEIR TOTAL SPIN. A NEGATIVE RESONANCE WAS ADDED AT -10 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 27 BARNS GIVEN BY MUGHABGHAB ET AL./4/ SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN IN REF./4/. EOD JENDI 2 THE TOTAL SPIN.

FOR JENDL-3, THE TOTAL SPIN OF 126 RESONANCE LEVELS WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS OF THESE LEVELS WERE MODIFIED ON THE BASIS OF THE ESTIMATED J-VALUES. NEUTRON AND RADIATION WIDTHS OF THE NEGATIVE RESONANCE LEVEL WERE ALSO MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION ACCORDING TO THE ABOVE MODIFICATION OF THE NEUTRON WIDTHS.

UNRESOLVED RESONANCE REGION : 3.391 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MACKLIN /3/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.532E-4, S1 = 1.332E-4, S2 = 0.887E-4, SG = 51.8E-4, GG = 0.160 EV, R = 5.390 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 33.47 ELASTIC 6.471 -CAPTURE 27.00 29.4

GAPTURE 27.00 29.4 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/5/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION, CHANGED FROM RO AND RSO OF IIJIMA AND KAWAI/7/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/.

/14/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING

CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/ NO. SPIN-PARITY ENERGY(MEV) GŖ. 0.0 0.0278 0.2784 7/2 + 5/2 + 3/2 + 1 0.4874 0.5596 0.6960 3456789011234 11234 5/2 1/2 9/2 7/2 3/2 7/2 5/2 5/2 3/2 2 1/2 9/2 0.6960 0.7296 0.7689 0.8299 0.8450 1.0470 1.0504 + + 1.1117 1.2100 1.2608 1.2821 1.2922 15 + 16 17 1.4016 18 1.4835 1/2 + LEVELS ABOVE 1.55 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (5.13E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 215 MILLI-BARNS AT 100 KEV MEASURED BY MACKLIN./3/ THE KALBACH'S CONSTANT K (= 221.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1500.00 MB (SYSTEMATICS OF WEN DEN LU+/18/) (N,P) 3.64 MB (SYSTEMATICS OF FORREST/19/) (N,ALPHA) 1.86 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM)

DEPTH (MEV)RADIUS(FM)DIFFUSENESS(FM)V = 45.97 - 0.199ER0 = 6.481A0 = 0.62WS = 6.502RS = 6.926AS = 0.35

VSO= 7.0 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE | A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) | PAIRING |
|---|--|---|--|
| 51 - SB - 125
51 - SB - 126
51 - SB - 127
51 - SB - 127
51 - SB - 128 | 1.700E+01 5.120E-01
1.700E+01 5.250E-01
1.700E+01 5.120E-01
1.468E+01 5.600E-01 | 7.883E-01 3.792E+00
7.566E+00 2.897E+00
6.326E-01 3.902E+00
4.264E+00 2.658E+00 | 1.090E+00
0.0
1.200E+00
0.0 |
| 52 - TE - 126
52 - TE - 127
52 - TE - 128
52 - TE - 128
52 - TE - 129 | 1.706E+01 6.100E-01
2.004E+01 5.380E-01
1.800E+01 6.090E-01
2.015E+01 5.350E-01 | 5.154E-01 6.554E+00
3.633E+00 5.165E+00
6.586E-01 7.010E+00
3.588E+00 5.141E+00 | 2.230E+00
1.140E+00
2.340E+00
1.140E+00 |
| 53-1 -127
53-1 -128
53-1 -129
53-1 -130 | 1.717E+01 6.263E-01
1.715E+01 6.200E-01
1.720E+01 6.200E-01
1.640E+01 6.000E-01 | 4.458E+00 5.757E+00
2.329E+01 4.542E+00
3.436E+00 5.762E+00
1.297E+01 3.896E+00 | 1.090E+00
0.0
1.200E+00
0.0 |
| SPIN CUTOFF P
IN THE CASTHY
ASSUMED TO BE | ARAMETERS WERE CALCUL
CALCULATION, SPIN CU
5.277 FOR I -129 AND | ATED AS 0.146*SQRT(
TOFF FACTORS AT 0 M
5.0 FOR I -130. | A)*A**(2/3).
EV WERE |
| REFERENCES
1) AOKI, T. E
AND APPLIE
2) KAWAI, M.
AND TECHNO
3) MACKLIN, R
4) MUGHABGHAE
PART A", A | T AL.: PROC. INT. CON
D SCIENCE, SANTA FE.,
ET AL.: PROC. INT. CO
DLOGY, MITO, P. 569 (1
S.L.: NUCL. SCI. ENG.,
S.S.F. ET AL.: "NEUTR
CADEMIC. PRESS (1981). | F. ON NUCLEAR DATA
VOL. 2, P.1627 (19
NF. ON NUCLEAR DATA
988).
85, 350 (1983).
ON CROSS SECTIONS, | FOR BASIC
85)
FOR SCIENCE
VOL. I, |
| 5) IGARASI, 5
6) IIJIMA, S.
7) IIJIMA, S.
(1983).
8) PEREY F G | S.: J. NUCL. SCI. TECH
ET AL.: JAERI-M 87-0
AND KAWAI, M.: J. NU
S. PHYS REV 131 745 | NOL., 12, 67 (1975)
25, P. 337 (1987).
CL. SCI. TECHNOL., | 20, 77 |
| 9) HUIZENGA,
10) LOHR, J.M.
11) BECCHETTI,
PHENOMENA
W. HAEBERL
(1071) | J.R. AND IGO, G.: NUC
AND HAEBERLI, W.: NU
F.D., JR. AND GREENL
IN NUCLEAR REACTIONS
I), P. 682, THE UNIVE | L. PHYS. 29, 462 (1
CL. PHYS. A232, 381
EES, G.W.: POLARIZA
((EDS) H.H. BARSHAL
RSITY OF WISCONSIN | 962).
(1974).
TION
L AND
PRESS. |
| 12) GILBERT, A | A. AND CAMERON, A.G.W. | : CAN. J. PHYS., 43 | , 1446 |
| 13) IIJIMA, S.
14) GRUPPELAAR
15) MATSUMOTO,
16) BENZI, V.
17) KIKUCHI, K | , ET AL.: J. NUCL. SC
, H.: ECN-13 (1977).
J., ET AL.: JAERI-M
AND REFFO, G.: CCDN-N
AND REFFO, G.: CCDN-N
AND KAWAI, M.: "NUC | I. TECHNOL. 21, 10
7734 (1978).
W/10 (1969).
LEAR MATTER AND NUC | (1984).
LEAR |
| 18) WEN DEN LU
19) FORREST, R | AND FINK, R.W.: PHYS
A.A.: AERE-R 12419 (19 | . REV., C4, 1173 (1
86). | 971). |

MAT number = 5337 53-1 -131 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 38 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.600E-4, S2 = 0.980E-4, SG = 20.1E-4, GG = 0.120 EV, R = 5.399 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 83.60 3.600 TOTAL ELASTIC CAPTURE 80.00 77.8 F = 3 NEUTRON CROSS SECTIONS BELOW 38 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 5.4 FM UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 38 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT SHEETS/14/. SPIN-PARITY 7/2 + 5/2 + NO. ENERGY(MEV) GŔ. 1 0.0 0.1497 3/2 5/2 11/2 0.4927 ż + 34 + 0.7737 + 0.8522 0.8767 9/2 1/2 5 + 6 + $\frac{1}{7}/\frac{1}{2}$ + 7 1.0058

| 8
9
10
11
12
13
14
15
LEVELS ABOVI | 1.0597
1.0983
1.1469
1.1489
1.2840
1.2982
1.3152
1.3465
1.377 MEV WERE A | 9/2 +
3/2 +
5/2 +
7/2 +
5/2 +
3/2 +
9/2 +
1/2 +
SSUMED TO BE OVERLAPPING. | |
|--|---|---|----------|
| MT = 102 CAPTUI
SPHERICAL OPT
CASTHY WAS ADO
SECTIONS WERE
AND REFFO/15/ | RE
ICAL AND STATISTIC
OPTED. DIRECT AND
ESTIMATED ACCORDI
AND NORMALIZED TO | AL MODEL CALCULATION WITH
SEMI-DIRECT CAPTURE CROSS
NG TO THE PROCEDURE OF BENZI
1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-RAY
THE SYSTEMATIO
S-WAVE RESONAI
LEVEL DENSITY | STRENGTH FUNCTION
CS OF RADIATION WI
NCE LEVEL SPACING
PARAMETERS. | (1.97E-03) WAS DETERMINED FRO
DTH (0.12 EV) AND THE AVERAGE
(60.7 EV) CALCULATED FROM THE | ЭМ |
| MT = 16 (N,2N)
MT = 17 (N,3N)
MT = 22 (N,N'A
MT = 28 (N,N'P)
MT = 32 (N,N'D)
MT = 103 (N,P) (
MT = 104 (N,D) (
MT = 105 (N,T) (
MT = 105 (N,ALP)
THESE REACTION
PREEQUILIBRIUM | CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
HA) CROSS SECTION
M CROSS SECTIONS W
AND MULTI-STEP E | ERE CALCULATED WITH THE
VAPORATION MODEL CODE PEGASUS. | |
| THE KALBACH'S
FORMULA DERIVI
DENSITY PARAMI | CONSTANT K (= 274
ED FROM KIKUCHI-KA
ETERS. | .9) WAS ESTIMATED BY THE
WAI'S FORMALISM/16/ AND LEVEL | |
| FINALLY, THE
NORMALIZED TO
(N,2N)
(N,P)
(N,ALPHA) | (N,2N), (N,P) AND
THE FOLLOWING VAL
1710.00 MB (SYST
1.99 MB (SYST
1.10 MB (SYST | (N,ALPHA) CROSS SECTIONS WERE
UES AT 14.5 MEV:
EMATICS OF WEN DEN LU+/17/)
EMATICS OF FORREST/18/)
EMATICS OF FORREST) | |
| MT = 251 MU-BA
CALCULATED WI | R
TH CASTHY. | | |
| MF = 4 ANGULAR D
LEGENDRE POLYNOI
GIVEN IN THE CEI
TIC LEVELS, AND
CALCULATED WITH
BUTIONS IN THE I | ISTRIBUTIONS OF SE
MIAL COEFFICIENTS
NTER-OF-MASS SYSTE
IN THE LABORATORY
CASTHY. FOR OTHE
LABORATORY SYSTEM | CONDARY NEUTRONS
FOR ANGULAR DISTRIBUTIONS ARE
M FOR MT=2 AND DISCRETE INELAS
SYSTEM FOR MT=91. THEY WERE
R REACTIONS, ISOTROPIC DISTRI-
WERE ASSUMED. | S -
- |
| MF = 5 ENERGY DIS
ENERGY DISTRIBU
PEGASUS FOR INEL
OTHER NEUTRON EI | STRIBUTIONS OF SEC
TIONS OF SECONDARY
LASTIC SCATTERING
MITTING REACTIONS. | ONDARY NEUTRONS
NEUTRONS WERE CALCULATED WITH
TO OVERLAPPING LEVELS AND FOR | Η |
| TABLE 1 NEUTRON (| OPTICAL POTENTIAL | PARAMETERS | |
| DI
V = 45.9
WS = 6.503
VSO= 7.0
THE FORM OF SURI | EPTH (MEV) R
7-0.199E R
2 R
FACE ABSORPTION PA | ADIUS(FM) DIFFUSENESS(FM)
0 = 6.481 A0 = 0.62
S = 6.926 AS = 0.35
S0= 6.49 AS0= 0.62
RT IS DER. WOODS-SAXON TYPE. | |
| TABLE 2 LEVEL DE | NSITY PARAMETERS | | |
| NUCLIDE A (| 1/MEV) T(MEV) | C(1/MEV) EX(MEV) PAIRING | |
| 51 - SB - 127 1 .
51 - SB - 128 1 .
51 - SB - 129 1 .
51 - SB - 129 1 .
51 - SB - 130 1 . | 700E+01 5.120E-01
468E+01 5.600E-01
596E+01 5.040E-01
566E+01 5.000E-01 | 6.326E-01 3.902E+00 1.200E+00
4.264E+00 2.658E+00 0.0
5.308E-01 3.333E+00 1.040E+00
3.630E+00 2.154E+00 0.0 | |
| 52 - TE - 128 1 . 3
52 - TE - 129 2 . 3
52 - TE - 130 1 . 3
52 - TE - 131 1 . 3 | 300E+01 6.090E-01
015E+01 5.350E-01
300E+01 5.470E-01
346E+01 5.360E-01 | 6.586E-01 7.010E+00 2.340E+00
3.588E+00 5.141E+00 1.140E+00
2.657E-01 5.735E+00 2.180E+00
1.800E+00 4.651E+00 1.140E+00 | |

53-1 -129 1.720E+01 6.200E-01 3.436E+00 5.762E+00 1.200E+00
53-1 -130 1.640E+01 6.300E-01 1.297E+01 3.896E+00 0.0
53-1 -132 1.550E+01 6.000E-01 8.595E+00 3.552E+00 1.040E+00
53-1 -132 1.550E+01 6.000E-01 8.595E+00 3.552E+00 0.0
SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.433 FOR 1 -131 AND 5.0 FOR 1 -132.
REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
3) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A". ACADEMIC PRESS (1981).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
6) PEREY, F.G: PHYS. REV. 131, 745 (1963).
7) HUIZENGA, J.R. AND IGO. G.: NUCL. PHYS. 29, 462 (1962).
8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. 29, 462 (1962).
8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA'IN NUCLEAR REACTIONS (IEDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971)
10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
11) JIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEERS, 17, 573 (1976).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
17) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
18) FORREST, R.A.: AERE-R 12419 (1986). MAT number = 5425 54-XE-124 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.29 KEV RESONANCE PARAMETERS FOR THE THREE POSITIVE LEVELS AT 5.16, 9.88, AND 252 EV WERE BASED ON THE DATA GIVEN BY MUGHABGHAB ET AL./2/ RADIATION WIDTH OF 90.4 MEV WAS DERIVED FROM THE TOTAL AND NEUTRON WIDTHS OF THE 2ND LEVEL, AND 90 MEV WAS ADOPTED AS THE AVERAGE RADIATION WIDTH FOR THE OTHER LEVELS. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE O FOR ALL RESONANCE LEVELS. SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED AT -118 EV, AND THE NEUTRON WIDTH WAS DETERMINED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 165+-20 BARNS/2/.

UNRESOLVED RESONANCE REGION : 0.29 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.970E-4, S1 = 1.700E-4, S2 = 1.100E-4, SG = 82.1E-4, GG = 0.140 EV, R = 5.374 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRAL 2200 M/S RES. INTEG INTEGRALS (BARNS) 266.0 TOTAL ELASTIC CAPTURE 101.0

2970

CAPTURE 165.0 2970
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/5/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/6/
ALPHA = HUIZENGA AND IGO/7/
DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/.

/12/.

MT =

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

ΜT

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT

- 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 | 0 + |
| 1 | 0.3540 | 2 + |
| 2 | 0.8469 | 2 + |

0.8792 34 56 7 89 10 11 12 430460200454 1.2481 + 5 1.2687 0 + 6 1.4383 4 + 7 1.5487 6 + 8 1.6224 0 + 9 1.6284 2 + 10 1.6500 0 + 11 1.6899 0 + 12 1.7113 4 + 13 1.8374 5 + 14 1.9785 4 + 15 2.1445 6 + 16 2.2051 4 + 17 2.3100 0 + 18 2.3314 8 + LEVELS ABOVE 2.375 MEV WERE ASSUMED TO BE OVERLAPPING. + MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (8.43E-03) WAS DETERMINED FR THE SYSTEMATICS OF RADIATION WIDTH (0.14 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (16.6 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. WAS DETERMINED FROM MT = 16МŤ ΜT MT MT MT MT МŤ МΤ ΜT MT THE KALBACH'S CONSTANT K (= 100.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1000.00 MB (RECOMMENDED BY BYCHKOV+/17/) (N,P) 34.30 MB (SYSTEMATICS OF FORREST/18/) (N,ALPHA) 14.90 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) R0 = 6.481. . . TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

52-TE-120 1.700E+01 5.940E-01 3.471E-01 6.309E+00 2.290E+00

1.800E+01 6.200E-01 5.720E+00 6.022E+00 1.140E+00 1.705E+01 6.350E-01 6.339E-01 7.160E+00 2.380E+00 1.874E+01 5.850E-01 4.619E+00 5.627E+00 1.140E+00 52 - TE - 121 52 - TE - 122 52 - TE - 123 1.889E+01 5.992E-01 6.188E+00 5.966E+00 1.150E+00 1.865E+01 5.968E-01 3.635E+01 4.680E+00 0.0 1.840E+01 5.943E-01 3.884E+00 5.783E+00 1.240E+00 1.950E+01 5.240E-01 2.017E+01 3.611E+00 0.0 53-1 -121 53-1 -122 53-1 -123 * 53-I -124 * 1.904E+01 5.968E-01 9.775E-01 7.096E+00 2.270E+00 1.908E+01 5.770E-01 4.895E+00 5.573E+00 1.120E+00 1.992E+01 5.860E-01 1.014E+00 7.286E+00 2.360E+00 2.050E+01 5.530E-01 6.059E+00 5.576E+00 1.120E+00 54-XE-122 54 - XE - 123 54 - XE - 124 54 - XE - 125 . SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.902 FOR XE-124 AND 5.0 FOR XE-125. REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 6) 7) 8) 9) (1971) 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 41, 413 (1984).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) KINUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
17) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5431 54-XE-126 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.485 KEV RESONANCE PARAMETERS WERE EVALUATED FOR A LEVEL AT 460 EV BASED ON THE DATA GIVEN BY MUGHABGHAB ET AL./2/ NEUTRON AND RADIATION WIDTHS WERE MODIFIED SO AS TO REPRODUCE THE NEUTRON RESONANCE CAPTURE INTEGRAL OF 60+-10 BARNS/2/. NEUTRON ORBITAL ANGULAR MOMENTUM L OF THIS LEVEL WAS ASSUMED TO BE 0. SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH(FIG.1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED AT -100 EV, AND THE NEUTRON AND RADIATION WIDTHS WERE DETERMINED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 3.5+-0.8 BARNS /2/. 0.8 BARNS /2/.

UNRESOLVED RESONANCE REGION : 0.485 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.700E-4, S2 = 1.000E-4, SG = 30.2E-4, GG = 0.150 EV, R = 5.358 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 11.72 -ELASTIC 7.453 -CAPTURE 4.269 23.4

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF ILJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY ILJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 0 + |
| 1 | 0.3886 | 2 + |
| 2 | 0.8799 | 2 + |
| 3 | 0.9419 | 4 + |

| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
|---|--|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (2.99E-03) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.15 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (50.1 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 117.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1400.00 MB (RECOMMENDED BY BYCHKOV+/17/)
(N,P) 19.00 MB (SYSTEMATICS OF FORREST/18/)
(N,ALPHA) 8.33 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $ \begin{array}{rcl} V &= 45.97 - 0.199E & R0 &= 6.481 & A0 &= 0.62 \\ WS &= 6.502 & RS &= 6.926 & AS &= 0.35 \\ VS0 &= 7.0 & RS0 &= 6.49 & AS0 &= 0.62 \\ THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. \end{array} $ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDESYST A(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING52-TE-1221.705E+016.350E-016.339E-017.160E+002.380E+0052-TE-1231.874E+015.850E-014.619E+005.627E+001.140E+0052-TE-1241.784E+016.740E-011.452E+008.479E+002.570E+0052-TE-1251.992E+015.590E-015.035E+005.527E+001.140E+00 | |
| 53-I -123 * 1.840E+01 5.943E-01 3.884E+00 5.783E+00 1.240E+00
53-I -124 1.950E+01 5.240E-01 2.017E+01 3.611E+00 0.0 | |

53-1 -125 * 1.789E+01 5.895E-01 2.042E+00 5.696E+00 1.430E+00
53-1 -126 * 1.763E+01 5.87TE-01 1.981E+01 4.127E+00 0.0
54-XE-124 1.992E+01 5.860E-01 1.014E+00 7.286E+00 2.360E+00
54-XE-125 2.050E+01 5.530E+01 6.059E+00 5.576E+00 1.120E+00
54-XE-126 1.908E+01 6.110E+01 8.260E+01 7.676E+00 2.550E+00
54-XE-127 1.982E+01 5.420E+01 3.686E+00 5.152E+00 1.120E+00
SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS.
SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 9.458 FOR XE-126 AND 5.0 FOR XE-127.
REFERENCES
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY. MITO. P. 569 (1988).
2) MUGHABGHAB, S.F. ET ÅL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
6) PEREY, F.G: PHYS. REV. 131, 745 (1963).
7) HUIZENGA, J.R. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA'IN NUCLEAR REACTIONS ((EDS)) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
11) JIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 36, 227 (1982).
15) BENDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 36, 227 (1982).
15) BENDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 36, 227 (1982).
15) BENDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).<

MAT number = 5437 54-XE-128 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.7 KEV RESONANCE PARAMETERS WERE BASED ON THE DATA GIVEN BY MUGHABGHAB ET AL./2/, EXCEPT NEUTRON WIDTH OF THE 3RD LEVEL WHICH WAS DERIVED FROM THE VALUE OF G*(REDUCED NEUTRON WIDTH) ESTIMATED ON THE BASIS OF THE SYSTEMATICS OF THOSE FOR NEIGHBORING LEVELS. RADIATION WIDTH OF 66 MEV FOR THE 1ST LEVEL WAS OBTAINED FROM THE TOTAL AND NEUTRON WIDTHS. AVERAGE RADIATION WIDTH OF 70 MEV CLOSE TO THAT OF THE 1ST LEVEL WAS ADOPTED FOR THE OTHER LEVELS. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL RESONANCE LEVELS. A NEGATIVE RESONANCE WAS ADDED AT -100 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN IN REF./2/. GIVEN IN REF./2/.

UNRESOLVED RESONANCE REGION : 1.7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.980E-4, S1 = 1.700E-4, S2 = 1.000E-4, SG = 7.60E-4, GG = 0.140 EV, R = 5.348 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) ΤΟΤΛΙ

| IOTAL | 19.05 | - |
|---------|-------|------|
| ELASTIC | 11.05 | - |
| CAPTURÉ | 8.000 | 12.5 |
| | | |

CAPIURE 8.000 12.5 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV; THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/.

/12/.

MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/. MT

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 0 + |

| 1 0.4429 2 +
2 0.9695 2 +
3 1.0331 4 +
4 1.4296 3 +
5 1.5830 0 +
6 1.6034 4 +
7 1.7370 6 +
8 1.8773 0 +
9 1.9965 5 +
10 1.9996 2 +
11 2.1271 1 +
12 2.2290 5 -
13 2.2529 1 -
14 2.2728 2 +
15 2.2809 5 +
16 2.3618 1 +
17 2.4211 3 -
18 2.4307 1 +
19 2.4439 0 +
20 2.4825 1 +
21 2.5008 4 -
22 2.5107 2 +
23 2.5125 8 +
LEVELS ABOVE 2.521 MEV WERE ASSUMED TO BE OVERLAPPING. |
|--|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (7.25E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.14 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (193 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 131.7) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1446.00 MB (RECOMMENDED BY BYCHKOV+/17/)
(N,P) 27.00 MB (RECOMMENDED BY FORREST/18/)
(N,ALPHA) 4.74 MB (SYSTEMATICS OF FORREST/18/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>#F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>#F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{cccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & V &= 45.97 \cdot 0.199E & \text{RO} = 6.481 & \text{AO} = 0.62 \\ & \text{WS} &= 6.502 & \text{RS} = 6.926 & \text{AS} = 0.35 \\ & \text{VSO} = 7.0 & \text{RSO} = 6.49 & \text{ASO} = 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ |
| IABLE Z LEVEL DENSITY PARAMETERS |

NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.784E+01 6.740E-01 1.452E+00 8.479E+00 2.570E+00 1.992E+01 5.590E-01 5.035E+00 5.527E+00 1.140E+00 1.706E+01 6.100E-01 5.154E-01 6.554E+00 2.230E+00 2.004E+01 5.380E-01 3.633E+00 5.165E+00 1.140E+00 52-TE-124 52 - TE - 125 52 - TE - 126 52 - TE - 127 * 1.789E+01 5.895E-01 2.042E+00 5.696E+00 1.430E+00 * 1.763E+01 5.871E-01 1.981E+01 4.127E+00 0.0 1.717E+01 6.263E-01 4.458E+00 5.757E+00 1.090E+00 1.715E+01 6.200E-01 2.329E+01 4.542E+00 0.0 53-| -125 53-| -126 53-| -127 53-I - 128 1.908E+01 6.110E-01 8.260E-01 7.676E+00 2.550E+00 1.982E+01 5.420E-01 3.686E+00 5.152E+00 1.120E+00 1.800E+01 5.830E-01 5.017E-01 6.396E+00 2.210E+00 1.936E+01 5.729E-01 5.108E+00 5.590E+00 1.120E+00 54 - XE - 126 54 - XE - 127 54 - XE - 128 54-XE-129 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.255 FOR XE-128 AND 8.187 FOR XE-129. REFERENCES (TERENCES)
(AWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 IIJIMA, S. AND. MARL, (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 6) 8) 9) (19/1) 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 10) GILBERI, A. AND GAMERUN, A.G.W.. CAN. J. FILS., 43, 1440 (1965).
11) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 38, 191 (1983).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
17) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980).
18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5440 54-XE-129 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.7 KEV RESONANCE PARAMETERS OF THE 69 LEVELS FROM 9.5 TO 4082 EV WERE BASED ON THE DATA GIVEN BY MUGHABGHAB ET AL./2/ NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL RESONANCE LEVELS. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS WERE DETERMINED FROM THE DATA OF 2G* (NEUTRON WIDTH). RADIATION WIDTHS FOR THE 56 LEVELS WERE OBTAINED FROM THE TOTAL AND NEUTRON WIDTHS. AVERAGE RADIATION WIDTH OF 200 MEV WAS OBTAINED BY TAKING THE WEIGHTED AVERAGE OF GIVEN DATA, AND WAS ADOPTED FOR THE 13 LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED AT -50 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 21+-5 BARNS/2/.

UNRESOLVED RESONANCE REGION : 2.7 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.600E-4, S2 = 1.000E-4, SG = 31.5E-4, GG = 0.140 EV, R = 5.407 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)

| | ZZUU W/3 | RES. INTEG. |
|------------|----------|-------------|
| TOTAL | 42.04 | - |
| ELASTIC | 21.04 | - |
| CAPTURÉ | 21.00 | 256 |
| O/AL LOTAL | | 200 |

MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF ILJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY ILJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/.

/12/.

ΜТ TOTAL 1

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/

> ENERGY(MEV) SPIN-PARITY NO

 $\begin{array}{c} 0.0\\ 0.0396\\ 0.2361\\ 0.3182\\ 0.3217\\ 0.4115\\ 0.5187\\ 0.5727\\ 0.5885\\ 0.6245\\ 0.6654\\ 0.7711\\ 0.8222\\ 0.8232\end{array}$ 1/2 3/2 5/2 5/2 5/2 3/2 7/2 3/2 13/2 15/2 15/2 3/2 GŖ. + 123456789 -+ + + + + + + 1Ŏ + 11 12 13 0.8680 0.9043 0.9460 14 15 + + 1/2 16 LEVELS ABOVE 0.986 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (3.12E-03) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.14 EV) AND AVERAGE S-WAVE RESONANCE LEVEL SPACING (45+-8 EV/2/). T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =106 (N,HE3) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16МŤ ΜT MŤ MT MT МŤ МŤ ΜT МТ THE KALBACH'S CONSTANT K (= 209.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 7.79 MB (SYSTEMATICS OF FORREST/17/) (N,ALPHA) 3.60 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - **`** - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 52 - TE - 125 52 - TE - 126 1.992E+01 5.590E-01 5.035E+00 5.527E+00 1.140E+00 1.706E+01 6.100E-01 5.154E-01 6.554E+00 2.230E+00 2.004E+01 5.380E-01 3.633E+00 5.165E+00 1.140E+00 52-TE-127

52-TE-128 1.800E+01 6.090E-01 6.586E-01 7.010E+00 2.340E+00
53-1 -126 * 1.763E+01 5.871E-01 1.981E+01 4.127E+00 0.0
53-1 -127 1.717E+01 6.263E-01 4.458E+00 5.757E+00 1.090E+00
53-1 -128 1.715E+01 6.200E-01 2.329E+01 4.542E+00 1.200E+00
54-XE-127 1.982E+01 5.420E-01 3.686E+00 5.152E+00 1.200E+00
54-XE-128 1.800E+01 5.802E-01 5.017E+01 6.396E+00 2.210E+00
54-XE-128 1.800E+01 5.729E+01 5.108E+00 5.590E+00 1.120E+00
54-XE-129 1.936E+01 5.729E+01 5.108E+00 5.590E+00 1.120E+00
54-XE-129 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
54-XE-130 1.671E+01 6.600E+01 8.841E+01 7.427E+00 2.320E+00
575TE * = LDP'S WERE DETERMINED FROM SYSTEMATICS.
SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*S0RT(A)*A**(2/3).
IN THE CASTHY CALCULATION. SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.187 FOR XE-129 AND 5.625 FOR XE-130.
REFERENCES 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TÉCHNOLOGY. MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJAMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IDARASI, S.: J. NUCL. SCI. TECHNOL. 20, 77 (1983).
PERVINGA, J.R. AND GAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
GUPPELAAR, H.: AND CA

MAT number = 5443 54-XE-130 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 3.6 KEV RESONANCE PARAMETERS OF THE 16 LEVELS FROM 430 TO 3564 EV WERE BASED ON THE DATA GIVEN BY MUGHABGHAB ET AL./2/ NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL RESONANCE LEVELS. RADIATION WIDTHS FOR THE 6 LEVELS WERE OBTAINED FROM THE TOTAL AND NEUTRON WIDTHS. AVERAGE RADIATION WIDTH OF 220 MEV WAS OBTAINED BY AVERAGING THE ABOVE 6 RADIATION WIDTHS, AND WAS ADOPTED FOR THE 10 LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED AT -400 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION/2/. NEUTRON

UNRESOLVED RESONANCE REGION : 3.6 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.600E-4, S2 = 0.990E-4, SG = 7.23E-4, GG = 0.130 EV, R = 5.402 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEGRALS TOTAL 40.48 -ELASTIC 14.48 -CAPTURE 26.00 17.8 INTEGRALS (BARNS)

CAPTURE 26.00 17.8 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/5/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/6/
 ALPHA = HUIZENGA AND IGO/7/
 DEUTERON = LOHR AND HAEBERLI/8/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAA
 /12/. WERE

TO GRUPPELAAR /12/.

MT =

Ν

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

МΤ

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4

F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 | 0 + |
| 1 | 0.5361 | 2 + |
| 2 | 1.1222 | 2 + |

| 3 1.2046 4 +
4 1.6325 3 +
LEVELS ABOVE 1.786 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|---|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-RAY STRENGTH FUNCTION (6.84E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.13 EV) AND AVERAGE
S-WAVE RESONANCE LEVEL SPACING (190+-60 EV/2/). | М |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. | |
| THE KALBACH'S CONSTANT K (= 189.9) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1590.00 MB (SYSTEMATICS OF WEN DEN LU+/17/)
(N,P) 10.00 MB (RECOMMENDED BY FORREST/18/)
(N,ALPHA) 2.74 MB (SYSTEMATICS OF FORREST/18/) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | - |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> | |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV)
V = 45.97-0.199E
WS = 6.502
VSO= 7.0
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING | |
| 52-1E-1261.706E+016.100E-015.154E-016.554E+002.230E+0052-TE-1272.004E+015.380E-013.633E+005.165E+001.140E+0052-TE-1281.800E+016.090E-016.586E-017.010E+002.340E+0052-TE-1292.015E+015.350E-013.588E+005.141E+001.140E+00 | |
| 53-1-1271.717E+016.263E-014.458E+005.757E+001.090E+0053-1-1281.715E+016.200E-012.329E+014.542E+000.053-1-1291.720E+016.200E-013.436E+005.762E+001.200E+0053-1-1301.640E+016.000E-011.297E+013.896E+000.0 | |
| 54-XE-1281.800E+015.830E-015.017E-016.396E+002.210E+0054-XE-1291.936E+015.729E-015.108E+005.590E+001.120E+0054-XE-1301.671E+016.600E-018.841E-017.427E+002.320E+0054-XE-1311.740E+016.000E-013.176E+005.394E+001.120E+00 | |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3)
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 5.625 FOR XE-130 AND 11.68 FOR XE-131. | |
REFERENCES

- (EFERENCES)
 (AWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 (2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 (3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 (4) IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 (5) IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 6) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

- 10) ĜIĹBEŔT, A. AND CAMERUN, A.G.W.: CAN. J. FHIG., 40, 1110 (1965).
 11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 12) GRUPPELAAR, H.: ECN-13 (1977).
 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 14) NUCLEAR DATA SHEETS, 13, 133 (1974).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
 18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5446 54-XE-131 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF M1=451 COMMENTS AND DICTIONANT F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.25 KEV RESONANCE PARAMETERS OF JENDL-2 WAS MODIFIED AS FOLLOWS: EVALUATION OF JENDL-2 WAS CARRIED OUT ON THE BASIS OF THE DATA MEASURED BY RIBON ET AL./3/ NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL THE 40 RESONANCE LEVELS UP TO 4 KEV. NEUTRON WIDTHS OF THE 40 LEVELS WERE DETERMINED FROM THE 2G* (NEUTRON WIDTH) MEASURED BY RIBON ET AL. HOWEVER, THE VALUE OF TOTAL SPIN J FOR EACH RESONANCE LEVEL WAS UNKNOWN EXCEPT 24 LEVELS ASSIGNED BY RIBON ET AL., AND THE TARGET SPIN OF 1.5 WAS ADOPTED FOR THE J-UNKNOWN LEVELS AS THE TOTAL SPIN. RADIATION WIDTHS WERE OBTAINED FROM THE TOTAL AND NEUTRON WIDTHS FOR 30 LEVELS. AVERAGE RADIATION WIDTH OF 111.94 MEV WAS DERIVED FROM THE ABOVE RADIATION WIDTHS, AND WAS ADOPTED FOR REMAINING 10 LEVELS. A NEGATIVE RESONANCE WAS ADDED AT -84 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 85+-10 BARNS GIVEN BY MUGHABGHAB ET AL./4/ SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. MF ET AL. FOR JENDL-3, THE TOTAL SPIN J OF 16 RESONANCE LEVELS WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS OF THESE LEVELS WERE MODIFIED ON THE BASIS OF THE ESTIMATED J-VALUES. UNRESOLVED RESONANCE REGION : 2.25 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: $\begin{array}{c} S0 = 0.700E\text{-}4, \ S1 = 1.580E\text{-}4, \ S2 = 0.990E\text{-}4, \ SG = 30.0E\text{-}4, \\ GG = 0.114 \ \text{EV}, \ R = 5.633 \ \text{FM}. \end{array}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. INTEGRALS (BARNS) 109.1 TOTAL ELASTIC CAPTURE 24.03 900 85.03 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/7/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. MF /14/ MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2

T = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/

| LEVELS | NO.
GR.
2
3
4
5
6
7
8
ABOVE 0 | ENERGY(MEV
0.0
0.0802
0.1640
0.3418
0.3644
0.6370
0.6671
0.7230
0.8064
.971 MEV W | () SPIN
3/2
1/2
11/2
5/2
7/2
7/2
5/2
15/2
VERE ASSUM | -PARITY
+
-
-
+
-
-
-
-
-
-
-
-
-
-
-
-
-
-
- | APPING. |
|---|---|--|---|--|---|
| MT = 102
SPHERIC/
CASTHY V
SECTIONS
AND REF | CAPTURE
AL OPTICA
VAS ADOPT
S WERE ES
FO/16/ AN | L AND STAT
ED. DIREC
TIMATED AC
D NORMALIZ | ISTICAL M
T AND SEM
CORDING T
ED TO 1 M | ODEL CALCULATIO
I-DIRECT CAPTUP
O THE PROCEDURE
ILLI-BARN AT 14 | ON WITH
RE CROSS
OF BENZI
4 MEV. |
| THE GAMM
THE SYS
S-WAVE F | MA-RAY ST
FEMATICS
RESONANCE | RENGTH FUN
OF RADIATI
LEVEL SPA | ICTION (2.
ON WIDTH
CING (39 | 92E-03) WAS DE
(0.114 EV) AND
EV). | FERMINED FROM
AVERAGE |
| MT = 16
MT = 17
MT = 22
MT = 28
MT = 32
MT =103
MT =104
MT =105
MT =107
THESE RE
PREEQUII | (N,2N) CR
(N,3N) CR
(N,N'A) C
(N,N'P) C
(N,P) CR
(N,P) CRC
(N,T) CRC
(N,ALPHA)
EACTION C
LIBRIUM A | OSS SECTIO
OSS SECTIO
ROSS SECTI
ROSS SECTI
SS SECTION
SS SECTION
SS SECTION
CROSS SECTION
CROSS SECTI
ROSS SECTI
ND MULTI-S | N
ON
ON
ON
TION
ONS WERE
TEP EVAPO | CALCULATED WITH
RATION MODEL CO | I THE
DDE PEGASUS. |
| THE KALE
FORMULA
DENSITY | BACH'S CC
DERIVED
PARAMETE | NSTANT K (
FROM KIKUC
RS. | = 268.1)
HI-KAWAI' | WAS ESTIMATED E
S FORMALISM/17, | 3Y THE
/ AND LEVEL |
| FINALLY
NORMALIZ
(N,P)
(N,ALF | , THE (N,
ZED TO TH
PHA) | P) AND (N,
E FOLLOWIN
6.00 MB
2.10 MB | ALPHA) CR
IG VALUES
(RECOMMEN
(SYSTEMAT | OSS SECTIONS WE
AT 14.5 MEV:
DED BY FORREST,
ICS OF FORREST, | ERE
(18/)
(18/) |
| MT = 251
CALCULAT | MU-BAR
FED WITH | CASTHY. | | | |
| MF = 4 ANGU
LEGENDRE F
GIVEN IN
TIC LEVELS
CALCULATED
BUTIONS IN | JLAR DIST
POLYNOMIA
THE CENTE
S, AND IN
D WITH CA
N THE LAB | RIBUTIONS
L COEFFICI
R-OF-MASS
THE LABOR
STHY. FOR
ORATORY SY | OF SECOND
ENTS FOR
SYSTEM FO
ATORY SYS
OTHER RE
STEM WERE | ARY NEUTRONS
ANGULAR DISTRIE
R MT=2 AND DIS(
TEM FOR MT=91.
ACTIONS, ISOTR(
ASSUMED. | BUTIONS ARE
CRETE INELAS-
THEY WERE
OPIC DISTRI- |
| MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT | RGY DISTR
STRIBUTIC
DR INELAS
FRON EMIT | IBUTIONS O
NS OF SECO
TIC SCATTE
TING REACT | OF SECONDA
NDARY NEU
RING TO O
IONS. | RY NEUTRONS
TRONS WERE CALC
VERLAPPING LEVE | CULATED WITH
ELS AND FOR |
| TABLE 1 NEU | JTRON OPT | ICAL POTEN | ITIAL PARA | METERS | |
| V =
WS =
VSO=
THE FORM (| DEPT
= 45.97-0
= 6.502
= 7.0
DF SURFAC | H (MEV)
.199E
E ABSORPTI | RADIU
RO =
RS =
RSO=
ON PART I | S(FM) DIFFUS
6.481 AO = (
6.926 AS = (
6.49 ASO= (
S DER. WOODS-S/ | SENESS(FM)
).62
).35
).62
AXON TYPE. |
| TABLE 2 LEV | /EL DENSI | TY PARAMET | ERS | | |
| NUCLIDE | A(1/N | EV) T(MEV | () C(1/ | MEV) EX(MEV) | PAIRING |
| 52 - TE - 127
52 - TE - 128
52 - TE - 129
52 - TE - 130 | 2.004
1.800
2.015
1.800 | E+01 5.380
E+01 6.090
E+01 5.350
E+01 5.470 | DE-01 3.63
DE-01 6.58
DE-01 3.58
DE-01 2.65 | 3E+00 5.165E+00
6E-01 7.010E+00
8E+00 5.141E+00
7E-01 5.735E+00 |) 1.140E+00
) 2.340E+00
) 1.140E+00
) 2.180E+00 |
| 53-I -128 | 1.715 | E+01 6.200 | E-01 2.32 | 9E+01 4.542E+00 | 0.0 |

1.720E+01 6.200E-01 3.436E+00 5.762E+00 1.200E+00 1.640E+01 6.000E-01 1.297E+01 3.896E+00 0.0 1.600E+01 6.330E-01 2.958E+00 5.342E+00 1.040E+00 53-1 -129 53-1 -130 53-1 -131 1.936E+01 5.729E-01 5.108E+00 5.590E+00 1.120E+00 1.671E+01 6.600E-01 8.841E-01 7.427E+00 2.320E+00 1.740E+01 6.000E-01 3.176E+00 5.394E+00 1.120E+00 1.563E+01 6.500E-01 5.485E-01 6.600E+00 2.160E+00 54 - XE - 129 54 - XE - 130 54 - XE - 131 54-XĒ-132 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 11.68 FOR XE-131 AND 11.02 FOR XE-132. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
RIBON, P.: PRIVATE COMMUNICATION TO NEA DATA BANK (1970), AND RIBON, P. ET AL.: CEA-N-1149 (1969).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 8) 9) 10) 11) W. HAEBERLI), P. 682, THE UNIVERSITY OF WIGGENERS (1971). 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 12) GILBERI, A. AND CAMERON, A.G.W.. CAN. J. THIO., 40, 1440 (1965).
13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
14) GRUPPELAAR, H.: ECN-13 (1977).
15) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5449 54-XE-132 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 4.4 KEV EVALUATION OF JENDL-2 WAS CARRIED OUT ON THE BASIS OF THE DATA MEASURED BY RIBON ET AL./3/ NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL THE 5 LEVELS UP TO 3.9 KEV. NEUTRON WIDTHS OF THE 5 LEVELS WERE DETERMINED FROM THE G* (NEUTRON WIDTH) MEASURED BY RIBON ET AL. RADIATION WIDTHS WERE OBTAINED FROM THE TOTAL AND NEUTRON WIDTHS. A NEGATIVE RESONANCE WAS ADDED AT -160 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 450+-60 MB GIVEN MUGHABGHAB ET AL./4/ SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. MF MODIFICATION OF JENDL-2 WAS NOT DONE IN THE PRESENT WORK FOR JENDL-3, BECAUSE THE NEW EXPERIMENTAL DATA HAVE NOT BEEN PUBLISHED AFTER JENDL-2. UNRESOLVED RESONANCE REGION : 4.4 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.600E-4, S2 = 0.970E-4, SG = 0.646E-4, GG = 0.120 EV, R = 5.393 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL ELASTIC CAPTURE 3.600 3.150 0.4500 4.51 CAPIURE 0.4500 4.51 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/7/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/8/
 ALPHA = HUIZENGA AND IGO/9/
 DEUTERON = LOHR AND HAEBERLI/10/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/14/. MF /14/. ΜТ TOTAL 1 SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/ NO. GR. SPIN-PARITY ENERGY(MEV) 0.0 0 2 ++

| 2 1.2978 2 +
3 1.4403 4 +
4 1.8037 3 +
5 1.9629 4 +
6 1.9853 2 +
7 2.0401 5 -
8 2.1102 4 +
9 2.1118 6 +
10 2.2151 7 -
LEVELS ABOVE 2.351 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (0.595E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 29.3 MILLI-BARNS AT 80
KEV WHICH WAS A 28 % SMALLER VALUE THAN JENDL-2/17/. |
| NOTE : RESULTS OF PREVIOUS INTEGRAL TEST OF JENDL-2/1,17/ WERE
REFLECTED IN THE PRESENT EVALUATION. |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 255.6) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 3.19 MB (SYSTEMATICS OF FORREST/19/)
(N,ALPHA) 1.61 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV)
V = 45.97-0.199E
WS = 6.502
VS = 7.0
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDEA(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING52-TE-1281.800E+016.090E-016.586E-017.010E+002.340E+0052-TE-1292.015E+015.350E-013.588E+005.141E+001.140E+0052-TE-1301.800E+015.470E-012.657E-015.735E+002.180E+0052-TE-1311.846E+015.360E-011.800E+004.651E+001.140E+00 |
| 53-1-1291.720E+016.200E-013.436E+005.762E+001.200E+0053-1-1301.640E+016.000E-011.297E+013.896E+000.053-1-1311.600E+016.330E-012.958E+005.342E+001.040E+0053-1-1321.550E+016.000E-018.595E+003.552E+000.0 |

54-XE-130 1.671E+01 6.600E-01 8.841E-01 7.427E+00 2.320E+00 54-XE-131 1.740E+01 6.000E-01 3.176E+00 5.394E+00 1.120E+00 54-XE-132 1.563E+01 6.500E-01 5.485E-01 6.600E+00 2.160E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54-XE-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 550 5.20 KaWa1 7. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE. SANTA FE., VOL 2. P.1627 (1985).
2) KAWA1 M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). NAUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). NAUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988). 3) RIBON, P.: PRIVATE COMMUNICATION TO NEA DATA BANK (1970), AND RIBON, P. ET AL.: MEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
5) IGARASI, S.: J. NUCL, SCI. TECHNOL., 12, 67 (1975).
6) IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
8) PEREY, F.G. PHYS. REV. 131, 745 (1963).
9) HUIZENGA, J.R. AND IGO, G.: NUCL PHYS. A232, 381 (1974).
11) BECCHETTI, F.D. JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS (IEDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
13) IJIMA, S., ET AL.: J. NUCL, SCI. TECHNOL. 21, 10 (1984).
14) GRUPPELAAR, H.: ECN-13 (1977).
15) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
16) BEXI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) WATANABE, T. ET AL.: JAERI-M 88-065, P. 14 MAT number = 5452 54-XE-133 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 80.5 EV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.040E-4, S1 = 1.580E-4, S2 = 0.990E-4, SG = 6.65E-4, GG = 0.110 EV, R = 5.333 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 193.6 3.600 TOTAL ELASTIC CAPTURE 190.0 90.1 F = 3 NEUTRON CROSS SECTIONS BELOW 80.5 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./4/, AND THE SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 5.4 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 80.5 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/ MT ENERGY(MEV) SPIN-PARITY NO. 3/2 + 11/2 - 1/2 + 5/2 +GR. 0.0 0.2332 0.2627 0.5299 1 2 3 5/2 + 3/2 + 9/2 -7/2 + 3/2 + 5/2 + 7/2 + 0.6802 45678 0.8753 0.9115 1.0523 9 1.2364

| 10
11
12
13
14
LEVELS A | 1.2982
1.3503
1.3850
1.4048
1.5901
NBOVE 1.65 MEV WERE | 5/2 +
5/2 +
7/2 +
7/2 -
5/2 -
ASSUMED TO BE OVERLAPPING. | |
|---|--|---|---|
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS W
AND REFFO/ | PTURE
OPTICAL AND STATIST
ADOPTED. DIRECT A
ERE ESTIMATED ACCOR
15/ AND NORMALIZED | ICAL MODEL CALCULATION WITH
ND SEMI-DIRECT CAPTURE CROSS
DING TO THE PROCEDURE OF BENZI
TO 1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-
THE SYSTEM
S-WAVE RES
LEVEL DENS | RAY STRENGTH FUNCTION
IATICS OF RADIATION
ONANCE LEVEL SPACING
SITY PARAMETERS. | ON (6.81E-04) WAS DETERMINED FRO
WIDTH (0.11 EV) AND THE AVERAGE
G (161 EV) CALCULATED FROM THE | М |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT = 32 (N,
MT = 103 (N,
MT = 104 (N,
MT = 105 (N,
MT = 107 (N,
THESE REAC
PREEQUILIB | 2N) CROSS SECTION
3N) CROSS SECTION
N'A) CROSS SECTION
N'P) CROSS SECTION
P) CROSS SECTION
P) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
ALPHA) CROSS SECTION
STION CROSS SECTIONS
BRIUM AND MULTI-STEP | N
WERE CALCULATED WITH THE
EVAPORATION MODEL CODE PEGASUS. | |
| THE KALBAC
FORMULA DE
DENSITY PA | H'S CONSTANT K (= 3
RIVED FROM KIKUCHI-
RAMETERS. | 90.3) WAS ESTIMATED BY THE
KAWAI'S FORMALISM/16/ AND LEVEL | |
| FINALLY, T
NORMALIŻED
(N,P)
(N,ALPHA | HE (N,P) AND (N,ALP)
TO THE FOLLOWING V
2.37 MB (SY
) 1.25 MB (SY | HA) CROSS SECTIONS WERE
ALUES AT 14.5 MEV:
STEMATICS OF FORREST/17/)
STEMATICS OF FORREST) | |
| MT = 251 MU
CALCULATED | I-BAR
) WITH CASTHY/3/. | | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED W
BUTIONS IN T | R DISTRIBUTIONS OF
YNOMIAL COEFFICIENT
CENTER-OF-MASS SYS
AND IN THE LABORATO
/ITH CASTHY. FOR OT
HE LABORATORY SYSTE | SECONDARY NEUTRONS
S FOR ANGULAR DISTRIBUTIONS ARE
TEM FOR MT=2 AND DISCRETE INELAS
RY SYSTEM FOR MT=91. THEY WERE
HER REACTIONS, ISOTROPIC DISTRI-
M WERE ASSUMED. | - |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTRO | DISTRIBUTIONS OF S
BUTIONS OF SECONDA
INELASTIC SCATTERIN
N EMITTING REACTION | ECONDARY NEUTRONS
RY NEUTRONS WERE CALCULATED WITH
G TO OVERLAPPING LEVELS AND FOR
S. | |
| TABLE 1 NEUTR | ON OPTICAL POTENTIA | L PARAMETERS | |
| V = 4
WS = 6
VSO= 7
THE FORM OF | 5.97-0.199E
5.92
SURFACE ABSORPTION | $ \begin{array}{llllllllllllllllllllllllllllllllllll$ | |
| TABLE 2 LEVEL | DENSITY PARAMETERS | | |
| 52 - TE - 129
52 - TE - 130
52 - TE - 131
52 - TE - 132 | 2.015E+01 5.350E-0
1.800E+01 5.470E-0
1.846E+01 5.360E-0
1.745E+01 4.920E-0 | 1 3.588E+00 5.141E+00 1.140E+00 1 2.657E-01 5.735E+00 2.180E+00 1 1.800E+00 4.651E+00 1.140E+00 1 1.477E-01 4.373E+00 1.840E+00 | |
| 53- -130
53- -131
53- -132
53- -133 | 1.640E+01 6.000E-0
1.600E+01 6.330E-0
1.550E+01 6.000E-0
1.559E+01 4.890E-0 | 1 1.297E+01 3.896E+00 0.0
1 2.958E+00 5.342E+00 1.040E+00
1 8.595E+00 3.552E+00 0.0
1 7.662E-01 2.691E+00 7.000E-01 | |
| 54 - XE - 131
54 - XE - 132
54 - XE - 133
54 - XE - 134 | 1.740E+01 6.000E-0
1.563E+01 6.500E-0
1.600E+01 6.250E-0
1.400E+01 6.300E-0 | 1 3.176E+00 5.394E+00 1.120E+00
1 5.485E-01 6.600E+00 2.160E+00
1 2.327E+00 5.284E+00 1.120E+00
1 3.184E-01 5.224E+00 1.820E+00 | |
| | | | |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.392 FOR XE-133 AND 10.95 FOR XE-134.

- REFERENCES
 ACTION DE CLOCE THAT
 REFERENCES
 ACTION APPLIED SCIENCE, SANTA FE., VOL. 2, P. 1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 PEREY, F.G. PHYS. REV. 131, 745 (1963).
 HUIZENGA, J.R. AND IGO. G.: NUCL. PHYS. 29, 462 (1962).
 LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
 (1971);
- (1971) 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 11) GILBERT, A. AND CAMERON, A.G.W. COM. C. L.C., (1965).
 12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 13) GRUPPELAAR, H.: ECN-13 (1977).
 14) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5455 54-XE-134 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 10.3235 KEV RESONANCE PARAMETERS OF JENDL-3 WERE NEWLY EVALUATED AS FOLLOWS : FOUR RESONANCE LEVELS AT 2186, 6315, 7260, AND 9383 EV WERE ADDED ON THE BASIS OF THE RECENT MEASUREMENT BY MACKLIN/3/. NEUTRON WIDTH OF THE 1ST LEVEL AT 1001 EV WAS BASED ON JENDL-2. NEUTRON WIDTHS FOR NEW FOUR LEVELS WERE DERIVED FROM THE NEUTRON CAPTURE AREA DATA BY MACKLIN AND THE AVERAGE RADIATION WIDTH OF 450 MEV ESTIMATED FROM THE NEUTRON CAPTURE AREAS. THIS AVERAGE RADIATION WIDTH WAS ALSO ADOPTED FOR THE 1ST LEVEL. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE O FOR ALL RESONANCE LEVELS. A NEGATIVE RESONANCE WAS ADDED AT -100 EV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 265+-20 MB GIVEN BY MUGHABGHAB ET AL /4/ SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. ĂND 9383 BY THERMAL AB ET AL.

UNRESOLVED RESONANCE REGION : 10.3235 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.980E-4, S1 = 1.600E-4, S2 = 0.960E-4, SG = 0.278E-4, GG = 0.110 EV, R = 5.385 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG.

| TOTAL | 3.985 | - |
|---------|--------|-------|
| ELASTIC | 3.720 | - |
| CAPTURÉ | 0.2650 | 0.617 |
| • | 0.2000 | 01011 |

MF = 3

CAPIURE 0.2650 0.617 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/7/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/8/
ALPHA = HUIZENGA AND IGO/9/
DEUTERON = LOHR AND HAEBERLI/10/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/14/.

/14/.

ΜТ TOTAL 1

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

. = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATIO ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/ CALCULATION WAS

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 0 + |
| 1 | 0.8470 | 2 + |

| 2 1.6138 2 +
3 1.7311 4 +
4 1.9196 3 +
5 1.9654 7 -
6 2.1366 5 +
LEVELS ABOVE 2.272 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|---|--|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BE
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | S
NZ I |
| THE GAMMA-RAY STRENGTH FUNCTION (0.253E-4) WAS ADJUSTED
REPRODUCE THE CAPTURE CROSS SECTION OF 15.6 MILLI-BARNS
KEV WHICH WAS 26 % SMALLPER THAN JENDL-2/17/. | TO
AT 80 |
| NOTE : RESULTS OF PREVIOUS INTEGRAL TEST OF JENDL-2/1,17/
REFLECTED IN THE PRESENT EVALUATION. | WERE |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEG</pre> | ASUS. |
| THE KALBACH'S CONSTANT K (= 294.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND L
DENSITY PARAMETERS. | EVEL |
| FINALLY, THE (N,P) CROSS SECTION WAS NORMALIZED TO THE
FOLLOWING VALUE AT 14.5 MEV:
(N,P) 2.00 MB (RECOMMENDED BY FORREST/19/) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE I
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DI
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | ARE
NELAS-
WERE
STRI- |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND
OTHER NEUTRON EMITTING REACTIONS. | WITH
FOR |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{ccccccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(} \\ & \text{V} &= 45.97 \cdot 0.199E & \text{R0} &= 6.481 & \text{A0} &= 0.62 \\ & \text{WS} &= 6.502 & \text{RS} &= 6.926 & \text{AS} &= 0.35 \\ & \text{VS0} &= 7.0 & \text{RS0} &= 6.49 & \text{AS0} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TY} \end{array}$ | ΡΕ. |
| TABLE 2 LEVEL DENSITY PARAMETERS | NO |
| NUCLIDE SYST A(17/MEV) T(MEV) C(17/MEV) EX(MEV) PATRI 52-TE-130 1.800E+01 5.470E-01 2.657E-01 5.735E+00 2.180 52-TE-131 1.846E+01 5.360E-01 1.800E+00 4.651E+00 1.140 52-TE-132 1.745E+01 4.920E-01 1.477E-01 4.373E+00 1.840 52-TE-133 * 1.516E+01 5.701E-01 7.561E-01 4.112E+00 1.140 | NG
E+00
E+00
E+00
E+00
E+00 |
| 53-I-1311.600E+016.330E-012.958E+005.342E+001.04053-I-1321.550E+016.000E-018.595E+003.552E+000.053-I-1331.559E+014.890E-017.662E-012.691E+007.00053-I-1341.500E+015.600E-014.764E+002.769E+000.0 | E+00
E-01 |
| 54-XE-1321.563E+016.500E-015.485E-016.600E+002.16054-XE-1331.600E+016.250E-012.327E+005.284E+001.12054-XE-1341.400E+016.300E-013.184E-015.224E+001.82054-XE-1351.550E+015.565E-017.506E-014.010E+001.120 | E+00
E+00
E+00
E+00 |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 10.95 FOR XE-134 AND 8.718 FOR XE-135.

- REFERENCES

 AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 MACKLIN, R.L.: ORNL/TM-10766 (1988).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

 - 8)
- IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 9) 10) 11)
- (1971). 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- 12) GILBERI, A. AND CAMERON, A.G.W., GAN. J. THOL, I.G., I.G., (1965).
 13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 14) GRUPPELAAR, H.: ECN-13 (1977).
 15) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
 16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 17) WATANABE, T. ET AL.: JAERI-M 88-065, P. 148 (1988).
 18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5458 54-XE-135 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW FORMULA) : BELOW 0.19 KEV RESONANCE PARAMETERS OF THE 0.084-EV RESONANCE WERE TAKEN FROM JENDL-2 AFTER THE FOLLOWING MODIFICATION. RADIATION WIDTH WAS MODIFIED TO 101 MEV SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF (2.65+-0.11)E+6 BARNS GIVEN BY MUGHABGHAB ET AL./3/ SCATTERING RADIUS WAS ALSO TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 0.19 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.040E-4, S1 = 1.580E-4, S2 = 0.990E-4, SG = 2.81E-4, GG = 0.110 EV, R = 5.319 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 2943100 295500 2647600 7610 CAPIURE 2647600 7610 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/4/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/ MT ENERGY(MEV) SPIN-PARITY NO. 3/2 + 1/2 + 1/2 + 1/2 - 7/2 + 7/2 + 1/2GR. 0.0 0.2885 + 1 2 3 0.5266 1.1315 1.2604 5/2 3/2 5/2 9/2 7/2 45678 1.4483 1.4576 1.5653 +

11/2 +

9

1.7814

| 10 1.7912 5/2 +
11 1.8945 7/2 -
12 1.9272 7/2 +
13 1.9683 5/2 +
14 2.0459 7/2 +
15 2.0486 11/2 -
16 2.0930 9/2 +
LEVELS ABOVE 2.112 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (2.99E-04) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.11 EV) AND AVERAGE
S-WAVE RESONANCE LEVEL SPACING (368 EV). |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 408.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) CROSS SECTION WAS NORMALIZED TO THE
FOLLOWING VALUE AT 14.5 MEV:
(N,P) 1.31 MB (SYSTEMATICS OF FORREST/17/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{cccccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & \text{V} &= 45.97 \cdot 0.199E & \text{RO} &= 6.481 & \text{AO} &= 0.62 \\ & \text{WS} &= 6.502 & \text{RS} &= 6.926 & \text{AS} &= 0.35 \\ & \text{VSO} &= 7.0 & \text{RSO} &= 6.49 & \text{ASO} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 52-1E-131 1.846E+01 5.360E-01 1.800E+00 4.051E+00 1.140E+00 52-TE-132 1.745E+01 4.920E-01 1.477E-01 4.373E+00 1.840E+00 52-TE-133 * 1.516E+01 5.701E-01 7.561E-01 4.112E+00 1.140E+00 52-TE-134 * 1.340E+01 5.677E-01 8.188E-02 4.291E+00 1.990E+00 |
| 53-I-1321.550E+016.000E-018.595E+003.552E+000.053-I-1331.559E+014.890E-017.662E-012.691E+007.000E-0153-I-1341.500E+015.600E-014.764E+002.769E+000.053-I-1351.350E+015.500E-015.307E-012.961E+008.500E-01 |
| 54-XE-1331.600E+016.250E-012.327E+005.284E+001.120E+0054-XE-1341.400E+016.300E-013.184E-015.224E+001.820E+0054-XE-1351.550E+015.655E-017.506E-014.010E+001.120E+0054-XE-1361.400E+016.500E-013.270E-015.679E+001.970E+00 |

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.718 FOR XE-135 AND 8.553 FOR XE-136.

- REFERENCES

 AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
 AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 6) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
 8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
- GILBERT, A. AND CAMERON, A.G.W. G. HILC., IC, I.C. (1965).
 IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 GRUPPELAAR, H.: ECN-13 (1977).
 MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
 BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5461 54-XE-136 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/.

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF

MF

MT=45T COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 490 KEV
RESONANCE PARAMETERS WERE NEWLY EVALUATED AS FOLLOWS :
RESONANCE ENERGIES OF THE 1ST LEVEL AND OF THE OTHER LEVELS
WERE BASED ON THE DATA MEASURED BY MACKLIN/3/ AND FOGELBERG ET
AL./4/, RESPECTIVELY. NEUTRON WIDTH OF THE 1ST LEVEL AT 2154
EV WAS DERIVED FROM THE NEUTRON CAPTURE AREA MEASURED AND THE
RADIATION WIDTH ASSUMED BY MACKLIN. NEUTRON WIDTHS OF THE
REMAINING 35 LEVELS FROM 18.393 TO 480.750 KEV WERE TAKEN FROM
THE DATA BY FOGELBERG ET AL. AVERAGE RADIATION WIDTH OF 122.5
MEV WAS ADOPTED FOR ALL THE RESONANCE LEVELS EXCEPT THE 1ST
AND 2ND LEVELS. NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME
RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS
/5/. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY
ESTIMATED WITH A RANDOM NUMBER METHOD. SCATTERING RADIUS WAS
TAKEN FROM THE GRAPH (FIG. 1, PART A) BY MUGHABGHAB ET AL./6/
A NEGATIVE RESONANCE WAS ADDED AT -822.03 EV, AND THE ABOVE
AVERAGE RADIATION WIDTH WAS DETERMINED SO AS TO REPRODUCE THE
THERMAL CAPTURE CROSS SECTION OF 260+-20 MEV GIVEN BY
MUGHABGHAB ET AL..
NO UNDESOLVED PESONANCE PECION

NO UNRESOLVED RESONANCE REGION

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 6.348 ELASTIC 6.088 CAPTURE 0.2600 0.142 INTEGRALS (BARNS)

CAPTURE0.26000.142MF = 3NEUTRON CROSS SECTIONS
BELOW 490 KEV, RESOLVED RESONANCE PARAMETERS WERE GIVEN.
ABOVE 490 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY/7/, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO AND RSO OF IIJIMA-KAWAI POTENTIAL/9/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/10/
ALPHA = HUIZENGA AND IGO/11/
DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/

| NO. | ENERGY(MEV) | SPIN-PARITY |
|----------|-------------|-------------|
| GR | | 0 + |
| <u> </u> | 4.0400 | 0 1 |
| 1 | 1.3132 | 2 + |
| 2 | 1.6947 | 4 + |
| 3 | 1 8920 | 6 + |
| Ĭ. | 1 0200 | ž i |
| | 1.3200 | <u> </u> |
| 5 | 2.1080 | 6 + |
| 6 | 2.2620 | 6 + |
| 7 | 2 2897 | 2 + |
| | 2.2001 | 2 ' |
| 8 | 2.4148 | 2 + |

9 2.4480 4 + 10 2.5604 4 + 11 2.6347 2 + 12 2.8490 3 + 13 2.8710 1 + 14 2.9565 2 + LEVELS ABOVE 3.141 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BĔŇZI THE GAMMA-RAY STRENGTH FUNCTION (7.48E-7) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 0.8 MILLI-BARN AT 100 KEV. F = 16 (N,2N) CROSS SECTION F = 17 (N,3N) CROSS SECTION F = 22 (N,N'A) CROSS SECTION F = 28 (N,N'P) CROSS SECTION F = 103 (N,P) CROSS SECTION F =104 (N,D) CROSS SECTION F =105 (N,T) CROSS SECTION F =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS MT = 16ΜТ MT МŤ ΜT ΜŤ МŤ ΜT PEGASUS. THE KALBACH'S CONSTANT K (= 307.3) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N) CROSS SECTION WAS NORMALIZED TO THE FOLLOWING VALUE AT 14.5 MEV: (N,2N) 1750.00 MB (RECOMMENDED BY BYCHKOV+/20/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) R0 = 6.481A0 = 0.62TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.745E+01 4.920E-01 1.477E-01 4.373E+00 1.840E+00 1.516E+01 5.701E-01 7.561E-01 4.112E+00 1.140E+00 1.340E+01 5.677E-01 8.188E-02 4.291E+00 1.990E+00 1.498E+01 5.653E-01 6.589E-01 3.980E+00 1.140E+00 52 - TE - 132 52 - TE - 133 52 - TE - 134 52 - TE - 135 * * 1.559E+01 4.890E-01 7.662E-01 2.691E+00 7.000E-01 1.500E+01 5.600E-01 4.764E+00 2.769E+00 0.0 1.350E+01 5.500E-01 5.307E-01 2.961E+00 8.500E-01 1.450E+01 5.500E-01 3.589E+00 2.460E+00 0.0 53-1 -133 53-1 -134 53-1 -135 53-1 -136 1.400E+01 6.300E-01 3.184E-01 5.224E+00 1.820E+00 1.550E+01 5.565E-01 7.506E-01 4.010E+00 1.120E+00 1.400E+01 6.500E-01 3.270E-01 5.679E+00 1.970E+00 1.550E+01 5.565E-01 7.470E-01 4.010E+00 1.120E+00 54-XE-134 54 - XE - 135 54 - XE - 136 54-XE-137 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS.

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.553 FOR XE-136 AND 5.0 FOR XE-137.

- REFERENCES

 AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P. 1627 (1985).
 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 MACKLIN, R.L.: ORNL/TM-10766 (1988).
 MACKLIN, R.L.: ORNL/TM-10766 (1988).
 FOGELBERG, B., HARVEY, J.A., MIZUMOTO, M., AND RAMAN, S.: PHYS. REV. C 31, 2041 (1985).
 BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV. 171,1293(1968).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 9) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 10) PEREY, F.G: PHYS. REV. 131, 745 (1963).
 11) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 12) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 13) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

MAT number = 5525 55-CS-133 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90

HISTORY

84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 92-01 COMMENTS (1,451) WERE CORRECTED.

F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF

= 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 5.98 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS : EVALUATION FOR JENDL-2 WAS PERFORMED ON THE BASIS OF DATA MEASURED BY HARVEY ET AL./3/, GARG ET AL./4/, JUNG ET AL./5/, THOMAS ET AL./6/, RIEHS AND THOMAS/7/, ANUFRIEV ET AL./8/ AND MACKLIN/9/. TWO NEGATIVE RESONANCES WERE ADOPTED FROM MUGHABGHAB ET AL. /10/ AND PARAMETERS OF THE NEGATIVE AND LOWEST TWO RESONANCES WERE SLIGHTLY ADJUSTED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 29+-1.5 BARNS AT 0.0253 EV AND THE NEUTRON RESONANCE CAPTURE INTEGRAL OF 437+-26 BARNS GIVEN BY MUGHABGHAB ET AL. HOWEVER, THE VALUES OF TOTAL SPIN J FOR MOST OF RESONANCE LEVELS WERE UNKNOWN EXCEPT THE 30 LEVELS IN THE LOW ENERGY REGION BELOW 800 EV, AND TARGET SPIN OF 3.5 WAS ADOPTED FOR THE ABOVE LEVELS AS THE TOTAL SPIN.

FOR JENDL-3, RESONANCE ENERGIES BELOW 500 EV WERE SOMEWHAT MODIFIED BY REVIEWING THE EXPERIMENTAL DATA /3/ MENTIONED ABOVE, AND THE 7 RESONANCE LEVELS WERE ADDED ON THE BASIS OF THE MEASUREMENTS BY POPOV AND TSHETSYAK/11/, BY GARG ET AL., BY ANUFRIEV ET AL., AND BY NAKJIMA ET AL./12/ THE VALUES OF NEUTRON ORBITAL ANGULAR MOMENTUM L WERE ASSUMED TO BE 0 FOR ALL THE RESONANCE LEVELS. THE J-VALUES FOR THE J-UNKNOWN LEVELS WERE TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. ACCORDING TO NEW ESTIMATION OF THE J-VALUES, NEUTRON AND RADIATION WIDTHS FOR MOST OF RESONANCE LEVELS WERE ALSO MODIFIED ON THE BASIS OF THE MEASURED DATA OF 2G* (NEUTRON WIDTH), TOTAL WIDTH, AND NEUTRON CAPTURE AREA. AVERAGE RADIATION WIDTH OF 120.48 MEV WAS DERIVED FROM THE DATA OF RADIATION WIDTH OF 120.48 MEV WAS DERIVED FROM THE DATA OF RADIATION WIDTH FOR THE TWO NEGATIVE RESONANCE LEVELS WERE RADIATION WIDTH FOR THE TWO NEGATIVE RESONANCE LEVELS WERE ALSO MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 29.0+-1.5 BARNS GIVEN BY MUGHABGHAB ET AL.

UNRESOLVED RESONANCE REGION : 5.98 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/13/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.700E-4, S1 = 1.400E-4, S2 = 1.300E-4, SG = 56.6E-4, GG = 0.120 EV, R = 5.839 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) TOT 1

| IUIAL | 33.30 | - |
|---------|-------|-----|
| ELASTIC | 4.294 | - |
| CAPTURE | 29.00 | 396 |
| | | |

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/14/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IGARASI ET AL./15/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/16/ ALPHA = HUIZENGA AND IGO/17/ DEUTERON = LOHR AND HAEBERLI/18/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/19/

PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/20/ WERE EVALUATED BY IIJIMA ET AL./21/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR 1221

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./23/

| NO. | ENERGY(N | IEV) | SPIN-PAR | ITY | |
|--------------|----------|------|------------|-----|--------------|
| GR. | 0.0 ` | , | 7/2 + | | |
| 1 | 0.0810 | | 5/2 + | | |
| 2 | 0.1616 | | 5/2 + | | |
| 3 | 0.3839 | | 3/2 + | | |
| 4 | 0.4370 | | 1/2 + | | |
| 5 | 0.6050 | | 11/2 - | | |
| 6 | 0.6325 | | 11/2 + | | |
| 7 | 0.6412 | | 3/2 + | | |
| 8 | 0.7060 | | 7/2 + | | |
| 9 | 0.7687 | | 9/2 + | | |
| 10 | 0.7870 | | 7/2 + | | |
| 11 | 0.8190 | | 9/2 + | | |
| 12 | 0.8718 | | 9/2 + | | |
| 13 | 0.9170 | | 3/2 + | | |
| LEVELS ABOVE | 0.95 MEV | WERE | ASSUMED TO | ΒE | OVERLAPPING. |

F = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/24/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (5.28E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 521 MILLI-BARNS AT 30 KEV MEASURED BY YAMAMURO ET AL./25/ AND BY MACKLIN/9/.

THE KALBACH'S CONSTANT K (= 262.4) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWA1'S FORMALISM/26/ AND LEVEL DENSITY PARAMETERS.

FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 10.50 MB (RECOMMENDED BY FORREST/27/) (N,ALPHA) 1.60 MB (RECOMMENDED BY FORREST)

MT = 251 MU-BAR CALCULATED WITH CASTHY.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 46.0-0.25E WI = 0.125E-0.0004E**2 R0 = 6.521A0 = 0.62WI = 0.125E-0.0004E**2 RI = 6.521 AI = 0.62 WS = 7.0 RS = 7.021 AS = 0.35 VSO= 7.0 RSO= 6.521 ASO= 0.62 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.720E+01 6.200E-01 3.436E+00 5.762E+00 1.200E+00 1.640E+01 6.000E-01 1.297E+01 3.896E+00 0.0 1.600E+01 6.330E-01 2.958E+00 5.342E+00 1.040E+00 1.550E+01 6.000E-01 8.595E+00 3.552E+00 0.0 53-1 -129 53-1 -130 53-1 -131 53-L -132 1.671E+01 6.600E-01 8.841E-01 7.427E+00 2.320E+00 1.740E+01 6.000E-01 3.176E+00 5.394E+00 1.120E+00 1.563E+01 6.500E-01 5.485E-01 6.600E+00 2.160E+00 1.600E+01 6.250E-01 2.327E+00 5.284E+00 1.120E+00 54 - XE - 130 54 - XE - 131 54 - XE - 132 54-XE-133 1.705E+01 5.750E-01 1.633E+00 4.913E+00 1.200E+00 1.676E+01 5.726E-01 1.123E+01 3.569E+00 0.0 1.750E+01 6.000E-01 3.784E+00 5.352E+00 1.040E+00 1.598E+01 6.450E-01 1.710E+01 4.505E+00 0.0 55-CS-131 55-CS-132 55-CS-133 55-CS-134 - - - - - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.076 FOR CS-133 AND 11.67 FOR CS-134. REFERENCES
1) AOKI T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
3) HARVEY, J.A., ET AL.: PHYS. REV., 99, 10 (1955).
4) GARG, J.B., ÉT AL.: PHYS. REV., B137, 547 (1965).
5) JUNG, H.H., ET AL.: "PROC. 2ND IAEA CONF. ON NUCL. DATA FOR REACTORS, HELSINKI 1970", VOL.1, 679.
6) THOMAS, B.W., ET AL.: AERE-PR/NP-18, 23 (1972).
7) RIEHS. P. AND THOMAS, B.W.: "PROC. 2ND INT. SYMPOS. ON NEUTRON CAPTURE GAMMA-RAY SPECTROSCOPY AND RELATED TOPICS, PETTEN 1974", 300.
8) ANUFRIEV, V.A., ET AL.: SOV. ATOM. ENER., 43, 828 (1978).
9) MACKLIN, R.L.: NUCL. SCI. ENG., 81, 418 (1982).
10) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
11) POPOV A.B. AND TSHETSYAK, K.: JINR-P3-81-721 (1981).
12) NAKAJIMA, Y. ET AL.: JAERI-M 87-025, P. 337 (1987).
13) IGARASI, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
14) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
15) IGARASI, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
16) PEREY, F.G: PHYS. REV. 131, 745 (1963).
17) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
18) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
19) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
20) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 REFERENCES 10́) (11)12) 13) 14) 15) 16) 17 Ì 18) 19) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 20) 20) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FITS., 43, 1440 (1965).
21) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
22) GRUPPELAAR, H.: ECN-13 (1977).
23) MATSUMOTO, J., ET AL.: JAERI-M 7734 (1978).
24) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
25) YAMAMURO, N. ET AL.: J. NUCL. SCI. TECHNOL. 20, 797 (1983).
26) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
27) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5528 55-CS-134 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90

HISTORY

90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/

= 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1

MF

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.179 KEV RESONANCE ENERGIES, NEUTRON WIDTHS, RADIATION WIDTHS, AND AVERAGE RADIATION WIDTH WERE BASED ON MUGHABGHAB ET AL./2/ AVERAGE RADIATION WIDTH OF 160 MEV WAS ADOPTED FOR THE RESONANCE LEVELS WHOSE RADIATION WIDTH WAS UNKNOWN. THE VALUI OF NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL RESONANCE LEVELS. THE VALUES OF TOTAL SPIN J FOR ALL RESONANCE LEVELS WERE TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. SCATTERING RADIUS WAS TAKEN FROM THE GRAPH (FIG. 1, PART A) GIVEN BY MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 140+-12 BARNS GIVEN BY MUGHABGHAB ET AL. 'THE VALUE

UNRESOLVED RESONANCE REGION : 0.179 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.400E-4, S1 = 1.300E-4, S2 = 1.300E-4, SG = 262.E-4, GG = 0.160 EV, R = 5.318 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 162.3 22.64 139.7 106

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IGARASI ET AL./5/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/

AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELA/ (12) TÖ GRÜPPELAAR /12/.

MT =

' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

ΜT

. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = ⊿

T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ´ | 4 + |
| 1 | 0.0112 | 5 + |
| 2 | 0.0600 | 3 + |

| 3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
223
24
25
26
27
28
29
LEVELS | 0.1388
0.1738
0.1764
0.1766
0.1903
0.1937
0.1978
0.2096
0.2243
0.22571
0.2677
0.22714
0.3831
0.3444
0.3771
0.3831
0.4342
0.4543
0.4514
0.4541
0.4541
0.4514
0.4514
0.4514
0.4514
0.4514
0.50193
0.5792
0.6240
0.6345
MEVE 0.684 MEV | V WERE | 83 | | OVERLAPPI | NG. |
|--|--|--|---|--|--|--|
| MT = 102 CA
SPHERICAL
CASTHY WAS
SECTIONS V
AND REFFO | APTURE
OPTICAL AND ST
S ADOPTED. DIF
VERE ESTIMATED
(15/ AND NORMAL | TATISTI
RECT AN
ACCORD
LIZED T | CAL MOD
D SEMI-
ING TO
O 1 MII | DEL CALC
-DIRECT
THE PRC
LLI-BARN | CULATION V
CAPTURE C
DCEDURE OF
I AT 14 ME | ITH
ROSS
BENZI |
| THE GAMMA
THE SYSTEM
S-WAVE RES
LEVEL DENS | -RAY STRENGTH F
MATICS OF RADIA
SONANCE LEVEL S
SITY PARAMETERS | FUNCTIO
ATION W
SPACING
S. | N (2.58
IDTH (0
6.18 | BE-02) W
D.16 EV)
EV) CAL | AS DETERN
AND THE
CULATED F | INED FROM
AVERAGE
ROM THE |
| MT = 16 (N
MT = 17 (N
MT = 22 (N
MT = 28 (N
MT = 33 (N
MT = 103 (N
MT = 104 (N
MT = 105 (N
MT = 106 (N
MT = 107 (N
MT = 107 (N
MT = 107 (N)
MT = 107 (N)
MT = 107 (N) | 2N) CROSS SECT
3N) CROSS SEC
N'A) CROSS SEC
N'P) CROSS SEC
(N'T) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SECT
(D) CROSS SEC | TION
TION
CTION
CTION
CTION
CTION
ION
ION
SECTION
SECTION
SECTIONS
I-STEP | WERE C | ALCULATE
ATION MC | D WITH TH
DEL CODE | IE
PEGASUS. |
| THE KALBAC
Formula de
Density pa | CH'S CONSTANT P
ERIVED FROM KIP
ARAMETERS. | < (= 45
<uchi-k< td=""><td>2.1) W/
AWAI'S</td><td>AS ESTIN
FORMALI</td><td>ATED BY 1
SM/16/ AN</td><td>HE
Id Level</td></uchi-k<> | 2.1) W/
AWAI'S | AS ESTIN
FORMALI | ATED BY 1
SM/16/ AN | HE
Id Level |
| FINALLY, T
NORMALIZED
(N,P)
(N,ALPHA | THE (N,P) AND (
D TO THE FOLLOV
3.76 M
A) 1.82 M | (N,ALPH
NING VA
MB (SYS
MB (SYS | A) CROS
LUES A
TEMATIC
TEMATIC | SS SECTI
T 14.5 N
CS OF FC
CS OF FC | ONS WERE
IEV:
DRREST/17/
DRREST) | ') |
| MT = 251 MU
CALCULATED | J-BAR
D WITH CASTHY. | | | | | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS,
CALCULATED V
BUTIONS IN T | AR DISTRIBUTION
LYNOMIAL COEFF
E CENTER-OF-MAS
AND IN THE LAE
WITH CASTHY. F
THE LABORATORY | NS OF S
ICIENTS
SS SYST
BORATOR
FOR OTH
SYSTEM | ECONDAN
FOR AN
EM FOR
Y SYSTE
ER REAC
WERE | RY NEUTR
NGULAR D
MT=2 AN
EM FOR N
CTIONS,
ASSUMED. | CONS
DISTRIBUTI
ID DISCRET
IT=91. TH
ISOTROPIC | ONS ARE
TE INELAS-
IEY WERE
C DISTRI- |
| MF = 5 ENERGY
ENERGY DIST
PEGASUS FOR
OTHER NEUTRO | Y DISTRIBUTIONS
RIBUTIONS OF SE
INELASTIC SCAT
DN EMITTING REA | S OF SE
ECONDAR
TTERING
ACTIONS | CONDARY
Y NEUTE
TO OVE | Y NEUTRC
RONS WER
ERLAPPIN | NS
RE CALCULA
IG LEVELS | ATED WITH
AND FOR |
| TABLE 1 NEUTE | RON OPTICAL POT
DEPTH (MEV) | TENTIAL | . PARAME
RADIUS | ETERS
(FM) | DIFFUSENE | SS(FM) |
| | · · · · · · · · · · · · · · · · · · · | | | · | | · · |

| V = 46.0-0.25E R0 = 6.536 A0 = 0.62
WI = 0.125E-0.0004E**2 RI = 6.536 AI = 0.62
WS = 7.0 RS = 7.036 AS = 0.35
VS0= 7.0 RS0= 6.536 AS0= 0.62
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
|---|
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 53-I-1301.640E+016.000E-011.297E+013.896E+000.053-I-1311.600E+016.330E-012.958E+005.342E+001.040E+0053-I-1321.550E+016.000E-018.595E+003.552E+000.053-I-1331.559E+014.890E-017.662E-012.691E+007.000E-01 |
| 54-XE-1311.740E+016.000E-013.176E+005.394E+001.120E+0054-XE-1321.563E+016.500E-015.485E-016.600E+002.160E+0054-XE-1331.600E+016.250E-012.327E+005.284E+001.120E+0054-XE-1341.400E+016.300E-013.184E-015.224E+001.820E+00 |
| 55-CS-132*1.676E+015.726E-011.123E+013.569E+000.055-CS-1331.750E+016.000E-013.784E+005.352E+001.040E+0055-CS-1341.598E+016.450E-011.710E+014.505E+000.055-CS-1351.343E+016.537E-011.831E+004.203E+007.000E-01 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 11.67 FOR CS-134 AND 4.75 FOR CS-135. |
| REFERENCES 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). 2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). 3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). 4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 5) IGARASI, S. ET AL.: JAERI-M 5752 (1974). 6) PEREY, F.G: PHYS. REV. 131, 745 (1963). 7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS (EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. |
| (1971). 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 11) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 12) GRUPPELAAR, H.: ECN-13 (1977). 13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). 14) NUCLEAR DATA SHEETS, 34, 475 (1981). 15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). 17) FORREST, R.A.: AERE-R 12419 (1986). |

MAT number = 5531 55-CS-135 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.088 KEV RESONANCE PARAMETERS OF JENDL-2 WERE MODIFIED AS FOLLOWS : EVALUATION FOR JENDL-2 WAS PERFORMED ON THE BASIS OF THE DATA (ONLY ONE POSITIVE LEVEL) MEASURED BY PRIESMEYER ET AL./3/ A NEGATIVE RESONANCE WAS ADDED AT -50 EV. THE PARAMETERS WERE ADJUSTED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 8.7+-0.5 BARNS AT 0.0253 EV AND THE NEUTRON RESONANCE CAPTURE INTEGRAL OF 62+-2 BARNS GIVEN BY MUGHABGHAB ET AL./4/ SINCE THE VALUES OF TOTAL SPIN J FOR THE NEGATIVE AND POSITIVE FIRST LEVELS WERE UNKNOWN, THE TARGET SPIN OF 3.5 WAS ADOPTED AS THE TOTAL SPIN. MF TOTAL SPIN. FOR JENDL-3, THE J-VALUES OF THE BOTH LEVELS WERE TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. NEUTRON WIDTHS FOR THE BOTH LEVELS WERE MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION AND THE NEUTRON RESONANCE CAPTURE INTEGRAL MENTIONED ABOVE. RADIATION WIDTHS AND SCATTERING RADIUS WERE TAKEN FROM JENDL-2. UNRESOLVED RESONANCE REGION : 0.088 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.500E-4, S1 = 1.200E-4, S2 = 1.400E-4, SG = 13.5E-4, GG = 0.100 EV, R = 5.293 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 13.55 -ELASTIC 4.850 -CAPTURE 8.702 62.5 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IGARASI ET AL./7/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ MF AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/

| | LEVEL | NO.
GR.
2
3
4
S AB | OVE | ENE
0
0
0
0
0 | ERGY
.0
.249
.408
.608
.786
31 M | (ME
8
0
2
9
EV | V)
Were | ΞA | SP
5
3
5
7
8
SS | IN-
/2
/2
/2
/2
UME | PAF
+
+
+
+
D 1 | r I T
r 0 | Y
BE | OVE | RLAF | PPIN | G. | |
|--|---|--|---|--|--|--|---|---|--|---------------------------------------|--|-------------------------------|--------------------------------------|---------------------------------|------------------------------------|---|---|-------------------------|
| MT =
SP
CA
SE
AN | 102
HERIC
STHY
CTION
D REF | CAP
AL C
WAS
S WE
F0/1 | TURE
PTIC
ADOP
RE E
6/ A | AL A
TED
STIN | AND
D
MATE
NORM | STA
IRE
D A
ALI | TIST
CT /
CCOF
ZED | FIC
AND
RDI
TC | CAL
SING
NG
1 | МО
ЕМІ
ТО
МІ | DEL
-DI
TH | – C
IRE
IE
I-B | ALC
CT
PRO
ARN | ULA
CAP
CED
AT | TIOI
TURI
URE
14 | N WI
E CRO
OF I
MEV | TH
DSS
BENZ | I |
| TH
TH
S-
LE | E GAM
E SYS
WAVE
VEL D | MA - R
TEMA
RESO
ENSI | AY S
TICS
NANC
TY P | TREN
OF
E LE
ARAN | NGTH
RAD
EVEL
METE | FU
IAT
SP
RS. | NCTI
ION
ACIN | ION
WI
NG | 1 (*
DTI
(90 | 1.3
H (
0.8 | 8E-
0.1
E\ | 03
25
/) |) W
EV
CAL | AS
) A
CUL | DET <u>I</u>
ND
ATEI | ERMII
THE J
D FRO | NED I
AVER/
DM TI | FROM
AGE
HE |
| MT =
MT =
MT =
MT =
MT =
MT =
MT =
MT = | 16
17
228
333
104
105
ESEQUI
EEQUI | (N,2
(N,3
(N,7
(N,7
(N,7
(N,7
(N,7
(N,7
(N,7
(N,7 | N) CC
N) C
' PD
' T CRA
' CRA
L PHN
L PHN
I UM | CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS
CROSS | SESSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS | CTITTTTTCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC | ON
ON
ION
ION
ION
N
N
CTIC
STEF | ON
S W | VERI | E C
POR | ALC | | ATE
MO | D W
Del | ІТН
СОІ | THE
DE PI | EGASI | JS. |
| TH
FO
DE | E KAL
RMULA
NSITY | BACH
DER
PAR | 'S C
IVED
AMET | ONST
FRO
ERS | TANT
DM K | K
I K U | (= 4
CHI· | 408
- K <i>A</i> | 8.0
WA |) W
I'S | AS
FC | ES
DRM | TIM
ALI | ATE
SM/ | D B`
17/ | Y THI
AND | ELEVI | ΞL |
| F I
NO | NALLY
RMALI
(N,P)
(N,AL | , TH
ŻED
PHA) | E (N
TO T | I, P)
HE F
2
1 | AND
=0LL
. 81
. 41 | (N
0\
MB
MB | , ALF
NG \
(S\
(S\ | PHA
/AL
/ST
/ST | UE
UE
EM/ | CRO
S A
ATI
ATI | SS
T 1
CS
CS | SE
14.
OF
OF | CTI
5 M
FO
FO | ONS
EV:
RRE
RRE | WEF
ST/ [,]
ST) | RE
18/) | | |
| MT =
CA | 251
LCULA | MU-
TED | BAR
WITH | I CAS | ЗТНΥ | /5/ | | | | | | | | | | | | |
| MF = 4
LEGE
GIVE
TIC
CALC
BUTI | ANG
NDRE
N IN
LEVEL
ULATE
ONS I | ULAR
POLY
THE
S, A
D WI
N TH | DIS
NOMI
CENT
ND I
TH C
E LA | GTRIE
AL (
ER-(
N TH
ASTH
BOR/ | BUTI
COEF
DF-M
HEL
HY.
ATOR | ONS
FIC
ASS
ABO
FO
Y S | OF
IENT
SYS
RATO
ROT
YSTE | SE
FS
STE
DRY
FHE
EM | FOI
FOI
M
S
R
WEI | NDA
R A
FOR
YST
REA
RE | RY
NGU
EM
CTI | NE
JLA
FO
FON
SUM | UTR
R D
AN
R M
S,
ED. | 0NS
IST
D D
T=9
ISO | RIBU
ISCI
1.
TROI | UTIO
RETE
THE
PICI | NS AF
Inei
Y Wef
DISTF | RE
LAS-
RE
RI- |
| MF = 5
ENER
PEGA
OTHE | ENE
GY DI
SUS F
R NEU | RGY
STRI
OR I
TRON | DIST
BUTI
NELA
EMI | RIBU
ONS
STIC
TTIN | JTIO
OF
CSC
NGR | NS
SEC
ATT
EAC | OF S
ONDA
ERIN
TION | SEC
ARY
NG
NS. | CONI
(NI
TO | DAR
EUT
OV | RON
YERL | NEU
NS
_AP | TRO
WER
PIN | NS
E C
G L | ALCI
EVEI | JLATI
_S AI | ED W
ND F(| ITH
DR |
| TABLE | 1 NE | UTRO | N OP | YDIT/ | AL P | OTE | NTIA | ۹L
- | PAI | RAM | | ERS | | | | | | |
| THE | V
WI
WS
VSO
FORM | = 46
= 0.
= 7.
= 7.
0F S | DEP
.0-0
125E
0
URFA | 0.25E | (MEV
2004
ABSO |)
E * * :
RPT |
2
I O N | R
R
R
R
R
R
R
R
R | (AD
(0)
(1)
(2)
(2)
(2)
(2)
(2)
(2)
(2)
(2)
(2)
(2 | IUS
= 6
= 6
= 7
= 6
IS | 6 (F N
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 - 55
5 | M)
51
51
51
8. | -
wo | AO
AI
AS
ASO
ODS | FUSE
= 0
= 0
= 0
- SA) | - NES
. 62
. 62
. 35
. 62
. 62
. 62
. 62 | S(FM) |)
-
- |
| TABLE | 2 LE | VEL | DENS | SITY | PAR | AME | TERS | 5 | 0 (| | | | - V / | | ` | D 4 1 | | |
| NUCLI
53-I
53-I
53-I
53-I
53-I | - 131
- 132
- 133
- 133
- 134 | | A (17
1.60
1.55
1.55
1.50 | 0E+(
0E+(
0E+(
9E+(
00E+(|) 1
01 6
01 6
01 4
01 5 | . 33
. 00
. 89
. 60 | V)
OE-(
OE-(
OE-(
OE-(|)1
)1
)1
)1
)1 | 2.9
8.9
7.0 | 958
595
662
764 | E + ()
E + ()
E + ()
E + () |)0
)0
)1
)0 | EX(
5.3
3.5
2.6
2.7 | 42E
52E
91E
69E |)
+00
+00
+00
+00 | 1.04
0.0
7.00
0.0 | 40E+(
00E-(| 00
01 |
| 54 - XE
54 - XE
54 - XE
54 - XE | - 132
- 133
- 134
- 135 | | 1.56
1.60
1.40
1.55 | 3E+0
0E+0
0E+0
0E+0
00E+0 | 01 6
01 6
01 6
01 5 | .50
.25
.30
.56 | 0E - (
0E - (
0E - (
0E - (
5E - (|)1
)1
)1
)1 | 5.4
2.3
3.7 | 485
327
184
506 | E - ()
E + ()
E - ()
E - () |)1
)0
)1
)1 | 6.6
5.2
5.2
4.0 | 00E
84E
24E
10E | +00
+00
+00
+00 | 2.1
1.1
1.8
1.8 | 30E+(
20E+(
20E+(
20E+(
20E+(| 00
00
00
00 |
| 55-CS
55-CS | - 133
- 134 | | 1.75
1.59 | 0E+(
8E+(| 01 6
01 6 | .00
.45 | 0E-(
0E-(|)1
)1 | 3.
1. | 784
710 | E+(
E+(|)0
)1 | 5.3
4.5 | 52E
05E | +00
+00 | 1.04
0.0 | 40E+(| 00 |
| | | | | | | | | | | | | | | | | | | |

| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 4.75 FOR CS-135 AND 5.0 FOR CS-136. REFERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). PRIESMEYER, H.G., ET AL.: NEADCO(E)212U, VOL V. 41 (1980). MUGHABGHAB, S.F. ET AL.: NEADTON CROSS SECTIONS, VOL. 1,
PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 5752 (1974). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POARIZATION
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). GIBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). IJJIMA, S. ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). EDRUELAR, H.: ECN-13 (1977). LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). | | 55-CS-135
55-CS-136 | 1.343E+01 6.537E-01 1.831E+00 4.203E+00 7.000E-01
1.400E+01 6.000E-01 4.424E+00 2.967E+00 0.0 | |
|--|---|---|--|--|
| REFERENCES ACKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). PRIESMEYER, H.G., ET AL.: NEANDC(E)212U, VOL. V., 41 (1980). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IGARASI, S. ET AL.: JAERI-M 5752 (1974). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). UOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GUPPELAAR, H.: ECN-13 (1977). LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). | | SPIN CUTOFF PA
IN THE CASTHY
ASSUMED TO BE | ARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
4.75 FOR CS-135 AND 5.0 FOR CS-136. | |
| 12) GIBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). 13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 14) GRUPPELAAR, H.: ECN-13 (1977). 15) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). 16) BENZI. V. AND REFFO. G.: CCDN-NW/10 (1969). | F | REFERENCES
1) AOKI, T. ET
AND APPLIED
2) KAWAI, M. E
AND TECHNOL
3) PRIESMEYER,
4) MUGHABGHAB,
PART A", AC
5) IGARASI, S.
6) IIJIMA, S.
7) IGARASI, S.
8) PEREY, F.G:
9) HUIZENGA, J.
10) LOHR, J.M.
11) BECCHETTI,
PHENOMENA I
W. HAEBERLI | AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
O SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
.OGY, MITO, P. 569 (1988).
H.G., ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
S.F. ET AL.: NEANDC(E)212U, VOL. V., 41 (1980).
CADEMIC PRESS (1981).
: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
ET AL.: JAERI-M 87-025, P. 337 (1975).
ET AL.: JAERI-M 8752 (1974).
FT AL.: JAERI-M 5752 (1974).
PHYS. REV. 131, 745 (1963).
J.R. AND IGO. G.: NUCL. PHYS. 29, 462 (1962).
AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
F.D., JR. AND GREENLEES, G.W.: POLARIZATION
N NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. | |
| 13) [13] MA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 14) GRUPPELAAR, H.: ECN-13 (1977). 15) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). 16) BENZI. V. AND REFFO. G.: CCDN-NW/10 (1969). | | 12) GILBERT, A. | AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 | |
| 16) BENZI, V. AND REFFO. G.: CCDN-NW/10 (1969). | | 13) IIJIMA, S.,
14) GRUPPELAAR,
15) LEDERER, C. | ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
H.: ECN-13 (1977).
M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY- | |
| 17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS" NORTH HOLIAND (1968) | | 16) BENZI, V. A
17) KIKUCHI, K. | ND REFFO, G.: CCDN-NW/10 (1969).
AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR | |

REACTIONS", NORTH HOLLAND (1968). 18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5534 55-CS-136 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 29 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.600E-4, S1 = 1.200E-4, S2 = 1.5E-4, SG = 15.6E-4, GG = 0.095 EV, R = 5.202 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 16.50 3.500 TOTAL ELASTIC CAPTURE 13.00 57.4 MF = 3 NEUTRON CROSS SECTIONS BELOW 29 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED BY THE SYSTEMATICS FROM THE NEIGHBORING NUCLIDES. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 29 EV TO 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/3/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED BY IGARASI ET AL./4/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/5/ AS FOLLOWS: PROTON = PEREY/5/ ALPHA = HUIZENGA AND IGO/6/ DEUTERON = LOHR AND HAEBERLI/7/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/8/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/9/ WERE EVALUATED BY IJJIMA ET AL./10/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (11) /11/ ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/12/ AND NUCLEAR DATA SHEETS/13/. МТ ENERGY(MEV) SPIN-PARITY GR. 0.0 5 + LEVELS ABOVE 0.05 MEV WERE ASSUMED TO BE OVERLAPPING. . = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT BENZI THE GAMMA-RAY STRENGTH FUNCTION (1.64E-03) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.095 EV) AND THE AVERAGE

| S | S-WAVE RESO
EVEL DENSI | NANCE LEVE
TY PARAMET | L SPACING
ERS. | (58 EV) C | CALCULATED FI | ROM THE |
|--|---|---|--|--|---|---|
| MT
MT
MT
MT
MT
MT
MT
MT
T
P | = 16 (N,2
= 17 (N,N
= 22 (N,N
= 32 (N,N
= 33 (N,N
= 103 (N,P
= 105 (N,T
= 105 (N,A
= 107 (N,A
HESE REACT
REEQUILIBR | N) CROSS S
N) CROSSS
'P) CROSSS
'D) CROSSS
'D) CROSSS
'T) CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE
CROSS SE | ECTION
ECTION
SECTION
SECTION
SECTION
CTION
CTION
CTION
S SECTION
S SECTION
S LTI-STEP | WERE CALCU | JLATED WITH -
N MODEL CODI | THE
E PEGASUS. |
| T
F
D | HE KALBACH
ORMULA DER
DENSITY PAR | 'S CONSTAN
IVED FROM
AMETERS. | T K (= 47
KIKUCHI-K | 9.9) WAS E
AWAI'S FOR | STIMATED BY
RMALISM/15/ / | THE
AND LEVEL |
| F
N | INALLY, TH
IORMALIŻED
(N,P)
(N,ALPHA) | E (N,P) AN
TO THE FOL
2.10
1.09 | D (N,ALPH
LOWING VA
MB (SYS
MB (SYS | A) CROSS S
LUES AT 14
TEMATICS C
TEMATICS C | SECTIONS WERN
1.5 MEV:
DF FORREST/10
DF FORREST) | E
6/) |
| MT | = 251 MU-
ALCULATED | BAR
WITH CASTH | Υ. | | | |
| MF =
LEG
GIV
TIC
CAL
BUT | 4 ANGULAR
ENDRE POLY
EN IN THE
LEVELS, A
CULATED WI
IONS IN TH | DISTRIBUT
NOMIAL COE
CENTER-OF-
ND IN THE
TH CASTHY.
E LABORATO | IONS OF S
FFICIENTS
MASS SYST
LABORATOR
FOR OTH
RY SYSTEM | ECONDARY N
FOR ANGUL
EM FOR MT=
Y SYSTEM F
ER REACTIC
WERE ASSU | IEUTRONS
AR DISTRIBU
2 AND DISCRI
OR MT=91.
NS, ISOTROP
MED. | TIONS ARE
ETE INELAS-
THEY WERE
IC DISTRI- |
| MF =
ENE
PEG
OTH | 5 ENERGY
RGY DISTRI
ASUS FOR I
IER NEUTRON | DISTRIBUTI
BUTIONS OF
NELASTIC S
EMITTING | ONS OF SE
SECONDAR
CATTERING
REACTIONS | CONDARY NE
Y NEUTRONS
TO OVERLA | UTRONS
S WERE CALCUI
APPING LEVELS | LATED WITH
S AND FOR |
| TABLE | 1 NEUTRO | N OPTICAL | POTENTIAL | PARAMETER | RS | |
| THE | V = 46
WI = 0.
WS = 7.
VSO= 7.
FORM OF S | DEPTH (ME
.0-0.25E
125E-0.000
0
URFACE ABS | V)
4E**2
ORPTION P | RADIUS(FM)
RO = 6.566
RI = 6.566
RS = 7.065
RSO= 6.566
ART IS DEF | DIFFUSE
A0 = 0.0
AI = 0.0
AS = 0.0
AS0= 0.0
C. WOODS-SAX | NESS(FM)
62
62
35
35
62
20N TYPE. |
| TABLE | 2 LEVEL | DENSITY PA | RAMETERS | | | |
| NUCL

53 - 1
53 - 1
53 - 1
53 - 1 | -132
-133
-133
-134
-135 | A(1/MEV)
1.550E+01
1.559E+01
1.500E+01
1.350E+01
1.350E+01 | T(MEV)
6.000E-01
4.890E-01
5.600E-01
5.500E-01 | C(1/MEV)
8.595E+00
7.662E-01
4.764E+00
5.307E-01 | EX(MEV)
3.552E+00
2.691E+00
2.769E+00
2.961E+00 | PAIRING
0.0
7.000E-01
0.0
8.500E-01 |
| 54-X
54-X
54-X
54-X
54-X | (E - 133
(E - 134
(E - 135
(E - 136 | 1.600E+01
1.400E+01
1.550E+01
1.400E+01 | 6.250E-01
6.300E-01
5.565E-01
6.500E-01 | 2.327E+00
3.184E-01
7.506E-01
3.270E-01 | 5.284E+00
5.224E+00
4.010E+00
5.679E+00 | 1.120E+00
1.820E+00
1.120E+00
1.970E+00 |
| 55 - C
55 - C
55 - C
55 - C
55 - C | S-134
S-135
S-136
S-136
S-137 | 1.598E+01
1.343E+01
1.400E+01
1.336E+01 | 6.450E-01
6.537E-01
6.000E-01
6.200E-01 | 1.710E+01
1.831E+00
4.424E+00
9.986E-01 | 4.505E+00 (
0.4.203E+00 (
2.967E+00 (
3.836E+00 (| 0.0
7.000E-01
0.0
8.500E-01 |
| SPIN
IN T
ASSU | L CUTOFF PA
HE CASTHY
IMED TO BE | RAMETERS W
CALCULATIO
5.0 FOR CS | ERE CALCU
N, SPIN C
-136 AND | LATED AS C
UTOFF FACT
4.571 FOR | 0.146*SQRT(A
ORS AT 0 ME
CS-137. |)*A**(2/3).
V WERE |
| REFER
1) K
2) 1
3) 1
4) 1
5) P
6) H | ENCES
AWAI, M. E
ND TECHNOL
GARASI, S.
IJIMA, S.
GARASI, S.
PEREY, F.G:
IUIZENGA, J | T AL.: PRO
OGY, MITO,
: J. NUCL.
ET AL.: JA
ET AL.: J
PHYS. REV
.R. AND IG | C. INT. C
P. 569 (
SCI. TEC
ERI-M 87-
AERI-M 57
. 131, 74
O, G.: NU | ONF. ON NU
1988).
HNOL., 12,
025, P. 33
52 (1974).
5 (1963).
CL. PHYS. | JCLEAR DATA I
67 (1975).
37 (1987).
29, 462 (198 | FOR SCIENCE
62). |

- 7) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 8) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.

W. HAEBERLI), P. 682, THE UNIVERSTIT OF WISCONSTANCES. (1971).
9) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
10) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
11) GRUPPELAAR, H.: ECN-13 (1977).
12) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
13) NUCLEAR DATA SHEETS, 26, 473 (1979).
14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
15) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
16) FORREST, R.A.: AERE-R 12419 (1986).

| M A
5 | T number
55-CS-137 | = 58
JND(| 537 | EVAL
DIST | -MAR90
-SEP90 | JNDC
REV2 | FP NU
-MAR93 | CLEAR | DATA W | .G. | |
|-----------------------|---|---|--|---|--|--|--|---|---|--|---|
| H I
84
90
93 | STORY
-10 EVAL
-03 MODI
-03 JEND | UATIO
FICAT
L-3.2 | DN FOR
FION FO
2 WAS M | JENDL
DR JENI
IADE BY | -2 WAS
DL-3 WA
7 JNDC | MADE
S MAI
FPND | BY JN
DE/2/.
W.G. | DC FPN | ND W.G. | /1/ | |
| | * * * * * *
(2,1
(3,1
* * * * * | 51)
), (3 | DIFIED
A
3,2), (
****** | PARTS
LL RES
3102)
ELOW | Solved | IENDL
RESON | -3.2
NANCES
***** | *****
WERE | DELETE | * * * * * * * * * *
D .
* * * * * * * * * * | |
| MF | = 1 GE | NERAL | _ INFOR | MATIO | N | | | | | | |
| MF | MT=451 C
:- 2 RF | SONAN | NTS AND | DICT | IONARY | | | | | | |
| | MT=151 U
RESOLV
ONLY U
ENERGY
RESONA
/3/ | NRESC
ED RE
NRESC
BOUN | DLVED R
ESONANC
DLVED R
NDARY W
INTEGRA | ESONAI
E PAR/
ESONAI
AS DE
L OF (| NCE PAR
AMETERS
NCE PAR
FERMINE
D.35+-0 | RAMETE
GIVE
AMETE
D SO
0.07 E | ERS
EN IN
ERS WE
AS TO
B MEAS | JENDL-
RE GIV
REPRO
URED E | ·3.1 WE
/EN. T
)DUCE T
}Y HARA | RE DELETED
HE LOWER
HE CAPTURE
DA ET AL. | • |
| | UNRESOLV
THE NE
WITH OB
CAPTUR
SCATTE
TOTAL
BASED
NUCLID | ED RE
UTRON
PTICA
SERVE
E CRO
CROSS
ON TH
ES. | ESONANC
N STREN
AL MODE
ED LEVE
DSS SEC
RADIUS
S SECTI
HE SYST | E REG
IGTH FI
L CODI
TION (
WAS (
ON AT
EMATI(| ION : 1
JNCTION
E CASTH
CING WA
CALCULA
DBTAINE
100 KE
CS OF M | .70
15, 50
17/4/
S DE
TED N
D FR
V
IEASUP | KEV -
D, S1
TERMIN
NITH C
DM FIT
THE RA
RED VA | 100 KE
AND S2
ED TO
ASTHY.
TING T
DIATIC
LUES F | WERE
REPROD
THE
TO THE
N WIDT
OR NEI | CALCULATED
UCE THE
EFFECTIVE
CALCULATED
H GG WAS
GHBORING | |
| | TYPICAL
SO = 1
GG = 0 | VALUE
.800E
.090 | S OF T
-4, S1
EV, R | HE PAR
= 1.7
= 5.7 | RAMETER
100E-4,
101 FM. | S AT
S2 = | 70 KE
= 1.60 | V:
0E-4, | SG = 0 | .801E-4, | |
| | CALCULAT | ED 22 | 200-M/S | CROSS | S SECTI | ONS / | AND RE | S INT | EGRALS | (BARNS) | |
| | TOTA
ELAS
CAPT | L
TIC
URE | | 2200
3.780
3.530
0.250 | //S
)
)
) | | | ŘEŠ. | TNTEG.
0.357 | . , | |
| MF | TOTA
ELAS
CAPT
= 3 NE | L
TIC
URE
UTRON | N CROSS | 2200
3.780
3.530
0.250
SECT | IONS | | | RES. | INTEG.
).357 | | |
| MF
- | TOTA
ELAS
CAPT
= 3 NE
BELOW 1.
CALCULAT
THE FORM
SECTION | L
URE
UTRON
7 KE
ED FF
IS SI | N CROSS
/: THE
ROM R =
I/V AND
JM OF T | 2200
3.78(
3.53(
0.25(
5.53(
5.31)
0.25(
HESE | IONS
IONS
INC SCA
IN TH
B AT
IWO. | TTRII
IE CAP
0.025 | NG CRO
PTURE
53 EV/ | RES. | TNTEG.
).357
CTION I
SECTIO
HE TOT | S
N IS IN
AL CROSS | |
| M F
- | TOTA
ELAS
CAPT
= 3 NE
BELOW 1.
CALCULAT
THE FORM
SECTION
BETWEEN | L
URE
UTRON
7 KEV
ED FF
IS SU
1.7 F | N CROSS
/: THE
ROM R =
I/V AND
JM OF T
KEV AND | 2200
3.78(
3.53(
0.25(
5.31(
5.31(
0.25(
100 | A/S
D
IONS
TIC SCA
TM TH
D B AT
TWO.
KEV: UF | ATTRII
IE CAI
0.023 | NG CRO
PTURE
53 EV/ | RES.
-
C
SS SEC
CROSS
3/. 1 | D.357
CTION I
SECTIO
HE TOT | S
N IS IN
AL CROSS | |
| M F
-
- | TOTA
ELAS
CAPT
= 3 NE
BELOW 1.
CALCULAT
THE FORM
SECTION
BETWEEN
ABOVE 10
CALCULAT
COMPETIN
WITH PEAT
EVAPORT
DETERMIN
OF THE T
ARE BASTO | L
TIC
URE
UTRON
7 KEV
ED FF
IOF
IS SU
1.7 H
G KEV
ASUS
ION V
G RES
ASUS
ION V
ED BV
OTAL
OUTAL | N CROSS
/: THE
COM R =
I/V AND
JM OF T
KEV AND
/, THE
VAS PER
ACTIONSA
/5/ STA
/0DEL.A
/ IGARA
/ IGARA
/ S EE | 2200
3.78(
3.53(
0.25(
5 SECT
5 SECT
5 SECT
6 SECT
100
5 SPHER
FORMEI
5, OF N
NDING
THE (
SI ET
SECTI(
777) | IONS
IONS
IONS
IONS
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC SCA
IC | ATTRIN
IE CAI
0.023
PTICAI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CASTI
CAS | NG CRO
PTURE
53 EV/
VEN.
L AND
SECTI
JILIBR
EUTRON
REPROD
P'S FO | SS SEC
CROSS
3/. 1
STATIS
TAKIN
ONS WE
IUM AN
GIVE
GIVE
R CHAF | TICAL
SECTION
SECTIO
HE TOT
G ACCO
RE CAL
J IN TA
SYSTEM
RGED PA | S
N IS IN
AL CROSS
MODEL
UNT OF
CULATED
I-STEP
BLE 1 WERE
ATIC TREND
RTICLES | |
| M F
-
- | TOTA
ELAS
CAPT
CAPT
BELOW 1.
CALCULAT
THE FORM
SECTION
BETWEEN
ABOVE 10
CALCULAT
COMPETIN
WITH PEG
EVAPORAT
DETERMIN
OF THE T
ARE AS
PROTO
ALPHA
DEUTE
HELIUE
PARAMETE
AND CAME
EXTENSIV
PRESENT
IN THE P
PARAMETE
/13/. | L
TICURE
UTRON
TEDFIS
ISSU
1.7 K
OFSS
ISSU
1.7 K
GASUS
ISSU
GASUS
N
CONCAS
SUS
N
N
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S | N CROSS
/: THE
ROM R =
I/V AND
JM OF T
VAS PERSA
/SCTIONSA
/SCTIONSA
/SCTIONSA
/SCTIONSA
/CROSS YE
IOR THE
NT THE
NT CALC
NT HE | 2200
3.78(
3.53(
0.25(
5 SECT
ELAS
5.3
0.25(
5 SECT
ELAS
5.3
0.25(
100
SPHERE
FORMEI
5, OF (
NDING
THE (
(77/
NDING
THE (
(77/
NDING
SECTI(
(77/
NDING
THE (
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
NDING
SECTI(
(77/
SECTI(
SECTI(
(77/
SECTI)))))))))))))))))))))))))))))))))))) | A/S
D
IONS
TIC SCA
M. TH
D B AT
TWO.
KEV: UF
ICAL OF
D WITH
CAL OF
D WITH C
ON A F
D N. TH
ND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND | ATTRIN
IE CAR
0.02
PTICAL
CASTR
CROSS
REEQU
TO F
IE OMF
79/
15
VEL I
89/
19/
15
VEL I
16
BY I
01FIC/
16
BY I
01FIC/
16
BY I
01FIC/
16
BY I
01
16
CASTR
20
20
20
20
20
20
20
20
20
20
20
20
20 | NG CRO
PTURE
53 EV/
VEN.
L AND
TY ELTI
JILIBR
EUTRON
REPROD
S'S FO
AND GR
DENSIT
IJIMA
ATION
E-JOI | STATIS
CROSS
CROSS
3/. T
STATIS
TAKIN
ONS WE
GIVEN
UCE A
R CHAF
EENLEE
Y FOR
STATIS
TAKIN
ONS WE
UCE A
R CHAF
EENLEE
Y FOR
NSITY
DENCE
NT IS | CTION I
SECTION
SECTIO
THE TOT
SECTIO
THE TOT
SECTIO
THE TOT
SECTIO
THE TOT
SECTION
SECTION
THE TOT
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SECTION
SE | S
N IS IN
AL CROSS
MODEL
UNT OF
CULATED
I-STEP
BLE 1 WERE
ATIC TREND
RTICLES
GILBERT
MORE
THE
TERS USED
N CUT-OFF
GRUPPELAAI | R |
| M F
-
- | TOTA
ELAS
CAPT
= 3 NE
BELOW 1.
CALCULAT
THE FORM
SECTION
BETWEEN
ABOVE 10
CALCULAT
COMPETIN
WITH PEG
EVAPORAT
DETTERMIN
OF THE TAS
ARE PROPHA
DEUTE
AND CAME
EXTENSIV
PRESENT
IN THE P
PARAMETE
/13/.
MT = 1
SPHERI | L
URE
UTRON
F
E OF S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
I
S
S
S
I
S
S
S
I
S
S
S
I
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S | N CROSS
(: THE
ROM R =
I/V AND
JM OF T
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND
V AND | 2200
3.78(
3.78(
3.53(
0.25(
SECT
ELAS
5.3.0.25(
SECT
SECT
NDING
SPHER
FORME(
SI ET
SECTI(
(/7/
NGA AI
AND H/
TON =
COMPOS
SECTI(
(/7/
NGA () () () () () () () () () (| A/S
D
IONS
FIC SCA
M TH
D B AT
TWO.
(EV: UF
ICAL OF
D WITH
VON A F
D WITH
ON A F
DAL./6/
DN. TH
BECCHE
SITE LE
SITE LE
AND MOD
HOWS TH
DN. EN
RANGE E | TTRIN
IE CAR
O. 023
TICAL
CAST
CAST
PREEQU
TO F
IE OMF
SPREEQU
TO F
IE OMF
SPREEQU
TO F
IE CA
PTICAL
SPREEQU
TO F
IE OMF
SPLE
IE CAST
PTICAL
SPLE
TICAL
SPLE
TICAL
SPLE
SPLE
IE CAST
SPLE
SPLE
SPLE
SPLE
SPLE
SPLE
SPLE
SPLE | NG CRO
PTURE
53 EV/
VEN.
L AND
SECTI
JUTRON
P'S FO
AND GR
DENSIT
JJIMA
ATION
VEL DE
DEPEN
E-JOI
ON WAS | SS SEC
CROSS
3/. 1
STATIS
TAKIN
ONS WE
IUM VEN
GIVE A
R CHAF
EENLEE
EENLEE
ST AL.
WERE A
NSITY
DENCE
NT IS | TICAL
SECTION I
SECTIO
THE TOT
SECTIO
THE TOT
SECTIO
CHE TOT
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECTIO
SECT | S
N IS IN
AL CROSS
MODEL
UNT OF
CULATED
I-STEP
BLE 1 WERE
ATIC TREND
RTICLES
GILBERT
MORE
THE
TERS USED
N CUT-OFF
GRUPPELAAI | R |
| M F - | TOTA
ELAS
CAPT
= 3 NE
BELOW 1.
CALCULAT
THE FORM
SECTION
BETWEEN
ABOVE 10
CALCULAT
COMPETIN
WITH PEG
EVAPORAT
DETTREMIN
OF THE T
ARE AS FO
ALLIU
PARAMETE
AND CAME
EXTENSIV
PRESENT
IN THE P
PARAMETE
/13/.
MT = 1
SPHERI
MT = 2
CALCUL | L
UTRON
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
T
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
F
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T
UTRON
T | N CROSS
(COM R =
N CROSS
(N AND
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N OF T
N O
N O
N O
N O
N O
N O
N O
N O | 2200
3.78(
3.53(
0.25(
5 SECT
5 SECT
5 SECT
5 SECT
6 SPHER
5 0.25(
100
5 SPHER
5 0.25(
100
5 SPHER
5 0.25(
100
100
5 SPHER
5 0.25(
100
100
5 SECT
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
100
10 | A/S
D
IONS
FIC SCA
FM TH
D B AT
TWO.
(EV: UF
ICAL OF
D WITH
VON A F
D WITH
ON A F
D IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
SITE LD
AND IGO/
AEBECCHE
AND IGO/
ABECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
AEBECCHE
AND IGO/
ABECCHE
AND IGO/
AEBECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
ABECCHE
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND IGO/
AND | TTRIN
IE CAR
O.023
TICAL
CAST
CAST
CAST
PREEQU
TO F
IE OMF
SPREEQU
TO F
IE OMF
SPREEQU
TO F
IE CAL
SPREEQU
TO br>IE CAL
SPREE
SPREE
TO F
IE CAL
SPREE
TO F
IE CAL
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET
SPREET | NG CRO
PTURE
53 EV/
VEN.
L AND
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF
SECTIF | RES.
RES.
CROSS
SS SEC
CROSS
3/. 1
STATIS
TAKIN
ONS MEN
TAKIN
ONS MEN
CROSS S
ADOP1
ROSS S | TICAL
SECTION I
SECTIO
SECTIO
THE TOT
SECTIO
SECTIO
SECTIO
SECTIO
SECTION
SECTION
SECTION | S
N IS IN
AL CROSS
MODEL
UNT OF
CULATED
I-STEP
BLE 1 WERE
ATIC TREND
RTICLES
GILBERT
MORE
THE
TERS USED
N CUT-OFF
GRUPPELAAI
S). | R |

SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./14/

| NO.
GR.
1
2
3
4
5
6
7
LEVELS AI | ENERGY(MEV)
0.0
0.4560
0.8490
0.9800
1.4900
1.8700
2.0700
2.1500
BOVE 2.3 MEV WERE ASS | SPIN-PARITY
7/2 +
5/2 +
3/2 +
5/2 +
1/2 +
1/2 -
3/2 +
1/2 +
1/2 +
UMED TO BE OVERLAPPING. |
|--|--|--|
| MT = 102 CA
SPHERICAL C
CASTHY WAS
SECTIONS WI
AND REFFO/ | PTURE
OPTICAL AND STATISTIC
ADOPTED. DIRECT AND
ERE ESTIMATED ACCORDI
15/ AND NORMALIZED TO | AL MODEL CALCULATION WITH
SEMI-DIRECT CAPTURE CROSS
NG TO THE PROCEDURE OF BENZI
1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-I
THE SYSTEM/
S-WAVE RES | RAY STRENGTH FUNCTION
ATICS OF RADIATION WI
ONANCE LEVEL SPACING | (9.13E-05) WAS DETERMINED FROM
DTH (0.125 EV) AND AVERAGE
(1370 EV). |
| NOTE: INTE
MEASI
CROS | GRAL CAPTURE CROSS SE
URED IN CFRMF COULD N
S SECTION CALCULATED | CTION OF 90(+-25%) MB/16/
OT BE REPRODUCED. AVERAGE
FROM PRESENT DATA IS 9.7 MB. |
| MT = 16 (N,
MT = 17 (N,
MT = 22 (N,
MT = 28 (N,
MT = 32 (N,
MT = 33 (N,
MT = 103 (N,
MT = 104 (N,
MT = 105 (N,
MT = 107 (N,
THESE REAC
PREEQUILIB | 2N) CROSS SECTION
3N) CROSS SECTION
N'A) CROSS SECTION
N'P) CROSS SECTION
N'D) CROSS SECTION
N'T) CROSS SECTION
P) CROSS SECTION
D) CROSS SECTION
T) CROSS SECTION
ALPHA) CROSS SECTION
TION CROSS SECTIONS W
RIUM AND MULTI-STEP E | ERE CALCULATED WITH THE
VAPORATION MODEL CODE PEGASUS. |
| THE KALBACI
FORMULA DEI
DENSITY PAI | H'S CONSTANT K (= 368
RIVED FROM KIKUCHI-KA
RAMETERS. | .2) WAS ESTIMATED BY THE
WAI'S FORMALISM/17/ AND LEVEL |
| FINALLY, TI
NORMALIŻED
(N,P)
(N,ALPHA | HE (N,P) AND (N,ALPHA
TO THE FOLLOWING VAL
1.57 MB (SYST
) 0.85 MB (SYST |) CROSS SECTIONS WERE
UES AT 14.5 MEV:
EMATICS OF FORREST/18/)
EMATICS OF FORREST) |
| MT = 251 MU
CALCULATED | -BAR
WITH CASTHY. | |
| MF = 4 ANGULA
LEGENDRE POL
GIVEN IN THE
TIC LEVELS, /
CALCULATED W
BUTIONS IN T | R DISTRIBUTIONS OF SE
YNOMIAL COEFFICIENTS
CENTER-OF-MASS SYSTE
AND IN THE LABORATORY
ITH CASTHY. FOR OTHE
HE LABORATORY SYSTEM | CONDARY NEUTRONS
FOR ANGULAR DISTRIBUTIONS ARE
M FOR MT=2 AND DISCRETE INELAS-
SYSTEM FOR MT=91. THEY WERE
R REACTIONS, ISOTROPIC DISTRI-
WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTR
PEGASUS FOR
OTHER NEUTROI | DISTRIBUTIONS OF SEC
IBUTIONS OF SECONDARY
INELASTIC SCATTERING
N EMITTING REACTIONS. | ONDARY NEUTRONS
NEUTRONS WERE CALCULATED WITH
TO OVERLAPPING LEVELS AND FOR |
| TABLE 1 NEUTRO | ON OPTICAL POTENTIAL | PARAMETERS |
| | DEPTH (MEV) R | ADIUS(FM) DIFFUSENESS(FM) |
| V = 4(
WI = 0
WS = 7
VSO= 7
THE FORM OF S | 6.0-0.25E R
.125E-0.0004E**2 R
.0 R
SURFACE ABSORPTION PA | 0 = 6.58 A0 = 0.62
I = 6.58 AI = 0.62
S = 7.08 AS = 0.35
S0 = 6.58 AS0 = 0.62
RT IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL | DENSITY PARAMETERS | |
| NUCLIDE | A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) PAIRING |
| 53-1 -133 | 1.5595+01 4.8905-01 | 7.002E-01 2.091E+00 7.000E-01 |

 53-1
 -134
 1.500E+01
 5.600E-01
 4.764E+00
 2.769E+00
 0.0

 53-1
 -135
 1.350E+01
 5.500E-01
 5.307E-01
 2.961E+00
 8.500E-01

1.450E+01 5.500E-01 3.589E+00 2.460E+00 0.0 53-I -136 1.400E+01 6.300E-01 3.184E-01 5.224E+00 1.820E+00 1.550E+01 5.565E-01 7.506E-01 4.010E+00 1.120E+00 1.400E+01 6.500E-01 3.270E-01 5.679E+00 1.970E+00 1.550E+01 5.565E-01 7.470E-01 4.010E+00 1.120E+00 54 - XE - 134 54 - XE - 135 54 - XE - 136 54 - XE - 137 1.343E+01 6.537E-01 1.831E+00 4.203E+00 7.000E-01 1.400E+01 6.000E-01 4.424E+00 2.967E+00 0.0 1.336E+01 6.200E-01 9.986E-01 3.836E+00 8.500E-01 1.470E+01 5.737E-01 4.715E+00 2.858E+00 0.0 55-CS-135 55-CS-136 55-CS-137 55-CS-138 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.571 FOR CS-137 AND 5.0 FOR CS-138. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
HARADA, H. ET AL.: "PROC. THE 1990 SYMPOSIUM ON NUCL. DATA", JAERI-M 91-032, P.199 (1991).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IGARASI, S. ET AL.: JAERI-M 5752 (1974).
PEREY, F.G. PHYS. REV. 131, 745 (1963).
HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). (1971) 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERUN, A.G.W.. CAN. J. THIG., 40, 110 (1965).
 IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 GRUPPELAAR, H.: ECN-13 (1977).
 LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
 BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 HARKER, Y.D. AND ANDERL, R.A.: "PROC. SPECIALISTS' MEETING ON NEUTRON CROSS SECTIONS OF FISSION PRODUCT NUCLEI", BOLOGNA, DEC. 12-14, 1979, NEANDC(E)209L, P.5 (1979).
 KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5625 56-BA-130 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.53 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL THE RESONANCES. AVERAGE RADIATION WIDTH WAS TAKEN FROM MUGHABGHAB ET AL. AND SCATTERING RADIUS WAS DETERMINED FROM OPTICAL MODEL CALCULATION WITH CASTHY/3/. MF UNRESOLVED RESONANCE REGION : 2.53 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE GAMMA WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB FT AL ÉT AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.300E-4, S1 = 0.890E-4, S2 = 0.600E-4, SG = 54.5E-4, GG = 0.100 EV, R = 4.562 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 14.42 -ELASTIC 3.126 -TOTAL ELASTIC CAPTURE 11.29 177 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING WS AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MF /12/. MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/. ΜТ NO. ENERGY(MEV) SPIN-PARITY DWBA CAL. 0.0 0.3573 0.9017 0 2 4 GŔ. + 1 2 4 3 0.9079 + 1.3609 4 + 5 1.4774 4 +

 $\begin{smallmatrix} 6 & 1.5573 & 2 & + \\ 7 & 1.5928 & 6 & + \\ LEVELS ABOVE 1.844 MEV WERE ASSUMED TO BE OVERLAPPING. \end{split}$ FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/15/. DEFORMATION PARAMETER (BETA2 = 0.230) WAS BASED ON THE DATA COMPILED BY RAMAN ET AL./16/ MT = 102CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (6.84E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 750 MILLI-BARNS AT 25 KEV MEASURED BY BRADLEY ET AL./18/ MT = 16MT MT MT = 28MT = 32MŤ МΤ MT MŤ MŤ ΜT THE KALBACH'S CONSTANT K (= 127.0) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1380.00 MB (SYSTEMATICS OF WEN DEN LU+/20/) (N,P) 24.60 MB (SYSTEMATICS OF FORREST/21/) (N,ALPHA) 10.10 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. $MF_{=}4$ F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) -------------TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.908E+01 6.110E-01 8.260E-01 7.676E+00 2.550E+00 1.982E+01 5.420E-01 3.686E+00 5.152E+00 1.120E+00 1.800E+01 5.830E-01 5.017E-01 6.396E+00 2.210E+00 1.936E+01 5.729E-01 5.108E+00 5.590E+00 1.120E+00 54-XE-126 54 - XE - 127 54 - XE - 128 54 - XE - 129

 55-CS-127
 *
 1.818E+01
 5.847E-01
 2.138E+00
 5.710E+00
 1.430E+00

 55-CS-128
 *
 1.791E+01
 5.822E-01
 2.111E+01
 4.140E+00
 0.0

 55-CS-129
 *
 1.763E+01
 5.798E-01
 2.754E+00
 5.088E+00
 1.090E+00

 55-CS-130
 *
 1.735E+01
 5.774E-01
 1.541E+01
 3.856E+00
 0.0
| 56-BA-128*1.832E+015.822E-011.449E-017.297E+003.010E+0056-BA-1291.978E+016.490E-011.150E+017.812E+001.580E+0056-BA-1301.850E+016.240E-016.573E-017.832E+002.670E+0056-BA-1311.990E+016.090E-015.764E+006.979E+001.580E+00 |
|--|
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 8.696 FOR BA-130 AND 5.0 FOR BA-131. |
| REFERENCES KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B",
ACADEMIC PRESS (1984). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77
(1983) |
| 6) PEREY, F.G: PHYS. REV. 131, 745 (1963). 7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971) |
| 10) GIĽBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965) |
| IIJIMA: S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). NUCLEAR DATA SHEETS, 13, 133 (1974). KUNZ, P.D.: PRIVATE COMMUNICATION. RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). BRADLEY, T., ET AL.: PROC. INT. CONF. NUCLEAR CROSS SECTIONS FOR TECHNOLOGY, KNOXVILLE 1979, P.344 (1980). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR PROC. |
| 20) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
21) FORREST, R.A.: AERE-R 12419 (1986). |
| |

MAT number = 5631 56-BA-132 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1[:] = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS NO RESOLVED RESONANCE PARAMETERS ONLY RESONANCE ENERGIES WERE AVAILABLE/2/. MF UNRESOLVED RESONANCE REGION : 68 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEICHBORING NUCLIDES OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.510E-4, S1 = 0.880E-4, S2 = 0.590E-4, SG = 24.3E-4, GG = 0.120 EV, R = 5.308 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 10.30 ELASTIC 3.300 CAPTURE 7.000 INTEGRALS (BARNS) RES. INTEG. 31.3 F = 3 NEUTRON CROSS SECTIONS BELOW 68 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./2/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 5.2 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 68 EV TO 100 KEV. MF ENERGY RANGE FROM 68 EV 10 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING WS AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/ ENERGY(MEV) DWBA CAL. NO. SPIN-PARITY GŔ. 0.0 0 2 2 4 + 0.4646 * 1 + 2 3 1.0317 1.5030 4 + 032 5 + 6 1.6858 +

| 7 1.7294 4 +
8 1.9328 6 +
9 1.9982 1 +
10 2.0270 3 -
LEVELS ABOVE 2.046 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/15/. DEFORMATION PARAMETERS (BETA2 = 0.186 AND
BETA3 = 0.070) WERE BASED ON THE DATA COMPILED BY RAMAN ET
AL./16/ AND SPEAR/17/, RESPECTIVELY. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.
THE CAMMA-PAY STRENGTH FUNCTION (2, 387E-03) WAS DETERMINED</pre> |
| FROM THE SYSTEMATICS.
MT = 16 (N, 2N) CROSS SECTION $MT = 17 (N, 3N) CROSS SECTION$ $MT = 22 (N, N'A) CROSS SECTION$ $MT = 22 (N, N'A) CROSS SECTION$ |
| MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =106 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 143.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1600.00 MB (RECOMMENDED BY BYCHKOV+/20/)
(N,P) 13.90 MB (SYSTEMATICS OF FORREST/21/)
(N,ALPHA) 4.84 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY/3/. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDESYST A(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING54-XE-1281.800E+015.830E-015.017E-016.396E+002.210E+0054-XE-1291.936E+015.729E-015.108E+005.590E+001.120E+0054-XE-1301.671E+016.600E-018.841E-017.427E+002.320E+0054-XE-1311.740E+016.000E-013.176E+005.394E+001.120E+00 |
| 55-CS-129*1.763E+015.798E-012.754E+005.088E+001.090E+0055-CS-130*1.735E+015.774E-011.541E+013.856E+000.055-CS-131*1.705E+015.750E-011.633E+004.913E+001.200E+0055-CS-132*1.676E+015.726E-011.123E+013.569E+000.0 |

| 56-BA-130 1.85
56-BA-131 1.99
56-BA-132 1.85
56-BA-133 1.94 | 0E+01 6.240E-01 6.573E-01 7.832E+00 2.670E+00
0E+01 6.090E-01 5.764E+00 6.979E+00 1.580E+00
0E+01 6.360E-01 6.996E-01 8.187E+00 2.780E+00
1E+01 5.930E-01 3.357E+00 6.465E+00 1.580E+00 | |
|--|--|---|
| SYST: * = LDP'S | WERE DETERMINED FROM SYSTEMATICS. | |
| SPIN CUTOFF PARAME
IN THE CASTHY CALC
ASSUMED TO BE 6.42 | TERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3)
ULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
5 FOR BA-132 AND 5.0 FOR BA-133. | • |
| REFERENCES
1) KAWAI, M. ET AL
AND TECHNOLOGY,
2) MUGHABGHAB, S.
PART A", ACADEN
3) IGARASI, S.: J.
4) IJJIMA, S. ET P | .: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENC
MITO, P. 569 (1988).
. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
IC PRESS (1981).
NUCL. SCI. TECHNOL., 12, 67 (1975).
L.: JAERI-M. 87-025, P. 337 (1987). | E |
| 5) IIJIMA, S. AND
(1983).
6) PEREY, F.G: PHY
7) HUIZENGA, J.R.
8) LOHR, J.M. AND
9) BECCHETTI F D | KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77
S. REV. 131, 745 (1963).
AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
JR AND GREENIEES G.W.: POLARIZATION | |
| PHENOMENA IN NU
W. HAEBERLI), F
(1971).
10) GILBERT, A. AND | CLEAR REACTIONS ((EDS) H.H. BARSHALL AND
. 682, THE UNIVERSITY OF WISCONSIN PRESS.
CAMERON, A.G.W.: CAN, J. PHYS., 43, 1446 | |
| (1965).
11) IIJIMA, S., ET
12) GRUPPELAAR, H.:
13) ENSDF: EVALUATE
14) NUCLEAR DATA SH
15) KUNZ, P.D.: PRI
16) RAMAN, S., ET A | AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
ECN-13 (1977).
D NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
EETS, 17, 225 (1976).
VATE COMMUNICATION.
L.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 | |
| 17) SPEAR, R.H.: AT
18) BENZI, V. AND R
19) KIKUCHI, K. AND
REACTIONS", NOF | OM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
EFFO, G.: CCDN-NW/10 (1969).
KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
TH HOLLAND (1968). | |

20) BYCHKOV, V.M. ET AL.: INDC(CCP)-146/LJ (1980). 21) FORREST, R.A.: AERE-R 12419 (1986). MAT number = 5637 56-BA-134 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 10.575KEV) EVALUATION FOR JENDL-2 MADE BY KIKUCHI/3/ WAS ADOPTED ALSO FOR JENDL-3. FOR THE RESONANCES BELOW 1.9 KEV, NEUTRON WIDTHS WERE DETERMINED FROM THE DATA OF ALVES ET AL./4/ AND VAN DE VYVER AND PATTENDEN/5/. ABOVE 3 KEV, PARAMETERS WERE EVALUATED ON THE BASIS OF THE DATA OF MUSGROVE ET AL./6/ IN THE ENERGY RANGE FROM 1.6 TO 3 KEV, ARTIFICIAL RESONANCES WERE GENERATED WITH STAT/7/ BY ASSUMING D = 127 EV, SO = 0.85E-4, S1 = 0.8E-4 AND THE AVERAGE RADIATION WIDTH OF 0.120 EV/8/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 2.0+-1.6 BARNS AT 0.0253 EV/8/. SCATTERING RADIUS WAS DETERMINED FROM SYSTEMATICS. MF UNRESOLVED RESONANCE REGION : 10.575 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.600E-4, S1 = 0.900E-4, S2 = 0.550E-4, SG = 7.72E-4, GG = 0.178 EV, R = 5.193 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.428 ELASTIC 3.427 -CAPTURE 2.002 24.8 CAPTURE 2.002 24.6 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING WS AND RSO OF IIJIMA-KAWAI POTENTIAL/11/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/12/
 ALPHA = HUIZENGA AND IGO/13/
 DEUTERON = LOHR AND HAEBERLI/14/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/18/. /18/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). МΤ " = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/. MT = 4NO. ENERGY(MEV) SPIN-PARITY DWBA CAL. 0.0 GŘ. 0 2 2 4 + 1 + 2 1.1679

+

+

3 +

3

4

1.4006

1.6433

| 5
6
7
8
9
10
11
12
13
LEVELS | 1.7605
1.9699
2.0292
2.0883
2.1597
2.2546
2.3368
2.3791
2.4886
ABOVE 2.54 MEV WEF | 0 +
4 +
2 +
0 +
3 -
0 +
0 +
0 +
0 +
0 +
0 +
RE ASSUMED TO BE | *
E OVERLAPPING. |
|--|---|--|---|
| FOR THE LI
INELASTIC
DWUCK-4 C(
BETA3 = 0
AL./21/ AI | EVELS WITH AN ASTE
SCATTERING CROSS
ODE/20/. DEFORMAT
.080) WERE BASED C
ND SPEAR/22/, RESF | ERISK, THE CONTR
SECTIONS WAS CA
FION PARAMETERS
ON THE DATA COMP
PECTIVELY. | RIBUTION OF DIRECT
ALCULATED BY THE
(BETA2 = 0.1636 AND
PILED BY RAMAN ET |
| MT = 102 C/
SPHERICAL
CASTHY WAS
SECTIONS N
AND REFFO | APTURE
OPTICAL AND STATI
S ADOPTED. DIRECT
WERE ESTIMATED ACC
/23/ AND NORMALIZE | ISTICAL MODEL CA
F AND SEMI-DIREC
CORDING TO THE F
ED TO 1 MILLI-BA | ALCULATION WITH
CT CAPTURE CROSS
PROCEDURE OF BENZI
ARN AT 14 MEV. |
| THE GAMMA
REPRODUCE
KEV MEASUI | -RAY STRENGTH FUNC
THE CAPTURE CROSS
RED BY MUSGROVE E1 | CTION (7.70E-04)
S SECTION OF 160
F AL./24/ |) WAS ADJUSTED TO
) MILLI-BARNS AT 70 |
| MT = 16 (N
MT = 17 (N
MT = 22 (N
MT = 28 (N
MT =103 (N
MT =104 (N
MT =105 (N
MT =107 (N
THESE REA(
PREEQUILIN | ,2N) CROSS SECTION
,3N) CROSS SECTION
,N'A) CROSS SECTION
,N'P) CROSS SECTION
,D) CROSS SECTION
,D) CROSS SECTION
,T) CROSS SECTION
,ALPHA) CROSS SECTION
CTION CROSS SECTION
BRIUM AND MULTI-ST | N
N
DN
DN
SNS WERE CALCULA
FEP EVAPORATION | ATED WITH THE
MODEL CODE PEGASUS. |
| THE KALBAG
FORMULA DI
DENSITY P/ | CH'S CONSTANT K (=
ERIVED FROM KIKUCH
ARAMETERS. | = 159.2) WAS EST
HI-KAWAI'S FORMA | TIMATED BY THE
ALISM/25/ AND LEVEL |
| FINALLY,
NORMALIZEI
(N,2N)
(N,P)
(N,ALPH) | THE (N,2N), (N,P)
D TO THE FOLLOWING
1590.00 MB (
7.84 MB (
A) 3.43 MB (| AND (N,ALPHA) C
VALUES AT 14.5
SYSTEMATICS OF
SYSTEMATICS OF
SYSTEMATICS OF | CROSS SECTIONS WERE
MEV:
WEN DEN LU+/26/)
FORREST/27/)
FORREST) |
| MT = 251 MU
CALCULATE | U-BAR
D WITH CASTHY. | | |
| MF = 4 ANGUL/
LEGENDRE POI
GIVEN IN THI
TIC LEVELS,
CALCULATED \
SCATTERING \
ISOTROPIC D | AR DISTRIBUTIONS (
LYNOMIAL COEFFICIE
E CENTER-OF-MASS S
AND IN THE LABORA
WITH CASTHY. CONT
WAS CALCULATED WIT
ISTRIBUTIONS IN TH | DF SECONDARY NEL
ENTS FOR ANGULAF
SYSTEM FOR MT=2
ATORY SYSTEM FOF
FRIBUTION OF DIF
FH DWUCK-4. FOF
HE LABORATORY SY | JTRONS
A DISTRIBUTIONS ARE
AND DISCRETE INELAS-
AMT=91. THEY WERE
RECT INELASTIC
OTHER REACTIONS,
'STEM WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTI
PEGASUS FOR
OTHER NEUTRO | Y DISTRIBUTIONS OF
RIBUTIONS OF SECON
INELASTIC SCATTEF
ON EMITTING REACTI | F SECONDARY NEUT
NDARY NEUTRONS W
RING TO OVERLAPF
IONS. | RONS
VERE CALCULATED WITH
PING LEVELS AND FOR |
| TABLE 1 NEUT | RON OPTICAL POTENT | TIAL PARAMETERS | |
| · · · · · | DEPIH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
| WS =
VSO=
THE FORM OF | 2.95+0.789E
7.0
SURFACE ABSORPTIC | RS = 7.098
RSO= 6.89
N PART IS DER. | AG = 0.02
AS = 0.35
ASO= 0.62
WOODS-SAXON TYPE. |
| TABLE 2 LEVE | L DENSITY PARAMETE | ERS | |
| NUCLIDE SYS | T A(1/MEV) T(MEV) |) C(1/MEV) E | X(MEV) PAIRING |
| 54 - XE - 130
54 - XE - 131
54 - XE - 132
54 - XE - 133 | 1.671L+01 6.600E
1.740E+01 6.000E
1.563E+01 6.500E
1.600E+01 6.250E | 01 8.841E-01 7
-01 3.176E+00 5
-01 5.485E-01 6
-01 2.327E+00 5 | (.427E+00 2.320E+00
5.394E+00 1.120E+00
5.600E+00 2.160E+00
5.284E+00 1.120E+00 |

55-CS-131 55-CS-132 55-CS-133 55-CS-133 55-CS-134 1.705E+01 5.750E-01 1.633E+00 4.913E+00 1.200E+00 1.676E+01 5.726E-01 1.123E+01 3.569E+00 0.0 1.750E+01 6.000E-01 3.784E+00 5.352E+00 1.040E+00 1.598E+01 6.450E-01 1.710E+01 4.505E+00 0.0 * 1.850E+01 6.360E-01 6.996E-01 8.187E+00 2.780E+00 1.941E+01 5.930E-01 3.357E+00 6.465E+00 1.580E+00 1.800E+01 6.100E-01 4.177E-01 7.309E+00 2.620E+00 1.902E+01 5.820E-01 2.277E+00 6.108E+00 1.580E+00 56 - BA - 132 56 - BA - 133 56 - BA - 134 56-BA-135 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.509 FOR BA-134 AND 5.285 FOR BA-135. REFERENCES (EFERENCES)
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
4) ALVES, R.N., ET AL. :NUCL. PHYS. A134,118 (1969).
5) VAN DE VYVER, R.E. AND PATTENDEN, N.J.: NUCL. PHYS., A177, 393 (1971) VAN DE VYVER, R.E. AND PATTENDEN, N.J.: NUCL. PHYS., A177, 393 (1971). MUSGROVE, A.R. DE L., ET AL.: NUCL. PHYS., A256, 173 (1976). KIKUCHI, Y.: JAERI-M 6248 (1975). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) 6) <u>ٰ8</u> 9) 10) 11) (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 12) 13) 14) 151 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHIS., 43, 1440 (1965).
17) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
18) GRUPPELAAR, H.: ECN-13 (1977).
19) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
20) KUNZ, P.D.: PRIVATE COMMUNICATION.
21) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987).
22) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
23) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
24) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
25) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
26) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
27) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5640 56-BA-135 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. (2,151)

F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 1

MI=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 5.96 KEV THE
 EVALUATION FOR JENDL-2 WAS MADE BY KIKUCHI/3/. FOR THE
 RESONANCES BELOW 1.4 KEV, NEUTRON WIDTHS WERE OBTAINED FROM
 THE EXPERIMENTAL DATA OF ALVES ET AL./4/ AND VAN DE VYVER AND
 PATTENDEN/5/. RADIATION WIDTHS WERE BASED ON THE DATA OF
 ALVES ET AL. OR AVERAGE VALUE OF 0.15 EV BY MUSGROVE ET AL./6/
 ABOVE 3 KEV, PARAMETERS WERE DETERMINED FROM THE DATA OF
 MUSGROVE ET AL. IN THE ENERGY RANGE BELOW 3 KEV, MANY
 ARTIFICIAL LEVELS WERE GENERATED WITH STAT/7/ BY ASSUMING
 D=39.3 EV, SO=0.8E-4, S1=0.48E-4 AND AVERAGE RADIATION WIDTH
 OF 0.15 EV. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE
 THE CAPTURE CROSS SECTION OF 5.8+-0.9 BARNS AT 0.0253 EV/8/.
 FOR JENDL-3. THE JENDL-2 DATA WERE MODIFIED ON THE BASIS OF
 THE LATEST EXPERIMENTAL DATA OF MIZUMOTO/9/. RESONANCE
 ENERGIES AND NEUTRON WIDTHS OF JENDL-2 WERE PARTIALLY MODIFIED
 WITH A RANDOM NUMBER METHOD. THE PARAMETERS OF NEGATIVE LEVEL
 WERE ADJUSTED TO THE CAPTURE CROSS SECTION OF THE VALUE STIMATED
 WITH A RANDOM NUMBER METHOD. THE PARAMETERS OF NEGATIVE LEVEL
 WERE ADJUSTED TO THE CAPTURE CROSS SECTION OF THE NEGATIVE LEVEL
 WAS MADE.
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 INF A SIGN NUMBER METHOD. THE PARAMETERS OF NEGATIVE LEVEL
 WAS MADE.
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 JENDL-3.2, A SLIGHT MODIFICATION OF THE NEGATIVE LEVEL
 WAS MADE.
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 JENDL-3.2, A SLIGHT MODIFICATION OF THE NEGATIVE LEVEL
 WAS MADE.
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 JENDL-3.2, A SLIGHT MODIFICATION OF THE NEGATIVE LEVEL
 WAS MADE.
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 JENDL-3.2, A SLIGHT MODIFICATION OF THE NEGATIVE LEVEL
 WAS MADE.
 UNRESOLVED RESONANCE REGION * 5.00 * 70*
 JENDL-3.2

UNRESOLVED RESONANCE REGION : 5.96 KEV - 100 KEV PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY/10/ (JENDL-2 VALUE) BELOW 40 KEV, AND THE CAPTURE CROSS SECTION MEASURED BY MUSGROVE ET AL./11/ ABOVE 40 KEV. THE INITIAL VALUES OF NEUTRON STRENGTH FUNCTIONS, SO AND S1, WERE ADOPTED FROM THE RECOMMENDATION BY MUGHABGHAB ET AL., AND S2 WAS TAKEN FROM CALCULATION WITH CASTHY/10/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF OF MUGHABGHAB ET AL.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.922E-4, S1 = 0.491E-4, S2 = 0.584E-4, SG = 70.2E-4, GG = 0.150 EV, R = 5.232 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)

| | ZZUU M/3 | KES. INIEG. |
|---------|----------|-------------|
| TOTAL | 7.594 | - |
| ELASTIC | 1.798 | - |
| CAPTURÉ | 5.796 | 131 |
| | | |

MF = 3

F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/12/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION BY CHANGING WS AND RSO OF IIJIMA-KAWAI POTENTIAL/13/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/14/ ALPHA = HUIZENGA AND IGO/15/ DEUTERON = LOHR AND HAEBERLI/16/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/17/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/18/ WERE EVALUATED BY IIJIMA ET AL./19/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED WERE

IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /20/. ' = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. МΤ - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT == 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./21/. МΤ SPIN-PARITY 3/2 + 1/2 + NO. ENERGY(MEV) 0.0 0.2210 0.2682 GŔ. 1 2 3 11/2 5/2 3/2 3/2 7/2 0.4806 0.5879 4 5 + 6 0.8745 7/2 + 7 0.9800 3/2 + LEVELS ABOVE 1.17 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (5.93E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 250 MILLI-BARNS AT 100 KEV MEASURED BY MUSGROVE ET AL./11/ [= 16 (N,2N) CROSS SECTION [= 17 (N,3N) CROSS SECTION [= 22 (N,N'A) CROSS SECTION [= 28 (N,N'P) CROSS SECTION [= 32 (N,N'D) CROSS SECTION [= 103 (N,P) CROSS SECTION [= 104 (N,D) CROSS SECTION [= 105 (N,T) CROSS SECTION [= 106 (N,HE3) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTION] MT = 16МŤ MT = 22MT = 28MT = 32MŤ МŤ МŤ MT = 106ΜT THE KALBACH'S CONSTANT K (= 268.3) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1630.00 MB (SYSTEMATICS OF WEN DEN LU+/24/) (N,P) 5.88 MB (SYSTEMATICS OF FORREST/25/) (N,ALPHA) 2.64 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DIFFUSENESS(FM) DEPTH (MEV) RADIUS(FM) V = 41.8 WS = 2.95+0.789E VSO = 7.0 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.

TABLE 2 LEVEL DENSITY PARAMETERS

| IDE S | YST A(| 1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|--|---|---|--|---|--|--|
| E - 131
E - 132
E - 133
E - 134 | 1 .
1 .
1 .
1 . | 740E+01
563E+01
600E+01
400E+01 | 6.000E-01
6.500E-01
6.250E-01
6.300E-01 | 3.176E+00
5.485E-01
2.327E+00
3.184E-01 | 5.394E+00
6.600E+00
5.284E+00
5.224E+00 | 1.120E+00
2.160E+00
1.120E+00
1.820E+00 |
| S - 132
S - 133
S - 134
S - 135 | * 1.
1.
1.
1. | 676E+01
750E+01
598E+01
343E+01 | 5.726E-01
6.000E-01
6.450E-01
6.537E-01 | 1.123E+01
3.784E+00
1.710E+01
1.831E+00 | 3.569E+00
5.352E+00
4.505E+00
4.203E+00 | 0.0
1.040E+00
0.0
7.000E-01 |
| A-133
A-134
A-135
A-136

T: * | 1.
1.
1.
1.
= LDP' | 941E+01
800E+01
902E+01
610E+01
 | 5.930E-01
6.100E-01
5.820E-01
6.500E-01
DETERMINED | 3.357E+00
4.177E-01
2.277E+00
5.721E-01
FROM SYSTE | 6.465E+00
7.309E+00
6.108E+00
6.928E+00 | 1.580E+00
2.620E+00
1.580E+00
2.280E+00 |
| CUTOF
HE CAS
MED TO | F PARA
THY CA
BE 5. | METERS
LCULATI
285 FOR | WERE CALCUI
ON, SPIN CU
BA-135 AND | ATED AS 0
JTOFF FACTO
0 6.925 FOR | 146*SQRT()
DRS AT 0 MI
R BA-136. | A)*A**(2/3).
EV WERE |
| ENCES
OKI, T
ND APP
AWAI,
IKUCHI
LVES,
AN DE | . ET A
LIED S
M. ET
Y. E
R.N.,
VYVER, | L.: PRC
CIENCE,
AL.: J.
T AL.:
ET AL.:
R.E., | C. INT. CON
SANTA FE.
NUCL. SCI
JAERI-M 86-
NUCL. PHYS
PATTENDEN, | NF. ON NUCL
VOL. 2, F
TECHNOL.
030 (1986)
3., A134,
N.J.: NUCL | EAR DATA
2.1627 (198
29, 195
18 (1969)
PHYS., | FOR BASIC
35).
(1992). |
| USGROV
IKUCHI
UGHABG
ART A"
IZUMOT
GARASI
USGROV
HYSICS
IJIMA,
IJIMA, | E, A.R
HAB.S
O, M:
O, M:
ACAD
O, M:
A.R
A.R
S. AN
S. ET
S. AN | . DE L.
JAERIEN
F. ET
EMIC PR
J. NUCL
ND FUKA
. DE L.
UCL. DA
AL.: J
D KAWAI | , ET AL.: /
6248 (1975
AL.: "NEUTF
ESS (1981)
SCI. TECF
HORI, T.:
ET AL.: F
TA FOR REAC
AERI-M 87-C
, M.: J. NU | AAEC/E325
5)
NOL., 25,
JAERI 1321
PROC. INT.
CTORS, HARV
025, P. 337
JCL. SCI. | (1974).
SECTIONS, V
(1991).
CONF. ON I
VELL 1978,
(1987).
FECHNOL., 2 | /OL. I,
).
NEUTRON
449.
20, 77 |
| EREY,
UIZENG
OHR, J
ECCHET
HENOME | F.G: P
A, J.R
.M. AN
TI, F.
NA IN
ERLI), | HYS. RE
. AND I
D HAEBE
D., JR.
NUCLEAR
P. 682 | V. 131, 745
GO, G.: NUC
RLI, W.: NU
AND GREENI
REACTIONS
, THE UNIVE | 5 (1963).
CL. PHYS. 2
JCL. PHYS.
LEES, G.W.
((EDS) H.H
ERSITY OF V | 29, 462 (1)
A232, 381
POLARIZA
H. BARSHALI
VISCONSIN I | 962).
(1974).
TION
AND
PRESS. |
| ILBERT
1965).
IJIMA,
EDERER
NTERSC
ENZI,
IKUCHI
EACTIO
EN DEN
ORREST | , A. A
S., E
AAR, H
C.M.
IENCE
V. AND
, K. A
NS", N
LU AN
, R.A. | ND CAME
T AL.:
ECN-
ET AL
PUBLICA
REFFO,
ND KAWA
ORTH HC
D FINK,
: AERE- | RON, A.G.W.
J. NUCL. S(
13 (1977).
.: "TABLE (
TION (1978)
G.: CCDN-H
I, M.: "NU(
LLAND (1968
R.W.: PHYS
R 12419 (19 | .: CAN. J.
CI. TECHNOL
DF ISOTOPES
WW/10 (1969
CLEAR MATTE
3).
REV., C4
286). | PHYS., 43
21, 10
6, 7TH ED.
9).
ER AND NUCI | , 1446
(1984).
", WILEY-
_EAR
971). |
| | S-
I | IDE SYST A(E-131 1. E-132 1. E-133 1. E-134 1. S-132 1. S-133 1. S-134 1. S-135 1. S-134 1. S-135 1. S-135 1. A-135 1. A-136 1. T: * CUTOFF PARA HE CASTHY CA F. S-135 1. A-134 1. S-135 1. A-136 1. S-137 1. A-138 1. A-136 1. T: ED CASTHY CA MED TO S A. ISGROVE, A. ISGROVE, A. ISGROVE, A. ISGROVE, A. ISGROVE, A. ISGROVE, < | IDE SYST A(1/MEV) E-131 1.740E+01 E-132 1.563E+01 E-133 1.600E+01 E-134 1.400E+01 S-132 * S-132 * A 1.598E+01 S-133 1.750E+01 S-134 1.598E+01 S-135 1.343E+01 A-133 1.941E+01 A-134 1.800E+01 A-135 1.902E+01 A-136 1.610E+01 A-135 1.902E+01 A-136 1.610E+01 A-135 1.902E+01 A-136 1.610E+01 A-137 1.902E+01 A-136 1.610E+01 T * LOPYS WERE CUTOFF PARAMETERS HE CASTHY MED TO BE S.285 ND APPLIED SCIENCES RE ND APPLIED SCIENCE, A.R. DE AND YVVER, R.E., <t< td=""><td>IDE SYST A(1/MEV) T(MEV) E-131 1.740E+01 6.000E-01 E-132 1.563E+01 6.500E-01 E-133 1.600E+01 6.250E-01 E-134 1.400E+01 6.300E-01 S-132 1.676E+01 5.726E-01 S-133 1.750E+01 6.450E-01 S-134 1.598E+01 6.450E-01 S-135 1.343E+01 6.537E-01 A-133 1.941E+01 5.930E-01 A-134 1.800E+01 6.100E-01 A-135 1.902E+01 5.820E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 CUTOFF PARAMETERS WER CALCULATION SPIN CC MCL MED TO BE 5.285 FOR BA-135 AND ENCES OKI, T. ET AL.: J. NUCL. SCI OKI, T. ET AL.: J. NUCL. SCI HKUCHI, Y. ET AL.: J. NUCL. SCI KUCES, R.N., ET AL.: J. NUCL. SCI ND ÉVVER, R.E., PATTENDEN, UJSGROVE, A.R. DE L., ET AL.: MEUF <</td><td>IDE SYST A(1/MEV) T(MEV) C(1/MEV) E-131 1.740E+01 6.000E-01 3.176E+00 E-132 1.563E+01 6.500E-01 2.327E+00 E-133 1.600E+01 6.250E-01 2.327E+00 E-134 1.400E+01 6.300E-01 3.184E-01 S-132 * 1.676E+01 5.726E-01 1.123E+01 S-133 1.750E+01 6.450E-01 1.710E+01 S-134 1.598E+01 6.450E-01 1.710E+01 S-135 1.343E+01 6.537E-01 3.357E+00 A-134 1.800E+01 6.100E-01 2.77E+00 A-135 1.902E+01 5.820E-01 2.277E+00 A-136 1.610E+01 6.500E-01 5.721E-01 T: * = LDP'S WERE CALCULATION SUTOFF PARAMETERS WERE CALCULATION SPIN CUTOFF IKUCHI, Y. T EAL.: JAERI-M 86-030<(1986)</td> LVES SUTOFF PARA</t<> | IDE SYST A(1/MEV) T(MEV) E-131 1.740E+01 6.000E-01 E-132 1.563E+01 6.500E-01 E-133 1.600E+01 6.250E-01 E-134 1.400E+01 6.300E-01 S-132 1.676E+01 5.726E-01 S-133 1.750E+01 6.450E-01 S-134 1.598E+01 6.450E-01 S-135 1.343E+01 6.537E-01 A-133 1.941E+01 5.930E-01 A-134 1.800E+01 6.100E-01 A-135 1.902E+01 5.820E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 A-136 1.610E+01 6.500E-01 CUTOFF PARAMETERS WER CALCULATION SPIN CC MCL MED TO BE 5.285 FOR BA-135 AND ENCES OKI, T. ET AL.: J. NUCL. SCI OKI, T. ET AL.: J. NUCL. SCI HKUCHI, Y. ET AL.: J. NUCL. SCI KUCES, R.N., ET AL.: J. NUCL. SCI ND ÉVVER, R.E., PATTENDEN, UJSGROVE, A.R. DE L., ET AL.: MEUF < | IDE SYST A(1/MEV) T(MEV) C(1/MEV) E-131 1.740E+01 6.000E-01 3.176E+00 E-132 1.563E+01 6.500E-01 2.327E+00 E-133 1.600E+01 6.250E-01 2.327E+00 E-134 1.400E+01 6.300E-01 3.184E-01 S-132 * 1.676E+01 5.726E-01 1.123E+01 S-133 1.750E+01 6.450E-01 1.710E+01 S-134 1.598E+01 6.450E-01 1.710E+01 S-135 1.343E+01 6.537E-01 3.357E+00 A-134 1.800E+01 6.100E-01 2.77E+00 A-135 1.902E+01 5.820E-01 2.277E+00 A-136 1.610E+01 6.500E-01 5.721E-01 T: * = LDP'S WERE CALCULATION SUTOFF PARAMETERS WERE CALCULATION SPIN CUTOFF IKUCHI, Y. T EAL.: JAERI-M 86-030<(1986) | IDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) E-131 1.740E+01 6.000E-01 3.176E+00 5.394E+00 E-132 1.663E+01 6.250E-01 2.327E+00 5.284E+00 E-133 1.600E+01 6.250E-01 2.327E+00 5.284E+00 S-132 * 1.676E+01 5.726E-01 1.710E+01 4.508E+00 S-133 1.750E+01 6.400E-01 3.764E+00 5.352E+00 S-133 1.750E+01 6.405E-01 1.710E+01 4.508E+00 S-133 1.941E+01 5.930E-01 3.357E+00 6.465E+00 A-134 1.800E+01 6.100E-01 4.77E+01 7.308E+00 A-135 1.902E+01 5.820E-01 2.277E+00 6.108E+00 A-134 1.800E+01 6.500E-01 5.721E-01 6.928E+00 A-134 1.802E+01 S.720E-01 5.271E-01 6.928E+00 A-134 1.800E+01 6.500E-01 5.721E-01 6.928E+00 A-135 1.902E+01 S.802E-01 |

MAT number = 5643 56-BA-136 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 34.49 KEV) THE PARAMETERS ARE THE SAME AS JENDL-2 EVALUATED BY KIKUCHI ET AL./3/ ON THE BASIS OF EXPERIMENTAL DATA OF ALVES ET AL./4/, VAN DE VYVER AND PATTENDEN/5/ AND MUSGROVE ET AL./6/ THE AVERAGE RADIATION WIDTH OF 0.125 EV/7/ WAS ASSUMED. BELOW 3 KEV, 6 ARTIFICIAL LEVELS WERE GENERATED WITH STAT/8/ BY ASSUMING D = 225 EV, SO = 0.8E-4/7/, S1 = 0.8E-4 AND THE RADIATION WIDTH OF 0.125 EV. A NEGATIVE RESONANCE WAS ADDED BY REFERRING TO REF./7/ IN ORDER TO REPRODUCE THE CAPTURE CROSS SECTION OF 0.4 BARNS AT 0.0253 EV/7/. MF UNRESOLVED RESONANCE REGION : 34.49 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV 100 KEV TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.520E-4, S1 = 0.850E-4, S2 = 0.550E-4, SG = 1.32E-4, GG = 0.112 EV, R = 5.288 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 2.965 TOTAL ELASTIC CAPTURE 2.06 0.4001 CAPIURE0.40012.06F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING WS AND RSO OF IIJIMA-KAWAI POTENTIAL/11/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/12/
ALPHA = HUIZENGA AND IGO/13/
DEUTERON = LOHR AND HAEBERLI/14/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/18/. MF = 3/18/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/. MT SPIN-PARITY ENERGY(MEV) NO DWBA CAL. GŘ. 0.0 0 2 2 0 + 0.8186 * + 1 2 3 1.5505 1.5792 1.8663 2.0540 2.0799 4 4 + 4 2 5 + 6 +

| 7 2.1280 2 +
8 2.1402 5 -
9 2.1415 0 +
10 2.2071 6 +
LEVELS ABOVE 2.284 MEV WERE ASSUMED TO BE OVERLAPPING. |
|--|
| FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/20/. DEFORMATION PARAMETER (BETA2 = 0.1242) WAS
BASED ON THE DATA COMPILED BY RAMAN ET AL./21/ |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.22E-04) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 45 MILLI-BARNS AT 70
KEV MEASURED BY MUSGROVE ET AL./23/ |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 257.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/24/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1670.00 MB (SYSTEMATICS OF WEN DEN LU+/25/)
(N,P) 6.00 MB (MEASURED BY IKEDA+/26/)
(N,ALPHA) 2.04 MB (SYSTEMATICS OF FORREST/27/) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 54-XE-1321.563E+016.500E-015.485E-016.600E+002.160E+0054-XE-1331.600E+016.250E-012.327E+005.284E+001.120E+0054-XE-1341.400E+016.300E-013.184E-015.224E+001.820E+0054-XE-1351.550E+015.565E-017.506E-014.010E+001.120E+00 |
| 55-CS-1331.750E+016.000E-013.784E+005.352E+001.040E+0055-CS-1341.598E+016.450E-011.710E+014.505E+000.055-CS-1351.343E+016.537E-011.831E+004.203E+007.000E-0155-CS-1361.400E+016.000E-014.424E+002.967E+000.0 |
| 56-BA-134 1.800E+01 6.100E-01 4.177E-01 7.309E+00 2.620E+00 |

| 56-
56-
56- | - BA - 135
- BA - 136
- BA - 137 | 1.902E+01 5.820E-01 2.277E+00 6.108E+00 1.580E+00
1.610E+01 6.500E-01 5.721E-01 6.928E+00 2.280E+00
1.645E+01 5.640E-01 5.394E-01 4.905E+00 1.580E+00 | |
|------------------------------------|--|---|---|
| SPI
IN
ASS | IN CUTOFF P/
THE CASTHY
SUMED TO BE | RAMS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
6.925 FOR BA-136 AND 5.625 FOR BA-137. | |
| REFE
1)
2)
3)
4)
5) | ERENCES
AOKI, T. ET
AND APPLIET
KAWAI, M. E
AND TECHNOL
KIKUCHI, Y
ALVES, R.N
VAN DE VVVE
(1971) | AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
T AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
OGY, MITO, P. 569 (1988).
ET AL.: JAERI-M 86-030 (1986).
, ET AL.: NUCL. PHYS., A134, 118 (1969).
R, R.E., PATTENDEN, N.J.: NUCL. PHYS., A177, 393 | Ξ |
| 6)
7)
8)
9)
10)
11) | MUŠGROVE, A
MUGHABGHAB
PART A", AC
KIKUCHI, Y
IGARASI, S
IJJIMA, S. | .R. DE L., ET AL.: NUCL. PHYS., A256, 173 (1976).
S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I,
ADEMIC PRESS (1981).
: JAERI-M 6248 (1975).
: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
ET AL.: JAERI-M 87-025, P. 337 (1987).
AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 | |
| 12)
13)
14)
15) | (1983).
PEREY, F.G:
HUIZENGA,
LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERLI
(1971) | PHYS. REV. 131, 745 (1963).
.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
F.D., JR. AND GREENLEES, G.W.: POLARIZATION
N NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. | |
| 16) | GILBERT, A.
(1965). | AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 | |
| 17)
18)
19) | ÌIJIMÁ, S.
GRUPPELAAR
LEDERER, C | ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
H.: ECN-13 (1977).
M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY- | |
| 20)
21) | KUNZ, P.D.:
RAMAN, S., | PRIVATE COMMUNICATION.
ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 | |
| 22)
23) | BENZI, V. A
MUSGROVE, A
PHYSICS AND | ND REFFO, G.: CCDN-NW/10 (1969).
.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON
NUCL DATA FOR REACTORS HARWELL 1978 449 | |
| 24) | KIKUCHI, K
REACTIONS" | AND KAWAI, M.: "NUCLEAR' MATTER AND NUCLEAR
NORTH HOLLAND (1968). | |
| 25)
26)
27) | WEN DEN LU
IKEDA, Y. E
FORREST, R | AND FINK, R.W.: PHYŠ. REV., C4, 1173 (1971).
T AL.: JAERI 1312 (1988).
A.: AERE-R 12419 (1986). | |

MAT number = 5646 56-BA-137 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-0CT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 11.885 KEV FOR JENDL-2, EVALUATION WAS MADE BY KIKUCHI/3/. BELOW 1.7 KEV, PARAMETERS WERE DETERMINED FROM THE EXPERIMENTAL DATA OF ALVES ET AL./4/ AND VAN DE VYVER AND PATTENDEN/5/. AVERAGE RADIATION WIDTHS WERE ASSUMED TO BE 0.08 EV FOR S-WAVE RESONANCES AND 0.068 EV FOR P-WAVE ONES EXCEPT FOR 420- AND 578-EV LEVELS. ABOVE 3 KEV, EVALUATION WAS BASED ON THE DATA OF MUSGROVE ET AL./6/. MANY ARTIFICIAL LEVELS WERE GENERATED WITH STAT/7/ BY ASSUMING D=380 EV, S0=0.57E-4, S1=0.45E-4. A NEGATIVE RESONANCE WAS ADDED AT -26 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 5.1 +- 0.4 BARNS AT 0.0253 EV/8/. FOR JENDL-3, THE RESONANCE PARAMETERS OF JENDL-2 WERE UPDATED BY USING THE NEWEST EXPERIMENTAL DATA BY MIZUMOTO /9/. THE RESONANCE ENERGIES AND NEUTRON WIDTHS WERE REPLACED BY MIZUMOTO'S DATA IN THE ENERGY RANGE FROM 418.3 EV TO 14.941 KEV. AVERAGE RADIATION WIDTH AND SCATTERING RADIUS WERE TAKEN FROM MUGHABGHAB ET AL./8/ TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. UNDESOLVED RESONANCE PECION • 11 885 KEV 100 KEV MF = 2UNRESOLVED RESONANCE REGION : 11.885 KEV - 100 KEV INITIAL VALUES OF NEUTRON STRENGTH FUNCTIONS, SO AND S1, WERE ADOPTED FROM THE RECOMMENDATION BY MUGHABGHAB ET AL., AND S2 WAS TAKEN FROM CALCULATION WITH CASTHY/10/. THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MUSGROVE ET AL./11/ THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION A 100 KEV. THE RADIATION WIDTH GG WAS ADOPTED FROM REF./8/. SECTION AT TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.695E-4, S1 = 0.525E-4, S2 = 0.949E-4, SG = 3.91E-4, GG = 0.080 EV, R = 5.729 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 9.0034 3.8816 4.75 5.1218 GAPTURE 5.1218 4.75 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/12/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING WS AND RSO OF IIJJMA-KAWAI POTENTIAL/13/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/14/
ALPHA = HUIZENGA AND IGO/15/
DEUTERON = LOHR AND HAEBERLI/16/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/17/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/18/ WERE EVALUATED BY IIJIMA ET AL./19/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/20/. /20/.

MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING

CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./21/.

| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 3/2 +
1 0.2792 1/2 +
2 0.6616 11/2 -
3 1.2900 5/2 +
4 1.4629 5/2 +
5 1.7900 7/2 -
6 1.8400 1/2 +
7 1.9000 5/2 +
8 2.0400 5/2 +
LEVELS ABOVE 2.12 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|---|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (3.65E-04) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 33 MILLI-BARNS AT 100
KEV MEASURED BY MUSGROVE ET AL./11/ | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 435.5) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/23/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1710.00 MB (SYSTEMATICS OF WEN DEN LU+/24/)
(N,P) 3.32 MB (SYSTEMATICS OF FORREST/25/)
(N,ALPHA) 1.59 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | - |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | २ |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{cccc} & \text{DEPTH} (\text{MEV}) & \text{RADIUS(FM}) & \text{DIFFUSENESS(FM}) \\ & V &= 41.8 & \text{RO} &= 6.89 & \text{AO} &= 0.62 \\ & \text{WS} &= 2.95 + 0.789E & \text{RS} &= 7.098 & \text{AS} &= 0.35 \\ & \text{VSO} &= 7.0 & \text{RSO} &= 6.89 & \text{ASO} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDEA(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING54-XE-1331.600E+016.250E-012.327E+005.284E+001.120E+0054-XE-1341.400E+016.300E-013.184E-015.224E+001.820E+0054-XE-1351.550E+015.56E-017.506E-014.010E+001.120E+0054-XE-1361.400E+016.500E-013.270E-015.679E+001.970E+00 | |

55-CS-134 55-CS-135 55-CS-136 55-CS-136 55-CS-137 1.598E+01 6.450E-01 1.710E+01 4.505E+00 0.0 1.343E+01 6.537E-01 1.831E+00 4.203E+00 7.000E-01 1.400E+01 6.000E-01 4.424E+00 2.967E+00 0.0 1.336E+01 6.200E-01 9.986E-01 3.836E+00 8.500E-01 1.902E+01 5.820E-01 2.277E+00 6.108E+00 1.580E+00 1.610E+01 6.500E-01 5.721E-01 6.928E+00 2.280E+00 1.645E+01 5.640E-01 5.394E-01 4.905E+00 1.580E+00 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 56-BA-135 56 - BA - 136 56 - BA - 137 56-BA-138 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.625 FOR BA-137 AND 7.914 FOR BA-138. REFERENCES (EFRENCES)
AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
3) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
4) ALVES, R.N., ET AL.: NUCL. PHYS., A134, 118 (1969).
5) VAN DE VYVER, R.E., PATTENDEN, N.J.: NUCL. PHYS., A177, 393 (1971). (1971). MUSGROVE, A.R. DE L., ET AL.: AUST. J. PHYS., 29, 157 (19 KIKUCHI, Y.: JAERI-M 6248 (1975). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). MIZUMOTO, M.: J. NUCL. SCI. TECHNOL., 25, 757 (1988). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449. IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 6) AUST. J. PHYS., 29, 157 (1976). 8) 9) 10) 11) 13) 18) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. FILLS., 40, 11065.
19) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
20) GRUPPELAAR, H.: ECN-13 (1977).
21) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
22) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
23) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
24) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
25) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5649 56-BA-138 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-0CT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MODIFIED PARTS FOR JENDL-3.2 ***** RESOLVED RESONANCE PARAMETERS * * * * * * * * * * * * * * * * * * * (2,151) RESOLVED RESOLVANCE (3,102) RE-NORMALIZATION (3,2), (3,4), (3,51-91) AND ANGULAR DISTRIBUTIONS SMALL EFFECTS OF THE RE-NORMALIZATION OF CAPTURE CROSS SECTION. (< 0.3%)</pre> * * * * * * * * * * * * * * * F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 100 KEV) FOR JENDL-2, EVALUATION WAS MADE BY KIKUCHI /3/ MAINLY ON THE BASIS OF THE DATA MEASURED BY MUSGROVE ET AL./4/ UP TO 92 KEV. ABOVE 100 KEV, NEUTRON WIDTHS WERE ADOPTED FROM BILPUCH ET AL./5/ AVERAGE CAPTURE WIDTHS WERE ASSUMED TO BE 0.055+-0.020 EV FOR S-WAVE RESONANCES AND 0.045+-0.020 EV FOR P-WAVE ONES, AND TO BE 0.095 EV IN THE ENERGY RANGE ABOVE 100 KEV. / NEGATIVE RESONANCE WAS ADDED AT -6.22 KEV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 0.360+-0.036 BARNS AT 0.0253 EV/6/. MF Α EV/6/. FOR JENDL-3, 10 RESONANCES WERE NEWLY ASIGNED BY TAKING THE EXPERIMENTAL DATA BY MIZUMOTO/7/ IN THE ENERGY RANGE FROM 648 EV TO 63.12 KEV. TOTAL SPIN J OF SOME RESONANCES WAS TENTA-TIVELY ESTIMATED WITH A RANDOM NUMBER METHOD NO UNRESOLVED RESONANCE REGION CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 5.9090 ELASTIC 5.5499 -CAPTURE 0.3591 0.265 CAPIURE0.35910.265F = 3NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY/8/, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE BA-NAT. TOTAL
CROSS SECTION BY CHANGING WS AND RSO OF ILJIMA-KAWAI POTENTIAL
/10/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/11/
ALPHA = HUIZENGA AND IGO/12/
DEUTERON = LOHR AND HAEBERLI/13/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/17/. MF /17/MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. МТ ENERGY(MEV) SPIN-PARITY DWBA CAL. GR. 0.0 0 2 4 + 1.4359 1.8987 * 1 + + 3 2.0907 6 +

FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/19/. DEFORMATION PARAMETERS (BETA2 = 0.0925 AND BETA3 = 0.118) WERE BASED ON THE DATA COMPILED BY RAMAN ET AL./20/ AND SPEAR/21/, RESPECTIVELY. MT = 102CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (2.54E-06) WAS ADJUSTED TO THE CAPTURE CROSS SECTION OF 2.7 MILLI-BARNS AT 700 KEV SO AS TO REPRODUCE THE CROSS SECTION MEASURED BY JOHNSRUD ET AL./23/ AND STAVISSKIJ AND TOLSTIKOV/24/ [= 16 (N,2N) CROSS SECTION = 17 (N,3N) CROSS SECTION [= 22 (N,N'A) CROSS SECTION [= 28 (N,N'P) CROSS SECTION [= 103 (N,P) CROSS SECTION [= 104 (N,D) CROSS SECTION [= 105 (N,T) CROSS SECTION [= 105 (N,ALPHA) CROSS SECTION [= 107 (N,ALPHA) CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16 MT = 17 MT = 22 MT = 28 MT = 103 МТ МŤ MT THE KALBACH'S CONSTANT K (= 144.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/25/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1750.00 MB (SYSTEMATICS OF WEN DEN LU+/26/) (N,P) 2.80 MB (MEASURED BY IKEDA+/27/) (N,ALPHA) 2.10 MB (MEASURED BY IKEDA+) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) -------------

TABLE 2 LEVEL DENSITY PARAMETERS

NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.400E+01 6.300E-01 3.184E-01 5.224E+00 1.820E+00 1.550E+01 5.565E-01 7.506E-01 4.010E+00 1.120E+00 1.400E+01 6.500E-01 3.270E-01 5.679E+00 1.970E+00 1.550E+01 5.565E-01 7.470E-01 4.010E+00 1.120E+00 54-XE-134 54 - XE - 135 54 - XE - 136 54-XE-137 55-CS-135 55-CS-136 55-CS-137 55-CS-138 1.343E+01 6.537E-01 1.831E+00 4.203E+00 7.000E-01 1.400E+01 6.000E-01 4.424E+00 2.967E+00 0.0 1.336E+01 6.200E-01 9.986E-01 3.836E+00 8.500E-01 1.470E+01 5.737E-01 4.715E+00 2.858E+00 0.0 1.610E+01 6.500E-01 5.721E-01 6.928E+00 2.280E+00 1.645E+01 5.640E-01 5.394E-01 4.905E+00 1.580E+00 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 2.022E+01 4.800E-01 5.326E-01 4.629E+00 1.580E+00 56-BA-136 56-BA-137 56-BA-138 56-BA-139 1.580E+00 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.914 FOR BA-138 AND 5.0 FOR BA-139. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL. 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
MUSGROVE, A.R. DE L., ET AL.: AUST. J. PHYS., 32, 213 (1979).
BILPUCH, E.G., ET AL.: ANN. PHYS., 14, 387 (1961).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A". ACADEMIC PRESS (1981).
MIZUMOTO, M.: J. NUCL. SCI. ENG., 25, 757 (1988).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). IIJIMA, S. AND KAWAI, W. C. MCC. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. 11)12) 13) 14) (1971) 15) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 15) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
16) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
17) GRUPPELAAR, H.: ECN-13 (1977).
18) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
19) KUNZ, P.D.: PRIVATE COMMUNICATION.
20) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
21) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
22) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
23) JOHNSRUD, A.E. ET AL.: PHYS. REV., 116, 927 (1959).
24) STAVISSKIJ, JU.JA. AND TOLSTIKOV, V.A.: AT. ENERGIJA, 10, 508 (1961). EXFOR 40642004.
25) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
26) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
27) IKEDA, Y. ET AL.: JÄERI 1312 (1988).

MAT number = 5655 56-BA-140 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1= 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 14 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.520E-4, S1 = 0.840E-4, S2 = 0.550E-4, SG = 0.0303E-4, GG = 0.075 EV, R = 5.301 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 4.900 TOTAL ELASTIC CAPTURE 1.600 0.728 F = 3 NEUTRON CROSS SECTIONS BELOW 14 KEV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 5.2 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 14 KEV TO 100 KEV. MF = 3ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE BA-NATURAL TOTAL CROSS SECTION BY CHANGING WS AND RSO OF IIJIMA-KAWAI POTENTIAL/5/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/6/ ALPHA = HUIZENGA AND IGO/7/ DEUTERON = LOHR AND HAEBERLI/8/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /12/. /12/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). - = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA MT SHEETS/14/. ENERGY(MEV) SPIN-PARITY NO. GR. 0.0 0.6023 02 + 1 + 1.1306 ż 423032 34 + 1.8027 1.8240 5 + 6 + 7 1.9937 +

LEVELS ABOVE 2.061 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (2.71E-06) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 3.2 MILLI-BARNS AT KEV MEASURED BY MUSGROVE ET AL./16/ FOR BA-138. (THE SAME CROSS SECTION AS BA-138 WAS ASSUMED.) 70 THE KALBACH'S CONSTANT K (= 304.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 1.40 MB (SYSTEMATICS OF FORREST/18/) (N,ALPHA) 0.76 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS C(1/MEV) EX(MEV) PAIRING NUCLIDE SYST A(1/MEV) T(MEV) 1.400E+01 6.500E-01 3.270E-01 5.679E+00 1.970E+00 1.550E+01 5.565E-01 7.470E-01 4.010E+00 1.120E+00 * 1.684E+01 5.580E-01 3.365E-01 5.240E+00 1.880E+00 * 1.849E+01 5.556E-01 2.542E+00 4.980E+00 1.120E+00 -----54-XE-136 54 - XE - 137 54 - XE - 138 54 - XE - 139 1.336E+01 6.200E-01 9.986E-01 3.836E+00 8.500E-01 1.470E+01 5.737E-01 4.715E+00 2.858E+00 0.0 * 1.696E+01 5.556E-01 2.545E+00 4.122E+00 7.600E-01 1.484E+01 6.545E-01 1.053E+01 4.162E+00 0.0 55-CS-137 55-CS-138 55-CS-139 55-CS-140 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 2.022E+01 4.800E-01 5.326E-01 4.629E+00 1.580E+00 1.500E+01 6.930E-01 5.738E-01 7.244E+00 2.340E+00 1.600E+01 7.010E-01 3.318E+00 7.141E+00 1.580E+00 56-BA-138 56 - BA - 139 56 - BA - 140 56-BA-141 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE

ASSUMED TO BE 4.553 FOR BA-140 AND 5.0 FOR BA-141.

- REFERENCES

 KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
- 5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).
 6) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 7) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 8) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 9) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

10) GILBERT, A. AND CAMERON, A.G.W. CONT. C. L. C., (1965).
11) IJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 51, 425 (1987).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL DATA FOR REACTORS, HARWELL 1978, 449.
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5725 57-LA-138 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.33 KEV RESONANCE PARAMETERS WERE BASED ON MUGHABGHAB ET AL./2/ TOTAL SPIN J OF SOME RESONANCES WAS EVALUATED BY MEANS OF A RANDOM NUMBER METHOD. NEUTRON ORBITAL ANGULAR MOMENTUM L WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/3/. AND FINALLY ALL RESONANCES WERE ASSIGNED TO S-WAVE ONES. AVERAGE RADIATION WIDTH WAS TAKEN FROM MUGHABGHAB ET AL. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL. MF UNRESOLVED RESONANCE REGION : 0.330 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.440E-4, S1 = 0.960E-4, S2 = 0.480E-4, SG = 35.2E-4, GG = 0.085 EV, R = 5.480 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 70.06 ELASTIC 12.98 TOTAL ELASTIC CAPTURE F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE THE LA-139 TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW./6/, ISLAM ET AL./7/, NISHIMURA ET AL./8/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PERFY/9/ 57.08 365 MF FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (15) /15/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA SHEETS/17/. ENERGY(MEV) SPIN-PARITY NO. 0.0 GŘ. 5323 + 1 + 0.1162 0.1612 + 3 +

4

0.1922

2 +

| 5 0.2304 4 +
6 0.2930 1 +
7 0.4133 3 +
8 0.4793 4 +
9 0.5105 3 +
10 0.5187 4 +
12 0.7377 2 -
13 0.7387 4 -
14 0.8234 3 -
15 0.8360 7 -
LEVELS ABOVE 0.843 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|-----|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (3.5E-03) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.085 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (24.5 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. | 1 |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 454.8) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 5.16 MB (SYSTEMATICS OF FORREST/20/)
(N,ALPHA) 2.29 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | } - |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | ł |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{ccccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & \text{V} &= 41.8 & \text{R0} &= 6.858 & \text{A0} &= 0.62 \\ & \text{WS} &= 2.95 + 0.789E & \text{RS} &= 7.064 & \text{AS} &= 0.35 \\ & \text{VS0} &= 7.0 & \text{RS0} &= 6.858 & \text{AS0} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| 55-CS-134 1.598E+01 6.450E-01 1.710E+01 4.505E+00 0.0 55-CS-135 1.343E+01 6.537E-01 1.831E+00 4.203E+00 7.000E-01 55-CS-136 1.400E+01 6.000E-01 4.424E+00 2.967E+00 0.0 55-CS-137 1.336E+01 6.200E-01 9.986E-01 3.836E+00 8.500E-01 | |
| 56-BA-1351.902E+015.820E-012.277E+006.108E+001.580E+0056-BA-1361.610E+016.500E-015.721E-016.928E+002.280E+00 | |

1.645E+01 5.640E-01 5.394E-01 4.905E+00 1.580E+00 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 56 - BA - 137 56 - BA - 138 1.638E+01 5.629E-01 8.565E+00 3.286E+00 0.0 1.558E+01 6.210E-01 3.521E+00 4.624E+00 7.000E-01 1.450E+01 6.310E-01 7.202E+00 3.634E+00 0.0 1.380E+01 6.500E-01 1.653E+00 4.468E+00 8.500E-01 57-LA-136 57 - LA - 137 57 - LA - 138 57 - LA - 139 - - - - - - - - - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 7.524 FOR LA-138 AND 7.875 FOR LA-139. REFERENCES REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: RHYS. REV., C3, 576 (1971). 05.L 1971). - ^M E HUSSAIN, M., AMEEN, N., ET AL.: NUCL. PHYS., A209, YAMANOUTI, Y., KIKUCHI, S., ET AL.: EANDC(J) 11) 12) (1971) 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERI, A. AND CAMERUN, A.G.W.. GAN. J. THIO., 10, 10, 11965).
14) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
17) NUCLEAR DATA SHEETS, 36, 289 (1982).
18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5728 57-LA-139 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1MI=451 COMMENTS AND DICTIONARY = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 15.0 KEV RESONANCE PARAMETERS OF JENDL-2/3/ WERE MODIFIED ON THE BASIS OF THE EXPERIMENTAL DATA OF NAKAJIMA/4/ AT 72.3 EV, AND IN THE ENERGY RANGE FROM 617.2 TO 2464 EV WHERE 20 RESONANCES WERE GIVEN. RESONANCE ENERGIES WERE MAINLY BASED ON THE DATA OF JENDL-2 AND SUPPLEMENTED WITH THE EXPERIMENTAL DATA OF NAKAJIMA. NEUTRON WIDTHS WERE DERIVED FROM THE NEUTRON CAPTURE AREA DATA BY USING THE AVERAGE RADIATION WIDTH OF 0.050 EV/3/. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. ASSIGNMENT OF NEUTRON ORBITAL ANGULAR MOMENTUM L IS THE SAME AS THE JENDL-2 EVALUATION. TWO NEGATIVE RESONANCES WERE ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL. FOR JENDL-3.2, THESE RESONANCE PARAMETERS WERE MODIFIED SO AS TO REPRODUCE THE AREA DATA MEASURED AT ORNL, BY TAKING ACCOUNT OF THE CORRECTION FACTOR OF 1.0737 ANNOUNCED BY ALLEN ET AL./5/. THE UUPER BOUNDARY WAS CHANGED FROM 25.9 KEV TO 15 KEV. UNRESOLVED RESONANCE DECIDE A 45 YEV A 45 YEV UNRESOLVED RESONANCE DECIDE A 45 YEV A 45 YEV UNRESOLVED RESONANCE DECIDE A 45 YEV NUMBER AND AND A 45 YEV NUMBER AND AND A 45 YEV NUMBER AND AND A 45 YEV NUMBER AND AND A 45 YEV NUMBER AND A MF = 2UNRESOLVED RESONANCE REGION : 15 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.780E-4, S1 = 0.400E-4, S2 = 0.500E-4, SG = 2.04E-4, GG = 0.055 EV, R = 5.455 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 19.060 10.130 8.930 TOTAL ELASTIC CAPTURE 11.8 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE THE LA-139 TOTAL CROSS SECTIONS MEASURED BY FOSTER AND GLASGOW/8/, ISLAM ET AL./9/, NISHIMURA ET AL./10/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/11/ FOLLOWS: PROTON = PEREY/11/ ALPHA = HUIZENGA AND IGO/12/ DEUTERON = LOHR AND HAEBERLI/13/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (17) /17/.

TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). МΤ F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. MT = 4SPIN-P/ 7/2 + 5/2 + 9/2 + 5/2 + 7/2 + 7/2 + 7/2 + 11/2 7/2 7/2 3/2 NO. ENERGY(MEV) SPIN-PARITY 0.0 GŔ. 1 1.2060 1.2191 1.2566 1.3813 1.4205 2 34 567 1.4390 7 1.4390 11/2 -8 1.4764 7/2 + 9 1.5363 7/2 + 10 1.5582 3/2 + 11 1.5782 9/2 + 12 1.6831 7/2 + LEVELS ABOVE 1.75 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/19/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (2.06E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 38 MILLI-BARNS AT 3 KEV MEASURED BY MUSGROVE ET AL./20/ 30 MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT = 32 (N,N'D) CROSS SECTION MT = 33 (N,N'T) CROSS SECTION MT =103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =106 (N,HE3) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 322.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/21/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.00 MB (RECOMMENDED BY FORREST/22/) (N,ALPHA) 2.50 MB (MEASURED BY WOELFLE+/23/) = 251 MU-BAR CALCULATED WITH CASTHY/6/. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) $\begin{array}{ccccccc} V &= 41.8 & R0 = 6.874 & A0 = 0.62 \\ WS &= 2.95 + 0.789E & RS = 7.081 & AS = 0.35 \\ VS0 &= 7.0 & RS0 = 6.874 & AS0 = 0.62 \\ THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. \end{array}$

TABLE 2 LEVEL DENSITY PARAMETERS

| NUC | CLIDE | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|---|--|---|--|--|---|--|
| 55 -
55 -
55 -
55 - | CS-135
CS-136
CS-137
CS-137
CS-138 | 1.343E+01
1.400E+01
1.336E+01
1.470E+01 | 6.537E-01
6.000E-01
6.200E-01
5.737E-01 | 1.831E+00
4.424E+00
9.986E-01
4.715E+00 | 4.203E+00
2.967E+00
3.836E+00
2.858E+00 | 7.000E-01
0.0
8.500E-01
0.0 |
| 56 -
56 -
56 -
56 - | BA - 136
BA - 137
BA - 138
BA - 138 | 1.610E+01
1.645E+01
1.390E+01
2.022E+01 | 6.500E-01
5.640E-01
7.200E-01
4.800E-01 | 5.721E-01
5.394E-01
4.123E-01
5.326E-01 | 6.928E+00
4.905E+00
7.233E+00
4.629E+00 | 2.280E+00
1.580E+00
2.430E+00
1.580E+00 |
| 57 -
57 -
57 -
57 - | LA - 137
LA - 138
LA - 139
LA - 139
LA - 140 | 1.558E+01
1.450E+01
1.380E+01
1.558E+01 | 6.210E-01
6.310E-01
6.500E-01
5.900E-01 | 3.521E+00
7.202E+00
1.653E+00
7.912E+00 | 4.624E+00
3.634E+00
4.468E+00
3.425E+00 | 7.000E-01
0.0
8.500E-01
0.0 |
| SPI
IN
ASS | N CUTOFF P
THE CASTHY
SUMED TO BE | ARAMETERS W
CALCULATIO
7.875 FOR | ERE CALCUL
N, SPIN CU
LÁ-139 AND | ATED AS 0.
TOFF FACTO
5.0 FOR L | 146*SQRT(/
DRS AT 0 ME
.A-140. | A)*A**(2/3)
EV WERE |
| REFE
1)
2)
3)
4)
5)
6)
7)
8) | RENCES
AOKI, T. E
AND APPLIE
KAWAI, M.
KIKUCHI, Y
NAKAJIMA, ALLEN, B.J
IGARASI, S.
IJJIMA, S.
FOSTER, D. | T AL.: PROC
D SCIENCE,
ET AL.: J.
. ET AL.: J
Y., ET AL.:
. AND FUKAH
ET AL.: JA
G. JR. AND | . INT. CON
SANTA FE.,
NUCL. SCI.
AERI-M 86-
J. NUCL.
NUCL. SCI.
ORI, T.: J
ERI-M 87-C
GLASGOW, D | IF. ON NUCL
VOL. 2, F
TECHNOL.,
O3O (1986)
SCI. TECHN
ENG., 82,
IAERI 1321
025, P. 337
O.W.: RHYS. | EAR DATA F
2.1627 (198
29, 195
10L., 20,
230 (1982
(1991)
(1987).
REV., C3 | OR BASIC
35).
(1992).
83(1983).
2).
576 |
| 9) | (1971).
ISLAM, E.,
189 (1973) | HUSSAIN, M | ., AMEEN, | N., ET AL. | : NUCL. PH | IYS., A209, |
| 10) | NISHIMURA,
-22. P.22 | K., YAMANO
(1971). | UTI, Y., K | (IKUCHI, S. | , ET AL.: | EANDC(J) |
| 11)
12)
13)
14) | NISHIMURA,
PEREY, F.G
HUIZENGA,
LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERL
(1071) | (K. ÉÍ'AL.:
: PHYS. REV
J.R. AND IG
AND HAEBER
F.D. JR.
IN NUCLEAR
I), P. 682, | JAERI-M 6
131, 745
0, G.: NUC
LI, W.: NU
AND GREENL
REACTIONS
THE UNIVE | 8833 (1977)
6 (1963).
7 PHYS. 2
9 CL. PHYS. 2
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PHYS.
9 CL. PH | 9, 462 (19
A232, 381
POLARIZAT
BARSHALL
VISCONSIN F | 962).
(1974).
TION
AND
PRESS. |
| 15) | GILBERT, A | . AND CAMER | ON, A.G.W. | : CAN. J. | PHYS., 43 | 1446 |
| 16)
17)
18)
19)
20)
21)
22)
22)
23) | ÌIJIMA, S.
GRUPPELAAR
MATSUMOTO,
BENZI, V.
MUSGROVE,
PHYSICS
REACTIONS"
FORREST, R
WOELFLE, R | , ET AL.: J
, H.: ECN-1
J., ET AL.
AND REFFO,
A.R. DE L.,
D NUCL. DAT
. AND KAWAI
NORTH HOL
.A.: AERE-R
., ET AL.: | . NUCL. SC
3 (1977).
: JAERI-M
G.: CCDN-N
ET AL.: F
A FOR REAC
, M.: "NUC
LAND (1968
12419 (19
APPLIED RA | CI. TECHNOL
7734 (1978
W/10 (1969
PROC. INT.
TORS, HARW
CLEAR MATTE
(LEAR MATTE
().
(DIATION AN | 21, 10 (
3).
CONF. ON N
VELL 1978,
ER AND NUCI | (1984).
NEUTRON
449.
EAR
3, 39, |

407 (1988).

MAT number = 5837 58-CE-140 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 200 KEV RESONANCE PARAMETERS EVALUATED BY KIKUCHI/3/ FOR JENDL-2 WERE ADOPTED. NEUTRON WIDTHS WERE OBTAINED FROM DATA MEASURED BY HACKEN ET AL./4/ AND CAMARDA /5/, AND RADIATION WIDTHS FROM CAPTURE AREAS BY MUSGROVE ET AL./6/ FOR THE RESONANCES ONLY WHOSE CAPTURE AREA WAS MEASURED, THE NEUTRON WIDTH WAS DEDUCED BY ASSUMING THE AVERAGE RADIATION WIDTH OF 0.034+-0.029 EV FOR S-WAVE RESONANCES AND 0.029+-0.008 EV FOR P-WAVE ONES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 0.57+-0.04 BARN AND THE ELASTIC SCATTERING CROSS SECTION OF 2.83+-0.11 BARNS AT 0.0253 EV/7/. FOR JENDL-3.2, NEUTRON WIDTHS OF 14 RESONANCES WERE REPLACED WITH EXPERIMENTAL DATA OBTAINED BY OHKUB0/8/ IN THE ENERGY RANGE FROM 2.5437 KEV TO 55.113 KEV. PARAMETERS OF THE NEGATIVE RESONANCE WERE RE-ADJUSTED TO THE ABOVE THERMAL CROSS SECTIONS /7/. NO UNDECODIVES DECOMMENTAL DATA OF THE TO THE ABOVE THERMAL CROSS SECTIONS /7/. NO UNRESOLVED RESONANCE PARAMETERS ARE GIVEN. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 3.3995 ELASTIC 2.8299 - 278 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 0.5697 0.278 MF = 3 NEUTRON CROSS SECTIONS BELOW 200 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 200 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/9/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WHICH WERE DETERMINED SO AS TO REPRODUCE THE LA-139 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/11/, ISLAM ET AL./12/, NISHIMURA ET AL./13/ AND SO ON WERE ADOPTED BY ASSUMING THAT THE TOTAL CROSS SECTION OF CE WAS SIMILER TO THAT OF LA-139. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/14/ ALPHA = HUIZENGA AND IGO/15/ DEUTERON = LOHR AND HAEBERLI/16/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/17/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/18/ WERE EVALUATED BY IJJIMA ET AL./19/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /20/. /20/ MT = 1T = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./21/. МТ ENERGY(MEV) SPIN-PARITY DWBA CAL. GR. 0.0 02 + 1.5964 1.9033 * 1 + ō + 3 2.0840 4 +

2.1081 2.3482 2.3500 2.4643 2.4643 2.5161 2.5217 2.5217 2.52344 2.5475 2.8997 3.0169 3.0169 3.0190 3.11904567890 101123 62533432122032 + + * + + 14 15 16 17 3.1190 2 + 18 3.2330 0 + 19 3.2500 5 -LEVELS ABOVE 3.32 MEV WERE ASSUMED TO BE OVERLAPPING. FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/22/. DEFORMATION PARAMETERS (BETA2 = 0.1012 A BETA3 = 0.127) WERE BASED ON THE DATA COMPILED BY RAMAN ET AL./23/ AND SPEAR/24/, RESPECTIVELY. AND MT = 102CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/25/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (6.30E-06) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 5.0 MILLI-BARNS AT 70 KEV MEASURED BY MUSGROVE ET AL./26/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T = 103 (N,P) CROSS SECTION T = 104 (N,D) CROSS SECTION T = 104 (N,D) CROSS SECTION T = 105 (N,T) CROSS SECTION T = 107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS/10/. MΤ МŤ МŤ МΤ MŤ MŤ MT МŤ THE KALBACH'S CONSTANT K (= 247.8) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/27/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 7.50 MB (MEASURED BY TENG DAN+/28/) (N,ALPHA) 4.60 MB (RECOMMENDED BY FORREST/29/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) --------TABLE 2 LEVEL DENSITY PARAMETERS

NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.610E+01 6.500E-01 5.721E-01 6.928E+00 2.280E+00 1.645E+01 5.640E-01 5.394E-01 4.905E+00 1.580E+00 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 2.022E+01 4.800E-01 5.326E-01 4.629E+00 1.580E+00 56-BA-136 56 - BA - 137 56 - BA - 138 56-BA-139 1.558E+01 6.210E-01 3.521E+00 4.624E+00 7.000E-01 1.450E+01 6.310E-01 7.202E+00 3.634E+00 0.0 1.380E+01 6.500E-01 1.653E+00 4.468E+00 8.500E-01 1.558E+01 5.900E-01 7.912E+00 3.425E+00 0.0 57 - LA - 137 57 - LA - 138 57 - LA - 139 57-LA-140 * 1.618E+01 5.580E-01 2.611E-01 5.011E+00 1.870E+00 1.374E+01 6.450E-01 9.282E-01 4.685E+00 1.170E+00 1.413E+01 6.541E-01 3.376E-01 5.852E+00 2.020E+00 1.714E+01 5.150E-01 7.134E-01 3.957E+00 1.170E+00 58-CE-138 58-CE-139 58-CE-140 58-CE-141 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.125 FOR CE-140 AND 9.569 FOR CE-141. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
HACKEN, G., ET AL.: USNDC-11, 79 (1974).
CAMARDA, H.S.: PHYS. REV., C18, 1254 (1978).
MUSGROVE, A.R. DE L., ET AL.: AUST. J. PHYS. 32, 213 (1979).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
OHKUBO, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA-FE., VOL.2, P.1623 (1985).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: RHYS. REV., C3, 576 (1971). REFERENCES 10) 11) 11) FOSTER, D.G. JR. AND GLASGUW, D.W.: KHYS. KEV., CS, 570 (1971).
12) ISLAM, E., HUSSAIN, M., AMEEN, N., ET AL.: NUCL. PHYS., A209, 189 (1973).
13) NISHIMURA, K., YAMANOUTI, Y., KIKUCHI, S., ET AL.: EANDC(J) -22, P.22 (1971), NISHIMURA, K. ET AL.: JAERI-M 6883 (1977).
14) PEREY, F.G: PHYS. REV. 131, 745 (1963).
15) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
16) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
17) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 18) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 18) ĠIĹBEŔT, A. AND CAMERON, A.G.W.: CAN. J. PHIS., 43, 1440 (1965).
19) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
20) GRUPPELAAR, H.: ECN-13 (1977).
21) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
22) KUNZ, P.D.: PRIVATE COMMUNICATION.
23) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
24) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
25) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
26) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
27) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
28) TENG DAN, ET AL.: CHINESE J. OF NUCL. PHYS., 7, 307 (1985).
29) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5840 58-CE-141 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.35 KEV. EXPERIMENTAL DATA BY ANUFRIEV ET AL./2/ FOR 6 RESONANCES BELOW 335 EV WERE USED FOR EVALUATION AS DESCRIBED BELOW. RESONANCE ENERGIES, NEUTRON AND RADIATION WIDTHS GIVEN BY ANUFRIEV ET AL. WERE ADOPTED FOR RECOMMENDED VALUES. TOTAL SPIN J WAS DETERMINED WITH A RANDOM NUMBER METHOD. FINALLY, A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL./3/ MF UNRESOLVED RESONANCE REGION : 0.35 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 0.560E-4, S1 = 0.780E-4, S2 = 0.590E-4, SG = 28.4E-4, GG = 0.070 EV, R = 5.211 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 31.47 -ELASTIC 2.349 -CAPTURE 29.12 503 CAPTURE 29.12 503 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WHICH WERE DETERMINED SO AS TO REPRODUCE THE LA-139 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/6/, ISLAM ET AL./7/, NISHIMURA ET AL./8/ AND SO ON WERE ADOPTED BY ASSUMING THAT THE TOTAL CROSS SECTION OF CE WAS SIMILER TO THAT OF LA-139. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IJJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/. /15/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA SHEETS/17/.

| NO. | ENERGY(MEV) | SPIN-PARITY |
|-----|-------------|-------------|
| GR. | 0.0 ` ′ | 7/2 - |
| 1 | 0.6621 | 3/2 - |
| 2 | 1.1370 | 1/2 - |
| 3 | 1.3545 | 9/2 - |
| 4 | 1.3687 | 13/2 + |
| 4 | 1.3687 | 13/2 + |

| 5 1.3780
6 1.4970
7 1.6265
8 1.6933
9 1.7390
10 1.7850
11 1.8087
12 1.8120
13 1.9150
14 1.9420
15 1.9625
16 1.9940
17 2.0440
18 2.1130
19 2.1650
20 2.1660
21 2.1711
22 2.1740
23 2.1890
24 2.1896
25 2.2074
26 2.2090
27 2.2430
28 2.2669
LEVELS ABOVE 2.274 MEV WEF | 9/2 -
5/2 -
3/2 +
11/2 -
7/2 -
1/2 +
3/2 -
5/2 -
11/2 +
15/2 +
11/2 -
11/2 -
5/2 -
11/2 -
3/2 -
9/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
3/2 -
5/2 -
5/2 -
3/2 -
5/2 -
5/2 -
5/2 -
3/2 -
5/2 -
5/2 -
3/2 -
5/2 -
5/2 -
3/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 -
5/2 |
|---|--|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATIS
CASTHY WAS ADOPTED. DIRECT
SECTIONS WERE ESTIMATED ACCC
AND REFF0/18/ AND NORMALIZED | STICAL MODEL CALCULATION WITH
AND SEMI-DIRECT CAPTURE CROSS
ORDING TO THE PROCEDURE OF BENZI
D TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCT
THE SYSTEMATICS OF RADIATION
S-WAVE RESONANCE LEVEL SPACI
LEVEL DENSITY PARAMETERS. | TION (2.80E-03) WAS DETERMINED FROM
N WIDTH (0.07 EV) AND THE AVERAGE
NG (24.9 EV) CALCULATED FROM THE |
| $\begin{array}{llllllllllllllllllllllllllllllllllll$ | ION
NS WERE CALCULATED WITH THE
EP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (=
FORMULA DERIVED FROM KIKUCHI
DENSITY PARAMETERS. | 311.1) WAS ESTIMATED BY THE
I-KAWAI'S FORMALISM/19/ AND LEVEL |
| FINALLY, THE (N,P) AND (N,AL
NORMALIZED TO THE FOLLOWING
(N,P) 4.55 MB (S
(N,ALPHA) 1.99 MB (S | _PHA) CROSS SECTIONS WERE
VALUES AT 14.5 MEV:
SYSTEMATICS OF FORREST/20/)
SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF
LEGENDRE POLYNOMIAL COEFFICIEN
GIVEN IN THE CENTER-OF-MASS SY
TIC LEVELS, AND IN THE LABORAT
CALCULATED WITH CASTHY. FOR C
BUTIONS IN THE LABORATORY SYST | F SECONDARY NEUTRONS
NTS FOR ANGULAR DISTRIBUTIONS ARE
(STEM FOR MT=2 AND DISCRETE INELAS-
FORY SYSTEM FOR MT=91. THEY WERE
DTHER REACTIONS, ISOTROPIC DISTRI-
TEM WERE ASSUMED. |
| MF = 5 ENERGY DISTRIBUTIONS OF
ENERGY DISTRIBUTIONS OF SECOND
PEGASUS FOR INELASTIC SCATTERI
OTHER NEUTRON EMITTING REACTIC | SECONDARY NEUTRONS
DARY NEUTRONS WERE CALCULATED WITH
ING TO OVERLAPPING LEVELS AND FOR
DNS. |
| TABLE 1 NEUTRON OPTICAL POTENTI | AL PARAMETERS |
| V = 41.8 | RO = 6.907 AO = 0.62 |
| WS = 2.95+0.789E
VSO= 7.0 | RS = 7.115 AS = 0.35
RS0= 6.907 AS0= 0.62 |

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING NUCLIDE - - - -1.645E+01 5.640E-01 5.394E-01 4.905E+00 1.580E+00 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 2.022E+01 4.800E-01 5.326E-01 4.629E+00 1.580E+00 1.500E+01 6.930E-01 5.738E-01 7.244E+00 2.340E+00 56-BA-137 56 - BA - 138 56 - BA - 139 56-BA-140 1.450E+01 6.310E-01 7.202E+00 3.634E+00 0.0 1.380E+01 6.500E-01 1.653E+00 4.468E+00 8.500E-01 1.558E+01 5.900E-01 7.912E+00 3.425E+00 0.0 1.894E+01 5.130E-01 3.056E+00 4.024E+00 7.600E-01 57 - LA - 138 57 - LA - 139 57-LA-140 57-LA-141 58-CE-139 58-CE-140 58-CE-141 1.374E+01 6.450E-01 9.282E-01 4.685E+00 1.170E+00 1.413E+01 6.541E-01 3.376E-01 5.852E+00 2.020E+00 1.714E+01 5.150E-01 7.134E-01 3.957E+00 1.170E+00 1.714E+01 5.150E-01 7.134E-01 5.674E+00 1.930E+00 1.600E+01 6.000E-01 4.210E-01 5.674E+00 1.930E+00 58-CE-142 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 9.569 FOR CE-141 AND 3.236 FOR CE-142. REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
ANUFRIEV, B.A. ET AL.: 80KIEV 2, P.136 (1980)
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: RHYS. REV., C3, 576 (1971). (1971).
7) ISLAM, E., HUSSAIN, M., AMEEN, N., ET AL.: NUCL. PHYS., A209, 189 (1973).
8) NISHIMURA, K. YAMANOUTI, Y., KIKUCHI, S., ET AL.: EANDC(J) -22, P.22 (1971), NISHIMURA, K. ET AL.: JAERI-M 6883 (1977).
9) PEREY, F.G: PHYS. REV. 131, 745 (1963).
10) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
11) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
12) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). (1971). 7) ISLAM, E. 1ŏŚ (11)(12)W. HAEBERLI), P. 682, THE UNIVERSITE OF WISCONSTRUCTION (1971) 13) GLEBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERON, A.G.W., GAN. S. THIOL, 40, 1406 (1965).
14) I JIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
17) NUCLEAR DATA SHEETS, 45, 1 (1985).
18) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
20) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 5843 58-CE-142 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-SEP93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-09 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MODIFIED PARTS FOR JENDL-3.2
(2,151)
UNRESOLVED RESONANCE PARAMETERS RE-ADJUSTED
SO AS TO REPRODUCE THE RE-NORMALIZED CAPTURE
CROSS SECTION.
(3,102)
RE-NORMALIZATION.
(3,2), (3,4), (3,51-91) AND ANGULAR DISTRIBUTIONS
SMALL EFFECTS OF THE RE-NORMALIZATION OF
CAPTURE CROSS SECTION. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 26 KEV RESONANCE PARAMETERS FOR JENDL-3 WERE EVALUATED BY TAKING INTO ACCOUNT THE EXPERIMENTAL DATA BY OHKUBO ET AL./3/ IN WHICH REDUCED NEUTRON WIDTHS WERE GIVEN IN THE ENERGY RANGE FROM 1.277 TO 54.9 KEV. THE UPPER BOUNDARY OF RESOLVED RESONANCE REGION WAS DETERMINED TO BE 26 KEV AS A RESULT OF STAIR-CASE PLOTTING. AVERAGE RADIATION WIDTH OF 0.08 EV WAS ESTIMATED FROM FIG. 9 IN REF./4/ AND THE SYSTEMATICS CURVE BY BENZI AND REFFO/5/. SCATTERING RADIUS OF 5.9 FM WAS ADOPTED FROM THE COMPILATION BY MUGHABGHAB ET AL./4/ NEUTRON ORBITAL ANGULAR MOMENTUM L OF SOME RESONANCES WAS ESTIMATED WITH A METHOD OF BOLLINGER AND THOMAS/6/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 0.95+-0.05 BARN RECOMMENDED BY MUGHABGHAB ET AL.. UNRESOLVED RESONANCE REGION : 26 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.200E-4, S1 = 0.700E-4, S2 = 0.600E-4, SG = 0.233E-4, GG = 0.070 EV, R = 4.537 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 1.618 ELASTIC 0.6145 TOTAL ELASTIC CAPTURE 1.004 0.933 CAPTURE 1.004 0.933 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WHICH WERE DETERMINED SO AS TO REPRODUCE THE LA-139 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/9/. ISLAM ET AL./10/. NISHIMURA ET AL./11/ AND SO ON WERE ADOPTED BY ASSUMING THAT THE TOTAL CROSS SECTION OF CE WAS SIMILER TO THAT OF LA-139. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IJJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/.

| | <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> | |
|----|---|-----------|
| | MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). | |
| | <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/.</pre> | |
| | NO. ENERGY(MEV) SPIN-PARITY DWBA CAL.
GR. 0.0 0 + *
1 0.6412 2 + *
2 1.2193 4 +
3 1.5361 2 + *
4 1.6526 3 - *
5 2.0042 2 + 6
6 2.0300 0 +
7 2.1870 1 +
8 2.3640 1 +
9 2.3980 1 +
LEVELS ABOVE 2.5 MEV WERE ASSUMED TO BE OVERLAPPING. | |
| | FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE
DWUCK-4 CODE/20/. DEFORMATION PARAMETERS (BETA2 = 0.1236 AN
BETA3 = 0.132) WERE BASED ON THE DATA COMPILED BY RAMAN ET
AL./21/ AND SPEAR/22/, RESPECTIVELY. | ۱D |
| | <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/5/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| | THE GAMMA-RAY STRENGTH FUNCTION (2.06E-05) WAS DETERMINED SC
TO REPRODUCE THE CAPTURE CROSS SECTION OF 19+-4 MB AT 25 KEV
MEASURED BY R.P. ANAND ET AL./23/ |) A
/ |
| | <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS</pre> | S. |
| | THE KALBACH'S CONSTANT K (= 100.0) WAS DETERMINED TO REPRODU
ENERGY DEPENDENCE OF THE (N,2N) CROSS SECTION MEASURED BY
TENG DAN ET AL./24/. | JCE |
| | FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 4.80 MB (RECOMMENDED BY FORREST/25/)
(N,ALPHA) 3.00 MB (RECOMMENDED BY FORREST)
THE (N,2N) CROSS SECTION WAS MODIFIED BY EYE-GUIDING OF THE
DATA MEASURED BY TENG DAN ET AL./24/ THE (N,3N) CROSS SECTI
WAS DETERMINED BY SUBTRACTING THE (N,2N) CROSS SECTION FROM
THE SUM OF (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED WITH
PEGASUS. | ION |
| | MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF | F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELA
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC
SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS,
ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | -
\S- |
| MF | F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WIT
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND F | ΓH
FOR |
OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) R0 = 6.923TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.390E+01 7.200E-01 4.123E-01 7.233E+00 2.430E+00 2.022E+01 4.800E-01 5.326E-01 4.629E+00 1.580E+00 1.500E+01 6.930E-01 5.738E-01 7.244E+00 2.340E+00 1.600E+01 7.010E-01 3.318E+00 7.141E+00 1.580E+00 56-BA-138 56-BA-139 56-BA-140 56-BA-141 1.380E+01 6.500E-01 1.653E+00 4.468E+00 8.500E-01 1.558E+01 5.900E-01 7.912E+00 3.425E+00 0.0 1.894E+01 5.130E-01 3.056E+00 4.024E+00 7.600E-01 2.026E+01 4.610E-01 1.125E+01 2.749E+00 0.0 57-LA-139 57 - LA - 140 57 - LA - 141 57 - LA - 142 1.413E+01 6.541E-01 3.376E-01 5.852E+00 2.020E+00 1.714E+01 5.150E-01 7.134E-01 3.957E+00 1.170E+00 1.600E+01 6.000E-01 4.210E-01 5.674E+00 1.930E+00 1.900E+01 5.500E-01 2.613E+00 5.094E+00 1.170E+00 58-CE-140 58-CE-141 58-CE-142 58-CE-143 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 3.236 FOR CE-142 AND 5.0 FOR CE-143. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
OHKUBO, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA-FE., VOL.2, P.1623 (1985).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
BOLLINGER, L.M. AND THOMAS, G.E.: PHYS. REV., 171,1293(1968).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: RHYS. REV., C3, 576 (1971). 9) FOSTER, D.G. JR. AND GLASGUW, D.W.: KHITS. KEV., 03, 370 (1971).
10) ISLAM, E., HUSSAIN, M., AMEEN, N., ET AL.: NUCL. PHYS., A209, 189 (1973).
11) NISHIMURA, K., YAMANOUTI, Y., KIKUCHI, S., ET AL.: EANDC(J) -22, P.22 (1971), NISHIMURA, K. ET AL.: JAERI-M 6883 (1977).
12) PEREY, F.G. PHYS. REV. 131, 745 (1963).
13) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
14) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
15) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHIS., 43, 1440 (1965).
17) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
18) GRUPPELAAR, H.: ECN-13 (1977).
19) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
20) KUNZ, P.D.: PRIVATE COMMUNICATION.
21) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
22) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989)
23) ANAND, R.P. ET AL.: NUOVO CIMENTO, A50, 274 (1979).
EXFOR 30390014.
24) TENG DAN, ET AL.: CHINESE J. OF NUCL. PHYS., 7, 307 (1985)
25) FORREST, R.A.: AERE-R 12419 (1986). 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 55 (1989).

MAT number = 5849 58-CE-144 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 NO RESOLVED RESONANCE PARAMETERS
 NO EXPERIMENTAL DATA WERE AVAILABLE. MF UNRESOLVED RESONANCE REGION : 50 EV - 100 KEV THE LOWER BOUNDARY OF 50 EV WAS DETERMINED SO THAT THE CAPTURE RESONANCE INTEGRAL MIGHT AGREE WITH THE RECOMMENDED DATA IN REF./3/. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 0.700E-4, S1 = 0.700E-4, S2 = 0.700E-4, SG = 0.308E-4, GG = 0.060 EV, R = 4.880 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 3.780 -ELASTIC 2.780 -2.55 TOTAL ELASTIC CAPTURE 1.000 2.55 F = 3 NEUTRON CROSS SECTIONS BELOW 50 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. TH CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 4.7 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 50 EV TO 100 KEV. MF = 3THE ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WHICH WERE DETERMINED SO AS TO REPRODUCE THE LA-139 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/6/, ISLAM ET AL./7/, NISHIMURA ET AL./8/ AND SO ON WERE ADOPTED BY ASSUMING THAT THE TOTAL CROSS SECTION OF CE WAS SIMILER TO THAT OF LA-139. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND 1GO/10/ MODEL PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (15) /15/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). МΤ " = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. MT = 4SPIN-PARITY ΝΟ. ENERGY(MEV)

T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = THE GAMMA-RAY STRENGTH FUNCTION (2.80E-05) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.06 EV) AND AVERAGE S-WAVE RESONANCE LEVEL SPACING (2150 EV). T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T = 33 (N,N'T) CROSS SECTION T = 103 (N,P) CROSS SECTION T = 104 (N,D) CROSS SECTION T = 105 (N,T) CROSS SECTION T = 107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = MT = 17MT = 22MT = 28 MT = 32 MT = 33MT = 103ŇТ MT MT THE KALBACH'S CONSTANT K (= 100.0) WAS ASSUMED TO BE THE SAME AS THAT OF CE-142. FINALLY, THE (N,P) CROSS SECTION WAS NORMALIZED TO THE FOLLOWING VALUE AT 14.5 MEV: (N,P) 1.98 MB (SYSTEMATICS OF FORREST/18/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - -- - - - - - - - - - - -- - - - - - -----TABLE 2 LEVEL DENSITY PARAMETERS C(1/MEV) EX(MEV) PAIRING NUCLIDE SYST A(1/MEV) T(MEV) 1.500E+01 6.930E-01 5.738E-01 7.244E+00 2.340E+00 1.600E+01 7.010E-01 3.318E+00 7.141E+00 1.580E+00 2.045E+01 5.484E-01 4.211E-01 6.848E+00 2.500E+00 2.216E+01 5.459E-01 4.559E+00 6.410E+00 1.580E+00 56-BA-140 56-BA-141 56-BA-142 * * 56-BA-143 1.894E+01 5.130E-01 3.056E+00 4.024E+00 7.600E-01 2.026E+01 4.610E-01 1.125E+01 2.749E+00 0.0 * 2.059E+01 5.459E-01 7.647E+00 5.265E+00 9.200E-01 1.843E+01 4.930E-01 8.672E+00 2.805E+00 0.0 57-LA-141 57 - LA - 142 57 - LA - 143 57-LA-144 1.600E+01 6.000E-01 4.210E-01 5.674E+00 1.930E+00 1.900E+01 5.500E-01 2.613E+00 5.094E+00 1.170E+00 1.700E+01 6.000E-01 5.074E-01 6.214E+00 2.090E+00 2.100E+01 5.500E-01 6.213E+00 5.723E+00 1.170E+00 58-CE-142 58-CE-143 58-CE-144 58-ČĒ-145 - - - - - - - -SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.0 FOR CE-144 AND 5.0 FOR CE-145. REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).

- KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 FOSTER, D.G. JR. AND GLASGOW, D.W.: RHYS. REV., C3, 576 (1971).

- 6) FOSTER, D.G. JR. AND GLASGOW, D.W. MILLOR MELL, C., L., (1971).
 7) ISLAM, E., HUSSAIN, M., AMEEN, N., ET AL.: NUCL. PHYS., A209, 189 (1973).
 8) NISHIMURA, K., YAMANOUTI, Y., KIKUCHI, S., ET AL.: EANDC(J) -22, P.22 (1971), NISHIMURA, K. ET AL.: JAERI-M 6883 (1977).
 9) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 10) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 11) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 12) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 9) 10) 11) 12)
- (1971) 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

MAT number = 5925 59-PR-141 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 13.226KEV) RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2/3/ AND SLIGHTLY MODIFIED. IN THE EVALUATION FOR JENDL-2, NEUTRON WIDTHS WERE EVALUATED ON THE BASIS OF WYNCHANK ET AL./4/, MORGENSTERN ET AL./5/ AND TAYLOR ET AL./6/ RADIATION WIDTHS WERE DETERMINED FROM CAPTURE AREAS MEASURED BY TAYLOR ET AL. FOR THE LEVELS WHOSE CAPTURE ARIA WAS ONLY THE EXISTING DATA, THEIR NEUTRON WIDTHS WERE DEDUCED BY ASSUMING THE AVERAGE RADIATION WIDTH OF 0.084+-0.024 EV. SCATTERING RADIUS OF 4.9 FM WAS ADOPTED FROM MUGHABGHAB ET AT./7/ FOR JENDL-3, PARAMETERS OF A NEGATIVE RESONANCE WERE MODIFIED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 11.5+-0.3 BARNS AT 0.0253 EV/7/ AND THE TOTAL CROSS SECTION MEASURED BY ZIMMERMAN ET AL./8/ AND HICKMAN/9/. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. FOR JENDL-3.2, THESE RESONANCE PARAMETERS WERE MODIFIED SO AS TO REPRODUCE THE CAPTURE ADATA MEASURED AT ORNL, BY TAKING ACCOUNT OF THE CORRECTION FACTOR OF 1.0737 ANNOUNCED BY ALLEN ET AL./10/. MF = 2UNRESOLVED RESONANCE REGION : 13.226 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL., AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/11/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.500E-4, S1 = 1.200E-4, S2 = 1.500E-4, SG = 6.06E-4, GG = 0.086 EV, R = 5.181 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 14.040 ELASTIC 2.540 TOTAL ELASTIC CAPTURE 11.500 18.4 CAPIURE 11.500 18.4 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/12/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM MOLDAUER/13/ SINCE THE PARAMETERS REPRODUCED WELL THE TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/14/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/15/ ALPHA = HUIZENGA AND IGO/16/ DEUTERON = LOHR AND HAEBERLI/177/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/18/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/19/ WERE EVALUATED BY IJJIMA ET AL./20/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /21/. /21/.

| <pre>MT = 1 TOTAL
BELOW 5 MEV, SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.
ABOVE 5 MEV, EYE-GUIDING WAS MADE ON THE BASIS OF THE DATA
MEASURED BY FOSTER AND GLASGOW/14/.</pre> |
|--|
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./22/.</pre> |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 5/2 +
1 0.1454 7/2 +
2 1.1180 11/2 -
3 1.1270 3/2 +
4 1.2927 5/2 +
5 1.2986 1/2 +
6 1.4350 3/2 +
7 1.4502 7/2 +
8 1.4561 5/2 -
LEVELS ABOVE 1.48 MEV WERE ASSUMED TO BE OVERLAPPING. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (6.38E-04) WAS ADJUSTED TO THE
CAPTURE CROSS SECTION OF 110 MILLI-BARNS AT 30 KEV MEASURED BY
MUSGROVE ET AL./24/ THE RESULTS WERE MODIFIED BY MULTIPLING
WITH AN ENERGY DEPENDENT FACTOR TO REPRODUCE WELL THE EXPERI-
MENTAL DATA SUCH AS THOSE MEASURED BY ZAIKIN ET AL./25/ AND
STUPEGIA ET AL./26/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 314.1) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/27/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 9.50 MB (RECOMMENDED BY FORREST/28/)
(N,ALPHA) 3.00 MB (RECOMMENDED BY FORREST)
THE (N,2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF
THE DATA MEASURED BY BORMANN ET AL./29/. |
| THE (N,ALPHA) CROSS SECTION BELOW 13.225 KEV WAS CALCULATED
FROM RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF
1.15E-8 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/7/.
THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS.
ABOVE 13.225 KEV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO
THE PEGASUS CALCULATION. |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) DIFFUSENESS(FM) |
|---|--|
| V = 46.0 | R0 = 6.638 A0 = 0.62 |
| WS = 7.0 | RS = 6.638 AS = 1.0 |
| VSO= 7.0 | RS0= 6.638 AS0= 0.62 |
| THE FORM OF SURFACE ABSORPTI | ION PART IS GAUSSIAN TYPE. |
| TABLE 2 LEVEL DENSITY PARAMET | FERS |
| NUCLIDE SYST A(1/MEV) T(MEV | /) C(1/MEV) EX(MEV) PAIRING |
| 57-LA-137 1.558E+01 6.210 | DE-01 3.521E+00 4.624E+00 7.000E-01 |
| 57-LA-139 1.380E+01 6.500 57-LA-140 1.558E+01 5.900 | DE-01 1.653E+00 4.468E+00 8.500E-01
DE-01 7.912E+00 3.425E+00 0.0 |
| 58-CE-138 * 1.618E+01 5.580 58-CE-139 1.374E+01 6.450 58-CE-140 1.413E+01 6.541 58-CE-141 1.714E+01 5.150 | DE-01 2.611E-01 5.011E+00 1.870E+00
DE-01 9.282E-01 4.685E+00 1.170E+00
IE-01 3.376E-01 5.852E+00 2.020E+00
DE-01 7.134E-01 3.957E+00 1.170E+00 |
| 59-PR-139 * 1.630E+01 5.556 | SE-01 2.158E+00 3.843E+00 7.000E-01 |
| 59-PR-140 1.448E+01 6.430 | DE-01 7.927E+00 3.814E+00 0.0 |
| 59-PR-141 1.400E+01 6.500 | JE-01 1.810E+00 4.559E+00 8.500E-01 |
| 59-PR-142 1.595E+01 6.150 | DE-01 1.201E+01 3.974E+00 0.0 |
| SYST: * = LDP'S WERE DETERN | AINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE O | CALCULATED AS 0.146*SQRT(A)*A**(2/3). |
| IN THE CASTHY CALCULATION, SF | PIN CUTOFF FACTORS AT 0 MEV WERE |
| ASSUMED TO BE 5.937 FOR PR-14 | 41 AND 5.267 FOR PR-142. |
| REFERENCES | CONE ON NUCLEAR DATA FOR BASIC |
| 2) KAWAI, M. ET AL.: J. NUCL. | A FE., VOL. 2, P.1627 (1985).
. SCI. TECHNOL., 29, 195 (1992). |
| 3) KIKUCHI, Y. ET AL.: JAERI- | M 86-030 (1986). |
| 4) WYNCHANK, S., ET AL.: PHYS | S. REV., 166, 1234 (1968). |
| 5) MORGENSIERN, J. EI AL.: N | NUCL. PHYS., A123, 561 (1969). |
| 6) TAYLOR, R.B., ET AL.: AUST | F. J. PHYS., 32, 551 (1979). |
| 7) MUCHARCHAR S E ET AL.: | 'NEUTRON CRÓSS SECTIONS VOL I |
| PART A", ACADEMIC PRESS (1 | 1981). |
| 8) ZIMMERMAN R FT AL | NUCL PHYS A95 683 (1967) |
| 9) HICKMAN, G.D.: BULL. AM. F | YYS. SOC., 10, 12 (AD3) (1965). |
| 10) ALLEN, B.J. ET AL.: NUCL. | SCI. ENG., 82, 230 (1982). |
| 11) IGARASI, S. AND FUKAHORI, | T.: JAERI 1321 (1991). |
| 12) IIJIMA, S. ET AL.: JAERI-N | 187-025, P. 337 (1987). |
| 14) FOSTER, D.G. JR. AND GLASC
(1971) | GOW, D.W.: PHYS. REV., C3, 576 |
| 15) PEREY, F.G. PHYS. REV. 131 | I, 745 (1963). |
| 16) HUIZENGA, J.R. AND IGO. G. | .: NUCL, PHYS, 29, 462 (1962). |
| 17) LOHR, J.M. AND HAEBERLI, V | V.: NUCL. PHYS. A232, 381 (1974). |
| 18) BECCHETTI, F.D., JR. AND G | GREENLEES, G.W.: POLARIZATION |
| PHENOMENA IN NUCLEAR REACT | FIONS ((EDS) H.H. BARSHALL AND |
| W. HAEBERLI), P. 682, THE | UNIVERSITY OF WISCONSIN PRESS. |
| 19) GILBERT, A. AND CAMERON, A | A.G.W.: CAN. J. PHYS., 43, 1446 |
| 20) IJJIMA, S., ET AL.: J. NUC
21) GRUPPELAAR H.: ECN-13 (19 | CL. SCI. TECHNOL. 21, 10 (1984). |
| 22) MATSUMOTO, J., ET AL.: JAE | ÉRÍ-M 7734 (1978). |
| 23) BENZI, V. AND REFFO, G.: C | CCDN-NW/10 (1969). |
| 24) MUSGROVE, A.R. DE L., ET A | AL.: "PROC. INT. CONF. ON NEUTRON |
| PHYSICS AND NUCL DATA FOR | R REACTORS, HARWELL 1978", 449. |
| 25) ZAIKIN, G.G., EI AL.: UKRA
(1971). DATA WERE TAKEN F | AINSKIJ FIZICHNIJ ZHURNAL, 16, 1205
FROM EXFOR 40255.
NUCL ENERG 22, 267 (1068) |
| 27) KIKUCHI, K. AND KAWAI, M.: | : "NUCLEAR MATTER AND NUCLEAR |
| REACTIONS" NORTH HOLIAND | (1968) |
| 28) FORREST, R.A.: AERE-R 1241 | 19 (1986). |
| 29) BORMANN, M., ET AL.: NUCL. | . PHYS., A115, 309 (1968). |

MAT number = 5931 59-PR-143 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS NO_RESOLVED RESONANCE PARAMETERS BECAUSE NO EXPERIMENTAL DATA MF WERE AVAILABLE. UNRESOLVED RESONANCE REGION : 4 EV - 100 KEV THE LOWER BOUNDARY OF 4 EV WAS DETERMINED SO AS TO REPRODUCE WELL THE CAPTURE RESONANCE INTEGRAL OF 190+-25 BARNS/2/. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.300E-4, S1 = 1.100E-4, S2 = 1.700E-4, SG = 5.98E-4, GG = 0.065 EV, R = 4.479 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 92.90 ELASTIC 2.900 TOTAL ELASTIC CAPTURE 90 00 185 F = 3 NEUTRON CROSS SECTIONS BELOW 4 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./2/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 4.8 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 4 EV TO 100 KEV. MF = 3ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM MOLDAUER/5/ SINCE THE PARAMETERS REPRODUCED WELL THE TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). T = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. ENERGY(MEV) SPIN-PARITY NO. 0.0 0.0574 7/2 + 5/2 + GŘ. 1 0.3506 0.4904 3/2 7/2 2 + 3 + 5/2 +4 0.7219

| 5 0.7401 1/2 -
6 0.9378 3/2 +
7 1.0603 5/2 +
8 1.1604 3/2 +
9 1.3820 3/2 +
10 1.3977 1/2 -
LEVELS ABOVE 1.526 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|----------|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-RAY STRENGTH FUNCTION (6.24E-04) WAS DETERMINED FR
THE SYSTEMATICS OF RADIATION WIDTH (0.065 EV) AND THE AVERAGI
S-WAVE RESONANCE LEVEL SPACING (104 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. | OM
E |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS</pre> | |
| THE KALBACH'S CONSTANT K (= 324.5) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 5.29 MB (SYSTEMATICS OF FORREST/18/)
(N,ALPHA) 2.22 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | S -
- |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | Η |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{cccc} & \text{DEPTH} & (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & \text{V} &= 46.0 & \text{RO} &= 6.666 & \text{AO} &= 0.62 \\ & \text{WS} &= 7.0 & \text{RS} &= 6.666 & \text{AS} &= 1.0 \\ & \text{VSO} &= 7.0 & \text{RSO} &= 6.666 & \text{ASO} &= 0.62 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS GAUSSIAN TYPE.} \end{array}$ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING | |
| 57-LA-1391.380E+016.500E-011.653E+004.468E+008.500E-0157-LA-1401.558E+015.900E-017.912E+003.425E+000.057-LA-1411.894E+015.130E-013.056E+004.024E+007.600E-0157-LA-1422.026E+014.610E-011.125E+012.749E+000.0 | |
| 58-CE-1401.413E+016.541E-013.376E-015.852E+002.020E+0058-CE-1411.714E+015.150E-017.134E-013.957E+001.170E+0058-CE-1421.600E+016.000E-014.210E-015.674E+001.930E+0058-CE-1431.900E+015.500E-012.613E+005.094E+001.170E+00 | |
| 59-PR-1411.400E+016.500E-011.810E+004.559E+008.500E-0159-PR-1421.595E+016.150E-011.201E+013.974E+000.0 | |

| 59-PR-1431.500E+016.280E-012.607E+004.558E+007.600E-0159-PR-1441.600E+016.000E-011.045E+013.744E+000.0 |
|---|
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3)
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 3.050 FOR PR-143 AND 5.0 FOR PR-144. |
| REFERENCES KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENC AND TECHNOLOGY, MITO, P. 569 (1988). MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). MOLDAUER, P. A.: NUCL. PHYS., 47, 65 (1963). FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 |
| (1971). 7) PEREY, F.G: PHYS. REV. 131, 745 (1963). 8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). |
| 11) ĠIĽBĖŔŤ, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). 12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 13) GRUPPELAAR, H.: ECN-13 (1977). 14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). 15) NUCLEAR DATA SHEETS, 48, 753 (1986). 16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). 17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS", NORTH HOLLAND (1968). 18) FORREST R A AFRER 12419 (1986) |

MAT number = 6025 60-ND-142 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ***** (2,151) RESOLVED RESONANCE PARAMETERS MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 26.0 KEV) RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2/3/ AFTER THE FOLLOWING MODIFICATION. EVALUATION FOR JENDL-2 WAS MADE BY MAINLY ON THE BASIS OF THE DATA MEASURED BY TELLIER/4/ AND MUSGROVE ET AL./5/ RESONANCE ENERGIES WERE ADJUSTED TO THOSE OF TELLIER. AVERAGE RADIATION WIDTHS WERE ASSUMED TO BE 0.078 EV FOR S-WAVE AND SOME LARGE P-WAVE RESONANCES AND TO BE 0.046 EV FOR P-WAVE ONES. MF = 2ONES. FOR JENDL-3, PARAMETERS OF A NEGATIVE RESONANCE WAS MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 18.7+-0.7 BARNS/6/ AND THE RESONANCE INTEGRAL. HOWEVER, THE CALCULATED RESONANCE INTEGRAL IS STILL TOO SMALL. FOR JENDL-3.2, THESE RESONANCE PARAMETERS WERE MODIFIED SO AS TO REPRODUCE THE CAPTURE AREA DATA MEASURED AT ORNL, BY TAKING ACCOUNT OF THE CORRECTION FACTOR (0.967) ANNOUNCED BY ALLEN ET AL./7/. THE PARAMETERS OF A NEGATIVE RESONANCE AND SCATTERING RADIUS WERE ADJUSETED TO GET BETTER AGREEMENT WITH RECOMMENDED THERMAL CROSS SECTIONS/8/. ÓNES. FÓR UNRESOLVED RESONANCE REGION : 26 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL./8/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTHS GG(S) AND GG(P) WERE BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.500E-4, S1 = 0.400E-4, S2 = 1.700E-4, SG(S)= 1.24E-4, SG(P)=0.828E-4, GG(S)=0.064 EV, GG(P)= 0.044 EV, R= 5.805 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 26.400 -ELASTIC 7.700 -CAPTURE 18.700 8.68 INTEGRALS (BARNS) F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM THE PARAMETERS DETERMINED BY IIJIMA AND KAWAI/11/ FOR ND-143. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/. MF /18/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/.

| | NO.
G.
2
34
5
6
7
8
0 | ENERGY(MEV)
0.0
1.5757
2.0844
2.1010
2.2090
2.2172
2.3400
2.3846
2.5833
2.8000 | SPIN-PARITY
0 +
2 +
3 -
4 +
6 +
0 +
2 +
1 +
2 +
1 +
2 + | DWBA CAL.
*
* |
|---|--|---|---|---|
| LEVEL | 10
11
S ABOVE 3 | 2.8459
2.9780
.008 MEV WERE | ASSUMED TO BE | OVERLAPPING. |
| FOR THE
INELAST
DWUCK-4
BETA3 =
AL./21/ | LEVELS W
IC SCATTE
CODE/20/
0.109) W
AND SPEA | ITH AN ASTERIS
RING CROSS SEC
. DEFORMATION
ERE BASED ON T
R/22/, RESPECT | SK, THE CONTRI
CTIONS WAS CAL
N PARAMETERS (
THE DATA COMPI
TIVELY. | BUTION OF DIRECT
CULATED BY THE
BETA2 = 0.0926 AND
LED BY RAMAN ET |
| MT = 102
SPHERIC
CASTHY
SECTION
AND REF | CAPTURE
AL OPTICA
WAS ADOPT
S WERE ES
F0/23/ AN | L AND STATIST
ED. DIRECT AN
TIMATED ACCORE
D NORMALIZED T | ICAL MODEL CAL
ND SEMI-DIRECT
DING TO THE PR
TO 1 MILLI-BAR | CULATION WITH
CAPTURE CROSS
OCEDURE OF BENZI
N AT 14 MEV. |
| THE GAM
REPRODU
KEV MEA | MA-RAY ST
CE THE CA
SURED BY | RENGTH FUNCTIO
PTURE CROSS SE
MUSGROVE ET AL | ON (0.969E-4)
ECTION OF 59.0
/5,7/ | WAS ADJUSTED TO
MILLI-BARNS AT 30 |
| MT = 16
MT = 17
MT = 22
MT = 28
MT = 103
MT =104
MT =105
MT =106
MT =106
MT =107
THESE R
PREEQUI | (N,2N) CR
(N,3N) CR
(N,N'A) CC
(N,N'P) CC
(N,P) CRO
(N,D) CRO
(N,D) CRO
(N,T) CRO
(N,HE3) C
(N,4LPHA)
EACTION C
LIBRIUM A | OSS SECTION
OSS SECTION
ROSS SECTION
ROSS SECTION
SS SECTION
SS SECTION
SS SECTION
ROSS SECTION
CROSS SECTION
ROSS SECTIONS
ND MULTI-STEP | N
WERE CALCULAT
EVAPORATION M | ED WITH THE
ODEL CODE PEGASUS. |
| THE KAL
FORMULA
DENSITY | BACH'S CO
DERIVED
PARAMETE | NSTANT K (= 21
FROM KIKUCHI-F
RS. | I3.8) WAS ESTI
(AWAI'S FORMAL | MATED BY THE
ISM/24/ AND LEVEL |
| FINALLY
NORMALI:
(N,P)
(N,AL | , THE (N,
ŻED TO TH
PHA) | P) AND (N,ALPH
E FOLLOWING V/
13.80 MB (REC
6.80 MB (REC | HA) CROSS SECT
ALUES AT 14.5
COMMENDED BY F
COMMENDED BY F | IONS WERE
MEV:
ORREST/25/)
ORREST) |
| MT = 251
CALCULA | MU-BAR
TED WITH | CASTHY. | | |
| MF = 4 ANG
LEGENDRE
GIVEN IN
TIC LEVEL
CALCULATE
SCATTERIN
ISOTROPIC | ULAR DISI
POLYNOMIA
THE CENTE
S, AND IN
D WITH CA
G WAS CAL
DISTRIBU | RIBUIIONS OF S
L COEFFICIENTS
R-OF-MASS SYST
THE LABORATOF
STHY. CONTRIE
CULATED WITH E
TIONS IN THE L | SECONDARY NEUT
S FOR ANGULAR
FOR MT=2 A
RY SYSTEM FOR
BUTION OF DIRE
DWUCK-4. FOR
ABORATORY SYS | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
MT=91. THEY WERE
CT INELASTIC
OTHER REACTIONS,
TEM WERE ASSUMED. |
| MF = 5 ENE
ENERGY DI
PEGASUS F
OTHER NEU | RGY DISTR
STRIBUTIO
OR INELAS
TRON EMIT | IBUTIONS OF SE
NS OF SECONDAP
TIC SCATTERING
TING REACTIONS | CONDARY NEUTR
Y NEUTRONS WE
TO OVERLAPPI | ONS
RE CALCULATED WITH
NG LEVELS AND FOR |
| TABLE 1 NE | UTRON OPT | ICAL POTENTIAL | PARAMETERS | |
| | DEPT | H (MEV) | KAUIUS(FM) | DIFFUSENESS(FM) |

V = 45.76R0 = 6.73A0 = 0.6WS = 6.97RS = 6.417AS = 0.45

VSO= 7.0 RSO= 6.678 ASO= 0.6 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|--|--|--|--|--|--|
| 58 - CE - 138 *
58 - CE - 139
58 - CE - 140
58 - CE - 141 | 1.618E+01
1.374E+01
1.413E+01
1.714E+01 | 5.580E-01
6.450E-01
6.541E-01
5.150E-01 | 2.611E-01
9.282E-01
3.376E-01
7.134E-01 | 5.011E+00
4.685E+00
5.852E+00
3.957E+00 | 1.870E+00
1.170E+00
2.020E+00
1.170E+00 |
| 59 - PR - 139 *
59 - PR - 140
59 - PR - 141
59 - PR - 142 | 1.630E+01
1.448E+01
1.400E+01
1.595E+01 | 5.556E-01
6.430E-01
6.500E-01
6.150E-01 | 2.158E+00
7.927E+00
1.810E+00
1.201E+01 | 3.843E+00
3.814E+00
4.559E+00
3.974E+00 | 7.000E-01
0.0
8.500E-01
0.0 |
| 60-ND-140 *
60-ND-141
60-ND-142
60-ND-143 | 1.641E+01
1.477E+01
1.288E+01
1.826E+01 | 5.532E-01
6.091E-01
6.710E-01
4.710E-01 | 2.596E-01
9.537E-01
2.250E-01
5.220E-01 | 5.024E+00
4.587E+00
5.526E+00
3.613E+00 | 1.880E+00
1.180E+00
2.030E+00
1.180E+00 |
| SYST: * = L | DP'S WERE | DETERMINED | FROM SYSTE | EMATICS. | |
| SPIN CUTOFF P
IN THE CASTHY
ASSUMED TO BE | ARAMETERS
CALCULATI
5.579 FOR | WERE CALCU
ON, SPIN CI
ND-142 ANI | LATED AS 0
JTOFF FACTO
D 7.227 FOF | .146*SQRT(#
DRS AT 0 ME
R ND-143. | A)*A**(2/3).
EV WERE |
| REFERENCES | | | | | |

1)

FERENCES) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL. 29, 195 (1992).) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).) TELLIER, H.: CEA-N-1459 (1971).) MUSGROVE, A.R. DE L., ET AL.: AEEC/E401 (1977).) MUSGROVE, A.R. DE L., ET AL.: AEEC/E401 (1977).) FEDOROVA, A.F., ET AL.: PROC. 3RD ALL-UNION CONF. ON NEUTRON PHYSICS, KIEV 1975, VOL. 1, 169.) ALLEN, B.J., ET AL.: NUCL. SCI. ENG. 82, 230 (1982).) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).) IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).) IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). 2) 3) 4) 5) 6)

8)

9)

10) 11)

12) 13)

IIJIMA, S. AND MARL, M. (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 14)15)

(1971) 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

16) GILBERT, A. AND CAMERUN, A.G.W.. CAN. J. THIO., 10, 111 (1965).
17) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
18) GRUPPELAAR, H.: ECN-13 (1977).
19) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
20) KUNZ, P.D.: PRIVATE COMMUNICATION.
21) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
22) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
23) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
24) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
25) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6028 60-ND-143 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=451 COMMENTS AND DICTIONARY
F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 5 KEV
FOR JENDL-2, RESONANCE ENERGIES WERE ADOPTED FROM
TELLIER/3/, AND THOSE NOT MEASURED BY TELLIER WERE TAKEN FROM
ROHR ET AL./4/ AND MUSGROVE ET AL./5/ AFTER NORMALIZATION TO
TELLIER'S DATA. RADIATION WIDTHS WERE DERIVED FROM CAPTURE
AREAS MEASURED BY ROHR ET AL. BELOW 2 KEV AND MUSGROVE ET AL.
ABOVE 2.5 KEV, FOR THE RESONANCES NOT MEASURED BY TELLIER,
NEUTRON WIDTHS WERE DETERMINED FROM CAPTURE AREAS BY ASSUMING
THE AVERAGE RADIATION WIDTHS OF 0.077 EV FOR S-WAVE RESONANCES
AND 0.085 EV FOR P-WAVE ONES. SCATTERING RADIUS WAS
DETERMINED FROM SYSTEMATICS OF MEASURED VALUES. A NEGATIVE
RESONANCE WAS ADDED AT -6 EV SO AS TO REPRODUCE THE CAPTURE
CROSS SECTION OF 325+-10 BARNS COMPILED BY MUGHABGHAB ET
AL./6/
FOR JENDL-3, TOTAL SPIN J OF SOME RESONANCES WAS ESTIMATED
WITH A RANDOM NUMBER METHOD.
FOR JENDL-3.2, THESE RESONANCE PARAMETERS WERE MODIFIED SO
AS TO REPRODUCE THE CAPTURE AREA DATA MEASURED AT ORNL, BY
TAKING ACCOUNT OF THE CORRECTION FACTOR (0.9507) ANNOUNCED BY
ALLEN ET AL./7/. THE PARAMETERS OF A NEGATIVE RESONANCE AND
SCATTERING RADIUS WERE ADJUSETED TO GET BETTER AGREEMENT WITH
RECOMMENDED THERMAL CROSS SECTIONS/6/.
UNRESOLVED RESONANCE REGION : 5 KEV - 100 KEV MF UNRESOLVED RESONANCE REGION : 5 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETARS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY AT 10 KEV. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.624E-4, S1 = 1.042E-4, S2 = 1.783E-4, SG = 21.4E-4, GG = 0.079 EV, R = 4.143 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) RES. INTEG. 408.2 78.29 TOTAL ELASTIC CAPTURE 329.9 130 0.0174 (N, ALPHA) (N,ALPHA) 0.0174 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS
SECTION BY CHANGING RO OF ILJIMA-KAWAI POTENTIAL/10/. THE OMP'S
FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/11/
 ALPHA = HUIZENGA AND IGO/12/
 DEUTERON = LOHR AND HAEBERLI/13/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/17/. MF = 3/17/.

| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> |
|---|
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/.</pre> |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 7/2 -
1 0.7418 3/2 -
2 1.2296 13/2 +
3 1.3060 1/2 -
4 1.4079 9/2 -
5 1.4320 11/2 +
6 1.5100 1/2 +
7 1.5400 3/2 +
8 1.5600 5/2 -
9 1.6100 1/2 +
10 1.7500 9/2 -
11 1.7670 3/2 +
LEVELS ABOVE 1.8 MEV WERE ASSUMED TO BE OVERLAPPING. |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/19/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (2.15E-03) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 280 MILLI-BARNS AT 30
KEV MEASURED BY NAKAJIMA ET AL./20/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 239.3) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/21/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 11.00 MB (RECOMMENDED BY FORREST/22/)
(N,ALPHA) 4.02 MB (SYSTEMATICS OF FORREST/22/) |
| THE (N,ALPHA) CROSS SECTION BELOW 5 KEV WAS CALCULATED FROM
RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF
3.48E-6 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/6/.
THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS.
ABOVE 5 KEV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO THE
PEGASUS CALCULATION. |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) DIFFUSENESS(FM) |
|--|---|
| V = 45.76
WS = 6.97
VSO= 7.0
THE FORM OF SURFACE ABSOR | R0 = 6.746 A0 = 0.6
RS = 6.432 AS = 0.45
RS0= 6.694 AS0= 0.6
PTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARA | METERS |
| NUCLIDE A(1/MEV) T(| MEV) C(1/MEV) EX(MEV) PAIRING |
| 58-CE-1391.374E+016.58-CE-1401.413E+016.58-CE-1411.714E+015.58-CE-1421.600E+016. | 450E-01 9.282E-01 4.685E+00 1.170E+00
541E-01 3.376E-01 5.852E+00 2.020E+00
150E-01 7.134E-01 3.957E+00 1.170E+00
000E-01 4.210E-01 5.674E+00 1.930E+00 |
| 59-PR-1401.448E+016.59-PR-1411.400E+016.59-PR-1421.595E+016.59-PR-1431.500E+016. | 430E-01 7.927E+00 3.814E+00 0.0
500E-01 1.810E+00 4.559E+00 8.500E-01
150E-01 1.201E+01 3.974E+00 0.0
280E-01 2.607E+00 4.558E+00 7.600E-01 |
| 60-ND-1411.477E+016.60-ND-1421.288E+016.60-ND-1431.826E+014.60-ND-1441.771E+015. | 091E-01 9.537E-01 4.587E+00 1.180E+00
710E-01 2.250E-01 5.526E+00 2.030E+00
710E-01 5.220E-01 3.613E+00 1.180E+00
640E-01 4.792E-01 5.691E+00 1.940E+00 |
| SPIN CUTOFF PARAMETERS WER
IN THE CASTHY CALCULATION,
ASSUMED TO BE 7.227 FOR ND | E CALCULATED AS 0.146*SQRT(A)*A**(2/3).
SPIN CUTOFF FACTORS AT 0 MEV WERE
-143 AND 8.725 FOR ND-144. |
| REFERENCES
1) AOKI, T. ET AL.: PROC.
AND APPLIED SCIENCE, SA
2) KAWAI, M. ET AL.: J. NU
3) TELLIER, H.: CEA-N-1459
4) ROHR, G., ÉT AL.: "PROC
AND TECHNOLOGY, KNOXVIL
5) MUSGROVE, A.R. DE L., E
6) MUGHABGHAB, S.F. ET AL.
PART A", ACADEMIC PRESS
7) ALLEN, B.J., ET AL.: NU
8) IGARASI, S. AND FUKAHOR
9) IJJIMA, S. ET AL.: JAER
10) IJJIMA, S. AND KAWAI, M
(1983).
11) PEREY, F.G: PHYS. REV.
12) HUIZENGA, J.R. AND IGO.
13) LOHR, J.M. AND HAEBERLI
14) BECCHETTI, F.D., JR. AN
PHENOMENA IN NUCLEAR RE.
W. HAEBERLI), P. 682, TI
(1971).
15) GILBERT, A. AND CAMERON
(1965).
16) IJJIMA, S., ET AL.: J. | <pre>INT. CONF. ON NUCLEAR DATA FOR BASIC
NTA FE., VOL. 2, P.1627 (1985).
CL. SCI. TECHNOL., 29, 195 (1992).
(1971).
. 3RD CONF. ON NEUTRON CROSS SECTIONS
LE 1971", VOL. 2, 743.
T AL.: AEEC/E401 (1977).
: "NEUTRON CROSS SECTIONS, VOL. I,
(1981).
CL. SCI. ENG., 82, 230 (1982).
I, T.: JAERI 1321 (1991).
I-M 87-025, P. 337 (1987).
.: J. NUCL. SCI. TECHNOL., 20, 77
131, 745 (1963).
G.: NUCL. PHYS. 29, 462 (1962).
, W.: NUCL. PHYS. A232, 381 (1974).
D GREENLEES, G.W.: POLARIZATION
ACTIONS ((EDS) H.H. BARSHALL AND
HE UNIVERSITY OF WISCONSIN PRESS.
, A.G.W.: CAN. J. PHYS., 43, 1446
NUCL., SCI. TECHNOL. 21, 10 (1984).</pre> |
| 17) GRÜPPELAÄR, H.: ECN-13
18) LEDERER, C.M., ET AL.:
INTERSCIENCE PUBLICATIO
19) BENZI, V. AND REFFO, G.
20) NAKAJIMA, Y., ET AL.: P
NUCL. DATA FOR REACTORS
21) KIKUCHI, K. AND KAWAI,
REACTIONS", NORTH HOLLA
22) FORREST, R.A.: AERE-R 12 | TABLE OF ISOTOPES, 7TH ED.", WILEY-
N (1978).
CCDN-NW/10 (1969).
ROC. INT. CONF. ON NEUTRON PHYSICS AND
HARWELL 1978, 438.
M.: "NUCLEAR MATTER AND NUCLEAR
ND (1968).
2419 (1986). |

MAT number = 6031 60-ND-144 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-0CT93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ***** MODIFIED PARTS FOR JENDL-3.2 ****** (2,151) RESOLVED RESONANCE PARAMETERS * * * * * * * * * * * * * * * * * * * MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 12 KEV) RESONANCE PARAMETERS ADOPTED IN JENDL-3.1 WERE TAKEN FROM JENDL-2/3/: RESONANCE ENERGIES WERE TAKEN FROM TELLIER/4/ AND MUSGROVE ET AL./5/ BY ADJUSTING TO THOSE OF REF./4/. NEUTRON WIDTHS WERE TAKEN FROM REF./4/, AND RADIATION WIDTHS WERE DEDUCED FROM THE CAPTURE AREAS OF MUSGROVE ET AL. FOR THE RESONANCES NOT MEASURED BY TELLIER, NEUTRON WIDTHS WERE ESTIMATED FROM THE CAPTURE AREAS BY ASSUMING THE AVERAGE RADIATION WIDTHS OF 0.047 EV FOR S-WAVE RESONANCES AND OF 0.041 EV FOR P-WAVE ONES. FOR THE LOWEST 2 LEVELS, THE CAPTURE WIDTHS OF KARZHAVINA ET AL./6/ WERE ADOPTED. A NEGATIVE RESONANCE WAS ADDED AT -76 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 3.8+-0.3 BARNS AT 0.0253 EV /7/. FOR JENDL-3.2, THE CAPTURE DATA MEASURED AT ORELA OF ORNL WERE RENORMALIZED (FACTOR = 0.967)/8/. THE NEUTRON WIDTH AND/OR THE RADIATION WIDTH WAS REVISED TO REPRODUCE THE RENORMALIZED CAPTURE AREA FOR EACH RESONANCE ABOVE 2.6 KEV. EFFECTIVE SCATTERING RADIUS RECOMMENDED IN REF./9/ WAS ADOPTED AND PARAMETERS OF THE NAGATIVE LEVEL WERE ADJUSTED TO THERMAL CROSS SECTIONS/9/. UNRESOLVED RESONANCE REGION : 12 KEV = 100 KEV MF = 2UNRESOLVED RESONANCE REGION : 12 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/10/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.928E-4, S1 = 0.688E-4, S2 = 3.543E-4, SG = 0.998E-4, GG = 0.041 EV, R = 7.660 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 4.6036 -ELASTIC 1.0007 -CAPTURE 3.6030 4.30 INTEGRALS (BARNS) F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/11/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WEF DETERMINED BY IIJIMA AND KAWAI/12/ TO REPRODUCE A SYSTEMATIC TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/17/ WERE EVALUATED BY IIJIMA ET AL./18/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPEL/ /19/. MF WERE USED NCE OF SPIN CUT-OFF IS DUE TO GRUPPELAAR /19/. MT = 1

T = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

* = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./20/. MT

| NO. | ENERGY(ME | V) | SPIN-P/ | ARITY | DWBA CAL. |
|--------------|------------------|------|------------|-------|-------------|
| 1
1 | 0.6965 | | 2 + | | * |
| 2
3 | 1.3147
1.5106 | | 4 +
3 - | | * |
| 4 | 1.5610 | | 2 + | | |
| LEVELS ABOVE | 1.817 MEV | WERE | ASSUMED | TO BE | OVERLAPPING |

FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/21/. DEFORMATION PARAMETER (BETA2 = 0.1309) WAS BASED ON THE DATA COMPILED BY RAMAN ET AL./22/ AND BETA3 = 0.143 WAS PRESENTLY DETERMINED.

MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/23/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (9.12E-05) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 70 MILLI-BARNS AT 30 KEV MEASURED BY MUSGROVE ET AL./24/ AND BY KONONOV ET AL. /25/

| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 103 (N,P') CROSS SECTION
MT =103 (N,P') CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE
PEGASUS.</pre> | |
|---|---|
| THE KALBACH'S CONSTANT K (= 25.0) WAS DETERMINED TO REPRODUC
ENERGY DEPENDENCE OF THE (N,2N) CROSS SECTION MEASURED BY
FREHAUT ET AL./26/. | E |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 12.00 MB (RECOMMENDED BY FORREST/27/)
(N,ALPHA) 5.40 MB (AVERAGE OF DATA MEASURED BY
GMUCA+/28/ AND QAIM/29/. | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS | |

MF F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) | |
|-------------|------------|-----------------|--|
| V = 47.94 | R0 = 6.718 | A0 = 0.6 | |
| WS = 9.13 | RS = 7.564 | AS = 0.45 | |
| VSO= 7.0 | RS0= 6.771 | AS0= 0.6 | |

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) A(1/MEV) T(MEV) NUCLIDE PAIRING - - - -- - - - - -1.413E+01 6.541E-01 3.376E-01 5.852E+00 2.020E+00 1.714E+01 5.150E-01 7.134E-01 3.957E+00 1.170E+00 1.600E+01 6.000E-01 4.210E-01 5.674E+00 1.930E+00 1.900E+01 5.500E-01 2.613E+00 5.094E+00 1.170E+00 58-CE-140 58 - CE - 141 58 - CE - 142 58 - CE - 143 1.400E+01 6.500E-01 1.810E+00 4.559E+00 8.500E-01 1.595E+01 6.150E-01 1.201E+01 3.974E+00 0.0 1.500E+01 6.280E-01 2.607E+00 4.558E+00 7.600E-01 1.600E+01 6.000E-01 1.045E+01 3.744E+00 0.0 59 - PR - 141 59 - PR - 142 59 - PR - 143 59-PR-144 1.288E+01 6.710E-01 2.250E-01 5.526E+00 2.030E+00 1.826E+01 4.710E-01 5.220E-01 3.613E+00 1.180E+00 1.771E+01 5.640E-01 4.792E-01 5.691E+00 1.940E+00 2.054E+01 5.120E-01 2.465E+00 4.869E+00 1.180E+00 60-ND-142 60-ND-143 60-ND-144 60-ND-145 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.725 FOR ND-144 AND 6.875 FOR ND-145. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
TELLIER, H.: CEA-N-1459 (1971).
MUSGROVE, A.R. DE L., ET AL.: AEEC/E401 (1977).
KARZHAVINA, E.N., ET AL.: SOV. J. NUCL. PHYS., 8, 371 (1969).
FEDOROVA, A.F., ET AL.: "PROC. 3RD ALL-UNION CONF. ON NEUTRON PHYSICS, KIEV 1975", VOL. 1, 169.
ALLEN, B.J. ET AL.: NUCL. SCI. ENG., 82, 230 (1982).
MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. 1, PART A", ACADEMIC PRESS (1981).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G. PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 13) 14) 15) 16) (1971). 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 17) GIBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1440 (1965).
18) IJJMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
19) GRUPPELAAR, H.: ECN-13 (1977).
20) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
21) KUNZ, P.D.: PRIVATE COMMUNICATION.
22) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
23) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
24) MUSGROVE, A.R. DE L., ET AL.: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 449.
25) KONONOV, V.N., ET AL.: SOV. J. NUCL. PHYS., 27, 5 (1978).
26) FREHAUT, J., ET AL.: SYMP. ON NEUTRON CROSS SECTIONS FROM 10-50MEV, BNL, P.399 (1980).
27) FORREST, R.A.: AERE-R 12419 (1986).
28) GUMCA, S., ET AL.: ACTA PHYS. SOLVOCA, 33, 9 (1983).
29) QAIM, S.M.: RADIOCHIMICA ACTA., 35, 9 (1984).

MAT number = 6034 60-ND-145 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV94 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-10 JENDL-3.2 WAS MADE BY JNDC FPND W.G. 94-11 UPPER BOUNDARY OF THE RESOLVED RESONANCE REGION CHANGED FROM 5.10069 KEV TO 4.0 KEV * * * * * * * * * * * * * * * * * * * MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MI=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 4 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2/3/ WITH MODIFICATION OF TOTAL SPIN J. FOR JENDL-2, RESONANCE ENERGIES WERE TAKEN FROM TELLIER /4/, AND AFTER CALIBRATION, DATA OF ROHR ET AL./5/ AND MUSGROVE ET AL./6/ WERE ADOPTED FOR THE LEVELS NOT MEASURED BY TELLIER. NEUTRON WIDTHS WERE ADOPTED FROM TELLIER, AND RADIA-TION WIDTHS WERE OBTAINED FROM THE CAPTURE AREAS MEASURED BY ROHR ET AL. AND MUSGROVE ET AL. THE AVERAGE RADIATION WIDTH OF 0.087 EV WAS ASSUMED FOR THE RESONANCES WHOSE CAPTURE AREA WAS NOT MEASURED, AND TO ESTIMATE NEUTRON WIDTHS FROM THE CAPTURE AREAS FOR THE RESONANCES NOT MEASURED BY TELLIER. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND TOTAL CROSS SECTIONS GIVEN BY MUGHABGHAB ET AL./7/ FOR JENDL-3. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVE-LY ESTIMATED WITH A RANDOM NUMBER METHOD. FOR JENDL-3.2, THE CAPTURE DATA MEASURED AT ORELA OF ORNL WERE RENORMALIZED (FACTOR = 0.9507)/8/. THE NEUTRON WIDTH AND/OR THE RADIATION WIDTH WAS REVISED TO REPRODUCE THE RENORMALIZED CAPTURE AREA FOR EACH RESONANCE ABOVE 2.592 KEV. MF = 2UNRESOLVED RESONANCE REGION : 4 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.927E-4, S1 = 0.685E-4, S2 = 3.510E-4, SG = 54.7E-4, GG = 0.0975EV, R = 7.683 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S R TOTAL 64.065 ELASTIC 20.222 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE 43.843 8.855E-05 204 2.03E-3 (N, ALPHA) (N,ALPHA) 8.855E-05 2.03E-3 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/11/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/12/
 ALPHA = HUIZENGA AND IGO/13/
 DEUTERON = LOHR AND HAEBERLI/14/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/18/. MF = 3/18/.

| <pre>MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.</pre> | |
|---|---|
| <pre>MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).</pre> | |
| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/.</pre> | |
| NO. ENERGY(MEV) SPIN-PARITY
GR. 0.0 7/2 -
1 0.0671 3/2 -
2 0.0722 5/2 -
3 0.5066 3/2 -
4 0.6570 11/2 -
5 0.7490 9/2 -
6 0.7804 3/2 -
7 0.8407 3/2 -
9 0.9371 5/2 -
10 1.0112 11/2 -
11 1.0514 7/2 -
12 1.0852 3/2 +
13 1.1503 9/2 -
14 1.1610 5/2 -
15 1.1620 9/2 -
16 1.2500 5/2 -
LEVELS ABOVE 1.3 MEV WERE ASSUMED TO BE OVERLAPPING. | |
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (5.58E-03) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 510 MILLI-BARNS AT 30
KEV MEASURED BY NAKAJIMA ET AL./21/ | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'T) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 168.3) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 7.50 MB (RECOMMENDED BY FORREST/23/)
(N,ALPHA) 2.47 MB (SYSTEMATICS OF FORREST/23/) | |
| THE (N,ALPHA) CROSS SECTION BELOW 4 KEV WAS CALCULATED FROM
RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF
1.50E-7 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/7/.
THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS.
ABOVE 4 KEV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO THE
PEGASUS CALCULATION. | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY/9/. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | - |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH</pre> | |

PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) |
|--|
| V = 47.94
WS = 9.13
VSO= 7.0
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 58-CE-1411.714E+015.150E-017.134E-013.957E+001.170E+0058-CE-1421.600E+016.000E-014.210E-015.674E+001.930E+0058-CE-1431.900E+015.500E-012.613E+005.094E+001.170E+0058-CE-1441.700E+016.000E-015.074E-016.214E+002.090E+00 |
| 59-PR-1421.595E+016.150E-011.201E+013.974E+000.059-PR-1431.500E+016.280E-012.607E+004.558E+007.600E-0159-PR-1441.600E+016.000E-011.045E+013.744E+000.059-PR-145*2.088E+015.411E-017.911E+005.258E+009.200E-01 |
| 60-ND-1431.826E+014.710E-015.220E-013.613E+001.180E+0060-ND-1441.771E+015.640E-014.792E-015.691E+001.940E+0060-ND-1452.054E+015.120E-012.465E+004.869E+001.180E+0060-ND-1462.019E+015.660E-011.121E+006.714E+002.100E+00 |
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.875 FOR ND-145 AND 6.125 FOR ND-146. |
| REFERENCES AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986). TELLIER, H.: CEA-N-1459 (1971). ROHR, G., ET AL.: "PROC. 3RD CONF. ON NEUTRON CROSS SECTIONS |
| AND TECHNOLOGY, A.R. DE L., ET AL.: AEEC/E401 (1977). MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984). |
| 8) ALLEN, B.J. ET AL.: NUCL. SCI. ENG., 82, 230 (1982).
9) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
10) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
11) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 |
| 12) PEREY, F.G: PHYS. REV. 131, 745 (1963). 13) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 14) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 15) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. |
| 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 |
| 17) IJJMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
18) GRUPPELAAR, H.: ECN-13 (1977).
19) LEDERER C.M. ET AL.: "TABLE OF ISOTOPES 7TH ED." WILEY- |
| 20) BENZI, V. AND REFFO. G.: CCDN-NW/10 (1969). |
| 21) NAKAJÍMA, Y., ET ALÍ: PROC. INT. CONF. ON NEUTRON PHYSICS AND NUCL. DATA FOR REACTORS, HARWELL 1978, 438. |
| 22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MÁTTÉR AND NUCLEAR
REACTIONS", NORTH HOLLAND (1968). |
| 23) FORREST, R.A.: AERE-R 12419 (1986). |

MAT number = 6037 60-ND-146 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 10 KEV) RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2/3/. RESONANCE ENERGIES WERE TAKEN FROM TELLIER/4/ AND MUSGROVE ET AL./5/ NEUTRON WIDTHS WERE ADOPTED FROM TELLIER, AND RADIATION WIDTHS WERE DEDUCED FROM CAPTURE AREAS MEASURED BY MUSGROVE ET AL. THE AVERAGE RADIATION WIDTHS WERE ASSUMED TO BE 0.051 EV FOR S-WAVE RESONANCES AND 0.040 EV FOR P-WAVE ONES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 1.4+-0.1 BARNS AT 0.0253 EV/6/. MF UNRESOLVED RESONANCE REGION : 10 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.927E-4, S1 = 0.682E-4, S2 = 3.479E-4, SG = 2.13E-4, GG = 0.051 EV, R = 7.701 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 10.90 -ELASTIC 9.496 - 0.01 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 2.91 1.399 CAPTURE 1.399 2.91 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/9/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/10/
 ALPHA = HUIZENGA AND IGO/11/
 DEUTERON = LOHR AND HAEBERLI/12/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. MF /16/. MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. ΜТ NO. SPIN-PARITY ENERGY(MEV) DWBA CAL. GŔ. 0.0 0.4538 02 + * + 1.0434 ż 4 + 34 1.1896 3 1 2 5 1.3728 1.4714 5 + 6 7 1.5384 3 +

| LEVE | 8 1.6
9 1.7
ELS ABOVE 1.777 | 870
510
MEV WERE AS | 0 +
4 +
SUMED TO BE | OVERLAPPING. |
|---|--|--|--|--|
| FOR TH
INELAS
DWUCK-
BETA3
AL./19 | HE LEVELS WITH
STIC SCATTERING
-4 CODE/18/. D
= 0.139) WERE
9/ AND SPEAR/20 | AN ASTERISK,
CROSS SECTI
EFORMATION P
BASED ON THE
/, RESPECTIV | THE CONTRIE
ONS WAS CALC
ARAMETERS (E
DATA COMPIL
ELY. | BUTION OF DIRECT
SULATED BY THE
SETA2 = 0.1524 AND
ED BY RAMAN ET |
| MT = 102
SPHER
CASTHY
SECTIC
AND RE | 2 CAPTURE
ICAL OPTICAL AN
Y WAS ADOPTED.
DNS WERE ESTIMA
EFF0/21/ AND NO | D STATISTICA
DIRECT AND
TED ACCORDIN
RMALIZED TO | L MODEL CALC
SEMI-DIRECT
G TO THE PRC
1 MILLI-BARN | CULATION WITH
CAPTURE CROSS
CEDURE OF BENZI
AT 14 MEV. |
| THE GA
REPROI
KEV ME | AMMA-RAY STRENG
DUCE THE CAPTUR
EASURED BY NAKA | TH FUNCTION
E CROSS SECT
JIMA ET AL./ | (1.92E-04) W
ION OF 114 M
22/ | AS ADJUSTED TO
IILLI-BARNS AT 30 |
| MT = 16
MT = 17
MT = 22
MT = 28
MT = 32
MT = 33
MT =103
MT =104
MT =105
MT =107
THESE
PREEQU | (N,2N) CROSS
(N,3N) CROSS
(N,N'A) CROSS
(N,N'P) CROSS
(N,N'D) CROSS
(N,P) CROSS
(N,P) CROSS S
(N,D) CROSS S
(N,D) CROSS S
(N,T) CROSS S
(N,ALPHA) CRO
REACTION CROSS
JILIBRIUM AND M | SECTION
SECTION
SECTION
SECTION
SECTION
ECTION
ECTION
ECTION
SS SECTION
SECTIONS WE
ULTI-STEP EV | RE CALCULATE
APORATION MC | D WITH THE
Del code pegasus. |
| THE KA
ENERGN
FREHAL | ALBACH'S CONSTA
Y DEPENDENCE OF
JT ET AL./23/ | NT K (= 12.
THE (N,2N) | 5) WAS DETER
CROSS SECTIO | MINED TO REPRODUCE
N MEASURED BY |
| FINALL
NORMAL
(N,F
(N,F | _Y, THE (N,P) A
_IZED TO THE FO
>) 4.5
ALPHA) 3.1 | ND (N,ALPHA)
LLOWING VALU
O MB (RECOM
O MB (RECOM | CROSS SECTI
ES AT 14.5 M
MENDED BY FC
MENDED BY FC | ONS WERE
IEV:
DRREST/24/)
DRREST) |
| MT = 251
CALCUI | 1 MU-BAR
_ATED WITH CAST | ΉΥ. | | |
| MF = 4 AN
LEGENDRE
GIVEN IN
TIC LEVE
CALCULAT
SCATTER
ISOTROP | NGULAR DISTRIBU
E POLYNOMIAL CO
N THE CENTER-OF
ELS, AND IN THE
FED WITH CASTHY
ING WAS CALCULA
IC DISTRIBUTION | TIONS OF SEC
EFFICIENTS F
-MASS SYSTEM
LABORATORY
. CONTRIBUT
TED WITH DWU
S IN THE LAB | ONDARY NEUTR
OR ANGULAR D
FOR MT=2 AN
SYSTEM FOR N
ION OF DIREC
CK-4. FOR C
ORATORY SYST | CONS
ISTRIBUTIONS ARE
D DISCRETE INELAS-
IT=91. THEY WERE
T INELASTIC
THER REACTIONS,
EM WERE ASSUMED. |
| MF = 5 EN
ENERGY D
PEGASUS
OTHER NE | NERGY DISTRIBUT
DISTRIBUTIONS O
FOR INELASTIC
EUTRON EMITTING | IONS OF SECO
F SECONDARY
SCATTERING T
REACTIONS. | NDARY NEUTRO
NEUTRONS WER
O OVERLAPPIN | NS
RE CALCULATED WITH
IG LEVELS AND FOR |
| TABLE 1 N | NEUTRON OPTICAL | POTENTIAL P | ARAMETERS | |
| V
WS
VS
THE FORM | = 47.94
S = 9.13
SO= 7.0
M OF SURFACE AB | RO
RS
SORPTION PAR | = 6.718
= 7.564
O= 6.771
T IS DER. WC | A0 = 0.6
AS = 0.45
AS0= 0.6
ODS-SAXON TYPE. |
| TABLE 2 L | LEVEL DENSITY P | ARAMETERS | | |
| NUCLIDE
58-CE-142 | 2 1.600E+01 | 6.000E-01 4 | (1/MEV) EX(
.210E-01 5.6 | MEV) PATRING
074E+00 1.930E+00 |
| 58 - CE - 143
58 - CE - 144
58 - CE - 145 | 3 1.900E+01
4 1.700E+01
5 2.100E+01 | 5.500E-01 2
6.000E-01 5
5.500E-01 6 | .613E+00 5.0
.074E-01 6.2
.213E+00 5.7 | 094E+00 1.170E+00
14E+00 2.090E+00
23E+00 1.170E+00 |
| 59 - PR - 143
59 - PR - 144
59 - PR - 144
59 - PR - 144
59 - PR - 144 | 3 1.500E+01
4 1.600E+01
5 * 2.088E+01
6 * 2.263E+01 | 6.280E-01 2
6.000E-01 1
5.411E-01 7
5.387E-01 8 | .607E+00 4.5
.045E+01 3.7
.911E+00 5.2
.918E+01 4.8 | 58E+00 7.600E-01
44E+00 0.0
58E+00 9.200E-01
15E+00 0.0 |
| 60-ND-144 | 4 1.771E+01 | 5.640E-01 4 | .792E-01 5.6 | 91E+00 1.940E+00 |

| 60
60
60 | - ND - 145
- ND - 146
- ND - 147 | 2.054E+01
2.019E+01
2.398E+01 | 5.120E-0
5.660E-0
4.850E-0 | 1 2.465E+(
1 1.121E+(
1 5.510E+(| 00 4.869E+00
00 6.714E+00
00 5.235E+00 | 0 1.180E+00
0 2.100E+00
0 1.180E+00 |
|---------------------------------|--|---|---|---|---|--|
| S | YST: * = L | DP'S WERE [| DETERMINE | D FROM SYS | STEMATICS. | |
| SP
IN
ASS | IN CUTOFF P
THE CASTHY
SUMED TO BE | ARAMETERS V
CALCULATIO
6.125 FOR | NERE CALC
DN, SPIN
ND-146 A | ULATED AS
CUTOFF FAG
ND 4.041 I | 0.146*SQRT
CTORS AT 0 M
FOR ND-147. | (A)*A**(2/3).
MEV WERE |
| REFI
1)
2)
3)
4) | ERENCES
AOKI, T. E
AND APPLIE
KAWAI, M.
AND TECHNO
KIKUCHI, Y
TELLIER, H | T AL.: PRO
D SCIENCE,
ET AL.: PRO
LOGY, MITO
. ET AL.: .
.: CEA-N-14 | C. INT. C
SANTA FE
DC. INT.
, P. 569
JAERI-M 8
459_(1971 | ONF. ON NI
., VOL. 2
CONF. ON I
(1988).
6-030 (198
) | UCLEAR DATA
, P.1627 (19
NUCLEAR DAT/
86). | FOR BASIC
985).
A FOR SCIENCE |
| 5)
6) | FEDOROVA, | A.R. DE L.
A.F., ET AI | , ET AL.:
L.: "PROC | . 3RD ALL | -UNION CONF | . ON NEUTRON |
| 7)
8)
9) | IGARASI, S
IIJIMA, S.
IIJIMA, S.
(1983) | IEV 1975",
.: J. NUCL
ET AL.: J/
AND KAWAI | VOL. 1,
SCI. †E
AERI-M 87
, M.: J. | 169.
CHNOL., 12
-025, P. 3
NUCL. SCI | 2, 67 (1975)
337 (1987).
. TECHNOL., |).
20, 77 |
| 10)
11)
12)
13) | PÉREY, F.G
HUIZENGA,
LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERL | : PHYS. REV
J.R. AND IO
AND HAEBEF
F.D., JR.
IN NUCLEAR
I), P. 682 | V. 131, 7
GO, G.: N
RLI, W.:
AND GREE
REACTION
, THE UNI | 45 (1963)
UCL. PHYS
NUCL. PHYS
NLEES, G.V
S ((EDS) H
VERSITY O | . 29, 462 (7
S. A232, 387
W.: POLARIZ/
H.H. BARSHAI
F WISCONSIN | 1962).
1 (1974).
ATION
LL AND
PRESS. |
| 14) | GILBERT, A | . AND CAME | RON, A.G. | W.: CAN | J. PHYS., 43 | 3, 1446 |
| 15)
16)
17)
18)
19) | (1965).
IIJIMA, S.
GRUPPELAAR
MATSUMOTO,
KUNZ, P.D.
RAMAN, S.,
(1987) | , ET AL.: ,
, H.: ECN-
J.: PRIVA
: PRIVATE (
ET AL.: A | J. NUCL.
13 (1977)
TE COMMUN
COMMUNICA
TOM. DATA | SCI. TECHI
ICATION (*
TION.
AND NUCL | NOL. 21, 10
1981).
. DATA TABLE | (1984).
ES 36, 1 |
| 20)
21)
22) | SPEAR, R.H
BENZI, V.
NAKAJIMA,
NUCL. DATA | .: ATOM. D/
AND REFFO,
Y., ET AL.
FOR_REACTO | ATA AND N
G.: CCDN
: PROC. I
DRS, HARW | UCL. DATA
-NW/10 (19
NT. CONF.
ELL 1978, | TABLE, 42,
969).
ON NEUTRON
438. | 55 (1989).
PHYSICS AND |
| 23) | FREHAUL, J
10-50MEV,
FORREST R | ., EI AL.:
BNL, P.399
A.: AFRF-F | SYMP. ON
(1980).
R 12419 (| 1986). | URUSS SECII | JNS FRUM |
| - ·) | | | | | | |

MAT number = 6040 60-ND-147 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 36 EV RESONANCE ENERGIES WERE BASED ON THE DATA OF 2*G*GAMMA(N) AND THE TOTAL SPIN J WHICH WAS ASSUMED TO BE 3 FOR ALL THE RESONANCES. AVERAGE RADIATION WIDTH WAS ASSUMED TO BE 0.075 EV/2/. THE SCATTERING RADIUS WAS TAKEN FROM THE SYSTEMATICS SHOWN IN REF./2/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB ET AL./2/ MF UNRESOLVED RESONANCE REGION : 0.036 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB ET AL. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.900E-4, S1 = 0.680E-4, S2 = 3.400E-4, SG = 159.E-4, GG = 0.075 EV, R = 7.717 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 510.3 79.28 TOTAL ELASTIC CAPTURE 431.0 631 CAPTURE 431.0 631 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/5/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/6/
 ALPHA = HUIZENGA AND IGO/7/
 DEUTERON = LOHR AND HAEBERLI/8/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/9/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/10/ WERE EVALUATED BY IIJIMA ET AL./11/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/12/. MF /12/. MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2STRUCTURE DATA FILE (1987 VERSION)/13/ AND NUCLEAR DATA SHEETS/14/. ΜТ NO. ENERGY(MEV) SPIN-PARITY 0.0 5/2 -7/2 -5/2 -GŔ. 1 0.1279 0.1903 0.2146 0.3147 9/2 1/2 3 --4 3/25

| 6 0.4636 3/2 -
7 0.5167 5/2 -
8 0.5750 7/2 -
9 0.6045 1/2 -
10 0.6315 3/2 -
11 0.7693 3/2 +
12 0.7926 3/2 -
LEVELS ABOVE 0.809 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|---|----------|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (1.50E-02) WAS DETERMINED FRO
THE RADIATION WIDTH (0.075 EV) AND AVERAGE S-WAVE RESONANCE
LEVEL SPACING (5+-2 EV) /2/. |)// |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS</pre> | |
| THE KALBACH'S CONSTANT K (= 109.9) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/16/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 3.59 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 1.54 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | 3 -
- |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | 4 |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING | |
| 58-CE-1431.900E+015.500E-012.613E+005.094E+001.170E+0058-CE-1441.700E+016.000E-015.074E-016.214E+002.090E+0058-CE-1452.100E+015.500E-016.213E+005.723E+001.170E+0058-CE-1461.918E+016.037E-011.355E+007.176E+002.160E+00 | |
| 59-PR-1441.600E+016.000E-011.045E+013.744E+000.059-PR-145*2.088E+015.411E-017.911E+005.258E+009.200E-0159-PR-146*2.263E+015.387E-018.918E+014.815E+000.059-PR-1472.440E+014.420E-013.742E+004.298E+009.900E-01 | |
| 60-ND-1452.054E+015.120E-012.465E+004.869E+001.180E+0060-ND-1462.019E+015.660E-011.121E+006.714E+002.100E+00 | |

2.398E+01 4.850E-01 5.510E+00 5.235E+00 1.180E+00 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 60-ND-147 60-ND-148 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.041 FOR ND-147 AND 4.791 FOR ND-148. REFERENCES (EFERENCES)
1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
2) MUGHABGHAB, S.F. ET AL.: "NEUTRON CROSS SECTIONS, VOL. I, PART A", ACADEMIC PRESS (1981).
3) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
4) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
5) IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). IIJIMA, S. AND NAMAL, W. C. M. (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 6) 8) 9) (1971). 10) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

10) GILBERI, A. AND CAMERON, A.G.M. C.M. C.M. (1965).
11) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
12) GRUPPELAAR, H.: ECN-13 (1977).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
14) NUCLEAR DATA SHEETS, 25, 113 (1978).
15) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
16) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
17) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6043 60-ND-148 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 8.0 KEV) RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2/3/. RESONANCE ENERGIES WERE TAKEN FROM TELLIER/4/ AND MUSGROVE ET AL./5/ NEUTRON WIDTHS WERE ADOPTED FROM TELLIER, AND RADIATION WIDTHS WERE DEDUCED FROM CAPTURE AREAS MEASURED BY MUSGROVE ET AL. THE AVERAGE RADIATION WIDTHS WERE ASSUMED TO BE 0.046 EV FOR S-WAVE RESONANCES AND 0.040 EV FOR P-WAVE ONES. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 2.5+-0.2 BARNS AT 0.0253 EV/6/. MF UNRESOLVED RESONANCE REGION : 8 KEV - 100 KEV UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2. THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.927E-4, S1 = 0.676E-4, S2 = 3.417E-4, SG = 2.16E-4, GG = 0.041 EV, R = 7.703 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 10TAL 6.997 TOTAL ELASTIC CAPTURE 4.505 2.493 14.7 CAPTURE 2.493 14.7 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/9/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/10/
 ALPHA = HUIZENGA AND IGO/11/
 DEUTERON = LOHR AND HAEBERLI/12/
 HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. MF /16/. MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. ΜТ NO. SPIN-PARITY ENERGY(MEV) DWBA CAL. 0.0 0.3020 0.7510 0.9110 GŔ. 02 + * + ż 4 3 4 0 3 + 0.9970 1 2 2 5 1.0200 6 7 1.1690 + 1.2410 +

| LEVE | 8 1.6
9 1.7
LS ABOVE 1.8 M | 830
240
EV WERE ASSUN | 4 +
3 -
MED TO BE OVI | ERLAPPING. |
|---|---|---|---|--|
| FOR TH
INELAS
DWUCK-
BETA3
AL./19 | E LEVELS WITH
TIC SCATTERING
4 CODE/18/. D
= 0.098) WERE
/ AND SPEAR/20 | AN ASTERISK
CROSS SECTIO
EFORMATION P
BASED ON THE
/, RESPECTIVE | THE CONTRIB
DNS WAS CALCI
ARAMETERS (BI
DATA COMPILI
ELY. | JTION OF DIRECT
JLATED BY THE
ETA2 = 0.2036 AND
ED BY RAMAN ET |
| MT = 102
SPHERI
CASTHY
SECTIO
AND RE | CAPTURE
CAL OPTICAL AN
WAS ADOPTED.
NS WERE ESTIMA
FF0/21/ AND NO | D STATISTICAL
DIRECT AND S
TED ACCORDING
RMALIZED TO | _ MODEL CALCI
SEMI-DIRECT (
G TO THE PRO
1 MILLI-BARN | ULATION WITH
CAPTURE CROSS
CEDURE OF BENZI
AT 14 MEV. |
| THE GA
REPROD
KEV ME | MMA-RAY STRENG
UCE THE CAPTUR
ASURED BY CRIC | TH FUNCTION
E CROSS SECT
CHIO ET AL./2 | (1.94E-4) WAS
ION OF 100 M
22/ | S ADJUSTED TO
ILLI-BARNS AT 50 |
| MT = 16
MT = 17
MT = 22
MT = 28
MT = 32
MT = 33
MT =103
MT =103
MT =105
MT =107
THESE
PREEQU | (N,2N) CROSS
(N,3N) CROSS
(N,N'A) CROSS
(N,N'P) CROSS
(N,N'D) CROSS
(N,N'T) CROSS
(N,P) CROSS
(N,P) CROSS
(N,D) CROSS S
(N,D) CROSS S
(N,ALPHA) CRO
REACTION CROSS
ILIBRIUM AND M | SECTION
SECTION
SECTION
SECTION
SECTION
ECTION
ECTION
ECTION
SS SECTION
SECTIONS WEF
ULTI-STEP EV | RE CALCULATE | D WITH THE
Del code pegasus. |
| THE KA
ENERGY
FREHAU | LBACH'S CONSTA
DEPENDENCE OF
T ET AL./23/. | NT K (= 10.0
THE (N,2N) (|)) WAS DETERI
CROSS SECTIO | MINED TO REPRODUCE
N MEASURED BY |
| FINALL
NORMAL
(N,P
(N,A | Y, THE (N,P) A
IZED TO THE FO
) 2.7
LPHA) 2.4 | ND (N,ALPHA)
LLOWING VALUE
5 MB (SYSTEM
0 MB (RECOMM | CROSS SECTIO
ES AT 14.5 MI
MATICS OF FOI
MENDED BY FOI | DNS WERE
EV:
RREST/24/)
RREST/24/) |
| MT = 251
CALCUL | MU-BAR
ATED WITH CAST | HY. | | |
| MF = 4 AN
LEGENDRE
GIVEN IN
TIC LEVE
CALCULAT
SCATTERI
ISOTROPI | GULAR DISTRIBU
POLYNOMIAL CO
THE CENTER-OF
LS, AND IN THE
ED WITH CASTHY
NG WAS CALCULA
C DISTRIBUTION | TIONS OF SECO
EFFICIENTS FO
-MASS SYSTEM
LABORATORY S
. CONTRIBUT
TED WITH DWUO
S IN THE LABO | DNDARY NEUTRO
DR ANGULAR D
FOR MT=2 ANI
SYSTEM FOR M
ION OF DIREC
CK-4. FOR O
DRATORY SYSTI | ONS
ISTRIBUTIONS ARE
D DISCRETE INELAS-
T=91. THEY WERE
T INELASTIC
THER REACTIONS,
EM WERE ASSUMED. |
| MF = 5 EN
ENERGY D
PEGASUS
OTHER NE | ERGY DISTRIBUT
ISTRIBUTIONS O
FOR INELASTIC
UTRON EMITTING | IONS OF SECON
F SECONDARY N
SCATTERING TO
REACTIONS. | NDARY NEUTROI
NEUTRONS WERI
D OVERLAPPING | NS
E CALCULATED WITH
G LEVELS AND FOR |
| TABLE 1 N | EUTRON OPTICAL | POTENTIAL PA | ARAMETERS | |
| -
V
WS
VS
THE FORM | = 47.94
= 9.13
0= 7.0
OF SURFACE AB | EV) RAI
RO
RS
SORPTION PAR | = 6.718
= 7.564
D= 6.771
T IS DER. WO | AO = 0.6
AS = 0.45
ASO = 0.6
DDS - SAXON TYPE. |
| TABLE 2 L | EVEL DENSITY P | ARAMETERS | | |
| 58-CE-144 | 1.700E+01 | 6.000E-01 5 | (1/MEV) EX(1
.074E-01 6.2 | 14E+00 2.090E+00 |
| 58 - CE - 145
58 - CE - 146
58 - CE - 147 | 2.100E+01
1.918E+01
* 2.514E+01 | 5.500E-01 6
6.037E-01 1
5.363E-01 2 | .213E+00 5.72
.355E+00 7.1
.925E+01 6.6 | 23E+00 1.170E+00
76E+00 2.160E+00
72E+00 1.170E+00 |
| 59 - PR - 145
59 - PR - 146
59 - PR - 147
59 - PR - 148 | * 2.088E+01
* 2.263E+01
2.440E+01
1.996E+01 | 5.411E-01 7
5.387E-01 8
4.420E-01 3
4.690E-01 1 | .911E+00 5.23
.918E+01 4.8
.742E+00 4.29
.108E+01 2.8 | 58E+00 9.200E-01
15E+00 0.0
98E+00 9.900E-01
07E+00 0.0 |
| 60-ND-146 | 2.019E+01 | 5.660E-01 1 | .121E+00 6.7 | 14E+00 2.100E+00 |

| 60 -
60 -
60 - | ND - 147
ND - 148
ND - 149 | 2.398E+01
2.359E+01
2.657E+01 | 4 . 850E -
5 . 150E -
4 . 750E - | 01 5.510
01 1.328
01 1.192 | DE+00 5.
BE+00 6.
2E+01 5. | 235E+00 1
751E+00 2
636E+00 1 | . 180E+00
. 170E+00
. 180E+00 |
|---------------------------------|---|--|---|---|--|---|-------------------------------------|
| SY | ST: * = L | DP'S WERE | DETERMIN | NED FROM | SYSTEMA | TICS. | |
| SPI
IN
ASS | N CUTOFF PA
THE CASTHY
UMED TO BE | ARAMETERS
CALCULATI
4.791 FOR | WERE CAL
ON, SPIN
ND-148 | CULATED
V CUTOFF
AND 5.0 | AS 0.14
FACTORS
FOR ND- | 6*SQRT(A)
AT 0 MEV
149. | *A**(2/3).
WERE |
| REFE
1)
2)
3)
4) | RENCES
AOKI, T. E
AND APPLIE
KAWAI, M.
AND TECHNO
KIKUCHI, Y
TELLIER. H | T AL.: PRO
D SCIENCE,
ET AL.: PR
LOGY, MITO
. ET AL.:
. : CEA-N-1 | C. INT.
SANTA F
OC. INT.
, P. 569
JAERI-M
459 (197 | CONF. 01
FE., VOL
CONF. (
9 (1988)
86-030 | N NUCLEA
2, P.1
DN NUCLE
(1986). | R DATA FO
627 (1985
AR DATA F | R BASIC
OR SCIENCE |
| 5) | MUSGROVÉ,
FEDOROVA, | A.R. DE L.
A.F., ET A | , ĔT`AL.
L.: "PRC | ÉÁEEC/I | E401 (19
ALL-UNIO | 77).
N CÓNF. O | N NEUTRON |
| 7)
8)
9) | PHYSICS, K
IGARASI, S
IIJIMA, S.
IIJIMA, S.
(1983) | IEV 1975",
.: J. NUCL
ET AL.: J
AND KAWAI | VOL. 1,
SCI. T
AERI-M 8
, M.: J. | 169.
ECHNOL.
37-025, F
NUCL. S | , 12, 67
5. 337 (
SCI. TEC | (1975).
1987).
HNOL., 20 | , 77 |
| 10)
11)
12)
13) | ÞÉREY, F.G
HUIZENGA, LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERL | : PHYS. RE
J.R. AND I
AND HAEBE
F.D., JR.
IN NUCLEAR
I), P. 682 | V. 131,
GO, G.:
RLI, W.:
AND GRE
REACTIC
, THE UN | 745 (196
NUCL. PI
NUCL. F
ENLEES,
NS ((EDS
NVERSIT | 63).
HYS. 29,
PHYS. A2
G.W.: P
S) H.H.
Y OF WIS | 462 (196
32, 381 (
OLARIZATI
BARSHALL
CONSIN PR | 2).
1974).
ON
AND
ESS. |
| 14) | GILBERT, A | . AND CAME | RON, A.G | G.W.: CAN | N. J. PH | YS., 43, | 1446 |
| 15)
16)
17)
18)
19) | (1905).
IIJIMA, S.
GRUPPELAAR
MATSUMOTO,
KUNZ, P.D.
RAMAN, S., | , ET AL.:
, H.: ECN-
J.: PRIVA
: PRIVATE
ET AL.: A | J. NUCL.
13 (1977
TE COMMU
COMMUNIC
TOM. DAT | SCI. TH
INICATION
CATION.
TA AND NU | ECHNOL.
N (1981)
JCL. DAT. | 21, 10 (1
A TABLES | 984).
36, 1 |
| 20)
21)
22) | SPEAR, R.H
BENZI, V.
CRICCHIO, A
SCIENCE AND | .: ATOM. D
AND REFFO,
A., ET AL.
D TECHNOLO | ATA AND
G.: CCC
: PROC.
GY, ANTW | NUCL. D/
DN-NW/10
INT. CON
VERP 1982 | ATA TABL
(1969).
NF. NUCL
2, P.175 | E, 42, 55
EAR DATA
(1982). | (1989).
FOR |
| 23) | FREHAUT, J
10-50MEV, J | ., ET AL.:
BNL, P.399 | SYMP. C
(1980). | N NEUTR | ON CROSS | SECTIÓNS | FROM |
| 24) | FURKESI, R | .A.: AERE- | к 12419 | (1986). | | | |

| MAT number = 6049
60-ND-150 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G.
DIST-SEP90 REV2-0CT93 |
|--|
| HISTORY
84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/
90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. |
| 93-10 MODIFICATION FOR JENDL-3.2 WAS MADE.
CONTRIBUTION OF THE DIRECT INELASTIC SCATTERING WAS
REPLACED BY A COUPLED-CHANNEL CALCULATION. |
| **** MODIFIED PARTS FOR JENDL-3.2 ************************************ |
| (4,51), (4,52), (4,54), (4,56), (4,58)
************************************ |
| <pre>MF = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY</pre> |
| <pre>MF = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 13.69 KEV)
RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2/3/.
NEUTRON WIDTHS WERE ADOPTED FROM TELLIER/4/. RADIATION
WIDTHS WERE TAKEN FROM THE RECOMMENDATION BY MAGHABGHAB AND
GARBER/5/. THE AVERAGE RADIATION WIDTH OF 0.070 EV WAS ASSUMED
FOR LEVELS WHICH HAD NO MEASURED RADIATION WIDTH. A NEGATIVE
RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS</pre> |
| SECTION OF 1.2+-0.2 BARNS AT 0.0253 EV /6/.
UNRESOLVED RESONANCE REGION : 13.69 KEV - 100 KEV |
| UNRESOLVED RESONANCE PARAMETERS WERE ADOPTED FROM JENDL-2.
THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED
WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING
WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION
CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS
OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT
100 KEV. |
| TYPICAL VALUES OF THE PARAMETERS AT 70 KEV:
S0 = 2.600E-4, S1 = 0.667E-4, S2 = 3.500E-4, SG = 3.39E-4,
GG = 0.037 EV, R = 7.993 FM. |
| CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS)
2200 M/S RES. INTEG. |
| TOTAL 5.982 -
ELASTIC 4.780 -
CAPTURE 1.202 15.9 |
| <pre>MF = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED BY IIJIMA AND KAWAI/9/ TO REPRODUCE A SYSTEMATIC
TREND OF THE TOTAL CROSS SECTION. THE OMP'S FOR CHARGED
PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/10/
ALPHA = HULZENGA AND IGO/11/</pre> |
| |
| DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/. |
| DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/.
MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. |
| DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/.
MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.
MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). |
| DEUTERON = LOHR AND HAEBERLI/12/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/16/.
MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.
MT = 2 ELASTIC SCATTERING
CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).
MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. |

| GR.
1
2
3
4
5
6
7
8 | 0.0
0.1301
0.3815
0.6767
0.7212
0.8514
0.9300
1.0624
1.1307 | 0 +
2 +
4 +
0 +
2 +
3 -
2 +
8 + | *
*
* |
|---|--|---|---|
| 9
10
LEVELS ABOV | 1.1386
1.3535
'E 1.45 MEV WERE | 4 +
4 +
ASSUMED TO BE | OVERLAPPING. |
| FOR THE LEVEL
INELASTIC SCA
ECIS-88 CODE/
BETA3 = 0.070
AL./19/ AND S
ROTATIONAL BA
BAND (135
IMAGINARY SUR | S WITH AN ASTERI
TTERING CROSS SE
18/. DEFORMATIO
) WERE BASED ON
PEAR/20/, RESPEC
ND (0+,2+,4+,6+,
5-) WAS CONSIDERE
FACE STRENGTH WA | SK. THE CONTR
CTIONS WAS CA
N PARAMETERS
THE DATA COMP
TIVELY. THE
8+,10+) AND C
D. IN THE CC
S REDUVED TO | LIBUTION OF DIRECT
LCULATED BY THE
(BETA2 = 0.2848 AND
TILED BY RAMAN ET
COUPLING OF G.S.
CTUPOLE VIBRATIONAL
CALCULATION, THE
7.35 MEV. |
| MT = 102 CAPTU
SPHERICAL OPT
CASTHY WAS AD
SECTIONS WERE
AND REFF0/21/ | RE
ICAL AND STATIST
OPTED. DIRECT A
ESTIMATED ACCOR
AND NORMALIZED | ICAL MODEL CA
ND SEMI-DIREC
DING TO THE F
TO 1 MILLI-BA | LCULATION WITH
T CAPTURE CROSS
ROCEDURE OF BENZI
RN AT 14 MEV. |
| THE GAMMA-RAY
REPRODUCE THE
KEV MEASURED | STRENGTH FUNCTI
CAPTURE CROSS S
BY KONONOV ET AL | ON (3.01E-04)
ECTION OF 153
/22/ | WAS ADJUSTED TO
B MILLI-BARNS AT 30 |
| MT = 16 (N,2N)
MT = 17 (N,3N)
MT = 22 (N,N'A
MT = 28 (N,N'P)
MT = 32 (N,N'T)
MT = 103 (N,P)
MT =104 (N,D)
MT =105 (N,T)
MT =107 (N,ALP)
THESE REACTIO
PREEQUILIBRIU | CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
CROSS SECTION
M AND MULTI-STEP | N
3 WERE CALCULA
2 EVAPORATION | TED WITH THE
MODEL CODE PEGASUS. |
| THE KALBACH'S
ENERGY DEPEND
FREHAUT ET AL | CONSTANT K (=
ENCE OF THE (N,2 | 10.0) WAS DET
N) CROSS SECT | ERMINED TO REPRODUCE
ION MEASURED BY |
| FINALLY, THE
FOLLOWING VAL
(N,P)
THE (N,2N) CR
THE DATA MEAS | (N,P) CROSS SECT
.UE AT 14.5 MEV:
1.61 MB (SY
OSS SECTION WAS
SURED BY FREHAUT | TION WAS NORMA
STEMATICS OF
DETERMINED BY
ET AL./23/ | LIZED TO THE
FORREST/24/)
′EYE-GUIDING OF |
| MT = 251 MU-BA
CALCULATED WI | R
TH CASTHY. | | |
| MF = 4 ANGULAR D
LEGENDRE POLYNC
GIVEN IN THE CE
TIC LEVELS, AND
CALCULATED WITH
SCATTERING WAS
ISOTROPIC DISTR | ISTRIBUTIONS OF
MIAL COEFFICIENT
NTER-OF-MASS SYS
O IN THE LABORATO
CASTHY. CONTRI
CALCULATED WITH
IBUTIONS IN THE | SECONDARY NEL
S FOR ANGULAR
TEM FOR MT=2
RY SYSTEM FOR
BUTION OF DIR
ECIS-88. FOR
LABORATORY SY | ITRONS
CONSTRIBUTIONS ARE
AND DISCRETE INELAS-
MT=91. THEY WERE
ECT INELASTIC
COTHER REACTIONS,
STEM WERE ASSUMED. |
| MF = 5 ENERGY DI
ENERGY DISTRIBU
PEGASUS FOR INE
OTHER NEUTRON E | STRIBUTIONS OF S
TIONS OF SECONDA
LASTIC SCATTERIN
MITTING REACTION | ECONDARY NEUT
RY NEUTRONS W
IG TO OVERLAPF
IS. | RONS
/ERE CALCULATED WITH
/ING LEVELS AND FOR |
| TABLE 1 NEUTRON | OPTICAL POTENTIA | L PARAMETERS | |
| D
V = 47.9
WS = 9.13
VSO= 7.0
THE FORM OF SUR | EPTH (MEV)
4
FACE ABSORPTION | RADIUS(FM)
RO = 6.748
RS = 7.598
RSO= 6.801
PART IS DER. | DIFFUSENESS(FM)
AO = 0.6
AS = 0.45
ASO= 0.6
WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DE | NSITY PARAMETERS | 5 | |

NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 1.918E+01 6.037E-01 1.355E+00 7.176E+00 2.160E+00 2.514E+01 5.363E-01 2.925E+01 6.672E+00 1.170E+00 2.454E+01 5.338E-01 2.640E+00 7.549E+00 2.280E+00 2.392E+01 5.314E-01 1.525E+01 6.206E+00 1.170E+00 58-CE-146 58-CE-147 * 58-CE-148 * * * * 58-CE-149 2.440E+01 4.420E-01 3.742E+00 4.298E+00 9.900E-01 1.996E+01 4.690E-01 1.108E+01 2.807E+00 0.0 * 2.470E+01 5.314E-01 2.403E+01 6.371E+00 1.110E+00 * 2.408E+01 5.290E-01 1.412E+02 5.027E+00 0.0 59 - PR - 147 59 - PR - 148 59 - PR - 149 59-PR-150 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 2.657E+01 4.750E-01 1.192E+01 5.636E+00 1.180E+00 2.415E+01 5.280E-01 1.867E+00 7.314E+00 2.290E+00 2.618E+01 4.800E-01 1.152E+01 5.656E+00 1.180E+00 60-ND-148 60 - ND - 149 60 - ND - 150 60-ND-151 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 10.32 FOR ND-150 AND 5.0 FOR ND-151. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
4) TELLIER, H.: CEA-N-1459 (1971).
5) MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL.1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973).
6) FEDOROVA. A.F., ET AL.: "PROC. 3RD ALL-UNION CONF. ON NEUTRON (1973). FEDOROVA, A.F., ET AL.: "PROC. 3RD ALL-UNION CONF. ON NEUTRON PHYSICS, KIEV 1975", VOL. 1, 169. IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IIJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 6) 7) 8) 9ý (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 10) 11) 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
15) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
16) GRUPPELAAR, H.: ECN-13 (1977).
17) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
18) RAYNAL, J.: PRIVATE COMMUNICATION.
19) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
20) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
22) KONONÓV, V.N., ET AL.: SOV. J. NUCL. PHYS., 27, 5 (1978).
23) FREHAUT, J., ÉT AL.: SYMP. ON NEUTRON CROSS SECTIONS FROM 10-50MEV, BNL, P.399 (1980).
24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6149 61-PM-147 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 102 EV) FOR JENDL-3, THE EXISTING JENDL-2 DATA WERE ENTIRELY REPLACED BY NEW EVALUATION MENTIONED BELOW. THE RADIATION WIDTHS AND NEUTRON WIDTHS WERE ADOPTED FROM REF./3/. THE ORBITAL ANGULAR MOMENTUM L WAS ASSIGNED BY TAKING INTO ACCOUNT THE MAGNITUDE OF NEUTRON WIDTHS. TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. SCATTERING RADIUS OF 8.21 FM WAS ESTIMETED FROM THE MEASURED VALUES FOR ADJACENT NUCLIDES/3/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS GIVEN BY MUGHABGHAB/3/. MF UNRESOLVED RESONANCE REGION : 0.102 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB /3/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB T 100 KEV. MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.100E-4, S1 = 1.000E-4, S2 = 2.100E-4, SG = 145.E-4, GG = 0.068 EV, R = 3.916 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) RES. INTEG. 188.6 20.<u>9</u>1 TOTAL ELASTIC CAPTURE 2210 167.7 GAPTURE 167.7 2210 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
ADOPTED FROM MOLDAUER/6/ BECAUSE THEY REPRODUCED WELL A THE
PM-147 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/7/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/8/
ALPHA = HUIZENGA AND IGO/9/
DEUTERON = LOHR AND HAEBERLI/10/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/14/. MF /14/ T = 1 TOTAL BELOW 5 MEV, SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ABOVE 5 MEV, AN EYE-GUIDED CURVE WAS DETERMINED ON THE BASIS OF EXPERIMENTAL DATA OF FOSTER AND GLASGOW/7/. МΤ = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2. = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./15/. NO. GR. SPIN-PARITY 7/2 + 5/2 + ENERGY(MEV) 0.0

| 2 0.4105 3/2 +
3 0.4893 5/2 +
4 0.5310 5/2 +
5 0.6800 7/2 +
6 0.6858 5/2 +
LEVELS ABOVE 0.7 MEV WERE ASSUMED TO BE OVERLAPPING. |
|--|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.40E-02) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.066 EV) AND AVERAGE
S-WAVE RESONANCE LEVEL SPACING (4.7 EV). |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =105 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 130.6) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 7.06 MB (SYSTEMATICS OF FORREST/18/)
(N,ALPHA) 2.73 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| V = 46.0 		 R0 = 6.722 		 A0 = 0.62 		 KADIOS(FM) 		 BTFF0SENESS(FM) 		 V = 46.0 		 R0 = 6.722 		 A0 = 0.62 		 KS = 7.0 		 RS = 6.722 		 AS = 1.0 		 KS0 = 7.0 		 RS0 = 6.722 		 AS0 = 0.62 		 KS0 = 0.62 		 KTHE FORM OF SURFACE ABSORPTION PART IS GAUSSIAN TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDE SYST A(1/MEV) I(MEV) C(1/MEV) EX(MEV) PATRING 59-PR-143 1.500E+01 6.280E-01 2.607E+00 4.558E+00 7.600E-01 59-PR-144 1.600E+01 6.000E-01 1.045E+01 3.744E+00 0.0 59-PR-145 * 2.088E+01 5.411E-01 7.911E+00 5.258E+00 9.200E-01 59-PR-146 * 2.263E+01 5.387E-01 8.918E+01 4.815E+00 0.0 |
| 60-ND-1441.771E+015.640E-014.792E-015.691E+001.940E+0060-ND-1452.054E+015.120E-012.465E+004.869E+001.180E+0060-ND-1462.019E+015.660E-011.121E+006.714E+002.100E+0060-ND-1472.398E+014.850E-015.510E+005.235E+001.180E+00 |
| 61-PM-145*1.769E+015.411E-012.780E+004.120E+007.600E-0161-PM-146*1.942E+015.387E-012.241E+013.849E+000.061-PM-1472.192E+014.913E-014.801E+004.589E+009.200E-0161-PM-1482.227E+014.300E-011.420E+012.672E+000.0 |
SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS.

SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 4.666 FOR PM-147 AND 5.0 FOR PM-148.

REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
5) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
6) MOLDAUER, P. A.: NUCL. PHYS., 47, 65 (1963).
7) FOSTER. D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).

- 8)
- 9́) 10)
- FOSTER. D.G. JR. AND SELECTION (1971). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 11)

(1971). 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446

- 12) GILBERI, A. AND CAMERON, A.G.M. C.M. C.M. (1965).
 13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 14) GRUPPELAAR, H.: ECN-13 (1977).
 15) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
 16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 17) KIUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6152 61-PM-148 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 1.1 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.200E-4, S1 = 0.960E-4, S2 = 2.230E-4, SG = 301.E-4, GG = 0.065 EV, R = 4.015 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2005 3.100 TOTAL ELASTIC CAPTURE 200Ŏ 2510 F = 3 NEUTRON CROSS SECTIONS BELOW 1.1 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 5.0 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 1.1 EV TO 100 KEV. MF = 3ABOVE 100 KEV. THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM MOLDAUER/5/ BECAUSE THEY REPRODUCED WELL A THE PM-147 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IJJIMA ET AL./12/. MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA MT SHEETS/15/ SPIN-PARITY NO. ENERGY(MEV) GR. 0.0 1 1 LEVELS ABOVE 0.2 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS

SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (2.90E-02) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.065 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (2.24 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. MT = 16 MT = 17MT = 22MT = 28MT = 32MT = 33 MT =103 MT =104 MT = 105МŤ МТ THE KALBACH'S CONSTANT K (= 109.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.43 MB (SYSTEMATICS OF FORREST/18/) (N,ALPHA) 2.16 MB (SYSTEMATICS OF FORREST) . CALCULATED WITH CASTHY. МТ F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) DIFFUSENESS(FM) RADIUS(FM) - - -A0 = 0.62----- - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING . _ _ _ _ ` 59-PR-144 59-PR-145 * 1.600E+01 6.000E-01 1.045E+01 3.744E+00 0.0 2.088E+01 5.411E-01 7.911E+00 5.258E+00 9.200E-01 2.263E+01 5.387E-01 8.918E+01 4.815E+00 0.0 2.440E+01 4.420E-01 3.742E+00 4.298E+00 9.900E-01 59-PR-147 2.054E+01 5.120E-01 2.465E+00 4.869E+00 1.180E+00 2.019E+01 5.660E-01 1.121E+00 6.714E+00 2.100E+00 2.398E+01 4.850E-01 5.510E+00 5.235E+00 1.180E+00 60-ND-145 60-ND-146 60-ND-147 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 60-ND-148 1.942E+01 5.387E-01 2.241E+01 3.849E+00 0.0 2.192E+01 4.913E-01 4.801E+00 4.589E+00 9.200E-01 2.227E+01 4.300E-01 1.420E+01 2.672E+00 0.0 2.377E+01 4.890E-01 8.141E+00 5.075E+00 9.900E-01 61-PM-146 61-PM-147 61-PM-148 61-PM-149 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.0 FOR PM-148 AND 6.071 FOR PM-149. REFERENCES 1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE

AND TECHNOLOGY, MITO, P. 569 (1988). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). MOLDAUER, P. A.: NUCL. PHYS., 47, 65 (1963). FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). 2) 3) 5) 6) 6) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
7) PEREY, F.G. PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

11) GILBERT, A. AND GAMERUN, A.G.W.. GAN. J. THIO., 50, 110 (1965).
12) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEETS, 42, 111 (1984).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6153 61-PM-148MJNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW FORMULA) : BELOW 0.6 EV PARAMETERS OF A SINGLE RESONANCE AT 0.169 EV WERE ADOPTED FROM MUGHABGHAB/2/ ASSUMING TO BE S-WAVE RESONANCE AND TOTAL SPIN OF 6.5. MF UNRESOLVED RESONANCE REGION : 0.6 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/3/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. IN ORDER TO GET REASONABLE LEVEL SPACING, THE RADIATION WIDTH GG WAS ASSUMED TO BE 0.08 EV WHICH WAS LARGER THAN 0.065 EV OBTAINED FROM THE SYSTEMATICS OF MEASURED VALUES. EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.652E-4, S1 = 1.141E-4, SG = 772.E-4, GG = 0.080 EV R = 2.860 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 10620 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 19.14 10600 3590 CAPIURE 10600 3590
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
ADOPTED FROM MOLDAUER/5/ BECAUSE THEY REPRODUCED WELL A THE
PM-147 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/6/.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/7/
ALPHA = HUIZENGA AND IGO/8/
DEUTERON = LOHR AND HAEBERLI/9/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/13/. /13/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). - 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA SHEETS/15/. SPIN-PARITY NO. ENERGY(MEV) GR. 0.0 6 GR. 0.0 1 -0.1370 1 -2 -0.0613 2 -LEVELS ABOVE 0.063 MEV WERE ASSUMED TO BE OVERLAPPING. . = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI

THE GAMMA-RAY STRENGTH FUNCTION (8.44E-02) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.065 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (0.770 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. MT = 16MT = 17 MT = 22 MT = 28 MT = 32 MT = 33 MT =103 $MT_{1} = 104$ МŤ ŇТ MΤ THE KALBACH'S CONSTANT K (= 109.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 5.43 MB (SYSTEMATICS OF FORREST/18/) (N,ALPHA) 2.16 MB (SYSTEMATICS OF FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) - - - - - -- - - - - - - -A0 = 0.62AS = 1.0AS0= 0.62ŤYPĚ TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING , - - - <u>-</u> - , 1.600E+01 6.000E-01 1.045E+01 3.744E+00 0.0 2.088E+01 5.411E-01 7.911E+00 5.258E+00 9.200E-01 2.263E+01 5.387E-01 8.918E+01 4.815E+00 0.0 2.440E+01 4.420E-01 3.742E+00 4.298E+00 9.900E-01 59-PR-144 59 - PR - 145 59 - PR - 146 59 - PR - 147 * 2.054E+01 5.120E-01 2.465E+00 4.869E+00 1.180E+00 2.019E+01 5.660E-01 1.121E+00 6.714E+00 2.100E+00 2.398E+01 4.850E-01 5.510E+00 5.235E+00 1.180E+00 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 60-ND-145 60-ND-146 60-ND-147 60-ND-148 1.942E+01 5.387E-01 2.241E+01 3.849E+00 0.0 2.192E+01 4.913E-01 4.801E+00 4.589E+00 9.200E-01 2.227E+01 4.300E-01 1.420E+01 2.672E+00 0.0 2.377E+01 4.890E-01 8.141E+00 5.075E+00 9.900E-01 61-PM-146 61-PM-147 61-PM-148 61-PM-149 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.0 FOR PM-148 AND 6.071 FOR PM-149. REFERENCES ANAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", 3)

ă١

5)

ACADEMIC PRESS (1984). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). MOLDAUER, P. A.: NUCL. PHYS., 47, 65 (1963). FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971) 6)

6) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

- 11) GILBERI, A. AND CAMERON, A.G.M. C.M. C. M. C. (1965).
 12) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 13) GRUPPELAAR, H.: ECN-13 (1977).
 14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 15) NUCLEAR DATA SHEETS, 42, 111 (1984).
 16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 18) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6155 61-PM-149 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 2.6 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.400E-4, S1 = 0.930E-4, S2 = 2.300E-4, SG = 137.E-4, GG = 0.068 EV, R = 3.970 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 1403 3.200 TOTAL ELASTIC CAPTURE 140Ŏ 1570 F = 3 NEUTRON CROSS SECTIONS BELOW 2.6 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/, AND THE ELASTIC SCATTERING CROSS SECTION WAS ESTIMATED BY ASSUMING R = 5.0 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 2.6 EV TO 100 KEV. MF = 3ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM MOLDAUER/5/, WHICH REPRODUCED WELL THE PM-147 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/6/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IJJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). - = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA MT SHEETS/15/. SPIN-PARITY 7/2 + 5/2 + ENERGY(MEV) NO. 0.0 0.1143 0.2113 0.2402 0.2702 0.2882 GR. 1 5/2 5/2 11/2 ż + 34 + 7/2 5/2 5 -6 + 5/2 +7 0.3600

| 8 0.3876 1/2 +
9 0.3968 5/2 +
10 0.4253 5/2 +
11 0.4622 3/2 -
12 0.5156 9/2 +
13 0.5379 5/2 -
14 0.6548 7/2 -
LEVELS ABOVE 0.7 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|-----|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-RAY STRENGTH FUNCTION (1.30E-02) WAS DETERMINED FRO
THE SYSTEMATICS OF RADIATION WIDTH (0.068 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (5.22 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. | M |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 128.4) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/17/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 4.17 MB (SYSTEMATICS OF FORREST/18/)
(N,ALPHA) 1.71 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | ; - |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | I |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) | |
| V = 46.0
WS = 7.0
VSO = 7.0
THE FORM OF SURFACE ABSORPTION PART IS GAUSSIAN TYPE. | |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| $ \begin{array}{c} V &= 46.0 \\ WS &= 7.0 \\ VSO &= 7.0 \\ THE FORM OF SURFACE ABSORPTION PART IS GAUSSIAN TYPE. \\ TABLE 2 LEVEL DENSITY PARAMETERS \\ NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING \\ \end{array} $ | |
| V = 46.0 $RO = 6.75$ $A0 = 0.62$ $WS = 7.0$ $RS = 6.75$ $AS = 1.0$ $VSO = 7.0$ $RSO = 6.75$ $ASO = 0.62$ THE FORM OF SURFACE ABSORPTION PART IS GAUSSIAN TYPE.TABLE 2LEVEL DENSITY PARAMETERSNUCLIDESYST A(1/MEV)T(MEV)C(1/MEV)EX(MEV)59-PR-145*2.088E+015.411E-017.911E+005.258E+009.200E-0159-PR-146*2.263E+015.387E-018.918E+014.815E+000.059-PR-1472.440E+014.420E-013.742E+004.298E+009.900E-0159-PR-1481.996E+014.690E-011.108E+012.807E+000.0 | |
| $ \begin{array}{c} \text{W} = 46.0 \\ \text{WS} = 7.0 \\ \text{VSO} = 7.0 \\ \text{VSO} = 7.0 \\ \text{RSO} = 6.75 \\ \text{ASO} = 0.62 \\ \text{THE FORM OF SURFACE ABSORPTION PART IS GAUSSIAN TYPE.} \\ \hline \text{TABLE 2 LEVEL DENSITY PARAMETERS} \\ \hline \text{NUCLIDE SYST A(1/MEV) T(MEV) } C(1/MEV) \\ \hline \text{EX(MEV) PAIRING} \\ \hline \text{S9-PR-145} \\ & 2.088E+01 \\ 59-PR-146 \\ & 2.263E+01 \\ 5.411E-01 \\ 7.911E+00 \\ 5.258E+00 \\ 9.200E-01 \\ 59-PR-146 \\ & 2.263E+01 \\ 5.387E-01 \\ 8.918E+01 \\ 4.815E+00 \\ 0.0 \\ 59-PR-148 \\ 1.996E+01 \\ 4.690E-01 \\ 1.108E+01 \\ 2.807E+00 \\ 0.0 \\ \hline \text{G0-ND-146} \\ 2.019E+01 \\ 5.660E-01 \\ 1.121E+00 \\ 6.714E+00 \\ 2.359E+01 \\ 5.150E-01 \\ 1.328E+00 \\ 6.751E+00 \\ 2.170E+00 \\ \hline \text{G0-ND-148} \\ 2.359E+01 \\ 4.750E-01 \\ 1.192E+01 \\ 5.636E+00 \\ 1.180E+00 \\ \hline \end{array} $ | |

| | 61-PM-149 2.377E+01 4.890E-01 8.141E+00 5.075E+00 9.900E-01
61-PM-150 2.270E+01 3.800E-01 7.943E+00 1.973E+00 0.0 |
|---|--|
| | SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| | SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 6.071 FOR PM-149 AND 5.0 FOR PM-150. |
| F | REFERENCES KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B",
ACADEMIC PRESS (1984). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). MOLDAUER, P. A.: NUCL. PHYS., 47, 65 (1963). FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 |
| 1 | 7) PEREY, F.G: PHYS. REV. 131, 745 (1963). 8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971) |
| 1 | 11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 |
| 1 | 12) IJJMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
13) GRUPPELAAR, H.: ECN-13 (1977).
14) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
15) NUCLEAR DATA SHEETS, 46, 1 (1985).
16) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
17) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR |

REACTIONS", NORTH HOLLAND (1968). 18) FORREST, R.A.: AERE-R 12419 (1986). **MAT number = 6225** 62-SM-144 JNDC

EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G.

* * * * * . (4.51-91)

MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY

F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS THE RESOLVED RESONANCE PARAMETERS WERE EVALUATED ON THE BASIS OF THE DATA RECENTLY MEASURED BY MACKLIN ET AL./2/ FOR RESO-NANCES WHOSE NEUTRON WIDTH WAS NOT MEASURED, THE NEUTRON WIDTH WAS OBTAINED FROM THE CAPTURE AREA ASSUMING THE RADIATION WIDTH OF 0.074 EV AND 0.089 EV FOR THE S-WAVE AND P-WAVE RESO-NANCES, RESPECTIVELY. FOR P-WAVE RESONANCES, THE VALUE OF THE TOTAL SPIN J WAS ARBITRARILY ASSIGNED WITH THE RATIO 1:2 IN THE NUMBER OF THE RESONANCES WITH J=1/2 AND J=3/2. TO REPRO-DUCE THE THERMAL CROSS SECTION OF 1.64+-0.10 B AT 0.0253 EV/3/, A NEGATIVE RESONANCE WAS ADDED AT 104 EV. THE EFFEC-TIVE SCATTERING RADIUS WAS EMPLOYED FROM THE MEASURED DATA BY MACKLIN ET AL./2/ MF = 2MACKLIN ET AL. /2/

UNRESOLVED RESONANCE REGION : 10 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB/4/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES.

TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.200E-4, S1 = 1.900E-4, S2 = 2.000E-4, SG = 1.27E-4, GG = 0.060 EV, R = 5.748 FM.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 2.3992 -INTEGRALS (BARNS)

| ÉLÁSTIC | 0.7588 | - |
|---------|--------|------|
| CAPTURE | 1.6404 | 1.91 |
| | | |

CAPTURE 1.6404 1.91
F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE THE TOTAL CROSS SECTIONS OF NATURAL SM
MEASURED BY FOSTER AND GLASGOW/7/, KELLIE ET AL./8/ AND SO
ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
PROTON = PEREY/9/
ALPHA = HUIZENGA AND IGO/10/
DEUTERON = LOHR AND HAEBERLI/11/
HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/15/.

/15/.

MT = 1

T = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING

CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/16/ AND NUCLEAR DATA SHEETS/17/.

| NOR
GR
12
33
44
55
67
89
101
112
134
156
17
89
201
212
223
245
226
27
289 | . ENE
. 0.
1.
2.
2.
2.
2.
2.
2.
2.
2.
3.
3.
3.
3.
3.
3.
3.
3.
3.
3 | RGY(MEV)
06002
1906
3232
4233
4779
5880
88000
8840
0210
1238
1980
22550
30100
32620
33100
3620
33100
3620
33100
3620
3761
3930
4605
5300
6501
6710
7340
8490
8530
8590 | SPIN-PARITY
0 +
2 +
3 -
4 +
6 +
2 +
0 +
4 +
2 +
4 +
3 -
1 -
6 +
3 -
1 -
6 +
3 -
3 -
3 -
3 -
4 -
9 -
5 -
5 -
5 -
5 -
5 -
5 -
5 -
5 | DWUCK CAL
* |
|---|--|--|---|--|
| LEVELS | ABOVE 3.86 | 9 MĚV WERE | ASSUMED TO BE | OVERLAPPING. |
| FOR THE L
INELASTIC
DWUCK-4 C
BETA3 = 0
AL./19/ A | EVELS WITH
SCATTERIN
ODE/18/.
.135) WERE
ND SPEAR/2 | AN ASTERIS
G CROSS SEC
DEFORMATION
BASED ON TH
0/, RESPECT | C, THE CONTRI
FIONS WAS CAL
PARAMETERS (
HE DATA COMPI
IVELY. | BUTION OF DIRECT
CULATED BY THE
BETA2 = 0.088 AND
LED BY RAMAN ET |
| MT = 102 C
SPHERICAL
CASTHY WA
SECTIONS
AND REFFO | APTURE
OPTICAL A
S ADOPTED.
WERE ESTIM
/21/ AND N | ND STATISTI(
DIRECT ANI
ATED ACCORD
ORMALIZED T(| CAL MODEL CAL
D SEMI-DIRECT
ING TO THE PR
D 1 MILLI-BAR | CULATION WITH
CAPTURE CROSS
OCEDURE OF BENZI
N AT 14 MEV. |
| THE GAMMA
REPRODUCE
KEV MEASU | -RAY STREN
THE CAPTU
RED BY MAC | GTH FUNCTION
RE CROSS SEC
KLIN ET AL., | N (1.128E-4)
CTION OF 57 M
/2/ | WAS ADJUSTED TO
ILLI-BARNS AT 90 |
| $\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$ | ,2N) CROSS
,3N) CROSS
,N'A) CROSS
,N'P) CROSS
,D) CROSS
,D) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T) CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS
,T] CROSS | SECTION
SECTION
S SECTION
S SECTION
SECTION
SECTION
SECTION
S SECTION
S SECTION
S SECTION
S SECTION
S SECTION
S SECTION
S SECTION | VERE CALCULAT | ED WITH THE
ODEL CODE PEGASUS. |
| THE KALBA
FORMULA D | CH'S CONST
ERIVED FRO | ANT K (= 158
M KIKUCHI-K/ | 3.4) WAS ESTI
AWAI'S FORMAL | MATED BY THE
ISM/22/ AND LEVEL |
| FINALLY,
NORMALIŻE
(N,P)
(N,ALPH | AKAMEIERS.
THE (N,P)
D TO THE F
24.
A) 10. | AND (N,ALPH)
OLLOWING VAI
00 MB (REC(
20 MB (SYS | A) CROSS SECT
LUES AT 14.5
DMMENDED BY F
FEMATICS OF F | IONS WERE
MEV:
ORREST/23/)
ORREST/23/) |
| MT = 251 M
CALCULATE | U-BAR
D WITH CAS | THY. | | |

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. CONTRIBUTION OF DIRECT INELASTIC SCATTERING WAS CALCULATED WITH DWUCK-4. FOR OTHER REACTIONS, ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| | | V
WS | = | 46 | D

9
45 | EP

6- | ТН

0. | (N
017 | IEV
2E |)
 | | - | R
-
R | | | S(I
6.2 | FM)
237
548 | | | DI
AO | F F
 | | ENE
 | ESS
55 | 6 (FI | M)
 | |
|--|--|---|--------------------------------------|--|--|--------------------------|---------------------------------|---------------------------------------|----------------------------|---------------------------------------|--------------------------------------|------------------------------|--|---|---------------------------|----------------------------------|---------------------------------|----------------------|--------------------------|----------------------------------|----------------------|-------------------------------|-------------------------------|--------------------------------|-------------------|--------------------------|----|
| ТН | IE F | VS
ORN | 0=
0 | τŢ.
FŚ | 0
UR | FA | CE | AE | SO | R P' | ті | DN | Ř | ŠC |)=
 | 6.1
S [| 709
DER |) | WO | AS | 0=
S- | : Ŏ
SA | .6
.01 | ۰.
۱۷٦ | ΓΥΡΙ | Ε. | |
| TABL | .E 2 | 2 L | .EVI | EL | DE | NS | IT | ΥF | AR | AM | ETE | ERS | 6 | | | | | | | | | | | | | | |
| NUC | |)E | SYS | SТ | Α(| 1/ | ME | V) | Т | (M | EV) |) | | C (| 1/ | ME | V) | E | Х(| ΜE | V) | | P | A I F | RIN | G | |
| 60 -
60 -
60 -
60 - | ND -
ND -
ND -
ND - | 140
141
142
143 |)
} | * | 1 .
1 .
1 .
1 . | 64
47
28
82 | 1E
7E
8E
6E | +01
+01
+01
+01 | 5
6
4 | .5
.0
.7
.7 | 32E
91E
10E
10E | - (
- (
- (|)1
)1
)1
)1 | 2 .
9 .
2 .
5 . | 59
53
25
22 | 6E
7E
0E
0E | - 01
- 01
- 01
- 01 | 5
4
5
3 | .0.5 | 24
87
26
13 | E+
E+
E+
E+ | 00
00
00 | 1
1
2
1 | . 88
. 18
. 03
. 18 | 80E
80E
80E | +00
+00
+00
+00 | • |
| 61 -
61 -
61 -
61 - | РМ-
РМ-
РМ-
РМ- | 141
142
143
143 | | *
*
* | 1.
1.
1.
1. | 65
61
43
83 | 3E
9E
0E
1E | +01
+01
+01
+01 | 5
5
5
5
5 | . 5
. 4
. 4
. 1 | 088
848
598
008 | - (
- (
- (|)1
)1
)1
)1 | 2.
6.
6.
1. | 22
72
68
01 | 4E-
1E-
3E-
1E- | +00
+00
-01
+01 |) 3
) 2
3
3 | . 8
. 9
. 1
. 0 | 45
97
87
40 | E+
E+
E+
E+ | 00
00
00 | 7
0
8
0 | . 00
. 0
. 50
. 0 | 00E | -01
-01 | |
| 62 -
62 -
62 -
62 - | SM -
SM -
SM -
SM -
SM - | 142
143
144
145 | <u>}</u> | * | 1.
1.
1.
2. | 66
62
55
04 | 5E
8E
7E
5E | +01
+01
+01
+01 | 5
5
5
4 | .4
.4
.5
.3 | 84E
31E
43E
43E | - (
- (
- (|)1
)1
)1
)1 | 2.
6.
1.
5. | 43
98
32
09 | 8E
1E
3E
5E | - 01
- 01
- 01
- 01 | 5
4
4
3 | . 0
. 1
. 9 | 66
67
51
96 | E+
E+
E+
E+ | 00
00
00 | 1
1
2
1 | . 92
. 22
. 07
. 22 | 20E
20E
70E | +00
+00
+00
+00 | |
| SY | ST: | * | = | LC | • • • | S | ŴĒ | RE | DE | ΤĒ | RMI | INE | D | FR | ОM | S | YST | ΕM | IAT | IC | S . | | | | | | |
| SPI
IN
ASS | N C
THE
UME | UTC
CA
D T | OFF
STI | PA
HY
BE | RA
CA
15 | ME
LC
.1 | TE
UL
2 | RS
ATI
FOF | WE
ON
S | RE
,
M- | C/
SP1
144 | ALC
In
1 <i>f</i> | CUL
CU | AT
TC | ED
FF | AS
F/
F(| S C
ACT
DR | 0.1
OR
SM | 46
S
I - 1 | * S
A T
4 5 | QR
0 | кт (/
М | A)'
EV | * A *
We | * (2
ERE | 2/3 |). |
| REFE
1)
2)
3)
4)
5) | REN
KAW
MAC
ALE
MUG
ACA | ICES
/AI
/KLI
XAN
HAE
DEN | M
N,
IDĖI
SGH/
IIC | . E
R.
,
AB,
PR | TL.
C.
SESA | AL
W.
S
ND | †
E
(1) | J.
AL.
T A
984 | N
L.
IEU | UC
PH
TR | L.
YS.
NU(
ON | SC
F
CL.
CF | XEV
Sev
Sos | , T
SĊİ
SS | EC
C
SE | HN(
48
EN(
CT
1; | DL.
;
;
10N
321 | 12
9
IS,
(| 29
0
5,
19 | (1
1
0L
91 | 19
99
94 | 95
(3)
(1, | (19
198
P/ | 992
37)
AR1 | 2).
ГВ | ", | |
| 6)
7) | F05
(19 | TEF | (, (
(, (| S.
5.0 | ET | Å
JR | L. | ĂNĔ | ĂĔ
G | Rİ
LA | -M
SGC | 87
)W, | 7 - 0
D |)25
).W | . : | P.
Pl | 33
HYS | 37`
3. | (1
RE | 98
V. | (†) | Ċ3 | , { | 576 | 6 | | |
| 8)
9)
10)
11)
12) | J.
PER
HUI
LOF
BEC
PHE
W.
(10 | ZEN
REY,
ZEN
R,
CHE
NON
HAE | Ś.
F
IGA
J.I
IEN/
BEI | J.L
, A
.G:
, J
M.
, J
M.
, J
R.L
I | , ,
P
R
A
N
F.
N
), | HY
HY
D
NU
P | AL
75
S
AN
HA
ĊL | L,
8 (
0 I
EBE
JR.
582 | S
19
GO
RL
R | J.
74
1
i,
ND
EA
TH |)
31
G
W
GF
CT
E | ND
, 7 | 45
NUC
NUC
NU
NU
NU
NU
NU
NU
NU | icl
icl
icl
icl
icl
icl
icl
((| 19
P
S
ED | 63
HY
PH
G
S)
Y (| , .
S
YS
.W
H
DF | 29
29
H.
WI | 23
P0
SC | 46
2
4
A
R
O
N | 2
3
RI
SH | (19
881
ZA
IALI
N | :
962
TIC
L /
PRE | 2).
197
2N
ANE
ESS | 74)
)
). | | |
| 13) | ĠİL
(19 | BEF | ά, | Α. | A | ND | С | AME | RO | N, | Α. | .G. | Ψ. | : | CA | Ν. | J. | Ρ | ΉY | S. | , | 43 | , | 144 | 16 | | |
| 14)
15)
16)
17)
18)
19) | ÌİJ
GRU
ENS
NUC
KUN
RAM
(10 | IIMA
DPPE
DF:
LEA
IZ,
IAN, | LA
E
R
I
P.I
S | S.,
AR,
VAL
DAT
D.: | UA
A
ET | T
SH
RI
A | AL
D
EE
VA
L. | .:
CN-
NUC
TS,
TE
: A | J .
13
2
2
COI | N
AR
7,
MM
M. | UCL
197
ST
UN
D <i>I</i> | 77)
FRU
97
ICA | SC
UCT
(1
ATI | UR
97
0N | T
(E
(9)
I.
N | ECI
DA ⁻
UCI | HNC
TA
∟. | DL.
FI
DA | 2
LE | 1,
(
T | 1
JU
AB | 0
INE
SLE | (19
19
S 3 | 984
987
36, | 1).
7).
1 | | |
| 20)
21)
22)
23) | SPE
BEN
KIK
REA
FOR | AR,
IZI,
UCH
CTI
RES | R
V
II,
ON:
ST, | . H .
. A
K .
S " ,
R . | :
ND
A
N | AT
R
ND
OR
: | OM
EFI
K
TH
AEI | . D
FO,
AWA
HC
RE- | AT
G
I,
DLL
R | A
M
AN
12- | ANE
CC
.:
D (
419 |) N
C D N
" N
(1 9 | UC
- N
UC
68 | ;L.
 W/
;LE
). | D
10
AR | АТ/
(?
М/ | A T
196
ATT | AB
9)
ER | LE
A | ,
ND | 42
N | IUCI | 55
LE/ | (1
AR | 98 | 9). | |

MAT number = 6234 62-SM-147 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-AUG93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-08 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MODIFIED PARTS FOR JENDL-3.2 (2,151) WAS CHANGED FROM 1.99 KEV TO 1.2 KEV. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 1.20 KEV) RESONANCE PARAMETERS FOR JENDL-2 EVALUATED BY KIKUCH1/3/ WERE REVISED. FOR JENDL-2. THE DATA OF MIZUMOTO/4/ WERE ADOPTED. THE J-ASSIGNMENT WAS BASED ON KVITECK AND POPOV/5/. CAUVIN ET AL./6/ AND KARZHAVINA ET AL./7/ ORBITAL ANGULAR MOMENTUM L WAS ASSUMED TO BE 0 FOR ALL RESONANCES. AVERAGE RADIATION WIDTH AND SCATTERING RADIUS WERE TAKEN FROM MUGHABGHAB/8/. FOR JENDL-3, TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. PARAMETERS OF A NEGA-TIVE RESONANCE WERE MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB. UNRESOLVED RESONANCE REGION : 1.2 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB/8/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/9/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 4.800E-4, S1 = 1.000E-4, S2 = 4.700E-4, SG =120.E-4, GG = 0.069 EV, R = 6.640 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. 59.07 INTEGRALS (BARNS) ELASTIC 1.057 58.01 5.783E-04 781 (N, ALPHA) (N,ALPHA) 5.783E-04 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TOTAL CROSS SECTIONS OF NATURAL SM MEASURED BY FOSTER AND GLASGOW/11/, KELLIE ET AL./12/ AND SO ON, AND THE S-WAVE NEUTRON STRENGTH FUNCTION OF (4.8+-0.5)E-4 /8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/13/ ALPHA = HUIZENGA AND IGO/14/ DEUTERON = LOHR AND HAEBERLI/15/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/16/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/17/ WERE EVALUATED BY IJJIMA ET AL./18/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /19/. /19/. T TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ΜТ ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2

= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./20/. MT = ADOPTED. ENERGY(MEV) SPIN-PARITY NO. 0.0 7/2 5/2 GŔ. -1 3/2 11/2 3/2 0.1974 0.7130 0.7988 2 3 4 3/2 13/2 11/2 1/2 11/2 5/2 5/2 0.8080 0.9250 1.0070 56789 $\begin{array}{c} 1.0070\\ 1.0290\\ 1.0540\\ 1.0650\\ 1.0770\\ 1.1030\end{array}$ + 1Ŏ + 11 9/2 11/2 12 13 1.1660 14 1.1800 7/2 -LEVELS ABOVE 1.2 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (98.4E-4) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 650 MILLI-BARNS AT 50 KEV MEASURED BY MACKLIN/22/. MT = 16MT = 10 MT = 17 MT = 22 MT = 28 MT = 32 MT = 33 MT = 103 MT = 104 MΤ MT MT THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME AS THAT OF SM-148. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 13.60 MB (SYSTEMATICS OF FORREST/23/) (N,ALPHA) 4.87 MB (SYSTEMATICS OF FORREST) THE (N,ALPHA) CROSS SECTION BELOW 1.99 KEV WAS CALCULATED FROM RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF 6.80E-7 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/8/. THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS. ABOVE 1.99 KEV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO THE PEGASUS CALCULATION. MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) R0 = 7.151 RS = 7.04 V = 43.42-0.1879E WS = 9.875-0.0019E VS0= 7.0 A0 = 0.6 AS = 0.45 AS0= 0.6

RŠO= 7.151

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) NUCLIDE SYST A(1/MEV) T(MEV) PAIRING - - - -1.826E+01 4.710E-01 5.220E-01 3.613E+00 1.180E+00 1.771E+01 5.640E-01 4.792E-01 5.691E+00 1.940E+00 2.054E+01 5.120E-01 2.465E+00 4.869E+00 1.180E+00 2.019E+01 5.660E-01 1.121E+00 6.714E+00 2.100E+00 60-ND-143 60 - ND - 144 60 - ND - 145 60-ND-146 1.831E+01 5.100E-01 1.011E+01 3.040E+00 0.0 * 1.769E+01 5.411E-01 2.780E+00 4.120E+00 7.600E-01 * 1.942E+01 5.387E-01 2.241E+01 3.849E+00 0.0 2.192E+01 4.913E-01 4.801E+00 4.589E+00 9.200E-01 61-PM-144 61-PM-145 61-PM-146 61-PM-147 2.045E+01 4.343E-01 5.095E-01 3.596E+00 1.220E+00 1.871E+01 5.117E-01 2.497E-01 5.159E+00 1.980E+00 2.275E+01 4.770E-01 2.660E+00 4.823E+00 1.220E+00 2.097E+01 5.505E-01 1.055E+00 6.694E+00 2.140E+00 62-SM-145 62 - SM - 146 62 - SM - 147 62-SM-148 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 9.964 FOR SM-147 AND 5.943 FOR SM-148. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
MIZUMOTO, M.: NUCL. PHYS., A357, 90 (1981).
KVITECK, J., POPOV, JU.P.: NUCL. PHYS., A154, 177 (1970).
CAUVIN, B., ET AL.: "PROC. 3RD CONF ON NEUTRON CROSS SECTIONS AND TECHNOL., KNOXVILLE 1971", 785.
KARZHAVINA, E.N., ET AL.: JINR-P3-6237 (1972).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). REFERENCES 11) FOSTER, D.G. JR. AND GLASGUW, D.W.. PHIS. NEV., 03, 570 (1971).
12) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
13) PEREY, F.G: PHYS. REV. 131, 745 (1963).
14) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
15) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
16) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 17) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MACKLIN, R.: TAKEN FROM EXFOR 12966 (1986). FORREST, R.A.: AERE-R 12419 (1986). 18) 19) 2ŎŚ 22) 23)

MAT number = 6237 62-SM-148 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. ĊŦĬŎŇ (3,102) F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 5.5 KEV RESONANCE PARAMETERS WERE NEWLY EVALUATED ON THE BASIS OF THE DATA MEASURED BY MIZUMOTO AND ZHAO/3.4/. RESONANCE ENERGIES AND NEUTRON WIDTHS WERE TAKEN FROM THE TRANSMISSION MEASURMENTS BY MIZUMOTO AND ZHAO. RADIATION WIDTH OF 0.06 EV USED FOR THEIR ANALYSIS WAS ADOPTED. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB/5/. MF = 2UNRESOLVED RESONANCE REGION : 5.5 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.800E-4, S1 = 1.900E-4, S2 = 2.200E-4, SG = 4.97E-4, GG = 0.065 EV, R = 5.150 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 3.4098 0.9966 2.4132 TOTAL ELASTIC CAPTURE 45.2 GAPTURE 2.4132 45.2 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL SM MEASURED BY FOSTER AND GLASGOW/8/, KELLIE ET AL./9/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/. /16/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING

CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. NO. SPIN-PARITY (DIRECT) ENERGY(MEV) GŖ. 0.0 0.5510 1.1620 0 2 3 + 1 + * 3 1.1800 4 4 1.4300 0 2 1 5 1.4530 6 7 1.4650 1.5950 1.6490 1.6630 1.7330 1.8940 5 2 2 8 9 10 4 Λ 11 LEVELS ABOVE 1.906 MEV WERE ASSUMED TO BE OVERLAPPING. FOR THE LEVELS WITH AN ASTERISK, THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING CROSS SECTIONS WAS CALCULATED BY THE DWUCK-4 CODE/18/. DEFORMATION PARAMETERS (BETA2=0.0202) AND BETA3=0.0251) WERE BASED ON THE DATA COMPILED BY RAMAN ET AL./19/ AND SPEAR/20/, RESPECTIVELY. * = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = 102THE GAMMA-RAY STRENGTH FUNCTION (4.73E-04) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 185 MILLI-BARNS AT 50 KEV MEASURED BY WISSHAK ET AL./22/ MT = 16 (N,2N) CROSS SECTION MT = 17 (N,3N) CROSS SECTION MT = 22 (N,N'A) CROSS SECTION MT = 28 (N,N'P) CROSS SECTION MT = 32 (N,N'T) CROSS SECTION MT = 103 (N,P) CROSS SECTION MT =104 (N,D) CROSS SECTION MT =105 (N,T) CROSS SECTION MT =106 (N,HE3) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION MT =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. THE KALBACH'S CONSTANT K (= 25.0) WAS DETERMINED TO REPRODUCE ENERGY DEPENDENCE OF THE (N,2N) CROSS SECTION MEASURED BY FREHAUT ET AL./23/ FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 8.00 MB (RECOMMENDED BY FORREST/24/) (N,ALPHA) 3.83 MB (SYSTEMATICS OF FORREST/24/) MT = 251 MU-BAR CALCULATED WITH CASTHY. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) R0 = 6.295RS = 7.617A0 = 0.655 AS = 0.448 AS0= 0.6V = 46.96-0.0172E WS = 8.455 VSO= 7.0

RŠO= 6.771

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

C(1/MEV) EX(MEV) NUCLIDE SYST A(1/MEV) T(MEV) PAIRING - - - -1.771E+01 5.640E-01 4.792E-01 5.691E+00 1.940E+00 2.054E+01 5.120E-01 2.465E+00 4.869E+00 1.180E+00 2.019E+01 5.660E-01 1.121E+00 6.714E+00 2.100E+00 2.398E+01 4.850E-01 5.510E+00 5.235E+00 1.180E+00 60-ND-144 60 - ND - 145 60 - ND - 146 60-ND-147 * 1.769E+01 5.411E-01 2.780E+00 4.120E+00 7.600E-01 * 1.942E+01 5.387E-01 2.241E+01 3.849E+00 0.0 2.192E+01 4.913E-01 4.801E+00 4.589E+00 9.200E-01 2.227E+01 4.300E-01 1.420E+01 2.672E+00 0.0 61-PM-145 61-PM-146 61-PM-147 61-PM-148 1.871E+01 5.117E-01 2.497E-01 5.159E+00 1.980E+00 2.275E+01 4.770E-01 2.660E+00 4.823E+00 1.220E+00 2.097E+01 5.505E-01 1.055E+00 6.694E+00 2.140E+00 2.325E+01 5.052E-01 5.886E+00 5.504E+00 1.220E+00 62 - SM - 146 62 - SM - 147 62 - SM - 148 62-SM-149 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.943 FOR SM-148 AND 5.300 FOR SM-149. REFERENCES REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
MIZUMOTO, M. AND ZHAO, W.R.: JAERI-M 86-112, 168 (1986).
ZHAO, W.R. AND MIZUMOTO, M.: PRIVATE COMMUNICATION (1986).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B" ACADEMIC PRESS (1984).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). ON NUCLEAR DATA FOR BASIC 8) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
9) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
10) PEREY, F.G: PHYS. REV. 131, 745 (1963).
11) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
12) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
13) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 10)11) 12) 13) W. HAEBERLI), P. 682, THE UNIVERSITY OF ALCOLUMN (1971) 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 14) GILBERT, A. AND CAMERUN, A.G.W.. GAN. G. HILG., I., (1965).
15) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
16) GRUPPELAAR, H.: ECN-13 (1977).
17) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
18) KUNZ, P.D.: PRIVATE COMMUNICATION.
19) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
20) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
21) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
22) WISSHAK, K., ET AL.: KFK 5067 (1992).
23) FREHAUT, J., ET AL.: SYMP. ON NEUTRON CROSS SECTIONS FROM 10-50 MEV, BNL, P.399 (1980).
24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6240 62-SM-149 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.52 KEV PARAMETERS WERE BASED ON JENDL-2 WHICH WERE EVALUATED BY KIKUCHI ET AL./3/ AS FOLLOWS: PARAMETERS OF THE LOWEST 2 LEVELS WERE EVALUATED ON THE BASIS OF DATA MEASURED BY AKYUEZ ET AL./4/, ASAMI ET AL./5/ AND PATTENDEN/6/. THE DATA OF MIZUMOTO/7/ WERE ADOPTED FOR OTHER RESONANCES. THE J VALUES WERE DETERMINED ACCORDING TO MARSHAK/8/, CAUVIN ET AL./9/, KARZHAVINA ET AL./10/ AND BECVAR ET AL./11/ RADIATION WIDTHS HAVE BEEN MEASURED FOR SEVEN RESONANCES AND THEIR AVERAGE VALUE OF 62 MEV WAS USED AS A RECOMMENDED VALUE. FOR JENDL-3, TOTAL SPIN J OF SOME RESONANCES WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. THE PARAMETERS OF THE 1ST LEVEL WERE MODIFIED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION AND RESONANCE INTEGRAL/12/. MF RESOLVED RESONANCE REGION : 0.52 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB/12/, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/13/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF UNRESOLVED RESONANCE MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 4.600E-4, S1 = 0.300E-4, S2 = 4.900E-4, SG = 487.E-4, GG = 0.062 EV, R = 7.900 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL ELASTIC CAPTURE 40330 175.8 40150 3490 0.0308 (N, ALPHA) (N,ALPHA) 0.0308 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/14/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL SM MEASURED BY FOSTER AND GLASGOW/15/, KELLIE ET AL./16/ AND SO ON, AND THE S-WAVE NEUTRON STRENGTH FUNCTION OF (4.6+-0.6)E-4/12/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/17/ ALPHA = HUIZENGA AND IGO/18/ DEUTERON = LOHR AND HAEBERLI/19/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/20/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/21/ WERE EVALUATED BY IIJIMA ET AL./22/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /23/. MF MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./24/. NO ENERGY(MEV) SPIN-PARITY

| GR. 0.0 7/2 -
1 0.0225 5/2 -
2 0.2770 5/2 -
3 0.2859 9/2 -
4 0.3500 3/2 -
5 0.3990 1/2 -
6 0.5285 3/2 -
7 0.5584 5/2 -
7 0.5584 5/2 -
8 0.5909 9/2 -
9 0.6060 3/2 -
10 0.6364 7/2 -
LEVELS ABOVE 0.65 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/25/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUNCTION (324.E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 1200 MILLI-BARNS AT 50
KEV MEASURED BY MACKLIN/26/. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME
AS THAT OF SM-148. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 8.10 MB (SYSTEMATICS OF FORREST/27/)
(N,ALPHA) 3.02 MB (SYSTEMATICS OF FORREST) |
| THE (N,ALPHA) CROSS SECTION BELOW 0.52 KEV WAS CALCULATED FROM
RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF
4.82E-8 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/12/.
THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS.
ABOVE 0.52 KEV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO
THE PEGASUS CALCULATION. |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 43.42-0.1879E R0 = 7.184 A0 = 0.6 WS = 9.875-0.0019E RS = 7.072 AS = 0.45 VS0= 7.0 RS0= 7.184 AS0= 0.6 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS
NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING |
| 60-ND-1452.054E+015.120E-012.465E+004.869E+001.180E+0060-ND-1462.019E+015.660E-011.121E+006.714E+002.100E+00 |

60-ND-147 60-ND-148 2.398E+01 4.850E-01 5.510E+00 5.235E+00 1.180E+00 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 1.942E+01 5.387E-01 2.241E+01 3.849E+00 0.0 2.192E+01 4.913E-01 4.801E+00 4.589E+00 9.200E-01 2.227E+01 4.300E-01 1.420E+01 2.672E+00 0.0 2.377E+01 4.890E-01 8.141E+00 5.075E+00 9.900E-01 61-PM-146 61 - PM - 147 61 - PM - 148 61-PM-149 2.275E+01 4.770E-01 2.660E+00 4.823E+00 1.220E+00 2.097E+01 5.505E-01 1.055E+00 6.694E+00 2.140E+00 2.325E+01 5.052E-01 5.886E+00 5.504E+00 1.220E+00 2.362E+01 5.230E-01 1.520E+00 6.973E+00 2.210E+00 62-SM-147 62-SM-148 62-SM-149 62-SM-150 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.300 FOR SM-149 AND 5.475 FOR SM-150. REFERENCES REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
AKYUEZ, OE.R., ET AL.: CNAEM-52 (1968).
ASAMI, T., ET AL.: J. PHYS. SOC. JPN., 26, 225 (1969).
PATTENDEN, N.J.: NUCL. SCI. ENG., 17, 371 (1963).
MARSHAK, H., ET AL.: PHYS. REV., 128, 1287 (1967).
CAUVIN, B., ET AL.: PHYS. REV., 128, 1287 (1967).
CAUVIN, B., ET AL.: NUCL. PHYS. A357, 90 (1981).
MARSHAK, H., ET AL.: PHYS. REV., 128, 1287 (1967).
CAUVIN, B., ET AL.: NUCL. PHYS. A236, 173 (1974).
KAZHAVINA, E.N., ET AL. INER-P3-6237 (1972).
BECVAR, F., ET AL.: NUCL. SCI. TECHNOL., 12, 67 (1975).
HJIJMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). 15) FOSTER, D.G. JR. AND GLASGOW, D.W.. PHIS. REV., 63, 676 (1971).
16) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
17) PEREY, F.G. PHYS. REV. 131, 745 (1963).
18) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
19) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
20) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
21) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MACKLIN, R.: TAKEN FROM EXFOR 12966 (1986). FORREST, R.A.: AERE-R 12419 (1986). 22) 23) 24) 25) 26) 27)

MAT number = 6243 62-SM-150 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-JUN94 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 94-06 JENDL-3.2 WAS MADE BY JNDC FPND W.G. (3,2) (3,4), (3,51) (3,102) WAS INCLUDED. RENORMALIZATION TO NEW EXPERIMENTAL DATA. THE EFFECTS TO INELASTIC SCATTERING CROSS SECTIONS ABOUT 1 % OR LESS. (4,51), (4,53), (4,55), (4,59) DIRECT INELASTIC SCATTERING CONTRIBUTION MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 1.538 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 WHICH WAS EVALUATED BY KIKUCHI ET AL./3/ ON THE BASIS OF THE EXPERIMENTAL DATA BY EILAND ET AL./4/ AND BY ANUFRIEV ET AL./5/ THE AVERAGE RADIATION WIDTH OF 0.060 EV WAS ASSUMED. A NEGATIVE RESONANCE WAS ADDED AT -3.5 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 107+-9 BARNS AND THE TOTAL CROSS SECTION OF 122+-12 BARNS/4/. MF = 2UNRESOLVED RESONANCE REGION : 1.538 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB/6/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.600E-4, S1 = 1.400E-4, S2 = 2.300E-4, SG = 10.98E-4, GG = 0.060 EV, R = 5.916 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 116.9 -ELASTIC 8.341 -CAPTURE 108.6 325 CAPIURE 108.6 325 F = 3 NEUTRON CROSS SECTIONS
BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN.
ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL
CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF
COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED
WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP
EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE
DETERMINED TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL SM
MEASURED BY FOSTER AND GLASGOW/9/, KELLIE ET AL./10/ AND SO ON.
THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS:
 PROTON = PEREY/11/
 ALPHA = HUIZENGA AND IGO/12/
 DEUTERON = LOHR AND HAEBERLI/13/
 HEIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/
PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT
AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE
EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE
PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED
IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF
PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR
/17/. MF /17/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS).

| <pre>MT = 4, 51 - 91 INELASTIC SCATTERING
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS
ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. THE
LEVELS MARKED WITH * INCLUDE THE CONTRIBUTION OF DIRECT
INELASTIC SCATTERING, WHICH WAS CALCUALTED BY THE COUPLED-
CHANNELS THEORY WITH ECIS88 CODE/19/. THE GROUND STATE
ROTATIONAL BAND (0+ 2+ 4+ 6+(1.27891MEV)) AND OCTUPOLE
VIBRATIONAL BAND (3- 1-(1.16573MEV) 5-) WERE COUPLED
SIMULTANEOUSLY. THE WS PARAMETER WAS ADJUSTED TO 3.5 MEV,
OTHERWISE THE SPHERICAL PARAMETERS WERE USED. THE BETA-2 (=
0.1931) AND BETA-3 (= 0.14526) WERE TAKEN FROM ORNL
COMPILATIONS/20,21/.</pre> |
|---|
| NO. ENERGY(MEV) SPIN-PARITY C.C. CALCULATION
GR. 0.0 0 + *
1 0.3343 2 + *
2 0.7403 0 + *
3 0.7733 4 + *
4 1.0463 2 + *
5 1.0720 3 - *
6 1.1650 2 + *
7 1.1940 2 + *
8 1.2550 0 + *
9 1.3570 5 - *
10 1.4170 2 + *
11 1.4490 4 + *
12 1.5050 3 + *
13 1.6430 4 + *
14 1.7610 0 + *
15 1.7940 2 + *
16 1.8200 4 + *
16 1.8200 4 + *
16 1.8200 4 + *
17 1.8340 2 + *
16 1.8200 4 + *
17 1.8340 2 + *
18 1.9270 2 + *
18 1.9270 2 + *
19 1.9510 3 - *
20 1.9710 4 + *
LEVELS ABOVE 2.006 MEV WERE ASSUMED TO BE OVERLAPPING. |
| <pre>MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (1.098E-03) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 320 MILLI-BARNS AT 50
KEV MEASURED BY WISSHAK ET AL./23/ |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'T) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME
AS THAT OF SM-148. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 6.90 MB (RECOMMENDED BY FORREST/24/)
(N,ALPHA) 3.40 MB (RECOMMENDED BY FORREST)
THE (N,2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF
THE DATA MEASURED BY FREHAUT ET AL./25/ |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. |

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS

ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) DIFFUSENESS(FM) RADIUS(FM) - - - - -- - - - - - - . V = 46.96-0.0172E R0 = 6.323 A0 = 0.655 WS = 8.455 RS = 7.651 AS = 0.448 VS0= 7.0 RS0= 6.801 AS0= 0.6 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 2.019E+01 5.660E-01 1.121E+00 6.714E+00 2.100E+00 2.398E+01 4.850E-01 5.510E+00 5.235E+00 1.180E+00 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 2.657E+01 4.750E-01 1.192E+01 5.636E+00 1.180E+00 60-ND-146 60-ND-147 60-ND-148 60-ND-149 2.192E+01 4.913E-01 4.801E+00 4.589E+00 9.200E-01 2.227E+01 4.300E-01 1.420E+01 2.672E+00 0.0 2.377E+01 4.890E-01 8.141E+00 5.075E+00 9.900E-01 61-PM-147 61-PM-148 61-PM-149 61-PM-150 2.270E+01 3.800E-01 7.943E+00 1.973E+00 2.097E+01 5.505E-01 1.055E+00 6.694E+00 2.140E+00 2.325E+01 5.052E-01 5.886E+00 5.504E+00 1.220E+00 2.362E+01 5.230E-01 1.520E+00 6.973E+00 2.210E+00 2.687E+01 5.000E-01 2.313E+01 6.327E+00 1.220E+00 62-SM-148 62 - SM - 149 62 - SM - 150 62 - SM - 150 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.475 FOR SM-150 AND 6.675 FOR SM-151. REFERENCES REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND ÅPPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
EILAND, H.M., ET AL.: NUCL. SCI. ENG., 54, 286 (1974).
ANUFRIEV, V.A., ET AL.: PROC. 4TH ALL UNION CONF. ON NEUTRON PHYSICS, KIEV 1977, VOL.2, 263.
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). 9) FOSTER, D.G. JR. AND GLASGOW, D.W., FILE, REV., CO, C.I. (1971).
10) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
11) PEREY, F.G: PHYS. REV. 131, 745 (1963).
12) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
13) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
14) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS (IEDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). (1971) 15) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERUN, A.G.W.. CAN. J. THIG., 40, THE (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J.: PRIVATE COMMUNICATION (1981). RAYNAL, J. CODE ECIS88 RAMAN, S. ET AL.:AT. DATA AND NUCL. DATA TABLES 36, 1 (198 SPEAR, R.H.: AT. DATA AND NUCL. DATA TABLES 42, 55 (1989). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). WISSHAK, K. ET AL.: KFK 5067 (1992). FORREST, R.A.: AERE-R 12419 (1986). FREHAUT, J., ET AL.: SYMP. ON NEUTRON CROSS SECTIONS FROM 10-50MEV, BNL, P.399 (1980). 16) 17) 18) 19) 20 Ì (1987).21) 22) 235

MAT number = 6246 62-SM-151 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.2461 KEV RESONANCE PARAMETERS WERE EVALUATED BY KIKUCHI ET AL./3/ FOR JENDL-2, AND TOTAL SPIN J WAS MODIFIED WITH A RANDOM NUMBER METHOD FOR JENDL-3. NEUTRON WIDTHS WERE OBTAINED BY AVERAGING THE DATA OF PATTENDEN/4/, KIROUAC AND EILAND/5/ AND ANUFRIEV ET AL./6/ RADIATION WIDTHS WERE TAKEN FROM REF./5/ OR THE AVERAGE VALUE OF 0.065+-0.015 EV WAS ADOPTED. A NEGATIVE RESONANCE WAS ADDED AT -0.12 EV SO AS TO REPRODUCE THE THERMAL CAPTURE AND TOTAL CROSS SECTIONS GIVEN BY MUGHABGHAB/7/. MF VALUE UNRESOLVED RESONANCE REGION : 0.2461 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB, AND S1 AND S2 WERE CALCULATED WITH THE OPTICAL MODEL CODE CASTHY/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 4.200E-4, S1 = 1.400E-4, S2 = 2.300E-4, SG = 481.E-4, GG = 0.092 EV, R = 5.720 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 15210 -TOTAL ELASTIC CAPTURE 50.41 15160 3410 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/8/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL SM MEASURED BY FOSTER AND GLASGOW/10/, KELLIE ET AL./11/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /18/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/. NO. ENERGY(MEV) SPIN-PARITY 0.0 0.0048 0.0658 5/2 -3/2 -7/2 -GŔ. 1 0.0697 0.0915 5/2 9/2 3 4 5 + 3/20.1048

| 6 0.1479 13/2 +
7 0.1677 5/2 +
8 0.1684 5/2 -
9 0.1754 9/2 -
10 0.2090 7/2 -
11 0.2611 11/2 -
12 0.2850 1/2 -
13 0.2946 9/2 -
14 0.3026 5/2 -
15 0.3068 3/2 +
16 0.3138 1/2 -
17 0.3153 3/2 -
18 0.3239 7/2 +
19 0.3449 3/2 +
20 0.3576 1/2 +
LEVELS ABOVE 0.37 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (5.57E-02) WAS DETERMINED FROM THE SYSTEMATICS. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME
AS THAT OF SM-148. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 4.83 MB (SYSTEMATICS OF FORREST/21/)
(N,ALPHA) 1.90 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) V = 46.96-0.0172E R0 = 6.337 A0 = 0.655 WS = 8.455 RS = 7.668 AS = 0.448 VS0= 7.0 RS0= 6.816 AS0= 0.6 THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDEA(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING60-ND-1472.398E+014.850E-015.510E+005.235E+001.180E+0060-ND-1482.359E+015.150E-011.328E+006.751E+002.170E+0060-ND-1492.657E+014.750E-011.192E+015.636E+001.180E+0060-ND-1502.415E+015.280E-011.867E+007.314E+002.290E+00 |
| 61-PM-1482.227E+014.300E-011.420E+012.672E+000.061-PM-1492.377E+014.890E-018.141E+005.075E+009.900E-01 |

2.270E+01 3.800E-01 7.943E+00 1.973E+00 0.0 2.882E+01 4.260E-01 8.842E+00 4.956E+00 1.110E+00 61-PM-150 61-PM-151 2.325E+01 5.052E-01 5.886E+00 5.504E+00 1.220E+00 2.362E+01 5.230E-01 1.520E+00 6.973E+00 2.210E+00 2.687E+01 5.000E-01 2.313E+01 6.327E+00 1.220E+00 2.375E+01 5.470E-01 2.365E+00 7.669E+00 2.330E+00 62-SM-149 62 - SM - 150 62 - SM - 151 62-SM-152 - - - - - - - - - -SPIN CUTOFF PARAMS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.675 FOR SM-151 AND 5.306 FOR SM-152. REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
4) PATTENDEN, N.J.: NUCL. SCI. ENG., 17, 371 (1963).
5) KIROUAC, G.J., EILAND, H.M.: PHYS. REV., C11, 895 (1975).
6) ANUFRIEV, V.A., ET AL.: PROC. 4TH ALL UNION CONF. ON NEUTRON PHYSICS, KIEV 1977, VOL. 2, 263.
7) MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
8) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
9) ILJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
10) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). 10) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
11) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
12) PEREY, F.G: PHYS. REV. 131, 745 (1963).
13) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
14) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
15) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). 16) GILBERT, A. AND CAMERON, A.G.W., ORN. S. THLOT, I.G., T.G., (1965).
17) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
18) GRUPPELAAR, H.: ECN-13 (1977).
19) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
20) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
21) FORREST, R.A.: AERE-R 12419 (1986).

| MAT number = 6249
62-SM-152 JNDC | EVAL-MAR90 JNDC FP NUC
DIST-SEP90 REV2-JUN94 | LEAR DATA W.G. |
|---|---|--|
| HISTORY
84-10 EVALUATION FOR
90-03 MODIFICATION F
94-06 JENDL-3.2 WAS | JENDL-2 WAS MADE BY JNC
OR JENDL-3 WAS MADE/2/.
MADE BY JNDC FPND W.G. |)C FPND W.G./1/ |
| ***** MODIFIE
(3,2) T
(3,4), (3,51),
(4,51), (4,52) | D PARTS FOR JENDL-3.2
O KEEP CONSISTENCY OF CF
(3.52), (3.55), (3.57),
IRECT INELASTIC SCATTERI
AS INCLUDED.
(4.55), (4.57), (4.60)
IRECT INFLASTIC SCATTERI | ACSS SECTIONS.
(3,60)
NG CONTRIBUTION |
| ************ | | *************** |
| MF = 1 GENERAL INFO
MT=451 COMMENTS AN | RMATION
D DICTIONARY | |
| MF = 2 RESONANCE PA
MT=151 RESOLVED AN
RESOLVED RESONANCE
RESONANCE PARAME
EVALUATED BY KIK
PARAMETERS WER
LEVELS WHOSE RAD
VALUE OF 0.065+-
WAS ADDED AT -20
SECTION OF 206+- | RAMETERS
D UNRESOLVED RESONANCE F
REGION (MLBW FORMULA) :
TERS WERE TAKEN FROM JEN
UCHI ET AL./3/ AS FOLLOW
E ADOPTED FROM RAHN ET A
IATION WIDTH WAS NOT MEA
0.015 EV WAS ASSUMED. A
EV SO AS TO REPRODUCE T
6 BARNS AT 0.0253 EV/5/. | ARAMETERS
BELOW 5.029 KEV
NDL-2 WHICH WAS
S:
LL/4/ FOR THE
SURED, THE AVERAGE
A NEGATIVE RESONANCE
THE CAPTURE CROSS |
| UNRESOLVED RESONAN
THE NEUTRON STRE
COMPILATION OF M
OPTICAL MODEL CO
DETERMINED TO RE
WITH CASTHY. TH
FROM FITTING TO
THE RADIATION WI
MUGHABGHAB. | CE REGION : 5.029 KEV -
NGTH FUNCTIONS, SO AND S
UGHABGHAB/6/, AND S2 WAS
DE CASTHY/7/. THE OBSEF
PRODUCE THE CAPTURE CROS
E EFFECTIVE SCATTERING F
THE CALCULATED TOTAL CRO
DTH GG WAS BASED ON THE | 100 KEV
1 WERE BASED ON THE
CALCULATED WITH
VED LEVEL SPACING WAS
S SECTION CALCULATED
ADIUS WAS OBTAINED
SS SECTION AT 100 KEV.
COMPILATION OF |
| TYPICAL VALUES OF
S0 = 2.200E-4, S
GG = 0.061 EV, R | THE PARAMETERS AT 70 KEV
1 = 0.550E-4, S2 = 2.300
= 7.556 FM. | /:
)E-4, SG = 23.6E-4, |
| CALCULATED 2200-M/
TOTAL
ELASTIC
CAPTURE | S CROSS SECTIONS AND RES
2200 M/S
207.2
0.9466
206.2 | 3. INTEGRALS (BARNS)
RES. INTEG.
-
2770 |
| MF = 3 NEUTRON CROS
BELOW 100 KEV, RES
ABOVE 100 KEV, THE
CALCULATION WAS PE
COMPETING REACTION
WITH PEGASUS/8/ ST
EVAPORATION MODEL.
DETERMINED TO REPR
MEASURED BY FOSTER
ON. THE OMP'S FOR
PROTON = PERE | S SECTIONS
ONANCE PARAMETERS WERE G
SPHERICAL OPTICAL AND S
RFORMED WITH CASTHY, BY
S, OF WHICH CROSS SECTIC
ANDING ON A PREEQUILIBRI
THE OMP'S FOR NEUTRON
ODUCE THE TOTAL CROSS SE
AND GLASGOW/9/, KELLIE
CHARGED PARTICLES ARE A
Y/11/ | GIVEN.
TATISTICAL MODEL
TAKING ACCOUNT OF
NS WERE CALCULATED
UM AND MULTI-STEP
GIVEN IN TABLE 1 WERE
CTION OF NATURAL SM
ET AL./10/ AND SO
AS FOLLOWS: |
| ALPHA = HUIZ
DEUTERON = LOHR
HELIUM-3 AND TR
PARAMETERS FOR THE
AND CAMERON/15/ WE
EXTENSIVE DETERMIN
PRESENT WORK. TAB
IN THE PRESENT CAL
PARAMETER IN THE E
/17/. | ENGA AND IGO/12/
AND HAEBERLI/13/
ITON = BECCHETTI AND GRE
COMPOSITE LEVEL DENSITY
RE EVALUATED BY IIJIMA E
ATION AND MODIFICATION W
LE 2 SHOWS THE LEVEL DEN
CULATION. ENERGY DEPEND
NERGY RANGE BELOW E-JOIN | ENLEES/14/
/ FORMULA OF GILBERT
T AL./16/ MORE
VERE MADE IN THE
VSITY PARAMETERS USED
DENCE OF SPIN CUT-OFF
VT IS DUE TO GRUPPELAAR |
| MT = 1 TOTAL
SPHERICAL OPTICA | L MODEL CALCULATION WAS | ADOPTED. |
| MT = 2 ELASTIC SC
CALCULATED AS (T | ATTERING
OTAL – SUM OF PARTIAL CF | ROSS SECTIONS). |
| MT = 4, 51 - 91 I
SPHERICAL OPTICA | NELASTIC SCATTERING
L AND STATISTICAL MODEL | CALCULATION WAS |

ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. THE LEVELS MARKED WITH * INCLUDE THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING, WHICH WAS CALCUALTED BY THE COUPLED-CHANNELS THEORY WITH ECIS88 CODE/19/. THE GROUND STATE ROTATIONAL BAND (0+ 2+ 4+ 6+(0.70696MEV)) AND OCTUPOLE VIBRATIONAL BAND (1- 3- 5-) WERE COUPLED SIMULTANEOUSLY. THE WS PARAMETER WAS ADJUSTED TO 2.5 MEV, OTHERWISE THE SPHERICAL PARAMETERS WERE USED. THE BETA-2 (= 0.3055) AND BETA-3 (= 0.09487) WERE TAKEN FROM ORNL COMPILATIONS/20, 21/. NO. ENERGY(MEV) SPIN-PARITY C.C. CALCULATION 0.0 GŔ. 02 + 1 2 4 0.3670 0.6880 0.8170 0.9640 1.0260 1.0450 3 0 2 1 + ă + 5 * 6 7 4 32 8 1.0860 Õ 9 1.0900 + 1Õ 1.2250 5 LEVELS ABOVE 1.298 MEV WERE ASSUMED TO BE OVERLAPPING. * = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/22/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = 102THE GAMMA-RAY STRENGTH FUNCTION (1.48E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 420 MILLI-BARNS AT KEV MEASURED BY MACKLIN ET AL./23/ 30 T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 33 (N,N'T) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16МŤ MT = 22MT = 28MT = 33MΤ MT MT ΜТ THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME AS THAT OF SM-148. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 3.73 MB (SYSTEMATICS OF FORREST/24/) (N,ALPHA) 2.10 MB (RECOMMENDED BY FORREST/24/) THE (N,2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF THE DATA MEASURED BY FREHAUT ET AL./25/ MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) - - - - - - -- - - - - - - - - -R0 = 6.351 RS = 7.685 RS0 = 6.831V = 46.96 - 0.0172EA0 = 0.655TABLE 2 LEVEL DENSITY PARAMETERS

NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 2.359E+01 5.150E-01 1.328E+00 6.751E+00 2.170E+00 2.657E+01 4.750E-01 1.192E+01 5.636E+00 1.180E+00 2.415E+01 5.280E-01 1.867E+00 7.314E+00 2.290E+00 2.618E+01 4.800E-01 1.152E+01 5.656E+00 1.180E+00 60-ND-148 60-ND-149 60-ND-150 60-ND-151 2.377E+01 4.890E-01 8.141E+00 5.075E+00 9.900E-01 2.270E+01 3.800E-01 7.943E+00 1.973E+00 0.0 2.882E+01 4.260E-01 8.842E+00 4.956E+00 1.110E+00 * 2.440E+01 5.242E-01 1.481E+02 5.009E+00 0.0 61-PM-149 61-PM-150 61-PM-151 61-PM-152 2.362E+01 5.230E-01 1.520E+00 6.973E+00 2.210E+00 2.687E+01 5.000E-01 2.313E+01 6.327E+00 1.220E+00 2.375E+01 5.470E-01 2.365E+00 7.669E+00 2.330E+00 2.572E+01 5.160E-01 2.101E+01 6.405E+00 1.220E+00 62-SM-150 62-SM-151 62-SM-152 62-SM-153 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 5.306 FOR SM-152 AND 10.66 FOR SM-153. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
RAHN, F., ET AL.: PHYS. REV., C6, 251 (1972).
MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL.1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
IJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). REFERENCES 9) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
10) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
11) PEREY, F.G: PHYS. REV. 131, 745 (1963).
12) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
13) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
14) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). W. HAEBERLI), P. 682, THE UNIVERSITY OF HIGGOROUS, (1971) (1971) 15) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERUN, A.G.W.. CAN. J. THIG., NO, THE (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J.: PRIVATE COMMUNICATION (1981). RAYNAL, J. CODE ECIS88 RAMAN, S. ET AL.: AT. DATA AND NUCL. DATA TABLES 36, 1 (1987). SPEAR, R.H.: AT. DATA AND NUCL. DATA TABLES 42, 55 (1989). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). MACKLIN, R.L., ET AL.: NATURE 197, 369 (1963). FORREST, R.A.: AERE-R 12419 (1986). FREHAUT, J., ET AL.: SYMP. ON NEUTRON CROSS SECTIONS FROM 10-50MEV, BNL, P.399 (1980). 16) 17 Ì 18) 19) 20) 21) 22) 23) 24 25)

MAT number = 6252 62-SM-153 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 4.4 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.300E-4, S1 = 1.200E-4, S2 = 2.400E-4, SG = 103.E-4, GG = 0.088 EV, R = 7.146 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 426.7 -TOTAL ELASTIC CAPTURE 6.700 420.0 717 MF = 3 NEUTRON CROSS SECTIONS BELOW 4.4 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS TAKEN FROM REF./3/ AND THE SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 7.3 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 4.4 EV TO 100 KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/4/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL SM MEASURED BY FOSTER AND GLASGOW/5/, KELLIE ET AL./6/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAF /13/. TO GRUPPELAAR /13/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 1' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA MT = 4SHEETS/15/.

| NU. | ENERGY(MEV) | SPIN-PARII |
|-----|-------------|------------|
| GR. | 0.0 `´´ | 3/2 + |
| 1 | 0.0075 | 5/2 + |
| 2 | 0.0358 | 3/2 - |
| 3 | 0.0535 | 7/2 + |
| 4 | 0.0655 | 9/2 + |
| 5 | 0.0909 | 5/2 - |
| 6 | 0.0984 | 11/2 - |
| 7 | 0.1273 | 3/2 - |
| 8 | 0.1742 | 7/2 - |
| - | | |

| 9 0.1829 5/2 -
10 0.1892 11/2 +
11 0.1946 5/2 +
12 0.1959 13/2 +
13 0.2463 13/2 -
14 0.2623 7/2 +
15 0.2659 7/2 -
16 0.2767 3/2 +
17 0.3211 3/2 +
18 0.3567 5/2 +
19 0.3623 5/2 +
20 0.3710 9/2 -
21 0.4055 3/2 -
22 0.4133 15/2 -
23 0.4149 1/2 +
24 0.4178 17/2 +
25 0.4253 15/2 +
26 0.4471 7/2 +
27 0.4500 5/2 -
28 0.4811 3/2 +
LEVELS ABOVE 0.492 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|---|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (1.00E-02) WAS DETERMINED FROM
THE SYSTEMATICS OF RADIATION WIDTH (0.088 EV) AND THE AVERAGE
S-WAVE RESONANCE LEVEL SPACING (8.76 EV) CALCULATED FROM THE
LEVEL DENSITY PARAMETERS. | N |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME
AS THAT OF SM-148. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 2.88 MB (SYSTEMATICS OF FORREST/17/)
(N,ALPHA) 0.97 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | - |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOF
OTHER NEUTRON EMITTING REACTIONS. | २ |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) | |
| $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(1/MEV) I(MEV) C(1/MEV) EX(MEV) PAIRING
60-ND-149 2.657E+01 4 750E-01 1 192E+01 5 636E+00 1 180E+00 | |

60-ND-150 60-ND-151 2.415E+01 5.280E-01 1.867E+00 7.314E+00 2.290E+00 2.618E+01 4.800E-01 1.152E+01 5.656E+00 1.180E+00 2.361E+01 5.242E-01 1.915E+00 6.885E+00 2.100E+00 * 60-ND-152 2.270E+01 3.800E-01 7.943E+00 1.973E+00 0.0 2.882E+01 4.260E-01 8.842E+00 4.956E+00 1.110E+00 2.440E+01 5.242E-01 1.481E+02 5.009E+00 0.0 2.285E+01 4.950E-01 7.324E+00 4.895E+00 9.200E-01 61-PM-150 61 - PM - 151 61 - PM - 152 * 61-PM-153 2.687E+01 5.000E-01 2.313E+01 6.327E+00 1.220E+00 2.375E+01 5.470E-01 2.365E+00 7.669E+00 2.330E+00 2.572E+01 5.160E-01 2.101E+01 6.405E+00 1.220E+00 2.190E+01 5.600E-01 1.960E+00 7.188E+00 2.140E+00 62-SM-151 62 - SM - 152 62 - SM - 153 62-SM-154 - - - -. SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 10.66 FOR SM-153 AND 9.75 FOR SM-154. REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971) 5) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971).
6) KELLIE, J.D., HALL, S.J. AND CRAWFORD, G.I. ET AL.: J. PHYS., A7, 1758 (1974).
7) PEREY, F.G: PHYS. REV. 131, 745 (1963).
8) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
9) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
10) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
11) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965). GILBERT, A. AND CAMERON, A.G.M. G. H. G. H. G., I.G., (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). NUCLEAR DATA SHEETS, 37, 487 (1982). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). FORREST, R.A.: AERE-R 12419 (1986). 12) 13) 14) 15) 16) 17)

MAT number = 6255 62-SM-154 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-JUN94 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 94-06 JENDL-3.2 WAS MADE BY JNDC FPND W.G. MODIFIED PARTS FOR JENDL-3.2
 (2,151) UPPER BOUNDARY OF RESOLVED RESONACE REGION CHANGED FROM 4.654 TO 3 KEV.
 (3,2) TO KEEP CONSISTENCY OF CROSS SECTIONS.
 (3,4), (3,51-56), (3,59), (3,64) DIRECT INELASTIC SCATTERING CONTRIBUTION WAS INCLUDED.
 (4,51-56), (4,59), (4,64) DIRECT INELASTIC SCATTERING CONTRIBUTIONS. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY # 1 = 101 OCMMENTE FARAMETERS MT = 151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 4.654 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 EVALUATED BY KIKUCHI ET AL./3/ AND WERE MODIFIED FOR JENDL-3. FOR JENDL-2, PARAMETERS WERE ADOPTED FROM RAHN ET AL./4/ FOR THE LEVELS WHOSE RADIATION WIDTH WAS NOT MEASURED. THE AVERAGE VALUE OF 0.079+-0.013 EV WAS ASSUMED. A NEGATIVE RESONANCE WAS ADDED AT -35 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 5.5+-1.1 BARNS AT 0.0253 EV/5/. FOR JENDL-3, THE RADIATION WIDTH OF THE NEGATIVE RESONANCE WAS CHANGED FROM 0.079 EV TO 0.1266 EV AND THE SCATTERING RADIUS FROM 8.34 FM TO 9.67 FM SO AS TO REPRODUCE WELL THE THERMAL CROSS SECTIONS (CAPTURE = 8.4 B, SCATTERING = 11 B) COMPILED BY MUGHABGHAB/3/. UNRESOLVED RESONANCE REGION : 4.654 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S1 WERE BASED ON THE COMPILATION OF MUGHABGHAB, AND S2 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.800E-4, S1 = 0.800E-4, S2 = 2.400E-4, SG = 7.09E-4, GG = 0.079 EV, R = 7.680 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 19.39 ELASTIC 11.00 -CAPTURE 8.393 36.3 GAPTURE 8.393 36.3 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL SM MEASURED BY FOSTER AND GLASGOW/8/, KELLIE ET AL./9/ AND SO ON. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/.

MT = 1 TOTAL

/16/.

SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED.

MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. THE LEVELS MARKED WITH * INCLUDE THE CONTRIBUTION OF DIRECT INELASTIC SCATTERING, WHICH WAS CALCUALTED BY THE COUPLED-CHANNELS THEORY WITH ECIS88 CODE/18/. THE GROUND STATE ROTATIONAL BAND (0+ 2+ 4+ 6+ 8+ 10+) AND OCTUPOLE VIBRATIONAL BAND (1- 3- 5-) WERE COUPLED SIMULTANEOUSLY. THE WS PARAMETER WAS ADJUSTED TO 2.5 MEV, OTHERWISE THE SPHERICAL PARAMETERS WERE USED. THE BETA-2 (= 0.3410) AND BETA-3 (= 0.080) WERE TAKEN FROM ORNL COMPILATIONS/19, 20/. NO. ENERGY(MEV) SPIN-PARITY C.C. CALCULATION 0.0 0.0820 0.2670 0.5470 GR. 0 2 4 6 1 2 3 * + * + 0.9060 0.9210 1.0120 4567890112314567 101123145167 * 813025034 + 1.0990 1.1780 1.1820 1.2020 1.2860 1.3380 1.3720 1.4010 1.4400 1.4750 1.5150 1.5390 1.5850 1.6620 1.6740+ + 4 10 2 1 3 3 3 18 19 4 20 21 22 23 24 Ó 1.7070 1.7550 1.8170 4 2 LEVELS ABOVE 1.85 MEV WERE ASSUMED TO BE OVERLAPPING. . = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/21/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. MT = THE GAMMA-RAY STRENGTH FUNCTION (5.84E-4) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 70 MILLI-BARNS AT 200 KEV MEASURED BY KONONOV ET AL./22/ AND BY FAWCETT ET AL./23/ THE KALBACH'S CONSTANT K (= 25.0) WAS ASSUMED TO BE THE SAME AS THAT OF SM-148. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 2.23 MB (SYSTEMATICS OF FORREST/24/) (N,ALPHA) 0.85 MB (MEASURED BY BARI/25/) THE (N,2N) CROSS SECTION WAS DETERMINED BY EYE-GUIDING OF THE DATA MEASURED BY FREHAUT ET AL./26/ MT = 251 MU-BAR CALCULATED WITH CASTHY.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| Ľ |)EPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|---|---|--|--|
| V = 46.9
WS = 8.45
VSO= 7.0 | 16-0.0172E
55 | R0 = 6.379
RS = 7.719
RS0= 6.861 | A0 = 0.655
AS = 0.448
AS0= 0.6 |
| THE FORM OF SUF | FACE ABSORPTION F | PART IS DER. | WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DE | INSITY PARAMETERS | | |
| NUCLIDE SYST A(| 1/MEV) T(MEV) | C(1/MEV) E | X(MEV) PAIRING |
| 60 - ND - 151 2 .
60 - ND - 152 * 2 .
60 - ND - 153 * 2 . | 618E+01 4.800E-0
361E+01 5.242E-0
297E+01 5.217E-0 | 1 1.152E+01 5
1 1.915E+00 6
1 7.977E+00 5 | .656E+00 1.180E+00
.885E+00 2.100E+00
.732E+00 1.180E+00 |
| 61-PM-151 2. 61-PM-152 * 2. 61-PM-153 2. 61-PM-154 * 2. | 882E+01 4.260E-07
440E+01 5.242E-07
285E+01 4.950E-07
312E+01 5.193E-07 | 1 8.842E+00 4
1 1.481E+02 5
1 7.324E+00 4
1 7.816E+01 4 | .956E+00 1.110E+00
.009E+00 0.0
.895E+00 9.200E-01
.543E+00 0.0 |
| 62-SM-152 2.
62-SM-153 2.
62-SM-154 2.
62-SM-155 2. | 375E+01 5.470E-07
572E+01 5.160E-07
190E+01 5.600E-07
402E+01 5.080E-07 | 1 2.365E+00 7
1 2.101E+01 6
1 1.960E+00 7 | 2.669E+00 2.330E+00
0.405E+00 1.220E+00
2.188E+00 2.140E+00
767E+00 1.220E+00 |
| SYST: * = LDP' | S WERE DETERMINE | D FROM SYSTEM | IATICS. |
| SPIN CUTOFF PARA
IN THE CASTHY CA
ASSUMED TO BE 9. | METERS WERE CALCU
LCULATION, SPIN (
75 FOR SM-154 ANI | JLATED AS 0.1
CUTOFF FACTOR
D 5.0 FOR SM- | 46*SQRT(A)*A**(2/3).
S AT O MEV WERE
155. |
| REFERENCES
1) AOKI, T. ET A | L.: PROC. INT. C | ONF. ON NUCLE | AR DATA FOR BASIC |
| 2) KAWAI, M. ET
3) MUGHABGHAB, S | AL.: J. NUCL. SC
S.F.: "NEUTRON CR(| I. TECHNOL.,
DSS SECTIONS, | 29, 195 (1992).
VOL. I, PART B", |
| 4) RAHN, F., ET
5) MUGHABGHAB, S
VOL.1, RESONA
(1973) | AL.: PHYS. REV.,
AL.: PHYS. REV.,
J.F. AND GARBER, [
NCE PARAMETERS", | C6, 251 (197
D.I.: "NEUTRC
BNL 325, 3RD | 2).
N CROSS SECTIONS,
D ED., VOL. 1, |
| 6) IGARASI, S. A
7) IIJIMA, S. ET
8) FOSTER, D.G.
(1971) | ND FUKAHORI, T.:
AL.: JAERI-M 87
JR. AND GLASGOW, | JAERI 1321 (
-025, P. 337
D.W.: PHYS. | 1991).
(1987).
REV., Ċ3, 576 |
| 9) ŘÉĽLIÉ, J.D.,
J. PHYS., A7, | HALL, S.J. AND (
1758 (1974). | CRAWFORD, G.I | . ET AL.: |
| 10) PEREY, F.G. F
11) HUIZENGA, J.F
12) LOHR, J.M. AN
13) BECCHETTI, F.
PHENOMENA IN
W. HAEBERLI),
(1971) | ANDS. REV. 131, 72
AND IGO, G.: NU
ID HAEBERLI, W.: N
D., JR. AND GREEN
NUCLEAR REACTIONS
P. 682, THE UNIN | 45 (1963).
JCL. PHYS. 29
NUCL. PHYS. A
NLEES, G.W.:
S ((EDS) H.H.
/ERSITY OF WI | 9, 462 (1962).
232, 381 (1974).
POLARIZATION
BARSHALL AND
SCONSIN PRESS. |
| 14) GIĽBERT, A. A
(1965) | ND CAMERON, A.G. | V.: CAN. J. P | PHYS., 43, 1446 |
| 15) IIJIMA, S., E
16) GRUPPELAAR, F
17) MATSUMOTO, J. | TAL.: J. NUCL. S
I.: ECN-13 (1977)
PRIVATE COMMUN | SCI. TECHNOL.
İCATION (1981 | 21, 10 (1984).
). |
| 19) RAMAN, S. ET
20) SPEAR, R.H.:
21) BENZI, V. ANE
22) KONONOV, V.N.
23) FAWCETT, L.R. | AL.: AT. DATA ANI
AT. DATA AND NUCI
REFFO, G.: CCDN
, ET AL.: SOV. J
JR., ET AL.: NU(| D NUCL. DATA
DATA TABLE
-NW/10 (1969)
. NUCL. PHYS.
CL. SCI. ENG. | TABLES 36, 1 (1987).
S 42, 55 (1989).
, 27, 5 (1978).
, 49, 317 (1972). |
| 24) FORREST, R.A.
25) BARI, A.: J.
26) FREHAUT, J., | : AERE-R 12419 (
OF RADIOANALYTICA
ET AL.: SYMP. ON | 1986).
AL CHEMISTRY,
NEUTRON CROS | 75, 189 (1982).
S SECTIONS FROM |

10-50MEV, BNL, P.399 (1980).

MAT number = 6300 63-EU- 0 JAERI,JNDC EVAL-MAR89 T.ASAMI, JNDC FP ND W.G. DIST-OCT89 REV2-NOV93 HISTORY 89-03 EVALUATION FOR EACH ISOTOPE WAS MADE BY T.ASAMI(JAERI) AND JNDC FP NUCLEAR DATA W.G. DATA FOR NATURAL EU WERE CONSTRUCTED FROM THE ISOTOPE DATA BY T.ASAMI AND T.NAKAGAWA(JAERI). 90-06 (MF3,MT251) MODIFIED. 93-11 JENDL-3.2 GAMMA-RAY PRODUCTION DATA RE-EVALUATED BY T.ASAMI(DATA ENG.) COMPILED BY T.NAKAGAWA (NDC/JAERI) (2,151) (3,102) (12,102) (15,102) MF = 1 GENERAL INFORMATION F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) EVALUATION FOR EACH ISOTOPE WAS MADE BY KIKUCHI /1/. 1) EU-151: BELOW 98.2 EV PARAMETERS WERE MAINLY BASED ON THE DATA OF RAHN ET AL. /2/, AND FOR THE LOWEST 2 LEVELS, THE DATA OF TASSAN ET AL./3/. THE CAPTURE WIDTH OF 0.093 EV /2/ WAS ASSUMED FOR THE LEVELS WHOSE RADIATIVE CAPTURE WIDTH WAS NOT MEASURED. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 9200 BARNS AT 0.0253 EV/4/. 2) EU-153: BELOW 97.2 EV NEUTRON WIDTHS WERE OBTAINED FROM THE DATA OF RAHN ET AL. /2/ AND ANUFRIEV ET AL./5/. RADIATIVE CAPTURE WIDTHS WERE ADOPTED FROM THE DATA OF RAHN ET AL. THE PARAMETERS OF 1.73-, 2.46-, 3.29- AND 3.94-EV LEVELS WERE TAKEN FROM MAGHABGHAB /6/ SO AS TO REPRODUCE THE CAPTURE RESONANCE INTEGRAL OF 1420 BARNS/6/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 390 BARNS AND THE ELASTIC SCATTERING OF 8.0 +- 0.2 BARNS AT 0.0253 EV/4/. UNRESOLVED RESONANCE REGION : UP TO 100 KEV THE PARAMETERS WEDE AD HIGTED TO 100 KEV MT=451 COMMENTS AND DICTIONARY MF = 2EV/4/. UNRESOLVED RESONANCE REGION : UP TO 100 KEV THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTIONS. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: 1) EU-151 S0 = 3.699E-4, S1 = 0.100E-4, S2 = 3.000E-4, GG = 0.091 EV D0 = 0.408 EV, R = 6.870 FM. 2) ĔŬ-153 $\overline{S0} = 2.602E-4$, S1 = 1.394E-4, S2 = 2.946E-4, GG = 0.094 EV D0 = 1.489 EV, R = 6.421 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 4566.6 INTEGRALS (BARNS) TOTAL ELASTIC CAPTURE 4500.0 6.925 4559.7 4.637E-06 2202 (N, ALPHA) F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. " = 1 TOTAL BELOW 10 MEV, CALCULATED WITH THE CASTHY CODE/7/. THE OPTIC POTENTIAL PARAMETERS LISTED IN TABLE 1 USED. ABOVE 10 MEV, CROSS SECTION WAS DETERMINED FROM THE DATA OF FOSTER AND GLASGOW/8/ FOR NATURAL EU. THE OPTICAL MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51-71, 91 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/7/. THE LEVEL SCHEME USED IN THE CALCULATIONS WAS TAKEN FROM REF./9/ EU-151 EU-153

| NO | ΜT | ENERGY(ME | V) J-PARITY | NO. | МΤ | ENERGY(MEV) | J-PARITY |
|----------|----------|-----------|-------------|----------|-----|-------------|-------------|
| G.Ş | - 4 | 0.0 | 5/2+ | G.Ş | - 0 | 0.0 | 5/2+ |
| 1 | 51 | 0.02150 | //2+ | 1 | 52 | 0.0834 | //2+
5/2 |
| 23 | 50
50 | 0.19620 | 3/2+ | 23 | 54 | 0.0974 | 3/2- |
| 4 | 61 | 0.2432 | 7/2- | 4 | 55 | 0.1516 | 7/2- |
| 5 | Ğ2 | 0.2604 | 5/2+ | 5 | 56 | 0.1729 | 5/2+ |
| <u>6</u> | 64 | 0.3070 | 7/2+ | <u>6</u> | 57 | 0.1931 | 9/2+ |
| (| 65 | 0.3075 | 5/2+ | (| 60 | 0.2353 | 9/2- |
| å | 60
60 | 0.3490 | 9/2- | o
Q | 66 | 0.2097 | 11/2+ |
| 10 | 71 | 0.4160 | 7/2+ | 10 | 67 | 0.3251 | 11/2+ |
| | • • | | ., | 11 | 70 | 0.3964 | 9/2+ |
| CONT | 91 | 0.420 | | CONT | 91 | 0.400 | |

Q-VALUES OF EXCITED LEVELS WERE SHIFTED A LITTLE SO AS TO BE CONSISTENT WITH THRESHOLD ENERGIES.

MT = 102 CAPTURE CALCULATED FROM EU-151 AND -153 CAPTURE CROSS SECTIONS. THE EU-151 CAPTURE CROSS SECTION BELOW 2 MEV WAS DETERMINED BY EYE-GUIDING THE DATA MEASURED BY MACKLIN AND YOUNG/10/, AND ABOVE 2 MEV, JENDL-2 DATA CALCULATED WITH CASTHY WAS NORMALIZED TO MACKLIN AND YOUNG AT 2 MEV. FOR EU-153, EVALUATION FOR JENDL-2 WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ADDED, WHICH WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/11/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

Q-VALUE WAS DETERMINED BY WEIGHTED AVERAGE.

MT=16, 17, 22, 28, 103, 107 (N,2N), (N,3N), (N,NA), (N,NP), (N,P) AND (N,A) CROSS SECTIONS CALCULATED WITH THE GNASH CODE/12/ USING THE OPTICAL MODEL PARAMETERS IN TABLE 2, WHICH WERE DETERMINED SO AS TO REPRODUCE WELL THE TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/8/ FOR NATURAL EU. THE LEVEL SCHEME DATA WERE TAKEN FROM REF./9/. THE CALCULATED (N,2N) AND (N,3N) CROSS SECTIONS WERE MODIFIED ON THE BASIS OF THE EXPERIMENTAL DATA OF FREHAUT ET AL./13/ AND BAYHURT/14/, RESPECTIVELY.

THE (N,ALPHA) CROSS SECTION IN THE RESONANCE REGION WAS CALCULATED FROM RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF 9.0E-11 EV FOR EU-151 AND 2.0E-10 EV FOR EU-153 SO AS TO REPRODUCE THE THERMAL CROSS SECTION/6/. THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS. ABOVE THE RESOLVED RESONANCE REGION, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO THE GNASH CALCULATION.

MT = 251 MU-BAR CALCULATED WITH CASTHY/7/.

F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY/7/. FOR OTHER REACTIONS, THE ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH GNASH/12/. MF =

MF = 12 PHOTON PRODUCTION MULTIPLICITIES MT=102 (BELOW 21.6437 KEV) CALCULUATED FROM ENERGY BALANCE. MT=107 (BELOW 21.6437 KEV) CALCULUATED WITH GNASH CODE/12/.

- MF = 13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 21.6437 KEV) CALCULUATED WITH GNASH CODE/12/.

MF = 15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3, 102, 107 CALCULATED WITH GNASH CODE/12/. SPECTRA OF MT=102 AT 1.0E-5 EV AND 0.0253 EV WERE CALCULATED WITH CASTHY/7/.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS (FOR CASTHY)

| | | $ \begin{array}{l} V &= 43.71 \ - \ 0.0 \\ WS &= 7.696 \ , \\ R &= 1.270 \ , \\ A &= 0.60 \ , \end{array} $ | 566*EN,
= 1.440,
= 0.45, | VSO = 7.9
WV = 0.0
RSO = 1.280
ASO = 0.60 | (MEV)
(MEV)
(FM)
(FM) |
|-------------------------------------|--|---|---|--|---|
| TABL | E 2 | NEUTRON OPTICAL | POTENTIAL | PARAMETERS (FO | R GNASH) |
| | | $ \begin{array}{rrrr} V &=& 43.71 & - & 0.0 \\ WS &=& 7.696 , \\ R &=& 1.272 , \\ A &=& 0.48 , \end{array} $ | 5655*EN,
= 1.440,
= 0.45, | VSO = 0.0
WV = 0.0
RSO = 1.270
ASO = 0.48 | (MEV)
(MEV)
(FM)
(FM) |
| REFE
1)
2)
3)
4) | RENCE
KIKUC
RAHN
TASSA
MUGHA
VOL 1 | ES
CHI, Y. ET AL.: J
, F., ET AL.: PHY
AN, S., ET AL.: N
ABGHAB, S.F., GAR
1, RESONANCE PARA | AERI-M 86-
S. REV., C
UCL. SCI.,
BER, D.I.:
METERS", B | 030 (1986).
6, 251 (1972).
ENG., 10, 169
"NEUTRON CROS
NL 325, 3RD ED | (1961).
S SECTIONS,
., VOL. 1, |
| 5)
6) | ÀNUFF
MUGHA
PART | ŘÍĖV, V.A., ET AL
ABGHAB, S.F. ET A
A" ACADEMIC PRE | .: SOV. AT
L.: "NEUTR
SS (1981) | . ENERGY, 46,
ON CROSS SECTI | 182 (1979).
ONS, VOL. I, |
| 7)
8)
9)
10)
11)
12) | IGARA
FOSTE
ENSDF
MACKL
BENZI
YOUNG | ASI, S. AND FUKAH
ER JR.D.G. AND GL
F: EVALUATED NUCL
LIN, R.L. AND YOU
I, V. AND REFFO,
G. P.G. AND ARTHU | ŎŔI, Ŧ.: J
ASGOW D.W.
EAR STRUCT
NG, P.G.:
G.: CCDN-N
R, E.D.: L | AERI 1321 (199
: PHYS. REV.,
URE DATA FILE
NUCL. SCI. ENG
W/10 (1969).
A-6947 (1977). | 1).
C3, 576 (1971).
(JUNE 1987).
., 95, 189(1987). |

13) FRÉHAUT, J. ET AL.: DATA (1980) IN THE EXFOR FILE. 14) BAYHURST, B.P. ET AL.: PHYS. REV., C12, 451 (1975).

MAT number = 6325 63-EU-151 JAERI,JNDC EVAL-MAR89 T.ASAMI, JNDC FP ND W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 89-03 EVALUATION FOR JENDL-3 WAS MADE BY T.ASAMI(JAERI) AND JNDC FP NUCLEAR DATA W.G. DATA ARE THE SAME AS MAT=3631 OF JENDL-3 GENERAL PURPOSE FILE/2/. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=45T COMMENTS AND DIGITIONART MF = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.0982 KEV FOR JENDL-2, RESONANCE PARAMETERS WERE EVALUATED BY KIKUCHI ET AL./3/ THE PARAMETERS WERE ADOPTED MAINLY FROM THE DATA MEASURED BY RAHN ET AL./4/ FOR THE LOWEST 2 LEVELS, THE DATA OF TASSAN ET AL./5/ WERE ADOPTED. THE AVERAGE RADIATION WIDTH OF 0.093 EV/4/ WAS ASSUMED FOR THE LEVELS WHOSE RADIATION WIDTH WAS NOT MEASURED. A NEGATIVE RESONANCE WAS ADDED AT -0.00361 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 9200+-100 BARNS AT 0.0253 EV/6/. FOR JENDL-3, TOTAL SPIN J OF SOME LEVELS WAS ESTIMATED WITH A RANDOM NUMBER METHOD. UNRESOLVED RESONANCE REGION : 0.0982 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS S0, S1, S2 WERE BASED ON THE COMPILATION OF MUGHABGHAB/7/. THE OBSERVED LEVEL SPACING WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MACKLIN AND YOUNG/8/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 3.699E-4, S1 = 0.100E-4, S2 = 3.000E-4, SG = 2230.E-4, GG = 0.091 EV, R = 6.870 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL ELASTIC CAPTURE 9201 3.207 919**8** 3070 8.806E-06 (N, ALPHA) F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THEORETICAL CALCULATION WAS MADE BY USING THE OPTICAL AND STATISTICAL MODEL CODE CASTHY/9/ AND THE PREEQUILI-BRIUM AND STATISTICAL MODEL CODE GNASH/10/. THE OMP'S FOR NEUTRON ARE GIVEN IN TABLES 1 AND 2, WHICH WERE DETERMINED SO AS TO REPRODUCE THE TOTAL CROSS SECTION OF NATURAL EU MEASURED BY FOSTER AND GLASGOW/11/. THOSE FOR CHARGED PARTICLES ARE ADOPTED FROM MENET ET AL./12/ FOR PROTON AND FROM HUIZENGA AND IGO/13/ FOR ALPHA PARTICLE. MF T = 1 TOTAL BELOW 10 MEV, CALCULATION WITH CASTHY WAS ADOPTED. THE OPTICAL POTENTIAL PARAMETERS LISTED IN TABLE 1 WERE USED. ABOVE 10 MEV, THE CROSS SECTION WAS DETERMINED BY EYE-GUIDING TO THE DATA OF FOSTER AND GLASGOW/11/ FOR NATURAL EU. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). " = 4, 51-60, 91 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE. THE LEVEL SCHEME USED IN THE CALCULATIONS WAS TAKEN FROM REF./14/ SPIN-PARITY LEVEL ENERGY(MEV) N₀ 0.0 0.02150 0.19620 0.19650 0.2432 0.2604 0.2070 G S 1 2 5/2+ 7/2+ 11/2-3/2+ 7/2-5/2+ 7/2+ 5/2+ 3 4 5 0.3070 0.3075 67

9/2-

8

0.3498

| 9
10 | $\begin{array}{c} 0.3536 \\ 0.4160 \end{array}$ | | 7/2-
7/2+ | | | |
|---------|---|--------|--------------|----|----|--------------|
| LĔVELS | ABOVE 0.420 | MEV WE | RE AŚŚŪŃED | Т0 | ΒE | OVERLAPPING. |

MT = 102 CAPTURE BELOW 2 MEV, CROSS SECTION WAS DETERMINED BY EYE-GUIDING THE DATA MEASURED BY MACKLIN AND YOUNG/8/. ABOVE 2 MEV, JENDL-2 DATA CALCULATED WITH CASTHY WAS NORMALIZED TO MACKLIN AND YOUNG AT 2 MEV. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ADDED, WHICH WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFF0/15/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

MT=16, 17, 22, 28, 103, 107 (N,2N), (N,3N), (N,NA), (N,NP), (N,P) AND (N,A) CROSS SECTIONS CALCULATED WITH THE GNASH CODE USING THE OPTICAL MODEL PARAMETERS IN TABLE 2. THE LEVEL SCHEME DATA WERE TAKEN FROM REF./14/. THE CALCULATED (N,2N) AND (N,3N) CROSS SECTIONS WERE MODIFIED ON THE BASIS OF THE EXPERIMENTAL DATA OF FREHAUT ET AL./16/ AND BAYHURT/17/, RESPECTIVELY.

THE (N,ALPHA) CROSS SECTION IN THE RESONANCE REGION WAS CALCULATED FROM RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF 9.0E-11 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/7/. THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS. ABOVE 98.2 EV. THE CROSS SECTION WAS CONNECTED SMOOTHLY TO THE GNASH CALCULATION.

MT = 251 MU-BAR CALCULATED WITH CASTHY.

F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, THE ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

E = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH MF GNASH.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS (FOR CASTHY)

| | V = 43.71 - 0.0566*EN
WS = 7.696,
R = 1.270, RS = 1.44
A = 0.60, B = 0.45 | I, VSO = 7.9
WV = 0.0
O, RSO = 1.280
G, ASO = 0.60 | (MEV)
(MEV)
(FM)
(FM) |
|---|--|---|---|
| TABLE 2 | NEUTRON OPTICAL POTENT | IAL PARAMETERS (FO | R GNASH) |
| | $ \begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$ | N, VSO = 0.0 (
WV = 0.0
0, RSO = 1.270
5, ASO = 0.48 | MEV)
(MEV)
(FM)
(FM) |
| REFERENC
1) AOKI
AND
2) SHIE
3) KIKU
4) RAHM
5) TASS
6) MUGH | CES
I, T. ET AL.: PROC. INT.
APPLIED SCIENCE, SANTA
BATA, K., ET AL.: JAERI
JCHI, Y. ET AL.: JAERI-M
N, F., ET AL.: PHYS. REV
SAN, S., ET AL.: NUCL. S
HABGHAB, S.F., GARBER, D | CONF. ON NUCLEAR
FE., VOL. 2, P.162
1319 (1990).
186-030 (1986).
2. C6, 251 (1972).
3. ENG. 10, 169
: "NEUTRON CROS | DATA FOR BASIC
7 (1985).
(1961).
S SECTIONS, |
| VOL.
(197
7) MUGH
ACAD | .1, RESONANCE PARAMETERS
73)
HABGHAB, S.F.: "NEUTRON
DEMIC PRESS (1984) | S", BNL 325, 3RD ED
CROSS SECTIONS, VO | ., VOL. 1,
L. I, PART B", |
| 8) MACK
9) IGAR | KLIN, R.L. AND YOUNG, P.
RASI, S.: J. NUCL. SCI. | G.: NUCL. SCI. ENG
TECHNOL., 12, 67 (| ., 95, 189(1987).
1975). |

IGARAST, S.: J. NUCL. SCI. IECHNOL., 12, 67 (1975). YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977). FOSTER JR.D.G. AND GLASGOW D.W.: PHYS. REV., C3, 576 (197 MENET, J.J.H., ET AL.: PHYS. REV., C4, 1114 (1971). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). FREHAUT, J. ET AL.: DATA (1980) IN THE EXFOR FILE. BAYHURST, B.P. ET AL.: PHYS. REV., C12, 451 (1975). 10)

11) 12) 576 (1971).

13) 14) 15)

16)

MAT number = 6328 63-EU-152 JNDC EVAL-DEC90 JNDC FP NUCLEAR DATA W.G. DIST-DEC90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 90-12 STATISTICAL MODEL CALUCULATION WAS MADE BY RENORMALIZING THE CAPTURE CROSS SECTION. MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 6.55 EV. RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 WHICH WAS EVALUATED BY KIKUCHI ET AL./3/ AS FOLLOWS: PARAMETERS WERE ADOPTED FROM THE DATA MEASURED BY VERTEBNY ET AL./4/ A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB/5/. FOR JENDL-3, TOTAL SPIN J WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. MF = 2UNRESOLVED RESONANCE REGION : 0.00655 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB/5/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 3.600E-4, S1 = 0.600E-4, S2 = 2.200E-4, SG = 3050.E-4, GG = 0.160 EV, R = 6.200 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL ELASTIC CAPTURE 29.06 12770 2170 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE THE EU-NATURAL TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/8/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. NO. ENERGY(MEV) SPIN-PARITY 0.0 GŔ. 3 1 ŏ 0.0682 0.0723 0.0899 3 3 4 -4 5 + 0.0923 1

| 6 0.1081 5 +
7 0.1148 4 +
8 0.1258 1 -
9 0.1427 3 +
10 0.1478 8 -
11 0.1507 4 -
LEVELS ABOVE 0.17 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (11040.0E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 3400 MILLI-BARNS AT 50
KEV WHICH WAS 21 % LARGER THAN JENDL-2 CALCULATION/18/. |
| NOTE : RESULTS OF PREVIOUS INTEGRAL TEST OF JENDL-2/1,18/ WERE
REFLECTED IN THE PRESENT EVALUATION. |
| MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 33 (N,N'T) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =106 (N,HE3) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (= 150.7) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 7.19 MB (SYSTEMATICS OF FORREST/20/)
(N,ALPHA) 2.64 MB (SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM)
V = 44.77-0.0164E R0 = 6.788 A0 = 0.475
WS = 6.878-0.1408E RS = 7.685 AS = 0.45
VS0= 7.0 RS0= 6.788 AS0= 0.48
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL DENSITY PARAMETERS |
| NUCLIDESYST A(1/MEV)T(MEV)C(1/MEV)EX(MEV)PAIRING61-PM-1482.227E+014.300E-011.420E+012.672E+000.061-PM-1492.377E+014.890E-018.141E+005.075E+009.900E-0161-PM-1502.270E+013.800E-017.943E+001.973E+000.061-PM-1512.882E+014.260E-018.842E+004.956E+001.110E+00 |
| 62-SM-1492.325E+015.052E-015.886E+005.504E+001.220E+0062-SM-1502.362E+015.230E-011.520E+006.973E+002.210E+0062-SM-1512.687E+015.000E-012.313E+016.327E+001.220E+0062-SM-1522.375E+015.470E-012.365E+007.669E+002.330E+00 |

| 63-EU-150*2.325E+015.290E-019.836E+014.788E+000.063-EU-1512.511E+014.680E-018.573E+004.962E+009.900E-0163-EU-1522.484E+014.850E-018.700E+014.264E+000.063-EU-1532.195E+015.750E-011.698E+016.504E+001.110E+00 |
|--|
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 8.852 FOR EU-152 AND 8.954 FOR EU-153. |
| REFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE
AND TECHNOLOGY, MITO, P. 569 (1988).
2) KIKUNA VET. I. I. I. M. 80 (2006). |
| 4) VERTEBNY, V.P., ET AL.: SOV. J. NUCL. PHYS., 26, 601 (1977).
5) MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", |
| ACADEMIC PRESS (1984).
6) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
7) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
8) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576
(1971) |
| 9) PEREY, F.G: PHYS. REV. 131, 745 (1963).
10) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
11) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
12) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971) |
| 13) ĠIĽBĖŔŤ, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). |
| 14) ÌÌJÌMĂ, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). |
| 17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) WATANABE, T. ET AL.: JAERI-M 88-065, P. 148 (1988).
19) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
DEACTIONS" NORTH HOLLAND (1068) ATTER AND NUCLEAR |
| 20) FORREST, R.A.: AERE-R 12419 (1986). |

MAT number = 6331 63-EU-153 JEARI,JNDC EVAL-MAR89 T.ASAMI, JI DIST-OCT89 REV2-JAN94 JNDC FP ND W.G. HISTORY HISTORY
84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/
89-03 EVALUATION FOR JENDL-3 WAS MADE BY T.ASAMI(JAERI) AND JNDC FP NUCLEAR DATA W.G.
90-02 A RESONANCE AT 0.457 EV WAS REMOVED. THIS MODIFICATION WAS MADE ONLY FOR MAT=6303.
94-01 JENDL-3.2 MODIFIED BY T.NAKAGAWA (NDC/JAERI) MF = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY F = 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 EVALUATION WAS MADE BY KIKUCHI /2/. NEUTRON WIDTHS WERE
 OBTAINED BY AVERAGING THE DATA OF RAHN ET AL./3/ AND ANUFRIEV
 ET AL./4/. RADIATIVE CAPTURE WIDTHS WERE ADOPTED FROM THE
 DATA MEASURED BY RAHN ET AL. THE PARAMETERS OF 1.73-, 2.46-,
 3.29- AND 3.94-EV LEVELS WERE TAKEN FROM MUGHABGHAB /5/ SO AS
 TO REPRODUCE THE CAPTURE RESONANCE INTEGRAL OF 1420 +- 100
 BARNS RECOMMENDED IN REF./5/. A NEGATIVE RESONANCE WAS ADDED
 AT -0.5 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 39(
 +- 20 BARNS AND THE ELASTIC SCATTERING OF 8.0 +- 0.2 BARNS AT 390 +- 20 BARNS AND THE ELASTIC SCATTERING OF 8.0 +- 0.2 BARNS AT 0.0253 EV /6/. UNRESOLVED RESONANCE REGION : 0.0972 KEV - 100 KEV INITAL VALUES OF NEUTRON STRENGTH FUNCTIONS WERE THE SAME AS JENDL-2 CALCULATED WITH OPTICAL AND STATISTIACL MODEL CODE CASTHY/7/. THEY WERE ADJUSTED TO THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY FOR JENDL-2 WHICH WAS IN GOOD AGREEMENT WITH EXPERIMENTAL DATA BY MACKLIN AND YOUNG/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION AT 30 KEV. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV 100 KEV. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.602E-4, S1 = 1.394E-4, S2 = 2.946E-4, GG = 0.094 EV D0 = 1.489 EV, R = 6.421 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 323.0 10.33 312.7 7.1E-07 TOTAL ÉLASTIC 1410 (N, ALPHA) = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. MF = 3TOTAL BELOW 10 MEV, CALCULATED WITH THE CASTHY CODE/7/. THE OPTICAL POTENTIAL PARAMETERS LISTED IN TABLE 1 USED. ABOVE 10 MEV, DETERMINED FROM THE DATA OF FOSTER AND GLASGOW/9/ FOR NATURAL EU. = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). ΜT . = 4, 51 - 91 INELASTIC SCATTERING CALCULATED WITH THE CASTHY CODE/7/. THE LEVEL SCHEME USED IN THE CALCULATIONS WAS TAKEN FROM REF./10/ MT = 4NO LEVEL ENERGY(MEV) SPIN-PARITY 5/2+ 7/2+ 5/2-3/2+ 7/2-G.S. 1 2 0.0834 0.0974 3 4 0.1516

| 5
6
7
8
9
10
11
LEVELS | 0.1729
0.1931
0.2353
0.2697
0.3219
0.3251
0.3964
ABOVE 0.400 MEV WERE | 5/2+
9/2+
9/2-
7/2+
11/2-
11/2+
9/2+
E ASSUMED TO BE OVERLAPPING. |
|---|--|---|
| MT = 102 CAP
CALCULATION
FOLLOWING PO
AL. /11/ TO
SECTION. | TURE
FOR JENDL-2 WITH CA
DTENTIAL PARAMETERS
REPRODUCE A SYSTEMA | ASTHY/7/ WAS ADOPTED. THE
WERE DETERMINED BY IIJIMA ET
ATIC TREND OF THE TOTAL CROSS |
| V = 49
WS = 10
WS0= 7.0 | DEPTH (MEV) F
61 F
595 F
9 F | RADIUS(FM) DIFFUSENESS(FM)
R0 = 6.7926 A0 = 0.6
RS = 7.6483 AS = 0.45
RS0= 6.8461 AS0= 0.6 |
| PARAMETERS
CAMERON WER
SPIN CUT-OF
DEPENDENCE
E-JOINT IS | OR THE COMPOSITE LE
EVALUATED AS FOLLO
PARAMETER C1 WAS T
OF SPIN CUT-OFF PARA
DUE TO GRUPPELAAR /1 | EVEL DENSITY FORMULA OF GIRBERT-
OWS/12/. THE COEFFICIENT OF
TAKEN AS 0.146. THE ENERGY
AMETER IN THE ENERGY RANGE BELOW
13/.
EU-153 EU-154 |
| PAIRI
A (1/I
SPIN
NUCLE,
C (1/I
E-JOII | NG ENERGY (MEV)
MEV)
CUT-OFF PARAM.
AR TEMP.(MEV)
MEV)
MT (MEV) | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| THE GAMMA-R,
REPRODUCE T
BARNS AT 250
AND SEMI-DI
ACCORDING T
NORMALIZED | AY STRENGTH FUNCTION
HE EXPERIMENTAL CAPT
KEV MEASURED BY MA
RECT CAPTURE CROSS S
THE PROCEDURE OF E
TO 1 MILLI-BARN AT 1 | N (= 809.E-4) WAS ADJUSTED TO
TURE CROSS SECTION OF 680 MILLI-
ACKLIN AND YOUNG/8/. DIRECT
SECTIONS WERE ESTIMATED
BENZI AND REFFO/14/ AND
14 MEV. |
| MT=16, 17, 22
(N,P) AND
CALCULATED
PARAMETERS
REPRODUCE WI
GLASGOW/9/
FROM REF./10
NORMALIZED
DATA AROUND | 28, 103, 107 (N,2
(N,A) CROSS SECTIONS
WITH THE GNASH CODE/
IN TABLE 2, WHICH WE
ELL THE TOTAL CROSS
OR NATURAL EU. THE
O/. THE CALCULATED
(14.5 MEV/16,17,18,1 | 2N), (N,3N), (N,NA), (N,NP),
S
/15/ USING THE OPTICAL MODEL
ERE DETERMINED SO AS TO
SECTION MEASURED BY FOSTER AND
E LEVEL SCHEME DATA WERE TAKEN
(N,P) CROSS SECTION WAS
VERAGE VALUE OF THE EXPERIMENTAL
19/. |
| THE (N,ALPH,
CALCULATED
WIDTH OF 2.0
SECTION/5/.
ENERGY INTE
CONNECTED SI | A) CROSS SECTION IN
FROM RESONANCE PARAM
DE-10 EV SO AS TO RE
THE CROSS SECTION
RVALS. ABOVE 97.2 E
MOOTHLY TO THE GNASH | THE RESONANCE REGION WAS
METERS, BY ASSUMING A MEAN ALPHA
EPRODUCE THE THERMAL CROSS
WAS AVERAGED IN SUITABLE
EV, THE CROSS SECTION WAS
H CALCULATION. |
| MT = 251 MU-I
CALCULATED | BAR
VITH CASTHY/7/. | |
| MF = 4 ANGULAR
LEGENDRE POLYI
GIVEN IN THE
TIC LEVELS, AI
CALCULATED WI
DISTRIBUTIONS | DISTRIBUTIONS OF SE
IOMIAL COEFFICIENTS
CENTER-OF-MASS SYSTE
ID IN THE LABORATORY
TH CASTHY/7/. FOR C
IN THE LABORATORY S | ECONDARY NEUTRONS
FOR ANGULAR DISTRIBUTIONS ARE
EM FOR MT=2 AND DISCRETE INELAS-
Y SYSTEM FOR MT=91. THEY WERE
OTHER REACTIONS, ISOTROPIC
SYSTEM WERE ASSUMED. |
| MF = 5 ENERGY
ENERGY DISTRI
GNASH/15/. | DISTRIBUTIONS OF SEC
BUTIONS OF SECONDARY | CONDARY NEUTRONS
Y NEUTRONS WERE CALCULATED WITH |
| TABLE 1 NEUTRO | N OPTICAL POTENTIAL | PARAMETERS (FOR CASTHY) |
| V = 4:
WS = 7
R = 1
A = 0 | 8.71 - 0.0566*EN,
696,
270, RS = 1.440,
60, B = 0.45, | VSO = 7.9 (MEV)
WV = 0.0 (MEV)
RSO = 1.280 (FM)
ASO = 0.60 (FM) |
| TABLE 2 NEUTRO | N OPTICAL POTENTIAL | PARAMETERS (FOR GNASH) |

| $\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$ | 0.05655*EN,
RS = 1.440,
B = 0.45, | VSO = 0.0
WV = 0.0
RSO = 1.270
ASO = 0.48 | (MEV)
(MEV)
(FM)
(FM) |
|--|---|--|--------------------------------|
| NCES | | | |

REFERE

REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986).
RAHN, F., ET AL.: PHYS. REV., C6, 251 (1972).
ANUFRIEV, V.A., ET AL.: SOV. AT. ENERGY, 46, 182 (1979).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL.1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973).
IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
MACKLIN, R.L. AND YOUNG, P.G.: NUCL. SCI. ENG., 95, 189(1987).
FOSTER JR.D.G. AND GLASGOW D.W.: PHYS. REV., C3, 576 (1971).
EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983).

8) 9) 10)

11)

IIJIMA, S. AND KAWAI, M. S. ROCL COLLECTION (1983). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). YOUNG, P.G. AND ARTHUR, E.D.: LA-6947 (1977). COLEMAN, R.F. ET AL.: PROC. PHYS. SOC., 73, 215 (1959). QAIM, S.M.: DATA IN THE EXFOR FILE (1974). PRUYS, H.S. ET AL.: J. INORG. NUCL. CHEM., 37, 1587 (1975 BARI, A.: J. RADIOANAL. CHEM., 75, 189 (1982). 12)

13) 14)

15)

16) 17)

181

37, 1587 (1975). 19)

| MAT number = 6334
63-EU-154 JNDC | EVAL-DEC90 JNDC FP NUCLEAN | R DATA W.G. |
|---|---|--|
| HISTORY
84-10 EVALUATION FOR
90-03 MODIFICATION FO
90-12 STATISTICAL MOD
THE CAPTURE CRO
93-11 JENDL-3.2 WAS M | JENDL-2 WAS MADE BY JNDC FF
R JENDL-3 WAS MADE/2/.
EL CALUCULATION WAS MADE B'
SS SECTION.
ADE BY JNDC FPND W.G. | PND W.G./1/
/ RENORMALIZING |
| ***** MODIFIED
(2,151)
*********** | PARTS FOR JENDL-3.2
RESOLVED RESONANCE PARAME
RESONANCE PARAMETERS WERE | ΓERS. ΝΕGATIVE
MODIFIED. |
| MF = 1 GENERAL INFOR
MT=451 COMMENTS AND | MATION
DICTIONARY | |
| MF = 2 RESONANCE PAR.
MT=151 RESOLVED AND
RESOLVED RESONANCE
RESONANCE PARAMET
MENDATION BY MUGH.
ESTIMATED WITH A
NEGATIVE LEVEL WE
SECTION AND RESON. | AMETERS
UNRESOLVED RESONANCE PARAM
REGION (MLBW FORMULA) : BEI
ERS IN JENDL-2 WERE REPLACI
ABGHAB/3/. TOTAL SPIN J W/
RANDOM NUMBER METHOD. PAR/
RE ADJUSTED TO THE THERMAL
ANCE INTEGRAL MEASURED BY S | METERS
LOW 0.0262 KEV
ED WITH THE RECOM-
AS TENTATIVELY
AMETERS OF THE
CAPTURE CROSS
SEKINE ET AL./4/ |
| UNRESOLVED RESONANC
THE NEUTRON STREN
WITH OPTICAL MODE
THE OBSERVED LEVE
CAPTURE CROSS SEC
EFFECTIVE SCATTER
CALCULATED TOTAL
THE RADIATION WID
MUGHABGHAB /3/. | E REGION : 0.0262 KEV - 10(
GTH FUNCTIONS, S0, S1 AND S
L CODE CASTHY/5/.
L SPACING WAS DETERMINED T(
TION CALCULATED WITH CASTH'
ING RADIUS WAS OBTAINED FR(
CROSS SECTION AT 100 KEV.
TH WAS BASED ON THE COMPIL/ |) KEV
S2 WERE CALCULATED
) REPRODUCE THE
/. THE
DM FITTING TO THE
ATION OF |
| TYPICAL VALUES OF T
SO = 2.200E-4, S1
GG = 0 126 EV R | HE PARAMETERS AT 70 KEV:
= 0.940E-4, S2 = 2.300E-4
= 7.006 EM | , SG = 2740.E-4, |
| 00 = 01120211 | = 7.000 TWL | |
| CALCULATED 2200-M/S
TOTAL 18
ELASTIC
CAPTURE 18 | CROSS SECTIONS AND RES. IN
2200 M/S RES
48.2
6.581
41.6 118 | NTEGRALS (BARNS)
. INTEG.
30 |
| CALCULATED 2200-M/S
TOTAL 18
ELASTIC
CAPTURE 18
MF = 3 NEUTRON CROSS
BELOW 100 KEV, RESO
ABOVE 100 KEV, THE
CALCULATION WAS PER
COMPETING REACTIONS
WITH PEGASUS/6/ STAL
EVAPORATION MODEL.
DETERMINED SO AS TO
MEASURED BY FOSTER
PARTICLES ARE AS FO
PROTON = PEREY
AI PHA - HUITE | CROSS SECTIONS AND RES. IN
2200 M/S RES
48.2
6.581
41.6 118
SECTIONS
NANCE PARAMETERS WERE GIVEN
SPHERICAL OPTICAL AND STAT
FORMED WITH CASTHY, BY TAK
, OF WHICH CROSS SECTIONS N
NDING ON A PREEQUILIBRIUM /
THE OMP'S FOR NEUTRON GIV
THE OMP'S FOR NEUTRON GIV
THE OMP'S FOR NEUTRON GIV
REPRODUCE THE EU-NATURAL
AND GLASGOW/7/. THE OMP'S
LOWS:
/8/ | NTEGRALS (BARNS)
INTEG.
30
N.
ISTICAL MODEL
ING ACCOUNT OF
VERE CALCULATED
AND MULTI-STEP
EN IN TABLE 1 WERE
FOTAL CROSS SECTION
FOR CHARGED |
| CALCULATED 2200-M/S
TOTAL 18
ELASTIC
CAPTURE 18
MF = 3 NEUTRON CROSS
BELOW 100 KEV, RESO
ABOVE 100 KEV, THE
CALCULATION WAS PER
COMPETING REACTIONS
WITH PEGASUS/6/ STAI
EVAPORATION MODEL.
DETERMINED SO AS TO
MEASURED BY FOSTER,
PARTICLES ARE AS FO
PROTON = PEREY
ALPHA = HUIZEI
DEUTERON = LOHR,
HELIUM-3 AND TRI
PARAMETERS FOR THE MAND
PRESENT WORK. TABL
IN THE PRESENT CALC
PARAMETER IN THE EN
/14/. | CROSS SECTIONS AND RES. IN
2200 M/S RES
48.2
6.581
41.6 118
SECTIONS
NANCE PARAMETERS WERE GIVEN
SPHERICAL OPTICAL AND STAT
FORMED WITH CASTHY, BY TAK
, OF WHICH CROSS SECTIONS V
NDING ON A PREEQUILIBRIUM /
THE OMP'S FOR NEUTRON GIVE
REPRODUCE THE EU-NATURAL
AND GLASGOW/7/. THE OMP'S
LLOWS:
/8/
NGA AND IGO/9/
AND HAEBERLI/10/
TON = BECCHETTI AND GREENLE
COMPOSITE LEVEL DENSITY FOR
E EVALUATED BY IIJIMA ET AN
TION AND MODIFICATION WERE
E 2 SHOWS THE LEVEL DENSITY
ULATION. ENERGY DEPENDENCE
ERGY RANGE BELOW E-JOINT IS | NTEGRALS (BARNS)
INTEG.
SO
N.
ISTICAL MODEL
ING ACCOUNT OF
VERE CALCULATED
AND MULTI-STEP
EN IN TABLE 1 WERE
FOTAL CROSS SECTION
FOR CHARGED
ES/11/
RMULA OF GILBERT
IN TABLE 1 WERE
FOTAL CROSS SECTION
FOR CHARGED
ES/11/
RMULA OF GILBERT
IN THE
MADE IN THE
PARAMETERS USED
E OF SPIN CUT-OFF
S DUE TO GRUPPELAAR |
| CALCULATED 2200-M/S
TOTAL 18
ELASTIC
CAPTURE 18
MF = 3 NEUTRON CROSS
BELOW 100 KEV, RESO
ABOVE 100 KEV, RESO
ABOVE 100 KEV, THE
CALCULATION WAS PER
COMPETING REACTIONS
WITH PEGASUS/6/STAL
EVAPORATION MODEL.
DETERMINED SO AS TO
MEASURED BY FOSTER
PARTICLES ARE AS FO
PROTON = PEREY
ALPHA = HUIZEI
DEUTERON = LOHR
HELIUM-3 AND TRI
PARAMETERS FOR THE
AND CAMERON/12/WER
EXTENSIVE DETERMINA
PRESENT WORK. TABL
IN THE PRESENT CALC
PARAMETER IN THE EN
/14/.
MT = 1 TOTAL
SPHERICAL OPTICAL | CROSS SECTIONS AND RES. IN
2200 M/S RES
48.2
6.581
41.6 118
SECTIONS
NANCE PARAMETERS WERE GIVEN
SHERICAL OPTICAL AND STAT
FORMED WITH CASTHY, BY TAK
, OF WHICH CROSS SECTIONS N
NDING ON A PREEQUILIBRIUM
OF WHICH CROSS SECTIONS N
NDING ON A PREEQUILIBRIUM
THE OMP'S FOR NEUTRON GIVEN
REPRODUCE THE EU-NATURAL
AND GLASGOW/7/. THE OMP'S
LOWS:
/8/
NGA AND IGO/9/
AND HAEBERLI/10/
TON = BECCHETTI AND GREENLE
COMPOSITE LEVEL DENSITY FO
E EVALUATED BY IJJIMA ET AN
TION AND MODIFICATION WERE
E 2 SHOWS THE LEVEL DENSITY
ULATION. ENERGY DEPENDENCE
ERGY RANGE BELOW E-JOINT IS
MODEL CALCULATION WAS ADOF | NTEGRALS (BARNS)
INTEG.
NTEG.
NTEG.
NOTICAL MODEL
NG ACCOUNT OF
VERE CALCULATED
AND MULTI-STEP
EN IN TABLE 1 WERE
TOTAL CROSS SECTION
FOR CHARGED
EES/11/
RMULA OF GILBERT
./13/ MORE
MADE IN THE
(PARAMETERS USED
E OF SPIN CUT-OFF
S DUE TO GRUPPELAAR
PTED. |
| CALCULATED 2200-M/S
TOTAL 18
ELASTIC
CAPTURE 18
MF = 3 NEUTRON CROSS
BELOW 100 KEV, RESO
ABOVE 100 KEV, THE
CALCULATION WAS PER
COMPETING REACTIONS
WITH PEGASUS/6/STAI
EVAPORATION MODEL.
DETERMINED SO AS TO
MEASURED BY FOSTER,
PARTICLES ARE AS FO
PROTON = PEREY
ALPHA = HUIZEI
DEUTERON = LOHR,
HELIUM-3 AND TRI
PARAMETERS FOR THE MAND
CAMERON/12/WER
EXTENSIVE DETERMINA
PRESENT WORK. TABL
IN THE PRESENT CALC
PARAMETER IN THE EN
/14/.
MT = 1 TOTAL
SPHERICAL OPTICAL
MT = 2 ELASTIC SCA
CALCULATED AS (TO | CROSS SECTIONS AND RES. IN
2200 M/S RES
48.2
6.581
41.6 118
SECTIONS
NANCE PARAMETERS WERE GIVEN
SPHERICAL OPTICAL AND STAT
FORMED WITH CASTHY, BY TAK
, OF WHICH CROSS SECTIONS V
NDING ON A PREEQUILIBRIUM /
THE OMP'S FOR NEUTRON GIVEN
REPRODUCE THE EU-NATURAL
AND GLASGOW/7/. THE OMP'S
LOWS:
/8/
NGA AND IGO/9/
AND HAEBERLI/10/
TON = BECCHETTI AND GREENLE
COMPOSITE LEVEL DENSITY FOR
E EVALUATED BY IIJIMA ET AN
TION AND MODIFICATION WERE
E 2 SHOWS THE LEVEL DENSITY
ULATION. ENERGY DEPENDENCE
ERGY RANGE BELOW E-JOINT IS
MODEL CALCULATION WAS ADOF
TTERING
TAL - SUM OF PARTIAL CROSS | NTEGRALS (BARNS)
INTEG.
INTEG.
STICAL MODEL
ING ACCOUNT OF
VERE CALCULATED
AND MULTI-STEP
EN IN TABLE 1 WERE
TOTAL CROSS SECTION
FOR CHARGED
EES/11/
RMULA OF GILBERT
./13/ MORE
MADE IN THE
MADE IN THE
MADE IN THE
PARAMETERS USED
OF SPIN CUT-OFF
S DUE TO GRUPPELAAR
PTED.
SECTIONS). |
| CALCULATED 2200-M/S
TOTAL 18
ELASTIC
CAPTURE 18
MF = 3 NEUTRON CROSS
BELOW 100 KEV, RESO
ABOVE 100 KEV, RESO
ABOVE 100 KEV, THE
CALCULATION WAS PER
COMPETING REACTIONS
WITH PEGASUS/6/ STAI
EVAPORATION MODEL.
DETERMINED SO AS TO
MEASURED BY FOSTER.
PARTICLES ARE AS FO
PROTON = PEREY
ALPHA = HUIZEI
DEUTERON = LOHR.
HELIUM-3 AND TRI
PARAMETERS FOR THE MANDEL
AND CAMERON/12/ WER
EXTENSIVE DETERMINA
PRESENT WORK. TABL
IN THE PRESENT CALC
PARAMETER IN THE EN
/14/.
MT = 1 TOTAL
SPHERICAL OPTICAL
MT = 4, 51 - 91 IN
SPHERICAL OPTICAL
ADOPTED. THE LEV | CROSS SECTIONS AND RES. IN
2200 M/S RES
48.2
6.581
41.6 118
SECTIONS
NANCE PARAMETERS WERE GIVEN
SPHERICAL OPTICAL AND STAT
FORMED WITH CASTHY, BY TAK
, OF WHICH CROSS SECTIONS V
NDING ON A PREEQUILIBRIUM /
THE OMP'S FOR NEUTRON GIVE
REPRODUCE THE EU-NATURAL
AND GLASGOW/7/. THE OMP'S
LLOWS:
/8/
NGA AND IGO/9/
AND HAEBERLI/10/
TON = BECCHETTI AND GREENLE
COMPOSITE LEVEL DENSITY FO
E EVALUATED BY IJIMA ET AN
TION AND MODIFICATION WERE
E 2 SHOWS THE LEVEL DENSITY
ULATION. ENERGY DEPENDENCE
ERGY RANGE BELOW E-JOINT IS
MODEL CALCULATION WAS ADOF
TTERING
TAL - SUM OF PARTIAL CROSS
ELASTIC SCATTERING
AND STATISTICAL MODEL CALC
EL SCHEME WAS TAKEN FROM RE | NTEGRALS (BARNS)
INTEG.
INTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTEG.
NTE |

| 1 0.0682 4 +
2 0.0957 4 +
3 0.0971 5 +
4 0.1000 5 -
5 0.1008 4 +
6 0.1367 5 +
7 0.1800 8 -
LEVELS ABOVE 0.2 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|--|--|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFF0/16/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. | |
| THE GAMMA-RAY STRENGTH FUNCTION (2840.0E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 2610 MILLI-BARNS AT 50
KEV WHICH WAS 20 % LARGER THAN JENDL-2 CALCULATION/17/. | |
| NOTE : RESULTS OF PREVIOUS INTEGRAL TEST OF JENDL-2/1,17/ WERE
REFLECTED IN THE PRESENT EVALUATION. | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,N'D) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =105 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 183.4) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 4.32 MB (SYSTEMATICS OF FORREST/19/)
(N,ALPHA) 1.68 MB (SYSTEMATICS OF FORREST) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> | |
| MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS. | |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) | |
| V = 44.77-0.0164E R0 = 6.818 A0 = 0.475
WS = 6.878-0.1408E RS = 7.719 AS = 0.45
VSO= 7.0 RSO= 6.818 ASO= 0.48
THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING | |
| 61-PM-1502.270E+01 3.800E-01 7.943E+00 1.973E+00 0.061-PM-1512.882E+01 4.260E-01 8.842E+00 4.956E+00 1.110E+0061-PM-152*2.440E+01 5.242E-01 1.481E+02 5.009E+00 0.061-PM-1532.285E+01 4.950E-01 7.324E+00 4.895E+00 9.200E-01 | |
| 62-SM-1512.687E+015.000E-012.313E+016.327E+001.220E+0062-SM-1522.375E+015.470E-012.365E+007.669E+002.330E+0062-SM-1532.572E+015.160E-012.101E+016.405E+001.220E+0062-SM-1542.190E+015.600E-011.960E+007.188E+002.140E+00 | |

| | 63-EU-152 2.484E+01 4.850E-01 8.700E+01 4.264E+00 0.0 63-EU-153 2.195E+01 5.750E-01 1.698E+01 6.504E+00 1.110E+00 63-EU-154 2.267E+01 4.320E-01 1.644E+01 2.784E+00 0.0 63-EU-155 2.083E+01 5.200E-01 5.190E+00 4.837E+00 9.200E-01 |
|------------------|---|
| | SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| | SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 15.98 FOR EU-154 AND 8.187 FOR EU-155. |
| F
1
1 | REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL., 29, 195 (1992). 3) MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B",
ACADEMIC PRESS (1984). 4) SEKINE, T. ET AL.: APPL. RADIAT. ISOT., 38, 513 (1987). 5) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). 6) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 7) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576
(1971). 8) PEREY, F.G: PHYS. REV. 131, 745 (1963). 9) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 10) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). |
| ' | PHENOMENA, IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). |
| 1 | I2) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). |
| 1
1
1
1 | I3) ÌIJIMÁ, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
I4) GRUPPELAAR, H.: ECN-13 (1977).
I5) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
I6) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). |
| 1 | 17) WATANABE, I. EI AL.: JAEKI-M 88-065, P. 148 (1988).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS". NORTH HOLLAND (1968). |

19) FORREST, R.A.: AERE-R 12419 (1988).

MAT number = 6337 63-EU-155 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-SEP90 REV2-NOV93 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. 93-11 JENDL-3.2 WAS MADE BY JNDC FPND W.G. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF = 1 F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 29.7 EV RESONANCE PARAMETERS WERE BASED ON JENDL-2 EVALUATION BY KUKICHI ET AL./3/ WHICH WERE MADE ON THE BASIS OF THE DATA MEASURED BY ANUFRIEV ET AL./4/ A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB/5/. FOR JENDL-3, TOTAL SPIN J WAS TENTATIVELY ESTIMATED WITH A RANDOM NUMBER METHOD. PARAMETERS OF THE NEGATIVE LEVEL WERE ADJUSTED TO THE THERMAL CAPTURE CROSS SECTION AND RESONANCE INTEGRAL MEASURED BY SEKINE ET AL./6/ UNRESOLVED RESONANCE REGION : 0.0297 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, S0, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULA-TED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB/5/. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.300E-4, S1 = 0.500E-4, S2 = 2.300E-4, SG = 226.E-4, GG = 0.094 EV, R = 7.036 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 3765.0 INTEGRALS (BARNS) ELASTIC 6.566 3758.4 15600 CAPIURE 3758.4 15600 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV; THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE THE EU-NATURAL TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/9/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/. /16/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). * = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. NO ENERGY(MEV) SPIN-PARITY

| GR. | 0.0 | | 5/2 + | | |
|--------------|------------|------|-------------------------------|----|--------------|
| 1 | 0.0786 | | 7/2 + | | |
| 2 | 0.1043 | | 5/2 - | | |
| 3 | 0.1690 | | 7/2 - | | |
| 4 | 0.1800 | | 9/2 + | | |
| 5 | 0.2457 | | $\frac{3}{2} +$ | | |
| 6 | 0.3074 | | 5/2 + | | |
| (| 0.3570 | | $\frac{11}{2} - \frac{11}{2}$ | | |
| | 0.3920 | WEDE | | DE | |
| LEVELS ADOVE | 0.42 11161 | WENE | ASSUMED TO | DE | UVERLAFFING. |

MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.

THE GAMMA-RAY STRENGTH FUNCTION (2.08E-02) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.10 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (4.8 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS.

I = 16 (N,2N) CROSS SECTION I = 17 (N,3N) CROSS SECTION I = 22 (N,N'A) CROSS SECTION I = 28 (N,N'P) CROSS SECTION I = 32 (N,N'D) CROSS SECTION I = 103 (N,P) CROSS SECTION I = 104 (N,D) CROSS SECTION I = 104 (N,D) CROSS SECTION I = 105 (N,T) CROSS SECTION I = 107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16ΜŤ МŤ MT MT MT МŤ ΜT MŤ ΜT THE KALBACH'S CONSTANT K (= 186.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/19/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 3.35 MB (SYSTEMATICS OF FORREST/20/) (N,ALPHA) 1.34 MB (SYSTEMATICS OF FORREST)

MT = 251 MU-BAR CALCULATED WITH CASTHY.

MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING FROM OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF = 5

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| DEPTH (MEV) | RADIUS(FM) | DIFFUSENESS(FM) |
|--------------------------------|--------------------------|------------------------|
| V = 44.77-0.0164E | R0 = 6.833 | A0 = 0.475 |
| WS = 6.878-0.1408E
VSO= 7.0 | RS = 7.735
RSO= 6.833 | AS = 0.45
ASO= 0.48 |
| THE FORM OF SURFACE ABSORPTION | PART IS DER. | WOODS-SAXON TYPE. |

TABLE 2 LEVEL DENSITY PARAMETERS

| NUCLIDE | SYST | A(1/MEV) | T(MEV) | C(1/MEV) | EX(MEV) | PAIRING |
|---------------|------|-----------|-----------|-----------|-----------|-----------|
| 61 - PM - 151 | * | 2.882E+01 | 4.260E-01 | 8.842E+00 | 4.956E+00 | 1.110E+00 |
| 61 - PM - 152 | | 2.440E+01 | 5.242E-01 | 1.481E+02 | 5.009E+00 | 0.0 |
| 61 - PM - 153 | | 2.285E+01 | 4.950E-01 | 7.324E+00 | 4.895E+00 | 9.200E-01 |
| 61 - PM - 154 | | 2.312E+01 | 5.193E-01 | 7.816E+01 | 4.543E+00 | 0.0 |
| 62-SM-152 | | 2.375E+01 | 5.470E-01 | 2.365E+00 | 7.669E+00 | 2.330E+00 |
| 62-SM-153 | | 2.572E+01 | 5.160E-01 | 2.101E+01 | 6.405E+00 | 1.220E+00 |
| 62-SM-154 | | 2.190E+01 | 5.600E-01 | 1.960E+00 | 7.188E+00 | 2.140E+00 |
| 62-SM-155 | | 2.402E+01 | 5.080E-01 | 8.478E+00 | 5.767E+00 | 1.220E+00 |

| 63-EU-1532.195E+015.750E-011.698E+016.504E+001.110E+0063-EU-1542.267E+014.320E-011.644E+012.784E+000.063-EU-1552.083E+015.200E-015.190E+004.837E+009.200E-0163-EU-1562.084E+014.030E-016.286E+001.992E+000.0 |
|---|
| SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. |
| SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3).
IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE
ASSUMED TO BE 8.187 FOR EU-155 AND 1.324 FOR EU-156. |
| REFERENCES 1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC
AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985). 2) KAWAI, M. ET AL.: J. NUCL. SCI. TECHNOL. 29, 195 (1992). 3) KIKUCHI, Y. ET AL.: JAERI-M 86-030 (1986). 4) ANUFRIEV, V.A., ET AL.: SOV. AT. ENERGY, 46, 182 (1979). 5) MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B",
ACADEMIC PRESS (1984). 6) SEKINE, T. ET AL.: APPL. RADIAT. ISOT., 38, 513 (1987). 7) IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). 8) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). 9) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576
(1971). 10) PEREY, F.G: PHYS. REV. 131, 745 (1963). 11) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). 12) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). 13) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION
PHENOMENA IN NUCLEAR REACTIONS (EDS) H.H. BARSHALL AND
W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS.
(1971). 14) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446
(1965). 15) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). 16] GRUPPELAAR, H.: ECN-13 (1977). 17) LEDERER, C.M., ET AL.: TABLE OF ISOTOPES, 7TH ED.", WILEY-
INTERSCIENCE PUBLICATION (1978). 18) BENZI, V. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR
REACTIONS", NORTH HOLLAND (1968). 20) FORREST, R.A.: AERE-R 12419 (1986). |
| |

MAT number = 6340 63-EU-156 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
NO RESOLVED RESONANCE PARAMETERS MF UNRESOLVED RESONANCE REGION : 1 EV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/2/. THE OBSERVED LEVEL SPACING WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE SYSTEMATICS OF MEASURED VALUES FOR NEIGHBORING NUCLIDES. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.300E-4, S1 = 0.520E-4, S2 = 2.400E-4, SG = 42.1E-4, GG = 0.100 EV, R = 7.074 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 106.6 TOTAL ELASTIC CAPTURE 100.0 1430 F = 3 NEUTRON CROSS SECTIONS BELOW 1.0 EV, THE CAPTURE AND ELASTIC SCATTERING CROSS SECTIONS WERE ASSUMED TO BE IN 1/V FORM AND CONSTANT, RESPECTIVELY. THE CAPTURE CROSS SECTION AT 0.0253 EV WAS DETERMINED WITH THE SYSTEMATICS FROM THE NEIGHBORING NUCLIDES. THE SCATTERING CROSS SECTION WAS ESTIMATED FROM R = 7.3 FM. UNRESOLVED RESONANCE PARAMETERS WERE GIVEN IN THE ENERGY RANGE FROM 1.0 EV TO 100 MF = 3KEV. KEV. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/2/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/3/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED SO AS TO REPRODUCE THE EU-NATURAL TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/4/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/5/ ALPHA = HUIZENGA AND IGO/6/ DEUTERON = LOHR AND HAEBERLI/7/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/8/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/9/ WERE EVALUATED BY IIJIMA ET AL./10/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /11/. /11/ MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. - = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/12/ AND NUCLEAR DATA SHEETS/13/ NO. ENERGY(MEV) SPIN-PARITY GŘ. 0.0 Ò + 0.0226 1 1 Ò 3 0.0872 0.1253 0.2911 Λ 2 5 LEVELS ABOVE 0.33 MEV WERE ASSUMED TO BE OVERLAPPING.

MT = 102CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFF0/14/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (3.82E-03) WAS DETERMINED FROM THE SYSTEMATICS OF RADIATION WIDTH (0.1 EV) AND THE AVERAGE S-WAVE RESONANCE LEVEL SPACING (26.2 EV) CALCULATED FROM THE LEVEL DENSITY PARAMETERS. THE KALBACH'S CONSTANT K (= 223.6) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/15/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,P) 2.60 MB (SYSTEMATICS OF FORREST/16/) (N,ALPHA) 1.08 MB (SYSTEMATICS OF FORREST) -= 251 MU-BAR CALCULATED WITH CASTHY. МТ F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. E = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) RADIUS(FM) DIFFUSENESS(FM) . - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING , - - - - - - - - - - - - - -61-PM-152 * 2.440E+01 5.242E-01 1.481E+02 5.009E+00 0.0 61-PM-153 2.285E+01 4.950E-01 7.324E+00 4.895E+00 9.200E-01 61-PM-154 * 2.312E+01 5.193E-01 7.816E+01 4.543E+00 0.0 61-PM-155 * 2.246E+01 5.169E-01 1.385E+01 5.040E+00 7.300E-01 2.572E+01 5.160E-01 2.101E+01 6.405E+00 1.220E+00 2.190E+01 5.600E-01 1.960E+00 7.188E+00 2.140E+00 2.402E+01 5.080E-01 8.478E+00 5.767E+00 1.220E+00 2.260E+01 5.145E-01 1.309E+00 6.251E+00 1.950E+00 62 - SM - 153 62 - SM - 154 62 - SM - 155 62-SM-156 * 2.267E+01 4.320E-01 1.644E+01 2.784E+00 0.0 2.083E+01 5.200E-01 5.190E+00 4.837E+00 9.200E-01 2.084E+01 4.030E-01 6.286E+00 1.992E+00 0.0 1.975E+01 5.400E-01 6.628E+00 4.704E+00 7.300E-01 63-EU-154 63 - EU - 155 63 - EU - 156 63 - EU - 156 63 - EU - 157 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 1.324 FOR EU-156 AND 5.0 FOR EU-157.

REFERENCES

- (1) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
 2) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 3) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
 4) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576

- 4) FUSTER, D.G. JR. AND GLASGOW, D.W. THIO. REL., C., C., (1971).
 5) PEREY, F.G. PHYS. REV. 131, 745 (1963).
 6) HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962).
 7) LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974).
 8) BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971).
 9) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

- 9) GILBERT, A. AND GAMERUN, A.G.W.. GAN. J. THIO., 50, 1116
 (1965).
 10) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
 11) GRUPPELAAR, H.: ECN-13 (1977).
 12) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
 13) NUCLEAR DATA SHEETS, 49, 383 (1986).
 14) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
 15) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
 16) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6425 64-GD-152 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1 F = 2 RESONANCE PARAMETERS
 MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
 RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.66 KEV
 RESONANCE PARAMETERS BELOW 10 EV WERE EVALUATED ON THE
 BASIS OF MUGHABGHAB/2/.
 ABOVE 12 EV, PARAMETERS WERE ADOPTED FROM MACKLIN/3/. FOR
 THE RESONANCES ONLY WHOSE CAPTURE AREA WAS MEASURED, NEUTRON
 WIDTHS WERE DETERMINED FROM THE CAPTURE AREA AND AN AVERAGE
 RADIATION WIDTH OF 0.0586 EV/3/. THE TOTAL SPIN J AND ORBITAL
 ANGULAR MOMENTUM L WERE ASSIGNED BY CONSIDERING THE MAGNITUDE
 OF THE CAPTURE AREA OF EACH RESONANCE.
 A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE
 THERMAL CAPTURE CROSS SECTION OF 735+-20 BARNS AND THE CAPTURE
 RESONANCE INTEGRAL OF 2020+-160 BARNS/2/.
 SCATTERING RADIUS OF 8.2 FM WAS ESTIMATED FROM AN OPTICAL
 MODEL CALCULATION SHOWN IN FIG. 2 OF REF./2/. MF UNRESOLVED RESONANCE REGION : 2.66 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY BEER AND MACKLIN/5/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: SO = 4.600E-4, S1 = 1.100E-4, S2 = 2.400E-4, SG = 50.6E-4, GG = 0.054 EV, R = 3.918 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 1070 -ELASTIC CAPTURE (N,ALPHA) 13.92 1056 991 Ğ.957E-03 (N,ALPHA) 6.937E-03 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/6/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/7/ AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/8/ ALPHA = HUIZENGA AND IGO/9/ DEUTERON = LOHR AND HAEBERLI/10/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/11/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/12/ WERE EVALUATED BY IIJIMA ET AL./13/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /14/. /14/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/15/ AND NUCLEAR DATA MT SHEETS/16/ SPIN-PARITY NO. ENERGY(MEV) GŘ. 0.0 0 +

| 1 0.3443 2 +
2 0.6154 0 +
3 0.7554 4 +
4 0.9306 2 +
5 1.0478 0 +
6 1.1092 2 +
7 1.1232 3 -
8 1.2273 6 +
9 1.2823 4 +
10 1.3147 1 -
11 1.3184 2 +
12 1.4340 3 +
13 1.4605 1 -
14 1.4705 5 5 -
15 1.5502 4 +
16 1.6056 2 +
17 1.6434 2 -
18 1.6681 6 +
19 1.6924 4 +
20 1.7467 8 +
21 1.7560 1 -
22 1.7716 2 +
23 1.8077 4 +
24 1.8396 2 +
25 1.8615 5 +
26 1.8620 7 -
28 1.9154 2 +
29 1.9412 2 +
LEVELS ABOVE 1.975 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> |
| THE GAMMA-RAY STRENGTH FUNCTION (39.9E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 531 MILLI-BARNS AT 250
KEV MEASURED BY BEER AND MACKLIN/5/. |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 33 (N,N'D) CROSS SECTION
MT = 103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> |
| THE KALBACH'S CONSTANT K (= 104.0) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/18/ AND LEVEL
DENSITY PARAMETERS. |
| FINALLY, THE (N,P) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,P) 13.60 MB (SYSTEMATICS OF FORREST/19/)
(N,ALPHA) 4.62 MB (SYSTEMATICS OF FORREST) |
| THE (N,ALPHA) CROSS SECTION BELOW 2.66 KEV WAS CALCULATED FROM
RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF 4.5E-6
EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/2/. THE
CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS.
ABOVE 2.66 KEV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO
THE PEGASUS CALCULATION. |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. |
| <pre>MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.</pre> |

MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS

ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS DEPTH (MEV) DIFFUSENESS(FM) RADIUS(FM) - - - - - -- - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 2.097E+01 5.505E-01 1.055E+00 6.694E+00 2.140E+00 2.325E+01 5.052E-01 5.886E+00 5.504E+00 1.220E+00 2.362E+01 5.230E-01 1.520E+00 6.973E+00 2.210E+00 2.687E+01 5.000E-01 2.313E+01 6.327E+00 1.220E+00 62-SM-148 62-SM-149 62-SM-150 62-SM-151 63-EU-149 * 2.146E+01 5.314E-01 8.410E+00 5.238E+00 9.200E-01 63-EU-150 * 2.325E+01 5.290E-01 9.836E+01 4.788E+00 0.0 2.511E+01 4.680E-01 8.573E+00 4.962E+00 9.900E-01 63-EU-152 2.484E+01 4.850E-01 8.700E+01 4.264E+00 0.0

 64-GD-150
 *
 2.160E+01
 5.290E-01
 1.363E+00
 6.202E+00
 1.890E+00

 64-GD-151
 *
 2.340E+01
 5.266E-01
 1.595E+01
 5.750E+00
 9.700E-01

 64-GD-152
 2.470E+01
 4.810E-01
 1.302E+00
 6.106E+00
 1.960E+00

 2.484E+01
 5.130E-01
 2.189E+01
 5.847E+00
 9.700E-01

 64-GD-152 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.194 FOR GD-152 AND 5.0 FOR GD-153. REFERENCES REFERENCES

KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
MACKLIN, R.L.: NUCL. SCI. ENG. 95, 304 (1987).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
BEER, H. AND MACKLIN, R.: ASTROPHYSICAL J., 331, 1047(1988).
IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
IJJMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 8) 9) 10) 11) (1971). 12) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 12) GILBERT, A. AND GAMERUN, A.G.W., GAN, G. THIG, I.G., I.G., (1965).
13) IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
14) GRUPPELAAR, H.: ECN-13 (1977).
15) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE (JUNE 1987).
16) NUCLEAR DATA SHEETS, 30, 1 (1980).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
19) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6431 64-GD-154 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 90-03 NEW EVALUATION FOR JENDL-3 WAS COMPLETED BY JNDC FPND W.G./1/ F = 1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MF = 1F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 2.76 KEV RESONANCE PARAMETERS BELOW 486 EV WERE EVALUATED ON THE BASIS OF MUGHABGHAB/2/. ABOVE 486 EV, PARAMETERS WERE ADOPTED FROM MACKLIN/3/. FOI THE RESONANCES ONLY WHOSE CAPTURE AREA WAS MEASURED, NEUTRON WIDTHS WERE DETERMINED FROM THE CAPTURE AREA AND AN AVERAGE RADIATION WIDTH OF 0.088 EV/2/. THE TOTAL SPIN J AND ORBITAL ANGULAR MOMENTUM L WERE ASSIGNED BY CONSIDERING THE MAGNITUDE OF THE CAPTURE AREA OF EACH RESONANCE. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION OF 85+-12 BARNS/2/. SCATTERING RADIUS OF 8.0 FM WAS ESTIMATED FROM AN OPTICAL MODEL CALCULATION SHOWN IN FIG. 2 OF REF./2/. MF FOR UNRESOLVED RESONANCE REGION : 2.76 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/4/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.000E-4, S1 = 1.100E-4, S2 = 2.400E-4, SG = 45.9E-4, GG = 0.088 EV, R = 6.802 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 92.35 ELASTIC 7.356 TOTAL ELASTIC CAPTURE 84.99 215 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/5/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/6/ AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/7/ ALPHA = HUIZENGA AND IGO/8/ DEUTERON = LOHR AND HAEBERLI/9/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/10/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/11/ WERE EVALUATED BY IIJIMA ET AL./12/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /13/. /13/ MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS BASED ON EVALUATED NUCLEAR STRUCTURE DATA FILE (1987 VERSION)/14/ AND NUCLEAR DATA МТ SHEETS/15/. NO. GR. ENERGY(MEV) SPIN-PARITY 0.0 0 + Ŏ.Ĭ231 2

| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 4 +
0 +
6 +
2 +
2 +
4 +
3 +
8 +
1 -
3 -
4 +
0 +
5 -
6 +
2 -
1 -
2 +
5 +
2 +
4 -
6 +
3 -
4 +
2 -
1 -
2 +
5 -
6 +
2 -
1 -
2 +
5 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
8 +
7 -
7 -
8 +
7 -
7 -
8 +
7 |
|--|--|
| MT = 102 CAPTURE
SPHERICAL OPTICAL AND STAT
CASTHY WAS ADOPTED. DIREC
SECTIONS WERE ESTIMATED AC
AND REFFO/16/ AND NORMALIZ | ISTICAL MODEL CALCULATION WITH
T AND SEMI-DIRECT CAPTURE CROSS
CORDING TO THE PROCEDURE OF BENZI
ED TO 1 MILLI-BARN AT 14 MEV. |
| THE GAMMA-RAY STRENGTH FUN
REPRODUCE THE CAPTURE CROS
KEV MEASURED BY BEER AND M | CTION (42.8E-4) WAS ADJUSTED TO
S SECTION OF 680 MILLI-BARNS AT 50
ACKLIN/17/ |
| $\begin{array}{llllllllllllllllllllllllllllllllllll$ | N
N
ON
ON
TION
DNS WERE CALCULATED WITH THE
TEP EVAPORATION MODEL CODE PEGASUS. |
| THE KALBACH'S CONSTANT K (
FORMULA DERIVED FROM KIKUC
DENSITY PARAMETERS. | = 106.1) WAS ESTIMATED BY THE
HI-KAWAI'S FORMALISM/18/ AND LEVEL |
| FINALLY, THE (N,P) AND (N,
NORMALIZED TO THE FOLLOWIN
(N,P) 8.23 MB
(N,ALPHA) 2.91 MB | ALPHA) CROSS SECTIONS WERE
G VALUES AT 14.5 MEV:
(SYSTEMATICS OF FORREST/19/)
(SYSTEMATICS OF FORREST) |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS
LEGENDRE POLYNOMIAL COEFFICI
GIVEN IN THE CENTER-OF-MASS
TIC LEVELS, AND IN THE LABOR
CALCULATED WITH CASTHY. FOR
BUTIONS IN THE LABORATORY SY | OF SECONDARY NEUTRONS
ENTS FOR ANGULAR DISTRIBUTIONS ARE
SYSTEM FOR MT=2 AND DISCRETE INELAS-
ATORY SYSTEM FOR MT=91. THEY WERE
OTHER REACTIONS, ISOTROPIC DISTRI-
STEM WERE ASSUMED. |
| MF = 5 ENERGY DISTRIBUTIONS O
ENERGY DISTRIBUTIONS OF SECO
PEGASUS FOR INELASTIC SCATTE
OTHER NEUTRON EMITTING REACT | F SECONDARY NEUTRONS
NDARY NEUTRONS WERE CALCULATED WITH
RING TO OVERLAPPING LEVELS AND FOR
IONS. |
| TABLE 1 NEUTRON OPTICAL POTEN | TIAL PARAMETERS |
| V = 38.0
WS = 8.0
VS0= 7.0 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |

THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS

| | NUC | CLIDE | A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) | PAIRING |
|---|---|--|--|---|--|
| | 62 -
62 -
62 -
62 - | SM-150
SM-151
SM-152
SM-153 | 2.362E+01 5.230E-01
2.687E+01 5.000E-01
2.375E+01 5.470E-01
2.572E+01 5.160E-01 | 1.520E+00 6.973E+00
2.313E+01 6.327E+00
2.365E+00 7.669E+00
2.101E+01 6.405E+00 | 2.210E+00
1.220E+00
2.330E+00
1.220E+00 |
| | 63 -
63 -
63 -
63 - | EU - 151
EU - 152
EU - 153
EU - 154 | 2.511E+01 4.680E-01
2.484E+01 4.850E-01
2.195E+01 5.750E-01
2.267E+01 4.320E-01 | 8.573E+00 4.962E+00
8.700E+01 4.264E+00
1.698E+01 6.504E+00
1.644E+01 2.784E+00 | 9.900E-01
0.0
1.110E+00
0.0 |
| | 64 -
64 -
64 -
64 - | GD - 152
GD - 153
GD - 154
GD - 155 | 2.470E+01 4.810E-01
2.484E+01 5.130E-01
2.349E+01 5.270E-01
2.500E+01 5.100E-01 | 1.302E+00 6.106E+00
2.189E+01 5.847E+00
2.018E+00 6.893E+00
2.181E+01 5.822E+00 | 1.960E+00
9.700E-01
2.080E+00
9.700E-01 |
| | SPI
IN
ASS | N CUTOFF P/
THE CASTHY
SUMED TO BE | ARAMETERS WERE CALCU
CALCULATION, SPIN C
9.839 FOR GD-154 AN | LATED AS 0.146*SQRT(
UTOFF FACTORS AT 0 M
D 7.017 FOR GD-155. | A)*A**(2/3).
EV WERE |
| I | REFE
1)
2) | ERENCES
KAWAI, M. I
AND TECHNOI
MUGHABGHAB
ACADEMIC PI | ET AL.: PROC. INT. CU
LOGY, MITO, P. 569 (
, S.F.: "NEUTRON CROP
RESS (1984). | ONF. ON NUCLEAR DATA
1988).
SS SECTIONS, VOL. I, | FOR SCIENCE
PART B", |
| | 3)
4)
5)
6) | IGARASI, S
IIJIMA, S.
IIJIMA, S.
(1983). | AND KAWAI, M.: J. NI
ET AL.: JAERI-M 87-I
AND KAWAI, M.: J. N | , 95. 304 (1987).
HNOL., 12, 67 (1975)
025, P. 337 (1987).
UCL. SCI. TECHNOL., | 20, 77 |
| | 7)
8)
9)
10) | PEREY, F.G
HUIZENGA,
LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERL | : PHYS. REV. 131, 74
J.R. AND IGO. G.: NU
AND HAEBERLI, W.: N
F.D., JR. AND GREEN
IN NUCLEAR REACTIONS
I), P. 682, THE UNIV | 5 (1963).
CL. PHYS. 29, 462 (1
UCL. PHYS. A232, 381
LEES, G.W.: POLARIZA
((EDS) H.H. BARSHAL
ERSITY OF WISCONSIN | 962).
(1974).
TION
L AND
PRESS. |
| | 11) | GILBERT, A | . AND CAMERON, A.G.W | .: CAN. J. PHYS., 43 | , 1446 |
| | 12)
13)
14)
15)
16)
17)
18) | IJJIMA, S.
GRUPPELAAR
ENSDF: EVAI
NUCLEAR DA
BENZI, V.
BEER, H. AI
KIKUCHI, K
REACTIONS | , ET AL.: J. NUCL. S
, H.: ECN-13 (1977).
LUATED NUCLEAR STRUC
TA SHEETS, 26, 281 (
AND REFFO, G.: CCDN-1
ND MACKLIN, R.: ASTR
, AND KAWAI, M.: "NU
, NORTH HOLLAND (196) | CI. TECHNOL. 21, 10
TURE DATA FILE (JUNE
1979).
NW/10 (1969).
OPHYSICAL J., 331, 1
CLEAR MATTER AND NUC
8). | (1984).
1987).
047(1988).
LEAR |
| | 19) | FURREST, R | .a aeke-k 12419 (1 | 986). | |

MAT number = 6434 64-GD-155 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 0.1818 KEV RESONANCE PARAMETERS WERE BASED ON JENDL-2 EVALUATION. PARAMETERS OF 3 LEVELS BELOW 2.6 EV WERE TAKEN FROM THE DATA OF MOLLER ET AL./3/ THESE ABOVE 3.6 EV WERE BASED ON THE MEASURED DATA BY FRIESENHAHN ET AL./4/ AND BY RIBON/5/. THE AVERAGE RADIATION WIDTH OF 0.12865 EV WAS ASSUMED. SCATTERING RADIUS OF 6.7 FM WAS ADOPTED FROM BNL 325(3RD.)/6/. FOR JENDL-3, TOTAL SPIN J OF J-UNKNOWN LEVELS WAS ESTIMATED WITH A RANDOM NUMBER METHOD. MF UNRESOLVED RESONANCE REGION : 0.1818 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB/7/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 2.000E-4, S1 = 1.100E-4, S2 = 2.300E-4, SG = 1260.E-4, GG = 0.110 EV, R = 6.826 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. 2200 M/S TOTAL 60950 INTEGRALS (BARNS) RES. INTEG. TOTAL ELASTIC CAPTURE (N,ALPHA) 58.82 6089Ō 1540 8.175E-05 (N,ALPHA) 8.1/5E-05 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/10/, AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/11/ ALPHA = HUIZENGA AND IGO/12/ DEUTERON = LOHR AND HAEBERLI/13/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /17/. MF = 3/17/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. MT SPIN-PARITY ENERGY(MEV) NO 3/2 5/2 5/2 3/2 9/2 7/2 GŘ. 0.0 -0.0600 0.0865 1 2 3 0.1053 + 4 0.1076 + 0.1180 5 + 6 11/2 0.1215

| | LEVE | 7
90
11234567
11234567
1122224567
222
222
222
222
222
222
222
2 | BOVE | 0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0 | .146
.235
.266
.2286
.3226
.3390
.3922
.3390
.3922
.3390
.3922
.3390
.3922
.3390
.3922
.3390
.3922
.3555
.5552
.5552
.6611
.48 | 54320769510700052308009450V | WER | :E , | 73395335511171335553711339S
AS | //222222222222222222222222222222222222 | -++-+++++ | ТО | BE | 0V1 | ERL. | APP | ING | | |
|----|--|---|---|---|---|--|--|-----------------------------|------------------------------------|--|---------------------------------------|--------------------------------------|-----------------------------------|------------------------------------|-------------------------------|-------------------------------------|------------------------------------|------------------------------|---------------------|
| | MT = 102
SPHERI
CASTHY
SECTIO
AND RE | CAL
WAS
NS W
FF0/ | PTURE
OPTIO
ADOF
ERE E
19/ / | EAL
TED
ESTI
AND | AND
. [
MATE
NORM | STA
DIRE
ED A
MALI | ATIS
ECT
ACCO
ZED | ANI
ANI
ORD
T | CAL
DS
ING
01 | EMI
TC
MI | DE
 -D
) T
 LL | L C
IRE
HE
I-B | AL(
CT
PR(
ARI | CUL/
CAI
DCEI | ATI
PTU
DUR
T 1 | ON \
RE (
E OI
4 MI | VITH
CROS
F BE
EV. | H
SS
ENZ I | |
| | THE GA
REPROD
KEV ME
THE FI
OF REF | MMA-
UCE
ASUR
NAL
S./2 | RAY
THE
ED B
RESUI
0,21, | STRE
CAPT
Y SH
LTS
/. | NGTH
URE
ORIN
WERE | H FU
CRO
N ET
E DE | JNCT
)SS
 AL
ETER | 10
SE
./: | N (
CTI
20/
NED | 1.2
ON
AN
B) | 28E
OF
ND
(E | -01
15
BY
YE- |) \
20
NAI
GU | NAS
MII
KAJ
IDII | AD
LLI
IMA
NG | JUS ⁻
BAI
ET
OF | TED
RNS
AL
THE | T0
AT
./21
DAT | 100
/
A |
| | MT = 16
MT = 17
MT = 22
MT = 28
MT = 32
MT = 103
MT = 104
MT = 107
THESE
PREEQU | (N,
(N,
(N,
(N,
(N,
(N,
(N,
(N,
(N,
(N, | 2N) (
3N) (
N'P)
N'D) CF
D) CF
D) CF
ALPN
RIUM | CROS
CRO
CRO
CRO
CRO
CRO
CRO
SOSS
CRO
SOSS
CRO
SOSS
CRO
SOSS
CRO
SOSS
CRO
SOSS
CRO
SOSS
CRO
SOSS
CRO
CRO
CRO
CRO
CRO
CRO
CRO
CRO
CRO
CRO | S S S S S S S S S S S S S S S S S S S | | ON
ION
ION
ION
ON
ON
ION
ION
ION
ION
ION | ON
IS
P | WER | E (| | CUL | ATI | | WIT | H TI
ODE | HE
PE(| GASU | S. |
| | THE KA
FORMUL
DENSIT | LBACI
A DEI
Y PAI | H'S (
RIVEI
RAME | CONS
D FR
TERS | TAN
OM H | Γ Κ
ΚΙΚΙ | (=
ІНЭС | 14
- K | 7.6
AWA |) V
1 ' S | VAS
5 F | ES
ORM | TI!
AL | MATI
ISM | ED
/ 22 | BY -
/ AI | THE
ND L | _EVE | L |
| | FINALL
NORMAL
(N,P
(N,A | Y TI
IŻED
)
LPHA | HE (<u>1</u>
To (1 | N,P)
THE
6
2 | AN[
FOLI
. 41
. 33 | D (N
_OWI
Me
Me | N,AL
NG
3 (S
3 (S | PH
VA
YS
YS | A)
LUE
TEM
TEM | CRC
S A
ATI
ATI | | SE
14.
0F
0F | CT
5
F(| ION:
MEV
ORRI
ORRI | S W
:
EST
EST | ERE
/23.
) | /) | | |
| | THE (N
RESONA
1.45E-
THE CR
ABOVE
THE PE | ,ALP
NCE
10 E
OSS
181.
GASU | HA) (
PARAM
V SO
SECT
8 EV
S CAI | CROS
METE
AS
ION
, TH
LCUL | S SE
RS,
TO F
WAS
E CF
ATIO | ECTI
BY
REPF
AVE
ROSS | ON
ASS
ODU
RAG
SE | BE
UM
ICE
ED
CT | LOW
ING
TH
IN | 18
A
E 1
Sl
W <i>A</i> | 31.
ME
THE
JIT
\S | 8 E
AN
RMA
ABL
CON | V \
ALI
E I
NE(| VAS
PHA
CROS
ENEI
CTEI | CA
WI
SS
RGY
D S | LCUI
DTH
SEC
IN
MOO | LATE
OF
TION
TER\
THL\ | ED F
N/7/
/ALS
/ TO | ROM |
| | MT = 251
CALCUL | ATED | -BAR
WITH | H CA | STH | Υ. | | | | | | | | | | | | | |
| ΜF | = 4 AN
LEGENDRE
GIVEN IN
TIC LEVE
CALCULAT
BUTIONS | GULA
POL
THE
LS,
ED W
IN T | R DIS
YNOM
CEN ⁻
AND
ITH (
HE L/ | STRI
IAL
TER-
IN T
CAST
ABOR | BUT
COEF
OF-N
HE I
HY.
ATOF | IONS
FIC
MASS
ABC
FC
RY | G OF
LEN
S SY
DRAT
DR O
SYST | ST
ST
OR
EM | ECO
FO
EM
Y S
ER
WE | NDA
RA
FOF
YS1
REA
RE | ARY
ANG
R M
FEM
ACT
AS | NE
ULA
T=2
FO
ION
SUM | UTI
RI
AI
RI
S,
ED | RONS
DIS
ND I
MT=9
IS0 | S
TRI
DIS
91.
OTR | BUT
CRE
TI
OPI(| IONS
TE
HEY
C D | S AR
INEL
WER
ISTR | E
AS-
E
I- |
| MF | = 5 EN
ENERGY D | ERGY | | TRIB | | DNS
SEC | OF
COND | SE | CON
Y N | DAF | RY
FRO | NEU
NS | | | CAL | сигл | ATFI | וש כ | тн |

ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS.

TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS

| | DEPTH (MEV) | RADIUS(FM) DIFFUSENESS(FM) |
|---|---|--|
| V = 3
WS = 8
VS0=_7 | 88.0
3.0
7.0 | $ \begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$ |
| TABLE 2 LEVEL | SURFACE ABSORPTION I | PART IS DER. WOODS-SAXON TYPE. |
| TABLE 2 LEVEL | DENSITY PARAMETERS | |
| NUCLIDE | A(1/MEV) T(MEV) | C(1/MEV) EX(MEV) PAIRING |
| 62-SM-151
62-SM-152
62-SM-153
62-SM-154 | 2.687E+01 5.000E-0
2.375E+01 5.470E-0
2.572E+01 5.160E-0
2.190E+01 5.600E-0 | 1 2.313E+01 6.327E+00 1.220E+00
1 2.365E+00 7.669E+00 2.330E+00
1 2.101E+01 6.405E+00 1.220E+00
1 1.960E+00 7.188E+00 2.140E+00 |
| 63 - EU - 152
63 - EU - 153
63 - EU - 154
63 - EU - 155 | 2.484E+01 4.850E-0
2.195E+01 5.750E-0
2.267E+01 4.320E-0
2.083E+01 5.200E-0 | 1 8.700E+01 4.264E+00 0.0
1 1.698E+01 6.504E+00 1.110E+00
1 1.644E+01 2.784E+00 0.0
1 5.190E+00 4.837E+00 9.200E-01 |
| 64 - GD - 153
64 - GD - 154
64 - GD - 155
64 - GD - 156 | 2.484E+01 5.130E-0
2.349E+01 5.270E-0
2.500E+01 5.100E-0
2.254E+01 5.200E-0 | 1 2.189E+01 5.847E+00 9.700E-01
1 2.018E+00 6.893E+00 2.080E+00
1 2.181E+01 5.822E+00 9.700E-01
1 1.630E+00 6.286E+00 1.890E+00 |
| SPIN CUTOFF P
IN THE CASTHY
ASSUMED TO BE | PARAMETERS WERE CALCU
CALCULATION, SPIN (
7.017 FOR GD-155 AU | JLATED AS 0.146*SQRT(A)*A**(2/3).
CUTOFF FACTORS AT 0 MEV WERE
ND 9.458 FOR GD-156. |
| REFERENCES
1) AOKI, T. E
AND APPLIE
2) KAWAI, M.
AND TECHNO
3) MOLLER, H.
4) FRIESENHAH
5) RIBON, P.:
6) MUGHABGHAB
VOL. 1. RE | T AL.: PROC. INT. C(
D SCIENCE, SANTA FE
ET AL.: PROC. INT. (
DLOGY, MITO, P. 569
B., ET AL.: NUCL. S(
N, S.J., ET AL.: NUC
CEA-N-1149 (1969).
S.F. AND GARBER, I
SONANCE PARAMETERS" | DNF. ON NUCLEAR DATA FOR BASIC
., VOL. 2, P.1627 (1985).
CONF. ON NUCLEAR DATA FOR SCIENCE
(1988).
CI. ENG., 8, 183 (1960).
CL. PHYS., A146, 337 (1970).
D.I.: "NEUTRON CROSS SECTIONS,
. BNL 325. 3RD ED., VOL. 1. |
| (1973).
7) MUGHABGHAB
ACADEMIC P
8) IGARASI, S
9) IIJIMA, S.
10) IIJIMA, S. | 3, S.F.: "NEUTRON CR(
PRESS (1984).
5.: J. NUCL. SCI. TE(
ET AL.: JAERI-M 87
AND KAWAI, M.: J. 1 | DSS SECTIONS, VOL. I, PART B",
CHNOL., 12, 67 (1975).
-025, P. 337 (1987).
NUCL. SCI. TECHNOL., 20, 77 |
| 11) PEREY, F.G
12) HUIZENGA,
13) LOHR, J.M.
14) BECCHETTI,
PHENOMENA
W. HAEBERL | 5: PHYS. REV. 131, 74
J.R. AND IGO, G.: NU
AND HAEBERLI, W.: 1
F.D., JR. AND GREE
IN NUCLEAR REACTION
I), P. 682, THE UNI | 45 (1963).
JCL. PHYS. 29, 462 (1962).
NUCL. PHYS. A232, 381 (1974).
NLEES, G.W.: POLARIZATION
S ((EDS) H.H. BARSHALL AND
VERSITY OF WISCONSIN PRESS. |
| 15) GILBERT, A | A. AND CAMERON, A.G. | W.: CAN. J. PHYS., 43, 1446 |
| (1965).
16) IIJIMA, S.
17) GRUPPELAAR
18) MATSUMOTO,
19) BENZI, V.
20) SHORIN, V.
21) NAKAJIMA,
22) KIKUCHI, K
REACTIONS"
23) FORREST, R | , ET AL.: J. NUCL. (
, H.: ECN-13 (1977)
J.: PRIVATE COMMUN
AND REFFO, G.: CCDN
S., ET AL.: SOV., J
Y., ET AL.: ANN. NU(
C. AND KAWAI, M.: "NU
(, NORTH HOLLAND (199
2.A.: AERE-R 12419 (| SCI. TECHNOL. 21, 10 (1984).
ication (1981).
-NW/10 (1969).
., MUCL. PHYS., 19, 2 (1974).
CL. ENERGY, 16, 589 (1989).
JCLEAR MATTER AND NUCLEAR
38).
1986). |

MAT number = 6437 64-GD-156 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 2.214 KEV) RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2. EVALUATION FOR JENDL-2 WAS MADE ON THE BASIS OF THE DATA BY KARZHAVINA ET AL. /3/ AND BY COCEVA AND STEFANON/4/. THE AVERAGE RADIATION WIDTH OF 0.10611 EV WAS ASSUMED. SCATTERING RADIUS OF 8.1 FM WAS ADOPTED FROM BNL 325(3RD.)/5/. MF UNRESOLVED RESONANCE REGION : 2.214 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS SO, S1, S2 WERE BASED ON THE COMPILATION OF MUGHABGHAB/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY/7/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.700E-4, S1 = 0.550E-4, S2 = 2.600E-4, SG = 36.7E-4, GG = 0.088 EV, R = 7.363 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.991 -ELASTIC 4.804 -CAPTURE 2.188 121 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/8/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/9/, AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/10/ ALPHA = HUIZENGA AND IGO/11/ DEUTERON = LOHR AND HAEBERLI/12/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/13/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/14/ WERE EVALUATED BY IIJIMA ET AL./15/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /16/. /16/. MT = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). ΜТ F = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./17/. SPIN-PARITY NO. ENERGY(MEV) 0.0 0.0890 0.2882 0.5847 0.9651 1.0494 0 2 4 GR. + 1 + 345678 680220 + + + 1.1294 + 1.1541 1.1681

+

+

1 3 +

2

9 10

11

1.2424 1.2480

1.2580

 $\begin{array}{c} 1.2761\\ 1.2981\\ 1.3196\\ 1.3554\\ 1.3664\\ 1.4082\\ 1.4147\\ 1.4623\\ 1.5069\\ 1.5105\\ 1.5105\\ 1.5388\end{array}$ 12 3 4 13 + 14 15 16 17 18 19 20 21 2 4 + 1 5 10 + + 454350 + 21 1.5105 4 + 22 1.5388 3 + 23 1.6225 5 + 24 1.7152 0 + 25 1.7710 1 + 26 1.8279 2 + 27 1.8517 3 -LEVELS ABOVE 1.916 MEV WERE ASSUMED TO BE OVERLAPPING. MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/18/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (2.32E-03) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 480 MILLI-BARNS AT 50 KEV MEASURED BY SHORIN ET AL./19/ AND KONONOV ET AL./20/ T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T =103 (N,P) CROSS SECTION T =104 (N,D) CROSS SECTION T =105 (N,T) CROSS SECTION T =105 (N,T) CROSS SECTION T =107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16MŤ MT ΜT MŤ MŤ МŤ МŤ MT THE KALBACH'S CONSTANT K (= 145.7) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/21/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1700.00 MB (SYSTEMATICS OF WEN DEN LU+/22/) (N,P) 6.99 MB (SYSTEMATICS OF FORREST/23/) (N,ALPHA) 3.10 MB (RECOMMENDED BY FORREST/23/) MT = 251 MU-BAR CALCULATED WITH CASTHY. MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) ------------ - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

 62-SM-152
 2.375E+01
 5.470E-01
 2.365E+00
 7.669E+00
 2.330E+00

 62-SM-153
 2.572E+01
 5.160E-01
 2.101E+01
 6.405E+00
 1.220E+00

 62-SM-154
 2.190E+01
 5.600E-01
 1.960E+00
 7.188E+00
 2.140E+00

 62-SM-155
 2.402E+01
 5.080E-01
 8.478E+00
 5.767E+00
 1.220E+00

2.195E+01 5.750E-01 1.698E+01 6.504E+00 1.110E+00 2.267E+01 4.320E-01 1.644E+01 2.784E+00 0.0 2.083E+01 5.200E-01 5.190E+00 4.837E+00 9.200E-01 2.084E+01 4.030E-01 6.286E+00 1.992E+00 0.0 63-EU-153 63 - EU - 154 63 - EU - 155 63-EU-156 2.349E+01 5.270E-01 2.018E+00 6.893E+00 2.080E+00 2.500E+01 5.100E-01 2.181E+01 5.822E+00 9.700E-01 2.254E+01 5.200E-01 1.630E+00 6.286E+00 1.890E+00 2.278E+01 5.210E-01 1.077E+01 5.454E+00 9.700E-01 64-GD-154 64 - GD - 155 64 - GD - 156 64-GD-157 SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 9.458 FOR GD-156 AND 8.107 FOR GD-157. REFERENCES (EFERENCES)
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) KARZHAVINA, E.N., ET AL.: YAD. FIZ., 9, 897 (1969).
4) COCEVA, C., STEFANON, M.: NUCL. PHYS., A315, 1 (1979).
5) MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL. 1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973). MUGHABGHAB, 3., (1973). VOL. 1, RESONANCE PARAMETERS", BNL 323, 300 LD., (1973). MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). DEV 131 745 (1963). DEV 131 745 (1963). 6) 7 8) 9) (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 10) 11) 12) 13) 14) ĠĺĽ́BĖŔŤ, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 GILBERT, A. AND CAMERON, A.G.W.. CAN. J. THIC., IC, I.C. (1965). IJJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). MATSUMOTO, J.: PRIVATE COMMUNICATION (1981). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). SHORIN, V.S., ET AL.: SOV. J. NUCL. PHYS., 19, 2 (1974). KONONOV, V.N., ET AL.: SOV. J. NUCL. PHYS., 27, 5 (1978). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971). FORREST, R.A.: AERE-R 12419 (1986). 15)1ĕ) 17) 18) 19) 20) 21) 231

MAT number = 6440 64-GD-157 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 303.7 EV) RESONANCE PARAMETERS WERE BASED ON JENDL-2, AND TOTAL SPIN J OF SOME RESONANCES WAS ESTIMATED FOR JENDL-3 WITH A RANDOM NUMBER METHOD. EVALUATION FOR JENDL-2 WAS MADE ON THE BASIS OF THE DATA MEASURED BY MOLLER ET AL./3/, RIBON/4/ AND KARZHAVINA ET AL./5/ THE AVERAGE RADIATION WIDTH OF 0.121 EV WAS ASSUMED. THE SCATTERING RADIUS WAS TAKEN FROM MUGHABGHAB AND GARBER/6/ MF=2AND GARBER/6/ UNRESOLVED RESONANCE REGION : 0.3037 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTION SO WAS BASED ON THE COMPILATION OF MUGHABGHAB/7/, AND S1 AND S2 WERE CALCULATED WITH OPTICAL MODEL CODE CASTHY/8/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.900E-4, S1 = 1.100E-4, S2 = 2.300E-4, SG = 233.E-4, GG = 0.097 EV, R = 6.881 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. 255085 1007 TOTAL ELASTIC CAPTURE 254078 763 4.775E-04 (N, ALPHA) (N,ALPHA) 4.775E-04 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/9/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/10/, AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/11/ ALPHA = HUIZENGA AND IGO/12/ DEUTERON = LOHR AND HAEBERLI/13/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/14/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/15/ WERE EVALUATED BY IIJIMA ET AL./16/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /17/. /17/ MT = TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./18/. ΜТ NO. SPIN-PARITY ENERGY(MEV) 0.0 0.0545 0.0640 0.1158 GŔ. 3/2 5/2 5/2 7/2 7/2 ż + 34 + 0.1315 0.1810 0.2274 9/2 9/2 5 6 -7 0.3460 11/2

8 0.3600 13/2 + 9 0.4250 11/2 -10 0.4366 5/2 -11 0.4772 3/2 + 12 0.5170 7/2 -13 0.5270 5/2 + 14 0.6170 9/2 -15 0.6390 15/2 -16 0.6830 3/2 + 17 0.6850 1/2 + 18 0.6870 3/2 + 19 0.7000 3/2 -20 0.7040 1/2 -21 0.7210 9/2 + 22 0.7450 3/2 -23 0.7510 5/2 -24 0.7650 7/2 -25 0.7910 5/2 -26 0.8100 3/2 -27 0.8130 7/2 -28 0.8390 5/2 -28 0.8390 5/2 -20 CAPTUPE MT = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BEN AND REFFO/19/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. BENZI THE GAMMA-RAY STRENGTH FUNCTION (2.23E-02) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 560 MILLI-BARNS AT KEV MEASURED BY SHORIN ET AL./20/ AND BY NAKAJIMA ET AL. /21/ 100 F = 16 (N,2N) CROSS SECTION
F = 17 (N,3N) CROSS SECTION
F = 22 (N,N'A) CROSS SECTION
F = 28 (N,N'P) CROSS SECTION
F = 32 (N,N'D) CROSS SECTION
F = 103 (N,P) CROSS SECTION
F = 104 (N,D) CROSS SECTION
F = 105 (N,T) CROSS SECTION
F = 107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. $MT = 16 \\ MT = 17 \\ MT = 22 \\ MT =$ MT = 28MT = 32MT = 103МŤ МŤ MT THE KALBACH'S CONSTANT K (= 175.4) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/22/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N), (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1750.00 MB (SYSTEMATICS OF WEN DEN LU+/23/) (N,P) 5.40 MB (RECOMMENDED BY FORREST/24/) (N,ALPHA) 1.49 MB (SYSTEMATICS OF FORREST/24/) THE (N,ALPHA) CROSS SECTION BELOW 303.7 EV WAS CALCULATED FROM RESONANCE PARAMETERS, BY ASSUMING A MEAN ALPHA WIDTH OF 2.0E-10 EV SO AS TO REPRODUCE THE THERMAL CROSS SECTION/7/. THE CROSS SECTION WAS AVERAGED IN SUITABLE ENERGY INTERVALS. ABOVE 303.7 EV, THE CROSS SECTION WAS CONNECTED SMOOTHLY TO THE PEGASUS CALCULATION. MT = 251 MU-BAR CALCULATED WITH CASTHY/8/. F = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. MF = 4F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. MF TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DIFFUSENESS(FM) DEPTH (MEV) ----
R0 = 7.439 A0 = 0.47 RS = 7.439 AS = 0.52 RS0= 7.439 AS0= 0.47 PART IS DER. WOODS-SAXON TYPE. TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 2.572E+01 5.160E-01 2.101E+01 6.405E+00 1.220E+00 2.190E+01 5.600E-01 1.960E+00 7.188E+00 2.140E+00 2.402E+01 5.080E-01 8.478E+00 5.767E+00 1.220E+00 2.260E+01 5.145E-01 1.309E+00 6.251E+00 1.950E+00 62-SM-153 62-SM-154 62-ŠM-155 62-SM-156 2.267E+01 4.320E-01 1.644E+01 2.784E+00 0.0 2.083E+01 5.200E-01 5.190E+00 4.837E+00 9.200E-01 2.084E+01 4.030E-01 6.286E+00 1.992E+00 0.0 1.975E+01 5.400E-01 6.628E+00 4.704E+00 7.300E-01 63 - EU - 154 63 - EU - 155 63 - EU - 156 63-ĒŬ-157 2.500E+01 5.100E-01 2.181E+01 5.822E+00 9.700E-01 2.254E+01 5.200E-01 1.630E+00 6.286E+00 1.890E+00 2.278E+01 5.210E-01 1.077E+01 5.454E+00 9.700E-01 64-GD-155 64-GD-156 64-GD-157 2.155E+01 5.420E-01 2.479E+00 6.260E+00 1.700E+00 64-GD-158 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 8.107 FOR GD-157 AND 6.845 FOR GD-158. REFERENCES (EFERENCES
1) AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE. VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) MOLLER, H.B., ET AL.: NUCL. SCI. ENG., 8, 183 (1960).
4) RIBON, P.: CEA-N-1149 (1969).
5) KARZHAVINA, E.N., ET AL.: JADERNO-FIZICHESKIE ISSLEDOVANIJA, 6, 135 (1968). 6, 135 (1968).
6) MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL.1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973). (1973). MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984). IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). IJJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987). IJJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983) 7) 10)(1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND HAEBERLI, W.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 11) 12) 131 141 15) ĠIĽBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 15) GILBERT, A. AND CAMERON, A.G.W. CAN. S. THOL, I.C., (1965).
16) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
17) GRUPPELAAR, H.: ECN-13 (1977).
18) MATSUMOTO, J.: PRIVATE COMMUNICATION (1981).
19) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
20) SHORIN, V.S., ET AL.: SOV. J. MUCL. PHYS., 19, 2 (1974).
21) NAKAJIMA, Y., ET AL.: ANN. NUCL. ENERGY, 16, 589 (1989).
22) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
23) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
24) FORREST, R.A.: AERE-R 12419 (1986).

MAT number = 6443 64-GD-158 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 6.58 KEV) RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2 WHOSE EVALUATION WAS MADE AS FOLLOWS: PARAMETERS WERE MAINLY TAKEN FROM THE EXPERIMENTAL DATA OF RAHN ET AL./3/. THE AVERAGE RADIATIVE CAPTURE WIDTH OF 0.088 EV WAS ASSUMED. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB AND GARBER/4/. SCATTERING RADIUS OF 6.5 FM WAS ADOPTED FROM REF./4/. MF UNRESOLVED RESONANCE REGION : 6.58 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO AND S2 WERE BASED ON THE COMPILATION OF MUGHABGHAB/5/, AND S1 WAS CALCULATED WITH OPTICAL MODEL CODE CASTHY/6/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.500E-4, S1 = 1.100E-4, S2 = 1.900E-4, SG = 9.30E-4, GG = 0.105 EV, R = 7.119 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 6.354 ELASTIC 3.858 -CAPTURE 2.496 64.0 CAFIURE 2.496 64.0 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY. BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/8/, AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/. MF MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). * = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. SPIN-PARITY NO. ENERGY(MEV) 0.0 0.0795 0.2614 0 2 4 GR. + 1 + 0.5390 0.9771 345 67 6 1 2 3 4 + 1.0237 1.0416 1.1590 8 5 1.1760

| 9 1.1870 2 +
10 1.1960 0 +
11 1.2600 2 +
12 1.2640 1 -
13 1.2650 3 +
14 1.3580 4 +
15 1.3720 6 -
16 1.3810 4 +
17 1.4030 3 -
18 1.4070 4 +
19 1.4520 0 +
20 1.5170 2 +
21 1.6360 4 -
22 1.6670 4 +
23 1.7430 0 +
24 1.7920 2 +
25 1.7940 2 -
LEVELS ABOVE 1.85 MEV WERE ASSUMED TO BE OVERLAPPING. | |
|---|----------|
| <pre>MT = 102 CAPTURE
SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH
CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS
SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI
AND REFFO/17/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV.</pre> | |
| THE GAMMA-RAY STRENGTH FUNCTION (8.02E-4) WAS ADJUSTED TO
REPRODUCE THE CAPTURE CROSS SECTION OF 250 MILLI-BARNS AT 50
KEV MEASURED BY KONONOV ET AL./18/ AND SHORIN ET AL./19/ | |
| <pre>MT = 16 (N,2N) CROSS SECTION
MT = 17 (N,3N) CROSS SECTION
MT = 22 (N,N'A) CROSS SECTION
MT = 28 (N,N'P) CROSS SECTION
MT = 32 (N,P) CROSS SECTION
MT =103 (N,P) CROSS SECTION
MT =104 (N,D) CROSS SECTION
MT =105 (N,T) CROSS SECTION
MT =107 (N,ALPHA) CROSS SECTION
THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE
PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS.</pre> | |
| THE KALBACH'S CONSTANT K (= 145.5) WAS ESTIMATED BY THE
FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/20/ AND LEVEL
DENSITY PARAMETERS. | |
| FINALLY, THE (N,2N) AND (N,ALPHA) CROSS SECTIONS WERE
NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV:
(N,2N) 1800.00 MB (SYSTEMATICS OF WEN DEN LU+/21/)
(N,ALPHA) 2.30 MB (MEASURED BY LAKSHMANA+/22/) | |
| MT = 251 MU-BAR
CALCULATED WITH CASTHY. | |
| MF = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE
GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS
TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE
CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-
BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. | 3 -
- |
| <pre>MF = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH
PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR
OTHER NEUTRON EMITTING REACTIONS.</pre> | 1 |
| TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS | |
| $\begin{array}{c cccc} & \text{DEPTH} (\text{MEV}) & \text{RADIUS(FM)} & \text{DIFFUSENESS(FM)} \\ & V &= 38.0 & \text{RO} &= 7.439 & \text{AO} &= 0.47 \\ & \text{WS} &= 8.0 & \text{RS} &= 7.439 & \text{AS} &= 0.52 \\ & \text{VSO} &= 7.0 & \text{RSO} &= 7.439 & \text{ASO} &= 0.47 \\ & \text{THE FORM OF SURFACE ABSORPTION PART IS DER. WOODS-SAXON TYPE.} \end{array}$ | |
| TABLE 2 LEVEL DENSITY PARAMETERS | |
| NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING 62-SM-154 2.190E+01 5.600E-01 1.960E+00 7.188E+00 2.140E+00 62-SM-155 2.402E+01 5.080E-01 8.478E+00 5.767E+00 1.220E+00 62-SM-156 * 2.260E+01 5.145E-01 1.309E+00 6.251E+00 1.950E+00 62-SM-157 * 2.193E+01 5.121E-01 3.892E+00 5.288E+00 1.220E+00 | |

2.083E+01 5.200E-01 5.190E+00 4.837E+00 9.200E-01 2.084E+01 4.030E-01 6.286E+00 1.992E+00 0.0 1.975E+01 5.400E-01 6.628E+00 4.704E+00 7.300E-01 * 2.207E+01 5.096E-01 4.288E+01 4.059E+00 0.0 63-EU-155 63 - EU - 156 63 - EU - 157 63-EU-158 2.254E+01 5.200E-01 1.630E+00 6.286E+00 1.890E+00 2.278E+01 5.210E-01 1.077E+01 5.454E+00 9.700E-01 2.155E+01 5.420E-01 2.479E+00 6.260E+00 1.700E+00 2.308E+01 5.160E-01 1.099E+01 5.433E+00 9.700E-01 64-GD-156 64 - GD - 157 64 - GD - 158 64-GD-159 SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 6.845 FOR GD-158 AND 5.0 FOR GD-159. REFERENCES

AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
RAHN, F., ET AL.: PHYS. REV., C10, 1904 (1974).
MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL.1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973).
MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984).
IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IJIMA, S. AND KAWAI, M.: J. NUCL. SCI. TECHNOL., 20, 77 (1983). (1983). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1071) 9) 10) $\frac{11}{12}$ 13) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 13) GILBERT, A. AND CAMERUN, A.G.W.: CAN. J. PHIS., 43, 1440 (1965).
14) IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984).
15) GRUPPELAAR, H.: ECN-13 (1977).
16) LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978).
17) BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969).
18) KONONOV, V.N., ET AL.: SOV. J. NUCL. PHYS., 27, 5 (1978).
19) SHORIN, V.S., ET AL.: SOV. J. NUCL. PHYS., 19, 2 (1974).
20) KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968).
21) WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971).
22) LAKSHMANA, N., ET AL.: ANNALS OF NUCLEAR ENERGY, 8(6),283 (1982).

MAT number = 6449 64-GD-160 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW FORMULA) : BELOW 4.224 KEV RESONANCE PARAMETERS WERE TAKEN FROM JENDL-2. THE EXPERIMEN-TAL DATA OF RAHN ET AL./3/ WERE MAINLY ADOPTED TO JENDL-2. THE AVERAGE RADIATION WIDTH WAS ASSUMED TO BE 0.088 EV. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION GIVEN BY MUGHABGHAB/4.5/. SCATTERING RADIUS OF 6.8 FM WAS BASED ON THE RECOMMENDATION IN REF./4/. MF UNRESOLVED RESONANCE REGION : 4.224 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS SO, S1, S2 WERE BASED ON THE COMPILATION OF MUGHABGHAB /5/. THE OBSERVED LEVEL SPACING WAS DETERMINED TO REPRODUCE THE CAPTURE CROSS SECTION CALCULATED WITH CASTHY/6/. THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION AT 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 70 KEV: S0 = 1.600E-4, S1 = 0.500E-4, S2 = 1.300E-4, SG = 4.87E-4, GG = 0.111 EV, R = 7.440 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 4.901 ELASTIC 4.105 TOTAL ELASTIC CAPTURE 0.7961 12.0 MF = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/7/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE ADOPTED FROM IIJIMA AND KAWAI/8/, AND WS WAS CHANGED. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/9/ ALPHA = HUIZENGA AND IGO/10/ DEUTERON = LOHR AND HAEBERLI/11/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/12/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/13/ WERE EVALUATED BY IIJIMA ET AL./14/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR /15/. /15/. MT = 1 TOTAL SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. ' = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). MT = 2= 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./16/. МΤ NO. SPIN-PARITY ENERGY(MEV) 0.0 0.0753 GŔ. 0 2 1 + 0.2482 0.5140 0.8680 0.9890 1.0100 23456789 46822324 + + 1.0580 + 1.0710 + + 10 1.1850 4 +

| 1
1
1
LEVELS | 1
2
3
4
5
6
ABOVE 1. | 1.2250
1.22900
1.4260
1.4620
1.5690
1.6880
97 MEV WERE | 1 -
3 -
5 -
3 -
1 -
3 -
ASSUMED TO BE (| OVERLAPPING. |
|--|---|--|--|--|
| MT = 102
SPHERICA
CASTHY W
SECTIONS
AND REFF | CAPTURE
L OPTICAL
AS ADOPTE
WERE EST
0/17/ AND | AND STATIST
D. DIRECT A
IMATED ACCOR
NORMALIZED | ICAL MODEL CAL
ND SEMI-DIRECT
DING TO THE PR
TO 1 MILLI-BAR | CULATION WITH
CAPTURE CROSS
DCEDURE OF BENZI
N AT 14 MEV. |
| THE GAMM
REPRODUC
KEV MEAS | A-RAY STR
E THE CAP
URED BY S | ENGTH FUNCTI
TURE CROSS S
HORIN ET AL. | ON (3.056E-04)
ECTION OF 125
/18/ | WAS ADJUSTED TO
WILLI-BARNS AT 70 |
| MT = 16 (
MT = 17 (
MT = 22 (
MT = 28 (
MT = 33 (
MT = 103 (
MT =104 (
MT =105 (
MT =105 (
MT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =105 (
HT =1 | N,2N) CRC
N,3N) CRC
N,N'A) CR
N,N'P) CR
N,N'D) CR
N,N'D) CROS
N,P) CROS
N,D) CROS
N,ALPHA
ACTIOM AN | SS SECTION
SS SECTION
OSS SECTION
OSS SECTION
OSS SECTION
S SECTION
S SECTION
S SECTION
CROSS SECTION
CROSS SECTION
D MULTI-STEP | N
WERE CALCULATI
EVAPORATION MO | ED WITH THE
DDEL CODE PEGASUS. |
| THE KALB
ENERGY D
FREHAUT+ | ACH'S CON
EPENDENCE
/19/. | STANT K (=
OF THE (N,2 | 50.0) WAS DETEN
N) CROSS SECTIO | RMINED TO REPRODUCE
ON MEASURED BY |
| FINALLY,
NORMALIZ
(N,2N)
(N,P)
(N,ALP | THE (N,2
ED TO THE
170
HA) | N) (N.P) AND
FOLLOWING V
0.00 MB (TO
FR
1.84 MB (SY
2.00 MB (RE | (N,ALPHA) CRO
ALUES AT 14.51
REPRODUCE THE
EHAUT+/19/)
STEMATICS OF F(
COMMENDED BY F(| SS SECTIONS WERE
MEV:
DATA MEASURED BY
DRREST/20/)
DRREST/20/) |
| | | | | |
| MT = 251
CALCULAT | MU-BAR
ED WITH C | ASTHY. | | |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN
TIC LEVELS
CALCULATED
BUTIONS IN | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
, AND IN
WITH CAS
THE LABC | ASTHY.
IBUTIONS OF
COEFFICIENT
-OF-MASS SYS
THE LABORATO
THY. FOR OT
RATORY SYSTE | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
RY SYSTEM FOR I
HER REACTIONS,
M WERE ASSUMED | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI- |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT | ASTHY.
IBUTIONS OF
COEFFICIENT
-OF-MASS SYS'
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
S OF SECONDA
IC SCATTERIN
ING REACTION | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
RY SYSTEM FOR I
HER REACTIONS,
W WERE ASSUMED
ECONDARY NEUTRO
RY NEUTRONS WEI
G TO OVERLAPPII
S. | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI-
ONS
RE CALCULATED WITH
NG LEVELS AND FOR |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN T
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT
TABLE 1 NEU | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
, AND IN
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT
TRON OPTI | ASTHY.
IBUTIONS OF
COEFFICIENT
-OF-MASS SYS
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
S OF SECONDA
IC SCATTERIN
ING REACTION
CAL POTENTIA | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
HER REACTIONS,
W WERE ASSUMED
ECONDARY NEUTRONS WEI
G TO OVERLAPPII
S.
L PARAMETERS | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI-
ONS
RE CALCULATED WITH
NG LEVELS AND FOR |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN T
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT
TABLE 1 NEU
TABLE 1 NEU | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT
TRON OPTI
DEPTH
38.0
8.0
7.0
F SURFACE | ASTHY.
IBUTIONS OF
COEFFICIENT
-OF-MASS SYS'
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
S OF SECONDA
IC SCATTERIN
ING REACTION
CAL POTENTIA
(MEV)
 | SECONDARY NEUTI
TEM FOR ANGULAR I
TEM FOR MT=2 AI
HER REACTIONS,
W WERE ASSUMED
ECONDARY NEUTRONS WEI
G TO OVERLAPPII
S.
L PARAMETERS
RADIUS(FM)
 | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI-
DNS
RE CALCULATED WITH
NG LEVELS AND FOR
DIFFUSENESS(FM)
-A0 = 0.47
AS = 0.52
ASO= 0.47
DODS-SAXON TYPE. |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN T
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT
TABLE 1 NEU
VSO=
THE FORM O
TABLE 2 LEV | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT
TRON OPTI
DEPTH
38.0
7.0
F SURFACE
EL DENSIT | ASTHY.
IBUTIONS OF
COEFFICIENT
-OF-MASS SYST
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
S OF SECONDA
IC SCATTERIN
ING REACTION
CAL POTENTIA
(MEV)

ABSORPTION
Y PARAMETERS | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
HER REACTIONS,
W WERE ASSUMED
ECONDARY NEUTRO
RY NEUTRONS WEI
G TO OVERLAPPII
S.
L PARAMETERS
RADIUS(FM)
 | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
MT=91. THEY WERE
ISOTROPIC DISTRI-
ONS
RE CALCULATED WITH
NG LEVELS AND FOR
DIFFUSENESS(FM)
 |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT
TABLE 1 NEU
V =
WS =
VSO=
THE FORM O
TABLE 2 LEV
NUCLIDE SY | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
AND IN
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT
TRON OPTI
DEPTH
38.0
8.0
7.0
F SURFACE
EL DENSIT
ST A(1/ME | ASTHY.
IBUTIONS OF
COEFFICIENT
OF-MASS SYS
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
OF SECONDA
IC SCATTERIN
ING REACTION
CAL POTENTIA
(MEV)
ABSORPTION
Y PARAMETERS
V) T(MEV) | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
HER REACTIONS,
W WERE ASSUMED
ECONDARY NEUTRONS WEI
G TO OVERLAPPII
S.
L PARAMETERS
RADIUS(FM)
 | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI-
ONS
RE CALCULATED WITH
NG LEVELS AND FOR
DIFFUSENESS(FM)
A0 = 0.47
AS = 0.52
ASO= 0.47
DODS-SAXON TYPE.
(MEV) PAIRING |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT
TABLE 1 NEU
TABLE 1 NEU
TABLE 1 NEU
TABLE 2 LEV
NUCLIDE SY
62-SM-156
62-SM-157
62-SM-158
62-SM-159 | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT
TRON OPTI
DEPTH
38.0
7.0
F SURFACE
EL DENSIT
ST A (1/ME
* 2.193E
* 2.193E | ASTHY.
IBUTIONS OF
COEFFICIENT
-OF-MASS SYST
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
OF SECONDA
IC SCATTERIN
ING REACTION
CAL POTENTIA
(MEV)

ABSORPTION
Y PARAMETERS
V) T(MEV)

+01 5.145E-0
+01 5.096E-0
+01 5.072E-0 | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
HER REACTIONS,
W WERE ASSUMED
ECONDARY NEUTRONS WEI
G TO OVERLAPPII
S.
L PARAMETERS
RADIUS(FM)

RO = 7.439
RS = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
RSO = 7.439
R | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI-
DNS
RE CALCULATED WITH
NG LEVELS AND FOR
DIFFUSENESS(FM)
 |
| MT = 251
CALCULAT
MF = 4 ANGU
LEGENDRE P
GIVEN IN
TIC LEVELS
CALCULATED
BUTIONS IN
MF = 5 ENER
ENERGY DIS
PEGASUS FO
OTHER NEUT
TABLE 1 NEU
TABLE 1 NEU
TABLE 1 NEU
TABLE 1 NEU
TABLE 2 LEV
NUCLIDE SY
62-SM-157
62-SM-157
62-SM-158
63-EU-157
63-EU-158
63-EU-159
63-EU-160 | MU-BAR
ED WITH C
LAR DISTR
OLYNOMIAL
HE CENTER
AND IN
WITH CAS
THE LABC
GY DISTRI
TRIBUTION
R INELAST
RON EMITT
TRON OPTI
DEPTH
38.0
7.0
F SURFACE
EL DENSIT
ST A (1/ME
* 2.124E
* 2.055E
* 2.075E
* 2.068E | ASTHY.
IBUTIONS OF
COEFFICIENT
OF-MASS SYS
THE LABORATO
THY. FOR OT
RATORY SYSTE
BUTIONS OF S
OF SECONDA
IC SCATTERIN
ING REACTION
CAL POTENTIA
(MEV)
ABSORPTION
Y PARAMETERS
V) T(MEV)
+01 5.145E-0
+01 5.096E-0
+01 5.096E-0
+01 5.072E-0
+01 5.048E-0 | SECONDARY NEUTI
S FOR ANGULAR I
TEM FOR MT=2 AI
RY SYSTEM FOR I
HER REACTIONS,
WERE ASSUMED
ECONDARY NEUTRONS WEI
G TO OVERLAPPII
S.
L PARAMETERS
RADIUS(FM)
 | RONS
DISTRIBUTIONS ARE
ND DISCRETE INELAS-
WT=91. THEY WERE
ISOTROPIC DISTRI
ONS
RE CALCULATED WITH
NG LEVELS AND FOR
DIFFUSENESS(FM)
A0 = 0.47
AS = 0.52
ASO= 0.47
DODS-SAXON TYPE.
(MEV) PAIRING
251E+00 1.950E+00
288E+00 1.220E+00
756E+00 1.920E+00
824E+00 1.220E+00
704E+00 7.300E-01
059E+00 0.0
527E+00 7.000E-01 |

| 64 -
64 - | GD-160
GD-161 | 2.130E+01
2.277E+01 | 5.150E-01
5.000E-01 | 1 1.325E+
1 6.973E+ | 00 5.623E+
00 5.024E+ | 00 1.670E+00
00 9.700E-01 | |
|------------------------------|---|---|---|---|---|---|---|
| SY | 'ST: * = L | DP'S WERE D | DETERMINED | FROM SY | STEMATICS. | | |
| SPI
IN
ASS | N CUTOFF F
THE CASTHY
SUMED TO BE | PARAMETERS V
CALCULATIO
8.875 FOR | VERE CALCU
DN, SPIN (
GD-160 AM | JLATED AS
CUTOFF FA
ND 5.0 FC | 0.146*SQR
CTORS AT 0
R GD-161. | T(A)*A**(2/3)
MEV WERE | • |
| REFE
1)
2)
3)
4) | RENCES
AOKI, T. E
AND APPLIE
KAWAI, M.
AND TECHNO
RAHN, F.
MUGHÅBGHÅE
VOL: 1, RE | T AL : PRO
D SCIENCE,
ET AL.: PRO
DLOGY, MITO
ET AL.: PHI
3, S.F. AND
SONANCE PAF | C. INT. CC
SANTA FE.
DC. INT. C
P. 569 (
YS. REV.,
GARBER, E
RAMETERS"; | DNF. ON N
., VOL. 2
CONF. ON
(1988).
C10, 190
D.I.: "NE
, BNL 325 | UCLEAR DAT
P.1627 (
NUCLEAR DA
4 (1974).
UTRON CROS
, 3RD ED., | A FOR BASIC
1985)
TA FOR SCIENC
S SECTIONS,
VOL. 1, | E |
| 5)
6)
7)
8) | MUGHABGHAE
ACADEMIC F
IGARASI, S
IIJIMA, S.
IIJIMA, S.
(1983). | B, S.F.: "NE
RESS (1984)
S.: J. NUCL
ET AL.: JA
AND KAWAI | EUTRON CRO
).
SCI. TEO
AERI-M 87-
, M.: J. M | DSS SECTI
CHNOL., 1
-025, P.
NUCL. SCI | ONS, VOL.
2, 67 (197
337 (1987)
. TECHNOL. | I, PART B",
5).
, 20, 77 | |
| 9)
10)
11)
12) | PEREY, F.G
HUIZENGA,
LOHR, J.M.
BECCHETTI,
PHENOMENA
W. HAEBERL
(1971) | G: PHYS. REV
J.R. AND IC
AND HAEBEF
F.D., JR.
IN NUCLEAR
I), P. 682 | /. 131, 74
GO, G.: NU
RLI, W.: N
AND GREEN
REACTIONS
, THE UNIN | 45 (1963)
JCL. PHYS
NUCL. PHY
NLEES, G.
S ((EDS)
/ERSITY C | : 29, 462
S. A232, 3
W.: POLARI
H.H. BARSH
F WISCONSI | (1962).
81 (1974).
ZATION
ALL AND
N PRESS. | |
| 13) | GILBERT, A | A. AND CAMER | RON, A.G.V | V.: CAN. | J. PHYS., | 43, 1446 | |
| 14)
15)
16) | IJIMA, S.
GRUPPELAAF
LEDERER, C | , ET AL.: .
R, H.: ECN-
C.M., ET AL. | J. NUCL. 8
13 (1977)
.: "TABLE | SCI. TECH
OF ISOTO | NOL. 21, 1
PES, 7TH E | 0 (1984).
D.", WILEY- | |
| 17)
18)
19) | BENZI, V.
SHORIN, V.
FREHAUT, J
10-50MEV, | AND REFFO,
S., ET AL.:
J., ET AL.:
BNL, P.399 | G.: CCDN-
: SOV. J.
SYMP. ON
(1980) | -NW/10 (1
NUCL. PH
NEUTRON | 969).
 YS., 19, 2
CROSS SECT | (1974).
IONS FROM | |
| 20) | FORREST, F | R.A.: AERÉ-F | R`12419 (1 | 1986). | | | |

MAT number = 6525 65-TB-159 JNDC EVAL-MAR90 JNDC FP NUCLEAR DATA W.G. DIST-NOV90 HISTORY 84-10 EVALUATION FOR JENDL-2 WAS MADE BY JNDC FPND W.G./1/ 90-03 MODIFICATION FOR JENDL-3 WAS MADE/2/. F = 1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY MF F = 2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA (BELOW 1.188KEV) RESONANCE PARAMETERS WERE BASED ON JENDL-2 AND TOTAL SPIN J OF J-UNKNOWN RESONANCES WAS ESTIMATED WITH A RANDOM NUMBER METION MF OF J-UNKNOWN RESONANCES WAS ESTIMATED WITH A RANDOM NUMBER METHOD. IN THE JENDL-2 EVALUATION, RESONANCE PARAMETERS WERE MAINL' TAKEN FROM THE EXPERIMENTAL DATA BY OHKUBO AND KAWARASAKI/3/ AND BY DERRIEN AND ALIX/4/. THE AVERAGE RADIATION WIDTH WAS ASSUMED TO BE 0.097 EV. A NEGATIVE RESONANCE WAS ADDED AT -0.1 EV SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 25.5 +-1.1 BARNS AND THE ELASTIC SCATTERING OF 20+-2 BARNS AT 0.0253 EV/5/. SCATTERING RADIUS OF 8.3 FM WAS TAKEN FROM THE RECOMMENDATION BY MUGHABGHAB AND GARBER/5/. MAINLY UNRESOLVED RESONANCE REGION : 1.188 KEV - 100 KEV THE NEUTRON STRENGTH FUNCTIONS, SO, S1 AND S2, WERE BASED ON THE COMPILATION OF MUGHABGHAB/6/. THE PARAMETERS WERE ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY MIZUMOTO ET AL./7,8/ THE EFFECTIVE SCATTERING RADIUS WAS OBTAINED FROM FITTING TO THE CALCULATED TOTAL CROSS SECTION A' 100 KEV. THE RADIATION WIDTH GG WAS BASED ON THE COMPILATION OF MUGHABGHAB AT 100 KEV. THE OF MUGHABGHAB. TYPICAL VALUES OF THE PARAMETERS AT 80 KEV: S0 = 1.207E-4, S1 = 1.480E-4, S2 = 1.090E-4, SG = 537.E-4, GG = 0.097 EV, R = 7.058 FM. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS (BARNS) 2200 M/S RES. INTEG. TOTAL 47.39 ELASTIC 20.87 CAPTURE 26.52 471 F = 3 NEUTRON CROSS SECTIONS BELOW 100 KEV, RESONANCE PARAMETERS WERE GIVEN. ABOVE 100 KEV, THE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS PERFORMED WITH CASTHY/9/, BY TAKING ACCOUNT OF COMPETING REACTIONS, OF WHICH CROSS SECTIONS WERE CALCULATED WITH PEGASUS/10/ STANDING ON A PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. THE OMP'S FOR NEUTRON GIVEN IN TABLE 1 WERE DETERMINED TO REPRODUCE THE TB-159 TOTAL CROSS SECTION MEASURED BY FOSTER AND GLASGOW/11/. THE OMP'S FOR CHARGED PARTICLES ARE AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ AS FOLLOWS: PROTON = PEREY/12/ ALPHA = HUIZENGA AND IGO/13/ DEUTERON = LOHR AND HAEBERLI/14/ HELIUM-3 AND TRITON = BECCHETTI AND GREENLEES/15/ PARAMETERS FOR THE COMPOSITE LEVEL DENSITY FORMULA OF GILBERT AND CAMERON/16/ WERE EVALUATED BY IIJIMA ET AL./17/ MORE EXTENSIVE DETERMINATION AND MODIFICATION WERE MADE IN THE PRESENT WORK. TABLE 2 SHOWS THE LEVEL DENSITY PARAMETERS USED IN THE PRESENT CALCULATION. ENERGY DEPENDENCE OF SPIN CUT-OFF PARAMETER IN THE ENERGY RANGE BELOW E-JOINT IS DUE TO GRUPPELAAR (18/ /18/. ' = 1 TOTAL
SPHERICAL OPTICAL MODEL CALCULATION WAS ADOPTED. MT = . = 2 ELASTIC SCATTERING CALCULATED AS (TOTAL - SUM OF PARTIAL CROSS SECTIONS). ΜT " = 4, 51 - 91 INELASTIC SCATTERING SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS ADOPTED. THE LEVEL SCHEME WAS TAKEN FROM REF./19/. MT = 4NO. ENERGY(MEV) SPIN-PARITY 3/2 + 5/2 + 7/2 + 9/2 +0.0 GŘ. 1 0.1375 0.2414 2

5/2 +

3

4

0.3479

5 0.3626 11/2 + 6 0.3637 5/2 -7 0.3895 7/2 -8 0.4290 7/2 + 9 0.4552 9/2 -10 0.5106 13/2 + 11 0.5340 9/2 + 12 0.5457 11/2 -13 0.5483 7/2 -14 0.5809 1/2 + 15 0.6177 3/2 + 16 0.6690 15/2 + 17 0.6743 5/2 + 18 0.6787 9/2 -19 0.7613 7/2 + 20 0.7780 7/2 + 21 0.8230 11/2 -22 0.8550 3/2 -LEVELS ABOVE 0.86 MEV WERE ASSUMED TO BE OVERLAPPING. T = 102 CAPTURE SPHERICAL OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY WAS ADOPTED. DIRECT AND SEMI-DIRECT CAPTURE CROSS SECTIONS WERE ESTIMATED ACCORDING TO THE PROCEDURE OF BENZI AND REFFO/20/ AND NORMALIZED TO 1 MILLI-BARN AT 14 MEV. THE GAMMA-RAY STRENGTH FUNCTION (3.65E-02) WAS ADJUSTED TO REPRODUCE THE CAPTURE CROSS SECTION OF 1050 MILLI-BARNS AT KEV MEASURED BY MIZUMOTO ET AL./7,8/ THE RESULTS WERE MODIFIED BY TAKING ACCOUNT OF THE DATA MEASURED BY BLOCK ET AL./21/, GIBBONS ET AL./22/ AND POENITZ/23/. 70 T = 16 (N,2N) CROSS SECTION T = 17 (N,3N) CROSS SECTION T = 22 (N,N'A) CROSS SECTION T = 28 (N,N'P) CROSS SECTION T = 32 (N,N'D) CROSS SECTION T = 103 (N,P) CROSS SECTION T = 104 (N,D) CROSS SECTION T = 105 (N,T) CROSS SECTION T = 107 (N,ALPHA) CROSS SECTION THESE REACTION CROSS SECTIONS WERE CALCULATED WITH THE PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL CODE PEGASUS. MT = 16 MT = 17 MT = 22 MT = 28 MT = 32 MT = 33 MT = 103 MT = 104 MT = 105 МŤ МŤ THE KALBACH'S CONSTANT K (= 177.9) WAS ESTIMATED BY THE FORMULA DERIVED FROM KIKUCHI-KAWAI'S FORMALISM/24/ AND LEVEL DENSITY PARAMETERS. FINALLY, THE (N,2N) (N,P) AND (N,ALPHA) CROSS SECTIONS WERE NORMALIZED TO THE FOLLOWING VALUES AT 14.5 MEV: (N,2N) 1860.00 MB (SYSTEMATICS OF WEN DEN LU+/25/) (N,P) 4.70 MB (RECOMMENDED BY FORREST/26/) (N,ALPHA) 2.50 MB (RECOMMENDED BY FORREST) MT = 251 MU-BAR CALCULATED WITH CASTHY. ^E = 4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS LEGENDRE POLYNOMIAL COEFFICIENTS FOR ANGULAR DISTRIBUTIONS ARE GIVEN IN THE CENTER-OF-MASS SYSTEM FOR MT=2 AND DISCRETE INELAS-TIC LEVELS, AND IN THE LABORATORY SYSTEM FOR MT=91. THEY WERE CALCULATED WITH CASTHY. FOR OTHER REACTIONS, ISOTROPIC DISTRI-BUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED. F = 5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE CALCULATED WITH PEGASUS FOR INELASTIC SCATTERING TO OVERLAPPING LEVELS AND FOR OTHER NEUTRON EMITTING REACTIONS. TABLE 1 NEUTRON OPTICAL POTENTIAL PARAMETERS RADIUS(FM) DEPTH (MEV) DIFFUSENESS(FM) - - - - - - - - - -TABLE 2 LEVEL DENSITY PARAMETERS NUCLIDE SYST A(1/MEV) T(MEV) C(1/MEV) EX(MEV) PAIRING

63-EU-155 2.083E+01 5.200E-01 5.190E+00 4.837E+00 9.200E-01 2.084E+01 4.030E-01 6.286E+00 1.992E+00 0.0 1.975E+01 5.400E-01 6.628E+00 4.704E+00 7.300E-01 63 - EU - 156 63 - EU - 157 * 2.207E+01 5.096E-01 4.288E+01 4.059E+00 0.0 63-EU-158 2.254E+01 5.200E-01 1.630E+00 6.286E+00 1.890E+00 2.278E+01 5.210E-01 1.077E+01 5.454E+00 9.700E-01 2.155E+01 5.420E-01 2.479E+00 6.260E+00 1.700E+00 2.308E+01 5.160E-01 1.099E+01 5.433E+00 9.700E-01 64-GD-156 64-GD-157 64-GD-158 64-GD-159 2.439E+01 5.121E-01 1.937E+01 5.654E+00 9.200E-01 2.372E+01 5.096E-01 8.443E+01 4.501E+00 0.0 2.150E+01 5.150E-01 8.937E+00 4.738E+00 7.300E-01 2.172E+01 4.850E-01 2.558E+01 3.503E+00 0.0 65-TB-157 65-TB-158 65-TB-159 65-TB-160 -----SYST: * = LDP'S WERE DETERMINED FROM SYSTEMATICS. SPIN CUTOFF PARAMETERS WERE CALCULATED AS 0.146*SQRT(A)*A**(2/3). IN THE CASTHY CALCULATION, SPIN CUTOFF FACTORS AT 0 MEV WERE ASSUMED TO BE 10.5 FOR TB-159 AND 5.0 FOR TB-160. REFERENCES REFERENCES
AOKI, T. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE, SANTA FE., VOL. 2, P.1627 (1985).
2) KAWAI, M. ET AL.: PROC. INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, P. 569 (1988).
3) OHKUBO, M. AND KAWARASAKI, Y.: JAERI-M 7545 (1978).
4) DERRIEN, H. AND ALIX, M.: CEA-N-1867 (1975).
5) MUGHABGHAB, S.F. AND GARBER, D.I.: "NEUTRON CROSS SECTIONS, VOL. 1, RESONANCE PARAMETERS", BNL 325, 3RD ED., VOL. 1, (1973). VOL. 1, RESONANCE PARAMETERS, DNL 523, ONE 11, PART B", (1973).
6) MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS, VOL. I, PART B", ACADEMIC PRESS (1984).
7) MIZUMOTO, M., MACKLIN, R.L. AND HALPERIN, J.: PHYS. REV., C17, 522 (1978).
8) MACKLIN, R.L. WINTERS, R.R.: NUCL.SCI. ENG., 78, 110(1981).
9) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
10) IIJIMA, S. ET AL.: JAERI-M 87-025, P. 337 (1987).
11) FOSTER, D.G. JR. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). 9) 10) 11 Ì (1971). PEREY, F.G: PHYS. REV. 131, 745 (1963). HUIZENGA, J.R. AND IGO, G.: NUCL. PHYS. 29, 462 (1962). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974). BECCHETTI, F.D., JR. AND GREENLEES, G.W.: POLARIZATION PHENOMENA IN NUCLEAR REACTIONS ((EDS) H.H. BARSHALL AND W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971) 131 14) W. HAEBERLI), P. 682, THE UNIVERSITY OF WISCONSIN PRESS. (1971). 16) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 ĠIĽBEŔT, A. AND CAMERON, A.G.W.: CAN. J. FILLS., 40, FILL (1965). IIJIMA, S., ET AL.: J. NUCL. SCI. TECHNOL. 21, 10 (1984). GRUPPELAAR, H.: ECN-13 (1977). LEDERER, C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION (1978). BENZI, V. AND REFFO, G.: CCDN-NW/10 (1969). BLOCK, R.C., ET AL.: PROC. EANDC CONF. ON TIME OF FLIGHT METHOD, SACLAY, P.203 (1961). GIBBONS, J.H., ET AL.: PHYS. REV., 122, 182 (1961). POENITZ, W.P.: ANL-83-4, 239 (1982). KIKUCHI, K. AND KAWAI, M.: "NUCLEAR MATTER AND NUCLEAR REACTIONS", NORTH HOLLAND (1968). WEN DEN LU AND FINK, R.W.: PHYS. REV., C4, 1173 (1971). FORREST, R.A.: AERE-R 12419 (1986). 18 Ì 19) 20) 21) 22) 23) 24) 261

```
MAT number = 7200
72-HF- 0 NAIG+
                                                                                                                    EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI)
DIST-SEP89 REV2-JAN94
  HISTORY
  89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA
(NAIG) AND K.SHIBATA (JAERI).
94-01 JENDL-3.2.
COMPILED BY T.NAKAGAWA (NDC/JAERI)
                                  **** MODIFIED PARTS FOR JENDL-3.2
(3,2), (3,3), (3,4), (3,51-54), (3,58-62), (3,66-68)
(3,70-74), (3,76-78)
CURVES OF INELASTIC SCATTERING CROSS SECTIONS
WERE SMOOTHED BY ADDING INTERPOLATED VALUES AT
SEVERAL ENERGY POINTS.
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,102)
(3,10)
                              * * * * *
                                 (3,102)
(12,102)
                                                                                                MODIFIED.
       IF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
  MF = 1
            F=2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESONANCE REGION: 1.0E-5 EV TO 50 KEV
RESOLVED RESONANCES FOR MLBW FORMULA
MADE UP OF ISOTOPIC FILES.
UNRESOLVED RESONANCES
MADE UP OF ISOTOPIC FILES.
  MF=2
        MT=151
                                 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS.

2200 M/SEC RES. INTEG.

TOTAL 114.9 B -

ELASTIC 9.9 B -

CAPTURE 105.0 B 1996. B
CAPTURE 105.0 B 1996. B

MF=3 NEUTRON CROSS SECTIONS

BELOW 50 KEV :

NO BACKGROUND WAS GIVEN.

ABOVE 50 KEV :

MT=1 TOTAL

50 KEV - 110 KEV : MADE UP OF ISOTOPIC FILES.

110 KEV - 7.5 MEV: SPLINE-FUNCTION FITTING TO THE EXPERIMENTAL

DATA/1,2,3/

7.5 MEV - 20 MEV : MADE UP OF ISOTOPIC FILES.

MT=2 ELASTIC

0BTAINED BY SUBTRACTING A SUM OF PARTIAL REACTION CROSS SECTIONS

FROM THE TOTAL CROSS SECTION.

MT=3 NONELASTIC

SUM OF MT=4, 16, 17, 102, 103, 107.

MT=4 TOTAL INELASTIC

SUM OF MT=51-79, 91 INELASTIC

MADE UP OF ISOTOPIC FILES.

THE DISCRETE LEVELS WERE LUMPED.

MT=16,17,102,103,107 (N,2N),(N,GAMMA),(N,P),(N,ALPHA)

MADE UP OF ISOTOPIC FILES.

THE DISCRETE LEVELS WERE LUMPED.

MT=251 MU-BAR

CALCULATED FROM MF/MT=4/2.

ME=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
  MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-79,91
MADE UP OF ISOTOPIC FILES.
MT=16,17
       MT=16,17
ISOTROPIC IN THE LABORATORY SYSTEM.
  MF=5 ENERGY DISTRIBUTIONS O
MT=16,17,91
MADE UP OF ISOTOPIC FILES.
                              ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
  MF=12 PHOTON PRODUCTION MULTIPLICITIES
       MT=3,102
MADE UP OF ISOTOPIC FILES.
  MF=14 PHOTON ANGULAR DISTRIBUTIONS
MT=3,102
ISOTROPIC.
  MF=15 CONTINUOUS PHOTON ENERGY SPECTRA
MT=3,102
MADE UP OF ISOTOPIC FILES.
```

REFERENCES 1) SHERWOOD G.L. ET AL.: NUCL. SCI. ENG., 39, 67 (1970). 2) FOSTER JR. D.G. AND GLASGOW D.W.: PHYS. REV. C3, 576 (1971). 3) POENITZ W.P. AND WHALEN J.F.: ANL/NDM-80 (1983).

MAT number = 7225 72-HF-174 NAIG+ EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI) DIST-SEP89 REV2-JAN94 HISTORY 89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA (NAIG) AND K.SHIBATA (JAERI). 94-01 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * MODIFIED PARTS FOR JENDL-3.2 * * * * * * * * * * * * * * * * * * * (3,2), (3,4), (3,51), (3,52), (3,55-63), (3,65-68) CURVES OF INELASTIC SCATTERING CROSS SECTIONS WERE SMOOTHED BY ADDING INTERPOLATED VALUES AT SEVERAL ENERGY POINTS. * * * * * * * * * * * * * * * * GENERAL INFORMATION 51 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 MF=2GAM-GAMMA RADIUS UNRESOLVED RESONANCES ENERGY RANGE SO, S1, R AND GAM-GAMMA RESULTS ARE D-OBS = 13.4 R = 7.9 FM AND GAM-GAMMA = 0.054 EV. 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 576.4 B -ELASTIC 15.0 B -CAPTURE 561.5 B 363.8 B MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV : MF=3 NEUTRON GROUP BELOW 50 KEV : NO BACKGROUND WAS GIVEN. ABOVE 50 KEV : MT=1,2,4,51-68,91,102 TOTAL,ELASTIC,INELASTIC AND CAPTURE CALCULATED WITH ECIS /2/ AND CASTHY /3/. DEFORMED OPTICAL POTENTIAL FOR ECIS CALCULATION WAS DETERMINED SO AS TO REPRODUCE THE EXPERIMENTAL TOTAL CROSS SECTION OF NATURAL HAFNIUM, STARTING WITH THE HAOUAT POTENTIAL /4/. V0 = 47.05-0.3*EN, WS = 3.92+0.4*EN (EN<10), VSO = 6.2 (MEV), 7.92 (EN>10) AS = 0.52, ASO = 0.47 (FM), RSO = 1.12 (FM), $\begin{array}{c} \text{AO}=47.05\text{-}0.3 \text{ EN}, \text{ WS}=3.92\text{+}0.4 \text{ EN} (\text{EN}(10), \text{ VSO}=0.2 \text{ (MEV}),\\ 7.92 \text{ (EN>10)}\\ \text{AO}=0.63, \text{ AS}=0.52, \text{ ASO}=0.47 \text{ (FM}),\\ \text{RO}=1.24, \text{ RS}=1.24, \text{ RSO}=1.12 \text{ (FM}),\\ \text{BETA-2}=0.266, \text{ BETA-4}=0.0.\\ \text{THE DEFORMATION PARAMETER BETA-2 WAS DETERMINED FROM THE}\\ \text{MEASURED E2 TRANSITION PROBABILITY DATA /5/. THE LOWEST THREE}\\ \text{LEVELS BELONGING TO THE GROUND STATE ROTATIONAL BAND WERE}\\ \text{COUPLED IN THE CALCULATION. THE SPHERICAL OPTICAL POTENTIAL FOR}\\ \text{CASTHY CALCULATION IS THE SAME AS THAT OF JENDL-2.}\\ \text{VO}=38.0, \text{ WS}=8.0+0.5^*\text{SQRT(EN)}, \text{ VSO}=7.0 \text{ (MEV)},\\ \text{AO}=0.47, \text{ AS}=0.52 \text{ , ASO}=0.47 \text{ (FM)},\\ \text{RO}=1.32, \text{ RS}=1.32 \text{ , RSO}=1.32 \text{ (FM)}.\\ \text{COMPETING PROCESSES (N,2N) AND (N,3N) WERE CALCULATED WITH GNASH}\\ \text{/6/ AND FED TO ECIS-CASTHY CALCULATION. THE LEVEL FLUCTUATION}\\ \text{AND INTERFERENCE EFFECTS WERE CONSIDERED. LEVEL SCHEME WAS}\\ \text{TAKEN FROM TABLE OF ISOTOPES /7/.}\\ \text{NO. ENERGY(MEV) SPIN-PARITY}\\ G.S. 0.0 0 + t \text{ } \end{array}$ RO. NO. G.S. 1 ? ENERGY (1 0.0 0.2975 0.6084 0.8282 0.9002 1.0622 1.268 1.3034 0 ž + 2 4 6 0 3 4 + 2 4 2 5 + + + -67 1.3034 1.3087 1.3194 8 322344 4 ğ 10 + 11 12 13 1.3365 1.3947 + + 1.4253

5 4 1.4429 14 15 1.4429 1.4489 1.4964 1.5034 + 16 17 ż + 17 1.5034 3 T 18 1.6261 4 + CONTINUUM LEVELS ASSUMED ABOVE 1.6487 MEV. THE LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON'S FORMULA /8/ ARE THE SAME AS THOSE OF JENDL-2. A(1/MEV) C(1/MEV) T(MEV) EX(MEV) SIGMA**2 HF-174 23.09 2.31 0.477 5.01 7.47 HF-175 22.93 10.0 0.484 4.42 6.00 3 + MT=16,17 (N,2N), (N,3N) CALCULATED WITH GNASH /6/. THE TRANSMISSION COEFFICIENTS FOR THE INCIDENT CHANNEL WERE GENERATED WITH ECIS /4/, WHILE THOSE FOR THE EXIT CHANNELS WITH ELIESE-3 /9/. THE PREEQUILIBRIUM PARAME-TER F2 WAS ADJUSTED TO REPRODUCE THE MEASURED (N,2N) CROSS SECTION AT 14.5 MEV AND RESULTED IN F2=5.0. MT=251 MU-BAR CALCULATED WITH ECIS /2/ AND CASTHY /3/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-68,91 __CALCULATED WITH ECIS /2/ AND CASTHY /3/. MT=16,17 ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 CALCULATED WITH GNASH /6/. MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIES MT=16,17,91,102 CALCULATED WITH GNASH /6/ AND STORED UNDER OPTION-1 (PHOTON PRODUCTION MULTIPLICITIES). THE PHOTON STRENGTH FUNCTIONS FOR MOST NUCLEI WERE TAKEN FROM /1/, WHILE THOSE FOR SOME HAFNIUM ISOTOPES WERE DETERMINED FROM CAPTURE CROSS SECTION NORMALIZA-TION TO THE EXPERIMENTAL DATA. THE PHOTON PROFILE FUNCTION IS SUPERPOSITION OF THE BERMAN-TYPE GIANT DIPOLE RESONANCE /10/ AN THE PYGMY RESONANCE WHOSE PARAMETER VALUES WERE CITED FROM THE NEIGHBOURING NUCLEUS TA /11/. EG1 = 15.23, EG2 = 12.3, EP = 5.2 (MEV), GG1 = 4.48, GG2 = 2.43, GP = 2.5 (MEV), SIG-PYGMY/SIG-GDR = 0.0245. ĂND MT=51-68 STORED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAY). DATA WERE TAKEN FROM /7/. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,17,51-68,91,102 ISOTROPIC. MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=16,17,91,102 CALCULATED WITH GNASH /6/. REFERENCES ERENCES MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B (1984). RAYNAL J.: IAEA SMR-9/8 (1970). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). RAMAN S. ET AL.: AT. DATA NUCL. DATA TABLES, 36, 1 (1987). YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977). LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES 7TH EDITION Ξí ă١ 5 6) 7) (1979). GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IGARASI S.: JAERI-1224 (1972). BERMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975). IGASHIRA M. ET AL.: INT. SYMP. CAPTURE GAMMA-RAY SPECROSCOPY AND RELATED TOPICS - 1984, 523 (1985). 8) 9) 10) (11)

MAT number = 7231 72-HF-176 NAIG+ EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI) DIST-SEP89 REV2-JAN94 HISTORY 89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA (NAIG) AND K.SHIBATA (JAERI). 94-01 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) * MODIFIED PARTS FOR JENDL-3.2 (3,2), (3,4), (3,51), (3,55-73) CURVES OF INELASTIC SCATTERING CROSS SECTIONS WERE SMOOTHED BY ADDING INTERPOLATED VALUES AT SEVERAL ENERGY POINTS. * * * * * * * * * * * * * * * * GENERAL INFORMATION 51 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 #F=40T 2____ #F=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA ENERGY RANGE : 1.0E-5 EV TO 700 EV. RES. ENERGIES AND GAM-N : BNL-325 /1/. GAM-GAMMA : 0.060 EV ASSUMED IF UNKNOWN. RADIUS : 7.6 FM MF=2RADIUS UNRESOLVED RESONANCES ENERGY RANGE SO, S1, R AND GAM-GAMMA 700 EV TO 50 KEV. ADJUSTED SO THAT THE CALCULATED TOTAL AND CAPTURE CROSS SECTIONS WERE RESULTS ARE D-OBS = 55.2 EV, SO = 2.00E-4, S1 = 1.00E-4, R = 9.1 FM AND GAM-GAMMA = 0.054 EV. 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 29.03 B -ELASTIC 5.54 B -CAPTURE 23.48 B 894.1 B MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV : MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV : NO BACKGROUND WAS GIVEN. ABOVE 50 KEV : MT=1,2,4,51-73,91,102 TOTAL,ELASTIC,INELASTIC AND CAPTURE CALCULATED WITH ECIS /2/ AND CASTHY /3/. DEFORMED OPTICAL POTENTIAL FOR ECIS CALCULATION WAS DETERMINED SO AS TO REPRODUCE THE EXPERIMENTAL TOTAL CROSS SECTION OF NATURAL HAFNIUM, STARTING WITH THE HAOUAT POTENTIAL /4/. V0 = 46.89-0.3*EN, WS = 3.84+0.4*EN (EN<10), VSO = 6.2 (MEV), = 7.84 (EN>10) AO = 0.63, AS = 0.52, ASO = 0.47 (FM), RO = 1.24, RS = 1.24, RSO = 1.12 (FM), BETA-2 = 0.276, BETA-4 = 0.0. THE DEFORMATION PARAMETER BETA-2 WAS DETERMINED FROM THE MEASURED E2 TRANSITION PROBABILITY DATA /5/. THE LOWEST THREE LEVELS BELONGING TO THE GROUND STATE ROTATIONAL BAND WERE COUPLED IN THE CALCULATION. THE SPHERICAL OPTICAL POTENTIAL FOR CASTHY CALCULATION IS THE SAME AS THAT OF JENDL-2. V0 = 38.0, WS = 8.0+0.5*SQRT(EN), VSO = 7.0 (MEV), AO = 0.47, AS = 0.52 , ASO = 0.47 (FM), RO = 1.32, RS = 1.32 , RSO = 1.32 (FM). CAPTURE CROSS SECTION WAS NORMALIZED TO THE MEASURED DATA OF BEER ET AL. /6/ AT 30 KEV. COMPETING PROCESSES (N,2N), (N,3N), (N,P), AND (N, ALPHA) WERE CALCULATED WITH GNASH /7/ AND FED TO ECIS-CASTHY CALCULATION. THE LEVEL FLUCTUATION AND INTERFERENCE EFFECTS WERE CONSIDERED. LEVEL SCHEME WAS TAKEN FROM TABLE OF ISOTOPES /8/. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 0 + + , HY WERE 2S /8/. NO. G.S. 1 2 3 ENERGY(MEV) SPIN-PARITY 0.0 0.0883 0.2902 0.5970 0 2 4 + + + 3 4 6 8 0 + + + -0.9980 1.1499 1.2266 5 6 220 1.2200 1.2477 1.2932 1.3133 1.3413 8 + 3 -2 + 2 + 9 1 Ŏ 1.3794 11

| 12 1.4046 4 -
13 1.4458 3 +
14 1.5777 3 +
15 1.6434 1 -
16 1.6723 1 +
17 1.7046 2 +
18 1.7102 3 -
19 1.7221 1 -
20 1.7675 2 -
21 1.7861 3 +
22 1.7937 3 -
23 1.8190 0 -
CONTINUUM LEVELS ASSUMED ABOVE 1.8400 MEV.
THE LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON'S FORMULA
/9/ ARE THE SAME AS THOSE OF JENDL-2.
A(1/MEV) C(1/MEV) T(MEV) EX(MEV) SIGMA**2
HF-176 22.77 1.74 0.454 4.38 6.09
HF-177 22.61 9.06 0.486 4.38 9.45 |
|---|
| MT=16,17,103,107 (N,2N), (N,3N), (N,P) AND (N,ALPHA)
CALCULATED WITH GNASH /7/. THE TRANSMISSION COEFFICIENTS FOR
THE INCIDENT CHANNEL WERE GENERATED WITH ECIS /2/, WHILE THOSE
FOR THE EXIT CHANNELS WITH ELIESE-3 /10/. THE PREEQUILIBRIUM
PARAMETER F2 WAS ADJUSTED TO REPRODUCE THE MEASURED (N,2N) CROSS
SECTION AT 14.5 MEV AND RESULTED IN F2=5.0. |
| MT=251 MU-BAR
CALCULATED WITH ECIS /2/ AND CASTHY /3/. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-73,91
CALCULATED WITH ECIS /2/ AND CASTHY /3/.
MT=16,17
ISOTROPIC IN THE LABORATORY SYSTEM. |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,91
CALCULATED WITH GNASH /7/. |
| <pre>MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIESP
MT=16,17,91,102,103,107
CALCULATED WITH GNASH /7/ AND STORED UNDER OPTION-1 (PHOTON
PRODUCTION MULTIPLICITIES). THE PHOTON STRENGTH FUNCTIONS FOR
MOST NUCLEI WERE TAKEN FROM /1/, WHILE THOSE FOR SOME HAFNIUM
ISOTOPES WERE DETERMINED FROM CAPTURE CROSS SECTION NORMALIZA-
TION TO THE EXPERIMENTAL DATA. THE PHOTON PROFILE FUNCTION IS A
SUPERPOSITION OF THE BERMAN-TYPE GIANT DIPOLE RESONANCE /11/
AND THE PYGMY RESONANCE WHOSE PARAMETER VALUES WERE CITED FROM
THE NEIGHBOURING NUCLEUS TA /12/.
EG1 = 15.23, EG2 = 12.3, EP = 5.2 (MEV),
GG1 = 4.48, GG2 = 2.43, GP = 2.5 (MEV),
SIG-PYGMY/SIG-GDR = 0.0245.</pre> |
| MT=51-73
STORED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAY). DATA WERE
TAKEN FROM /8/. |
| MF=14 PHOTON ANGULAR DISTRIBUTIONS
MT=16,17,51-68,91,102,103,107
ISOTROPIC. |
| MF=15 CONTINUOUS PHOTON ENERGY SPECTRA
MT=16,17,91,102,103,107
CALCULATED WITH GNASH /7/. |
| REFERENCES MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B (1984). RAYNAL J.: IAEA SMR-9/8 (1970). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). RAMAN S. ET AL.: AT. DATA NUCL. DATA TABLES, 36, 1 (1987). BEER H. ET AL.: PHYS. REV., C30, 464 (1984). YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977). LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES 7TH EDITION (1979). GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IGARASI S.: JAERI-1224 (1972). BERMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975). IGASHIRA M. ET AL.: INT. SYMP. CAPTURE GAMMA-RAY SPECROSCOPY AND RELATED TOPICS - 1984, 523 (1985). |

MAT number = 7234 72-HF-177 NAIG+ EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI) DIST-SEP89 REV2-JAN94 HISTORY 89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA (NAIG) AND K.SHIBATA (JAERI). 94-01 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) (3,2), (3,4), (3,51-57), (3,59), (3,61), (3,62-65) CURVES OF INELASTIC SCATTERING CROSS SECTIONS WERE SMOOTHED BY ADDING INTERPOLATED VALUES AT SEVERAL ENERGY POINTS. * GENERAL INFORMATION 51 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 #F=401 0221 #F=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA ENERGY RANGE : 1.0E-5 EV TO 250 EV. RES. ENERGIES AND GAM-N : BNL-325 /1/. GAM-GAMMA : 0.065 EV ASSUMED IF UNKNOWN. RADIUS : 7.0 FM MF=2RADIUS UNRESOLVED RESONANCES ENERGY RANGE SO, S1, R AND GAM-GAMMA 250 EV TO 50 KEV. ADJUSTED SO THAT THE CALCULATED TOTAL AND CAPTURE CROSS SECTIONS WERE RESULTS ARE D-OBS = 3.58 EV, S0 = 2.50 E-4, S1 = 1.00 E-4, R = 7.3 FM AND GAM-GAMMA = 0.065 EV. 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 373.7 B -ELASTIC 0.2 B -CAPTURE 373.5 B 7210. B MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV : MF=3 NEUTRON GROUP BELOW 50 KEV : NO BACKGROUND WAS GIVEN. ABOVE 50 KEV : MT=1,2,4,51-66,91,102 TOTAL,ELASTIC,INELASTIC AND CAPTURE CALCULATED WITH ECIS /2/ AND CASTHY /3/. DEFORMED OPTICAL POTENTIAL FOR ECIS CALCULATION WAS DETERMINED SO AS TO REPRODUCE THE EXPERIMENTAL TOTAL CROSS SECTION OF NATURAL HAFNIUM, STARTING WITH THE HAOUAT POTENTIAL /4/. V0 = 46.82-0.3*EN, WS = 3.81+0.4*EN (EN<10), VSO = 6.2 (MEV), 7.81 (EN>10) AS = 0.52, ASO = 0.47 (FM), RSO = 1.12 (FM), AO = 0.63, AS = 0.52, ASO = 0.47 (FM), RO = 1.24, RS = 1.24, RSO = 1.12 (FM), BETA-2 = 0.273, BETA-4 = 0.0. THE DEFORMATION PARAMETER BETA-2 WAS DETERMINED FROM THE MEASURED E2 TRANSITION PROBABILITY DATA /5/. THE LOWEST THREE LEVELS BELONGING TO THE GROUND STATE ROTATIONAL BAND WERE COUPLED IN THE CALCULATION. THE SPHERICAL OPTICAL POTENTIAL FOR CASTHY CALCULATION IS THE SAME AS THAT OF JENDL-2. VO = 38.0, WS = 8.0+0.5*SQRT(EN), VSO = 7.0 (MEV), AO = 0.47, AS = 0.52, ASO = 0.47 (FM), RO = 1.32, RS = 1.32, RSO = 1.32 (FM). CAPTURE CROSS SECTION WAS NORMALIZED TO THE MEASURED DATA OF BEER ET AL. /6/ AT 30 KEV. COMPETING PROCESSES (N,2N), (N,3N), (N,P), AND (N,ALPHA) WERE CALCULATED WITH GNASH /7/ AND FED TO ECIS-CASTHY CALCULATION. THE LEVEL FLUCTUATION AND INTERFERENCE EFFECTS WERE CONSIDERED. LEVEL SCHEME WAS TAKEN FROM TABLE OF ISOTOPES /8/. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 7/2 -1 0.1130 9/2 -2 0.2497 11/2 -3 0.3213 0/72 -0.2497 0.3213 0.4095 0.4267 0.5081 0.5552 0.5913 0.6044 9/2 13/2 11/2 3 4 + 5 + 5/2 13/2 15/2 7/2 15/2 6 8 0.6044 0.7085 9 1 Ŏ + 7/2 +0.7459 11

12 0.7945 17/2 -13 0.8057 3/2 -14 0.8474 9/2 + 15 0.8730 5/2 -16 0.8828 17/2 + CONTINUUM LEVELS ASSUMED ABOVE 0.9480 MEV. THE LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON'S FORMULA /9/ ARE THE SAME AS THOSE OF JENDL-2. A(1/MEV) C(1/MEV) T(MEV) EX(MEV) SIGMA**2 HF-177 22.61 9.06 0.486 4.38 9.45 HF-178 22.36 2.22 0.451 4.08 12.94 MT=16,17,103,107 (N,2N), (N,3N), (N,P) AND (N,ALPHA) CALCULATED WITH GNASH /7/. THE TRANSMISSION COEFFICIENTS FOR THE INCIDENT CHANNEL WERE GENERATED WITH ECIS /2/, WHILE THOSE FOR THE EXIT CHANNELS WITH ELIESE-3 /10/. THE PREEQUILIBRIUM PARAMETER F2 WAS F2=5.0. MT=251 MU-BAR CALCULATED WITH ECIS /2/ AND CASTHY /3/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-66,91 CALCULATED WITH ECIS /2/ AND CASTHY /3/. MT=16 ISOTROPIC IN THE LABORATRY SYSTEM. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS ME = 5MT=16,17,91 CALCULATED WITH GNASH /7/. MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIES MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIES MT=16,17,91,102,103,107 CALCULATED WITH GNASH /7/ AND STORED UNDER OPTION-1 (PHOTON PRODUCTION MULTIPLICITIES). THE PHOTON STRENGTH FUNCTIONS FOR MOST NUCLEI WERE TAKEN FROM /1/, WHILE THOSE FOR SOME HAFNIUM ISOTOPES WERE DETERMINED FROM CAPTURE CROSS SECTION NORMALIZA-TION TO THE EXPERIMENTAL DATA. THE PHOTON PROFILE FUNCTION IS A SUPERPOSITION OF THE BERMAN-TYPE GIANT DIPOLE RESONANCE /11/ AND THE PYGMY RESONANCE WHOSE PARAMETER VALUES WERE CITED FROM THE NEIGHBOURING NUCLEUS TA /12/. EG1 = 15.23, EG2 = 12.3, EP = 5.2 (MEV), GG1 = 4.48, GG2 = 2.43, GP = 2.5 (MEV), SIG-PYGMY/SIG-GDR = 0.0245. MT=51-66 STORED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAY). DATA WERE TAKEN FROM /8/. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=16,17,51-66,91,102,103,107 ISOTROPIC. MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=16,17,91,102,103,107 CALCULATED WITH GNASH /7/. REFERENCES ERENCES MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B (1984). RAYNAL J.: IAEA SMR-9/8 (1970). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). RAMAN S. ET AL.: AT. DATA NUCL. DATA TABLES, 36, 1 (1987). BEER H. ET AL.: PHYS. REV., C30, 464 (1984). YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977). LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES 7TH EDITION ģ 3 4 5) 6) żś (1979). GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IGARASI S.: JAERI-1224 (1972). BERMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975). IGASHIRA M. ET AL.: INT. SYMP. CAPTURE GAMMA-RAY SPECROSCOPY AND RELATED TOPICS - 1984, 523 (1985). 9) 10) 11) 12)

MAT number = 7237 72-HF-178 NAIG+ EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI) DIST-SEP89 REV2-JAN94 HISTORY 89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA (NAIG) AND K.SHIBATA (JAERI).
94-01 JENDL-3.2. GAMMA-RAY PRODUCTION DATA: MODIFIED BY K. SHIBATA (JAERI) COMPILED BY T.NAKAGAWA (NDC/JAERI) (12,91), (15,91 NEW 91) IEW CALCULATION WITH GNASH. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1

 MT=451
 Jest

 MT=151
 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS

 RESOLVED RESONANCES FOR MLBW FORMULA

 ENERGY RANGE
 0.5 EV TO 1.5 KEV

 RES. ENERGIES AND GAM-N
 ENL 325 /1/.

 GAM-GAMMA
 0.054 EV ASSUMED IF UNKNOWN.

 PADIUS
 7.5 FM

 MF=2UNRESOLVED RESONANCES ENERGY RANGE SO, S1, R AND GAM-GAMMA INRESOLVED RESONANCES ENERGY RANGE : 1.5 KEV TO 50 KEV. SO, S1, R AND GAM-GAMMA : ADJUSTED SO THAT THE CALCULATED TOTAL AND CAPTURE CROSS SECTION WERE REPRODUCED WELL. RESULTS ARE D-OBS = 89.9 EV, SO = 2.20E-4, S1 = 0.51E-4, R = 8.5 M AND GAM-GAMMA = 0.054 EV. 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 88.49 B -ELASTIC 4.46 B -CAPTURE 84.03 B 1916 B LLDSTIVE44.40 B1916 BMF=3NEUTRON CROSS SECTIONSBELOW 50 KEV:NO BACKGROUND WAS GIVEN.ABOVE 50 KEV:MT=1,2,4,51-71,91,102TOTAL,ELASTIC,INELASTIC AND CAPTURECALCULATED WITH ÉCIS /2/ AND CASTHY /3/. DEFORMED OPTICALPOTENTIAL FOR ECIS CALCULATION WAS DETERMINED SO AS TOREPRODUCE THE EXPERIMENTAL TOTAL CROSS SECTION OF NATURALHAFNIUM, STARTING WITH THE HAOUAT POTENTIAL /4/.V0 = 46.74-0.3*EN, WS = 3.77+0.4*EN (EN<10), VSO = 6.2 (MEV),</td>AO = 0.63,RO = 1.24,RO = 1.24,RS = 0.52,BETA-2 = 0.262,BETA-4 = 0.0.RETA-2 = 0.262,BETA-4 = 0.0.RO = 1.24,RS = 0.52,RS = 1.124,RS = 0.52,AS 0 = 0.47 (FM),RO = 1.24,RS = 0.52,BETA-2 = 0.262,BETA-4 = 0.0.THE DEFORMATION PARAMETER BETA-2 WAS DETERMINED FROM THEMEASURED E2 TRANSITION PROBABILITY DATA /5/.THE DEFORMATION IS THE GROUND STATE ROTATIONAL BAND WERECOUPLED IN THE CALCULATION.CASTHY CALCULATION IS THE SAME AS THAT OF JENDL-2.V0 = 38.0, WS = 8.0+0.5* SQRT(EN), VSO = 7.0 (MEV),AO = 0.47, AS = 0.52,ASO = 0.47 (FM),RO = 1.32, RS = 1.32MO = 0.47, AS = 0.52,ASO = 0.47 (FM),RO = 1.32, RS = 1.32, NORMALIZED TO THE MEASURED DATA OFBEERE TAL. /6/ AT 30 KEV.COMPETING PROCESSES (N.2N), (N.3N),(N, P), AND (N, ALPHA) WERE CALCULATED WITH GNASH /7/ AND FED TO,ECIS-CASTHY CALCULAT 0.0932 0.3066 0.6322 4 + 3 6 + 4 1.0585 8 + 1.1474 8 5 -6 1.1746 2 +

| TH
/9 | 7 1.1993 0 +
8 1.2602 2 -
9 1.2766 2 +
10 1.3099 1 -
11 1.3224 3 -
12 1.3624 2 -
13 1.3641 9 -
14 1.4340 0 +
15 1.4438 0 +
16 1.4790 8 -
17 1.4961 2 +
18 1.5136 1 -
19 1.5613 2 +
20 1.5665 1 -
21 1.6015 10 -
DNTINUUM LEVELS ASSUMED ABOVE 1.6400 MEV.
LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON'S FORMULA
ARE THE SAME AS THOSE OF JENDL-2.
A(1/MEV) C(1/MEV) T(MEV) EX(MEV) SIGMA**2
HF-178 22.36 2.22 0.451 4.08 12.94
HF-179 22.57 6.88 0.465 3.98 9.31 |
|---|--|
| MT= | 5,17,103,107 (N,2N), (N,3N), (N,P) AND (N,ALPHA) |
| CA | ULATED WITH GNASH /7/. THE TRANSMISSION COEFFICIENTS FOR |
| TH | INCIDENT CHANNEL WERE GENERATED WITH ECIS /2/, WHILE THOSE |
| FO | THE EXIT CHANNELS WITH ELIESE-3 /10/. THE PREEQUILIBRIUM |
| PA | METER F2 WAS F2=5.0. |
| MT= | 51 MU-BAR |
| CA | CULATED WITH ECIS /2/ AND CASTHY /3/. |
| MF=4 | ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS |
| MT= | 51-71,91 |
| CA | CULATED WITH ECIS /2/ AND CASTHY /3/. |
| MT= | 5,17 |
| IS | ROPIC IN THE LABORATORY SYSTEM. |
| MF=5 | ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS |
| MT= | 3,17,91 |
| CA | JULATED WITH GNASH /7/. |
| MF=1
MT=
CA
PR
MO
IS
TI
SU
AN
TH | PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIES
5,17,91,102,103,107
DULATED WITH GNASH /7/ AND STORED UNDER OPTION-1 (PHOTON
DUCTION MULTIPLICITIES). THE PHOTON STRENGTH FUNCTIONS FOR
NUCLEI WERE TAKEN FROM /1/, WHILE THOSE FOR SOME HAFNIUM
OPES WERE DETERMINED FROM CAPTURE CROSS SECTION NORMALIZA-
1 TO THE EXPERIMENTAL DATA. THE PHOTON PROFILE FUNCTION IS A
RPOSITION OF THE BERMAN-TYPE GIANT DIPOLE RESONANCE /11/
THE PYGMY RESONANCE WHOSE PARAMETER VALUES WERE CITED FROM
NEIGHBOURING NUCLEUS TA /12/.
EG1 = 15.23, EG2 = 12.3, EP = 5.2 (MEV),
GG1 = 4.48, GG2 = 2.43, GP = 2.5 (MEV),
SIG-PYGMY/SIG-GDR = 0.0245. |
| MT= | -71 |
| ST | RED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAY). DATA WERE |
| TA | N FROM /8/. |
| MF=1 | PHOTON ANGULAR DISTRIBUTIONS |
| MT= | 5,17,51-71,91,102,103,107 |
| IS | ROPIC. |
| MF=1 | CONTINUOUS PHOTON ENERGY SPECTRA |
| MT= | 3,17,91,102,103,107 |
| CA | .ULATED WITH GNASH /7/. |
| REFE
1)
2)
3)
4)
5)
6)
7)
8) | ENCES
JGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B (1984).
JYNAL J.: IAEA SMR-9/8 (1970).
GARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
JOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982).
MAN S. ET AL.: AT. DATA NUCL. DATA TABLES, 36, 1 (1987).
ER H. AND MACKLIN R.L.: PHYS. REV., C26, 1404 (1982).
DUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
DERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES 7TH EDITION
1979).
LEEPT A. AND CAMERON A G.W.: CAN IN PHYS. 42, 1446 (1965). |
| 10)
11)
12) | ARASI S.: JAERI-1224 (1972).
RMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975).
RMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975).
RASHIRA M. ET AL.: INT. SYMP. CAPTURE GAMMA-RAY SPECROSCOPY
ID RELATED TOPICS - 1984, 523 (1985). |

MAT number = 7240 72-HF-179 NAIG+ EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI) DIST-SEP89 REV2-JAN94 HISTORY 89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA (NAIG) AND K.SHIBATA (JAERI). 94-01 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * * GENERAL INFORMATION 51 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 IF=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA ENERGY RANGE : 1.0E-5 EV TO 250 EV RES. ENERGIES AND GAM-N : BNL-325 /1/. IF UNKNOWN, GAM-N IS CALCULATED FROM D-OBS AND SO GIVEN IN /1/. MF=2IN /1/. 0.066 EV ASSUMED IF UNKNOWN. 7.8 FM GAM-GAMMA RADIUS UNRESOLVED RESONANCES ENERGY RANGE ENERGY RANGE : 250 EV TO 50 KEV. SO, S1, R AND GAM-GAMMA : ADJUSTED SO THAT THE CALCULATED TOTAL AND CAPTURE CROSS SECTIONS WERE REPRODUCED WELL. RESULTS ARE D-OBS = 5.71 EV, SO = 2.20E-4, S1 = 0.83E-4, R = 7.7 FM AND GAM-GAMMA = 0.066 EV. 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 49.5 B -ELASTIC 6.8 B -CAPTURE 42.8 B 523.0 B MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV : NO BACKGROUND WAS GIVEN. NO BACKGROUND WAS GIVEN. ABOVE 50 KEV : MT=1,2,4,51-62,91,102 TOTAL,ELASTIC,INELASTIC AND CAPTURE CALCULATED WITH ECIS /2/ AND CASTHY /3/. DEFORMED OPTICAL POTENTIAL FOR ECIS CALCULATION WAS DETERMINED SO AS TO REPRODUCE THE EXPERIMENTAL TOTAL CROSS SECTION OF NATURAL HAFNIUM, STARTING WITH THE HAOUAT POTENTIAL /4/. VO = 46.66-0.3*EN, WS = 3.73+0.4*EN (EN<10), VSO = 6.2 (MEV), 7.73 (EN>10) ASO = 0.47 (FM), V0 = 46.66-0.3*EN, WS = 3.73+0.4*EN (EN<10), VS0 = 6.2 (MEV), 7.73 (EN>10) AO = 0.63, AS = 0.52, AS0 = 0.47 (FM), RO = 1.24, RS = 1.24, RS0 = 1.12 (FM), BETA-2 = 0.261, BETA-4 = 0.0. THE DEFORMATION PARAMETER BETA-2 WAS DETERMINED FROM THE MEASURED E2 TRANSITION PROBABILITY DATA /5/. THE LOWEST THREE LEVELS BELONGING TO THE GROUND STATE ROTATIONAL BAND WERE COUPLED IN THE CALCULATION. THE SPHERICAL OPTICAL POTENTIAL FOR CASTHY CALCULATION IS THE SAME AS THAT OF JENDL-2. V0 = 38.0, WS = 8.0+0.5*SQRT(EN), VS0 = 7.0 (MEV), A0 = 0.47, AS = 0.52 , AS0 = 0.47 (FM), R0 = 1.32, RS = 1.32 , RS0 = 1.32 (FM). CAPTURE CROSS SECTION WAS NORMALIZED TO THE MEASURED DATA OF BEER ET AL. /6/ AT 30 KEV. COMPETING PROCESSES (N,2N), (N,3N), (N,P), AND (N,ALPHA) WERE CALCULATED WITH GNASH /7/ AND FED TO ECIS-CASTHY CALCULATION. THE LEVEL SCHEME WAS TAKEN FROM TABLE OF ISOTOPES /8/. NO. ENERGY(MEV) SPIN-PARITYS 787. NO. G.S. SPIN-PARITY 9/2 + 11/2 + ENERGY(MEV) 0.0 0.1227 0.2143 0.2688 1 2 3 7/2 -13/2 + 0.3377 0.3750 0.4386 9/24 1/2 15/2 5 6 + 0.5184 0.6169 5/2 8 -17/2 +9 0.6312

| 10 0.8483 19/2 +
11 0.8702 7/2 -
12 1.0034 5/2 +
CONTINUUM LEVELS ASSUMED ABOVE 1.0700 MEV.
THE LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON'S FORMULA
/9/ ARE THE SAME AS THOSE OF JENDL-2.
A(1/MEV) C(1/MEV) T(MEV) EX(MEV) SIGMA**2
HF-179 22.57 6.88 0.465 3.98 9.31
HF-180 21.37 2.35 0.519 5.42 7.64 |
|--|
| MT=16,17,103,107 (N,2N), (N,3N), (N,P) AND (N,ALPHA)
CALCULATED WITH GNASH /7/. THE TRANSMISSION COEFFICIENTS FOR
THE THE INCIDENT CHANNEL WERE GENERATED WITH ECIS /2/, WHILE
THOSE FOR THE EXIT CHANNELS WITH ELIESE-3 /10/. THE PREEQUILI-
BRIUM PARAMETER F2 WAS F2=5.0. |
| MT=251 MU-BAR
CALCULATED WITH ECIS /2/ AND CASTHY /3/. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-62,91
CALCULATED WITH ECIS /2/ AND CASTHY /3/.
MT=16,17
ISOTROPIC IN THE LABORATORY SYSTEM. |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,91
CALCULATED WITH GNASH /7/. |
| <pre>MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIES
MT=16,17,91,102,103,107
CALCULATED WITH GNASH /7/ AND STORED UNDER OPTION-1 (PHOTON
PRODUCTION MULTIPLICITIES). THE PHOTON STRENGTH FUNCTIONS FOR
MOST NUCLEI WERE TAKEN FROM /1/, WHILE THOSE FOR SOME HAFNIUM
ISOTOPES WERE DETERMINED FROM CAPTURE CROSS SECTION NORMALIZA-
TION TO THE EXPERIMENTAL DATA. THE PHOTON PROFILE FUNCTION IS A
SUPERPOSITION OF THE BERMAN-TYPE GIANT DIPOLE RESONANCE /11/
AND THE PYGMY RESONANCE WHOSE PARAMETER VALUES WERE CITED FROM
THE NEIGHBOURING NUCLEUS TA /12/.
EG1 = 15.23, EG2 = 12.3, EP = 5.2 (MEV),
GG1 = 4.48, GG2 = 2.43, GP = 2.5 (MEV),
SIG-PYGMY/SIG-GDR = 0.0245.</pre> |
| MT=51-62
STORED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAY). DATA WERE
TAKEN FROM /8/. |
| MF=14 PHOTON ANGULAR DISTRIBUTIONS
MT=16,17,51-62,91,102,103,107
ISOTROPIC. |
| MF=15 CONTINUOUS PHOTON ENERGY SPECTRA
MT=16,17,91,102,103,107
CALCULATED WITH GNASH /7/. |
| REFERENCES MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B (1984). RAYNAL J.: IAEA SMR-9/8 (1970). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). RAMAN S. ET AL.: AT. DATA NUCL. DATA TABLES, 36, 1 (1987). BEER H. AND MACKLIN R.L.: PHYS. REV., C26, 1404 (1982). YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977). LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES 7TH EDITION (1979). GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965). IGARASI S.: JAERI-1224 (1972). BERMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975). IGASHIRA M. ET AL.: INT. SYMP. CAPTURE GAMMA-RAY SPECROSCOPY AND RELATED TOPICS - 1984, 523 (1985). |

MAT number = 7243 72-HF-180 NAIG+ EVAL-JUL89 HIDA, YOSHIDA AND SHIBATA(JAERI) DIST-SEP89 REV2-JAN94 HISTORY 89-07 NEW EVALUATION FOR JENDL-3 WAS MADE BY K.HIDA, T.YOSHIDA (NAIG) AND K.SHIBATA (JAERI). 94-01 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * * GENERAL INFORMATION 51 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 MI=401 DEGGNALLA MF=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA ENERGY RANGE : 1.0E-5 EV TO 2.5 KEV RES. ENERGIES AND GAM-N : BNL-325 /1/. IF UNKNOWN, GAM-N IS CALCULATED FROM D-OBS AND SO, AND IN THIS CASE, GAM-GAMMA FROM (GAM-GAMMA : 0.050 EV ASSUMED IF UNKNOWN. RADIUS : 0.050 EV ASSUMED IF UNKNOWN. MF=2RADIUS UNRESOLVED RESONANCES ENERGY RANGE SO, S1,R AND GAM-GAMMA INRESOLVED RESONANCES ENERGY RANGE : 2.5 KEV TO 50 KEV. SO, S1,R AND GAM-GAMMA : ADJUSTED SO THAT THE CALCULATED TOTAL AND CAPTURE CROSS SECTIONS WERE REPRODUCED WELL. RESULTS ARE D-OBS = 158 EV, SO = 1.90E-4, S1 = 0.44E-4, R = 8.5 FM AND GAM-GAMMA = 0.05 EV. 2200 M/SEC CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 34.2 B -ELASTIC 21.2 B -CAPTURE 13.0 B 34.1 B CAPIURE MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV : NO BACKGROUND WAS GIVEN. ABOVE 50 KEV : MT=1,2,4,51-61,91,102 TOTAL,ELASTIC,INELASTIC AND CAPTURE CALCULATED WITH ECIS /2/ AND CASTHY /3/. DEFORMED OPTICAL POTENTIAL FOR ECIS CALCULATION WAS DETERMINED SO AS TO REPRODUCE THE EXPERIMENTAL TOTAL CROSS SECTION OF NATURAL HAFNIUM, STARTING WITH THE HAOUAT POTENTIAL /4/. VO = 46.60-0.3*EN, WS = 3.70+0.4*EN (EN<10), VSO = 6.2 (MEV), 7.70 (EN>10) AS = 0.52, ASO = 0.47 (FM), RSO = 1.12 (FM), vu = 46.60-0.3^{EN}, WS = $3.70+0.4^{EN}$ (EN<10), VSO = 6.2 (MEV), 7.70 (EN>10) A0 = 0.63, AS = 0.52, ASO = 0.47 (FM), R0 = 1.24, RS = 1.24, RSO = 1.12 (FM), BETA-2 = 0.256, BETA-4 = 0.0. THE DEFORMATION PARAMETER BETA-2 WAS DETERMINED FROM THE MEASURED E2 TRANSITION PROBABILITY DATA /5/. THE LOWEST THREE LEVELS BELONGING TO THE GROUND STATE ROTATIONAL BAND WERE COUPLED IN THE CALCULATION. THE SPHERICAL OPTICAL POTENTIAL FOR CASTHY CALCULATION IS THE SAME AS THAT OF JENDL-2. V0 = 38.0, WS = 8.0+0.5*SQRT(EN), VSO = 7.0 (MEV), A0 = 0.47, AS = 0.52 , ASO = 0.47 (FM), R0 = 1.32, RS = 1.32 , RSO = 1.32 (FM). CAPTURE CROSS SECTION WAS NORMALIZED TO THE MEASURED DATA OF BEER ET AL. /6/ AT 30 KEV. COMPETING PROCESSES (N,2N), (N,3N), (N,P), AND (N,ALPHA) WERE CALCULATED WITH GNASH /7/ AND FED TO ECIS-CASTHY CALCULATION. THE LEVEL FLUCTUATION AND INTERFERENCE EFFECTS WERE CONSIDERED. LEVEL SCHEME WAS TAKEN FROM TABLE OF ISOTOPES /8/. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 0 + 1 0.09332 2 + 2 0 30962 4 + 1 0.0 0.09332 0.3086 0.6409 1.0839 1.1416 0 2 4 1 2 + + 3 + 6 8 + 5 8 -1.1832 1.1997 + 67 4 2 + 4 + 8 1.2910

| 9 1.3744 3 -
10 1.4092 4 +
11 1.5393 3 -
CONTINUUM LEVELS ASSUMED ABOVE 1.6076 MEV.
THE LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON'S FORMULA
/9/ ARE THE SAME AS THOSE OF JENDL-2.
A(1/MEV) C(1/MEV) T(MEV) EX(MEV) SIGMA**2
HF-180 21.37 2.35 0.519 5.42 7.64
HF-181 21.91 6.47 0.479 4.08 4.88 |
|---|
| MT=16,17,103,107 (N,2N), (N,3N), (N,P) AND (N,ALPHA)
CALCULATED WITH GNASH /7/. THE TRANSMISSION COEFFICIENTS FOR
THE INCIDENT CHANNEL WERE GENERATED WITH ECIS /2/, WHILE THOSE
FOR THE EXIT CHANNELS WITH ELIESE-3 /10/. THE PREEQUILIBRIUM
PARAMETER F2 WAS F2=5.0. |
| MT=251 MU-BAR
CALCULATED WITH ECIS /2/ AND CASTHY /3/.
MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-61,91
CALCULATED WITH ECIS /2/ AND CASTHY /3/.
MT=16.17 |
| ISOTROPIC IN THE LABORATORY SYSTEM.
MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,91
CALCULATED WITH GNASH /7/. |
| <pre>MF=12 PHOTON MULTIPLICITIES AND TRANSITION PROBABILITIES
MT=16,17,91,102,103,107
CALCULATED WITH GNASH /7/ AND STORED UNDER OPTION-1 (PHOTON
PRODUCTION MULTIPLICITIES). THE PHOTON STRENGTH FUNCTIONS FOR
MOST NUCLEI WERE TAKEN FROM /1/, WHILE THOSE FOR SOME HAFNIUM
ISOTOPES WERE DETERMINED FROM CAPTURE CROSS SECTION NORMALIZA-
TION TO THE EXPERIMENTAL DATA. THE PHOTON PROFILE FUNCTION IS
A SUPERPOSITION OF THE BERMAN-TYPE GIANT DIPOLE RESONANCE /11/
AND THE PYGMY RESONANCE WHOSE PARAMETER VALUES WERE CITED FROM
THE NEIGHBOURING NUCLEUS TA /12/.
EG1 = 15.23, EG2 = 12.3, EP = 5.2 (MEV),
GG1 = 4.48, GG2 = 2.43, GP = 2.5 (MEV),
SIG-PYGMY/SIG-GDR = 0.0245.</pre> |
| MT=51-61
STORED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAY). DATA WERE
TAKEN FROM /8/. |
| MF=14 PHOTON ANGULAR DISTRIBUTIONS
MT=16,17,51-61,91,102,103,107
ISOTROPIC. |
| MF=15 CONTINUOUS PHOTON ENERGY SPECTRA
MT=16,17,91,102,103,107
CALCULATED WITH GNASH /7/. |
| REFERENCES
1) MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B (1984).
2) RAYNAL J.: IAEA SMR-9/8 (1970).
3) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
4) HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982).
5) RAMAN S. ET AL.: AT. DATA NUCL. DATA TABLES, 36, 1 (1987).
6) BEER H. AND MACKLIN R.L.: PHYS. REV., C26, 1404 (1982).
7) YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
8) LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES 7TH EDITION
(1970) |
| 9) ĠİĽBĔŔİ A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
10) IGARASI S.: JAERI-1224 (1972).
11) BERMAN B.L.: AT. DATA NUCL. DATA TABLES, 15, 319 (1975).
12) IGASHIRA M. ET AL.: INT. SYMP. CAPTURE GAMMA-RAY SPECROSCOPY
AND RELATED TOPICS - 1984, 523 (1985). |

MAT number = 7328 73-TA-181 NAIG EVAL-MAR87 N.YAMAMURO DIST-SEP89 REV2-FEB94 HISTORY
76-03 THE EVALUATION FOR JENDL-1 /1/ WAS MADE BY H.YAMAKOSHI (SHIP RESEARCH INSTITUTE) AND JENDL-1 COMPILATION GROUP.
83-03 JENDL-1 DATA WERE ADOPTED FOR JENDL-2 AND EXTENDED TO 20 MEV. MF=5 WAS REVISED, AND UNRESOLVED RESONANCE PARAMETERS WERE ADDED BY Y.KIKUCHI (JAERI) /2/.
83-11 COMMENT DATA WERE ADDED.
87-03 THE EVALUATION FOR JENDL-3 WAS MADE BY N.YAMAMURO (NAIG). RESONANCE PARAMETERS WERE ADDED BY NEW EXPERIMENTAL DATA. NEUTRON CROSS SECTIONS, EXCEPT TOTAL AND ELASTIC SCATTERING CROSS SECTIONS, AND ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS AND PHOTONS WERE CALCULATED WITH GNASH /3/ AND CASTHY /4/ CODES.
94-02 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY ČŌMPĪLĔĎ BY T.NAKAGAWA (NDC/JAERI) * MODIFIED PARTS FOR JENDL-3.2 (12,102) DATA WERE DETERMINED FROM ENERGY BALANCE. GENERAL INFORMATION 451 DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 =2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA MF=2THE ENERGY REGION FROM 1.0E-5EV TO 1.0 KEV. PARAMETERS WERE TAKEN FROM REFS./5,6,7/ FOR POSITIVE RESONANCES, AND FROM ENDF/B-IV FOR A NEGATIVE RESONANCE. THE RADIATIVE WIDTH OF 0.059EV WAS ASSUMED FOR THE RESONANCE WHOSE RADIATIVE WIDTH WÁŠ ŰŃKNÖWŇ. UNRESOLVED PARAMETERS IN THE ENERGY RANGE FROM 1 TO 100KEV, PARAMETERS WERE DETERMINED TO REPRODUCE THE MEASURED CAPTURE CROSS SECTIONS /6,8/. THE PARAMETERS ARE AS FOLLOWS, R= 7.8 FM , DOBS= 4.2 EV , RADIATIVE WIDTH= 0.065 EV, S0= 1.7E-04 S1= 2.0E-05 S2= 2.3E-04 NL= 3 CALCULATED 2200-M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ELASTIC CAPTURE TOTAL 5.65 B 20.67 B 26.32 B 660.43 B F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL EVALUATED FROM EXPERIMENTAL DATA. MT=2 ELASTIC SCATTERING (TOTAL CROSS SECTION) - (REACTION CROSS SECTION) MT=4,51-64,91 INELASTIC SCATTERING BELOW 3 MEV, CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/, AND ABOVE 3 MEV CALCULATED WITH STATISTICAL AND PREEQUILIBRIUM MODEL CODE GNASH/3/. WILMORE-HODGSON'S OPTICAL-MODEL POTENTIAL PARAMETERS/9/ WERE USED, WHICH REPRODUCED THE EXPERIMENTAL NONELASTIC CROSS SECTIONS UP TO 15 MEV. MF=315 MEV. V=47.01-0.267E-0.00118E WS=9.52-0.053E R0=1.268, AS=0.66 RS=1.241, AS=0.48 (MEV) (MEV) (FM) (FM) THE LEVEL SCHEME WAS ADOPTED FROM REF./10/. ENERGY (MEV) SPIN-PARITY NO G.S. 1 0.0 0.0062 0.136 0.159 7/2+ 9/2-9/2+ 9/2+ 11/2-11/2+ 13/2-5/2+ ż 3 Ã 0.301 0.338 5 6

0.495

7

13/2+

15/2-1/2+ 3/2+ 15/2+ 17/2-17/2+ 19/2-0.543 0.615 0.619 0.717 0.773 89 10 11 12 13 0.965 1.028 14 LEVELS ABOVE 1.03MEV WERE ASSUMED TO OVERLAPPING. LEVEL DENSITY PARAMETERS USED WERE AS FOLLOWS, E (MEV) 4.2 4.2 4.2 4.2 4.3 4.3 1/MEV 22.5 22.0 22.5 22.0 T(MEV) 0.54 0.53 0.54 0.52 PAIR-E SPIN-CUTOFF 0.0 0.4 0.0 0.73 TA-178 13.0 TA - 179 TA - 180 TA - 181 18.0 13.0 29.0 TA-182 21.8 0.0 0.56 13.0 MT=16 (N,2N) CROSS SECTION CALCULATED WITH GNASH/3/.
MT=17 (N,3N) CROSS SECTION CALCULATED WITH GNASH/3/.
MT=28 (N, N P) CROSS SECTION CALCULATED WITH GNASH/3/.
MT=102 RADIATIVE CAPTURE CROSS SECTION CALCULATED WITH CASTHY/4/.
MT=103 (N,P) CROSS SECTION CALCULATED WITH GNASH/3/.
MT=203 TOTAL HYDROGEN PRODUCTION CALCULATED WITH GNASH/3/.
MT=251 MU-BAR CALCULATED WITH CASTHY/4/. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 CALCULATED WITH CASTHY/4/. MT=51-64,91,16,17,28 ISOTROPIC IN THE CENTER-OF-MASS SYSTEM WAS ASSUMED. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,28,91 CALCULATED WITH GNASH/3/. F=12 PHOTON PRODUCTION MULTIPLICITIES (OPTION1) MT=51-64.91,16,17,28,103 ...CALCULATED WITH GNASH/3/. MF = 12MT = 102FROM ENERGY BALANCE. 4 PHOTON ANGULAR DISTRIBUTIONS ISOTROPIC IN THE CENTER-OF-MASS SYSTEM WAS ASSUMED. MF = 14E=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=91,16,17,28,102,103 CALCULATED WITH GNASH/3/. MF=15 REFERENCES
1) IGARASI S. ET AL.: JAERI 1261 (1979)
2) (ED.) NAKAGAWA T.: JAERI-M 84-103 (1984)
3) YOUNG, P.G. AND ARTHUR, E.D.: "GNASH, A PREEQUILIBRIUM STATISTICAL NUCLEAR-MODEL CODE FOR CALCULATION OF CROSS SECTIONS AND EMISSION SPECTRA", LA-6974 (1977).
4) IGARASHI, S. AND FUKAHORI, T.: JAERI 1321 (1991).
5) MUGHABGHAB, S.F., AND GARDER, D.I.: BNL325, 3RD ED. (1973).
6) MACKLIN, R, L,: NUCL, SCI, ENG., 86, 362 (1984).
7) TSUBONE, I., NAKAJIMA, Y. AND KANDA, Y.: PRIVATE COMMUNICATION
8) YAMAMURO, N., SAITO, K., EMOTO, T., WADA, T., FUJITA, Y. AND KOBAYASHI, K.: J.NUCL.SCI.TECHNOL., 17, 582 (1980).
9) WILMORE, D. AND HODGSON, P.E.: NUCL, PHYS., 55, 673 (1964).
10) FIRESTONE, R.B.* NUCL, DATA SHEETS 43, 289 (1984).

MAT number = 7400 74-W - 0 KHI,NEDAC EVAL-MAR87 T.WATANABE(KHI), T.ASAMI(NEDAC) DIST-SEP89 REV2-JUN94 87-03 NEW EVALUATION WAS MADE FOR JENDL-3. 87-03 COMPILED BY T.ASAMI. 89-08 MF/MT=15/102 MODIFIED. 94-06 JENDL-3.2. GAMMA PRODUCTION DATA MODIFIED BY T.ASAMI(DATA ENG.). OTHERS WERE MAINLY BASED ON JENDL FUSION FILE. COMPILED BY T.NAKAGAWA (NDC/JAERI) COMPTLED BT TINARAGAWA (NDOFGALAT)
***** MODIFIED PARTS FOR JENDL-3.2
ALL CROSS SECTIONS EXCEPT TOTAL
THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP),
(N,NA), (N,P), (N,D) AND (N,A) CROSS SECTIONS WERE
TAKEN FROM JENDL FUSION FILE. FURTHER MODIFICATION
WAS MADE FOR THE INELASTIC SCATTERING AND CAPTURE
CROSS SECTIONS.
(4,16-28), (4,91), (5,16-91)
TAKEN FROM JENDL FUSION FILE.
(12,102) UP TO 400 KEV
(13,4) UP TO 400 KEV
(13,3), (15,3) ENERGY RANGE WAS CHANGED
(15,102) JENDL FUSION FILE /1/ (AS OF JAN. 1994) EVALUATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. THE INELASTIC SCATTERING CROSS SECTIONS TO HIGH EXCITED LEVELS WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-11 SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT THE (N,2N), (N,3N), (N,NA), (N,NP), (N,P), (N,D) AND (N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103, 104, 107) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM. THE RESONANCE PARAMETERS, TOTAL AND CAPTURE CROSS SECTIONS WERE TAKEN FROM JENDL3.1. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. REACTIONS ALL THE DATA WERE CONSTRUCTED WITH THE EVALUATED ONES OF W-182, -183, -184 AND -186, TAKING ACCOUNT OF THEIR ABUNDANCES IN THE W ELEMENT. THE ABUNDANCE DATA WERE TAKEN FROM REF./5/ TO BE 0.263, 0.143, 0.3067 AND 0.286 FOR W-182, -183, -184 AND -186, RESPECTIVELY. ALL THE DATA OF W-180 WERE IGNORED BECAUSE OF ITS VERY LOW ABUNDANCE. THE ABUNDANCE OF 0.2643 WAS USED FOR W-182 ĩ†s W-182 SOMETIMES. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 12 RESONANCE PARAMETERS =151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE TAKEN FROM THE EVALUATED DATA ON EACH STABLE ISOTOPE. THE ENERGY REGION WAS TAKEN FROM 1.0E-5 EV TO 15 KEV. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: MF=2MT=151 2200 M/S CROSS SECTION(B) 23.224 4.973 RES. INTEGRAL(B) TOTAL ELASTIC CAPTURE 18.251 317.5 MF=3 NEUTRON CROSS SECTIONS BELOW 15 KEV, BACKGROUND CROSS SECTION WAS GIVEN. FOR JENDL-3.1, ABOVE THE RESONANCE REGION, THE TOTAL AND PARTIAL CROSS SECTIONS OF EACH ISOTOPE WERE MAINLY BASED ON THEORETICAL CALCULATIONS. THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE

| COUPLED-C
MODEL. T
OF CASTHY
USED ARE: | HANNEL MODEL AN
HE CALCULATIONS
/6/ AND ECIS/7 | ND THE SP
S WERE PE
/. THE C | HERICAL
RFORMED
PTICAL | OPTICAL
WITH A
POTENTIA | STATISTICAL
COMBINED PROGRAN
AL PARAMETERS |
|---|---|--|--|--|---|
| V =
WS =
R =
THE DEFOR | 48.83 - 0.0809
6.73 - 0.0536
1.168, RS = 0.617, ASO = 0
MED POTENTIAL F | 9*EN,
*EN,
1.268,
0.664,
PARAMÉTER | VSO = 5
WV = 0
RSO = 1
B = 0
S WERE | .6 (M
.592 (F
.563 (F
TAKEN FF | MEV)
MEV)
M)
M)
M)
ROM THE WORK OF |
| FOR JENDL
ELASTC SC
FILE. NE
SYSTEM/2/
FOR NEUTR
ARTHUR AN
DEUTERON,
AND STAND | -3.2, ALL CROSS
ATTERING AND C/
W THEORETICAL
BY ADOPTING W/
ON, PEREY OMP
D YOUNG/10/ FOI
BECCHETTII-GRI
ARD LEVEL DENS | S SECTION
APTURE WE
CALCULAT
ALTER-GUS
(9/ FOR F
R ALPHA,
EENLEES C
ITY PARAM | I DATA E
RE ADOP
ION WAS
SOMP M
PROTON,
LOHR-HA
MP/12/
IETERS O | XCEPT FC
TED FROM
MADE WI
ODIFIED
LEMOS ON
EBERLI (
FOR TRIT
F SINCR(| OR THE TOTAL,
/ JENDL FUSION
ITH SINCROS-II
BY YAMAMURO/2/
IP MODIFIED BY
MP/11/ FOR
TON AND HE-3,
OS-II SYSTEM. |
| MT=1 TOTAL
[SAME AS
THE DATA
WERE CALC | JENDL-3.1]
WERE CONSTRUCTI
ULATED WITH THI | ED FROM T
OPTICAL | HOSE OF
MODEL. | FOUR W | ISOTOPES WHICH |
| MT=2 ELASTI
OBTAINED
FROM THE | C SCATTERING
BY SUBTRACTING
TOTAL CROSS SE(| THE SUM
CTION. | OF THE | PARTIAL | CROSS SECTIONS |
| MT=4, 51-90
THE DATA
OF THE EC
NATURAL W
W ISOTOPE | , 91 INELASTIC
FOR ISOTOPES WI
IS/7/ AND CAST
WERE CONSTRUC
AS FOLLOWS: | SCATTERI
ERE CALCU
HY /6/, A
FED FROM | NG
ULATED W
ND SINC
THE CAL | ITH THE
ROS-II.
CULATED | COMBINED PROGRAM
THE DATA FOR
VALUES FOR EACH |
| MT LEV
G.S.
51
52
53
54
55
56
57
58 | EL ENERGY(MEV)
0.0
0.0465
0.0991
0.1001
0.1122
0.1226
0.2070
0.2088
0.2017 | W-182
51 | W-183
51
52
53
54 | W-184 V
51 | V-186
51 |
| 50
50
61
62
63
64
65
66
67 | 0.3095
0.3294
0.3641
0.3968
0.4121
0.4870
0.5500
0.6805 | 52 | 55
56
57
58
59
60 | 52 | 52 |
| 68
69
70
71
72
73
74
75 | 0.7377
0.7483
0.8088
0.8618
0.8620
0.9033
0.9526
1.0023 | | | 53
54
55 | 53
54
55
56
57 |
| 70
77
78
79
80
81
82
83
83
84 | 1.0039
1.0316
1.0452
1.1214
1.1357
1.1445
1.1500
1.2213 | 54
55 | | 57 | 58
59
60
61 |
| 85
86
87
88
89
90
THE OTHER | 1.2214
1.2840
1.2950
1.3221
1.3311
1.4428
INELASTIC SCA | 56
60
57
TTERING C | ROSS SE | 59
CTIONS V | 62
VERE SUMMED UP |
| MT=16, 17,
(N,2N) | 22, 28, 102, 10
, (N,3N), (N,N/ | 03 AND 10
A), (N,NF |)7
'), CAPT | URE, (N. | P) AND (N,A) |

CONSTRUCTED FROM THE EVALUATED DATA FOR FOUR STABLE ISOTOPES OF W. THE CALCULATED CAPTURE CROSS SECTION FOR EACH W ISOTOPE WAS NORMALIZED SO AS TO REPRODUCE THE ELEMENT W DATA OF 60+-6 MB AT 500 KEV/13/. MT=251 MU-BAR CALCULATED FROM MF/MT=4/2. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS (MF=2, 51-90: THE SAME AS JENDL-3.1) MT=2MI=2 CONSTRUCTED FROM THE EVALUATED DATA FOR FOUR STABLE ISOTOPES OF W. MT=51-90 CONSTRUCTED FROM THE EVALUATED DATA FOR FOUR STABLE ISOTOPES. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=12 PHOTON PRODUCTION MULTIPLICITIES MT=102 (BELOW 400 KEV) CALCULATED FROM ENERGY BALANCE. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 (ABOVE 400 KEV) CALCULATED WITH THE GNASH CODE/14/. MT=4 (UP TO 400 KEV) CALCULATED FROM CROSS SECTIONS AND TRANSITION PROBABILITIES FOR LEVELS UP TO 400 KEV. MF=14 PHOTON ANGULAR DISTRIBUTIONS MT=3, 4, 102 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3CALCULATED WITH THE GNASH CODE/14/. MT=102 CALCULATED WITH THE GNASH CODE/14/ IN THE ENERGY RANGE ABOVE 10 KEV, AND WITH CASTHY/6/ BELOW 1 KEV. REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
HOLDEN, N.E., MARTIN, R.L. AND BARNES, I.L.: PURE & APPL. CHEM. 56, 675 (1984).
IGARASI S. AND FUKAHORI T.: JAREI 1321 (1991).
RAYNAL J.: IAEA-SMR-9/8 P.281 (1972).
DELAROCHE J.F. ET AL.: 1979 KNOXVILLE CONF. 336 (1979).
PEREY F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BCCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). (1971) 13) VOIGNIER J. ET AL.: NUCL. SCI. ENG., 93, 43 (1986). 14) YOUNG, P.G. AND ARTHUR, E.D. : LA-6947 (1977).

| MAT
74 | - W | um
- | be 1
182 | r
2 | КH | 74
 , | 13
N | 1
E D | AC | | E V
D I | AL
ST | -
 - | M A
S E | R8
P8 | 87
89 | T
R | .W
EV | A
2 | TAI
- J | N A
A N | BE
94 | ()
 | КH | 1) | , | Τ. | Α | SA | MI | (N I | ED/ | AC) | |
|-----------------------------|--------------------------------|--|---|----------------------|--|--------------------------------------|---|---|---------------------------------------|-----------------------------------|-----------------------------|---|-------------------------|--------------------|----------------------|--------------------------|---------------------------|-----------------------------------|-------------|---------------------------------------|--|---------------------------|---|----------------------|---------------------------------|------------------------------|-------------------|--|--------------------------|---------------------------------|-------------------------------------|---|---|---------------|
| HTS
87 -
87 -
94 - | 03
03
01 | | EW
DMF
ENE
DMF | | VA
LE
- 3
LE | Ll
D
.2 | JA
B
2
B | Υ
Υ | ON
T. | N
A S
N A | AS
AM | G A | 1 A I | D E | F
(N | :0I | R
C/ | JE
JA | N | | - 3
) | | | | | | | | | | | | | |
| | · · · · | * *
A | * * *
LL | *
C | RO | | | | IE
CT
NE
)
F
AD | D
IC
LA
RC
E | PA
NS
ST
N,
FC | | | FECSC
SC
DLE | OR
PT
AT
N, | | JE
TO
ER
)
SI | ND
TA
IN
AN
ON | | - 3
,
- 1
 0 | ,
2
(N
N,
LÉ
S | ,2
Å)
ĊA | 2N (|),
CR
FU
TE | * *
0 | ××
S
HE | 3N
SE
R | | * *
† I
D
D | **
ON
IF
CA | , NI
S \
I C/
P T I | ××
P)
WEF
AT
URF | * * *
?E
I O N
E | |
| | | (·
* * | 4,'
* * ' | 16 | - 9
* * | 1)
TF | ļĘ | \$Ę | 5,
D | 16
AT | - 9
A
* * | 1)
WE | R | •
E
* * | ŢĄ
* * | K K | EN
* * | ۴ | Ŗ | ₽M
* * | ل
* * | ĒŇ | Į D I | <u> </u> | ₽Ų
** | \$ I | ٩Ų
٩ | \ | FI
* * | ĻĘ | * * * | * * : | * * * | |
| | |
J | ENC | DL | F
E
C | | | JA
JA | F
TE
ED | IL
D | E
BY
BY | //
// |
 /
(.
(. |
K0
K0 | (A
SA
SA | S
K | 0000. |
F
(N | J/
E[| AN
DA(|
Ċ) | 19
A | 994
NI | 4)
5 |
S . | C | : |
I B. |
A | (N | DC. |
/ J/ | AER | 1) |
| | | D,/
-
-
- | A T /
2
2
0
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2
2 | | WEOALSE,4E NCTTEV- | RIETUE() GHI OCSL | | TATEDE/NA)I M SMRH - | KS5 D) C SC U OOE - | NCAULCERLENCE | F SDRHU,
ITTLNNEBULRU, W | | | JEG SG SCND TEEC - | NRLEHC(L BEB LE- | | -G EYTNCE E 1 NIR- | ·CISAL
OBCAL ET
OBCAL ET | | | C BTWO, (GA AENDO, | PETNCSPTAY EPR E | T I I I I I I I I I I I I I I I I I I I | | RNON, 1NRDKPI EA | T FLSDP7 OXUO PDS | LEOLANR, HSSANDAN | FTETRC (2 WOE/EM O | OHLIOTN SEFCERF - | L S) - RD2NET MYEFE - | WIII
VELCA
RREYOTE 201
SDI | NG
ELI
RE
TI
ND
SPL/
TEN
ND
SF
/ - | :
S
- Y
DNS
3
1
1.
A
C
E
MA -
E
D | D
IN |
| MF=
MT | 1
=4 | G
51 | ENE | ER | AL
SC | R | N
 P | =0
T I | RM.
VE | A T
C | I C
A T | N | AI | ND | C |) (| ст | 10 | N | ٩R | Y | | | | | | | | | | | | | |
| MF=
MT | 2 = RE
RR
DRA
P2SCWA | RI
50
50
FA
CA
CA
CA
CA
CA
CA
CA
CA
CA
CA
CA
CA
CA | ESC
F
LVE
ON
AR/
S
ATI
MET
MET
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S | NEDFM6VES | AN
RO
E
É
R
C
F
C
M
E | CELAF
AF
F
R
CZC | 20
1
1
1
1
1
1
1
1
1
1
1
1
1 | PA
MEO
WDH
RS 7 | RAEE-RT
AEBREAR | MECS
R5EHANETRU
AUT | | RS
OF
AL
VE
VE | | PL1TMG GARM | AB2EEERRNDA. | | MEOVNEL | TEM
· EDEN
UEN
WI
ENE | | S
A
TA
D
F
V
P
I | W NISE
WARS | ER
IN
3
RE
IN | | G
BFLEMTH | IV
./L
LE
AL
E | EN
H 8/
CT
ND
SC | | HE
W | T EOSOA
ER | HE
R AT
PT
IN | EI
UNI
SSU
HA
URI
GI | NEF
I ME
Kn(
UME
E (
OT/
RAI | RGY
ENT
ED.
ED.
FHE
CRO
AL
DIU | AL
SS
S |
| | CAI
ARI
CAI
TO | | JL/
AS
TI(
JRE | AT
F | ED
OL
22 | 2
L(
0(| 22
)\\\
) | 20
S:
M/
2
2 | M
S
8.
0.
9. | /S
CR
84
7
5 | EC
OS | S | SI
SI | DS
EC | S
TI | SI
01 | ECN(| TI
B) | 10 | ١S | A | N D
R E |)
:
(| RE
62 | S0
IN
9. | N A
T E | GF | RAI | I
L(| NT
B) | EGI | RAI | _S | |
| MF= | 3
BEI
THI
RE | | EUT
N
CRC
LVE | TR
12
DS
ED | ON
K
S-
R | E\
SE
ES | CR
/
C
SOI | DS
Z
TI
NA | S
ER
ON
NC | SE
0
E | ECT
BA
PAT
PA | CP
A
R/ | ON
(GI
Al | S
RO
RE | UN
R
ER | | C
PR | RO
OD | S
U
U | S :
Cei | SE
D | CT
FR | -1(
201 | N C
M | тH | AS
E | E \ | G I '
A I | VE
LU | N
A T | ANI
ED | D | AL | L |
| | FOI
SEC
CRI
ANI
EC | | JEN
S S
THE
PE
/ 1 ()
WS | NDSTER/ | L -
HETPO
·== | 3
EF
10
HE
RM
48
6 | | G
G
G
G
G
G
G
G
G
G
G
G
G
G
G
G
G
G
G | AB
IV
WE
AL
WI
OP
- | OV
EN
REC
TH
TI
O. | E
LA
P
CA
0.05 | 12
 A
 S
 A
 A
 A
 A
 A
 A
 A
 A | | | V
ANTSINN, | A
ID
E
IE
IE | TH
SE
DTI
DTI | E
DE
WI
STR
L
V | | | A L
T H
T H
A M
A M
= = | A
ECEMCCT
E50 | | | PA
OR
TT
PL
ÅS
U | RTEETTS(N | | AL
AG
AG
AG
A
A
A
A
A
A
A
A
A
A
A
A
A
A | C
ẢN
CA
/
RE | RO
CA
NE
LC
AN
: | SS
LCI
D
UL
D | UL/
CAR
MOI
AT | A-
DEL
ION | RE
S |

| R = 1.168, RS = 1.268, RSO = 1.592 (FM)
A = 0.617, ASO = 0.664, B = 0.563 (FM)
THE DEFORMED POTENTIAL PARAMETERS WERE TAKEN FROM THE WORK OF
DELAROCHE/11/. |
|--|
| FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE TOTAL,
ELASTIC SCATTERING AND CAPTURE WERE ADOPTED FROM JENDL FUSION
FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY
ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON,
PEREY OMP /12/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND
YOUNG/13/ FOR ALPHA, LOHR-HAEBERLI OMP/14/ FOR DEUTERON,
BECCHETTII-GREENLEES OMP/15/ FOR TRITON AND HE-3, AND STANDARD
LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. |
| MT=1 TOTAL
CALCULATED WITH THE COMBINED PROGRAM OF THE ECIS AND CASTHY
CODES. ALMOST THE SAME AS JENDL-3.1. |
| MT=2 ELASTIC SCATTERING
OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS
FROM THE TOTAL CROSS SECTION. |
| MT=4, 51-70, 91 INELASTIC SCATTERING
THE DATA OF MT=51 TO 58 WERE CALCULATED WITH THE COMBINED
PROGRAM OF ECIS/10/ AND CASTHY /9/. THESE CROSS SECTIONS IN
JENDL-3.2 ARE THE SAME AS JENDL-3.1 EXCEPT THAT NEW CALCULATION
WAS MADE AT SEVERAL ENERGY POINTS. THE OTHER CROSS SECTIONS
WERE CALCULATED WITH SINCROS-II FOR JENDL FUSION FILE. THE
LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT
PROCESS WAS CALCULATED FOR THE LEVELS MARKED WITH '*'. |
| NO. MT ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS)
G.S. 0.0 0+ *
1 51 0.1001 2+ *
2 52 0.3294 4+ *
3 53 0.6805 6+ *
4 54 1.1358 0+ *
5 55 1.1444 8+ *
6 56 1.2214 2+ *
7 56 1.2574 2+ *
9 57 1.3311 3+ *
10 57 1.3738 3-
11 58 1.4428 4+ *
12 58 1.4875 4- *
13 58 1.5102 4+ *
14 58 1.5532 4- *
15 58 1.6213 5- *
16 58 1.6235 5+ *
17 58 1.6604 5- *
18 59 1.7119 10+ *
19 60 1.7568 6+ *
20 61 1.7654 4+ *
21 62 1.7690 5- *
22 63 1.8097 5- *
23 64 1.8134 4- *
25 66 1.8295 6- *
24 65 1.8134 4- *
25 66 1.8295 6- *
27 68 1.8560 2+ *
28 69 1.8560 2+ *
29 70 1.8712 1- *
29 70 1.8712 1- *
29 70 1.8712 1- *
29 70 1.8712 1- *
29 70 1.8712 1- *
20 67 1.8331 2- *
27 68 1.8560 2+ *
29 70 1.8712 1- *
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
LEVELS ABOVE 1.872 MEV WERE ASSUMED TO BE OVERLAPPING. DATA OF
1.872 CALCULATED ALSO FOR THE LEVELS AT 1.959, 2.372, 2.493, 3.112, 3.397, 3.6, 4.0, 4.5, 5.0, 5.5 AND 6.0 MEV AND ADDED TO MT=91. |
| <pre>MT=16, 17, 22, 28, 103, 104, 107
(N,2N), (N,3N), (N,NA), (N,NP), (N,P), (N,D), (N,A)
ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS
MADE WITH SINCROS-II. THE RESULTS WERE NORMALIZED TO
(N,2N) 2.161 B AT 14.7 MEV MEASURED BY QAIM/16/,
(N,P) 0.0059 B AT 14.7 MEV MEASURED BY QAIM/16/,
(N,D)+(N,NP) 0.002 B AT 14.7 MEV (SYSTEMATICS OF QAIM/16/),
(N,A) 0.002 B AT 14.7 MEV (SYSTEMATICS OF QAIM/16/).</pre> |
| MT=102 CAPTURE
CALCULATED WITH THE CASTHY CODE/9/ AND NORMALIZED TO 72+-9 MB
AT 500 KEV OF VOIGNIER ET AL./17/. FOR JENDL-3.2, ABOVE 3
MEV, A STRAIGHT LINE IN LOG-LOG SCALE WAS ADOPTED ASSUMING 1.0
MILLI-BARN AT 14 MEV. |

MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS (MT=2, 51-58: THE SAME AS JENDL-3.1) MT=2 CALCULATED WITH THE CASTHY CODE/9/. MT=51-58 CALCULATED WITH THE COMBINED PROGRAM OF THE CASTHY/9/ AND ECIS/10/ CODES. MT=59-70 TAKEN FROM JENDL FUSION FILE. MT=16. 17, 22, 28 91 TAKEN FROM JENDL FUSION FILE. MT=6. 17, 22, 28 91 TAKEN FROM JENDL FUSION FILE. MT=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16. 17, 22, 28 91 TAKEN FROM JENDL FUSION FILE. REFERENCES 1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 2) YAMAMURO, N.: JAERI-M 90-006 (1990). 3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). 4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA'FILE, BNL/NDC. 5) CAMARDA H.S. ET AL.: PHYS. REV. C8, 1813 (1973). 6) OHKUBO M.: JAERI-M 5624 (1974). 7) MACKLIN R.L. ET AL.: LA-9200-MS (1982). 8) MUGHABGHAB S.F. AND GARBER D.I.: "NEUTRON CROSS SECTIONS", VOL. 2, PART B (1984) 9) IGARASI S. AND FUKAHORI T.: JAREI 1321 (1991). 10) RAYNAL J.: IAEA-SMR-9/8 P.281 (1972). 11) DELAROCHE J.F. ET AL. : 1979 KNOXVILLE CONF. 336 (1979). 12) PEREY F.G.: PHYS. REV., 131, 745 (1963). 13) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980). 14) LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A222, 381 (1974). 15) BECCHETTI F.D. JA. AND GREENLES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). 16) QAIM,S.M. AND GRACA, C.: NUCL. PHYS., A242, 317 (1975). 17) VOIGNIER J. ET AL.: NUCL. SCI. ENG., 93, 43 (1986).

| MAT number = 7434
74-W -183 KHI,NEDAC EVAL-MAR87 T.WATANABE(KHI), T.ASAMI(NEDAC)
DIST-SEP89 REV2-JAN94 |
|--|
| HISTORY
87-03 NEW EVALUATION WAS MADE FOR JENDL-3.
94-01 JENDL-3.2. |
| COMPILED BY I.NAKAGAWA (NDC/JAERI) |
| ALL CROSS SECTIONS EXCEPT TOTAL
THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP),
(N,NA), (N,P), (N,D) AND (N,A) CROSS SECTIONS WERE
TAKEN FROM JENDL FUSION FILE. FURTHER MODIFICATION
WAS MADE FOR THE INELASTIC SCATTERING AND CAPTURE
CROSS SECTIONS.
(4,16-91), (5,16-91)
THESE DATA WERE TAKEN FROM JENDL FUSION FILE. |
| ********************* |
| JENDL FUSION FILE /1/ (AS OF JAN. 1994)
EVALUATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. |
| DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
- THE INELASTIC SCATTERING CROSS SECTIONS TO COTINUUM
(MT=91) WAS CALCULATED WITH CASTHY2Y AND DWUCKY IN
SINCROS-11 SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT |
| REACTIONS.
- THE (N,2N) (N,3N), (N,NA), (N,NP), (N,P), (N,D) AND
(N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103,
(N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103, |
| ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE
CONTINUUM NEUTRONS WERE CALCULATED BY KIMADE'S SYSTEMA |
| TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
RATIO WAS CALCULATED BY THE SINCROS- II CODE SYSTEM. |
| THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| |
| |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 2.2 KEV. PARAMETERS WERE EVALUATED BY
EXAMINING BOTH THE EXPERIMENTAL DATA/5,6,7/ AND THE RECOMMENDED
DATA OF BNL/8/. FOR UNKNOWN RADIATIVE WIDTH, AN AVERAGE VALUE
OF 55 MILLI-EV WAS ASSUMED. PARAMETERS FOR A NEGATIVE
RESONANCE WERE SELECTED SO THAT THE 2200 M/S CROSS SECTION FOR
CAPTURE REPRODUCED GAVE A RECOMMENDED VALUE OF 10.2 BARNS/8/
AND GAVE A GOOD FIT TO THE EXPERIMENTAL DATA FOR TOTAL CROSS
SECTIONS AROUND THERMAL ENERGIES. THE SCATTERING RADIUS WAS
ASSUMED TO BE 7.3 FM. CALCULATED 2200 M/SEC CROSS SECTIONS AND
RESONANCE INTEGRALS ARE AS FOLLOWS:</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 2.2 KEV. PARAMETERS WERE EVALUATED BY
EXAMINING BOTH THE EXPERIMENTAL DATA/5,6.7/ AND THE RECOMMENDED
DATA OF BNL/8/. FOR UNKNOWN RADIATIVE WIDTH, AN AVERAGE VALUE
OF 55 MILLI-EV WAS ASSUMED. PARAMETERS FOR A NEGATIVE
RESONANCE WERE SELECTED SO THAT THE 2200 M/S CROSS SECTION FOR
CAPTURE REPRODUCED GAVE A RECOMMENDED VALUE OF 10.2 BARNS/8/
AND GAVE A GOOD FIT TO THE EXPERIMENTAL DATA FOR TOTAL CROSS
SECTIONS AROUND THERMAL ENERGIES. THE SCATTERING RADIUS WAS
ASSUMED TO BE 7.3 FM. CALCULATED 2200 M/SEC CROSS SECTIONS AND
RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 2.38
CAPTURE 10.11 335.
TOTAL 12.49</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 2.2 KEV. PARAMETERS WERE EVALUATED BY
EXAMINING BOTH THE EXPERIMENTAL DATA/5,6,7/ AND THE RECOMMENDED
DATA OF BNL/8/. FOR UNKNOWN RADIATIVE WIDTH, AN AVERAGE VALUE
OF 55 MILLI-EV WAS ASSUMED. PARAMETERS FOR A NEGATIVE
RESONANCE WERE SELECTED SO THAT THE 2200 M/S CROSS SECTION FOR
CAPTURE REPRODUCED GAVE A RECOMMENDED VALUE OF 10.2 BARNS/8/
AND GAVE A GOOD FIT TO THE EXPERIMENTAL DATA FOR TOTAL CROSS
SECTIONS AROUND THERMAL ENERGIES. THE SCATTERING RADIUS WAS
ASSUMED TO BE 7.3 FM. CALCULATED 2200 M/SEC CROSS SECTIONS AND
RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 2.38
CAPTURE 10.11 335.
TOTAL 12.49
MF=3 NEUTRON CROSS SECTIONS
BELOW 2.2 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESONANCE PARAMETERS WITH MLBW FORMULA.</pre> |
| <pre>MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED RESONANCE PARAMETERS
RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY
REGION FROM 1.0E-5 EV TO 2.2 KEV. PARAMETERS WERE EVALUATED BY
EXAMINING BOTH THE EXPERIMENTAL DATA/5,6,7/ AND THE RECOMMENDED
DATA OF BNL78/. FOR UNKNOWN RADIATIVE WIDTH, AN AVERAGE VALUE
OF 55 MILLI-EV WAS ASSUMED. PARAMETERS FOR A NEGATIVE
RESONANCE WERE SELECTED SO THAT THE 2200 M/S CROSS SECTION FOR
CAPTURE REPRODUCED GAVE A RECOMMENDED VALUE OF 10.2 BARNS/8/
AND GAVE A GOOD FIT TO THE EXPERIMENTAL DATA FOR TOTAL CROSS
SECTIONS AROUND THERMAL ENERGIES. THE SCATTERING RADIUS WAS
ASSUMED TO BE 7.3 FM. CALCULATED 2200 M/SEC CROSS SECTIONS AND
RESONANCE INTEGRALS ARE AS FOLLOWS:
2200 M/S CROSS SECTION(B) RES. INTEGRAL(B)
ELASTIC 2.38
CAPTURE 10.11 335.
TOTAL 12.49
MF=3 NEUTRON CROSS SECTIONS
BELOW 2.2 KEY, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESONANCE PARAMETERS WITH MLBW FORMULA.
FOR JENDL-3.1, ABOVE 2.2 KEY, THE TOTAL AND PARTIAL CROSS
SECTIONS WERE GIVEN MAINLY BASED ON THE THEORETICAL CALCULA-
TIONS. THE TOTAL LASTIC AND INELASTIC SCATTERING, AND CAPTURE
CROSS SECTIONS WERE CALCULATED WITH THE COUPLED-CHANNEL MODEL
AND THE SPHERICAL OPTICAL POTENTIAL PARAMETERS USED ARE:
V = 48 83 - 0.0809*EN, VSO = 5.6 (MEV)
WS = 6.73 - 0.0536*EN, WSO = 5.6 (MEV)
WS = 6.73 - 0.0536*EN, WSO = 5.6 (MEV)</pre> |

DELAROCHE/11/.

FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE TOTAL ELASTIC SCATTERING AND CAPTURE WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /12/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/13/ FOR ALPHA, LOHR-HAEBERLI OMP/14/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/15/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT=1 TOTAL CALCULATED WITH THE COMBINED PROGRAM OF THE ECIS AND CASTHY CODES. ALMOST THE SAME AS JENDL-3.1.

MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION.

MT=4, 51-60, 91 INELASTIC SCATTERING THE DATA OF MT=51 TO 60 WERE CALCULATED WITH THE COMBINED PROGRAM OF CASTHY /9/ AND ECIS/10/. THESE CROSS SECTIONS IN JENDL-3.2 ARE THE SAME AS JENDL-3.1 EXCEPT THAT NEW CALCULATION WAS MADE AT ADDITIONAL SEVERAL ENERGY POINTS. THE CROSS SECTION OF MT=91 WAS CALCULATED WITH SINCROS-II FOR JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | | NQ. | ΜT | ENER | GY(ME) | /) | SP | IN - P | ARI | ΓY (| (DIR | ЕСТ | PROC | CESS |) | |
|-----|--------------------|----------------------|-------------------------|-------------------|---------------------|------------------------|-----------------------|----------------------|---------------------|--------------------|--------------------|-------------|----------------------|--------------|--------------|---|
| | | 1
2 | 51
52 | 0.04 | 465
991 | | | $\frac{3}{2}$ | - | | | * * | | | | |
| | | 3
4
5 | 53
54
55 | 0.20 |)70
)88
917 | | | 7/2
3/2
5/2 | - | | | | | | | |
| | | 6
7 | 56
57 | 0.3
0.3 | 089
095 | | 1 | 9/2
1/2 | -
+ | | | * | | | | |
| | | 8
9
10 | 58
58
59 | 0.4 | 121
530
870 | | 1 | 7/2
7/2
3/2 | - | | | | | | | |
| | | 11
12 | 59
60 | 0.5 | 330
500 | | ' | 1/2
9/2 | + | | | | | | | |
| | | 13
14 | 60
60 | 0.59 | 953
228
MEV V | | 10011 | 9/2
9/2 | -
‡^ | | | | | n | ATA (| |
| | LEV
LEV
ABO | ELS
ELS
VE T | ABOVE
8-9,
ABLÉ. | 10-11
THE | AND 12 | 2-14
INE | WERE | | PED | AS
FERI | IS | | ICATE | ED I | N THE | |
| | CAL
1.8 | CULA | TED A | LSO FOI | R THẾ
5, 2.9 | LEVE
912, | LS A
3.40 | T 0.
4, 4 | 904
.0, | , 0.
4.5 | .935
5,5 | , 1
.0 / | .025
AND 5 | , 1.
5.5 | 485,
MEV, | - |
| МТ | ΑΝD
Γ=16 | ADD
17 | ED TU
22 | 28 1 | 03 1(| 04 1 | 07 | | | | | | | | | |
| | ADO | , (N
PTED | ,2N),
_FROM | (Ň, 3Ň
JENDL |), (N
FUSI | , NÅ)
DN_FI | (Ν,
LE. | NP),
THĖ | (N
ORE | P) | (N | ,D)
ALCI | , (N
JLAT | , A)
I ON | WAS | |
| | MAD | | IH SI
,2N)
P) | 2.150
0.004 | II.
DBA
1 BA | ΙΗΈ Κ
Γ 14.
Γ 14 | TESUL
7 ME
7 ME | IS W
V (S
V MF | ERE
YSTE
ASUE | NOF
EMAT
RED | RMAL
FICS
BY | | 0 10
QAIN
M/16 | //16 | /), | |
| | (N, | D)+(
(N | ,Å)
Å,Å) | 0.001 | 3 B A
3 B A | Г 14.
Г 14. | 7 ME
7 ME | V ME
V (S | ASUF
YSTE | RËD
Emat | ΒΫ́
ΓΙCS | QAIN
OF | QAIN | /,
//16 | /). | |
| MT | Γ=10
CAL | 2
СШ А | | PTURE | | гну с | | 9 / A | א חא | | 1 I I A | ZED | то т | 70+- | 9 MR | |
| | ĂT
WAS | 500
AD0 | ΚΈV/Ί
PTED | 7/. AI
ASSUMII | BOVE (
NG 1.0 | 3 MEV
D MB | ÅT 1 | ŠTRA
4 ME | IGH
V F(| DR . | Í NE
JEND | ΪΝ Ι
L-3 | _0Ğ-İ
. 2 . | LÕĠ | ŠCÄĽE | 1 |
| MT | T=25
CAL | 1
CULA | MU
TED W | -BAR
ITH THI | E OPT | ICAL | MODE | L. | | | | | | | | |
| MF= | =4 | ANGU | | ISTRIB | JTIONS | S_OF | SECO | NDAR | YNE | EUTF | RONS | | | | | |
| MT | Г=2
САІ | | 2, 51
TFD W | -60: 11
1TH TH | TE SAT
E CAST | ME AS
Thy C | ODE/ | DL-3
9/ | . 1) | | | | | | | |
| MT | T=51
CAL | -60
CULA | ŢED W | <u>Т</u> Н ТН | E COME | BINED | PRO | GRAM | 0F | CAS | бтнү | /9/ | AND | | | |
| MT | ЕСІ
Г=16
т∆к | S/10
, 17
ÉN F | / COD
, 22,
ROM 1 | 28,9
101 FI | 1
ISTON | FILF | : | | | | | | | | | |
| MF= | =5 | ENER | GY DI | STRIBU | TIONS | OF S | ECON | DARY | NEU | JTRO | ONS | | | | | |

MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE.

- REFERENCES
 1) CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
 2) YAMAMURO, N.: JAERI-M 90-006 (1990).
 3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
 5) CAMARDA H.S. ET AL. : PHYS. REV. C8, 1813 (1973).
 6) OHKUBO M.: JAERI-M 5624 (1974).
 7) MACKLIN R.L. ET AL. : LA-9200-MS (1982).
 8) MUGHABGHAB S.F. AND GARBER D.I. : "NEUTRON CROSS SECTIONS", VOL. 2, PART B (1984).
 9) IGARASI S. AND FUKAHORI T.: JAREI 1321 (1991).
 10) RAYNAL J. : IAEA-SMR-9/8 P.281 (1972).
 11) DELAROCHE J.F. ET AL. : 1979 KNOXVILLE CONF. 336 (1979).
 12) PEREY F.G.: PHYS. REV. 131, 745 (1963).
 13) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 14) LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
 15) BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971).
 16) ONLOGE M. AND GRACA. C.: NUCL. PHYS. A242, 317 (1975).
- (1971). 16) QAIM,S.M. AND GRACA, C.: NUCL. PHYS., A242, 317 (1975). 17) VOIGNIER J. ET AL.: NUCL. SCI. ENG., 93, 43 (1986).

MAT number = 7437 74-W -184 KHI,NEDAC EVAL-MAR87 T.WATANABE(KHI), T.ASAMI(NEDAC) DIST-SEP89 REV2-JAN94 HISTORY 87-03 NEW EVALUATION WAS MADE FOR JENDL-3. 87-03 COMPILED BY T.ASAMI. 94-01 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2
ALL CROSS SECTIONS EXCEPT TOTAL
THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP),
(N,NA), (N,P), (N,D) AND (N,A) CROSS SECTIONS WERE
TAKEN FROM JENDL FUSION FILE. FURTHER MODIFICATION
WAS MADE FOR THE INELASTIC SCATTERING AND CAPTURE
CROSS SECTIONS.
(4,16-91), (5,16-91)
THESE DATA WERE TAKEN FROM JENDL FUSION FILE. JENDL FUSION FILE /1/ (AS OF JAN. 1994) EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING: - THE INELASTIC SCATTERING CROSS SECTIONS TO COTINUUM (MT=91) WAS CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-11 SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT REACTIONS. THE (N,2N), (N,3N), (N,NA), (N,NP), (N,P), (N,D) AND (N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103, 104, 107) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. USED IN IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1WF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS RESOLVED PARAMETERS FOR MLBW FORMULA WERE GIVEN IN THE ENERGY REGION FROM 1.0E-5 EV TO 12 KEV. PARAMETERS WERE EVALUATED IN EXAMINING BOTH THE EXPERIMENTAL DATA/5,6,7/ AND THE RECOMMENDED DATA OF BNL/8/. FOR UNKNOWN RADIATIVE WIDTH, AN AVERAGE VALUE OF 57 MILLI EV WAS ASSUMED. PARAMETERS FOR NEGATIVE RESONANCE WERE SELECTED SO THAT THE 2200 M/S CROSS SECTION FOR CAPTURE REPRODUCED GAVE A RECOMMENDED VALUE OF 1.7 BARNS/8/ AND GAVE A GOOD FIT TO THE EXPERIMENTAL DATA FOR TOTAL CROSS SECTIONS AROUND THERMAL ENERGIES. THE SCATTERING RADIUS WAS ASSUMED TO BE 7.5 FERMI. CALCULATED 2200 M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS ARE AS FOLLOWS: 2200 M/S CROSS SECTION(B) RES. INTEGRAL(BV) ELASTIC 7.35 CAPTURE 1.70 16.2 TOTAL 9.05 MF=2■3 NEUTRON CROSS SECTIONS BELOW 12 KEV, NO BACKGROUND CROSS SECTION WAS GIVEN AND ALL THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA. MF=3FOR JENDL-3.1, ABOVE 12 KEV, THE TOTAL AND PARTIAL CROSS SECTIONS WERE GIVEN MAINLY BASED ON THE THEORETICAL CALCULA-TIONS. THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS WERE CALCULATED WITH THE COUPLED-CHANNEL MODEL AND THE SPHERICAL OPTICAL-STATISTICAL MODEL. THE CALCULATIONS WERE PERFORMED WITH A COMBINED PROGRAM OF CASTHY/9/ AND ECIS /10/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS USED ARE: $V = 48.83 - 0.0809 \times EN$, VSO = 5.6 (MEV) WS = 6.73 - 0.0536 $\times EN$, WV = 0 (MEV) R = 1.168, RS = 1.268, RSO = 1.592 FM) A = 0.617, ASO = 0.664, B = 0.563 (FM) THE DEFORMED POTENTIAL PARAMETERS WERE TAKEN FROM THE WORK OF
DELAROCHE/11/.

FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE TOTAL ELASTIC SCATTERING AND CAPTURE WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /12/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/13/ FOR ALPHA, LOHR-HAEBERLI OMP/14/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/15/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1

- E TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY CODE/9/. THE ABOVE-MENTIONED OMP WAS USED. ALMOST THE SAME AS JENDL3.1.

MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION.

MT=4, 51-60, 91 INELASTIC SCATTERING THE DATA OF MT=51 TO 60 WERE CALCULATED WITH THE COMBINED PROGRAM OF CASTHY /9/ AND ECIS/10/. THESE CROSS SECTIONS IN JENDL-3.2 ARE THE SAME AS JENDL-3.1 EXCEPT THAT NEW CALCULATION WAS MADE AT ADDITIONAL SEVERAL ENERGY POINTS. THE CROSS SECTION OF MT=91 WAS CALCULATED WITH SINCROS-II FOR JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | NO. | МΤ | ENERGY(MEV |) | SPIN-PARITY | (DIRECT | PROCESS) |
|------------------|--|--|--|---|--|---|--|
| LEFHE ·N
2 ·N | G.S.
1
2
3
4
5
6
7
8
9
10
12
4
5
6
7
8
9
10
12
13
14
16
7
8
9
10
12
12
4
5
6
7
8
9
10
12
12
4
5
6
7
8
9
10
12
12
4
5
6
7
8
9
10
12
12
12
4
5
6
7
8
9
10
12
12
12
12
12
12
12
12
12
12 | 5123456777899900000 E - 240
555555555566666600 E - 240
80000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
80000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 240
8000 E - 24000 E - 24000
8000 E - 24000 E - 24000
8000 E - 24000 E - 24000
8000 E - 24000 E - 24000
8000 E - 24000 E - 24000
8000 E - 24000 E - 24000
8000 E - 24000 E - 24000 E - 24000
8000 E - 2400000000 E - 24000000000 | 0.0
0.1112
0.3641
0.7483
0.9033
1.0023
1.0023
1.0059
1.1214
1.1300
1.1338
1.2213
1.2850
1.2941
1.3453
1.3290
1.4320
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4310
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 MEV
1.4320 ME | WERE /
13-1
RECT
LSO F(
, 3.4 | 0+
2+
4+
6+
2+
0+
3+
2+
2-
4+
3-
5-
5+
0+
4-
4+
2+
3+
2+
2+
3+
2+
2+
3+
2+
2+
5-
5+
0+
4-
4-
4-
4-
4-
5-
5+
0+
3+
2+
2+
2-
4-
3+
2+
2+
2-
4-
3+
2+
2+
2-
5+
2+
2+
2+
2-
5+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+
2+ | E OVERLA
D AS IS
ATTERING
S AT 1.50
.5, 5.0 | PPING. DATA
INDICATED IN
CROSS
D1, 1.861.
AND 5.5 MEV, |
| MI=1
AD
MA | 6, 17,
(N,
OPTED
DE WIT
(N, | 22,
2N),
FROM
H SIN
2N) | 28, 103, 10
(N,3N), (N,
JENDL FUSIO
ICROS-II. T
2.162 B AT
1.93 B AT | 4, 107
NA), N
HE RES
14.7
14. | (N,NP), (N,P
E. THÉORETII
SULTS WERE N
MEV (SYSTEM,
MEV MEASURE
MEV MEASURE |), (N,D)
CÁL CÁLCI
ORMALIZEI
ATICS OF
D BY FREI | , (N,A)
JLATION WAS
D TO
QAIM/16/),
HAUT/17/, |

(N,3N) 0.022 B AT 14.76MEV MEASURED BY FREHAUT/17/, (N,P) 0.00334 B AT 14.96MEV MEASURED BY IKEDA/18/, 0.0029 B AT 14.7 MEV MEASURED BY QAIM/16/, (N,D)+(N,NP) 0.00065 B AT 14.7 MEV MEASURED BY QAIM/16/, (N,A) 0.00079 B AT 14.28MEV MEASURED BY CAIM/16/, 0.00115 B AT 14.7 MEV MEASURED BY CAIM/16/.

MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/9/ AND NORMALIZED TO 49+-6 MB AT 500 KEV/20/. ABOVE 3 MEV, A STRAIGHT LINE IN LOG-LOG SCALE WAS ADOPTED ASSUMING 1.0 MB AT 14 MEV FOR JENDL-3.2.

MT=251

=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS (MT=2, 51-60: THE SAME AS JENDL-3.1) MT=2

CALCULATED WITH THE CASTHY CODE/9/.

MT=51-60 CALCULATED WITH THE COMBINED PROGRAM OF THE CASTHY/9/ AND ECIS/10/ CODES. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
CAMARDA H.S. ET AL.: PHYS. REV. C8, 1813 (1973).
OHKUBO M.: JAERI-M 5624 (1974).
MACKLIN R.L. ET AL.: LA-9200-MS (1982).
MUGHABGHAB S.F. AND GARBER D.I.: "NEUTRON CROSS SECTIONS", VOL. 2, PART B (1984).
IGARASI S. AND FUKAHORI T.: JAREI 1321 (1991).
RAYNAL J.: IAEA-SMR-9/8 P.281 (1972).
DELAROCHE J.F. ET AL.: 1979 KNOXVILLE CONF. 336 (1979).
PEREY F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). PHENUMENA IN NUCL. REACTIONS, ONLY ADDRESS, (1971).
(1971).
(AIM S.M. AND GRACA C.: NUCL. PHYS., A242, 317 (1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).
(1975).<

| MAT number = 7443
74-W -186 KHI,NEDAC EVAL-MAR87 T.WATANABE(KHI), T.ASAMI(NEDAC)
DIST-SEP89 REV2-JAN94 | |
|--|---|
| HISTORY
87-03 NEW EVALUATION WAS MADE FOR JENDL-3.
87-03 COMPILED BY T.ASAMI.
94-01 JENDL-3.2. | |
| ČOMPILED BY T.NAKAGAWA (NDC/JAERI) | |
| ***** MODIFIED PARTS FOR JENDL-3.2
ALL CROSS SECTIONS EXCEPT TOTAL
THE INELASTIC SCATTERING, (N,2N), (N,3N), (N,NP),
(N,NA), (N,P), (N,D) AND (N,A) CROSS SECTIONS WERE
TAKEN FROM JENDL FUSION FILE. FURTHER MODIFICATION
WAS MADE FOR THE INELASTIC SCATTERING AND CAPTURE
CROSS SECTIONS | |
| (4,16-91), (5,16-91)
THESE DATA WERE TAKEN FROM JENDL FUSION FILE. | |
| JENDL FUSION FILE /1/ (AS OF JAN. 1994)
EVALUATED BY K.KOSAKO (NEDAC) AND S. CHIBA (NDC/JAERI)
COMPILED BY K.KOSAKO. | - |
| DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
- THE INELASTIC SCATTERING CROSS SECTIONS TO COTINUUM
(MT=91) WAS CALCULATED WITH CASTHY2Y AND DWUCKY IN
SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT | |
| THE (N,2N), (N,3N), (N,NA), (N,NP), (N,P), (N,D) AND
(N,A) REACTION CROSS SECTIONS (MT=16, 17, 22, 28, 103,
104, 107) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
BY THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE
CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND
RATIO WAS CALCULATED BY THE SINCROS- II CODE SYSTEM. | |
| THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/.
LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. | - |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY | |
| MF=2RESONANCEPARAMETERSMT=151RESOLVEDRESONANCEPARAMETERSRESOLVEDPARAMETERSFORMLBWFORMULAWEREGIVENINTHEENERGYREGIONFROM1.0E-5EVTO12KAMININGBOTHTHEEXPERIMENTALDATA/5,6,7/ANDRECOMMENDEDDATAOFBNL/8/.FORUNKNOWNRADIATIVEWIDTHAVERAGEVALUEOF60MILLI-EVWASASSUMED.PARAMETERSFORNEGATIVERESONANCEWERESELECTEDSOTHATTHE2200M/SCROSSSECTIONFORCAPTUREREPODUCEDGAVEARECOMMENDEDVALUEOF37.8BARNS/8/ANDGAVEAGOODFITTOTHESCATTERINGRADIUSWASASSUMEDTOBE7.64FERMI/8/.CALCULATED2200M/SECCROSSSECTIONSANDRESONANCEINTEGRALSAREASFOLLOWS:2200M/SECCROSSSECTIONSANDRESONANCEINTEGRALSAREASFOLLOWS:2200M/SECCROSSSECTIONSANDRESONANCEINTEGRAL(B)ELASTIC0.14CAPTURE37.89347.TOTAL38.03347.TOTAL38.03347.TOTAL347. | 1 |
| MF=3 NEUTRON CROSS SECTIONS
BELOW 12 KEV, ZERO BACKGROUND CROSS SECTION WAS GIVEN AND ALL
THE CROSS-SECTION DATA ARE REPRODUCED FROM THE EVALUATED
RESOLVED RESONANCE PARAMETERS WITH MLBW FORMULA. | |
| FOR JENDL-3.1, ABOVE 12 KEV, THE TOTAL AND PARTIAL CROSS
SECTIONS WERE GIVEN MAINLY BASED ON THE THEORETICAL CALCULA-
TIONS. THE TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE
CROSS SECTIONS WERE CALCULATED WITH THE COUPLED-CHANNEL MODEL
AND THE SPHERICAL OPTICAL-STATISTICAL MODEL. THE CALCULATIONS
WERE PERFORMED WITH A COMBINED PROGRAM OF CASTHY/9/ AND ECIS
/10/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS USED ARE:
V = 48.83 - 0.0809*EN, VSO = 5.6 (MEV)
WS = 6.73 - 0.0536*EN, WV = 0 (MEV)
R = 1.168, RS = 1.268, RSO = 1.592 (FM)
A = 0.617, ASO = 0.664, B = 0.563 (FM) | |

DELAROCHE/11/.

FOR JENDL-3.2, ALL CROSS SECTION DATA EXCEPT FOR THE TOTAL, ELASTIC SCATTERING AND CAPTURE WERE ADOPTED FROM JENDL FUSION FILE. THE CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /12/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/13/ FOR ALPHA, LOHR-HAEBERLI OMP/14/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/15/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT=1 TOTAL OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY CODE/9/. THE ABOVE-MENTIONED OMP WAS USED. ALMOST THE SAME AS JENDL-3.1.

MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF THE PARTIAL CROSS SECTIONS FROM THE TOTAL CROSS SECTION.

MT=4, 51-62, 91 INELASTIC SCATTERING THE DATA OF MT=51 TO 62 WERE CALCULATED WITH THE COMBINED PROGRAM OF CASTHY /9/ AND ECIS/10/. THESE CROSS SECTIONS IN JENDL-3.2 ARE THE SAME AS JENDL-3.1 EXCEPT THAT NEW CALCULATION WAS MADE AT ADDITIONAL SEVERAL ENERGY POINTS. THE CROSS SECTION OF MT=91 WAS CALCULATED WITH SINCROS-II FOR JENDL FUSION FILE. THE LEVEL SCHEME WAS BASED ON REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

| | N | ١ <u>٥</u> . | МΤ | E | NER | GY(| MEV |) | | SP | ΙN | -PA | RI | TΥ | (D | I R | ЕСТ | P | ROC | ES | 3) | | |
|----|----------------|--------------|---------------------|--------------|-------------------|-------------------|-----------------|----------------|--------------------|------------------|-------------------|-------------------|----------------|-------------------|-------------------|-------------|-------------------|------------------|-------------------|-----------------|------------|-----|--|
| | 1
2 | 5. | 51
52 | | 0.0 | 226
968 | | | | | | 0+
2+
4+ | | | | | *
* | | | | | | |
| | 3
4
5 | - | 53
54
55 | | 0.7
0.8
0.8 | 377
088
618 | | | | | | 2+
6+
3+ | | | | | * | | | | | | |
| | 6
7
8 | | 56
57
58 | | 0.8
0.9
1.0 | 820
526
070 | | | | | | 0+
2-
2+ | | | | | | | | | | | |
| | 9
10
11 | | 59
60
61 | | 1.0 | 316
452
500 | | | | | | 4+
3-
0+ | | | | | | | | | | | |
| | 12
13
14 | | 62
62
62 | | 1.2
1.2
1.3 | 840
980
220 | | | | | | 2+
2+
2+ | | | | | | | | | | | |
| | LEVEL | S A | BÖVE
MT= | 1.
⊧62 | 323
ARE | MĔ
SU | V W
M O | ERE
F (| E A
CRO | SSU
SS
NG | ME | D T
CTI | 0
0N | BE
S (| 0V
)F | ER
12 | LAF
TH | | NG.
141 |
 H | | LS. | |
| | ALSO
5.5 A | FOR | THE 6.0 | MEV | VEL
, A | S A
ND | T 1
ADD | .38
ED | 34,
TÓ | 2.
MŤ | 00
=9 | 2,
1. | 2. | 588 | 3, | 3. | 0, | 3. | 5, | 4.0 |), 5 | .0, | |
| М٦ | 「=16, | 17,
(N, | 22,
2N), | 28
(N | , 1
,3N | 03,
) <u>,</u> | 10
(N, | 4
NÅ | 10
2. | 7
(N, | N₽ |),, | (<u>N</u> | ,P) | | (N | ,D) | | (<u>N</u> , | A) | | | |
| | MADE | WIT | FROM
H SI
2N) | | 0S-
.27 | FU
11.
2 B | STU
T
AT | HE
14 | - I L
RE
4.7 | E.
SUL
ME | TS | WE | RE | |) RM
) B | AL
Y | | D
M/ | ATT
TO
16/ | UN
.,_ | WAS | • | |
| | | (N,
(N, | 3N)
P) | 1
0
0. | .9
.05
001 | В
8 В
4 В | A I
AT
AT | 14
14
14 | 4.
4.7
4.7 | ME
6ME
ME | V I
V I
V I | MEA
MEA
MEA | SU
SU
SU | REL
REL
REL |) B
) B
) B | Y
Y
Y | FRE
QAI | HA
HA
M/ | UT/
UT/
16/ | 17
17
17 | / ,
/ , | | |
| (| (N,D)+ | (N, | NP)
A) | 0.0 | 002 | 5 B
4 B
6 B | AT
AT
AT | 14
14
14 | 4.7
4.8
4.8 | МЕ
7МЕ
7МЕ | V I
V I
V I | MEA
MEA
MEA | SU
SU | RED
RED
RED |) B
) B
) B | Y
Y
Y | QAI
KAS
KAS | M/
SUG
SUG | 16/
AI/
AI/ | ,
18,
18, | /, | | |
| | | 、 , | , | Õ.Õ | 005 | 5 B | ÂŤ | 'i₄ | 4.7 | MĒ | Ý İ | MEA | ŠŬ | RĒ | ĴΒ | Ý | QAI | M/ | 16/ | '. '' | , | | |

MT=102 CAPTURE CALCULATED WITH THE CASTHY CODE/9/ AND NORMALIZED TO 49+-6 MB AT 500 KEV/19/. ABOVE 3 MEV, A STRAIGHT LINE IN LOG-LOG SCALE WAS ADOPTED ASSUMING 1.0 MB AT 14 MEV (BASED ON EXPERIMENTAL DATA STORED IN EXFOR) FOR JENDL-3.2.

MT=251 MU-BAR CALCULATED WITH THE OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS (MT=2, 51-62: THE SAME AS JENDL-3.1) MT=2

CALCULATED WITH THE CASTHY CODE/9/.

MT=51-62 CALCULATED WITH THE COMBINED PROGRAM OF THE CASTHY/9/ AND ECIS/10/ CODES. MT=16, 17, 22, 28, 91

TAKEN FROM JENDL FUSION FILE.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE.

REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
CAMARDA H.S. ET AL. : PHYS. REV. C8, 1813 (1973).
OHKUBO M. : JAERI-M 5624 (1974).
MACKLIN R.L. ET AL. : LA-9200-MS (1982).
MUGHABGHAB S.F. AND GARBER D.I. : "NEUTRON CROSS SECTIONS", VOL. 2, PART B (1984).
IGARASI S. AND FUKAHORI T.: JAREI 1321 (1991).
RAYNAL J. : IAEA-SMR-9/8 P.281 (1972).
DEREY F.G.: PHYS. REV. 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971).

PHENOMENA IN NUCL. REACTIONS, ONLY. MISSINGLA FREES, 1122 (1971).
16) QAIM S.M. AND GRACA C.: NUCL. PHYS., A242, 317 (1975).
17) FREHAUT J. ET AL.: 1980 BNL SYMPOSIUM, BNL-NCS-51245, VOL. 1, P.399 (1980).
18) KASUGAI Y. ET AL.: JAERI-M 93-046, P.277 (1993).
19) VOIGNIER J. ET AL.: NUCL. SCI. ENG., 93, 43 (1986).

MAT number = 8200 82-PB- 0 JAERI EVAL-JUL87 M.MIZUMOTO DIST-SEP89 REV2-JUN94 HISTORY HISTORY 87-03 NEWLY EVALUATED FOR JENDL-3 BY M.MIZUMOTO (JAERI) 87-01 REVISION IS RECOMMENDED. 89-09 REVISION IS COMPLETED. COMPILATION WAS MADE BY. T.NARITA AND T.FUKAHORI (JAERI) 94-06 JENDL-3.2. RESONANCE PARAMETERS CORRECTED BY T.NAKAGAWA DATA FOR MF=3,4,5 WERE ADOPTED FROM JENDL FUSION FILE GAMMA-RAY PRODUCTION DATA MODIFIED BY K.SHIBATA(JAERI) COMPILED BY T.NAKAGAWA (NDC/JAERI) * (4,,.. (2,151) RE, 208. UF, CHANGED. 1) BELOW 1 MEV ^OMPANSA (3,1) BELOW 1 MEV (3,102) (3,2) TO COMPANSATE THE ABOVE MODIFICATIONS (12,102), (13,3), (13,4), (15,3), (15,102) JENDL FUSION FILE /1/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT REACTIONS.
THE (N,2N), (N,3N), (N,NA) AND (N,NP) REACTION CROSS SECTIONS (MT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. THE (N,2N) CROSS SECTION WAS RENORMALIZED TO EXPERIMENTAL DATA.
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED WITH THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM.
OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1F=2 RESONANCE PARAMETERS WT=151 RESOLVED RESONANCE PARAMETERS RESONANCE RANGES AND FORMULA PB-204: 1.0E-5 EV TO 50 KEV, MLBW PB-206: 1.0E-5 EV TO 500 KEV, REICH-MOORE PB-207: 1.0E-5 EV TO 475 KEV, REICH-MOORE PB-208: 1.0E-5 EV TO 1 MEV, REICH-MOORE PARAMETERS WERE EVALUATED FROM THE FOLLOWING EXPERIMENTAL DATA AND RECOMMENDATION BY MUGHABGHAB/5/. PB-204: HOREN+84 /6/ PB-206: HOREN+79 /7/, MIZUMOTO+79 /8/ PB-208: HOREN+86 /10/ MF=2MT = 151CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTE 2200 M/S RES. INTEG. INTEGRALS. 2200 M/S 11.073 B 0.174 B 11.248 B ELASTIC CAPTURE TOTAL 0.143 B =3 NEUTRON CROSS SECTIONS BELOW 1 MEV, BACKGROUND CROSS SECTIONS ARE GIVEN. MF=3FOR JENDL-3.2, THE THRESHOLD REACTION CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THEIR CALCULATION WAS MADE WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY

YAMAMURO/2/ FOR NEUTRONS, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/11/ FOR ALPHA, THE SAME OMP'S AS THE PEGASUS CALCULATION FOR OTHER CHARGED PARTICLES AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. DATA FOT NATURAL PB WERE CONSTRUCTED FROM DATA FOR ISOTOPES.

MT=1 TOTAL CROSS SECTIONS IN THE ENERGY RANGE FROM 1 TO 15 MEV WERE OBTAINED BASED ON THE EXPERIMENTAL DATA OF SCHWARTZ+74 /12/. ABOVE 15 MEV, CROSS SECTIONS WERE CALCULATED WITH AN OPTICAL AND STATISTICAL MODEL CODE CASTHY /13/. THE OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING AVERAGE TOTAL CROSS SECTION OF NATURAL LEAD AS FOLLOWS, V=47.0 - 0.250*E, WS = 2.30 + 0.41*E, VSO = 6.0 (MEV) R0 = 1.25 , RS = 1.30 , RSO = 1.30 (FM) A0 = 0.65 , B = 0.48 , ASO = 0.689 (FM) LEVEL DENSITY PARAMETERS WERE DETERMINED USING LOW-LYING LEVEL DATA AND OBSERVED NEUTRON RESONANCE SPACING.

MT=2 ELASTIC SCATTERING (TOTAL)-(ALL OTHER PARTIAL CROSS SECTIONS)

MT=4,51-90,91 INELASTIC SCATTERING TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS TAKEN FROM REF./4/. THE DATA FOR SOME LEVELS WERE LUMPED AS FOLLOWS:

| MT
51 | ENERGY(MEV) | PB-204 | PB-206 | PB-207 | PB-208 | |
|----------------------------|--------------------------------|------------------------|-------------|------------------------|---------------------------------|---|
| 52 | 0.8031 | E 4 | 51 | 50 | | |
| 53 | 1.165 | 51 | 52 | 52 | | |
| 55
56 | 1.3405 | 52
53 | 53 | | | |
| 57
58 | 1.467
1.5631 | 54-56 | 54 | | | |
| 59
60 | 1.6334
1.665 | 57 | | 53 | | |
| 61
62 | 1.682 | 58
59 | 55
56 | | | |
| 63
64 | 1.7619
1.9977 | 60,61 | 57
58 | | | |
| 65
66 | 2.149
2.2002 | | 59
60 | | | |
| 67
68 | 2.315
2.379 | | 61
62-64 | 54 | | |
| 69
70 | 2.424
2.6146 | | 65 | | 51 | |
| 71
72 | 2.6232
2.703 | | | 55,56
57,58 | | |
| 73
74 | 3.1977
3.4751 | | | | 52
53 | |
| 75
76 | 3.7087
3.9198 | | | | 54
55,56 | |
| 77
78 | 3.961
4.037 | | | | 57,58
59-61 | |
| 79
80 | 4.0854
4.106 | | | | 62
63,64 | |
| 81
82 | 4.141
4.1804 | | | | 65,66
67 | |
| 83
84 | 4.2054
4.2295 | | | | 68
69.70 | |
| 85
86 | 4.2535 | | | | 71
72 | |
| 87
91 | 4.296 | 91 | 91 | 91 | 73
91 | |
| MT=16. 17. 2 | 2. 28 | (N.2N). | (N.3N). | (N.NA). (| N.NP) | |
| ADOPTED FRO
MADE WITH S | M'JENDL FUSIO | ON FILE.
The (N.21 | THÉORÉT | ÌCẢL CẢLỜ
SECTION W | ULATÍON WAS
AS ADJUSTED TO |) |
| REPRODUCE T | HE MEASURED I
AKOV ET AL | ENĀRĠŸ'ŠF
/15/ WFRF | ÉCTRĂ/14 | / (FACTOR
KEN INTO | = 1.2). THE
CONSIDERATION | |
| MT=102 CA | PTURE | | | | | |
| CALCULATED
PB-208 EST | WITH CASTHY | /13/ FOR
THE EXPER | PB-204, I | PB-206 AN
DATA TH | D PB-207. FOR
E CAPTURE CROS | s |
| SECTION OF | NATURAL LEAD
WEIGHTED AVE | WAS CONS | STRUCTED I | FROM THES | Ē ISOTOPĒS.
Es | |
| MT=103 107 | (N.P). (N | A) | | | | |
| CALCULATED
ACCORDING T | WITH GNASH //
O THEIR ABUNI | 16/ FOR E
DANCES. | EACH ISOT | OPE AND C | ONSTRUCTED | |

MT=251 MU-BAR CALCULATED WITH CASTHY /13/. IF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4ĊĀĹCULATED WITH CASTHY /13/. MT=51-87 TAKEN FROM JENDL FUSION FILE WHICH WERE CONSTRUCTED FROM ISOTOPE DATA CALCULATED WITH SINCROS-II(CASTHY AND DWUCKY). MT=16,17,22,28,91 ADOPTED FROM JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,22,28,91 ADOPTED FROM JENDL FUSION FILE. MF=12 GAMMA-RAY MULTIPLICITY PRODUCED BY NEUTRON REACTIONS MT=102 (BLELOW 1.8 MEV) CALCULATED FROM ENERGY BALANCE. MF=13 GAMMA-RAY PRODUCTION CROSS SECTIONS MT=3 (ABOVE 1.8 MEV) CALCULATED WITH GNASH /16/ FOR EACH ISOTOPE AND CONSTRUCTED ACCORDING TO THEIR ABUNDANCES. MT=4 (BELOW 1.8 MEV) CALCULATED FROM INELASTIC SCATTERING CROSS SECTIONS AND TRANSITION PROBABILITIES OF ISOTOPES. MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS MT=3, 4, 102 : ASSUMED ISOTROPIC. MF=15 ENERGY DISTRIBUTION OF SECONDARY GAMMA-RAYS MT=3 (ABOVE 1.8 MEV) CALCULATED WITH GNASH /16/ FOR EACH ISOTOPE AND CONSTRUCTED ACCORDING TO THEIR ABUNDANCES. ABOVE 10 MEV, THE CALCULATED SPECTRA WERE MODIFIED SO AS TO REPRODUCE THE MEASUREMENTS OF CHAPMAN ET AL./17/ MT=102 (BELOW 1.8 MEV) CALCULATED WITH CASTHY/13/. REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B, ACADEMIC PRESS (1984).
HOREN D.J. ET AL.: PHYS. REV. C29, 2126 (1984).
HOREN D.J. ET AL.: PHYS. REV. C20, 478 (1979).
MIZUMOTO M. ET AL.: PHYS. REV. C19, 335 (1979).
HOREN D.J. ET AL.: PHYS. REV. C19, 335 (1979).
HOREN D.J. ET AL.: PHYS. REV. C18, 722 (1978).
HOREN D.J. ET AL.: PHYS. REV. C18, 420 (1986).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
SCHWARTZ R.B. ET AL.: NBS-MONO-138 (1974), DATA IN EXFOR (1971).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
TAKAHASHI A. ET AL.: WORKSHOP ON NUCL DATA FOR FUSION REA (1971): IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). TAKAHASHI A. ET AL.: JAERI-M 86-080, 393 (1986). SIMAKOV S.P. ET AL: WORKSHOP ON NUCL. DATA FOR FUSION REACTOR TECHNOL., DEL MAR, MAR 3-6 (1993). YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977). CHAPMAN G.T. ET AL.: ORNL/TM-4822 (1975). 15) 16) 17)

| MAT number
82-PB-204 | = 8225
JAERI I | EVAL-JUL87 M.MIZUMOTO
DIST-SEP89 REV2-APR94 |
|--|--|---|
| 87-03 NEWL
87-11 REVI
89-09 REVI
COMP | Y EVALUATED I
SE IS RECOMME
SION IS COMPI
ILATION WAS P | FOR JENDL-3 BY M. MIZUMOTO (JAERI)
ENDED.
LETED.
MADE BY T. NARITA AND T.FUKAHORI (JAERI) |
| 94-04 JEND
BY
GA
COMP | L-3.2.
ADOPTING THE
MMA-RAY PRODU
ILED BY T.NA | E DATA FROM JENDL FUSION FILE
UCTION DATA MODIFIED BY K.SHIBATA(JAERI)
KAGAWA (NDC/JAERI) |
| *****
(3,2
(4,1)
(12,
**** | MODIFIED F
(3,4), (3
5-91), (5,16
THESE DAT
102) FROM E
102) SPECTRU | PARTS FOR JENDL-3.2 ************************************ |
| JEND | L FUSION FILE
EVALUATED E
COMPILED E | E /1/ (AS OF OCT. 1993)
BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI)
BY K.KOSAKO. |
| DATA
- T
D
C
D | WERE TAKEN I
HE INELASTIC
ISTRIBUTIONS
ONTINUUM INEI
WUCKY IN SING | FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
SCATTERING CROSS SECTIONS AND ANGULAR
OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
LASTIC) WERE CALCULATED WITH CASTHY2Y AND
CROS-11 SYSTEM/2/ INCLUDING CONTRIBUTIONS |
| - T
S
R
F | ROM DIRECT RE
HE (N,2N), (1
ECTIONS (MT=
N THE SINCROS
ENORMALIZED
VERGY DISTRIC | EACTIONS.
N,3N), (N,NA) AND (N,NP) REACTION CROSS
16, 17, 22, 28) WERE CALCULATED BY EGNASH2
S-11. THE (N,2N) CROSS SECTION WAS
TO EXPERIMENTAL DATA.
BULLONS OF SECONDARY NEUTRONS WERE REPLACED |
| Ū
C
T
- O
T
L | TH THOSE CAL
DNTINUUM NEU
ICS /3/ USINO
ATIO WAS CALO
PTICAL-MODEL
HE SINCROS-I
EVEL SCHEMES | LCULATED BY EGNASH2. THE DDX'S OF THE
TRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
G F15TOB /1/. THE PRECOMPOUND/COMPOUND
CULATED BY THE SINCROS-II CODE SYSTEM.
, LEVEL DENSITY AND OTHER PARAMETERS USED IN
I CALCULATION ARE DESCRIBED IN REF./2/.
WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| MF=1 GENE
MT=451 D | RAL INFORMAT
ESCRIPTIVE D/ | ION
ATA AND DICTIONARY |
| MF=2 RESO
MT=151 R
RESONANC
PARAMETE
EFFECTIV | NANCE PARAME
ESOLVED RESON
E RANGES: 1.0
RS WERE EVALU
E SCATTERING | TERS
NANCE PARAMETERS FOR MLBW FORMULA
OE-5 EV TO 50 KEV
UATED FROM THE DATA OF HOREN+84 /5/.
RADIUS OF 8.5 FM WAS SELECTED. |
| CAL
ELAS
CAPT
TOTA | CULATED 2200
22
TIC 1
JRE (
L 1 | -M/S CROSS SECTIONS AND RES. INTEGRALS.
200 M/S RES. INTEG.
1.197 B -
0.661 B 1.848 B
1.857 B - |
| MF=3 NEUT
BELOW 50
BACKGROU
AND CAPT | RON CROSS SEC
KEV
ND CROSS SEC
JRE CROSS SEC | CTIONS
TIONS ARE GIVEN FOR THE ELASTIC SCATTERING
CTIONS. |
| ABOVE 50
CROSS SE
STATISTI
TERS WER
NATURAL
V=4 | KEV
CTIONS FOR JI
CAL MODEL CAI
E OBTAINED B
LEAD:
7.0 - 0.250*1 | ENDL-3.1 WERE OBTAINED FROM OPTICAL AND
LCULATIONS. THE OPTICAL POTENTIAL PARAME-
Y FITTING AVERAGE TOTAL CROSS SECTION OF
E. WS = 2.30 + 0.41*E. VSO = 6.0 (MEV) |
| RO
AO
LEVEL DE
DATA AND | = 1.25
= 0.65
NSITY PARAME
OBSERVED NEU | , RS = 1.30 , RSO = 1.30`(FM)
B=0.48 , ASO = 0.689 (FM)
TERS WERE DETERMINED USING LOW-LYING LEVEL
UTRON RESONANCE SPACING. |
| FOR JEND
SCATTERI | L-3.2, THE (1 | N,2N), (N,3N), (N,NA), (N,NP) AND INELASTIC |

/6/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/7/ FOR ALPHA, LOHR-HAEBERLI OMP/8/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/9/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. THE DATA OF TOTAL, CAPTURE, (N,P), (N,D) AND (N,A) CROSS SECTIONS ARE THE SAME AS JENDL-3.1. MT=1 TOTAL CALCULATED WITH OPTICAL AND STATISTICAL MODE CODE CASTHY /10/ MT=2 ELASTIC SCATTERING (TOTAL)-(ALL OTHER PARTIAL CROSS SECTIONS) MT=4,51-61,91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS ADOPTTED FROM REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*', USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./11/ AND 4, CHEME CHEME DEFORMATION SPEAR/12/. NO. G.S. 1 2 3 4 ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) 0.0 + 2.0 + 4.0 + 2.0 + 0.0 0.8992 1.2739 1.3514 * * 4 1.5631 4.0 1.5836 1.6047 1.665 0.0 5 6 7 3.0 + 2.0 + * 1.682 1.73 1.0 0.0 8 + ğ + 1.7619 10 1.0 11 1.8173 4.0 + * LEVELS ABOVE 1.817 MEV WERE ASSUMED TO BE CONTINUUM. MT=16, 17, 22, 28 (N,2N), (N,3N), (N,NA), (N,NP) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE (N,2N) CROSS SECTION WAS NORMALIZED TO 2.12 B AT 13.98 MEV MEASURED BY IKEDA ET AL./13/, MT=102 CAPTURE CALCULATED WITH CASTHY /10/. MT=103, 107 (N,P), (N,A) CALCULATED WITH GNASH /14/. MT=251 MU-BAR CALCULATED WITH CASTHY /10/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS CALCULATED WITH CASTHY /10/. MT=51-61 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY AND DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=12 GAMMA-RAY MULTIPLICITY PRODUCED BY NEUTRON REACTIONS MT=16,17,22,91 .._CALCULATED WITH GNASH /14/. MT=51-61 TRANSITION PROBABILITIES WERE GIVEN. MT = 102FROM ENERGY BALANCE. MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS MT=16,17,51-61,22,91,102: ASSUMED TO BE ISOTROPIC. MF=15 ENERGY DISTRIBUTION OF SECONDARY GAMMA-RAYS MT=16,17,91,102: CALCULATED WITH THE GNASH /14/. REFERENCES 1) CHENGLS 1) CHEBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). 2) YAMAMURO, N.: JAERI-M 90-006 (1990). 3) KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). 4) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. 5) HOREN D.J. ET AL. : PHYS. REV. C29, 2126 (1984).

- 6) PEREY F.G.: PHYS. REV., 131, 745 (1963).
 7) ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 8) LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
 9) BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971).
 10) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 11) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
 12) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
 13) IKEDA Y. ET AL.: JAERI 1312 (1987).
 14) YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977).

MAT number = 8231 82-PB-206 JAERI EVAL-JUL87 M.MIZUMOTO DIST-SEP89 REV2-APR94 HISTORY NEWLY EVALUATED FOR JENDL-3 BY M.MIZUMOTO (JAERI) REVISE IS RECOMMENDED. REVISION IS COMPLETED. COMPILATION IS MADE BY T.NARITA AND T.FUKAHORI (JAERI) 87-03 87-11 89-09 94-04 JENDL-3.2. MF2: REICH-MOORE FORMULA ADOPTED. MF3, 4, 5: BY ADOPTING THE DATA FROM JENDL FUSION FILE MF12.15: MODIFIED BY K.SHIBATA(JAERI) COMPILED BY T.NAKAGAWA (NDC/JAERI) **** MODIFIED PARTS FOR JENDL-3.2 ********* (3,4), (3,16). (3,17), (3,22), (3,28), (3,51-91) (4,16-91), (5,16-91) THESE DATA WERE TAKEN FROM JENDL FUSION F (2,151) REICH-MOORE FORMULA ADOPTED * * * * * JENDL FUSION FILE. (2,151) REICH-MOORE FORMULA ADOPTED (3,102) RENORMALIZED (3,2) (12,102), (15,102) CALCULATED WITH CASTHY JENDL FUSION FILE /1/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT REACTIONS.
THE (N,2N), (N,3N), (N,NA) AND (N,NP) REACTION CROSS SECTIONS (MT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. THE (N,2N) CROSS SECTION WAS RENORMALIZED TO EXPERIMENTAL DATA.
ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED WITH THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM.
OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR REICH-MOORE FORMULA RESONANCE RANGE: 1.0E-5 EV TO 500 KEV PARAMETERS WERE EVALUATED FROM THE DATA OF HOREN+79 /5/, AND MIZUMOTO+79 /6/. VALUES OF RADIATIVE WIDTH WERE TAKEN FROM REF./7/. EFFECTIVE SCATTERING RADIUS OF 8.042 FM AND DUMMY RESONANCES AT -4 AND 8 MEV WERE ADOPTED FROM REF./5/. MF=2MT=151 CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTE 2200 M/S RES. INTEG. ELASTIC 10.035 B -CAPTURE 0.0306 B 0.1108 B INTEGRALS. ELASTIC CAPTURE TOTAL 10.066 В MF=3 NEUTRON CROSS SECTIONS BELOW 500 KEV NO BACKGROUND CROSS SECTIONS ARE GIVEN. ABOVE 500 KEV CROSS SECTIONS FOR JENDL-3.1 WERE OBTAINED FROM OPTICAL AND STATISTICAL MODEL CALCULATIONS. THE OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING AVERAGE TOTAL CROSS SECTION OF NATURAL LEAD: WAT 0 = 0.250*F WS = 2.30 + 0.41*E, VS0 = 6.0 (MEV)

FOR JENDL-3.2, THE (N,2N), (N,3N), (N,NA), (N,NP) AND INELASTIC SCATTERING CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THEY WERE CALCULATED WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /8/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/9/ FOR ALPHA, LOHR-HAEBERLI OMP/10/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/11/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM. THE DATA OF TOTAL, CAPTURE, (N,P), (N,D) AND (N,A) CROSS SECTIONS ARE THE SAME AS JENDL-3.1. MT=1 TOTAL CALCULATED WITH OPTICAL AND STATISTICAL MODE CODE CASTHY /12/ MT=2 ELASTIC SCATTERING (TOTAL)-(ALL OTHER PARTIAL CROSS SECTIONS) MT=4,51-65.91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LE SCHEME WAS ADOPTTED FROM REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*', USING DEFORMATION PARAMETERS COMPILED BY RAMAN ET AL./13/ AND THE LEVEL USĪŇĠ SPEAR/14/. NO. G.S. 2 ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) 0.0 0.0 + 2.0 + 0.0 + * 1.1650 3.0 + 2.0 + 4.0 + * 3 1.467 4 1.6841 * 5 1.6841 1.703 1.784 1.9977 2.149 2.2002 2.315 2.379 2.3842 2.3914 2.424 6 7 1.0 2.0 4.0 2.0 7.0 0.0 * 8 + q + 1Ŏ * 11 + 12 4.0 14 2.3914 4.0 + 15 2.424 2.0 + LEVELS ABOVE 2.424 MEV WERE ASSUMED TO BE CONTINUUM. THE DIRECT INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED FOR THE LEVELS AT 2.648, 3.014, 3.774, 4.114, 4.33, 5.261, 6.103 AND 6.187 MEV, AND ADDED TO MT=91. + MT=16. 17, 22, 28 (N,2N), (N,3N), (N,NA), (N,NP) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE (N,2N) CROSS SECTION WAS ADJUSTED TO REPRODUCE THE MEASURED ENARGY SPECTRA/15/ (FACTOR = 1.2). THE DATA OF SIMAKOV ET AL. /16/ WERE ALSO TAKEN INTO CONSIDERATION. MT=102 CAPTURE CALCULATED WITH CASTHY /12/, AND NORMALIZED TO 0.0085 B AT AT 50 KEV WHICH WAS AN AVERAGE VALUE OBTAINED FROM THE RESONANCE PARAMETERS. MT=103 (N,P) CALCULATED WITH GNASH /17/ AND NORMALIZED TO 2.0 MB AT 14.5 MEV BY BELOVICKIJ+76 18/. MT=107 (N,A) CALCULATED WITH GNASH /17/ AND MULTIPLIED BY 5. MT=251 MU-BAR CALCULATED WITH CASTHY /12/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS CALCULATED WITH CASTHY /12/. MT=51-65 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY AND DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=12 GAMMA-RAY MULTIPLICITY PRODUCED BY NEUTRON REACTIONS MT=16,17,22,28,91,103,107

CALCULATED WITH GNASH /17/.

MT=51-65 TRANSITION PROBABILITIES ARE GIVEN.

M=102 CALCULATED WITH CASTHY /12/. MULTIPLICITY OF A LINE SPECTRUM AT THERMAL IS 1.0.

MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS MT=16,17,22,28,51-65,91,102,103,107 : ASSUMED ISOTROPIC.

MF=15 ENERGY DISTRIBUTION OF SECONDARY GAMMA-RAYS MT=16,17,22,28,91,107 CALCULATED WITH THE GNASH /17/.

M=102 CALCULATED WITH CASTHY /12/. AT THERMAL, A LINE SPECTRUM OF 6.73835 MEV WAS ASSUMED.

REFERENCES

REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
HOREN D.J. ET AL.: PHYS. REV. C20, 478 (1979).
MIZUMOTO M. ET AL.: PHYS. REV. C19, 335 (1979).
MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1 PART B ACADEMIC PRESS (1984).
PEREY F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR J.M. AND HAEBERLI W.: NUCL. PHYS. A232, 381 (1974).
BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971):

PHENOMENA IN NUCL. REACTIONS, UNIV. WISCONSIN FRESS, 1.002 (1971).
12) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
13) RAMAN, S., ET AL.: ATOM. DATA AND NUCL. DATA TABLES 36, 1 (1987)
14) SPEAR, R.H.: ATOM. DATA AND NUCL. DATA TABLE, 42, 55 (1989).
15) TAKAHASHI A. ET AL.: JAERI-M 86-080, 393 (1986).
16) SIMAKOV S.P. ET AL: WORKSHOP ON NUCL. DATA FOR FUSION REACTOR TECHNOL., DEL MAR, MAR 3-6 (1993).
17) YOUNG P.G. AND ARTHUR E.D.: LA-6974 (1977).
18) BELOVICKIJ ET AL.: 75 KIEV, 4, 209 (1976).

MAT number = 8234 82-PB-207 JAERI EVAL-JUL87 M.MIZUMOTO DIST-SEP89 REV2-APR94 HISTORY 87-03 NEWLY EVALUATED FOR JENDL-3 BY M.MIZUMOTO (JAERI) 87-11 REVISE IS RECOMMENDED. 89-09 REVISION IS COMPLETED COMPILATION IS MADE BY T.NARITA AND T.FUKAHORI (JAERI) 94-04 JENDL-3.2. RESONANCE PARAMETERS CORRECTED BY T.NAKAGAWA DATA FOR MF=3,4,5 WERE ADOPTED FROM JENDL FUSION FILE GAMMA-RAY PRODUCTION DATA MODIFIED BY K.SHIBATA(JAERI) COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY * * * * * (3,102) RENORMALIZED (3,107) 0 AT 500 KEV WAS INSERTED (3,2) (12,102), (15,102) CALCULATED WITH CASTHY JENDL FUSION FILE /1/ (AS OF OCT. 1993) EVALUATED BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI) COMPILED BY K.KOSAKO. TA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING: THE INELASTIC SCATTERING CROSS SECTIONS AND ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT CONTINUUM INELASTIC) WERE CALCULATED WITH CASTHY2Y AND DWUCKY IN SINCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS FROM DIRECT REACTIONS. THE (N.2N). (N.3N) (N.NA) AND (N.NP) REACTION CROSS DATA WERE FROM DIRECT REACTIONS. THE (N,2N), (N,3N), (N,NA) AND (N,NP) REACTION CROSS SECTIONS (MT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2 IN THE SINCROS-II. THE (N,2N) CROSS SECTION WAS RENORMALIZED TO EXPERIMENTAL DATA. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED WITH THOSE CALCULATED BY EGNASH2. THE DDX'S OF THE CONTINUUM NEUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-TICS /3/ USING F15TOB /1/. THE PRECOMPOUND/COMPOUND RATIO WAS CALCULATED BY THE SINCROS-II CODE SYSTEM. OPTICAL-MODEL, LEVEL DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/4/. IF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MF = 1#F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR REICH-MOORE FORMULA RESONANCE RANGES: 1.0E-5 EV TO 475 KEV PARAMETERS WERE BASED ON THE DATA OF HOREN+78 /5/ AND RECOMMEN-DATION OF MUGHABGHAB/6/ PARAMETERS OF DUMMY RESONANCES WERE TAKEN FROM ENDF/B-VI EVALUATION/7/. AVERAGE RADIATIVE WIDTH OF 0.11 EV WAS USED FOR THE RESONANCES WHOSE VALUE WAS UNKNOWN. EFFECTIVE SCATTERING RADIUS OF 9.53 FM WAS DETERMINED TO REPRODUCE WELL THE EXPERIMENTAL DATA OF TOTAL CROSS SECTION. MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS. 2200 M/S RES. INTEG. ELASTIC 11.254B -CAPTURE 0.7120 B 0.3911 B TOTAL 11.966 B -MF=3 NEUTRON CROSS SECTIONS BELOW 475 KEV NO BACKGROUND CROSS SECTIONS ARE GIVEN. ABOVE 475 KEV CROSS SECTIONS FOR JENDL-3.1 WERE OBTAINED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY /8/. THE OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING AVERAGE TOTAL CROSS SECTION OF NATURAL LEAD. V=47.0 - 0.250*E, WS = 2.30 + 0.41*E, VSO = 6.0 (MEV) R0 = 1.25 , RS = 1.30 , RSO = 1.30 (FM)

AO = 0.65 B=0.48 ASO = 0.689 (FM) LEVEL DENSITY PARAMETERS WERE DETERMINED USING LOW-LYING LEVEL DATA AND OBSERVED NEUTRON RESONANCE SPACING.

FOR JENDL-3.2, THE (N,2N), (N,3N), (N,NA), (N,NP) AND INELASTIC SCATTERING CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THEY WERE CALCULATED WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /9/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/10/ FOR ALPHA, LOHR-HAEBERLI OMP/11/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/12/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1

IT=1 TOTAL CALCULATED WITH CASTHY /8/.

MT=2 ELASTIC SCATTERING (TOTAL)-(ALL OTHER PARTIAL CROSS SECTIONS)

MT=4,51-58,91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS ADOPTTED FROM REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'. NO. ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) G.S. 0.0 1/2 -NO. G.S. 1 2 3 1/2 5/2 3/2 13/2 7/2 5/2 7/2 0.0 0.5697 0.8977 1.6334 2.3399 2.6232 2.66232 * + * ă * 5 0 2.6624 7/2 + 7 2.7030 7/2 + 8 2.7280 9/2 + LEVELS ABOVE 2.728 MEV WERE ASSUMED TO BE CONTINUUM. THE DIRECT INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED FOR THE LEVELS AT 3.384, 3.509, 3.583, 3.62, 3.901, 4.103, 4.14, 4.19, 4.313, 4.364, 4.404, 4.627, 5.081, 5.352 AND 6.188 MEV, AND ADDED TO MT=91. + MT=16, 17, 22, 28 (N,2N), (N,3N), (N,NA), (N,NP) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE (N,2N) CROSS SECTION WAS ADJUSTED TO REPRODUCE THE MEASURED ENARGY SPECTRA/13/ (FACTOR = 1.2). THE DATA OF SIMAKOV ET AL. /14/ WERE ALSO TAKEN INTO CONSIDERATION. MT=102 CAPTURE CALCULATED WITH CASTHY /8/ AND NORMALIZED TO A 30 KEV MAXWELLIAN SPECTRUM AVERAGE OF 0.011 B/15/. MT=103 (N,P) CALCULATED WITH GNASH /16/ AND NORMALIZED TO 1.6 MB AT 14.5 MEV BY BELOVICKIJ+76 /17/ MT=107 (N,A) CALCULATED WITH GNASH /16/ AND MULTIPLIED BY 5. MT=251 MU-BAR CALCULATED WITH CASTHY /5/. IF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2 MF = 4CALCULATED WITH CASTHY /5/. MT=51-58 TAKEN FROM JENDL FUSION FILE. C DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY AND MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=12 GAMMA-RAY MULTIPLICITY PRODUCED BY NEUTRON REACTIONS MT=16,17,22,28,91,103,107 CALCULATED WITH GNASH /18/. MT=51-58 TRANSITION PROBABILITIES ARE GIVEN. M=102 CALCULATED WITH CASTHY /5/. MULTIPLICITY OF A LINE SPECTRUM AT THERMAL IS 1.0. MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS

MT=16,17,22,28,51-58,91,102,103,107 : ASSUMED ISOTROPIC.

MF=15 ENERGY DISTRIBUTION OF SECONDARY GAMMA-RAYS MT=16,17,22,28,91,107 _____CALCULATED WITH THE GNASH /18/.

- M=102 CALCULATED WITH CASTHY /5/. AT THERMAL, A LINE SPECTRUM OF 7.36735 MEV WAS ASSUMED.

REFERENCES

- REFERENCES

 CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
 YAMAMURO, N.: JAERI-M 90-006 (1990).
 KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
 EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
 HOREN D.J. ET AL.: PHYS. REV. C18, 722 (1978)
 MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B, ACADEMIC PRESS (1984).
 FU C.Y. ET AL.: BNL-NCS-17541(ENDF-201), P.336 (1991).
 IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 PEREY F.G.: PHYS. REV., 131, 745 (1963).
 ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
 LOHR J.M. AND HAEBERLI W.: NUCL. PHYS., A232, 381 (1974).
 BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971).
- PHENOMENA IN NUCL. REACTIONS, "UNIV. WISCONSIN PRESS, P.682 (1971).
 13) TAKAHASHI A. ET AL.: JAERI-M 86-080, 393 (1986).
 14) SIMAKOV S.P. ET AL: WORKSHOP ON NUCL. DATA FOR FUSION REACTOR TECHNOL., DEL MAR, MAR 3-6 (1993).
 15) ALLEN B.J. ET AL.: PHYS. REV., C8, 1504 (1973).
 16) YOUNG P.G. AND ARTHUR E.D. : LA-1974 (1977)
 17) BELOVICKIJ ET AL.: 75 KIEV, 4, 209 (1976)
 18) LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES, 7TH ED.

| MAT number = 8237
82-PB-208 JAERI | EVAL-JUL87 M.MIZUMOTO |
|---|--|
| HISTORY
87-03 NEWLY EVALUAT
87-11 REVISION IS R | ED FOR JENDL-3 BY M.MIZUMOTO (JAERI) |
| 29-09 REVISION IS C
COMPILATION I
94-06 JENDL-3.2. | OMPLETED.
S MADE BY T.NARITA AND T.FUKAHORI (JAERI) |
| RESONANCE PAR
DATA FOR MF=3
GAMMA-RAY PRO
COMPILED BY T. | AMETERS CORRECTED BY T.NAKAGAWA
,4,5 WERE ADOPTED FROM JENDL FUSION FILE
DUCTION DATA MODIFIED BY K.SHIBATA(JAERI)
NAKAGAWA (NDC/JAERI) |
| ***** MODIFIE
(3,4), (3,16). | D PARTS FOR JENDL-3.2 ************************************ |
| (4,18-9T); SE
(2,151) REICH
(2,151) REICH
(3,2) OF RESO
(3,2) (15 | ATA WERE TAKEN FROM JENDL FUSION FILE.
-MOORE FORMULA ADOPTED, AND UPPER BOUNDARY
NANCE REGION WAS CHANGED FROM 0.8 TO 1 MEV |
| (12,102), (13, ************************************ | 102) |
| JENDL FUSION F
EVALUATE
COMPILED | ILE /1/ (AS OF OCT. 1993)
D BY K.KOSAKO (NEDAC) AND S.CHIBA (NDC/JAERI)
BY K.KOSAKO. |
| DATA WERE TAKE
- THE INELAST
DISTRIBUTIO
CONTINUUM I
DWUCKY IN S | N FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING:
IC SCATTERING CROSS SECTIONS AND ANGULAR
NS OF INELASTICALLY SCATTERED NEUTRONS (EXCEPT
NELASTIC) WERE CALCULATED WITH CASTHY2Y AND
INCROS-II SYSTEM/2/ INCLUDING CONTRIBUTIONS |
| - THE (N,2N),
SECTIONS (M | (N,3N), (N,NA) AND (N,NP) REACTION CROSS
IT=16, 17, 22, 28) WERE CALCULATED BY EGNASH2 |
| RENORMALIZE
- ENERGY DIST
WITH THOSE | TO TO EXPERIMENTAL DATA.
RIBUTIONS OF SECONDARY NEUTRONS WERE REPLACED
CALCULATED BY EGNASH2. THE DDX'S OF THE |
| CONTINUUM N
TICS /3/ US
RATIO WAS C | EUTRONS WERE CALCULATED BY KUMABE'S SYSTEMA-
ING F15TOB /1/. THE PRECOMPOUND/COMPOUND
ALCULATED BY THE SINCROS-II CODE SYSTEM. |
| - OPTICAL-MOD
THE SINCROS
LEVEL SCHEM | EL, LEVEL DENSITY AND OTHER PARAMETERS USED IN
-II CALCULATION ARE DESCRIBED IN REF./2/.
ES WERE DETERMINED ON THE BASIS OF ENSDF/4/. |
| ME-1 GENERAL INFORM | |
| MT=451 DESCRIPTIVE | DATA AND DICTIONARY |
| MT=151 RESOLVED RES
RESONANCE RANGES : | ONANCE PARAMETERS FOR REICH-MOORE FORMULA |
| PARAMETERS WERE AD
AVERAGE RADIATIVE
WHOSE VALUE WAS UN
FM/5/ WAS ADOPTED.
REPRODUCE THE LOW
UNIVERSITY/7/ AND
AL./5/ IN THE 100- | WIDTH OF 0.18 EV WAS USED FOR THE RESONANCES
KNOWN. EFFECTIVE SCATTERING RADIUS OF 9.69
BACKGROUND CROSS SECTIONS WERE GIVEN TO
ENERGY TOTAL CROSS SECTION MEASURED AT KYOTO
THE TOTAL CROSS SECTION MEASURED BY HOREN ET
460 KEV REGION. |
| CALCULATED 22 | 00-M/S CROSS SECTIONS AND RES. INTEGRALS.
2200 M/S _ RES. INTEG. |
| ELASTIC
CAPTURE
TOTAL | 11.471 B -
0.5007 MB 6.755 MB
11.472 B |
| MF=3 NEUTRON CROSS
BELOW 1 MEV
BCKGROUND CROSS SE
SCATTERING CROSS S | SECTIONS
CTIONS ARE GIVEN TO THE TOTAL AND ELASTIC
ECTIONS. |
| ABOVE 1 MEV
CROSS SECTIONS OF
STATISTICAL MODEL
POTENTIAL PARAMETE
CROSS SECTION OF N
V=47.0 - 0.25
R0 = 1.25 | JENDL-3.1 WERE OBTAINED WITH AN OPTICAL AND
CALCULATION CODE CASTHY /8/. THE OPTICAL
RS WERE OBTAINED BY FITTING AVERAGE TOTAL
ATURAL LEAD AS FOLLOWS,
0*E, WS = 2.30 + 0.41*E, VSO = 6.0 (MEV)
, RS = 1.30 , RSO = 1.30 (FM) |
| | |

AO = 0.65 B=0.48 ASO = 0.689 (FM) LEVEL DENSITY PARAMETERS WERE DETERMINED USING LOW-LYING LEVEL DATA AND OBSERVED NEUTRON RESONANCE SPACING.

FOR JENDL-3.2, THE (N,2N), (N,3N), (N,NA) AND INELASTIC SCATTERING CROSS SECTIONS WERE ADOPTED FROM JENDL FUSION FILE. THEY WERE CALCULATED WITH SINCROS-II SYSTEM/2/ BY ADOPTING WALTER-GUSS OMP MODIFIED BY YAMAMURO/2/ FOR NEUTRON, PEREY OMP /9/ FOR PROTON, LEMOS OMP MODIFIED BY ARTHUR AND YOUNG/10/ FOR ALPHA, LOHR-HAEBERLI OMP/11/ FOR DEUTERON, BECCHETTII-GREENLEES OMP/12/ FOR TRITON AND HE-3, AND STANDARD LEVEL DENSITY PARAMETERS OF SINCROS-II SYSTEM.

MT = 1

IT=1 TOTAL CALCULATED WITH CASTHY /8/.

MT=2 ELASTIC SCATTERING (TOTAL)-(ALL OTHER PARTIAL CROSS SECTIONS)

MT=4,51-73,91 INELASTIC SCATTERING THE CROSS SECTIONS WERE TAKEN FROM JENDL FUSION FILE. THE LEVEL SCHEME WAS ADOPTTED FROM REF./4/ CONTRIBUTIONS OF THE DIRECT PROCESS WERE CALCULATED FOR THE LEVELS MARKED WITH '*'.

NO. G.S. 1 2 ENERGY(MEV) SPIN-PARITY (DIRECT PROCESS) 0.0 2.6146 3.1977 3.4751 3.7087 3.9198 0 + + 3 -* 5 3 Ž 4 5 5 õ 67 3.9464 4 3.9404 3.9610 3.9957 4.0370 4.0450 4.050555753234255 8 q 1Ŏ 11 12 $\begin{array}{c} 4.0505\\ 4.0854\\ 4.1060\\ 4.1253\\ 4.1410\\ 4.1590\\ 4.1804\\ 4.2054\\ 4.2295\\ 4.2295\\ 4.2295\\ 4.2535\\ 4.2624\end{array}$ * + 13 14 -15 16 17 + 18 6 19 24 20 21 22 23 3 21 4.2535 3 -22 4.2624 5 -23 4.2960 5 - * LEVELS ABOVE 4.296 MEV WERE ASSUMED TO BE CONTINUUM. THE DIRE INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED FOR THE LEVELS AT 4.3237, 4.4235, 4.698, 4.973, 5.087, 5.242, 5.345, 5.483, 5.514, 5.542, 5.689, 5.813, 5.993, 6.688 AND 7.019 MEV, AND ADDED TO MT=91. THE DIRECT MT=16, 17, 22 (N,2N), (N,3N), (N,NA) ADOPTED FROM JENDL FUSION FILE. THEORETICAL CALCULATION WAS MADE WITH SINCROS-II. THE (N,2N) CROSS SECTION WAS ADJUSTED TO REPRODUCE THE MEASURED ENARGY SPECTRA/13/ (FACTOR = 1.2). THE DATA OF SIMAKOV ET AL. /14/ WERE ALSO TAKEN INTO CONSIDERATION. MT = 16 $^{\rm MT=28}$ (N,N'P) CALCULATED WITH GNASH /15/ AND NORMALIZED TO 26 MB AT 20 MEV BY WELCH+81 /16/. MT=102 CAPTURE ESTIMATED FROM THE EXPERIMENTAL DATA BY CSIKAI+67 /17/, DRAKE+ /18/, BERGQVIST+72 /19/, DIVEN+60 /20/ AND LEIPUNSKIJ+58 /21/. DRAKE+71 MT=103 (N,P) CALCULATED WITH GNASH /15/ AND NORMALIZED TO 4 MB AT 18 MEV BY BASS+68 /22/. MT=107 (N,ALPHA) CALCULATED WITH GNASH /15/ AND NORMALIZED TO 1.6 MB AT 14.5 BY COLEMAN+59 /23/. MT=251 MU-BAR CALCULATED WITH CASTHY /8/. $\mathsf{MF}{=}4$ Angular distributions of secondary neutrons $\mathsf{MT}{=}2$

CALCULATED WITH CASTHY /8/. MT=51-73 TAKEN FROM JENDL FUSION FILE. C DWUCKY IN THE SINCROS-II SYSTEM. MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. CALCULATED WITH THE CASTHY AND MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 TAKEN FROM JENDL FUSION FILE. MF=12 GAMMA-RAY MULTIPLICITY PRODUCED BY NEUTRON REACTIONS MT=16,17,22,28,91,103,107 _____CALCULATED WITH GNASH /15/. MT=51-73 TRANSITION PROBABILITIES ARE GIVEN. M=102 FROM ENERGY BALANCE. MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS MT=16,17,22,28,51-73,91,102,103,107 : ASSUMED ISOTROPIC. MF=15 ENERGY DISTRIBUTION OF SECONDARY GAMMA-RAYS MT=16,17,22,28,91,107 CALCULATED WITH THE GNASH /15/. M = 102ČÁLCULATED WITH CASTHY /8/. REFERENCES

CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992).
YAMAMURO, N.: JAERI-M 90-006 (1990).
KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990).
ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC.
HOREN D. J. ET AL.: PHYS. REV. C34, 420 (1986).
MUGHABGHAB S.F.: NEUTRON CROSS SECTIONS, VOL.1, PART B, ACADEMIC PRESS (1984).
SHCHERBAKOV O. ET AL.: 1993 FALL MEETING OF THE ATOMIC ENERGY SCI. JAPAN, P.139 (1993).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
PEREY F.G.: PHYS. REV., 131, 745 (1963).
ARTHUR, E.D. AND YOUNG, P.G.: LA-8626-MS (1980).
LOHR J.M. AND HAEBERLI W.: NUCL. PHYS. A232, 381 (1974).
BECCHETTI F.D. JR. AND GREENLEES G.W.: "POLARIZATION PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971). PHENOMENA IN NUCL. REACTIONS," UNIV. WISCONSIN PRESS, P.682 (1971).
13) TAKAHASHI A. ET AL.: JAERI-M 86-080, 393 (1986).
14) SIMAKOV S.P. ET AL.: WORKSHOP ON NUCL. DATA FOR FUSION REACTOR TECHNOL., DEL MAR, MAR 3-6 (1993).
15) YOUNG P.G. AND ARTHUR E.D. : LA-6974 (1977).
16) WELCH P. ET AL. : BAP, 26, 708 (1981).
17) CSIKAI J. ET AL.: NUCL. PHYS. A95, 229 (1967).
18) DRAKE D. ET AL.: PHYS. LETTERS B36, 557 (1971).
19) BERGQVIST I. ET AL.: NUCL. PHYS. A191, 641 (1972).
20) DIVEN B.C. ET AL. PHYS. REV. 120, 556 (1960).
21) LEIPUNSKIJ A.I. ET AL.: 58 GENEVA, 15, 50 (1958).
22) BASS ET AL. : EANDC(E)-89,58 (1968).
23) COLEMAN R.F. ET AL. : PROC. ROY. SOC. (LONDON) 73 215 (1959). MAT number = 8325 83-BI-209 JAERI EVAL-MAY89 N.YAMAMURO,A.ZUKERAN,JENDL-3 C.G. DIST-SEP89 REV2-FEV94 HISTORY EVALUATION WAS PERFORMED FOR JENDL-3. COMPILED BY K.SHIBATA AND T.NARITA (JAERI). JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) 89-04 89-05 94 - 02* MODIFIED PARTS FOR JENDL-3.2 (3,2), (3,4), (3,58) AROUND 3 MEV. (4,16-91), (5,16-91) TAKEN FROM JENDL FUSION FILE. (12,102) FROM ENERGY BALANCE. JENDL FUSION FILE /1/ (AS OF SEP. 1993) EVALUATED AND COMPILED BY S. CHIBA (NDC/JAERI) DATA WERE TAKEN FROM JENDL-3.1 EXCEPT FOR THE FOLLOWING: THE NEUTRON ENERGY DISTRIBUTIONS OF MT=16, 17, 22, 28 AND 91 WERE REPLACED WITH CALCULATED VALUES WITH SNICROS-11/2/. HOWEVER, THOSE OF MT=16 AND 91 ABOVE 17 MEV WERE TAKEN FROM JEND L-3.1 BECAUSE THEY REPRODUCED THE DATA MEASURED BY MATSUYAMA ET AL./3/ AT 18 MEV BETTER THAN THE SINCROS-II CALCULATION. THE ANGULAR DISTRIBUTIONS OF CONTINUUM NEUTRONS WERE CREATED BY F15TOB/1/. THE MSD/MSC RATIO WAS TAKEN FROM THE SINCROS-II CALCULATION, AND KUMABE'S SYSTEMATICS/4/ WAS USED. OPTICAL-MODEL, LEVEL-DENSITY AND OTHER PARAMETERS USED IN THE SINCROS-II CALCULATION ARE DESCRIBED IN REF./2/. LEVEL SCHEMES WERE DETERMINED ON THE BASIS OF ENSDF/5/. GENERAL INFORMATION DESCRIPTIVE DATA AND DICTIONARY MF = 1MT=451 RESONANCE PARAMETERS 151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA PARAMETERS WERE MAINLY TAKEN FROM THE WORK OF MUGHABGHAB MF=2 $M\bar{T} = 151$ PARAMETERS WERE WORKE WO NEUTRON CROSS SECTIONS MF=3TOTĂĽ $M\tilde{T}=1$ BELOW 200 KEV : BACKGROUND CROSS SECTIONS GIVEN BETWEEN 30 KEV AND 200 KEV 200 KEV 200 KEV TO 20 MEV: $\underline{\beta}\underline{A}\underline{S}\underline{E}\underline{D}$ ON THE EXPERIMENTAL DATA 200 KEV TO 20 MEV: BASED ON THE EXPERIMENTAL DATA /7.8,9/. MT=2 ELASTIC SCATTERING (TOTAL) - (REACTION CROSS SECTION) MT=3 NON ELASTIC SUM OF MT=4, 16, 17, 22, 28, 102, 103, 104, 107 MT=4,51-62,91 INELASTIC SCATTERING STATISTICAL MODEL CALCULATIONS WERE MADE WITH THE SINCROS SYSTEM /2/ USING THE MODIFIED WALTER-GUSS POTENTIAL PARAMETERS FOR NEUTRONS. FOR MT=51,52,58,62, THE EXPERI-MENTAL DATA OF SMITH ET AL./10/ WERE ADOPTED BELOW 5 MEV. THE CALCULATED CROSS SECTION OF MT=91 WAS MODIFIED SO AS TO REPRODUCE THE MEASUREMENTS OF THE TOTAL INELASTIC CROSS SECTION BELOW 8 MEV. THE DIRECT-PROCESS COMPONENTS WERE CONSIDERED FOR THE LEVELS OF MT=51,52,58,91 BY THE DWBA CALCULATIONS. ĆŔŎSS CALCULATIONS. THE LEVEL SCHEME IS GIVEN AS FOLLOWS: NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 9/2 -1. 0.8964 7/2 -2. 1.6085 13/2 + NERGY (M 0.0 0.8964 1.6085 2.4300 2.4920 2.5645 2.5830 2.5830 2.6017 3. Ă. 5. 6. 7. 2.6017 8.

2.6170 2.7411 2.7660 2.8220 5/2 + 15/2 + 5/2 + 5/2 -9. 1Ŏ. 11. 12. LEVELS ABOVE 2.85 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16,17,22,28,103,104,107 (N,2N),(N,3N),(N,N'A),(N,N'P),(N,P) (N,D) AND (N,A) CROSS SECTIONS CALCULATED WITH SINCROS/2/. OPTICAL POTENTIAL PARAMETERS FOR PROTON, ALPHA-PARTICLE AND DEUTERON WERE TAKEN FROM THE WORKS OF PEREY/11/, LEMOS/12/ AND LOHR AND HAEVERLI /13/, RESPECTIVELY. THE CALCULATED (N,P) CROSS SECTION WAS MULTIPLIED BY 0.3333 IN ORDER TO FIT TO THE EXPERIMENTAL DATA /14,15,16/ AROUND 14 MEV. 2 RADIATIVE CAPTURE CROSS SECTION 1.0E-5 EV TO 200 KEV: RESONANCE PARAMETERS GIVEN BETWEEN 30 KEV AND 200 KEV. 200 KEV TO 3 MEV: CALCULATED WITH THE CASTHY CODE/17/. THE CALCULATION WAS NORMALIZED TO 4 MB AT 100 KEV. 3 MEV TO 20 MEV: BASED ON THE MEASUREMENTS./18,19,20/. MT=102 MT=251 MU-BAR CALCULATED FROM FILE-4. MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-62 CALCULATED WITH CASTHY FOR EQUILIBRIUM PROCESS. THE COMPONENTS OF THE DIRECT PROCESS WERE ADDED TO THE LEVELS OF MT=51,52,58 BY USING THE DWUCK CODE /21/. , 17, 22, 28 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MT = 16, MT=91 THE KALBACH-MANN SYSTEMATICS/22/ ADOPTED AT 14 MEV. =5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 22, 28, 91 CALCULATED WITH SINCROS. F=12 PHOTON PRODUCTION MULTIPLICITIES MT=3 (ABOVE 200 KEV) CALCULATED WITH SINCROS. MT=102 (BELOW 200 KEV) CALCULATED FROM ENERGY BALANCE. MF = 12PHOTON ANGULAR DISTRIBUTIONS MF = 14MT=3,102 ASSUMED TO BE ISOTROPIC. MF = 15PHOTON ENERGY DISTRIBUTIONS MT=3,102 CALCULATED WITH SINCROS. REFERENCES ERENCES CHIBA, S. ET AL.: JAERI-M 92-027, P.35 (1992). YAMAMURO, N.: JAERI-M 90-006 (1990). MATSUYAMA, S. ET AL.: JAERI-M 92-027, P.309 (1992). KUMABE, I. ET AL.: NUCL. SCI. ENG., 104, 280 (1990). ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC. MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984). FOSTER, JR., D.G. AND GLASGOW, D.W.: PHYS. REV., C3, 576 (1971). 1) 2) 3) 4 5) 6١ 7) FOSTER, JR., D.G. AND GLASGOW, D.H. A.B. (1971). SMITH, A.B., ET AL.: NUCL. SCI. ENG. 41, 63 (1970). CIERJACKS, S., ET AL.: "HIGH RESOLUTION TOTAL NEUTRON CROSS-SECTIONS BETWEEN 0.5 AND 30 MEV", KFK-1000, (1968). SMITH, A., ET AL.: NUCL. SCI. ENG. 75, 69 (1980). PEREY, F.G.: PHYS. REV. 131, 745 (1963). LEMOS, O.F.: "DIFFUSION ELASTIQUE DE PARTICULES ALPHA DE 21 A 29.6 MEV SUR DES NOYAUX DE LA REGION TI-ZN", ORSAY REPORT, SERIES A., NO. 136, (1972). LOHR, J.M. AND HAEBERLI, W.: NUCL. PHYS. A232, 381 (1974) COLEMAN, R.F., ET AL.: PROC. PHYS. REV., 115, 989 (1959). ٩ĵ 10) 11) 12) 13) 14) (1974).COLEMAN, R.F., ET AL.: PROC. PHYS. SUC.(LONDON), 73, 215 (1959). POULARIKAS, A. AND FINK, R.W.: PHYS. REV., 115, 989 (1959). BELOVITCKIJ, G.E., ET AL.: PROC. 3RD ALL UNION CONF. NEUTRON PHYSICS, KIEV, 1975, 4, 209 (1976). IGARASI, S. AND FUKAHORI, T.: JAERI 1321 (1991). BUDNAR, M., ET AL.: "PROMPT GAMMA-RAY SPECTRA AND INTEGRATED CROSS SECTIONS FOR THE RADIATIVE CAPTURE OF 14 MEV NEUTRONS 1ē) 18 Í

FOR 28 NATURAL TARGETS IN THE MASS REGION FROM 12 TO 208", INDC(YUG)-6,(1979).
19) CSIKAI, J., ET AL.: NUCL. PHYS., A95, 229 (1967).
20) BERGQVIST, I., ET AL.: NUCL. PHYS., A120, 161 (1968).
21) KUNZ, P.D.: UNIV. COLORADO (1974).
22) KALBACH, C. AND MANN, F.M.: PHYS. REV., C23, 112 (1981).

MAT number = 8825 88-RA-223 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) E=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION EVALUATED WITH SEMI EMPIRICAL FORMULA OF HOWERTON/1/. MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 143.10 B -ELASTIC 12.40 B -FISSION 0.70 B 1.06 CAPTURE 130.00 B 435 RES. INT. B B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 4 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 4 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE POTENTIAL PARAMETERS/3/ USED ARE AS FOLLOWS, V = 41.0 - 0.05 * EN WS = 6.4 - 0.15 * SQRT(EN) WV = 0 R = RS0 = 1.31, RS = 1.38 A = ASO = 0.47, B = 0.47(MEV) (MF=3 $M\tilde{T} = 1$ ELASTIC SCATTERING CROSS SECTION BELOW 4 EV, THE CONSTANT CROSS SECTION OF 12.4 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-52,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE LEVEL SCHEME WAS TAKEN FROM REF. 4. NO ENERGY(KEV) SPIN-PARITY G.S. 0.0 1/2 + 1 50.19 3/2 -2 61.53 5/2 + 3 79.77 3/2 -4 123.91 5/2 -5 130.27 7/2 + 6 174.72 9/2 + 7 174.78 7/2 -8 247.47 9/2 -9 280.31 3/2 + 10 286.16 3/2 + 286.16 329.95 334.52 3/2 3/2 3/2 10 + 11 MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 0.7 BARN WAS TAKEN FROM REF. 6 , AND 1/V FORM WAS ASSUMED BELOW 4 EV. ABOVE THIS ENERGY, THE CONSTANT CROSS SECTION WAS ADOPTED. MT=18 MT=102 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 130 BARNS WAS TAKEN FROM REF. 6 AND 1/V FORM WAS ASSUMED BELOW 4 EV. ABOVE 4 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 8 EV. MT=251 MU-L CALCULATED WITH CASTHY. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

CALCULATED WITH OPTICAL MODEL. ISOTROPIC IN THE LAB SYSTEM. MT=2,51-64,91 MT=16,17,18,37

F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/7/.

- REFERENCES

 HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
 IGARASI S.: J.NUCL.SCI.TECHNOL., 12, 67 (1975).
 OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981).
 MAPLES C.: NUCL. DATA SHEETS, 22, 243 (1977).
 GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS , PART B, Z=61-100", ACADEMIC PRESS (1984).
 SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 8828 88-RA-224 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) F=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I ĬNT. TOTAL ELASTIC CAPTURE 24.50 12.50 12.00 B Ē 29.0 B В NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 45 EV, CALCULATED AS SUM OF MT'S = 2 AND 102. ABOVE 45 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE POTENTIAL PARAMETERS/3/ USED ARE AS EDITORS MF=3 MT=1 FOLLOWS, $V = 41.0 - 0.05 \times EN$ $WS = 6.4 - 0.15 \times SQRT(EN)$ WV = 0, VSO = 7.0 R = RSO = 1.31, RS = 1.38 A = ASO = 0.47, B = 0.47(MEV) (MEV) (MEV) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 45 EV, THE CONSTANT CROSS SECTION OF 12.5 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-61,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE LEVEL SCHEME WAS TAKEN FROM REF. 4. NO ENERGY (KEV) SPIN-PARITY G.S. 0.0 2 + 1 84.37 2 + 2 215.99 1 -3 250.78 4 + 4 290.36 3 -5 433.08 5 -6 479.30 6 + 7 916.33 0 + 8 965.51 2 + 9 992.65 2 + 10 1052.95 1 -11 1052.95 1 -11 1052.95 1 -11 1089.98 2 -LEVELS ABOVE 1187 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF. 5. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. 2 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 12 BARNS WAS TAKEN FROM REF. 6 , AND 1/V FORM WAS ASSUMED BELOW 45 EV. ABOVE 45 EV, CROSS SECTION WAS CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 90 EV. MT=102 MT=251 MU-L CALCULATED WITH CASTHY. =4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-61,91 CALCULATED WITH OPTICAL MODI MT=16,17,37 ISOTROPIC IN THE LAB SYSTEM MF = 4MODEL. ==5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5REFERENCES 1) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977). 2) IGARASI S.: J.NUCL.SCI.TECHNOL.,12,67 (1975). 3) OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981).

| IARTIN M.J.: NUCL | . DATA SHEETS, | 49, 83 (| (1986). | |
|-------------------|---|--|--|---|
| GILBERT A., CAMER | ON A.G.W.: CAN | . J. PHYS | 5., 43, 144 | 6 (1965). |
| IUGHABGHAB S.F.: | "NEUTRON CROSS | SECTIONS | S, VOL.1, N | IEUTRONÍ |
| RESONANCE PARAMET | ERS AND THERMAL | _ CROSS S | SÉCTIONS', | PART B, |
| Z=61-100", ACADEN | IC PRESS (1984) |). | | |
| | ARTIN M.J.: NUCL
ILBERT A., CAMER
UGHABGHAB S.F.:
ESONANCE PARAMET
=61-100", ACADEM | ARTIN M.J.: NUCL. DATA SHEETS,
ILBERT A., CAMERON A.G.W.: CAN
UGHABGHAB S.F.: "NEUTRON CROSS
ESONANCE PARAMETERS AND THERMAL
=61-100", ACADEMIC PRESS (1984) | ARTIN M.J.: NUCL. DATA SHEETS, 49, 83 (
ILBERT A., CAMERON A.G.W.: CAN. J. PHYS
UGHABGHAB S.F.: "NEUTRON CROSS SECTIONS
ESONANCE PARAMETERS AND THERMAL CROSS S
=61-100", ACADEMIC PRESS (1984). | ARTIN M.J.: NUCL. DATA SHEETS, 49, 83 (1986).
ILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 144
UGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, N
ESONANCE PARAMETERS AND THERMAL CROSS SECTIONS ,
=61-100", ACADEMIC PRESS (1984). |

MAT number = 8831 88-RA-225 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) F=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MF = 12 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. MF=22200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. INT. TOTAL 112.40 B -ELASTIC 12.40 B -ELASTIC 100.00 Ē 593 B F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 2.5 EV, CALCULATED AS SUM OF MT'S = 2 AND 102. ABOVE 2.5 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE POTENTIAL PARAMETERS/3/ USED ARE AS MF = 3 $\begin{array}{c} \text{CASTHY/2/.} & \text{The Fotential formula}\\ \text{FOLLOWS,} & \text{V} = 41.0 - 0.05*\text{EN}\\ \text{WS} = 6.4 - 0.15*\text{SQRT(EN)}\\ \text{WV} = 0 & , \text{VSO} = 7.0\\ \text{R} = \text{RSO} = 1.31 & , \text{RS} = 1.38\\ \text{A} = \text{ASO} = 0.47 & , \text{B} = 0.47 \end{array}$ (MEV (MEV) (MEV) (FM) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 2.5 EV, THE CONSTANT CROSS SECTION OF 12.4 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-56,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE LEVEL SCHEME WAS TAKEN FROM REF. 4. NO ENERGY(KEV) SPIN-PARITY G.S. 0.0 3/2 + 1 25.39 5/2 + 2 42.75 3/2 + 3/2 + 9/2 + 7/2 +3 100.60 Λ 111.60 4 111.60 7/2 + 5 149.90 3/2 + 6 179.80 3/2 + LEVELS ABOVE 203 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF. 5. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. MT=102 CAPTURE CROSS SECTION ASSUMED TO BE 100 BARNS AT 0.0253 EV, AND IN 1/V FORM BELOW 2.5 EV. ABOVE 2.5 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 5 EV. MT=251 MU-L CALCULATED WITH CASTHY. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-56,91 CALCULATED WITH OPTICAL MODE MT=16,17,37 ISOTROPIC IN THE LAB SYSTEM. MODEL. =5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5REFERENCES 1) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977). 2) IGARASI S.: J.NUCL.SCI.TECHNOL., 12,67 (1975). 3) OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981). 4) TOTH K.S.: NUCL. DATA SHEETS, 27, 701 (1979). 5) GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

| MA1
88 | Г
3- | nu
RA | mb
-2 | ег
26 | 1 | | 88
T | 33 | 4 | | | E
D | V/ | AL
ST | - A
- S | U
SE | 38
P8 | 8
9 | N
R | .T | A K
2 - | (A)
• N(| G I
O V | 93 | } | | | | | | | | | |
|---------------|----------------|--------------|---------------------|-----------------------------|----------------------------|---|-----------------------------|------------------|--|-----------------------|-------------------------|---|-----------------------|--------------------------|---------------------------------|---|---------------------|---------------------------------|--|----------------------------|----------------------------|----------------------------|------------------------------|---------------------|------------------------|------------------------|----------------------|----------------------------------|----------------------------|--------------------------------------|---|-------------------------|-------------------|-----------------|
| 93- | - 0
- 1 | 0R
8
1 | Y
NE
TE
JE | W
CH
ND | E\
N(
L· | /A
)L
-3 | | JA
SY
B | т I
,
v | 10
T | N
I T | WA
)/ | S
1, | , М
/ | A C | Ε | B | Y
D | N | | TA | K/ | A G | I | (1 | -0ł | ٢Y | 0 | INS | STI | ΙΤΙ | JTE | OF | - |
| | | * | * *
(3 | **
,1
** |) | | MC
(3 |)D | F
18 |)
)
* | . N
ED
* * | P
* * | PAF | RT | S
S
E | F
BE | | ₩, | JE
6 | | | 3 | ,
. 2
* * | * * | * | : * 1
: * 1 | * * | * * | * * * | * * * | * * 1 | * * * | * * * | * * * |
| MF=
N
N | =1
ИТ
ИТ | =4
=4 | GE
51
52 | NE | RA
(| | I
Mn
Me
V <i>f</i> | | FO
NT
R
UA | | | TI
D
NE
W | 01
D
U
U | N
I C
F R
F H | T I
ON
S | | NA
P
MI | R \
E F | r
R
E M | FI | S S
R I | 61 (
C/ | O N
A L | F | -0F | RWI | JL. | A | 0F | H | DWE | ERT | ON/ | 2/. |
| MF=
N | =2
//T | =1 | RE
51 | SO | N A
F
F | | CE
SC
LT
R A
F | | PA
VE
- L
SS
AV
EF | | AM
RESONACE | ET
ES
W
GE
TI | | RSARET
RECTA | NC
IT
H
M-
SC | E
A
W
G | P
KE
AS
TT | | | ME
RO
VE
02
NG | TE
FC
N
58 | R
R
F
F
R
A | S
MU
HO
DR
DI | :
LA
SE
US | 1.
V
E
L
L | 0E
/AS
3Y
= 9 | Е-
S-
ГН
Э. | 5
AD
VA
E
60 | EV
OP
NO
RE
FI | TC
TEI
V/3
SON |)
)
3/
NAN | 100
NCE | 0 E
S. | EV. |
| 4 | 22 | 00 | - M | /S
TO
EL
FI
CA | T
A
S
S
P
T | | | S | S | E | СТ | 102 |)NS
2(2 | 5
22
9
7 | AN
.58
.07 | ID
1/3
80
80
80
80
80
80
80
80
80
80
80
80
80 | 8
- 6 | ES
VA | SO
L
B
B
B
B
B
B
B
B
B | NA
UE | NC | ε | I | ΝТ | EQ
RE | BR/
SS | AL
-
-
21 | S
I N
19
6 | T.
B
B | | | | | |
| MF=
N | =3
MT | =1 | NE | UT
BE
PA
AR | | NAL
NAL
NAL
NAL
NAL
NAL
NAL | 001
ET
S = = = = = | RR ETF460RA | 0S
0S
KES
0L
1.4
S0
S0 | S
S
V
L
O | SS
ASW
- | ECC
EC
BC
BC
BC
BC
BC
BC
BC
C
C
C
C
C
C | 3
4
3
3
4 | 10
35
4
55
7 | NS
NS
1 / .
* E
S C | SE
K | CT
EV
T | H
H
E
N
S
S
S | 0
0
1
0
1
0
0 | W
PT
PO
=
= | AS
IC
TE
7
1.0 | 2 A I | RE
L
TI
0
8
7 | PR
MC
AL | RES
DE | SEN
SL
PAF | NT
C
RA | ED
AL
ME | | ITH
LAT
RS/
ME
ME
(FN | H F
FIC
/ 5 /
/)
/)
/)
/) | RES
DN
/ U | ONA
WAS
SEI | ANCE |
| N | ИΤ | =2 | | EL
BE
PA
AD | AS
L(
R/
OF | ST
DW
AM
PT | I (
1
E1
E0 | ;
E
). | SC
KE
RS | A
V | ГТ
' А | ER
CR
BO | 208
08 | NG
SS | 2
1 | CR
SE
K | DS
CT
EV | S
1 (| S
N
O | EC
W
PT | T I
A S
I C | 01
5
5
5 | N
RE
L | P R
M C | ES
De | BEN
EL | NT
C | E D
A L | cůi | I TH
LA 1 | 4 F
F I (| RES
DN | ONA
WAS | NCE |
| Μ | ИТ | =4 | , 5 | 1 -
OP
CA
LE
TH | 60
TI
ST | | 91
AL
SEV | A
E | H
AN
/.
BO | | LSTOS1234567890123456 N | ASTA
HE
14 | | | STI
VE | | A T LSE
WAM | C HE | ROER 223446668889001EE | IDMG 6152142562576473 R | | | RAL) | DT | | | | I 0 024136570809201210R
1 1 F | NSA
WA
A
VO | REFIT | |)E
/6/
PIN
./7 | ₩ I 1
 | ΓH |
| Ν | ИΤ | =1 | 6, | 17
CA | , 3
Ľ(| 37
20 | LA | (| N,
ED | 21 | (/
/ / | т́н | ()
 | ∖,
ΞV | 3N
AF | ,
)
) | A
R A | NE |)
 0 | (N
N | ,4
MC | IN
DI |)
El | R E
· | AC | т | 0 | N | CR | 088 | 5 5 | SEC | TIC | ONS |
| N | ЛΤ | =1 | 8 | F
ME
FR
EN | IS
AS
ON
EF | 85
80
1
86 | IC
RE
RE
Y |)
D
F
R | C
T
./
EG | R(
HI
8 | DS
ER
/,
DŇ | S
M A
A
A | | | TI
RC
1/
E | 0
 S
 V
 1 | N
S
F
M | SE
OF
E\ | EC
RM
/, | T I
W
T | ON
AS
HE | | OF
AS
EV | 7
SL
AL | / N
J M E
_ U A | | CR
B | 0 -
E L
N | BAI
OW
WAS | RN
10
S E | WA
D E
BAS | AS
EV.
Sed | TAK
F
ON | KEN
FOR
N |

EXPERIMENTAL DATA /9,10,11,12/, AND BETWEEN 15 EV AND FISSION THRESHOLD, CROSS SECTION WAS ASSUMED TO BE TH SAME AS THE VALUE AT 15 EV. THE

2 CAPTURE CROSS SECTION BELOW 1 KEV, CROSS SECTION WAS REPRESENTED WITH RESONANCE PARAMETERS. ABOVE 1 KEV, IT WAS CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 30.3 EV. MT=102

MT=251 MU-L CALCULATED WITH CASTHY.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-66,91 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37 ISOTROPIC IN THE LAB SYSTEM.

==5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/13/.

REFERENCES

REFERENCES
1) TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
2) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
3) IVANOV R.N. ET AL.: AT. ENERG., 42, 505 (1977).
4) IGARASI S. AND FUKAFORI T.: JAERI 1321 (1991).
5) OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981).
6) ELLIS-AKOVALI Y.A.: NUCL. DATA SHEETS, 50, 229 (1987).
7) GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
8) NAKAHARA H. ET AL.: J. INORG. NUCL. CHEM., 38, 203 (1976).
9) NOBLES R.A ET AL.: NUCL. PHYS., 5, 211 (1958).
10) BABENKO JU.A. ET AL.: YAD. FIZ., 7, 269 (1968).
11) ZHAGROV E.A. ET AL.: AUCL. PHYS., A213, 436 (1973).
12) NEMILOV YU.A. ET AL.: ANL/NDM-50 (1979).

MAT number = 8925 89-AC-225 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) F=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 1012.40 B -ELASTIC 122.40 B -RÉS. INT. TOTAL ELASTIC CAPTURE 1000.00 В 1590 B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 0.6 EV, CALCULATED AS SUM OF MT'S = 2 AND 102. ABOVE 0.6 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE POTENTIAL PARAMETERS/3/ USED ARE AS EDITOWS MF=3 MT=1 FOLLOWS, $V = 41.0 - 0.05 \times EN$ $WS = 6.4 - 0.15 \times SQRT(EN)$ WV = 0, VSO = 7.0 R = RSO = 1.31, RS = 1.38 A = ASO = 0.47, B = 0.47(MEV) (MEV) (MEV) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 0.6 EV, THE CONSTANT CROSS SECTION OF 12.4 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-52,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE LEVEL SCHEME WAS TAKEN FROM REF. 4. NO ENERGY(KEV) SPIN-PARITY G.S. 0.0 3/2 + 1 40.0 3/2 + LEVELS ABOVE 64 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF. 5. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. 2 CAPTURE CROSS SECTION ASSUMED TO BE 1000 BARNS AT 0.0253 EV BY THE CORRELATION OF THERMAL CROSS SECTION WITH NUMBER OF EXCESS NEUTRONS. BELOW 0.6 EV, THE 1/V FORM WAS ASSUMED. ABOVE THIS ENERGY, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 1.2 EV. MT=102 NU-L CALCULATED WITH CASTHY. MT=251 MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-52,91 CALCULATED WITH OPTICAL MODE MT=16,17,37 ISOTROPIC IN THE LAB SYSTEM. MÖĎEL. F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. REFERENCES 1) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977). 2) IGARASI S.: J.NUCL.SCI.TECHNOL. 12,67 (1975). 3) OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981). 4) TOTH K.S.: NUCL. DATA SHEETS, 27, 701 (1979). 5) GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

MAT number = 8928 89-AC-226 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) F=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 112.40 B -ELASTIC 12.40 B -RÉS. INT. TOTAL ELASTIC CAPTURE 100.00 В 1680 B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 0.4 EV, CALCULATED AS SUM OF MT'S = 2 AND 102. ABOVE 0.4 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE POTENTIAL PARAMETERS/3/ USED ARE AS MF=3 MT=1 FOLLOWS, $V = 41.0 - 0.05 \times EN$ $WS = 6.4 - 0.15 \times SQRT(EN)$ WV = 0, VSO = 7.0 R = RSO = 1.31, RS = 1.38 A = ASO = 0.47, B = 0.47(MEV) (MEV) (MEV) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 0.4 EV, THE CONSTANT CROSS SECTION OF 12.4 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-52,91 INELASTIC SCATTERING CROSS SECTIONS. CALCULATED WITH OPTICAL AND STATISTICAL MODELS BY MEANS OF CASTHY/2/. NO EXCITED LEVELS WERE TAKEN INTO CALCULATION, BECAUSE SPIN OF ALL LEVELS WERE UNKNOWN/4/. NO ENERGY(KEV) SPIN-PARITY G.S. 0.0 1 + LEVELS ABOVE 290 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF. 5. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. 2 CAPTURE CROSS SECTION ASSUMED TO BE 100 BARNS AT 0.0253 EV, AND IN 1/V FORM BELOW 0.4 EV. ABOVE 0.4 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 0.8 EV. MT=102 MT=251 MU-L CALCULATED WITH CASTHY. E=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,91 CALCULATED WITH OPTICAL MODEL. MT=16,17,37 ISOTROPIC IN THE LAB SYSTEM. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. REFERENCES 1) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977). 2) IGARASI S.: J.NUCL.SCI.TECHNOL., 12, 67 (1975). 3) OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981). 4) ELLIS-AKOVALI Y.A.: NUC;. DATA SHEETS, 50, 229 (1987). 5) GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).

MAT number = 8931 89-AC-227 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) F=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION EVALUATED WITH SEMI EMPIRICAL FORMULA OF HOWERTON/1/. MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 902.40 B -ELASTIC 12.40 B -FISSION 0.00029 B 0.13 CAPTURE 800.000 B 1650 RES. INT. ELASTIC FISSION CAPTURE 0.138 B 1650 B 890.00 В NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 36 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 36 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE POTENTIAL PARAMETERS/3/ USED ARE AS FOLLOWS, $V = 41.0 - 0.05 \times EN$ $WS = 6.4 - 0.15 \times SQRT(EN)$ WV = 0 R = RS0 = 1.31, RS = 1.38 A = ASO = 0.47, B = 0.47(MEV) (MEV) (FM) MF=3 $M\tilde{T} = 1$ ELASTIC SCATTERING CROSS SECTION BELOW 36 EV, THE CONSTANT CROSS SECTION OF 12.4 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2ABOVE THIS ENERGY, MT=4,51-59.91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/2/. THE LEVEL SCHEME WAS TAKEN FROM REF. 4. NO ENERGY(KEV) SPIN-PARITY G.S. 0.0 3/2 -1 27.36 3/2 + 2 29.95 5/2 -3 46.37 5/2 + 4 74.14 7/2 -5 84.56 7/2 + 6 110 00 9/2 + 3/2 - 3/2 + 5/2 - 5/2 + 7/2 + 7/2 + 90/26 110.00 126.85 187.36 210.92 9/2 11/2 13/2 7 8 _ 9 + LEVELS ABOVE 273 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF. 5. MT=16, 17, 37 (N, 2N) (N, 3N) AND (N, 4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 0.29 MILLI-BARN WAS TAKEN FROM REF. 6 , AND 1/V FORM WAS ASSUMED BELOW 36 EV. ABOVE FISSION THRESHOLD ENERGY, EXPERIMENTAL DATA/7/ WERE ADOPTED, AND IN THE ENERGY RANGE BETWEEN 36 EV AND FISSION THRESHOLD, CROSS SECTION WAS ASSUMED TO BE CONSTANT WITH THE VALUE AT 36 EV. MT = 182 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 890 BARNS WAS TAKEN FROM REF. 6 , AND 1/V FORM WAS ASSUMED BELOW 36 EV. THE CROSS SECTION NEAR 36 EV WAS ADJUSTED SO AS TO REPRODUCE THE MEASURED RESONANCE INTEGRAL/6/. ABOVE 0.45 EV, CROSS SECTION WAS CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 72 EV. MT = 102MU-L MT=251 CAÜČULATED WITH CASTHY. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS

CALCULATED WITH OPTICAL MODEL. ISOTROPIC IN THE LAB SYSTEM. MT=2,51-59,91 MT=16,17,18,37

==5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/8/.

- REFERENCES
 1) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
 2) IGARASI S.: J.NUCL.SCI.TECHNOL., 12, 67 (1975).
 3) OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981).
 4) MAPLES C.: NUCL. DATA SHEETS, 22, 275 (1977).
 5) GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 6) MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON
 RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS , PART B,
 Z=61-100", ACADEMIC PRESS (1984).
 7) KUKS I.M. ET AL.: YAD. FIZ. ISS., 26, 46 (1978).
 8) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9025 90-TH-227 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ADOPTED FROM THE EVALUATION BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 1749.40 B -ELASTIC 12.40 B -FISSION 202.00 B 210 CAPTURE 1535.00 B 1420 ΪNΤ. В F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 0.45 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 0.45 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/8/. THE POTENTIAL PARAMETERS/9/ USED ARE AS MF = 3FOLLOWS (MEV) (MEV) (MEV) (FM) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 0.45 EV, THE CONSTANT CROSS SECTION OF 12.4 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4, 91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/8/. NO EXCITED LEVELS WERE TAKEN INTO THE CALCULATION. LEVELS ABOVE 9.3 KEV/10/ WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./11/. MT=16,17,37 (N,2N) (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 202 BARNS WAS TAKEN FROM REF./12/, AND 1/V FORM WAS ASSUMED BELOW 0.45 EV. IN THE ENERGY RANGE ABOVE 0.45 EV, THE SHAPE WAS ASSUMED TO BE THE SAME AS TH-233 FISSION CROSS SECTION AND IT WAS NORMALIZED TO THE SYSTEMATICS OF BEHRENS AND HOWERTON/13/. MT = 182 CAPTURE CROSS SECTION THE THERMAL CROSS SECTION OF 1535 BARNS WAS ESTIMATED FROM THE RATIO OF FISSION AND CAPTURE CROSS SECTIONS AT 1 EV AND THE MEASURED FISSION CROSS SECTION AT 0.0253 EV/12/, AND THE 1/V FORM WAS ASSUMED BELOW 0.45 EV. ABOVE 0.45 EV, CROSS SECTION WAS CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = MT = 102

0.040 EV AND LEVEL SPACING = 0.9 EV.

MT=251 MU-L CALCULATED WITH CASTHY.

MF=4ANGULARDISTRIBUTIONSOFSECONDARYNEUTRONSMT=2,91CALCULATEDWITHOPTICALMODEL.MT=16,17,18,37ISOTROPICINTHELABSYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS.

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/14/.

REFERENCES

REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989).
MANERO F. AND KONSHIN V.A.: AT. ENERGY REV., 10, 637 (1972).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
OHSAWA T. AND OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408(1981).
MAPLES C.: NUCL. DATA SHEETS, 22, 275 (1977).
GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446(1965).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS, PART B, Z=61-100", ACADEMIC PRESS (1984).
BEHRENS J.W. AND HOWERTON R.J: NUCL. SCI. ENG., 65, 464(1978).
SMITH A.B. ET AL.: ANL/NDM-50 (1979).
MAT number = 9028 90-TH-228 KINKI U. EVAL-JUN87 T.OHSAWA DIST-SEP89 REV2-JUN94 HISTORY
BIT OLF OLF OF NELL CONNECT
BIT OLF OLF OF NELL CONNECT
BIT OLF OF NELL CONNECT
BIT OLF OF NELL CONNECT
BIT OLF OF NELL CONNECT
BIT OLF OF NELL CONNECT
BIT FISSION SPECTRUM WAS ADDED. RESONANCE FORMULA WAS CHANGED TO MLBW FORMULA. THE TOTAL, (N,2N) AND (N,3N) CROSS SECTIONS WERE MODIFIED.
BIT OLF OF JENDL 2 DATA WERE ADOPTED FOR JENDL 3. (MF3,MT17), (MF3,MT91) AND (MF3,MT102) WERE SLIGHTLY MODIFIED IN HIGH ENERGY REGION. COMPILATION WAS MADE BY T.NAKAGAWA (JAERI).
94-06 JENDL 3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY MODIFIED PARTS FOR JENDL-3.2 (1,452), (1,455), (1,456) MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF TH-229 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON THE SEMI-EMPIRICAL FORMULA OF HOWERTON /6/. RESONANCE PARAMETERS 151 RESOLVED RESONANCES RESONANCE REGION IS BELOW 7.798 EV. PARAMETERS WERE GIVEN FOR THE MLBW FORMULA. ONLY TWO RESONANCES WERE OBSERVED BY SIMPSON ET AL./7/. AN ADDITIONAL TERM WITH 1/V DEPENDENCE WAS ASSUMED TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION. FISSION CROSS SECTION WAS ALSO ASSUMED TO HAVE 1/V BEHAVIOR. MF=2 $M\overline{T} = 15\overline{1}$ CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEG. (BARNS) 2200-M/S RES. INTEG. ELASTIC CAPTURE FISSION TOTAL 12.81 119.9 0.300 133.0 1170 1.02 =3 NEUTRON CROSS SECTIONS BELOW 7.798 EV IS THE RESONANCE REGION. BACKGROUND DATA WERE GIVEN. THE CROSS SECTIONS WERE EVALUATED IN THE ENERGY REGION ABOVE 7.798 EV AS FOLLOWS. MT=1 TOTAL CROSS SECTION OPTICAL MODEL CALCULATION WITH THE FOLLOWING PARAMETERS: V = 41.0 - 0.05*E (MEV), WS = 6.4 + 0.15*SQRT(E) (MEV), -- DER. WOODS-SAXON --VSO= 7.0 RO = RSO = 1.31 (FM), RS = 1.38 (FM), A = B = ASO= 0.47 (FM). THESE PARAMETERS WERE TAKEN FROM THOSE FOR TH-232 /8/. MT=2 ELASTIC SCATTERING CROSS SECTION BASED ON STATISTICAL AND OPTICAL MODEL CALCULATIONS USING THE CODE CASTHY /9/. MT=4,51-62,91 INELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS. MF = 3LEVEL SCHEME OF TH-228 /10/. NQ. ENERGY(MEV) SPIN-PARITY 0 + 2 + Ġ.S. 0.0 1 2 0.1869 4 + 3 4 0.328 0.3961 0.5193 0.8317 1 ż --5 5 6 7 0221 -0.8746 + 8 0.9441 + ğ 0.952 0.9688 10 2 +

3 -3 + 11 1.016 3 -12 1.0224 3 + LEVELS ABOVE 1.025 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED BY MEANS OF THE EVAPORATION MODEL OF SEGEV AND CANER /11/. MT=18 FISSION CROSS SECTION THE DATA OF VOROTNIKOV ET AL./12/ WERE ADOPTED UP TO 5 MEV. THE FISSION CROSS SECTION OF THE NEIGHBORING EVEN-EVEN ISOTOPE TH-230 NORMALIZED TO JOIN SMOOTHLY TO THE DATA OF VOROTNIKOV ET AL. WAS ADOPTED ABOVE 5 MEV. MT=102 CAPTURE CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS WITH GAMMA-RAY STRENGTH FUNCTION OF 0.00791. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2,51-62,91 STATISTICAL AND OPTICAL MODEL CALCULATIONS. MT=16,17,18 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,91
EVAPORATION SPECTRA
MT=18
FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH
ET AL./13/. REFERENCES

OHSAWA T. AND OHTA M.: MEMOIRS FACULTY OF ENGINEERING, KYUSHU UNIV. 40, 149 (1980).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG, 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989).
HOWERTON R.J.: NUCL. SCI. ENG. 62, 438 (1977).
SIMPSON O.D. ET AL.: IBID. 29, 423 (1967).
OHSAWA T. AND OHTA M.: J. NUCL. SCI. TECHNOL. 18, 408 (1981).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
LEDERER C.M. AND SHIRLY V.S. (ED.): TABLE OF ISOTOPES, 7TH EDITION (1978).
SMITH A.B. ET AL.: SOV. J. NUCL. PHYS. 16, 505 (1973). REFERENCES

MAT number = 9031 90-TH-229 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 RREV2-JUN94 HISTORY 87-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ADOPTED FROM THE EVALUATION BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS : 1.0E-5 EV TO 9.5 EV SINGLE-LEVEL BREIT WIGNER FORMULA WAS ADOPTED. PARAMETERS WERE DETERMINED ON THE BASIS OF RECOMMENDATION OF MUGHABGHAB /8/. FOR THE LEVELS WHOSE RADIATIVE WIDTH AND/OR FISSION WIDTH WERE UNKNOWN, AVERAGE GAMMA-G OF 0.043 EV WAS ASSUMED, FISSION WIDTHS WERE CALCULATED FROM (PEAK SIG)*(GAMMA-F). EFFECTIVE SCATTERING RADIUS WAS ASSUMED TO BE 10 FM. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 104.09 B -ELASTIC 9.928 B -RÉS. INT. TOTAL ELASTIC FISSION CAPTURE 30.81 B 63.34 B 444 B 1236 B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION ABOVE 9.5 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/9/. THE POTENTIAL PARAMETERS/10/ USED ARE AS MF=3 MT = 1ABOVE 9. CASTHY/9/. THE CASTHY/9/. THE CASTHY/9/. THE CASTHY/9/. THE CASTHY/9/. THE CASTHY/9/. THE CASTHY SOLUTION STATES TO A STATE OF THE CAST AND A STATES TO A STATE OF THE CAST AND A STATES TO A STATE OF THE CAST AND A STATES TO A STATE OF THE CAST AND A STATES TO (MEV) (MEV) (MEV) (MEV) (FM) (FM) MT=2 ELASTIC SCATTERING CROSS SECTION OPTICAL MODEL CALCULATION WAS ADOPTED. MT=4,51-54,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODE LCALCULATION WAS MADE WITH CASTHY/9/. THE LEVEL SCHEME WAS TAKEN FROM REF./11/. NO ENERGY(KEV) SPIN-PARITY NU ENERGY(KEV) SPIN-PARITY G.S. 0.0 5/2 + 1 0.1 3/2 + 2 20.0 3/2 + 3 29.2 5/2 + 4 42.5 7/2 + LEVELS ABOVE 67 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./12/. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION ABOVE 9.5 EV, THE CROSS-SECTION SHAPE WAS ASSUMED TO BE THE SAME AS TH-233 FISSION CROSS SECTION AND IT WAS NORMALIZED BY THE FACTOR OBTAINED FROM SYSTEMATICS OF MT=18 BEHRENS AND HOWERTON/13/. MT=102 CAPTURE CROSS SECTION CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-G = 0.040 EV AND LEVEL SPACING = 0.53 EV.

MT=251 MU-L CALCULATED WITH CASTHY.

MF=4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONSMT=2,51-54,91CALCULATED WITH OPTICAL MODEL.MT=16,17,18,37ISOTROPIC IN THE LAB SYSTEM.

MF=5ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONSMT=16,17,37EVAPORATION SPECTRA WERE GIVENMT=18MAXWELLIAN FISSION SPECTRUM. TEMPERATURE
WAS ESTIMATED FROM Z**2/A VALUES /14/.

- REFERENCES

 TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
 TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
 BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
 WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
 BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989).
 MANERO F. AND KONSHIN V.A.: AT. ENERGY REV., 10, 637 (1972).
 HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
 MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS , PART B, Z=61-100", ACADEMIC PRESS (1984).
 IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
 OHSAWA T. AND OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981).
 TOTH K.S.: NUCL. DATA SHEETS, 24, 263 (1978).
 GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
 BEHRENS J.W. AND HOWERTON R.J: NUCL. SCI. ENG., 65, 464(1978).

MAT number = 9034 90-TH-230 KINKI U. EVAL-JUL87 T.OHSAWA DIST-SEP89 REV2-JUN94 HISTORY 81-04 EVALUATION FOR JENDL-2 WAS MADE BY T. OHSAWA AND M. OHTA (KYUSHU UNIVERSITY: PRESENT ADDRESS OF OHSAWA IS KINKI UNIVERSITY). DETAILS OF EVALUATION ARE DESCRIBED IN REF. UNIVERSITY). DETAILS OF EVALUATION AND DECOMPLET IN NE /1/.
83-11 FISSION SPECTRUM WAS ADDED. RESONANCE PARAMETERS, AND TOTAL, (N,2N) AND (N,3N) CROSS SECTIONS WERE MODIFIED.
87-07 EVALUATION FOR JENDL-2 WAS ADOPTED TO JENDL-3. BUT RECALCULATION OF CROSS SECTIONS AND ANGULAR DISTRIBUTIONS WAS MADE WITH THE SAME OMP AND LEVEL DENSITY PARAMETERS COMPILATION WAS MADE BY T.NAKAGAWA (JAERI).
94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF TH-229 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON THE SEMI-EMPIRICAL FORMULA OF HOWERTON /6/. F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES RESONANCE REGION IS BELOW 564.26 EV. THE MLBW FORMULA WAS SELECTED TO REPRODUCE RESONANCE CROSS SECTIONS. A TOTAL NUMBER OF 28 RESONANCES UP TO 563 EV MEASURED BY KALEBIN ET AL. /7/ WERE ADOPTED IN THE PRESENT EVALUATION. A BACKGROUND TERM WITH 1/V DEPENDENCE WAS ADDED IN ORDER TO REPRODUCE THE THERMAL CAPTURE CROSS SECTION. MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEG.(BARNS) 2200-M/S RES. INTEG. TOTAL ELASTIC FISSION CAPTURE 32.32 9.774 0.0 22.55 1.08 1040 MF=3 NEUTRON CROSS SECTIONS BELOW 564.26 EV IS THE RESONANCE REGION WHERE THE BACKGROUND CROSS SECTIONS ARE GIVEN. ABOVE 564.26 EV, THE CROSS SECTIONS WERE EVALUATED AS FOLLOWS. MT=1 TOTAL CROSS SECTION OPTICAL MODEL CALCULATION WITH THE FOLLOWING PARAMETERS: V = 41.0 - 0.05*E (MEV), WS = 6.4 + 0.15*SQRT(E) (MEV), -- DER. WOODS-SAXON --VS0= 7.0 (MEV), R0 = RS0 = 1.31 (FM), RS = 1.38 (FM), A = B = AS0= 0.47 (FW). THESE PARAMETERS WERE TAKEN FROM THOSE FOR TH-232 /8/. MT=2 ELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS USING THE CODE CASTHY /9/. MT=4,51-63,91 INELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS. LEVEL SCHEME OF TH-230 /10/ NO. ENERGY(MEV) SPIN-PARITY NÖ. Ģ.S. 0 2 4 0.0 + 0.0534 0.173 1 + ż + 0.357 +
-3 6 4 1 5 0.571 3 0 + 2 + 5 -67 0.635 + 0.678 + 8 0.682

| 9 0.781 2 +
10 0.881 4 +
11 0.951 1 -
12 1.009 2 +
13 1.012 3 -
LEVELS ABOVE 1.02 MEV WERE ASSUMED TO BE OVERLAPPING. |
|---|
| <pre>MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS
CALCULATED BY MEANS OF THE EVAPORATION MODEL OF SEGEV AND
CANER /11/.
MT=18 FISSION CROSS SECTION
EVALUATION WAS MADE ON THE BASIS OF THE DATA OF MUIR ET
AL. /12/ UP TO 2 MEV. ABOVE 2 MEV, THE FISSION PROBABILITY
DATA OF BACK ET AL. /13/ WERE USED TO CALCULATE THE FISSION
CROSS SECTION.
MT=102 CAPTURE CROSS SECTION
STATISTICAL AND OPTICAL MODEL CALCULATIONS WITH GAMMA-RAY
STRENGTH FUNCTION OF 0.00791.
MT=251 MU-BAR
CALCULATED WITH CASTHY.</pre> |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-63,91
STATISTICAL AND OPTICAL MODEL CALCULATIONS.
MT=16,17,18
ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. |
| <pre>MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRA. MT=18 FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /14/.</pre> |
| REFERENCES OHSAWA T. AND OHTA M.: MEMOIRS FACULTY OF ENGINEERING,
KYUSHU UNIV. 40, 149 (1980). TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979), BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982). WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981). BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989). HOWERTON R.J.: NUCL. SCI. ENG. 62, 438 (1977). KALEBIN S.M. ET AL.: SOV. J. ATOM. ENERGY 26, 588 (1969). OHSAWA T. AND OHTA M.: J. NUCL. SCI. TECHNOL. 18, 408 (1981). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). LEDERER C.M. AND SHIRLY V.S. (ED.): TABLE OF ISOTOPES,
7TH EDITION (1978). |

SEGEV M. AND CANER M.: ANN. NUCL. ENERGY 5, 239(1978).
 MUIR D.W. ET AL.: PROC. 3RD CONF. ON NEUTRON CROSS SECTIONS AND TECHNOLOGY, KNOXVILLE (1971), P.292.
 BACK B.B. ET AL.: PHYS. REV. C13, 2374 (1974).
 SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9040 90-TH-232 KINKI U. EVAL-MAR87 T.OHSAWA DIST-SEP89 REV2-AUG93 HISTORY
87-03 RE-VALUATION WAS MADE BY T. OHSAWA (KINKI UNIVERSITY). THE FOLLOWING PARTS OF PREVIOUS EVALUATION /1/ WERE REVISED WITH NEW ONE. RESONANCE PARAMETERS, ELASTIC AND INELASTIC SCATTERING, NU-P, NU-D, ENERGY DISTRIBUTIONS OF NEUTRONS.
88-09 FISSION CROSS SECTION WAS MODIFIED A LITTLE.
89-02 FISSION PRODUCT YIELDS (MF=8) WERE REPLACED WITH JNDC FP DECAY FILE VERSION-2.
89-04 FISSION SPECTRUM WAS MODIFIED. COMPILATION WAS MADE BY T. NAKAGAWA(JAERI).
93-08 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF PROMPT AND DELAYED NEUTRONS. MT=455 DELAYED NEUTRONS PER FISSION NU-D BASED ON TUTTLE'S RECOMMENDATION /2/. MT=456 PROMPT NEUTRONS PER FISSION TAKEN FROM DAVEY'S RECOMMENDATION /3/. F=2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 EV - 3.5 KEV
THE PARAMETERS OF JENDL-2 WHICH WERE MAINLY BASED ON REF./4/
AND BNL 325(3RD) WERE MODIFIED AS FOLLOWS:

(1) FOR 22 RESONANCES IN THE LOWER ENERGY REGION WHICH MAKE
MAJOR CONTRIBUTION TO THE RESONANCE INTEGRAL, THE NEW
PARAMETERS OF KOBAYASHI /5/ WERE ADOPTED;
(2) THE AVERAGE RADIATIVE WIDTH OF 24.7 MEV WERE ATTRIBUTED TO THOSE RESONANCES FOR WHICH THE RADIATIVE WIDTH WAS
NOT KNOWN.

UNRESOLVED RESONANCES : 3.5 KEV - 50 KEV
AVERAGE RESONANCES : 3.5 KEV - 50 KEV
AVERAGE RESONANCES SECTIONS IN THIS REGION.
FIXED PARAMETERS : MF=2FIXED PARAMETERS : GG = 0.0212 EV, D-OBS = 18.64 EV, R = 10.01 FM.TYPICAL STRENGTH FUNCTIONS AT 10 KEV : S0 = 0.93E-4, S1 = 1.96E-4CALCULATED 2200-M/SEC CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/SEC 21.11 B 13.70 B 0.0 B RES. INTEG. TOTAL ELASTIC FISSION CAPTURE - - -0.636 B 7.40 B 84.4 IF=3 NEUTRON CROSS SECTIONS BELOW 3.5 KEV : BACKGROUND CROSS SECTION IS GIVEN FOR THE CAPTURE. ABOVE 50 KEV : MT=1 TOTAL MT=1 TOTAL
 BASED ON THE EXPERIMENTAL DATA OF WHALEN/6/, FOSTER/7/ AND FASOLI/8/ IN THE SIZE RESONANCE REGION, AND KOBAYASHI/9/, WHALEN/6/ AND UTTLEY/10, 11/ BELOW 1.5 MEV, AND OPTICAL MODEL CALCULATION ABOVE 14 MEV.
 MT=2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF CAPTURE, INELASTIC, FISSION, (N,2N), (N,3N) CROSS SECTIONS FROM THE TOTAL CROSS SECTION.
 MT=4 TOTAL INELASTIC SCATTERING CROSS SECTIONS.
 MT=16 (N,2N) (NTH THE MODEL OF SEGEV ET AL./12/. CALCULATED WITH THE MODEL OF SEGEV ET AL./12/. 8 FISSION MT = 17MT=18 FISSION THE RATIO DATA TH-232/U-235 OF BEHRENS/13/ WERE MULTIPLIED WITH THE EVALUATED DATA/14/ OF U-235(N,F). MT=51-52 INELASTIC SCATTERING TO THE 1ST AND 2ND LEVELS.

| CALCULATED WITH CONSISTENT COMBINATION OF COUPLED-CHANNEL
(CC) AND HAUSER-FESHBACH(HF) METHODS (CC/HF METHOD)/15/.
THE CODE JUPITOR-1/16/ WAS USED FOR CC-CALCULATIONS,
ELIESE-3/17/ FOR THE HF-CALCULATIONS.
MT=55,59,62,66 INELASTIC SCATTERING TO THE 5TH, 9TH, 12TH
AND 16TH LEVELS.
COMPOUND NUCLEAR COMPONENT WAS CALCULATED WITH THE CODE
ELIESE-3 USING THE GENERALIZED TRANSMISSION COEFFICIENTS
CALCULATED WITH JUPITOR-1 FOR THE ENTRANCE CHANNEL. DIRECT
REACTION COMPONENT WAS CALCULATED WITH THE CODE DWUCK/18/.
MT=53,54,56-58,60,61,63-65,67-70,91 INELASTIC SCATTERING
TO THE OTHER DISCRETE AND CONTINUUM LEVELS.
CALCULATED WITH ELIESE-3 USING THE GENERALIZED TRANS-
MISSION COEFFICIENTS FOR THE ENTRANCE CHANNEL.
MT=102 CAPTURE
BASED ON THE MEASUREMENT OF KOBAYASHI/19/ AND CALCULATION
WITH THE CODE COSTHY/20/ |
|---|
| THE PARAMETERS FOR THE CC AND SPHERICAL OPTICAL POTENTIALS
WERE TAKEN FROM HAOUAT ET AL./21/ AND OHSAWA ET AL./22/,
RESPECTIVELY: |
| $ \begin{array}{llllllllllllllllllllllllllllllllllll$ |
| THE LEVEL SCHEME WAS TAKEN FROM REF./23/.
NO. ENERGY(MEV) SPIN-PARITY |
| GS 0 0 0+
1 0.049 2+
2 0.162 4+
3 0.557 8+
5 0.714 1-
6 0.730 0+
7 0.7741 2+
8 0.7743 3-
9 0.785 2+
10 0.830 3-
11 0.873 4+
12 0.883 5-
13 0.889 4+
14 0.960 5+
15 1.054 2-
16 1.073 2+
17 1.0777 1-
18 1.078 0+
19 1.094 3+
20 1.105 3-
CONTINUUM LEVELS WERE ASSUMED ABOVE 1.110MEV.
THE LEVEL DENSITY PARAMETERS OF GILBERT AND CAMERON/24/
WERE USED. |
| MI=251 MU-BAR
CALCULATED WITH THE OPTICAL MODEL. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2 ELASTIC SCATTERING
CALCULATED WITH CC/HF METHOD/15/.
MT=51-70 INELASTIC
CALCULATED WITH CC/HF METHOD/15/ AND DWBA/18/.
MT=16,17,18,91 (N,2N), (N,3N), FISSION AND CONTINUUM INELASTIC
ASSUMED TO BE ISOTROPIC IN THE LAB SYSTEM. |
| <pre>MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16.17.91 (N.2N), (N.3N) AND CONTINUUM INELASTIC
CALCULATED WITH PEGASUS/25/.
MT=18 FISSION
MAXWELL SPECTRUM. THE TEMPERATURE PARAMETERS WERE ESTIMATED
FROM THE SYSTEMATICS OF HOWERTON-DOYAS/26/.
MT=455 DELAYED NEUTRONS
SPECTRUM EVAUATED BY SAPHIER ET AL./27/ WAS ADOPTED.
RELATIVE ABUNDANCE WAS TAKEN FROM REF./28/.</pre> |

F=8 FISSION PRODUCT YIELD DATA MT=454 INDEPENDENT YIELDS TAKEN FROM JNDC FP DECAY FILE VERSION-2/29/. MT=459 CUMULATIVE YIELDS TAKEN FROM JNDC FP DECAY FILE VERSION-2/29/. MF = 8REFERENCES ERENCES OHSAWA,T., ET AL.; J. NUCL. SCI. TECHNOL., 18, 408 (1981). TUTTLE,R.J., ET AL.; INDC(NDS)-107/G, P.29 (1979). DAVEY,W.G.; NUCL. SCI. ENG., 44, 345 (1971). RAHN,F., ET AL.; PHYS. REV., C6, 1854 (1972). KOBAYASHI,K.; PRIVATE COMMUNICATION (1986). WHALEN,F.F., AND SMITH,A.B.; NUCL. SCI. ENG., 67, 129 (1978). FOSTER,D.G. ET AL.; PRIVATE COMMUNICATION (1967); PHYS. REV. C3, 596 (1971) FASOLI,U., ET AL.; NUCL. PHYS., A151, 369 (1970). KOBAYASHI,K., ET AL.; NUCL. SCI. ENG., 65, 347 (1978). UTTLEY,C.A., ET AL.; EANDC CONF. ON TOF METHODS, SACLAY (1961) P.109 Ξí 4) 5 ý 6 7) 8) 9) 10) 10) UTTLEY, C.A., ET AL.; EANDC CONF. ON TOP METHODS, SACLAY (1981) P.109
11) UTTLEY, C.A., ET AL.; PROC. 1ST CONF. ON NUCLEAR DATA FOR REACTORS, PARIS (1966).
12) SEGEV, M., ET AL.; ANN. NUCL. ENERGY 5, 239 (1978).
13) BEHRENS, J.W., ET AL.; UCID-17442 (1977); PHYS. LETT. 69B, 278 (1977). BEHRENS, J.W., ET AL.; UCID-17442 (1977); PHYS. LEII. 09B, 270 (1977).
MATSUNÓBU, H.; PRIVATE COMMUNICATION (1979).
OHSAWA, T., ET AL.; PROC. INT. CONF. ON NUCLEAR DATA FOR BASIC AND APPLIED SCIENCE (1985) VOL.2, P.1193
TAMURA, T.; REV. MOD. PHYS., 37, 679 (1965).
IGARASI,S.; JAERI-1223 (1973).
KUNZ, P.D.; COO-535-606 AND -613 (1969).
KOBAYASHI,K., ET AL; PREPRINT 1978 FALL MTG. AT. ENERGY SOC.
JAPAN, D23 (1978).
IGARASI,S. AND FUKAHORI,T.; JAERI 1321 (1991).
HAOUAT,G., ET AL.; NUCL. SCI. ENG., 81, 491 (1982).
OHSAWA,T. ET AL.; J. NUCL. SCI. TECHNOL. 18, 408 (1980).
CHAN,D.W.S., ET AL.; PHYS. REV., C26, 841 (1982).
GILBERT,A. AND CAMERON,A.G.W.; CAN. J. PHYS., 24, 63 (1965).
IIJIMA,S., ET AL.; JAERI-M 87-025, P.337 (1987).
HOWERTÓN, R.J. AND DOYAS, R.J.: NUCL. SCI. ENG., 46, 414 (1971).
SAPHIER,D., ET AL.; PHYS. REV., 107, 1044 (1957).
JNDC DECAY HEAT EVALUATION WG; PRIVATE COMMUNICATION (1989). 14)15) 16) 17) 18) 19) 20) 21) 22) 23) 245 25) 26) 27) 28)

291

MAT number = 9043 90-TH-233 KINKI U. EVAL-JUL87 T.OHSAWA DIST-SEP89 REV2-JUN94 HISTORY 81-04 EVALUATION FOR JENDL-2 WAS MADE BY T. OHSAWA AND M. OHTA (KYUSHU UNIVERSITY: PRESENT ADDRESS OF OHSAWA IS KINKI UNIV.). DETAILS OF THE EVALUATION ARE DESCRIBED IN REF. OHTA 83-11 FISSION SPECTRUM WAS ADDED. THE TOTAL, (N,2N) AND (N,3N) CROSS SECTIONS WERE MODIFIED. 87-07 JENDL-2 DATA WERE ADOPTED FOR JENDL-3. COMPILATION WAS MADE BY T.NAKAGAWA (JAERI). 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 (1,452), (1,455), (1,456) * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF TH-232 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON THE SEMI-EMPIRICAL FORMULA OF HOWERTON /6/. MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES NO RESOLVED RESONANCES WERE ADOPTED, SINCE THERE WERE NO MEASUREMENTS MADE. THE THERMAL CAPTURE CROSS SECTION OF 1450+-100 BARNS WAS ADOPTED FROM REF./7/, AND THE THERMAL FISSION CROSS SECTION OF 15 BARNS FROM LLL EVALUATED NUCLEAR DATA LIBRARY/8/. THE CAPTURE AND FISSION CROSS SECTIONS AT 0.0253 EV WERE EXTRAPOLATED UP TO 200 EV BY ASSUMING THE FORM OF 1/V FOR THE FORMER, AND UP TO 20 KEV BY ASSUMING THE FORM OF 1/V PLUS THE CONSTANT VALUE OF 0.3 BARNS FOR THE IATTER LATTER. CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEG.(BARNS) 2200-M/S RES. INTEG. TOTAL 1478.0 -ELASTIC 13.0 -FISSION 15.0 11.1 TOTAL ELASTIC FISSION CAPTURE 1450.0 643 MF = 3(MEV), (MEV), (MEV), (MEV), (FM), (FM), -- DER. WOODS-SAXON --R0 = RS0 = 1.31 (FM), RS = 1.38 (FM), A = B = AS0= 0.47 (FM). THESE PARAMETERS WERE TAKEN FROM THOSE FOR TH-232 /9/. MT=2 ELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS USING THE CODE CASTHY /10/. MT=4,51-65,91 INELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS. LEVEL SCHEME OF TH-233 /11/ NO. ENERGY(MEV) SPIN-PARITY Ģ.S. $\frac{1}{2} + \frac{3}{2} + \frac{5}{2} + \frac{5}{2} + \frac{5}{2} + \frac{5}{2} + \frac{5}{2} + \frac{1}{2} + \frac{1}{2} + \frac{5}$ 0.0 0.01687 0.05456 2 3 4 0.09363 $\begin{array}{c} 0.37121 \\ 0.53958 \\ 0.58393 \\ 0.6115 \end{array}$ 5 1/2 3/2 5/2 3/2 1/2 6 7 8 0.62902 + 0.6822 0.7135 0.7218 9 10 + 3/2 +11

0.7695 0.8145 0.8914 0.9476 5/2 + 3/2 + 3/2 + 3/2 -12 13 14 15 LEVĖĽS ABOVE O.95 MEV WERE ÁSSUMED TO BE OVERLAPPING. MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED BY MEANS OF THE EVAPORATION MODEL OF SEGEV AND CANER /12/.
MT=18 FISSION CROSS SECTION FISSION PROBABILITY DEDUCED FROM DIRECT REACTION /13, 14/ WAS USED TO CALCULATE THE FISSION CROSS SECTION.
MT=102 CAPTURE CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS WITH GAMMA-RAY STRENGTH FUNCTION OF 0.00352.
MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL CALCULATED WITH OPTICAL MODEL. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2,51-65,91 STATISTICAL AND OPTICAL MODEL CALCULATIONS. MT=16,17,18 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,91
EVAPORATION SPECTRA.
MT=18
FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS OF SMITH
ET AL. /15/ FERENCES OHSAWA T. AND OHTA M.: MEMOIRS FACULTY OF ENGINEERING, KYUSHU UNIV. 40, 149 (1980). D TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979), BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982). WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981). BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989). HOWERTON R.J.: NUCL. SCI. ENG. 62, 438 (1977). JOHNSTONE F.J. AND HALPERIN J.: J. NUCL. ENERGY, 11, 95(1960). UCRL-50400, VOL. 15, PART D (1977). OHSAWA T. AND OHTA M.: J. NUCL. SCI. TECHNOL. 18, 408 (1981). IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991). LEDERER C.M. AND SHIRLY V.S. (ED.): TABLE OF ISOTOPES, 7TH EDITION (1978). SEGEV M. AND CANER M.: ANN. NUCL. ENERGY 5, 239(1978). BACK B.B. ET AL.: PHYS. REV. C13, 2374 (1974). CRAMER J.D. AND BRITT H.C.: NUCL. SCI. ENG. 41, 177 (1970). SMITH A.B. ET AL.: ANL/NDM-50 (1979). REFERENCES 1) 2 Ξí 4 5) 6) 7) 8)

- 9) 10)
- 11)
- 12)
- 13) 14) 15)

MAT number = 9046 90-TH-234 KINKI U. EVAL-JUL87 T.OHSAWA DIST-SEP89 REV2-JUN94 HISTORY 81-04 EVALUATION FOR JENDL-2 WAS MADE BY T. OHSAWA AND M. OHTA (KYUSHU UNIVERSITY: PRESENT ADDRESS OF OHSAWA IS KINKI UNIV.). DETAILS OF THE EVALUATION ARE DESCRIBED IN REF. OHTA 83-11 FISSION SPECTRUM WAS GIVEN. THE TOTAL, (N,2N) AND (N,3N) CROSS SECTIONS WERE MODIFIED.
87-07 JENDL-2 DATA WERE ADOPTED FOR JENDL-3. COMPILATION WAS MADE BY T.NAKAGAWA(JAERI).
94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF TH-232 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON THE SEMI-EMPIRICAL FORMULA OF HOWERTON /6/. F=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCES NO RESOLVED RESONANCES WERE ADOPTED, SINCE THERE WERE NO MEASUREMENTS MADE. THE CAPTURE CROSS SECTION AT 0.0253 EV /7/ WAS EXTRAPOLATED ON AN 1/V BASIS UP TO AN ENERGY OF 15 EV. THE FISSION CROSS SECTION AT 0.0253 EV IS LESS THAN 0.0 BARN /8/, THEREFORE IT WAS ASSUMED TO 0.0 BARN. MF = 2THAN 0.02 CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEG.(BARNS) 2200-M/S RES. INTEG. TOTAL 14.75 ÉLÁSTIC FISSION CAPTURE 13.0 0.0 0.26 1.75 93.7 NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION OPTICAL MODEL CALCULATION WITH THE FOLLOWING PARAMETERS: $V = 41.0 - 0.05 \times E$ (MEV), $WS = 6.4 + 0.15 \times SQRT(E)$ (MEV), -- DER. WOODS-SAXON - VSO= 7.0 (MEV), RO = RSO = 1.31 (FM), RS = 1..38 (FM). MF=3 $M\tilde{T}=1$ -- DER. WOODS-SAXON --RS = 1.38FMS RS = 1.38 (FM), A = B = ASO= 0.47 (FM), THESE PARAMETERS WERE TAKEN FROM THOSE FOR TH-232 /9/. MT=2 ELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS USING THE CODE CASTHY /10/. MT=4,51-67,91 INELASTIC SCATTERING CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS. LEVEL SCHEME OF TH-234 (ESTIMATED FROM SYSTEMATICS) ÑŌ. Ģ.S. 0.0 0 2 + 0.0 0.048 0.160 0.336 0.576 0.730 0.767 1 + ż 4 + 3 6 + 4 8 5 6 7 0 2 2 4 1 + 0.785 0.853 0.882 0.889 + 89 + 10 4 + 0.942 0.987 11 ż 12 6 + 13 14 1.050 5 6 + 1.053 15 8 + 1.073

16 1.206 7 + 17 1.277 8 + LEVELS ABOVE 1.06 MEV WERE ASSUMED TO BE OVERLAPPING. MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED BY MEANS OF THE EVAPORATION MODEL OF SEGEV AND CANER /11/. MT=18 FISSION CROSS SECTION FISSION PROBABILITY DEDUCED FROM DIRECT REACTION /12/ AND SYSTEMATICS OF BEHRENS /13/ WERE USED TO OBTAIN FISSION CROSS SECTION. MT=102 CAPTURE CROSS SECTION STATISTICAL AND OPTICAL MODEL CALCULATIONS WITH GAMMA-RAY STRENGTH FUNCTION OF 0.00791. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-67,91 STATISTICAL AND OPTICAL MODEL CALCULATIONS. MF = 4MT=16,17,18 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRA WERE GIVEN. MT=18 FISSION SPECTRUM WAS ESTIMATED FROM Z**2/A SYSTEMATICS OF SMITH ET AL. /14/. ERENCES OHSAWA T. AND OHTA M.: MEMOIRS FACULTY OF ENGINEERING, KYUSHU UNIV. 40, 149 (1980). TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979), BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982). WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981). BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989). HOWERTON R.J.: NUCL. SCI. ENG. 62, 438 (1977). HARVEY B.G. AND PARSONS B.I.: PHYS. REV., 80, 1098 (1950). OSBORNE C. AND COVEYOU I.: MON-P-178, P.10 (1948), AS CITED IN HUIZENGA J.R. ET AL. "THE ACTINIDE ELEMENTS", NATIONAL NUCLEAR ENERGY SERIESEM DIV. IV, VOL.14A (ED. SEABORG ET AL.) P.839 (1954). REFERENCES 1) 2) ζĵ ă١ 5) 6) 7) 8) ENERGY SERIESEM DIV. IV, VOL.14A (ED. SEABORG ET AL.) P.839 (1954).
9) OHSAWA T. AND OHTA M.: J. NUCL. SCI. TECHNOL. 18, 408 (1981).
10) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
11) SEGEV M. AND CANER M.: ANN. NUCL. ENERGY 5, 239(1978).
12) BACK B.B. ET AL.: PHYS. REV. C13, 2374 (1974).
13) BEHRENS J.W.: UCID-17509-2 (1977); PHYS. REV. LETT. 39, 68 (1977).
14) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9131 91-PA-231 KINKI U.+ EVAL-MAR87 T.OHSAWA, M.INOUE AND T.NAKAGAWA DIST-SEP89 HISTORY 87-03 NEW EVALUATION WAS PERFORMED FOR JENDL-3 BY T. OHSAWA AND M. INOUE. 87-07 RESONANCE PARAMETERS WERE EVALUATED BY T.NAKAGAWA(JAERI). 88-07 UNRESOLVED RESONANCE REGION WAS MODIFIED. COMPILATION WAS MADE BY T.NAKAGAWA. =1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT'S = 455 AND 456. MT=455 DELAYED NEUTRONS DECAY CONSTS WERE ASSUMED TO BE SAME AS THORIUM. NU-D WAS EVALUATED ON THE BASIS OF TUTTLE'S RECOMMENDA-TION/1/ MF = 1Ťľ0Ň/1/ 110N/17. 6 NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON THE BOIS-FREHAUT'S SEMI-EMPIRICAL FORMULA /2/. MT = 456BASED ON THE BOTS-FREHAUT'S SEMT-EMPTRICAL FORMULA /2/. =2, MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR SLBW FORMULA: 1.0-5 - 115 EV NEUTRON AND RADIATIVE WIDTHS WERE MAINLY ADOPTED FROM HUSSEIN ET AL./3/, AND FISSION WIDTH ESTIMATED FROM THE DATA OF FISSION AREA MEASURED BY PLATTERD ET AL. /4/. FOR THE RESONANCES WHOSE FISSION AREA WAS NOT MEASURED, AN AVERAGE VALUE OF 40 MICRO-EV WAS ASSUMED. A NEGATIVE RESONANCE WAS GIVEN ON THE BASIS OF RECOMMENDATION BY MUGHABGHAB /5/ TO REPRODUCE RECOMMENDED THERMAL CROSS SECTIONS /5/. UNRESOLVED RESONANCES : 115 EV - 40 KEV PARAMETERS WERE BASED ON THE AVERAGE VALUES OBTAINED FROM THE RESOLVED RESONANCE PARAMETERS. S1 WAS DETERMINED FROM THE OPTICAL MODEL CALCULATION. SCATTERING RADIUS WAS ADJUSTED SO AS TO REPRODUCE ELASTIC SCATTERING AT 40 KEV. S0 = 0.90E-4, S1 = 1.2E-4, D-OBS = 0.47EV, RADIATIVE WIDTH = 0.040 EV, R = 9.05 FM BACKGROUND CROSS SECTION WAS GIVEN TO THE CAPTURE CROSS SECTION TO CONNECT SMOOTHLY TO THAT IN HIGH ENERGY REGION. MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INT 2200 M/S RESONANCE INTEGRALS INTEGRALS 210.69 B TOTAL -ÉLÁSTIC FISSION CAPTURE 9.954 0.0196 4.61 B 200.72 596 B MF=3 NEUTRON CROSS SECTIONS CROSS SECTION WERE REPRESENTED WITH RESONANCE PARAMETERS BELOW 40 KEV. ABOVE THIS ENERGY, CROSS SECTIONS WERE EVALUATED AS FOLLOWS. MT=1 TOTAL CROSS SECTION CALCULATED WITH THE COUPLED-CHANNEL(CC) MODEL CODE JUPITOR-1/6/. THE POTENTIAL PARAMETERS USED FOR THE CC-CALCULATIONS ARE GIVEN BELOW. 2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF CAPTURE, INELASTIC, FISSION, (N,2N) AND (N,3N) REACTION CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=2:16 (N,2N) CALCULATED WITH THE MODEL OF SEGEV ET AL./7/. MT = 1617 (N,3N) CALCULATED WITH THE MODEL OF SEGEV ET AL./7/. MT = 17FISSION MT=18 BASED ON THE EXPERIMENTAL DATA OF PLATTARD/4/ BELOW 12 MEV. ABOVE 12 MEV, THE EVALUATION OF MANN/9/ WAS ADOPTED AFTER APPROPRIATE RENORMALIZATION. MT=53,63 INELASTIC SCATTERING TO THE 3RD AND 13TH EXCITED LEVELS(MEMBERS OF THE GROUND STATE ROTATIONAL BAND). CALCULATED WITH THE CONSISTENT COMBINATION OF CC AND HAUSER-FESHBACH(HF) METHODS (CC/HF METHOD)/9/. THE CODE JUPITOR-1 WAS USED FOR THE CC CALCULATIONS, AND ELIESE-3 /10/ FOR THE HF CALCULATIONS. MT=51-52,54-62,64-70,91 INELASTIC SCATTERING TO THE OTHER

DISCRETE AND CONTINUUM LEVELS. COMPOUND NUCLEAR COMPONENT WAS CALCULATED WITH THE CODE ELIESE-3 USING THE GENERALIZED TRANSMISSION COEFFICIENTS CALCULATED WITH JUPITOR-1 FOR THE ENTRANCE CHANNEL. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM GILBERT-CAMERON /11/. MT=102 CAPTURE CALCULATED WITH THE CODE CASTHY/12/. THE AVERAGE RADIATIVE WIDTH AND LEVEL SPACING USED TO NORMALIZE THE CALCULATION ARE 40 MEV AND 0.47 EV, RESPECTIVELY/3/. THE PARAMETERS FOR THE CC AND SPHERICAL OPTICAL POTENTIALS WERE TAKEN FROM HAOUAT ET AL./13/ AND OHSAWA ET AL./14/ RESPECTIVELY. $\begin{array}{r} & & & & & & \\ & = & 46.4 - 0.3 * EN \\ & = & 3.6 + 0.4 * EN \\ & & & & \\ 0 = & 6.2 \\ & = & 1.26 \\ & & & & \\ 0 = & 1.12 \\ & & & & \\ 0 = & 0.62 \end{array}$ SOM V = 41.0-0.05*EN WS = 6.4+0.15*SQRT(EN) VS0= 7.0 R = 1.31 RS = 1.38 RS0= 1.31 A = 0.47 (MEV) (MEV) (MEV) (FM) (FM) (FM) ŵѕ VSO= 7.0 1.31 1.38 1.31 0.47 0.52 0.47 R = RS = RS0= A = 0.63 A = 0.63 AS = 0.52 ASO = 0.47 BETA2 = 0.190A = AS =(FM) (FM) AŠ0= - - -BETA4=0.071 THE LEVEL SCHEME WAS TAKEN FROM NUCLEAR DATA SHEETS/15/. NO. ENERGY(MEV) SPIN-PARITY GS 0.0 3/2-1 0.0093 1/2-2 0.0585 7/2-3 0.0778 5/2-4 0.0842 5/2+ 5 0.1013 7/2+ 6 0.1020 3/2+ $\begin{array}{c} 0.0093\\ 0.0585\\ 0.0778\\ 0.0842\\ 0.1013\\ 0.1029\\ 0.1116\\ 0.1340\\ 0.1693\\ 0.1741 \end{array}$ 23456789 10 3/2+9/2+ 11/2+ 11/2-9 0.1693 11/2-10 0.1741 5/2-11 0.1835 5/2+ 12 0.189 13/2+ 13 0.2183 7/2-14 0.2473 7/2+ 15 0.2720 9/2-16 0.287 1/2+ 17 0.3179 3/2+ 18 0.3202 3/2-19 0.3400 11/2-20 0.3518 5/2-CONTINUUM LEVELS WERE ASSUMED ABOVE 0.38 MEV. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM GILBERT-CAMERON/11/. 251 MU-BAR CALCULATED WITH THE OPTICAL MODEL. MT=251 ANGULAR DISTRIBUTION OF SECONDARY NEUTRONS MF = 4MT=2 ELASTIC SCATTERING CALCULATED WITH THE CC/HF METHOD. MT=51-70 INELASTIC SCATTERING CALCULATED WITH THE CC/HF METHOD FOR THE 3RD AND 13TH EXCITED LEVELS. FOR THE OTHER LEVELS, CALCULATIONS WITH ELIESE-3 USING THE GENERALIZED TRANSMISSION COEFFICIENTS FOR THE ENTRANCE CHANNEL WERE ADOPTED, AND ISOTROPIC DISTRIBUTIONS WERE ASSUMED ABOVE 5.0 MEV BECAUSE OF ZERO CROSS SECTIONS. 91 INELASTIC SCATTERING TO THE CONTINUUM ISOTROPIC DISTRIBUTIONS IN LAB. SYSTEM WAS ASSUMED. MT=91 MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 (N,2N), (N,3N) AND CONTINUUM INELASTIC EVAPORATION SPECTRA. MT=18 FISSION MAXWELL SPECTRUM (TAKEN FROM ENDF/B-V).

REFERENCES

TUTTLE, R.J.; INDC(NDS)-107/G (1979).
 BOIS, R. AND FREHAUT, J.: CEA-R-4791 (1976).
 HUSSEIN, A. ET AL.: NUCL. SCI. ENG., 78, 370 (1981).
 PLATTARD, S. ET AL.: 79 KNOXVILLE, P.491
 MUGHABGHAB, S.F.: "NEUTRON CROSS SECTIONS", VOL. 1, PART B, ACADEMIC PRESS (1984).
 TAMURA,T.: REV. MOD. PHYS. 37, 679 (1965).
 SEGEV,M. ET AL.: ANN. NUCL. ENERGY 7, 577 (1980).
 MANN, F.M.: HEDL-THE-78-100 (1979).
 OHSAWA,T., ET AL.: 85 SANTA FE, 2 1193 (1985).
 IGARASI, S.: JAERI-1223 (1973).
 GILBERT, M. AND CAMERON, A.G.W.: CAN. J. PHYS., 43, 1446 (1966).
 IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 HAOUAT, G. ET AL.: J. NUCL. SCI. TECHNOL. 18, 408 (1980).
 SCHMORAK, M.R.: NUCL. DATA SHEETS 21, 91 (1977).

MAT number = 9134 91-PA-232 TIT EVAL-AUG88 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY 88-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 ******** (1,452), (1,455), (1,456) * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ADOPTED FROM THE EVALUATION BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 1176.23 B -ELASTIC 12.23 B -FISSION 700.00 B 313 B CAPTURE 464.00 B 309 B RES. INT. F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 1 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 1 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/8/. THE POTENTIAL PARAMETERS/9/ USED ARE AS MF = 3FOLLOWS (MEV) (MEV) (MEV) (FM) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 1 EV, ASSUMED TO BE THE SAME AS SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH THE OPTICAL MODEL. ABOVE 1 EV, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4, 91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/8/. NO EXCITED LEVELS WERE RECOMMENDED IN REF./10/. NO ENERGY (KEV) SPIN-PARITY G.S. LEVELS ABOVE 50 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./11/. MT=16,17,37 (N,2N) (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 700 BARNS WAS TAKEN FROM REF./12/, AND 1/V FORM WAS ASSUMED BELOW 1 EV. FOR ENERGIES ABOVE 1 EV, THE SHAPE WAS ASSUMED TO BE THE SAME AS U-233 FISSION CROSS SECTION AND NORMALIZED TO THE SYSTEMATICS BY BEHRENS AND HOWERTON/13/. MT = 182 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 464 BARNS WAS TAKEN FROM REF./12/, AND 1/V FORM WAS ASSUMED BELOW 1 EV. THE CROSS SECTION SHAPE NEAR 1 EV WAS ADJUSTED SO AS TO REPRODUCE THE RESONANCE INTEGRAL/12/. ABOVE 1 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 0.417 EV. MT=102

MT=251 MU-L CALCULATED WITH CASTHY.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,91 CALCULATED WITH OPTICAL MODE MT=16,17,18,37 ISOTROPIC IN THE LAB SYSTEM. MODEL.

==5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/14/.

REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989).
MANERO F. AND KONSHIN V.A.: AT. ENERGY REV., 10, 637 (1972).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
OHSAWA T., OHTA M.: J. NUCL. SCI. TECHNOL., 18, 408 (1981).
SCHMORAX M.R.: NUCL. DATA SHEETS, 36, 367 (1982).
GILBERT A., CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS, PART B, Z=61-100", ACADEMIC PRESS (1984).
BHRENS J.W., HOWERTON R.J.: NUCL. SCI. ENG., 65, 464, (1978).

MAT number = 9137 91-PA-233 KINKI U.+ EVAL-MAR87 T.OHSAWA, M.INOUE AND T.NAKAGAWA DIST-SEP89 87-03 RE-EVALUATION WAS PERFORMED FOR JENDL-3 BY T. OHSA M. INOUE (KYUSHU UNIVERSITY) AND T.NAKAGAWA(JAERI) COMPILATION WAS MADE BY T.NAKAGAWA. OHSAWA. =1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455) MT=455 NUMBER OF DELAYED NEUTRONS TAKEN FROM TUTTLE'S SEMI-EMPIRICAL FORMULA /1/. ENERGY DEPENDENCE WAS IGNORED. MT=456 NUMBER OF PROMPT NEUTRONS BASED ON THE SEMI-EMPIRICAL FORMULA BY BOIS AND FREHAUT /2/. MF = 1=2, MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR SLBW FORMULA: FROM 1.0E-5 TO 16.5 EV PARAMETERS WERE TAKEN FROM THE RECOMMENDATION BY MUGHABGHAB /3/ AND MODIFIED TO REPRODUCE THERMAL CROSS SECTIONS AND RESONANCE INTEGRAL OF CAPTURE/3/. UNRESOLVED RESONANCE PARAMETERS: FROM 16.5 EV TO 40 KEV AVERAGE RESONANCE PARAMETERS RECOMMENDED BY MUGHABGHAB /3/ WERE ADDITED MF=2WERAGE RESONANCE FARMETERS RECOMMENDED BY MOONLEADER (WERE ADOPTED. SO = 0.75E-4, S1 = 1.5E-4, D-OBS = 0.59 EV, GAMMA WIDTH = 0.047 EV (S1 WAS ADJUSTED WITH ASREP/5/ SO AS TO REPRODUCE TOTAL AND CAPTURE CROSS SECTIONS AROUND 20 KEV.) CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/S RES. INTEG. TOTAL 53.051 B ELASTIC FISSION CAPTURE 13.021 0.0 2.1 B 864 MF=3 NEUTRON CROSS SECTIONS BELOW 40 KEV, THE RESONANCE PARAMETERS WERE GIVEN. ABOVE 40 KEV, CROSS SECTIONS WERE EVALUATED AS FOLLOWS. 1 TOTAL CROSS SECTION CALCULATED WITH THE COUPLED-CHANNEL(CC) MODEL CODE JUPITOR-1/5/. THE POTENTIAL PARAMETERS USED FOR THE CC-CALCULATIONS ARE GIVEN BELOW. MT = 1■2 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE SUM OF CAPTURE, INELASTIC, FISSION, (N,2N) AND (N,3N) REACTION CROSS SECTIONS FROM THE TOTAL CROSS SECTION. MT=2MT=16 (N,2N) CALCULATED WITH THE MODEL OF SEGEV ET AL./6/. 17 (N.3N) CALCULATED WITH THE MODEL OF SEGEV ET AL./6/. MT = 1718 FISSION CALCULATED USING THE EXPERIMENTAL DATA ON THE FISSION PROBABILITY/7/. MT=18 53,66 INELASTIC SCATTERING TO THE 3RD AND 16TH EXCITED LEVELS(MEMBERS OF THE GROUND STATE ROTATIONAL BAND CALCULATED WITH THE CONSISTENT COMBINATION OF CC AND HAUSER-FESHBACH(HF) METHODS (CC/HF METHOD)/8/. THE CODE JUPITOR-1 WAS USED FOR THE CC CALCULATIONS, AND ELIESE-3 /9/ FOR THE HF CALCULATIONS. MT=53.66 BAND). MT=51-52,54-65,67-70,91 INELASTIC SCATTERING TO THE OTHER DISCRETE AND CONTINUUM LEVELS. COMPOUND NUCLEAR COMPONENT WAS CALCULATED WITH THE CODE ELIESE-3 USING THE GENERALIZED TRANSMISSION COEFFICIENTS CALCULATED WITH JUPITOR-1 FOR THE ENTRANCE CHANNEL. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM GILBERT-CAMERON /10/. 102 CAPTURE CALCULATED WITH THE CODE CASTHY/11/. THE AVERAGE RADIATIVE WIDTH AND LEVEL SPACING USED TO NORMALIZE THE CALCULATION ARE 40 MEV AND 0.79 EV, RESPECTIVELY/12/. MT=102

| | THE PARAMETERS FOR THE CC
WERE TAKEN FROM HAOUAT ET
RESPECTIVELY. | AND SPHERICAL OPTICAL POTENTIALS
AL./13/ AND OHSAWA ET AL./14/ |
|--|--|---|
| | V = 46.4-0.3*EN
WS = 3.6+0.4*EN
VSO= 6.2
R = 1.26
RS = 1.26
RSO= 1.12
A = 0.63
AS = 0.63
ASO= 0.47
BETA2=0.190
BETA4=0.071 | $ \begin{array}{rcl} & & \text{SOM} \\ \text{V} &=& 41.0-0.05^{*}\text{EN} & (\text{MEV}) \\ \text{WS} &=& 6.4+0.15^{*}\text{SQRT(EN)} & (\text{MEV}) \\ \text{VSO} &=& 7.0 \\ \text{MEV} & (\text{MEV}) \\ \text{R} &=& 1.31 & (\text{FM}) \\ \text{RS} &=& 1.38 & (\text{FM}) \\ \text{RS0} &=& 1.31 & (\text{FM}) \\ \text{RS0} &=& 1.31 & (\text{FM}) \\ \text{A} &=& 0.47 & (\text{FM}) \\ \text{AS0} &=& 0.52 & (\text{FM}) \\ \text{AS0} &=& 0.47 & (\text{FM}) \\ &=& & & \end{array} $ |
| | THE LEVEL SCHEME WAS TAKEN F EXCEPT THE 300.4 KEV-LEVEL, INSTEAD OF 7/2+ ACCORDING TO NO. ENERGY (M GS 0.0 1 0.0667 2 0.0572 3 0.0706 4 0.0865 5 0.0947 6 0.1036 7 0.1090 8 0.1634 9 0.1691 10 0.1792 11 0.2017 12 0.2123 13 0.2379 14 0.2573 15 0.2796 16 0.3004 17 0.3061 19 0.4477 20 0.4546 CONTINUUM LEVELS WERE AS DENSITY PARAMETERS WERE | ROM NUCLEAR DATA SHEETS/15/,
FOR WHICH 7/2- WAS ADOPTED
THE SUGGESTION OF GONZALEZ/16/.
EV) SPIN-PARITY
3/2-
1/2-
5/2-
5/2+
3/2+
7/2+
9/2+
11/2+
9/2+
11/2+
9/2-
3/2+
5/2+
9/2-
3/2+
5/2+
9/2+
5/2-
7/2+
9/2+
5/2-
3/2+
5/2-
3/2+
5/2-
3/2+
5/2-
3/2+
5/2-
3/2+
5/2-
5/2+
9/2+
3/2-
5/2+
5/2-
3/2+
5/2+
5/2+
3/2+
5/2-
5/2+
3/2+
5/2+
5/2+
5/2+
3/2+
5/2+
5/2+
5/2+
3/2+
5/2+
5/2+
5/2+
3/2+
5/2+
5/2+
5/2+
5/2+
5/2+
5/2+
5/2+
5 |
| | MT=251 MU-BAR
CALCULATED FROM ANGULAR | DISTRIBUTIONS. |
| MF=4 | ANGULAR DISTRIBUTION OF SEC | ONDARY NEUTRONS |
| | CALCULATED WITH THE CC/H | F METHOD. |
| | MI=51-70 INELASTIC SCATTER
CALCULATED WITH THE CC/H
EXCITED LEVELS. FOR THE
ELIESE-3 USING THE GENER
FOR THE ENTRANCE CHANNEL | ING
F METHOD FOR THE 3RD AND 13TH
OTHER LEVELS, CALCULATIONS WITH
ALIZED TRANSMISSION COEFFICIENTS
WERE ADOPTED. |
| | MT=91 INELASTIC SCATTERING
ISOTROPIC DISTRIBUTION W
SYSTEM. | TO THE CONTINUUM
AS ASSUMED IN THE LABORATORY |
| MF=5 | ENERGY DISTRIBUTIONS OF SEC | ONDARY NEUTRONS |
| | MT=16,17,91 (N,2N) (N,3N)
EVAPORATION SPECTRA BASE | AND CONTINUUM INELASTIC
D ON THE LEVEL DENSITY PARAMETERS |
| | MT=18 FISSION
MAXWELL SPECTRUM (TAKEN | FROM ENDF/B-V). |
| REFE
1)
2)
3)
4)
5)
6)
7)
8) | RENCES
TUTTLE, R.J.: INDC(NDS)-107/G
BOIS, R. AND FREHAUT, J.: CEA
MUGHABGHAB, S.F: "NEUTRON CRO
ACADEMIC PRESS (1984).
KIKUCHI, Y.: PRIVATE COMMUNIC
TAMURA, T.: REV. MOD. PHYS. 3
SEGEV, M. ET AL.: ANN. NUCL.
GAVRON, A.: PHYS. REV. C13, 2
OHSAWA, T. ET AL.: PROC. CONF
APPLIED SCI. 2, 1193 (1985). | , P.29 (1979).
-R-4791 (1976).
SS SECTIONS", VOL. 1, PART B,
ATION.
7, 679 (1965).
ENERGY 7, 577 (1980).
374 (1978).
. NUCL. DATA FOR BASIC AND |

| 9) | IGARASI, S.: JAERI-1223 (1973). |
|-----|---|
| 10) | GILBERT, M. AND CAMERON, À.G.W.: CAN. J. PHYS., 43, 1446(1966). |
| 11) | IGARASI, S.: J. NUCL. SCI. TECHNOL.,12, 67 (1975). |
| 12) | HUSSEIN, Z. ET AL.: NUCL. SCI. ENG., 78, 370 (1981). |
| 13) | HAOUAT, G. ET AL.: IBID. 81, 419 (1982). |
| 14) | OHSAWA, T. ET AL.: J. NUCL. SCI. TECHNOL. 18, 408 (1980). |
| 15) | ELLIS, Y.A.: NUCL. DATA SHEETS, 24, 289 (1978). |
| 16) | GONZALEZ, L. ET AL.: NUCL. PHYS. A324, 126 (1979). |

MAT number = 9219 92-U -232 KINKI U.+ EVAL-MAR87 T.OHSAWA AND T. NAKAGAWA DIST-SEP89 REV2-MAR94 HISTORY 87-03 EVALUATION WAS CARRIED OUT BY T. OHSAWA (KINKI UNIVERSITY) AND T. NAKAGAWA (JAERI). T.NAKAGAWA: RESONANCE PARAMETERS T.OHSAWA : OTHER QUANTITIES COMPILATION WAS MADE BY T.NAKAGAWA (JAERI). 94-03 JENDL-3.2 * * * * * ***** MODIFIED PARTS FOR JENDL-3.2 ** (3,102) ONLY Q-VALUE WAS MODIFIED. * * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 TOTAL NUMBER OF NEUTRONS PER FISSION SUM OF NU-P AND NU-D MT=455 NUMBER OF DELAYED NEUTRONS DETERMINED FROM TUTTLE'S SEMI-EMPIRICAL FORMULA /1/. MT=456 NUMBER OF PROMPT NEUTRONS BASED ON THE SEMI-EMPIRICAL FORMULA BY BOIS AND FREHAUT /2/. =2, MT=151 RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS (FROM 1.0E-5 TO 200 EV) RECOMMENDATION BY MUGHABGHAB /3/ WAS ADOPTED, AND ITS FORMULA WAS CHANGED FROM REICH-MOORE TO MULTILEVEL BREIT- WIGNER TYPE. BACKGROUND CROSS SECTION WAS GIVEN TO REPRODUCE MEASURED FISSION CROSS SECTIONS /4,5/ AT VALLEYS OF LEVELS. MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/S RES. INTEG. TOTAL 162.3 B ELASTIC 10.79 B FISSION 76.66 B 364 B CADEURC 74.00 B 172 B 74.88 B 173 B THESE VALUES ARE ALMOST THE SAME AS RECOMMENDATION BY MUGHABGHAB/3/ EXCEPT CAPTURE RESONANCE INTEGRAL WHICH IS RECOMMENDED AS 280+-15 BARNS. CAPTURE MF=3 NEUTRON CROSS SECTIONS ABOVE 200 EV MT=1 TOTAL CĂLCŪLATED WITH THE SPHERICAL OPTICAL MODEL. THE PARAMETERS FOR THE SPHERICAL OPTICAL PARAMETERS WERE AS FOLLOWS: $\begin{array}{l} \mathsf{V} = 40.47 - 0.06^*\mathsf{EN} & (\mathsf{MEV})\,, \quad \mathsf{VSO} = 8.8 & (\mathsf{MEV})\,\\ \mathsf{WS} = 6.8 + 0.04^*\mathsf{SQRT}(\mathsf{EN}) & (\mathsf{MEV})\,, \quad \mathsf{WV} = 0.0\,\\ \mathsf{R} = 1.32 & (\mathsf{FM})\,, \quad \mathsf{RS} = 1.38 & (\mathsf{FM})\,, \quad \mathsf{RSO} = 1.22 & (\mathsf{FM})\,\\ \mathsf{A} = \mathsf{AS} = \mathsf{ASO} = 0.47 & (\mathsf{FM})\,, \end{array}$ VSO = 8.8 (MEV) THIS SET OF PARAMETERS WAS FOUND TO GIVE GOOD AGREEMENT WITH THE MEASUREMENTS OF SIMPSON ET AL./6/ IN THE ENERGY REGION FROM 1 KEV TO 10 KEV. ELASTIC SCATTERING CODE CASTUX/7/ MT=2CALCULATED WITH THE CODE CASTHY/7/. (N,2N) CALCULATED WITH THE MODEL OF SEGEV-FAHIMA/8/. MT = 16CALCULATED WITH THE WODEL OF SEGEV-FAHIMA/8/. (N.3N) CALCULATED WITH THE MODEL OF SEGEV-FAHIMA/8/. FISSION CALCULATED BY USING THE FISSION PROBABILITY DATA OF GAVRON ET AL./9/ AND COMPOUND FORMATION CROSS SECTIONS CALCULATED WITH THE OPTICAL MODEL. BELOW 1 KEV, THE CROSS SECTION WAS DETERMINED ON THE BASIS OF FARRELL /5/. -60,91 INELASTIC SCATTERING TO THE DISCRETE AND CON-TIMUOUS LEVELS MT = 17MT = 18MT=51-60,91 60,91 INELASTIC SCATTERING AND TINUOUS LEVELS CALCULATED WITH THE CODE CASTHY/7/. THE LEVEL SCHEME WAS TAKEN FROM LEDERER ET AL./10/ AND SCHMORAK/11/. NO. ENERGY(MEV) SPIN-PARITY 0+ NO. GS 1 0.0 0+ 2+ 0.157 0.323 0.541 ż 4+ 3 6+ 4 8+ 0.563 0.629 5 1 -3 -6 0 +7 0.692

| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | |
|---|----------------------------|
| CONTINUŬM REGION WĂŠĂSSUMED ABOVĒ 1.0 MEV.
DENSITY PARAMETERS OF GILBERT-CAMERON/12/ WE | THE LEVEL
ERE USED. |
| MT=102 CALCULATED WITH THE CODE CASTHY/7/.
MT=251 MU-BAR | |
| MF=4ANGULAR_DISTRIBUTIONS OF SECONDARY NEUTRONS | |
| MT=2 ELASTIC SCATTERING
CALCULATED WITH THE CODE CASTHY/7/.
MT=51-60,91 INELASTIC SCATTERING
CASTHY/7/ | |
| MT=16,17 (N,2N), (N,3N)
ASSUMED TO BE ISOTROPIC IN THE LAB SYSTEM. | |
| MF=5 ENERGY DISTRIBUTIONS OF THE SECONDARY NEUTRONS
MT=16,17 91 (N,2N), (N,3N) AND CONTINUUM INELAST
EVAPORATION SPECTRA. | S
I C |
| MAXWELL SPECTRUM. THE TEMPERATURE PARAMETER
MATED FROM THE SYSTEMATICS OF HOWERTON-DOYAS | RS WERE ESTI-
S/13/. |
| REFERENCES
1) TUTTLE,R.J.: INDC(NDS)-107/G, P.29 (1979).
2) BOIS,R. AND FREHAUT,J.: CEA-R-4791 (1976). | |
| 3) MUGHABGHAB,S.F.: "NEUTRON CROSS SECTIONS", VOL.1,
ACADEMIC PRESS (1984). | , PART B, |
| 5) FARRELL, J.A.: LA-4420, 3 (1970). DATA = EXFOR 1005
6) SIMPSON, O.D., ET AL.: NUCL. SCI. ENG. 29, 415 (1977) | (1900).
55002.
967). |
| 8) SEGEV, M. AND FAHIMA, Y.: ANN. NUCL. ENERGY 7, 557
9) GAVRON, A. ET AL.: PHYS. REV. C13, 2374 (1976). | (1980). |
| 11) SCHMORAK, M.K.: NUCL. DATA SHEETS 20, NO.2 (1977)
12) GILBERT, A. AND CAMERON, A.G.: CAN. J. PHYS. 43, 14 | |

MAT number = 9222 92-U - 233 SAEI+ EVAL-MAR87 H.MATSUNOBU,Y.KIKUCHI,T.NAKAGAWA DIST-SEP89 REV2-APR94 HISTORY HISTORY
82-06 EVALUATION FOR JENDL-2 WAS MADE BY N. ASANO (SAEI), H. MATSUNOBU (SAEI) AND Y.KIKUCHI(JAERI).
87-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY H.MATSUNOBU (SAEI) MAIN PART OF REVISION WAS THE CROSS SECTIONS ABOVE 10 KEV AND ANGULAR AND ENERGY DISTRIBUTIONS OF NEUTRONS. DATA WERE COMPILED BY T. NAKAGAWA (JAERI). 94-04 JENDL-3.2. RESONANCE PARAMETERS REEVALUATED BY H.DERRIEN (JAERI)/1/ CROSS SECTIONS REEVALUATED BY H.MATSUNOBU(SAEI) FISSION SPECTRUM REEVALUATED BY T.OHSAWA(KINKI UNIV.) COMPILED BY T.NAKAGAWA (NDC/JAERI) **** MODIFIED PARTS FOR JENDL-3.2
(2,151); NEW ANALYSIS WITH SAMMY
MF=3 ; ALL DATA EXCEPT FISSION CROSS SECTION BELOW 6.75
MEV AND TOTAL CROSS SECTION
MF=4 ; FOR INELASTIC SCATTERING
(5,18) * MF = 4MF=4 , FOR TREE (5,18) ***** MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NU-TOTAL SUM OF NU-D AND NU-P MT=455 NU-D BELOW 4 MEV NU-D = 0.0075094 + 4.627E-5*LN(E(MEV)) BETWEEN 4 AND 20 MEV BASED ON THE DATA OF MASTERS ET AL. /2/ AND EVANS ET AL. /3/. /3/. NU-P MT=456 ´NU-P RENORMALIZATION WAS MADE TO 3.756 OF CF-252. RENORMALIZATION WAS MADE TO 3.756 OF CF-252. BELOW 1 MEV NU-P = 2.486 + 0.1121*(E-DE), WHERE DE IS DIFFERENCE OF AVERAGE FRAGMENT KINETIC ENERGY BETWEEN INCIDENT AND THERMAL NEUTRON ENERGIES. IT WAS TAKEN FROM DATA OF BOLDEMAN ET AL. /4/. BETWEEN 1 AND 2.73 MEV NU-P = 2.436 + 0.1279*E BETWEEN 2.73 AND 7.47 MEV NU-P = 2.327 + 0.1678*E ABOVE 7.47 MEV NU-P = 2.857 + 0.09689*E MF=2 RESONANCE PARAMETERS MT=151 A) RESOLVED RESONANCE REGION (1 EV TO 150 EV) RESOLVED RESONANCE PARAMETERS FOR THE REICH-MOORE FORMULA WERE OBTAINED BY USING SAMMY/5/. DETAILS ARE GIVEN IN APPENDIX. B) UNRESOLVED RESONANCE REGION (0.15 KEV TO 30 KEV) PARAMETERS WERE DEDUCED WITH ASREP CODE /6/ SO AS TO REPRODUCE THE EVALUATED CROSS SECTIONS IN THIS ENERGY REGION. 2200-M/S CROSS SECTIONS AND CALCULATED RES. INTEGRALS 2200 M/S RES. INTEG. TOTAL 588.38 B -ELASTIC 11.97 B -FISSION 531.16 B 774 B CAPTURE 45.25 B 138 B MF=3 NEUTRON CROSS SECTIONS SMOOTH PART (ABOVE 30 KEV) A TOTAL BASED ON THE DATA OF POENITZ /7,8/. BETWEEN 10 AND 48 KEV, CROSS-SECTION CURVE CALCULATED WITH THE STATISTICAL-MODEL CODE CASTHY /9/ AND THE COUPLED-CHANNEL THEORY CODE ECIS /10/ WAS NORMALIZED AT 48 KEV. 20 TAINED BY SUBTRACTING NON-FLASTIC SCATTERING CROSS SECT MT = 1MT = 2MT=2 ELASTIC OBTAINED BY SUBTRACTING NON-ELASTIC SCATTERING CROSS SECTION FROM THE TOTAL CROSS SECTION.
 MT=4 AND 51-64,91 INELASTIC SCATTERING CALCULATED WITH CASTHY /9/ AND ECIS /10/. COUPLED LEVELS WERE FIRST THREE LEVELS. DEFORMED OMP RECOMMENDED BY HAOUAT ET AL. /11/, WAS SLIGHTLY MODIFIED SO AS TO REPRODUCE THE

EXPERIMENTAL DATA OF SMITH ET AL. /12/, AND SPHERICAL OMP WAS THE SAME AS THAT USED FOR JENDL-2. IN THE ENERGY RANGE ABOVE 8.25 MEV, THE CROSS SECTION WAS APPROXIMATED BY USING AN EXTPONENTIAL-TYPE FUCTION, BECAUSE THE CROSS SECTION CURVE OBTAINED BY CASTHY AND ECIS SHOWED LARGE FLUCTUATION. DEFORMED OMP V =46.4-0.3*E R0=1.26 A0=0.63 , WS=3.5 +0.4*E , VSO=6.2 (MEV) , RS=1.26 , RSO=1.12 (FM) , B =0.52 , ASO=0.47 (FM) BETA-2=0.20, BETA-4=0.074 SPHERICAL OMP IERICAL OMP V =41.8-0.20*E+0.008*E**2, WS=6.50-0.15*E, VSO=6.0 (MEV) RO=1.31 , RS=1.36 , RSO=1.32 (FM) A0=0.57 , B =0.44 , ASO=0.50 (FM) (DIR. W.S.) LEVEL SCHEME WAS TAKEN FROM REF F. /13/. SPIN-PARITY NO. G.S. 1 2 ENERGY (ME 0.0 0.04035 0.0922 0.1551 0.29882 0.31191 0.3208 0.34047 0.3537 0.397 0.39849 0.41576 0.5039 5/2 + 7/2 + 9/2 + * * 9/2 + 11/2 + 5/2 + 5/2 + 7/2 + 5/2 + 9/2 - 11/2 + 7/* 3 4 5 6 7 89 1Ŏ 11 12 0.5039 12 0.5059 13 0.567 14 0.5971 ABOVE 0.6 MEV, ASSUMED TO BE OVERLAPPED. LEVELS WITH ASTERISK WERE COUPLED IN THE ECIS CALCULATION. MT=16,17 (N,2N) AND (N,3N) CALCULATED BY USING THE EGNASH-2 CODE /14/. THE (N,2N) CROSS SECTION WAS NORMALIZED TO FISSION-SPECTRUM-AVERAGED VALUE OF 0.00408 B MEASURED BY KOBAYASHI ET AL./15/. THE SAME NORMALIZATION FACTOR WAS ALSO APPLIED TO THE (N,3N) CROSS SECTION. MT=18 FISSION
BASED ON THE EXPERIMENTAL DATA OF GWIN ET AL. /16/, CARLSON ET AL. /17/, MANABE ET AL. /18/, KANDA ET AL. /19/, IWASAKI ET AL. /20/, MEADOWS /21/, LISOWSKI ET AL./22/ AND THE FISSION CROSS SECTION OF U-235 OBTAINED BY THE SIMULTANEOUS EVALUATION /23/ AND MEASURED BY CARLSON ET AL./24/ BETWEEN 13.25 AND 20 MEV.
MT=102 CAPTURE
IN THE ENERGY RANGE FROM 30 KEV TO 1 MEV, THE ALPHA VALUES
MEASURED BY HOPKINS AND DIVEN /25/ WERE MULTIPLIED BY THE
FISSION CROSS SECTION. IN THE HIGH ENERGY REGION, VALUES
CALCULATED WITH CASTHY AND ECIS WERE NORMALIZED TO 0.0578 B
AT 1 MEV. MT = 18FISSION AT 1 MEV. MT=251 MU-BAR CALCULATED WITH CASTHY AND ECIS. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2, 51-64 AND 91 CALCULATED WITH CASTHY AND ECIS. MT=16,17 AND 18 ASSUMED TO BE ISOTROPIC IN THE LAB SYSTEM. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 CALCULATED WITH PEGASUS /26/. MT=18 FISSION SPECTRUM DISTRIBUTIONS WERE CALCULATED WITH THE MODIFIED MADLAND-NIX MODEL/27,28/. THE COMPOUND NUCLEUS FORMATION CROSS SECTIONS FOR FISSION FRAGMENTS (FF) WERE CALCULATED USING BECCHETTI-GREENLEES POTENTIAL/29/. UP TO 4TH-CHANCE-FISSION WERE CONSIDERED AT HIGH INCIDENT NEUTRON ENERGIES. THE IGNATYUK FORMULA/30/ WERE USED TO GENERATE THE LEVEL DENSITY PARAMETERS. PARAMETERS ADOPTED: TOTAL AVERAGE FF KINETIC ENERGY = 172.311-0.0212*E(MEV) AVERAGE ENERGY RELEASE = 188.438 MEV AVERAGE MASS NUMBER OF LIGHT FF = 95 AVERAGE MASS NUMBER OF LIGHT FF = 139 LEVEL DENSITY OF THE LIGHT FF = 9.999- 10.094

LEVEL DENSITY OF THE HEAVY FF = 11.89 - 12.20 NOTE THAT THE PARAMETERS VARY WITH THE INCIDENT ENERGY WITHIN THE INDICATED RANGE. 55 DELAYED NEUTRONS MT = 455RECOMMENDATION BY SAPHIER ET AL. /31/ WAS ADOPTED. MF=8 FISSION PRODUCT YIELDS MT=454 FISSION PRODUCT YIELD DATA (INDEPENDENT) MT=459 FISSION PRODUCT YIELD DATA (CUMULATIVE) BOTH WERE TAKEN FROM JNDC FP DECAY DATA FILE VERSION 2 /32/. SMITH AL. D. LI AL. HUGL ATTACK THE OF ISOTOPES, 7TH ED. LEDERR D.G. AND SHIRLEY V.S.: TABLE OF ISOTOPES, 7TH ED. (1978). YAMAMURO N.: JAERI-M 90-006 (1990). KOBAYASHI K.: J. NUCL. SCI. TECHNOL., 10, 668 (1973). GWIN R. ET AL.: NUCL. SCI. TECHNOL., 10, 668 (1973). GWIN R. ET AL.: NUCL. SCI. TECHNOL., 10, 668 (1973). CARLSON G.W. AND BEHRENS J.W.: NUCL. SCI. ENG., 66, 205 (1978) MANABE F., ET AL.: 1987 ANNUAL MEETING OF ATOMIC ENERGY SOCIETY OF JAPAN, NAGOYA, P.167 (1987) IN JAPANESE. KANDA K., ET AL.: 1985 SANTA-FE, P.569 (1985). IWASAKI T., ET AL.: 1985 SANTA-FE, P.569 (1987). MEADOWS J.W.: NUCL. SCI. ENG., 54, 317 (1974). LISOWSKI P.W.: 1991 JUELICH, P.732 (1992). KANDA Y. ET AL.: 1985 SANTA FE, 2, 1567 (1986). CARLSON A.D. ET AL.: 1991 JUELICH, P.518 (1992). HOPKINS J.C. AND DIVEN B.C.: NUCL. SCI. ENG., 12, 169 (1962). IIJIMA S, ET AL.: JAERI-M 87-025, P.337 (1987). MADLAND D.G. AND NIX J.R.: NUCL. SCI. ENG., 81, 213 (1982). OHSAWA T. AND SHIBATA T.: 1991 JUELICH CONF., 965 (1992). BECCHETTI JR.F.D. AND GREENLEES G.W.: PHYS. REV., 182, 1190 (1969). 14) 15) 16) 17) 18) 19) 20) 22) 223) 223) 225) 225) 226) 227) 229) (1969). IGNATYUK A.V.: SOV. J. NUCL. PHYS., 29, 450 (1979). SAPHIER D., ET AL.: NUCL. SCI. ENG., 62, 660 (1977). TASAKA K. ET AL.: JAERI 1320 (1990). 30) 31) APPENDIX RESONANCE DATA , JAERI DECEMBRE 1992 THE REICH-MOORE R-MATRIX RESONANCE PARAMETERS WERE OBTAINED FROM SEQUENCIAL BAYESIAN FITS OF SELECTED EXPERIMENTAL TOTAL, FIS-SION AND CAPTURE CROSS SECTIONS PERFORMED WITH THE COMPUTING CODE SAMMY. THE SELECTED EXPERIMENTAL DATA WERE THE FOLLOWING: 1) TOTAL CROSS SECTIONS MEASURED BY PATTENDEN/1/, MOORE/2/, KOLAR/3/, HARVEY/4/: 2) FISSION CROSS SECTIONS MEASURED BY WESTON/5,6/, BLONS/7/, DERUYTER/8/, WAGEMANS/9/. 3) CAPTURE CROSS SECTIONS MEASURED BY WESTON/5,6/. IN THE LOW ENERGY RANGE THE DATA OF PATTENDEN, MOORE, HARVEY, KOLAR, WESTON, DERUYTER AND WAGEMANS WERE CONSIDERED.IN THE ENERGY RANGE FROM 15 EV TO 150 EV, ONLY THE DATA FROM KOLAR, BLONS AND WESTON COULD BE ANALYSED OWING TO THE POOR RESOLUTION OF THE OTHER DATA. SOME OF THE DATA WERE RENORMALIZED TO THE AXTON STANDARD /10/ AT 0.0253 EV. THE FISSION CROSS SECTION MEASUREMENT OF WESTON /5/ AVAILABLE IN THE ENERGY RANGE ABOVE 1 EV WAS RENORMALISED TO THE DATA OF WAGEMANS/9/ OVER THE ENERGY RANGE FROM 1 EV TO 20 EV, RESULTING IN AN INCREASE OF THE CROSS SECTION BY 2.4% COMPARED TO THE OATA OF WAGEMANS/9/ OVER THE ENERGY RANGE FROM 15 EV TO 150 EV, RESULTING IN AN INCREASE OF THE CROSS SECTION BY 2.4% COMPARED TO THE DATA OF WAGEMANS/9/ OVER THE ENERGY RANGE FROM 15 EV TO 150 EV, RESULTING IN AN INCREASE OF THE CROSS SECTION BY 2.4% COMPARED TO THE DATA OF WAGEMANS/9/ OVER THE ENERGY RANGE FROM 15 EV TO 150 EV, RESULTING IN AN INCREASE OF THE CROSS SECTION BY 2.9% COMPARED TO THE DATA OF WAGEMANS/9/ OVER THE ENERGY RANGE FROM 15 EV TO 150 EV, RESULTING IN AN INCREASE OF THE CROSS SECTION BY 2.9% COMPARED TO THE DATA OF WESTON OVER THE ENERGY RANGE FROM 15 EV TO 150 EV, RESULTING IN AN INCREASE OF THE CROSS SECTION BY 2.9% COMPARED TO THE DATA IN THE ORIGINAL EXFOR FILE. THE TOTAL CROSS SECTION OF KOLAR NEEDED A BACKGROUND CORRECTION OF (2.3-0.038E) BARN, E IN EV, IN THE ENERGY RANGE FROM 77 EV TO 150 EV, CORRESPONDING TO 0 TO 1.5% OF THE MEASURED TRANSMISSION. THESE RENORMALIZATIONS AND BACKGROUND CORRECTIONS WERE PERFORMED AFTER PRELIMINARY FITS OF TH CONSISTENCY OF +-2% AMONG THE CROSS SECTION OF THE EXPERIMENTAL DATA BASE. THE FINAL SAMMY FITS WERE PERFORMED WITHOUT RENORMALI-ZATION AND BACKGROUND CORRECTION PARAMETERS THE TRANSMISSION DATA OF PATTENDEN, MOORE, HARVEY AND KOLAR ARE NOT AVAILABLE FROM THE EXFOR FILE AND WERE NOT REQUESTED FROM THE AUTHORS. THE SAMMY FITS WERE PERFORMED ON THE EXPERIMENTAL EF-FECTIVE TOTAL CROSS SECTIONS USING THE SAMPLE THICKNESSES AND THE EXPERIMENTAL RESOLUTION TO CALCULATE THE THEORITICAL EFFECTIVE GROSS SECTIONS. ENOUGH INFORMATIONS WERE FOUND IN THE PUBLICATIONS BY THE AUTHORS TO ENSURE THE ACCURACY OF THE CALCULATIONS. DUE TO THE HIGH RESOLUTION OF THE TRANSMISSION MEASUREMENTS OF KOLAR(100 M FLIGHT PATH) AND OF THE FISSION MEASUREMENTS OF BLONS (50 M FLIGHT PATH AND SAMPLE COOLED DOWN AT LIQUID NITROGEN TEMPE-RATURE) THE ANALYSIS COULD BE PERFORMED UP TO 150 EV NEUTRON ENER-GY. THE HIGH RESOLUTION FITHE DATA. THE CAPTURE CROSS SECTIONS OF WESTION OF CAO/11/ WERE NOT INCLUDED IN THE EXPERIMENTAL DATA BASE OWING TO A SEVERE PROBLEM OF THE RENORMALIZATION OF THE DATA. THE CAPTURE CROSS SECTIONS OF WESTON WERE INCLUDED IN THE FITS BELOW 30 EV ONLY. ABOVE 30 EV THE STATISTICAL ACCURACY OF THE DATA AWAS TOO POOR AND THE TRY AND ERROR METHOD WAS USED IN A PRELIMINA-AY WORK TO OBTAIN THE CAPTURE WIDTH OF SOME STRONG CAPTURE RESON-ANCES. THE CAPTURE WIDTH OF THE OTHER RESONANCES WAS KEPT AT A CONSTANT VALUE OF 41 MEY CLOSE TO THE AVERAGE VALUE OBTAINED BY FITTING THE ENERGY RANGE BELOW 30 EV. SOME RESONANCES NOT PERTAIN-ING TO 233U WERE DISCLOSED IN THE EXPERIMENTAL DATA AND WERE IDEN-TIFIED AS 1957T RESONANCES. THE EXPERIMENTAL DATA AND WERE IDEN-TIFIED AS 1957T RESONANCES. THE EXPERIMENTAL DATA AND WERE IDEN-THE VALUES OF THE CROSS SECTIONS OF BAINED BY AXTON AT 0.0253 EV WERE INCLUDED IN ALL THE EXPERIMENTAL DATA AVAILABLE IN THE THERMAL RANGE WITH THE SMALL ERROR BARS OBTAINED BY AXTON AT 0.0253 EV WERE INCLUDED IN ALL THE EXPERIMENTAL DATA AVAILABLE IN THE THERMAL RANGE WITH THE BAL THE CARCULATED FROM THE RESO

| (RES | CALCULATION
SENDD 0.1% 300 K | AXTON
) EVALUATION |
|------------|---------------------------------|-----------------------|
| FISSION | 531.29 B | 530.70+-1.34 B |
| CAPTURE | 45.27 B | 45.62+-0.70 B |
| SCATTERING | 11.99 B | 12.19+-0.67 B |

TABLES 1 AND 2 SHOW THE AVERAGE CROSS SECTIONS CALCULATED FROM THE RESONANCE PARAMETERS COMPARED WITH THE AVERAGE EXPERIMEN-TAL DATA AND WITH AVERAGE JENDL-3, ENDF/B-VI AND JEF-2 DATA.

| TABLE 1 | FISSION CR | ROSS SECTIO | NS | | |
|---|---|--|--|---|--|
| ENERGY W
RANGE(EV) | NAGEM DERUY | WESTO BLON | S CALCU | JENDL ENI | DF6 JEF2 |
| 0.021-0.031 5
0.031-0.082 3
0.082-1.000 1
1.000-2.100 3
2.100-2.750 2
2.750-3.000 3
.000-15.00 1 | 525.6 526.7
362.9 363.5
151.3 150.9
388.8 387.7
204.4 204.6
50.1 53.4
106.2 105.6 | 526.8
363.9
150.6
391.7
207.5
51.9
104.9 | 526.5
361.7
150.1
387.9
204.6
50.2
104.3 | 528.8 523
363.9 36
149.4 149
383.0 378
205.9 198
52.9 50
103.6 10 | 3.9 520.6
1.9 359.7
9.0 148.6
8.9 382.1
8.1 198.8
0.6 50.8
1.2 101.5 |
| 0.021-15.00 1 | 134.2 133.5 | 133.5 | 132.5 | 131.7 129 | 9.1 129.5 |
| $\begin{array}{c} 15.00 - 30.00\\ 30.00 - 50.00\\ 50.00 - 75.00\\ 75.00 - 100.0\\ 100.0 - 125.0\\ 125.0 - 150.0\end{array}$ | | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccc} 0 & 95.51 \\ 0 & 40.27 \\ 9 & 40.53 \\ 0 & 36.03 \\ 9 & 36.97 \\ 9 & 20.78 \end{array}$ | $\begin{array}{ccccc} 96.49 & 91 \\ 40.19 & 38 \\ 40.79 & 35 \\ 36.58 & 33 \\ 31.78 & 29 \\ 16.30 & 22 \end{array}$ | .80 92.69
.85 39.16
.80 39.90
.36 32.74
.94 28.94
.10 26.25 |
| 15.00-150.0 | | 41.39 41.4 | 8 41.45 | 39.91 38 | .49 40.05 |
| TABLE 2 CA | APTURE CROSS | S SECTIONS | | | |
| ENERGY
RANGE(EV) | WESTON | CALCUL | JENDL | B ENDF6 | JEF2.2 |
| 0.021-0.031 | 45.17 | 44.90 | 44.82 | 2 45.40 | 45.54 |

| $\begin{array}{c} 0.031 - 0.082 \\ 0.082 - 1.000 \\ 1.000 - 2.100 \\ 2.100 - 2.750 \\ 2.750 - 3.000 \\ 3.000 - 15.00 \end{array}$ | 32.51
14.06
66.83
111.83
7.50
17.43 | 32.57
14.44
66.54
110.67
8.25
17.61 | 32.45
13.99
70.54
106.25
8.85
19.51 | 32.58
13.24
67.46
112.04
7.53
17.66 | 32.68
13.13
67.31
110.80
5.74
17.02 |
|---|--|--|--|--|--|
| 0.021-15.00 | 24.85 | 24.97 | 26.57 | 24.22 | 24.43 |
| $\begin{array}{c} 15.00 - 30.00\\ 30.00 - 50.00\\ 50.00 - 75.00\\ 75.00 - 100.0\\ 100.0 - 125.0\\ 125.0 - 150.0 \end{array}$ | 13.25
5.21
4.91
8.71
5.37
3.38 | 13.97
5.81
5.38
9.07
6.01
3.78 | 11.92
4.85
4.42
5.39
3.55
2.12 | 13.27
5.47
3.80
4.30
3.88
3.54 | 12.67
5.00
5.25
5.33
4.63
4.12 |
| 15.00-150.0 | 6.39 | 6.90 | 4.91 | 5.16 | 5.73 |
| THE EXPERI
A BACKGROUND C
ET AL./12/ AND
THE ENERGY RAN | MENTAL CAPTUR
CORRECTION ACC
RENORMALIZED
IGE 1.0 EV TO | E DATA OF
ORDING TO
TO THE OR
2.75 EV. | WESTON
THE EVA
IGINAL | WAS INCR
LUATION
VALUE OF | EASED BY
OF REYNOLDS
WESTON IN |

RESONANCE INTEGRAL FISSION

| ENERGY RANGE | THIS WORK | JENDL-3 | ENDF/B-6 | JEF-2 |
|---------------|-----------|---------|----------|--------|
| 0.5 EV-150 EV | 710.34 | 710.53 | 691.08 | 697.18 |
| 150 EV-20 MEV | | 64.25 | 63.34 | 65.29 |
| 0.5 EV-20 MEV | | 774.79 | 754.43 | 762.47 |

RESONANCE INTEGRAL CAPTURE

| ENERGY RANGE | THIS WORK | JENDL-3 | ENDF/B-6 | JEF-2 |
|---------------|-----------|---------|----------|--------|
| 0.5 EV-150 EV | 131.92 | 131.77 | 128.79 | 127.51 |
| 150 EV-20 MEV | | 6.65 | 7.58 | 7.24 |
| 0.5 EV-20 MEV | | 138.42 | 136.37 | 134.75 |

REFERENCES OF APPENDIX

| 1) | PATTENDEN ET AL.: NUCL. SCI. ENG., 17, 404 (1963) |
|-----|---|
| 2) | MOORE ET AL.: PHYS. REV., 118, 714 (1960) ` (|
| 3) | KOLAR ET AL.: 1970 HELSIŃKI, VOL.I, `387 (1970) |
| 4) | HARVEY ET AL.: 1979 KNOXVILLE, P.690 (1979) (|
| 5) | WESTON ET AL.: NUCL. SCI. ENGÍ, 34, 1`(1968) |
| 6) | WESTON ET AL.: NUCL. SCI. ENG., 42, 143 (1970) |
| 7) | BLONS ET AL.: NUCL. SCI. ENG., 51, 130 (1973) |
| 8) | DERUYTER ET AL.: NUCL. SCI. ENG., 54, 423 (1974) |
| 9) | WAGEMANS ET AL.: 1988 MITO, 91 (1988) |
| 10) | AXTON ET AL.: BCMN REPORT, GE/PH/01/86 (1986) |
| 11) | CAO ET AL.: 1970 HELSINKI. VOL.I, 419 (1970) |
| 12) | REYNOLDS ET AL.: KAPL-M-7323 (1973) |
| | |

MAT number = 9225 92-U -234 KAWASAKI EVAL-MAR87 T.WATANABE DIST-SEP89 REV2-JUL93 HISTORY 87-03 NEW EVALUATION FOR JENDL-3 WAS MADE BY T.WATANABE (KWASAKI HEAVY IND.) 87-06 COMPILATION WAS MADE BY T.NAKAGAWA (JAERI) 93-07 JENDL-3.2. MODIFIED BY T.NAKAGAWA (NDC/JAERI) MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND 456. MT=455 DELAYED NEUTRONS PER FISSION SYSTEMATICS OF TUTTLE/1/. SIX GROUP DECAY CONSTANTS WERE ADOPTED FROM BRADY ET AL./2/ MT=456 PROMPT NEUTRONS PER FISSION BASED ON THE EXPERIMENTAL DATA BY MATHER ET AL./3/ NU-P OF CF-252 SPONTANEOUS FISSION WAS ASSUMED TO BE 3.756. MF=2 RESONANCE PARAMETERS MT=251 RESONANCE PARAMETERS ; 1.0E-5 EV - 50 KEV RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 EV - 1.5 KEV PARAMETERS OF REF./4/ WERE ADOPTED AFTER MODIFICATION OF AN AVERAGE RADIATIVE WIDTH TO 0.026 EV/5/. A NEGATIVE LEVEL WAS ADDED AT -2.06 EV SO AS TO REPRODUCE THE CROSS SECTIONS AT 0.0253 EV/5/. TOTAL = 119.1 +- 1.3 B ELASTIC = 19.6 +- 1.0 B CAPTURE = 99.8 +- 1.3 B UNRESOLVED RESONANCES : 1.5 KEV - 50 KEV THE FOLLOWING PARAMETERS WERE GIVEN. <WG> = 0.026 EV/2/, <WF> = 0.0 EV, D-OBS = 10.6 EV/2/, S-0 = 0.96E-4 (CALCULATED WITH ECIS/6/), S-1 = 1.197E-4 (ADJUSTED TO THE TOTAL CROSS SECTION CALCULATED WITH ECIS/6/), R = 9.70 FM (ADJUSTED TO THE TOTAL CROSS SECTION AT 50 KEV). CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/S RESONANCE INTEGRAL 119.2 B ---ELASTIC 19.41 B ---FISSION 6.22 MB 6.72 B CAPTURE 99.75 B 632 B MF=3 NEUTRON CROSS SECTIONS BELOW 50 KEV, RESONANCE PARAMETERS WERE EVALUATED. BACKGROUND CROSS SECTIONS FOR THE FISSION WERE GIVEN IN THE UNRESOLVED RESONANCE REGION. MT=1,2,4,51-69,91,102 TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CALCULATED WITH COUPLED-CHANNEL CODE ECIS/6/ AND SPHERICAL OPTICAL AND STATISTICAL MODEL CODE CASTHY/7/. THE DEFORMED OPTICAL POTENTIAL PARAMETERS OF LAGRANGE/8/ WERE ADOPTED FOR THE ECIS CALCULATION. RO = 1.26, AO = 0.63RS = 1.26, B = 0.52= 7.72 EN ABOVE 10 MEV VSO = 6.2 BETA2 = 0.194 BETA4 = 0.071 RSO= 1.12 ASO= 0.47 THE FOLLOWING SPHERICAL OPTICAL POTENTIAL PARAMETERS FOR THE CASTHY CALCULATION WERE DETERMINED SO AS TO REPRODUCE THE TOTAL CROSS SECTION CALCULATED WITH ECIS BY USING THE ABOVE OMP

V = 41.49 - 0.1359 * EN



6) RAYNAL J.: IAEA SMR-9/8 (1970).
7) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
8) LAGRANGE C.H.: NEANDC(E)-228 (1982).
9) ELLIS-AKOVALI Y.A.: NUCL. DATA SHEETS, 40, 567 (1983). AND ENSDF AS IS 1993.
10) BEHRENS J.W. AND CARLSON G.W.: NUCL. SCI. ENG., 63, 2501977).
11) MEADOWS J.W.: NUCL. SCI. ENG., 65, 171 (1978).
12) KANDA K. ET AL.: 1985 SANTA FE, 1, 569 (1986).
13) MATSUNOBU H.: JENDL-3 U-235 EVALUATION (1987).
14) ILJIMA S. ET AL.: TO BE PUBLISHED.
15) MADLAND D.G. AND NIX J.R.: NUCL. SCI. ENG., 81, 213 (1982).

MAT number = 9228 92-U - 235 SAEI+ EVAL-MAR87 H.MATSUNOBU,K.HIDA,T.NAKAGAWA+ DIST-SEP89 REV2-AUG93 HISTORY 87-03 NEWLY EVALUATED FOR JENDL-3 BY THE FOLLOWING EVALUATORS. K.HIDA (NAIG) Y.NAKAJIMA (JAERI) T.NAKAGAWA (JAERI) MATSUNOBU (SAEI) 88-08 DATA WERE PARTLY MODIFIED TO FINAL JENDL-3 DATA. NU-BAR, UNRESOLVED RESONANCE PARAMETERS. 89-02 FP YIELDS WERE REPLACED WITH JNDC FP DECAY FILE VERSION-2. DATA WERE COMPILED IN ENDF-5 FORMAT BY T.NAKAGAWA (JAERI) 93-08 JENDL-3.2. H.MATSUNOBU (SAEI): NU-P, FISSION CROSS SECTION T.OHSAWA (KINKI UNIV.): FISSION SPECTRUM Y.KIKUCHI AND T.NAKAGAWA (JAERI): RESONANCE PARAMETERS COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY (1,452), (1,456) (2,151) (3,2), (3,18) (5,18) F=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 TOTAL NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA EVALUATED ON THE BASIS OF THE EXPERIMENTAL DATA BY KEEPIN ET AL. /1/, KEEPIN /2/, MASTERS ET AL. /3/, CONANT AND PALMEDO /4/, EVANS AND THORPE /5/, COX /6/, BESANT ET AL. /7/ AND SYNETOS AND WILLIAMS /8/. MT=456 NUMBER OF PROMPT NEUTRONS EVALUATED ON THE BASIS OF THE FOLLOWING EXPERIMENTAL DATA: BELOW 60 EV 20 EV - 500 EV GWIN ET AL./9/ 20 EV - 500 EV GWIN ET AL./10/ 0.5 KEV - 5.15 MEV GWIN ET AL./11/ 5.15 MEV - 15 MEV FREHAUT ET AL./12/ 15 MEV - 20 MEV FREHAUT ET AL./13/, HOWE /14/ THE STANDARD VALUE OF 3.756 OF CF-252 NU-P WAS USED IN THE PRESENT EVALUATION. MF = 1MF=2 RESONANCE PARAMETERS
MT=151
1) RESOLVED RESONANCES : BELOW 500 EV
REICH-MOORE PARAMETERS IN ENDF/B-VI/15,16/ WAS ADOPTED.
AVERAGE CAPTURE WIDTH OF 0.035 EV WAS INCREASED TO 0.0385 EV
IN THE ENERGY REGION ABOVE 300 EV. 2) UNRESOLVED RESONANCE PARAMETERS : 500 EV - 30 KEV THE EVALUATED TOTAL, CAPTURE AND FISSION CROSS SECTIONS WERE FITTED BY ADJUSTING SO, S1 AND FISSION WIDTH THE FISSION CROSS SECTION WAS BASED ON THE EXPERIMENTAL DATA OF WESTON AND TODD /17/. THE CAPTURE CROSS SECTION WAS CALCULATED AS (SIG-F)*ALPHA, WHERE ALPHA VALUES WERE DETERMINED FROM EXPERIMENTAL DATA OF MURADYAN ET AL. /18/ THE TOTAL CROSS SECTION WAS EVALUATED ON THE BASIS OF THE EXPERIMENTAL DATA BY UTTLEY ET AL. /19/, BOECKOFF ET AL. /20/, MICHAUDON ET AL. /21/ AND DERRIEN /22/ 2200-M/S CROSS SECTIONS AND CALCULATED RES. INTEGRALS. 2200 M/S RES. INTEG. ELASTIC 15.03 B FISSION 584.4 B 279 B CAPTURE 98.81 B 134 B 698.2 TOTAL =3 NEUTRON CROSS SECTIONS BELOW 30 KEV: NO BACKGROUND DATA FOR RESONANCE PARAMETERS ARE GIVEN. MF = 3ABOVE 30 KEV: DATA WERE EVALUATED AS FOLLOWS. MT=1____TOTAL EVALUATED ON THE BASIS OF THE EXPERIMENTAL DATA BY UTTLEY ET AL. /19/, BOECKOFF ET AL. /20/, SCHWARTZ ET AL. /23/, GREEN ET AL. /24/, FOSTER AND GLASGOW /25/, POENITZ ET AL. /26/, AND POENITZ AND WHALEN /27/. ELASTIC SCATTERING MT=2

EVALUATED ON THE BASIS OF THE EXPERIMENTAL DATA BY SMITH /28/, SMITH AND WHALEN /29/ AND KNITTER ET AL. /30/ IN THE ENERGY RANGE FROM 0.3 TO 2.3 MEV. IN THE REMAINING ENERGY RANGE IT WAS DERIVED BY SUBTRACTING SUM OF PARTIAL CROSS SECTIONS FROM TOTAL CROSS SECTION. MT=4,51-79,91,251 INELASTIC SCATTERING CROSS SECTION AND MU-BAR EVALUATED ON THE BASIS OF EXPERIMENTAL DATA AND CALCULATION WITH OPTICAL AND STATISTICAL MODELS, AND COUPLED CHANNEL THEORY TAKING INTO ACCOUNT OF DEFORMATION OF NUCLEUS. THE CALCULATED INELASTIC SCATTERING CROSS SECTIONS WERE DECREASED BY FACTOR OF 0.9 BELOW ABOUT 2 MEV SO AS TO BE IN AGREEMENT WITH SMITH ET AL. /31/. DEFORMED OPTICAL POTENTIAL PARAMETERS WERE ADOPTED FROM THE RECOMMENDATION BY HAOUAT ET AL. /32/.V = 46.4 - 0.3*EN, WS = 3.3 + 0.4*EN, VSO= 6.2 (MEV) RO = 1,26, RS = 1.26, RSO= 1.12 (FM) AO = 0.63, B = 0.52, ASO= 0.47 (FM) BETA-2 = 0.22, BETA-4 = 0.08 THE SPHERICAL OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING THE EXPERIMENTAL DATA OF THE TOTAL CROSS SECTION. V = 40.90 - 0.04*EN, WS = 6.5 + 0.25*EN, VSO= 7.0 (MEV) RO = 1.312, RS = 1.375, RSO= 1.320 (FM) A = 0.490, B = 0.454, AO = 0.470 (FM) STATISTICAL MODEL CALCULATION WITH CASTHY CODE /33/. COMPETING PROCESSES : FISSION (N,2N), (N,3N), (N,4N). LEVEL FLUCTUATION WAS CONSIDERED. L SCHEME TAKEN FROM REFS./34,35/. NO. ENERGY(KEV) SPIN-PARITY G.S. 0.0 7/2 -1 0.075 1/2 + 2 13.038 3/2 + 3 46.347 9/2 -4 51.697 5/2 + 5 81.732 7/2 + 6 103.2 11/2 -7 129.292 5/2 + 8 150.4 9/2 + 9 170.7 13/2 -10 171.378 7/2 + 11 197.1 11/2 + 12 225.40 9/2 + THE LEVEL 9/22 15/22 113/22 17/22 13/22 13/22 13/22 13/22 13/22 11/22 77/22 99/22 11/22 12 225.40 + 225.40 249.1 291.1 294.7 332.818 338.8 357.2 367.05 13 14 15 + 16 17 + 18 19 20 368.8 13/2 + 21 393.184 3/2 + 22 414.8 9/2 + 23 426.71 5/2 + 24 445.7 7/2 + 25 474.27 7/2 + 26 510.0 9/2 + 27 533.2 9/2 + 28 607.7 11/2 + 29 633.04 5/2 -CONTINUUM LEVELS ASSUMED ABOVE 650 KEV. THE LEVEL DENSITY PARAMETERS : GILBERT AND CAMERON /36/. 2Õ 368.8 + MT=16,17,37 (N,2N), (N,3N), (N,4N) EVALUATED ON THE BASIS OF THE FOLLOWING EXPERIMENTAL DATA AND CALCULATION WITH EVAPORATION MODEL. (N,2N) : FREHAUT ET AL. /37/ (N,3N) AND (N,4N) : VEESER AND ARTHUR /38/ MT=18 FISSION (N.SN) AND (N.4N) . VELSER AND ANTHOR /SG/ 18 FISSION DERIVED WITH SIMULTANEOUS EVALUATION/47/ ON THE BASIS OF THE CAPTURE CROSS SECTIONS OF AU-197 AND U-238, THE FISSION CROSS SECTIONS OF U-235, -238, PU-239, -240 AND -241 IN THE ENERGY RANGE FROM 50 KEV TO 20 MEV. RESULTS WERE ADOPTED IN THE ENERGY RANGE UP TO 13 MEV. EXPERIMENTAL DATA OF U-235 CONSIDERED IN THIS EVALUATION ARE AS FOLLOWS: PEREZ ET AL. /39/, POENITZ /40,41/, CZIRR AND SIDHU /42,43,44/, SZABO AND MARQUETTE /45/, BARTON ET AL. /46/, CANCE AND GRENIER /47,48/, CARLSON AND PATRICK /49/, KARI /50/, ADAMOV ET AL. /51/, ARLT ET AL. /52, 53/, WASSON ET AL. /54,55/, LI ET AL. /56/, MAHDAVI ET AL. /57/, CARLSON AND BEHRENS /58/, CORVI ET AL. /59/,

DUSHIN ET AL. /60/ AND WESTON AND TODD /17/. ABOVE 13 MEV, BASED ON THE EXPERIMENTAL DATA OF CARLSON ET AL./61/. MT=102 CAPTURE DERIVED FROM THE EVALUATED ALPHA VALUE AND FISSION CROSS SECTION BELOW 1 MEV. CALCULATED WITH CASTHY ABOVE 1 MEV. ALPHA VALUE WAS EVALUATED ON THE BASIS OF THE EXPERIMENTAL DATA BY HOPKINS AND DIVEN /62/, MURADYAN /18/ AND CORVI ET AL. /59/ =4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2, 51-79, 91 CALCULATED WITH CASTHY AND ECIS CODES. MT=16,17,18,37 ISOTROPIC IN THE LAB SYSTEM. MF = 4F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 CALCULATED WITH PEGASUS/63/ ON THE BASIS OF PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. MF = 5MT = 18■18 DISTRIBUTIONS WERE CALCULATED WITH THE MODIFIED MADLAND-NIX MODEL/64,65/. THE COMPOUND NUCLEUS FORMATION CROSS SECTIONS FOR FISSION FRAGMENTS (FF) WERE CALCULATED USING BECCHETTI-GREENLEES POTENTIAL/66/. UP TO 4TH-CHANCE-FISSION WERE CONSIDERED AT HIGH INCIDENT NEUTTRON ENERGIES. THE IGNATYUK FORMULA/67/ WERE USED TO GENERATE THE LEVEL DENSITY PARAME-TEDS FORMULA/67/ WERE USED TO GENERATE THE LEVEL DELOC. TERS. PARAMETERS ADOPTED: TOTAL AVERAGE FF KINETIC ENERGY = 169.9 - 171.8 MEV AVERAGE ENERGY RELEASE = 185.896 MEV AVERAGE MASS NUMBER OF LIGHT FF = 96 AVERAGE MASS NUMBER OF HEAVY FF = 140 LEVEL DENSITY OF THE LIGHT FF = 9.76 - 9.80 LEVEL DENSITY OF THE HEAVY FF = 11.34 - 11.48 RATIO OF NUCLEAR TEMPERATURE FOR LIGHT TO HEAVY FF = 0.9 - 1.05 NOTE THAT THE PARAMETERS VARY WITH THE INCIDENT ENERGY WITHIN THE INDICATED RANGE. =455 MT = 455TĂKEN FROM SAPHIER ET AL. /68/ MF=8 FISSION PRODUCT YIELD DATA MT=454 AND 459 BOTH WERE TAKEN FROM JNDC FP DECAY FILE VERSION-2 /69/. MF=12 PHOTON PRODUCTION MULTIPLICITIES (OPTION 1) GIVEN FOR THE FOLLOWING SECTIONS BELOW 369.579 KEV MT=18 FISSION THE THERMAL NEUTRON-INDUCED FISSION GAMMA SPECTRUM MEASURED BY VERBINSKI /70/ WAS ADOPTED. MT=51-69 INELASTIC SCATTERING THE PHOTON BRANCHING DATA TAKEN FROM /35/ WERE CONVERTED TO THE PHOTON MULTIPLICITIES. MT=102 CAPTURE CALCULATED WITH GNASH /71/, WHERE THE PYGMY RESONANCE WAS INTRODUCED /72/. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 NON-ELASTIC CALCULATED WITH GNASH /71/ ABOVE 369.579 KEV. VERBINSKI'S DATA /70/ WERE USED UP TO 20 MEV. 4 PHOTON ANGULAR DISTRIBUTIONS MT=3,18,51-69,102 ISOTROPIC DISTRIBUTIONS WERE ASSUMED. MF = 14CONTINUOUS PHOTON ENERGY SPECTRA MF=15 MT=3,102 CALCULATED WITH GNASH /71/ MT = 18EXPERIMENTAL DATA BY VERBINSKI /70/ WERE ADOPTED. REFERENCES ERENCES KEEPIN G.R. ET AL.: J. NUCL. ENERGY, 6, 1 (1957). KEEPIN G.R.: LA-4320 (1969). MASTERS C.F. ET AL.: NUCL. SCI. ENG., 36, 202 (1969). CONANT J.F. AND PALMEDO P.F.: NUCL. SCI. ENG., 44, 173(1971). EVANS A.E. AND THORPE M.M.: NUCL. SCI. ENG., 50, 80 (1973). COX S.A.: ANL/NDM-5 (1974). BESANT C.B. ET AL.: BRITISH NUCL. ENERGY SOC., 16, 161(1977). SYNETOS S. AND WILLIAMS J.G.: INDC(NDS)-107, 183 (1979). GWIN R. ET AL.: NUCL. SCI. ENG., 87, 381 (1984). Ξí 4 6 81 91

GWIN R. ET AL: ORNL-TM-6246 (1978). GWIN R. ET AL: NUCL. SCI. ENG. 94, 365 (1986). FREHAUT J. ET AL.: EXFOR 20506.002 (1980). HOWE R.E.: NUCL. SCI. ENG. 86, 157 (1984) UEAL L.C. ET AL.: NUCL. SCI. ENG. 109, 1 (1991). WESTON L.W. ET AL.: ENDF. VI, REVISION 2, MAT=9228 (1993). WESTON L.W. ET AL.: INDF. VI, REVISION 2, MAT=9228 (1993). WESTON L.W. ET AL.: INDF. VI, REVISION 2, MAT=9228 (1993). WESTON L.W. ET AL.: INDF. VI, REVISION 2, MAT=9228 (1993). WESTON L.W. ET AL.: 1996 PARIS CONF., 488 (1979). UTLEY C. A. ET AL.: 1996 PARIS CONF., VOL.1, P. 165 (1966). BOECKOFF.K.H. ET AL.: 1996 PARIS CONF., VOL.1, P. 165 (1966). BOECKOFF.K.H. ET AL.: 1979 KNOXVILLE CONF. 488 (1979). UTLEY C. A. ET AL.: NUCL. SCI. ENG. 78, 333 (1981). POENITZ W.P. AND WALEN J.F.: ANL/NDM-80 (1983). SWITH A.B.: NUCL. SCI. ENG. 78, 333 (1981). POENITZ W.P. AND WHALEN J.F.: ANL/NDM-80 (1983). SWITH A.B.: AND WHALEN J.F.: ANL/NDM-80 (1983). SWITH A.B.: AND WHALEN J.F.: ANTLYNDM-80 (1982). IGARASI S. AND FUKAHORI J.: JAERI 1321 (1991). SWITHA A.B. ET AL.: NUCL. SCI. ENG. 81; 491 (1982). IGARASI S. AND FUKAHORI J.: JAERI 1321 (1991). SUMITH A.B. ET AL.: NUCL. SCI. ENG. 74 (1983). GLEBRER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES, 7TH ED. SCHWORAK M.R.: NUCL. SCI. ENG. 74, 29 (1980). GLEBRER C.M. AND SHIRLEY V.S.I. TABLE OF ISOTOPES, 7TH ED. SCHWORAK M.R.: NUCL. SCI. ENG. 55, 203 (1974). POENITZ W.P. INUCL. SCI. ENG. 74, 29 (1980). GLEBRER C.M. AND SHIRLEY V.S.I. ENG. 55, 203 (1974). POENITZ W.P.: NUCL. SCI. ENG. 66, 363 (1977). CZIRR J.B. AND SIDHU G.S.: NUCL. SCI. ENG. 56, 333 (1976). SZABOI A.B. AND MATHER E.D.: 1978 HARWELL CONF., P.1054(1978). PEREZ R.B. ET AL.: NUCL. SCI. ENG. 60, 389 (1977). CZIRR J.B. AND SIDHU G.S.: NUCL. SCI. ENG. 68, 1977 (1978). CANCE M. AND GRENIER G.: NUCL. SCI. ENG. 60, 383 (1976). SZABOI A.B. AND SHDHU G.S.: NUCL. SCI. ENG. 60, 383 (1976). SZABOI A.B. AND SHDHU G.S.: NUCL. SCI. ENG. 60, 380 (1977). CANCE M. AND GRENIER G.: NUCL. SCI. ENG. 68, 1977 (1978). CANCE M. AND GRENIER G.: NUCL. SCI. ENG. 68, 1977 (1978) $11) \\ 12)$ 15) 16) 17) 181 19) 20) 21) 22) 23) 23) 24) 25) 40) 41 42 43 44 45 46 47 48) 49) 50) 51) 52) 53) 54) 55) 55) 56) 57) 58) 59) ĞŌ) 61) 62) 63) 64) 65) 66) 1969) (1969). IGNATYÜK A.V.: SOV. J. NUCL. PHYS., 29, 450 (1979). SAPHIER D. ET AL.: NUCL. SCI. ENG., 62, 660 (1977). TASAKA K. ET AL.: JAERI 1320 (1990). VERBINSKI V.V. ET AL.: PHYS. REV., C7, 1173 (1973). YOUNG P.G. ET AL.: LA-6947 (1977). HIDA K.: JAERI-M 85-035, P. 166, (1985). 67) 68) 69) 70) 71)

MAT number = 9231 92-U - 236 NAIG EVAL-MAR88 T.YOSHIDA DIST-SEP89 REV2-DEC93 HISTORY HISTORY 79-03 NEW EVALUATION FOR JENDL-2 WAS MADE BY T.YOSHIDA(NAIG). 86-12 JENDL-2 DATA WERE CRITICALLY REVIEWED. 88-03 JENDL-2 DATA WERE REVISED TO MAKE JENDL-3 ON THE BASIS OF THE 86-12 REVIEW. NEW RUSSIAN MEASUREMENTS (1982- 1986) WERE FULLY ADOPTED, RESULTANTLY LEADING TO A NEARLY 30 PER-CENT REDUCTION OF CAPTURE CROSS-SECTION ABOVE 1.5 KEV. SUB-THRESHOLD FISSION CURVE WAS INTRODUCED BETWEEN 1.5 KEV AND 700 KEV. UNKNOWN GAMMA-F WAS ASSUMED TO BE 0.354 MILLIEV SUB-THRESHOLD FISSION CURVE WAS INTRODUCED BETWEEN 1.3 AND 700 KEV. UNKNOWN GAMMA-F WAS ASSUMED TO BE 0.354 MILLI-EV. DATA WERE COMPILED BY T.NAKAGAWA (JAERI). 90-07 FP YIELD DATA WERE MODIFIED. 90-10 MF=5, MT=16,17,91: SPECTRA AT THRESHOLD ENERGIES WERE MODIFIED. 93-12 JENDL-3.2. MODIFIED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 ******** (1,452), (1,455), (1,456) * * * * * MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT'S 455 AND 456. MT=455 DELAYED NEUTRONS PER FISSION SIX GROUP DECAY CONSTANTS WERE ADOPTED FROM BRADY ET AL./1/ NU-D BELOW 6 MEV WAS ADOPTED FROM GUDKOV ET AL./2/, AND THAT ABOVE 7 MEV FROM BOBKOV ET AL./3/, RESPECTIVELY. MT=456 PROMPT NEUTRONS PER FISSION TAKEN FROM MALINOVSKII'S PAPER /4/. ABOVE 5.9 MEV, THEIR RECOMMENDATION WAS EXTRAPOLATED. RECOMMENDATION WAS EXTRAPOLATED. F=2 MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 EV TO 1.5 KEV RES. ENERGIES AND GAM-N(FOR GAM-N GREATER THAN 0.1*GAM-G) : CARRARO /5/ GAM-N (FOR GAM-N SMALLER THAN 0.1*GAM-G) : MEWISSEN /6/ GAM-G : MEWISSEN /6/, WHEN NOT GIVEN, MEAN VALUE WAS TAKEN. GAM-F : THEOBALD /7/. AVERAGE GAM-G = 23.0 MILLI-EV AVERAGE GAM-F = 0.354 MILLI-EV A NEGATIVE RESONANCE WAS INTRODUCED TO REPRODUCE THE 2200-M/S CAPTURE CROSS SECTION OF (5.11+-0.21) BARNS RECOMMENDED IN BNL-325 4TH EDITION. UNRESOLVED RESONANCES : 1.5 KEV TO 40 KEV PARAMETERS WERE DETERMINED TO REPRODUCE TOTAL AND CAPTURE CROSS SECTIONS CALCULATED WITH CASTHY AND EVALUATED FISSION CROSS SECTION. OBTAINED PARAMETERS ARE: S0 = 0.906E-4, S1 = ENERGY DEPENDENT (1.8E-4 - 2.7E-4) GAM-G = 0.023 EV, GAM-F = ENERGY DEPENDENT R = 9.36 FM, D-OBS ECTIONS AND DES INTECDALS MF=2CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS TOTAL ELASTIC FISSION CAPTURE 13.69 B 8.337 B 0.0613 B 5.295 B -7.77 B 346. B F=3 NEUTRON CROSS SECTIONS BELOW 1.5 KEV, ALL BACKGROUND CROSS SECTIONS ARE ZERO. ABOVE 1.5 KEV, DATA WERE EVALUATED AS FOLLOWS. IN THE ENERGY RANGE FROM 1.5 TO 40 KEV, UNRESOLVED RESONANCE PARAMETERS WERE EVALUATED AND BACKGROUND CROSS SECTION WAS GIVEN TO ELASTIC MF=3 SCATTERING. MT=1,2,4,51-79,91,102,251 SIG-T,SIG-EL,SIG-IN,SIG-C,MU-BAR COUPLED CHANNEL AND STATISTICAL MODEL CALCULATIONS WERE MADE WITH ECIS /8/ AND CASTHY CODES /9/, RESPECTIVELY. THE DEFORMED OPTICAL POTENTIAL PARAMETERS AFTER HAOUAT AND LAGRANGE /10/: VR =49.8 - 16*SY - 0.3*EN WS = 5.3 - 8*SY + 0.4*EN (EN .LT. 10 MEV), = 9.3 - 8*SY (EN .GE. 10 MEV), VSO= 6.2 VS0= 6.2 ΜΕΥΊ WHÉRE SY=(N-Z)/A R=1.26, RS=1.26, RS0=1.12 (FM),
A=0.63, AS=0.52, ASO=0.47 (FM). THE SPHERICAL OPTICAL POTENTIAL PARAMETERS FOR THE STATISTI-CAL MODEL CALCULATION WITH CASTHY: VR =40.8 - 0.05*EN, (MEV), WS = 6.5 + 0.15*EN, (MEV), VSO= 7.0 (MEV), R=1.32, RS=1.38, RSO=1.32 (FM), A=0.47, AS=0.47, ASO=0.47 (FM). COMPETING PROCESSES : FISSION, (N,2N) AND (N,3N) LEVEL FLUCTUATION WAS CONSIDERED. THE GAMMA-RAY STRENGTH FUNCTION WAS DETERMINED SO THAT THE CALCULATED CAPTURE CROSS SECTION REPRODUCED THE MEASURED VALUE OF 0.85 BARNS /11/ AROUND 10 KEV. THE LEVEL SCHEME TAKEN FROM REF. /12/. NO. ENERGY(MEV) J-PARITY NO. ENERGY(MEV) J-PARITY GS 0.0 0 + 1 0.04524 2 + 2 0.14948 4 + 3 0.30979 6 + 4 0.52225 8 + 5 0.68757 1 -6 0.7442 3 - 7 0.7828 10 + 8 0.8476 5 - 9 0.91916 0 + 10 0.9581 2 + 11 0.9604 2 + 12 0.9670 1 - 13 0.9880 2 -14 1.0014 3 + 15 1.0020 7 -16 1.0356 3 - 17 1.0512 4 + 02274 3 + 3 -4 -15 17 1.00141.03561.05291.0020 1.0512 1.0587 16 19 18 4 + 4 + 12 + 5 + 3 -1.0661 1.0862 1.1044 1.1267 20 22 24 26 21 23 25 27 1.0700 422 + 1.1110 3 1.1470 + 20 1.1207 0 + 27 1.1470 3 + 28 1.1494 3 - 29 1.1640 6 -CONTINUUM LEVELS ASSUMED ABOVE 1.17 MEV. THE GROUND STATE, 1-ST AND 2-ND EXCITED LEVELS WERE COUPLED IN THE ECIS CALCULATION. MT=16,17 (N,2N) AND (N,3N) CALCULATED WITH THE PEGASUS CODE /13/. MT=18...FISSION MT=18 FISSION EVALUATED ON THE BASIS OF MEASURED DATA OF U-236/U-235 /14,15/. TO GET ABSOLUTE VALUE MATSUNOBU'S EVALUATION /16/ FOR U-235(N,F) WAS EMPLOYED. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51,52 CALCULATED WITH ECIS AND CASTHY MT=53-79,91 CALCULATED WITH CASTHY. MT=16,17,18 ISOTROPIC DISTRIBUTION IN THE LAB. SYSTEM. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS 16,17,91 CALCULATED WITH PEGASUS. 18 MAXWELLIAN FISSION SPECTRUM. TEMP ESTIMATED FROM Z**2/A VALUES /17/. MF = 5MT=16,17,91 MT=18 TEMPERATURE WAS MF=8 FISSION PRODUCT YIELDS DATA MT=454 INDEPENDENT YIELDS MT=459 CUMULATIVE YIELDS BOTH WERE TAKEN FROM JNDC FP DECAY DATA FILE VERSION-2/18/. BOTH WERE TAKEN FROM JNDC FP DECAY DATA FILE VERSION-2/187.
REFERENCES

M.C. BRADY AND T.R. ENGLAND: NUCL. SCI. ENG., 103 (1989) 129.
A.N. GUDKOV ET AL.: ATOMNAYA ENERGIYA, 66 (1989) 100.
E.YU. BOBKOV ET AL.: ATOMNAYA ENERGIYA, 67 (1989) 408.
V.V. MALINOVSKII ET AL.: ATOMNAYA ENERGIYA, 67 (1989) 408.
V.V. MALINOVSKII ET AL.: ATOMNAYA ENERGIYA, 53 (1982) 83.
G. CARRARO, ET AL.: NUCL. PHYS., A275 (1976) 333.
L. MEWISSEN, ET AL.: 1975 WASHINGTON, 729 (1975).
J.P. THEOBALD: NUCL. PHYS., 181 (1972) 637.
J. RAYNAL: IAEA SMR-9/8 (1970).
S. IGARASI AND T. FUKAHORI: JAERI 1321(1991).
CITED BY P.G. YOUNG IN PROC. SPECIALISTS' MTG ON USE OF OPTICAL MODEL, PARIS, NEANDC - 222 U (1986)
A.A. BERGMAN: ATOMNAYA ENERGIYA, 52 (1982) 409.
O.T. GRUDZEVICH ET AL.: IAEA INDC(CCP) -220/L (1984)
A.N. GUDKOV: ATOMNAYA ENERGIYA, 61 (1986) 379
M.R. SCHMORAK: NUCL. DATA SHEETS, 20 (1977) 192.
S. IIJIMA ET AL.: JAERI-M 87-025, 337 (1987).
J.W. BEHRENS AND C.W. CARLSON: NUCL. SCI. ENG., 63 (1977) 250.
J.W. MEADOWS: NUCL. SCI. ENG., 63 (1977) 250.
J.W. MEADOWS: AUCL. ATAL: SHEETS, 20 (1977).

M. A. SUMITH ET AL.: ANL/NDM-50 (1979).
K. TASAKA ET AL.: JAERI 1320 (1990). MAT number = 9234 92-U - 237 JAERI EVAL-MAR93 T.NAKAGAWA DIST-MAR94 HISTORY 93-03 NEW EVALUATION WAS MADE FOR JENDL-3.2. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 TOTAL NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA DETERMINED FROM SYSTEMATICS BY TUTTLE/1/, BENEDETTI/2/ AND WALDO ET AL./3/ DECAY CONSTANTS WERE TAKEN FROM THE EVALU-ATION OF BRADY AND ENGLAND/4/. MT=456 NUMBER OF PROMPT NEUTRONS HOWERTON'S SYSTEMATICS/5/. MF = 1MF=2RESONANCE PARAMETERS $M\bar{T} = 151$ MT=151
1) RESOLVED RESONANCE PARAMETERS: MLBW (1.0E-5 - 200 EV) BELOW 45 EV, HYPOTHETICAL RESONANCES WERE GENERATED FROM FISSION WIDTH OF 0.004 EV, S0 OF 1.0E-4 AND LEVEL SPACING OF 3.5 EV, AND ADJUSTED TO REPRODUCE THERMAL CROSS SECTIONS. ABOVE 46 EV, PARAMETERS WERE ESTIMATED FROM FISSION-AREA DATA MEASURED BY MCNALLY ET AL./6/
2) UNRESOLVED RESONANCE PARAMETERS: 200 EV - 30 KEV OBTAINED BY FITTING TO CAPTURE AND FISSION CROSS SECTIONS WITH ASREP/7/. S0 AND S2 = (0.97 - 1.02)E-4, S1 = (1.95 - 2.04)E-4, S0 AND S2 = (0.97 - 1.02)E-4, S1 = (1.95 - 2.04)E-4, GAMMA-F = (0.006 - 0.070)EV, GAMMA-G = 0.035EVR = 9.668FMCALCULATED THERMAL CROSS SECTIONS AND RES. INTEGRAL (BARNS) 0.0253 EV RESONANCE INTEGRAL TOTAL 478.5 -ELASTIC 24.39 -FISSION 1.70 48.7 CAPTURE 1080 452.4 NEUTRON CROSS SECTIONS BELOW 200 EV, CROSS SECTIONS WERE REPRESENTED WITH RESOLVED RESONANCE PARAMETERS. ABOVE 200 EV, THEY WERE EVALUATED AS FOLLOWS, AND THE UNRESOLVED RESONANCE PARAMETERS WERE GIVEN SO AS TO REPRODUCE THE CROSS SECTIONS IN THE ENERGY RANGE FROM 200 EV TO 30 KEV. MF = 31 TOTAL CROSS SECTION CALCULATED FROM THE OPTICAL MODEL WITH CASTHY/8/. PARAMETERS ARE LISTED IN TABLE 1. MT = 1MT= 2 ELASTIC SCATTERING CROSS SECTION TOTAL - SUM OF PARTIAL CROSS SECTIONS MT= 16, 17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED FROM A FORMULA GIVEN BY SAGEV AND CANER/9/. THE REACTION CROSS SECTIONS CALCULATED WITH CASTHY WAS ADOPTED AS THE NON-ELASTIC SCATTERING CROSS SECTION. 18 FISSION CROSS SECTION CROSS SECTION OF 2.5 B AT 200 EV WAS ASSUMED FROM THE DATA OF MCNALLY ET AL./6/ CROSS SECTION AT 100 KEV WAS ASSUMED TO BE 0.6 B. ABOVE 5 MEV. A SIMPLE FORMULA BY BYCHKOV ET AL./9/ WAS USED. EXPERIMENTAL DATA OF CRAMER AND BRITT/10/ AND SYSTEMATICS/11/ WERE ALSO CONSIDERED. MT= 18 MT= 4, 51-79, 91 INELASTIC SCATTERING CROSS SECTION CALCULATED WITH CASTHY (OPTICAL AND STATISTICAL MODEL). PARAMETERS USED ARE LISTED IN TABLES 1, 2 AND 3. THE LEVEL SCHEME WAS TAKEN FROM EVALUATION BY ELLIS-AKOVALI/12,13/. 102 CAPTURE CROSS SECTION CALCULATED WITH CASTHY. AVERAGE CAPTURE WIDTH AND LEVEL SPACING WAS ASSUMED TO BE 0.035 EV AND 3.5 EV, RESPECTIVELY. DIRECT AND SEMI-DIRECT CAPTURE WAS CALCULATED FROM A SIMPLE FORMULA OF BENZI AND REFF0/14/. MT= 102 251 MU-L CALCULATED WITH CASTHY MT= 251

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT= 2, 51-79, 91 CALCULATED WITH CASTHY

MT=16, 17, 18 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 5MT=16, 17, 91 EVAPORATION SPECTRA OBTAINED FROM THE LEVEL DENSITY PARAMETERS WERE GIVEN. MT=18 EVAPORATION SPECTRA. TEMPERATURE WAS DETERMINED FROM SYSTEMATICS BY SMITH ET AL./15/ OPTICAL POTENTIAL PARAMETERS DETERMINED BY MURATA/16/ EXCEPT A CONSTANT TERM OF V THAT WAS SELECTED SO AS TO REPRODUCE SO OF 1.0E-4. TABLE 1 $\begin{array}{l} v = 40.5 - 0.05^{*}E & (MEV) \\ wS = 6.5 + 0.15^{*}E & (MEV) \\ VSO = 7.0 & (MEV) \\ RO = RSO = 1.32, RS = 1.38 & (FM) \\ A = B = ASO = 0.47 & (FM) \end{array}$ TABLE 2 LEVEL SCHEME OF U-237 /12,13/ - - -NO. ENERGY(MEV) SPIN-PARITY -----_ _ _ _ _ _ _ _ _ _ _ _ . G.S 1 0.0 1/2 +0.01139 0.05630 0.08286 + ż + 3 + $\begin{array}{c} 0.08286\\ 0.15996\\ 0.20419\\ 0.2740\\ 0.3160\\ 0.42615\\ 0.4820\\ 0.54062\\ 0.55498\\ 0.57801\\ 0.66427 \end{array}$ 4 56789 + + + -10 11 12 13 14 15 - $\begin{array}{c} 0.66427\\ 0.66645\\ 0.67759\end{array}$ ++++ $\begin{array}{c} 0.67759\\ 0.69765\\ 0.72045\\ 0.73434\\ 0.75816\\ 0.83245\\ 0.84694\\ 0.8650\\ 0.87215\\ 0.89343\\ 0.9034 \end{array}$. + -+ + + + 0.9034 0.9057 0.9094 0.9110 0.9206 + 28 29 -+ LEVELS ABOVE 0.94785 MEV WERE ASSUMED TO BE OVERLAPPING. TABLE 3 LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON FORMULA, BASED ON THE EXCITED LEVELS GIVEN IN ENSDF AND RESONANCE LEVEL SPACINGS /17/.
 PAIRING A(1/MEV)
 PAIRING T(MEV)
 SPIN-CUTOFF ENERGY(MEV)
 F. (MEV**0.5)

 5
 31.4
 0.39
 0.69
 31.55

 6
 30.42
 0.39
 1.18
 30.752

 7
 31.6
 0.37
 0.69
 31.431

 8
 30.1
 0.38
 1.12
 20.431
 EX(MEV) - - - - - - - -U-235 U-236 U-237 U-238 4.1984 4.5349 3.807 4.227 REFERENCES 1) R.J.TUTTLE: INDC(NDS)-107/G+SPECIAL, P.29 (1979). 2) G.BENEDETTI, ET AL.: NUCL. SCI. ENG., 80, 379 (1982). 3) R.WALDO ET AL.: PHYS. REV., C23, 1113 (1981). 4) M.C.BRADY AND T.R.ENGLAND: NUCL. SCI. ENG., 103, 129 (1989). 5) R.J.HOWERTON: NUCL. SCI. ENG., 62, 438 (1977). 6) J.H.MCNALLY ET AL: PHYS. REV., C9, 717 (1974). 7) Y.KIKUCHI: UNPUBLISHED.

8) S.IGARASI AND T.FUKAHORI: JAERI 1321 (1991).
9) V.M.BYCHKOV ET AL.: INDC(CCP)-184/L (1982).
10) J.D.CRAMER AND H.C.BRITT: NUCL. SCI. ENG., 41, 177 (1970).
11) J.W.BEHRENS AND R.J.HOWERTON: NUCL. SCI. ENG., 65, 464 (1978).
12) Y.A.ELLIS-AKOVALI: NUCLEAR DATA SHEETS, 49, 181 (1986).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC, AS OF JAN. 1993.
14) V.BENZI AND G.REFFO: CCDN-NW/10 (1969).
15) A.B.SMITH ET AL.: ANL/NDM-50 (1979).
16) H.MATSUNOBU ET AL.: PROC. IN. CONF. ON NUCLEAR CROSS SECTIONS FOR TECHNOL., KNOXVILLE, 1979, P.715 (1980).
17) S.F.MUGHABGHAB: NEUTRON CROSS SECTIONS, VOL.1, PART A, ACADEMIC PRESS (1984).

| MAT number = 9237
92-U -238 KYU,JAERI+ EVAL-APR87 Y.KANDA ET
DIST-SEP89 REV2-MAR94 | AL. |
|--|--|
| 87-01 SIMULTANEOUS EVALUATION FOR FISSION A
SECTIONS WAS COMPLETED IN THE ENERGY
87-04 OTHER QUANTITIES WERE EVALUATED BY
Y. KANDA AND Y. UENOHARA (KYUSHU UN
ABOVE RESONANCE REGION.
T. NAKAGAWA (JAERI) : RESOLVED RESO
BACKGROUND CROSS SECTIONS.
K. HIDA (NAIG) : DATA FOR GAMMA-RAY
88-03 DATA OF TOTAL, ELASTIC, INELASTIC (MT | ND CAPTURE CROSS
RANGE ABOVE 50 KEV.
NIV.): MF'S = 3, 4 AND 5
DNANCE PARAMETERS AND
Y PRODUCTION.
=59,60) AND CAPTURE |
| 89-03 DATA OF TOTAL, ELASTIC, INELASTIC AND
WERE MODIFIED. UNRESOLVED RESONANCE
MODIFIED. FP YIELDS WERE ADDED.
94-03 JENDL-3.2. | O CAPTURE CROSS SECTIONS
PARAMETERS WERE ALSO |
| RELASTIC SCATTERING AND (N,3N) CROSS
BY Y.KANDA AND T.KAWANO (KYUSHU U
RESOLVED RESONANCE PARAMETERS MODIFIE
UNRESOLVED RESONANCE PARAMETERS MODIF
FISSION SPECTRA CALCULATED BY T.OHSAW
COMPILED BY T.NAKAGAWA (NDC/JAERI) | A SECTIONS RE-EVALUATED
INIV.)/1/
E BY T.NAKAGAWA(JAERI)
TED BY Y.KIKUCHI(JAERI)
A(KINKI UNIV.) |
| ***** MODIFIED PARTS FOR JENDL-3.2
(2,151) RESOLVED AND UNRESOLVE
UP TO 150 KEV
(3,2), (3,4), (3,17), (3,51-91)
MAINLY INELASTIC SCATT | ED RESONANCE PARAMETERS |
| (5,18)
(5,91)
(5,91)
(5,91)
(12,51-57)
(13,3), (15,3), (12,102), (15,102)
WAS CHANGED TO 934.74 | DERING MULTI-CHANCE
COMPOUND PROCESS ADDED.
DEVEL SCHEME.
OWEST ENERGY OF MT=3
KEV |
| MF=1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DIRECTORY RE
MT=452 NUMBER OF NEUTRONS PER FISSION
SUM OF MT'S= 455 AND 456
MT=455 DELAYED NEUTRON DATA
TAKEN FROM REF./2/.
MT=456 NUMBER OF PROMPT NEUTRONS PER FIS
TAKEN FROM EVALUATION BY FREHAUT /3/. | CORDS |
| <pre>MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE
1) RESOLVED RESONANCE PARAMETERS FOR MLBW
(RESOLVED RESONANCE REGION = 1.0E-
PARAMETERS WERE ADOPTED FROM JEF-2 EV
ENERGY RANGE WAS DIVIDED INTO 10 INTE
HYPOTHETICAL RESONANCES OUTSIDE EACH
OF THE HYPOTETICAL RESONANCES WERE DE
SAMMY/5/.</pre> | PARAMETERS
/ FORMULA
5 EV TO 10 KEV)
/ALUATION /4/ AND THE
:RVALS BY ASSUMING
INTERVAL. PARAMETERS
:TERMINED BY MEANS OF |
| 2) UNRESOLVED RESONANCE PARAMETERS
(UNRESOLVED RESONANCE REGION = 10
PARAMETERS WERE OBTAINED WITH THE PAR
ASREP/6/ SO AS TO REPRODUCE THE CROSS
THIS ENERGY REGION. | KEV TO 150 KEV)
RAMETER FITTING CODE
S SECTIONS EVALUATED IN |
| 2200-M/S CROSS SECTIONS AND CALCULATED R
2200 M/S(B) RES.
TOTAL 12.077
ELASTIC 9.360
FISSION 11.8E-6 1
CAPTURE 2.717 277 | RESONANCE INTEGRALS.
INTEG.(B)
72 |
| MF=3 NEUTRON CROSS SECTIONS
BELOW 10 KEV, NO BACKGROUND CROSS SECT
ABOVE 10 KEV, CROSS SECTIONS WERE EVAL
THEY WERE REPRESENTED WITH THE UNRESOL
PARAMETERS EXCEPT THE FISSION CROSS SE | TIONS WERE GIVEN.
UATED AS FOLLOWS, AND
VED RESONANCE
CTION. |
| MT=1 TOTAL
THE SAME AS JENDL-2 WHICH WERE BASED O
EXPERIMENTAL DATA.
BELOW 500 KEV: UTTLEY ET AL./7/, WH | ON THE FOLLOWING
HALEN ET AL./8/. |



| | | | 3
3
3
3 | 0
1
2
3 | | | 2.5
3.0
3.5
4.0 | | | | | | | | | | | | | | | | | | |
|----|-----------------------|---|--|--|--|--------------------------------|---|--|-------------------------------------|-------------------------------------|--|--------------------------------------|------------------------------|----------------------------------|----------------------------|---------------------------------------|--|---------------------------------|---|--------------------------------------|-----------------------------------|---------------------------------|--|----------------------------------|-----------------------|
| | MT= | =16 (
SMOOT
ET AL
AL./2 | (N,2
H C
./2
9/ | N)
ROS
8/
AB(| SS
BE
OVE | SE(
LOV
15 | CTIC
V 15
Me | DN
5 M
EV. | WAS
EV | S E
, <i>A</i> |)ET
AND | E R
V | RM I
VEE | NE
SE | D
R | ON
ET | TH
AL | E
./ | BA
25 | SI
/ | S (
Ani | DF | FR
KAR | EHAU
IUS | JT
ET |
| | MT= | =17 (
BASED
THAT
AND I | N,3
ON
CON
NEL | N)
VI
SIS
AS | EES
STE
TIC | ER
NCN
S(| ET
Y MI
CATI | AL
IGH
FER | ./:
T I
I N (| 30/
3E
G (| ,
KE
CRO | AB
PT
SS | 80V
A
S S | E
MO
EC | 16
NG
TI | ME
FI
ONS | EV,
ISS
S. | RIO | ΕN
N, | OR
C | MAI
AP | L I I
T U I | ZED
RE, | S0
(N | ,2N) |
| | MT: | =18 F
BELOV
100 -
ABOVE | ISS
000
000
000
000
000
000
000
000
000 | 101
0
FII
DB(
0
C01
36 | N
KEV
KEV
CRG
CRG
NSI
, 38 | PO
ET
DEF
, 39 | TAP
EVA
ET
RES
RINO
9,40 | (EN
ALU
AL
SUL
GUL
G
T | FI
ATI
/34
TS
HE
1,4 | RON
ED
/32
4/
E>
42, | / E
ON
2/,
AN
S
(PE
43 | XP
B
D
IM
RI
,4 | PER
HEB
ME
ME
ME | IM
RE
AD
TA
NT
45 | EN
NS
NS
NE
AL | TAL
IS
AN
S
D
D
6,2 | - D
OF
10
35
35
35
47/ | AT
CA
CA
VA | A
HE
RL
6/ | /3
D
SO
ÅT
RE | 1/
AT/
N
ION
FS | 4 (
/ 3
/ 3 | 0F
3/,
/37
33, | / M/
34, | ADE |
| | MT: | =102
BELOW
MEASL
TAKEN
MEASL
MOXON
/52/. | CAP
30
JRED
JRED
JREM
JREM
A /5 | TUI
OM
IEN
O/ | REV
YKEV
JE
TS
FIG | AZA
NDL
BY
RIC
H E | EVAL
AKOV
2
POE
CKE
ENEF | UA
VE
WH
ENI
ET
RGI | TIC
TZ
TZ
AI
ES | DN
AL.
H V
/ 2
L. | WA
/4
VER
47/
/5
SLI | S /
E
1 /
G H | , MA
DE
PA | IN
A
TE
ND
MO | LY
BO
RM
TK
DI | BA
VE
INE
IN
ENL | ASE
30
ED
AN
OV | D
MA
D
E
I
O | ON
KE
SH
SH
N | U
V
L
Y
E
R
W
A | HE
D/
FF
MAN
POE
S | D
AT
ROI
N
EN | ATA
A W
M T
/49
ITZ
DE. | ERE
HE
/, | |
| | MT= | =251
CALCU | MU-
JLAT | E D | BAR
FR | ОМ | THE | ΞA | NGI | JLA | ٨R | DI | SТ | RI | BU. | TIC | ONS | I | Ν | MF | =4 | , I | MT= | 2. | |
| ΜF | =4
MT= | ANGL
=2 | JLAR | D | IST | RIE
Cal | | | S (
ED | DF
WI | SE
TH | C O
E |) N D
E C I | AR
S/ | Y
53 | NEl
/, | JTR
CA | ON
ST | S
HY | / 5 | 4/ | A | ND | | |
| | MT=
MT= | =51,52
=53-64 | 2
,66 | ,6 | 7,6 | ČĂI
9-7
ÇAI | _CŬI
72,7 | AT
74
AŤ | ED
75
ED | i w`
۱ | TH
TH | E | C I | S8
S8 | 8/
8, | 15/
H <i>A</i> | ′.
AUS | ER | - F | ES | HB/ | ACI | H - M | OLD/ | AUER |
| | MT: | =65,68 | 3,73
7 1 0 | ,70 | 6,7
1 | | -M)
_CUL | | EDI
ED | ΥΥ.
WI | TH | H | IEM | T | ΗĘ | ORY | (. ₋ | | | ۸ D | c | | отг | м | |
| MF | ™⊺=
=5 | ENEF | , 18
ÇGY | ,9
D <u>I</u> | STR | IBU | J <u>T</u> I(| NS | | E | | 90
0 N | ID A | RY | N | EUT | r i | NS | | AB. | | 51 | 51E | IVI . | |
| | M T =
MT =
MT = | =16,17
=91
=18 | | Ë, | ALC | ULA | ATE |) W | | | SNA | M
SH | 1/5 | 6/ | | | | | | | | | | | |
| | | DISIF
MODEL
FOR F
GREEN
CONSI
FORMU
PARAM | LEE
JLEE
JLA/ | 10
10
50
50
80
80
80 | DNS
B/.
POT
AT
/ W | | ERE
THE
GMEN
TTAL
TGH
E US | CA
CO
NTS
/5
IN
SED | LC(
MP(
(1
9/
CII
T(| JLA
DUN
FF)
DEN
DEN | ND
W
UP
NT
GEN | D
E
R
N
E
R
E
R | | IH
EU
CA
4T
TR
E | S
LC
H-
ON
TH | HE
FOF
ULA
CHA
EN
E | MO
RMA
ATE
ANC
AER
LEV | DI
DE-
GI | FI
ON
US
FI
ES | ED
C
IN
SS
EN | ROS
G E
ION
TH
SI | AD
SS
BE
N
HE
TY | LAN
SE
CHE
WER
IG | D-N
CTIC
TTI-
E
NATY | IX
DNS
-
YUK |
| | | PAF | AME
TO
AV
AV
AV
LE
RA | TEI
ER
ER
VEI
VEI | RS
AGE
AGE
AGE
D
C
O
O | ADC
VEF
MA
ENS
F | DPTE
RAGE
NER(
ASS
ASS
ASS
ASS
ASS
ASS
ASS
ASS
ASS
AS | D:
F
NU
NU
(O
(O
(O | F I
REI
MBI
F -
R | | | | E
IEA
HT
VY | NE
VY
F
RE | RG
F
F
F | Y =
F =
F =
F = | = 1
= 9
= 1
= 1
= 1 | 67
86
9
28
0.
1. | . 4
. 1
. 1
. 1
. 1
. 1
. 1
. 1
. 1
. 1
. 1 | 1
15
11
1
6 | 1
40
- | 17:
13
10
7.3 | 2.6
86.
.96
811 | 5 ME
364
3 | EV
Mev |
| | MT= | NOT
WIT
455= | E T
HIN | HA
TI | T T
HE | HE
INC | PĂF
DIC/ | λΑΜ
ΑΤΕ | ĖŤI
D I | ËŔS
Ran | S'Ŭ
NGE | A R | ξŢ | Ŵİ | ТĤ | TF | IE . | İŇ | CI | DE | NT | EI | NER | GΥ | |
| MF | -8 | TĂKEN | | OM
PI | SA
ROD | PHI | IER
F VI | ET | AI
PS | ∟.
⊿ח | /6 | 1/ | , | | | | | | | | | | | | |
| 1 | MT:
MT: | =454
=459
BOTH | UND
CUM
WER | EPI
UL/
E | ÈND
ATI
TAK | ĔŇ1
VE
EN | ΓΫ́
ΥΙΕ
FR(| IEL
ELD
DM | DŠ
S
JNI |)
DC | FP | D |)EC | AY | D | AT <i>A</i> | \ F | ΊL | .E | VE | RS | 10 | N - 2 | /62/ | 1. |
| ΜF | =12
MT- | 2 PHOT
GIVE | | | DDU
TH | CTI
E F | ION
Foll | MU
_OW | LT
IN(| I P L
G S | LIC
SEC | T
T | ON | S
S | (0
BE | PT I
LOV | ION
V 9 | 1
34 |)
. 7 | 4 | KE١ | ۷. | | | |
| | IVI I = | THE
MEAS
REGI | THE
SURE
ON. | | ĂĹ
BY
THE | NEU
Vef | JTR(
RBIN
NTEN | ON-
NSK
NST | INI
I
TY | 000
/63
0F | CED
3/
P | F
W A
H O | TIS
S
TO | SI
AD
N | ON
OP
BEI | GA
TEC
LOV | AMM
D F
V O | A
0 R
. 1 | SP
T
4 | EC
HE
ME | TRI
WH
V, | JM
IOF
WI | OF
LE
HER | U-2
ENEF
E NO | 235
RGY
D |

DATA WERE GIVEN, WAS ASSUMED TO BE THE SAME AS THAT BETWEEN 0.14 AND 0.3 MEV. MT=51-57 INELASTIC. MI=51-57 INELASTIC PHOTON BRANCHING DATA WERE TAKEN FROM REF./64/, AND CONVERTED TO PHOTON MULTIPLICITIES. MT=102 CAPTURE CALCULATED WITH GNASH/56/. IN THE CASE WHERE THE OBTAINED MULTIPLICITIES WERE TOO LARGE, THEY WERE RENORMALIZED BY USING ENERGY BALANCE. MF=13 PHOTON PRODUCTION CROSS SECTIONS MT=3 NON-ELASTIC PHOTON PRODUCTION CROSS SECTION CALCULATED WITH GNASH /56/ WERE GROUPED INTO THE NON-ELASTIC IN THE ENERGY RANGE ABOVE 934.74 KEV. TRANSMISSION COEFFICIENTS FOR INCIDENT CHANNEL WERE GENERATED WITH ECIS/53/, AND THOSE FOR EXIT CHANNEL WITH ELIESE-3/55/. THE DATA FOR FISSION WERE BASED ON THE MEASURED U-235 SPECTRA /63/. FURTHER DETAILS ARE GIVEN IN REF./65/ MF=14 ANGULAR DISTRIBUTIONS OF PHOTONS ISOTROPIC DISTRIBUTIONS WERE ASSUMED FOR ALL SECTIONS. MF=15 CONTINUOUS PHOTON ENERGY SPECTRA MT=3 NON-ELASTIC MT=3 NUN-ELASIIC CALCULATED WITH GNASH /56/. MT=18 FISSION U-235 SPECTRA MEASURED BY VERBINSKI/63/. MT=102 CAPTURE CALCULATED WITH GNASH/56/. CALCULATED WITH GNASH/56/. REFERENCES 1) KAWANG T. ET AL.: PROC. 1993 SYMPOSIUM ON NUCLEAR DATA, TOKAI, NOV. 1993, JAERI-M 94-019, P.290 (1990). 2) EVANCE A.E. ET AL.: NUCL. SCI. ENG., 50, 80 (1973), AND TUTLE T.R.J.: NUCL. SCI. ENG., 56, 37 (1975). 3) FREHAUT J.: NEANDC(E) 238/L (1986). 4) MOXON M.C. ET AL.: 1988 JACKSON HOLE. VOL.1, P.281 (1988). 5) LARSON N.M.: ORNL/TM-9179, REV.1 (1985). 6) KIKUCHI Y.: PRIVATE COMMUNICATION. 7) UTLEY C.A. ET AL.: 1986 PARIS CONF., 1, 165 (1967). 8) WHALEN J.F. ET AL.: NUCL. INST. METH., 39, 185 (1966). 9) POENITZ W.P. ET AL.: NUCL. SCI. ENG., 78, 833 (1981). 10) TSUBONE I. ET AL.: NUCL. SCI. ENG., 78, 833 (1981). 11) KOPSCH D. ET AL.: NUCL. SCI. ENG., 78, 833 (1981). 12) FOSTER D.G.JR. AND GLASGOW D.W.: PHYS. REV., 120, 520 (1964). 13) BRATENAHL A. ET AL.: PHYS. REV., 120, 520 (1966). 14) POENTZ W. D. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). 15) RAYNAL J.: ECIS88 UNPUBLISHED. 16) HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). 17) SMITH A.B.: NUCL. PHYS. REV., 120, 520 (1966). 16) HAOUAT G. ET AL.: NUCL. SCI. ENG., 81, 491 (1982). 17) SMITH A.B.: NUCL. PHYS. CTI. PHYS. REV. 47, 633 (1963). 18) OLSEN D.K. ET AL.: NUCL. SCI. ENG., 81, 491 (1986). 21) VOVOTONIKOV P.E. ET AL.: PRIC. INT. CONF. ON NUCLEAR CROSS SECTIONS FOR TECHNOL., KNOXVILLE, OCT 1979, P.677 (1980). 21) VOVOTONIKOV P.E. ET AL.: PROC. 4TH ALL UNION CONF. ON NEUTRON PHYSICS. KIEV, APR. 1977, P.119 (1977). 22) BABA M. ET AL.: NUCL. SCI. TECHNOL., 27, 601 (1990). 23) MOLDAUER P.A.: NUCL. SCI. TECHNOL., 27, 601 (1990). 24) MADLAND D.G. AND YOUNG P.G.: "NEUTRON NUCLEUS OFTICAL POTENTIAL FOR THE ACTINIDE REGION" IAEA-190, P.251 (1978). 25) SMITH A.B. ET AL.: NUCL. SCI. ENG., 01 (1988). 26) KORNILOV N.V. ET AL.: NUCL. SCI. ENG., 01 (1980). 27) SHURSKIKOV E.N.: NUCLEAR DATA SHEETS, 53, 601 (1988). 28) FREHAUT J. ET AL.: NUCL. SCI. ENG., 63, 153 (1977). 30) VEESER L.R. ET AL.: NUCL. SCI. ENG., 63, 153 (1977). 31) DIFILLIPO F.C. ET AL.: NUCL. SCI. ENG., 68, 43 (1977). 32) DIFILLIP (1977). NORDBORG C. ET AL: ANL-76-90, 128 (1976). MEADOWS J.W.: NUCL. SCI. ENG., 58, 255 (1975). MEADOWS J.W.: NUCL. SCI. ENG., 49, 310 (1972). KANDA Y. ET AL.: 1985 SANTA FE, 2, 1567 (1986). CANCE M. AND GRENIER G.:NUCL. SCI. ENG., 68, 197 (19 BILAUD P. ET AL.:1958 GENEVA,16, 106, 5809 (1958). ADAMOV V.M. ET AL.: 1977 NBS, 313 (1977). ARLT R. ET AL.: KE, 24, 48, 8102 (1981). CIERJACKS S. ET AL.:1976 ANL, 94 (1976). GOVERDOVSKII A.A. ET AL.: 1983 KIEV, 2, 159 (1983). 34) 35 36) 37) (1978). 38 í 39) 40) 41) 42 43)

44) ANDROSENKO S.D. ET AL.: 1983 KIEV, 2, 153 (1983).
45) FURSOV B.I. ET AL.: SOV. ATOM. ENERG., 43, 808 (1978).
46) POENITZ W.P. AND ARMANI R.J.: J. NUCL. ENEG., 26, 483 (1972).
47) POENITZ W.P.: NUCL. SCI. ENG., 57, 300 (1975).
48) KAZAKOV L.E. ET AL.: YAD. KONST., 3 (1986).
49) PANITKIN YU.G. AND SHERMAN L.E.: ATOMNAYA ENERGIYA, 39, 17 (1975).
50) MOXON M.C.: PRIVATE COMMUNICATION TO THE NEA DATA BANK (1971).
51) FRICKE M.P. ET AL.: 1970 HELSINKI, 265 (1970).
52) MENLOVE H.O. AND POENITZ W.P.: NUCL. SCI. ENG., 33, 24 (1968).
53) RAYNAL J.: IAEA SMR-9/8 (1970).
54) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
55) IGARASI S.: JAERI-1224 (1972).
56) YOUNG P.G. ET AL.: LA-6947 (1977).
57) MADLAND D.G. AND NIX J.R.: NUCL. SCI. 81, 213 (1982).
58) OHSAWA T.: PRIVATE COMMUNICATION (1992).
59) BECCHETTI JR.F.D. AND GREENLEES G.W.: PHYS. REV., 182, 1190 (1969).

- 59) BECCHEITT JR.F.D. AND GREENLEES G.W.. FILG. REV., 132, 132 (1969).
 60) IGNATYUK A.V.: SOV. J. NUCL. PHYS., 29, 450 (1979).
 61) SAPHIER D. ET AL.: NUCL. SCI. ENG., 62, 660 (1977).
 62) TASAKA K. ET AL.: JAERI 1320 (1990).
 63) VERBINSKI V.V. ET AL.: PHYS. REV., C7, 1173 (1973).
 64) SHURSHIKOV E.N. ET AL.: NUCL. DATA SHEETS, 38, 277 (1983).
 65) HIDA K.: JAERI-M 85-035, 166 (1985).

MAT number = 9343 93-NP-236 JAERI EVAL-MAR93 T.NAKAGAWA DIST-MAR94 HISTORY 93-03 NEW EVALUATION WAS MADE FOR JENDL-3.2. =1 GENERAL INFORMATION
MT=451 DESCRIPTIVE DATA AND DICTIONARY
MT=452 TOTAL NUMBER OF NEUTRONS PER FISSION
SUM OF NU-P (MT=456) AND NU-D (MT=455).
MT=455 DELAYED NEUTRON DATA
DETERMINED FROM SYSTEMATICS BY TUTTLE/1/, BENEDETTI/2/ AND
WALDO ET AL./3/ DECAY CONSTANTS WERE TAKEN FROM THE EVALUATION FOR NP-238 BY BRADY AND ENGLAND/4/.
MT=456 NUMBER OF PROMPT NEUTRONS
BASED ON THE DATA BY LINDNER AND SEEGMILLER /5/ AND
HOWERTON'S SYSTEMATICS/6/. MF = 1MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS ARE GIVEN. THERMAL CROSS SECTIONS AND CALCULATED RES. INTEGRAL (BARNS) 0.0253 EV RESONANCE INTEGRAL TOTAL 3483. ELASTIC 12.27 TOTAL ELASTIC FISSION CAPTURE 2770. 1030 701. 259 MF=3 NEUTRON CROSS SECTIONS BELOW 20 KEV ================= 1 TOTAL CROSS SECTION SUM OF PARTIAL CROSS SECTIONS. MT = 1MT= 2 ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. 18 FISSION CROSS SECTION BASED ON THE DATA MEASURED BY VAL'SKIY ET AL./8/ MT= 18 MT= 102 CAPTURE CROSS SECTION CAPTURE-TO-FISSION RATIO WAS ASSUMED TO BE 0.253 THAT WAS OBTAINED FROM THE CAPTURE CROSS SECTION CALCULATED AT 20 KEV AND THE FISSION CROSS SECTION. ABOVE 20 KEV MT= 1 TOTAL CROSS SECTION CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. PARAMETERS ARE LISTED IN TABLE 1. MT= 2 ELASTIC SCATTERING CROSS SECTION TOTAL - (SUM OF PARTIAL CROSS SECTIONS) MT= 16, 17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED FROM A FORMULA GIVEN BY SAGEV AND CANER/9/. THE REACTION CROSS SECTIONS CALCULATED WITH CASTHY WAS ADOPTED AS THE NON-ELASTIC SCATTERING CROSS SECTION. 18 FISSION CROSS SECTION ABOVE 5 MEV, A SIMPLE FORMULA BY BYCHKOV ET AL./9/ WAS USED. EXPERIMENTAL DATA OF BRITT AND WILHELMY/10/ AND SYSTEMA-TICS/11/ WERE CONSIDERED. THE CROSS-SECTION CURVE WAS SMOOTHLY CONNECTED AT 20 KEV TO THE DATA OF VAL'SKIY ET MT = 18AL. / 8/ MT= 4, 51-54, 91 INELASTIC SCATTERING CROSS SECTION CALCULATED WITH CASTHY (OPTICAL AND STATISTICAL MODEL). PARAMETERS USED ARE LISTED IN TABLES 1, 2 AND 3. THE LEVEL SCHEME WAS TAKEN FROM EVALUATION BY SCHMORAK/12,13/. 102 CAPTURE CROSS SECTION CALCULATED WITH CASTHY. AVERAGE CAPTURE WIDTH AND LEVEL SPACING WAS ASSUMED TO BE 0.035 EV AND 0.11EV, RESPECTIVELY DIRECT AND SEMI-DIRECT CAPTURE WAS CALCULATED FROM A SIMPLE FORMULA OF BENZI AND REFF0/14/. MT= 102 MT= 251 MU-L CALCULATED WITH CASTHY MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT= 2, 51-54, 91

MT=16, 17, 18 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 91 EVAPORATION SPECTRA OBTAINED FROM THE LEVEL DENSITY PARAMETERS WERE GIVEN. MF=5 MT = 18ÉVAPORATION SPECTRA. TEMPERATU SYSTEMATICS BY SMITH ET AL./15/ TEMPERATURE WAS DETERMINED FROM OPTICAL POTENTIAL PARAMETERS DETERMINED BY MURATA/16/ EXCEPT A CONSTANT TERM OF V THAT WAS SELECTED SO AS TO REPRODUCE SO OF 1.0E-4. TABLE 1 - - - - - - - - -. TABLE 2 LEVEL SCHEME OF NP-236 /12,13/ NO. ENERGY(MEV) SPIN-PARITY G.S 0.0 1 0.00 2 0.23 6 -0.060 0.231 0.273 1 + Ś 3 4 -4 0.324 5 -LEVELS ABOVE 0.370 MEV WERE ASSUMED TO BE OVERLAPPING. TABLE 3 LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON FORMULA, BASED ON THE EXCITED LEVELS GIVEN IN ENSDF. PAIRING SPIN-CUTOFF F. A(1/MEV) T(MEV) ENERGY(MEV) (MEV**0.5) . EX(MEV) - - - - - - -NP-234* 27.16 0.0 17.57 3.1410 NP-235 NP-236 0.57 0.0
 31.4
 0.35
 0.57

 28.0
 0.35
 0.0

 29.6
 0.39
 0.49
 31.16 29.50 30.42 3.2900 2.2579 NP-236 3.7161 * TAKEN FROM GILBERT AND CAMERON/17/ REFERENCES
1) R.J.TUTTLE: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
2) G.BENEDETTI, ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
3) R.WALDO ET AL.: PHYS. REV., C23, 1113 (1981).
4) M.C.BRADY AND T.R.ENGLAND: NUCL. SCI. ENG., 103, 129 (1989).
5) M.LINDNER AND D.W.SEEGMILLER: RADIOCHIMICA ACTA, 49, 1(1990).
6) R.J.HOWERTON: NUCL. SCI. ENG., 62, 438 (1977).
7) S.IGARASI AND T.FUKAHORI: JAERI 1321 (1991).
8) G.V.VAL'SKIY ET AL.: PROC. 1ST INT. CONF. ON NEUTRON PHYSICS,
KIEV 1987, VOL. 3, P.99 (1987). DATA WERE TAKEN FROM EXFOR
9) V.M.BYCHKOV ET AL.: INDC(CCP)-184/L (1982). 40995
9) V.M.BYCHKOV ET AL.: INDC(CCP)-184/L (1982).
10) H.C.BRITT AND J.B.WILHELMY: NUCL. SCI. ENG., 72, 222 (1979).
11) J.W.BEHRENS AND R.J.HOWERTON: NUCL. SCI. ENG., 65, 464 (1978).
12) M.R.SCHMORAK: NUCLEAR DATA SHEETS, 63, 139 (1991).
13) ENSDF: EVALUATED NUCLEAR STRUCTURE DATA FILE, BNL/NNDC, AS OF JAN. 1993.
14) V.BENZI AND G.REFFO: CCDN-NW/10 (1969).
15) A.B.SMITH ET AL.: ANL/NDM-50 (1979).
16) H.MATSUNOBU ET AL.: PROC. IN. CONF. ON NUCLEAR CROSS SECTIONS FOR TECHNOL., KNOXVILLE, 1979, P.715 (1980).
17) A.GILBERT AND A.G.W.CAMERON: CAN. J. PHYS., 43, 1446 (1965).

CALCULATED WITH CASTHY

MAT number = 9346 93-NP-237 KYUSHU U.+ EVAL-NOV87 Y.UENOHARA, Y.KANDA DIST-JAN88 REV2-AUG93 HISTORY
79-03 NEW EVALUATION WAS MADE BY N.WACHI AND Y.KANDA (KYUSHU UNIVERSITY), AND Y.KIKUCHI (JAERI).
87-11 (N,2N), (N,3N) AND FISSION CROSS SECTIONS WERE RE-EVALUATED IN THE ENERGY RANGE ABOVE 100 KEV BY Y.UENOHARA AND Y.KANDA (KYUSHU UNIVERSITY).
88-01 COMPILED BY T.NAKAGAWA (JAERI). MODIFIED QUANTITIES : (1,452), (1,456), (3,2), (3,16) (3,17) AND (3,18)
89-02 FP YIELDS WERE TAKEN FROM JNDC FP DECAY FILE VERSION-2.
89-03 (N,2N) REACTION CROSS SECTION WAS MODIFIED.
93-08 JENDL-3.2. MODIFIED BY T.NAKAGAWA (NDC/JAERI) HISTORY * * * * * * * * * * * * * * * * * * * MODIFIED PARTS FOR JENDL-3.2 (2,151) (3,18) (8,16) (9,16) BELOW 350 KEV MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 DELAYED NEUTRON DATA EXPERIMENTAL DATA OF BENEDETTI+/1/ AND SYSTEMATICS BY TUTTLE/2/. MT=456 NUMBER OF NEUTRONS PER FISSION BASED ON EXPERIMENTAL DATA OF FREHAUT+/3/. =2, MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR SLBW FORMULA : 1.0E-5 - 130 EV RES. ENERGY, GAM-N, GAM-G: WESTON AND TODD /4/. GAM-F --> FOR JENDL-3.2, 5 TIMES LARGE VALUES ARE USED ON THE BASIS OF NEW MEASUREMENT AT KYOTO UNIV./6/. AVERAGE GAM-G = 40 MILLI-EV. TWO NEGATIVE RESONANCE ARE GIVEN. PARAMETERS OF 0.22-EV RESONACE WERE ADJUSTED SO AS TO REDUCE THE THERMAL CAPTURE CROSS SECTION/7/ UNRESOLVED RESONANCES : 130 EV - 30 KEV PARAMETERS BY WESTON AND TODD/4/ WITH SLIGHT MODIFICATION ADOPTED PARAMETERS : S0=1.02E-4 , S1=1.888E-4 , D-0BS=0.45 EV GAM-G=40 MILLI-EV. GAM-F VALUES DETERMINED SO THAT SIG-F = 0.009 B. MF=2CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS: 2000 M/S VALUE RES.INT. TOTAL : 192.11 B -ELASTIC : 27.44 P -ELASTIC : FISSION : CAPTURE : 27.44 В 7.06 662 Ē В B 164.6 Ē MF=3 NEUTRON CROSS SECTIONS MT=1,4,51-64,91,102,251 TOTAL, INELASTIC, CAPTURE AND MU-BAR CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY 787. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS THE SPHERICAL OPTICAL POTENTIAL PARAMETERS : V = 43.55 , WS = 11.0 , VSO = 7.0 (MEV) R = RS = 1.32 , RSO= 1.3 (FM) A = B = 0.47 , ASO= 0.4 (FM). IN THE STATISTICAL MODEL CALCULATION WITH CASTHY CODE, COMPETING PROCESSES, FISSION, (N,2N) AND (N,3N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME WAS TAKEN FROM COMPILATION BY ELLIS /9/. NO ENERGY(MEV) SPIN-PARITY G S 0.0 5/2+ NO G.S. ERGY (MEV) 0.0 0.03320 0.05954 0.07580 0.10296 0.13000 0.15852 0.2260 0.26754 0.281 5/2+ 7/2+ 5/2-9/2+ 1 2 3 $\frac{7}{2}$ -11/2+ 9/2-11/2-3/2-6 7 8 9 1/2-

| | CONTII
THE LEVEL I
CAMERON /1(
CAPTURE CR(| 10
11
12
13
14
NUUM LEVELS AS:
DENSITY PARAME
D/. THE GAMMA
DSS SECTION WAS | 0.305
0.327
0.332
0.357
0.369
SUMED ABOVE 0.370
TERS WERE TAKEN FR
-RAY STRENGTH FUNC
S DETERMINED S0 TH | 13/2-
7/2-
1/2+
5/2-
5/2+
MEV.
OM GILBERT AND
TION FOR THE
AT SIG-C = 0.742 |
|--|--|--|---|---|
| MT=2 | B AT 200 KI | EV.
ELASTIC SCATT
AS (TOTAL - S | ERING
JM OF PARTIAL CROS | S SECTIONS). |
| MT=16 | FOR JENDL-2
MODEL OF SI
BY FITTING
PERKIN+ | (N,2N)
2, DATA WERE C/
EGEV+/11/. THI
TO THE FOLLOW
/12/, LANDRUM | ALCULATED WITH THE
E DATA FOR JENDL-3
ING EXPERIMENTAL D
+ /13/, LINDKE+ /1 | EVAPORATION
WERE EVALUATED
ATA.
4/, FORT+ /15/, |
| | THE DATA OI
FRACTIONAL | JENDL-2 WERE
STANDARD DEVI | USED AS PRIOR VAL
ATIONS WERE ASSIGN | UES, AND 50%
ED TO THEM. |
| M I = 17 | FOR JENDL-2
SEGEV+ /11
MODIFIED B
(SIG-2N OF
CROSS SECT
VALUE AT 10 | (N.3N)
2, CALCULATED V
/. ABOVE 16.5
Y ADDING THE V
JENDL-3). BEI
ION OF JENDL-2
6.5 MEV. | WITH THE EVAPORATI
MEV, THE JENDL-2
ALUES OF (SIG-2N O
LOW 16.5 MEV, THE
WAS NORMALIZED TO | ON MODEL OF
DATA WERE
F JENDL-2)-
SHAPE OF (N,3N)
THE MODIFIED |
| MT=18 | EVALUATED
EVALUATION
FOLLOWING
KLEMA /14
/21/, IYI
ARLT+ /2
WHITE+ /2
/33/. | FISSION
FROM MEASURED
METHOD WAS USI
EXPERIMENTAL D/
3/, PROTOPOPOV
ER+ /22/, JIACO
5/, CANCE+ /26
29,30/, STEIN+ | DATA. ABOVE 100 K
ED BY TAKING ACCOU
ATA.
+ /19/, SCHMITT+ /
DLETTI+ /23/, KOBA
/, GARLEA+ /27/, K
/31/, BEHRENS+ /3 | EV, SIMULTANEOUS
NT OF THE
20/, GRUNDL
YASHI+ /24/,
UPRIJANOV+ /28/,
2/ AND MEADOWS |
| | FOR JENDL-:
AS AS TO SI
/6/ | 3.2, CROSS SEC
MOOTHLY CONNEC | TIONS BELOW 350 KE
T TO THE DATA MESU | V WAS MODIFIOED
RED BY YAMANAKA+ |
| MF=4 AN
MT=2,5
MT=16 | NGULAR DISTI
51-64,91 (
,17,18 | RIBUTIONS OF SI
CALCULATED WITI
ISOTROPIC IN TI | ECONDARY NEUTRONS
H THE OPTICAL MODE
HE LABORATORY SYST | L.
EM. |
| MF=5 EN
MT=16
MT=18 | NERGY DISTR
,17,91 | IBUTIONS OF SEC
EVAPORATION SP
ESTIMATED FROM
BY ASSUMING E(| CONDARY NEUTRONS
ECTRUM.
Z**2/A SYSTEMATIC
CF-252) = 2.13 MEV | S BY SMITH+/34/ |
| MF=8 RA
MT=16
DE
MT=454
BC | ADIOACTIVE I
ECAY DATA OI
4 AND 459
DTH WERE TAI | DECAY AND FISS
F NP-236 ARE G
KEN FROM JNDC I | ION PRODUCT YIELDS
IVEN.
FP DECAY DATA FILE | VERSION-2/35/. |
| MF=9 MU
MT=16
ME
BE | JLTIPLICITI
TA-STABLE 3
75 %. | ES FOR PRODUCT
STATE (T-1/2 =: | ION OF RADIOACTIVE
22.5 H) PRODUCTIOI | NUCLIDES
N WAS ASSUMED TO |
| REFERENC
1) G. E
2) R.J.
3) J. F
4) L.W.
5) S. H
6) A. H
8) S. A
10) A. (
11) M. S
12) J. E
13) J. L
14) K.E.
15) E.A
16) E.A
17) N.V | CES
BENEDETTI E
SEHAUT EL I
FREHAUT ET I
WESTON ANI
ANDANAKA, E
(OBAYASHI, I
GARASI AND
GELIS: NU
GILBERT AND
SEGEV ET AL
PERKIN, ET I
ANDRUM, ET
ANDRUM, ET
GRT, ET AL
GROMOVA, I
KORNILOV, | T AL.: NUCL.
NDC(NDS)-107/G
AL.: CEA-N-21
D J.H. TODD: NI
AL.: NUCL. SC
T AL: J. NUCL.
ET AL: TO BE PI
T. FUKAHORI: SC
CL. DATA SHEET
A.G.W. CAMERO
A.G.W. CAMERO
AL.: PHYS. REV., C1
AL.: PHYS. REV
PHYS. REV., C1
ET AL.: AT. EN
ET AL.: AT. EN | SCI. ENG., 80, 379
+SPECIAL, P.29 (19
96 (1981).
UCL. SCI. ENG., 79
I. ENG., 61, 477 (
SCI. TÉCHNOL., 30
UBLISHED IN JAERI-
JAERI 1321 (1991).
S. B6, 539 (1971).
S. CAN. J. PHYS.,
UCL. ENERGY, 5, 23
RG., 14, 69 (1961)
V., C8, 1938 (1969)
2, 1507 (1975).
673 (1982).
ERG., 54, 108 (198
NERG., 58, 117 (19 | (1982).
79).
184 (1981).
1976).
863 (1993).
M REPORT(1994).
43, 1446 (1965)
9 (1978).
j.
3). |

18) E.D. KLEMA: PHYS. REV., 72, 88, (1947).
19) A.N. PROTOPOPOV, ET AL.: AT. ENERG., 4, 190 (1958).
20) H.W. SCHMITT, ET AL.: PHYS. REV., 116, 1575 (1959).
21) J.A. GRUNDL: NUCL. SCI. ENG., 30, 39 (1967).
22) R.H. IYER, ET AL.: 69ROORKEE, 2, 289 (1969).
23) R.J. JIACOLETTI, ET AL.: NUCL. SCI. ENG., 48, 412 (1972).
24) K. KOBAYASHI, ET AL.: PRIVATE COMMUNICATION (1973).
25) R. ARLT, ET AL.: KERNENERGIE 24, 48 (1981).
26) M. CANCE, ET AL.: NUCL. SCI. ENEG., 45, 440 (1978).
27) I. GARLEA, ET AL.: INDC(ROM)-15 (1983).
28) V.M. KUPRIJANOV, ET AL.: AT. ENERG, 45, 440 (1978).
29) P.H. WHITE, ET AL.: J. NUCL. ENERG., 21, 671 (1967).
30) P.H. WHITE, ET AL.: G8WASHIGTON, 1, 627 (1968).
32) J.W. BEHRENS, ET AL.: NUCL. SCI. ENG., 80, 393 (1982).
33) J.W. MEADOWS: NUCL. SCI. ENG., 85, 271 (1983).
34) A.B. SMITH ET AL.: ANL/NDM-50 (1979).
35) K. TASAKA, ET AL.: JAERI 1320 (1990).

MAT number = 9349 93-NP-238 JAERI EVAL-MAR93 T.NAKAGAWA DIST-MAR94 HISTORY 93-03 NEW EVALUATION WAS MADE FOR JENDL-3.2. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 TOTAL NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA DETERMINED FROM SYSTEMATICS BY TUTTLE/1/, BENEDETTI/2/ AND WALDO ET AL./3/ DECAY CONSTANTS WERE TAKEN FROM THE EVALU-ATION BY BRADY AND ENGLAND/4/. MT=456 NUMBER OF PROMPT NEUTRONS BASED ON THE DATA BY SOLONKIN ET AL./5/ AND HOWERTON'S SYSTEMATICS/6/. A CONSTANT TERM IS AN AVERAGE OF THESE TWO. MF = 1ŤŴŎ. MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS ARE GIVEN. THERMAL CROSS SECTIONS AND CALCULATED RES. INTEG 0.0253 EV RESONANCE INTEGRAL TOTAL 2532.5 INTEGRAL (BARNS) TOTAL ELASTIC FISSION CAPTURE 12.41 2070. 940 450. 201 MF=3 NEUTRON CROSS SECTIONS MT= 1 TOTAL CROSS SECTION CALCULATED WITH OPTICAL MODEL CODE CASTHY/7/. PARAMETERS ARE LISTED IN TABLE 1. MT= 2 ELASTIC SCATTERING CROSS SECTION TOTAL - (SUM OF PARTIAL CROSS SECTIONS) MT= 16, 17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED FROM A FORMULA GIVEN BY SAGEV AND CANER/8/. THE REACTION CROSS SECTIONS CALCULATED WITH CASTHY WAS ADOPTED AS THE NON-ELASTIC SCATTERING CROSS SECTION. 18 FISSION CROSS SECTION CROSS SECTION OF 2070 BARNS MEASURED BY SPENCER AND BAUMANN AT 0.0253 EV/9/ WAS ADOPTED AND 1/V FORM ASSUMED BELOW 20 KEV. ABOVE 6.6 MEV, A SIMPLE FORMULA BY BYCHKOV ET AL./8/ WAS USED. BELOW THIS, EXPERIMENTAL DATA OF BRITT AND WILHELMY/10/ AND SYSTEMATICS/11/ WERE CONSIDERED. THE CROSS-SECTION CURVE WAS SMOOTHLY CONNECTED AT 20 KEV TO THE ABOVE-MENTIONED DATA. MT = 18MT= 4, 51-79, 91 INELASTIC SCATTERING CROSS SECTION CALCULATED WITH CASTHY (OPTICAL AND STATISTICAL MODEL) PARAMETERS USED ARE LISTED IN TABLES 1, 2 AND 3. THE SCHEME WAS TAKEN FROM EVALUATION BY SHURSHIKOV/12,13/. ′ĖEVEL 102 CAPTURE CROSS SECTION CALCULATED WITH CASTHY. AVERAGE CAPTURE WIDTH AND LEVEL SPACING WAS ASSUMED TO BE 0.035EV AND 0.294EV, RESPECTIVELY. DIRECT AND SEMI-DIRECT CAPTURE WAS CALCULATED FROM A SIMPLE FORMULA OF BENZI AND REFF0/14/. MT = 102MT= 251 MU-L CALCULATED WITH CASTHY MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT= 2, 51-79, 91 CALCULATED WITH CASTHY MT=16, 17, 18 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16, 17, 91 EVAPORATION SPECTRA OBTAINED FROM THE LEVEL DENSITY PARAMETERS WERE GIVEN. MT = 18evaporation spectra. temperature was determined from systematics by smith et al./15/ OPTICAL POTENTIAL PARAMETERS DETERMINED BY MURATA/16/ EXCEPT A CONSTANT TERM OF V TABLE 1

THAT WAS SELECTED SO AS TO REPRODUCE SO OF 1.0E-4. $\begin{array}{l} V = 40.5 - 0.05*E \ (MEV) \\ WS = 6.5 + 0.15*E \ (MEV) : DERRIVATIVE WOOD-SAXON TYPE \\ /SO = 7.0 \ (MEV) \\ RO = RSO = 1.32, \ RS = 1.38 \ (FM) \\ A = B = ASO = 0.47 \ (FM) \end{array}$ VSO =TABLE 2 LEVEL SCHEME OF NP-238 /12.13/ - -NO. ENERGY(MEV) SPIN-PARITY G.S 1 2 2 0.0 + 0.02643 0.06222 0.08665 0.10626 0.12176 0.13601 0.16577 0.17915 0.23280 0.225870 0.225870 0.225870 0.2983 0.33225 0.33225 0.3350841 0.3741 0.40853 + + 3 3 5 4 + + 4 5 + 67890112345678901223456789 1112345678901223456789 35423654516661532264 -+ -+ -+
-+ 0.4313 + 0.4404 4 0.4563 0.4626 0.5242 5 + 6 + ŏ + LEVELS ABOVE 0.528 MEV WERE ASSUMED TO BE OVERLAPPING. TABLE 3 LEVEL DENSITY PARAMETERS FOR GILBERT AND CAMERON FORMULA, BASED ON THE EXCITED LEVELS GIVEN IN ENSDF AND RESONANCE LEVEL SPACINGS /17/. PAIRING SPIN-CUTOFF F. A(1/MEV) T(MEV) ENERGY(MEV) (MEV**0.5) 236 28.0 0.35 0.0 29.50 237 29.6 0.39 0.49 30.42 238 30.0 0.344 0.0 30.71 239 30.38 0.376 0.43 24 72 EX(MEV) ′- - - - - - - - -- - - -NP-236 NP-237 NP-238 NP-239 2.2579 3.7161 2.4075 3.4944 * TAKEN FROM GILBERT AND CAMERON/18/ REFERENCES

R.J.TUTTLE: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
G.BENEDETTI, ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
R.WALDO ET AL.: PHYS. REV., C23, 1113 (1981).
M.C.BRADY AND T.R.ENGLAND: NUCL. SCI. ENG., 103, 129 (1989).
A.A.SOLONKIN ET AL.: ATOM. ENERGY, 64, 497 (1988).
R.J.HOWERTON: NUCL. SCI. ENG., 62, 438 (1977).
S.IGARASI AND T.FUKAHORI: JAERI 1321 (1991).
V.M.BYCHKOV ET AL.: INDC(CCP)-184/L (1982).
J.D.SPENCER AND N.P.BAUMANN: TRANS. AMER. NUCL. SOC., 12, 284 (1969). DATA WERE TAKEN FROM EXFOR 12475.
H.C.BRITT AND J.B.WILHELMY: NUCL. SCI. ENG., 65, 464 (1978).
E.N.SHURSHIKOV: NUCLEAR STRUCTURE DATA FILE, BNL/NNDC, AS OF JAN. 1993.
V.BENZI AND G.REFFO: CCDN-NW/10 (1969).
A.B.SMITH ET AL.: ANL/NDM-50 (1979).
H.MATSUNOBU ET AL.: PROC. IN. CONF. ON NUCLEAR CROSS SECTIONS FOR TECHNOL., KNOXVILLE, 1979, P.715 (1980).
S.F.MUGHABGHAB: NEUTRON CROSS SECTIONS, VOL.1, PART A, ACADEMIC PRESS (1984). 18) A.GILBERT AND A.G.W.CAMERON: CAN. J. PHYS., 43, 1446 (1965).

MAT number = 9352 93-NP-239 KYUSHU U.+ EVAL-MAR76 Y.KANDA, JI DIST-SEP89 REV2-JUN94 JENDL-CG HISTORY 76-03 THE EVALUATION FOR JENDL-1 WAS PERFORMED BY KANDA (KYUSHU UNIV.) AND JENDL-1 COMPILATION GROUP. DETAILS ARE GIVEN IN REF. /1/.
83-03 JENDL-1 DATA WERE ADOPTED FOR JENDL-2 AND EXTENDED TO 20 MEV. MF=5 WAS REVISED.
87-07 DATA FORMAT WAS CONVERTED INTO ENDF-5 FORMAT AND ADOPTED 94-06 JENDL-3. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 *** (1,452), (1,455), (1,456) * * * * * * * * * * * * * * * * * * * F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D.
 MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF NP-237 EVALUATED BY BRADY AND ENGLAND/5/ MF = 1ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS WERE GIVEN. TOTAL ELASTIC FISSION CAPTURE 7.06 B 0.0 B 37.00 B 445. F=3 NEUTRON CROSS SECTIONS BELOW 4.0 EV. MT=1 TOTAL SUM OF PARTIAL CROSS SECTIONS. MT=2 ELASTIC SCATTERING THE CONSTANT CROSS SECTION OF 10.5 BARNS WAS ASSUMED FROM SIG=4*3.14*(0.147*A**(1/3))**2. MT=18 FISSION ASSUMED TO BE ZERO BARNS. MT=102 CAPTURE THE FORM OF 1/V WAS ASSUMED. THE 2200-M/SEC CROSS SECTION WAS ADOPTED FROM THE EXPERIMENTAL DATA BY STOUGHTON AND HALPERIN /8/. ABOVE 4.0 EV. MT=1 TOTAL CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY MF=3MD = 1 TOTAL CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY /9/. OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY OHTA AND MIYAMOTO /10/ BY USING THE TOTAL CROSS SECTION OF PU-239. V = 45.87-0.2*EN, WI= 0.06, WS= 14.1, VSO= 7.3 (MEV) R = 1.27, RI= 1.27, RS=1.302, RSO= 1.27(FM) A0= 0.652, AI=0.315, AS= 0.98, ASO=0.652(FM) MT=2 ELASTIC SCATTERING CALCULATED WITH CASTHY /9/. MT=4,51-58,91 INELASTIC SCATTERING CALCULATED WITH CASTHY /9/. THE LEVEL SCHEME WAS ADOPTED FROM NUCL. DATA SHEETS VOL.6. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 5/2 + 3PIN-F, 5/2 + 7/2 + 9/2 + 5/2 -11/2 -7/2 9/2 NO. ENERGY(MEV) SPIN-PARITY G.S. 0.0 5/2 + 1 0.03114 7/2 + 2 0.07112 9/2 + 3 0.07467 5/2 -4 0.11766 11/2 + 5 0.1230 7/2 -6 0.17305 9/2 -7 0.2414 11/2 -8 0.320 13/2 -LEVELS ABOVE 430 KEV WERE ASSUMED TO OVERLAPPING. IN THE CALCULATION THE CAPTURE, FISSION, (N,2N) AND (N,3N) CROSS SECTIONS WERE CONSIDERED AS COMPETING PROCESSES.

MT=16,17 (N,2N) AND (N,3N) CALCULATED WITH PEARLSTEIN'S METHOD /11/. MT=18 FISSION ESTIMATED FROM THE NP-237 FISSION CROSS SECTION BY NORMALI-ZING WITH NEUTRON SEPARATION ENERGIES. MT=102 CAPTURE BELOW 100 KEV, THE CROSS SECTION WAS CALCULATED FROM SIG = 435 / SQRT(EN) BARNS. ABOVE 100 KEV, THE SHAPE OF THE EXPERIMENTAL DATA FOR NP-237 BY NAGLE ET AL. /12/ WAS ADOPTED AND NORMALIZED TO 1.4 BARNS AT 100 KEV. MT=251 MU-BAR CALCULATED WITH CASTHY /9/. MF=4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONSMT=2CALCULATED WITH CASTHY CODE /9/.MT=51-58ISOTROPIC IN THE CENTER-OF-MASS SYSTEM.MT=16,17,18,91ISOTROPIC IN THE LABORATORY SYSTEM. MF=5ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONSMT=16,17,91EVAPORATION SPECTRUM.MT=18MAXWELLIAN FISSION SPECTRUM ESTIMATED FROM
Z**2/A SYSTEMATICS /13/. REFERENCES
1) IGARASI S. ET AL.: JAERI 1261 (1979).
2) TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
3) BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
4) WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
5) BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129 (1989).
6) MANERO F. AND KONSHIN V.A.: AT. ENERGY REV., 10, 637 (1972).
7) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
8) STOUGHTON R.W. AND HALPERIN J.: NUCL. SCI. ENG., 6, 100
(1959).
9) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
10) OHTA M. AND MIYAMOTO K.: J. NUCL. SCI. TECHNOL., 10, 583
(1973).
11) PEARLSTEIN S.: NUCL. SCI. ENG., 23, 238 (1965).
12) NAGEL R.J. ET AL.: 1971 KNOXVILLE CONF., 259 (1971).
13) SMITH A.B. ET AL.: ANL/NDM-50 (1979). REFERENCES

MAT number = 9428 94-PU-236 MAPI,JAERI EVAL-APR79 T.HOJUYAMA, Y.KIKUCHI, T.NAKAGAWA DIST-SEP89 REV2-JUN94 HISTORY HISTORY
79-04 NEW EVALUATION WAS MADE BY T.HOJUYAMA (MAPI) /1/ IN THE ENERGY RANGE FROM 1.0E-5 EV TO 20 MEV.
89-07 CROSS SECTIONS BELOW 9.15 EV WERE MODIFIED BY Y.KIKUCHI AND T.NAKAGAWA (JAERI).
94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * MODIFIED PARTS FOR JENDL-3.2 (1,452), (1,455), (1,456) MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF PU-238 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS : 1.0E-5 TO 9.15 EV AVERAGE CAPTURE WIDTH, SO, <D> AND R WERE ESTIMATED FROM SYSTEMATICS/8,9/. THE FIRST POSITIVE RESONANCE WAS LOCATED AT 6.3 EV, AND ITS NEUTRON WIDTH WAS ESTIMATED FROM SO. THE FISSION WIDTH WAS DETERMINED SO THAT THE FISSION CROSS SECTION CALCULATED FROM UNRESOLVED RESONANCE FORMULA WITH THE FISSION WIDTH MIGHT SMOOTHLY CONNECT AT 10 KEV TO THE CROSS SECTION IN HIGH ENERGY REGION. A NEGATIVE RESONANCE WAS ADDED AT -0.8 EV AND THE PARAMETERS WERE ADJUSTED SO AS TO REPRODUCE THE FISSION CROSS SECTION OF 170 B AT 0.0253 EV/10/ AND REASONABLE CAPTURE CROSS SECTION. : 0.030 EV : 9.46 FM : 6.3 EV <\G> R <D> : 1.25E-4 /8,9/ S0 CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 331.1 B -ELASTIC 16.34 B -ELASTIC 16.34 B -ÉLÁSTIC FISSION CAPTURE MF=3 NEUTRON CROSS SECTIONS MT= 1 TOTAL CROSS SECTION OBTAINED BY OPTICAL MODEL CALCULATION. OPTICAL POTENTIAL PARAMETERS WERE TAKEN FROM MURATA'S EVALUATION /11/ EXCEPT REAL POTENTIAL. ---OPTICAL POTENTIAL PARAMETERS---V = 39.5-0.05*EN (MEV) WS = 6.5+0.15*EN (MEV) WS = 6.5+0.15*EN (MEV) NS = 6.5+0.15*EN (MEV) RO = RSO= 0.47, B = 0.47 (FM) A = ASO= 0.47, B = 0.47 (FM) MT= 2 ELASTIC SCATTERING CROSS SECTION OBTAINED BY OPTICAL AND STATISTICAL MODEL CALCULATIONS. MT=4,51-54,91 INELASTIC SCATTERING CROSS SECTIONS OBTAINED BY OPTICAL AND STATISTICAL MODEL CALCULATIONS. LEVEL SCHEME WAS TAKEN FROM REF./12/ EXCEPT 4TH LEVEL OF WHICH ENERGY WAS BASED ON LYNN /13/. NO. EN(KEV) SPIN-PARITY G.S. 0.0 0 + 1 44.6 2 + 2 145 4 + 305 6 + 8 + 169.4 145.4 B 58.8 B 401 B CONTINUUM LEVELS ASSUMED ABOVE 661 KEV. MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED WITH STATISTICAL MODEL BASED ON PEARLSTEIN /14/. MT=18,19,20,21 FISSION CROSS SECTIONS

BELOW 10 KEV: CALCULATED FROM THE UNRESOLVED RESONANCE FORMULA WITH THE CALCULATED FROM THE UNRESOLVED RESONANCE FORMULA WITH THE FOLLOWING PARAMETERS. S0 = 1.25E-4, S1 = 2.22E-4, <D> = 6.3 EV, <WG>= 0.0415 EV. <WF> = 0.00355 EV. ABOVE 10 KEV: CALCULATED FROM FISSION PLATEAU CROSS SECTIONS /11,15/ AND HILL-WHEELER TYPE BARRIER PENETRATION FACTOR /16/. FISSION BARRIER PARAMETERS WERE TAKEN FROM WEIGMANN /17/. MT=102 CAPTURE CROSS SECTION CALCULATED BY OPTICAL AND STATISTICAL MODEL WITH <WG> OF 41.5 MILLI-EV AND <D> OF 6.3 EV. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. CALCULATED WITH OPTICAL MODEL. $\begin{array}{rcl} \text{MF=4} & \text{ANGULAR DISTRIBUTION OF SECONDARY NEUTRONS} \\ \text{MT=} & & & & \text{BASED ON OPTICAL AND STATISTICAL MODEL CALCULA-} \end{array}$ TION ISOTROPIC IN THE CENTER-OF-MASS SYSTEM. ISOTROPIC IN THE LABORATORY SYSTEM. MT=51-54 MT=16-21,91 MF=5 ENERGY DISTRIBUTION OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM ASSUMED MT=18,19,20,21 FISSION SPECTRUM OF MAXWELLIAN FORM ADOPTED THETA TAKEN FROM EVALUATION OF TERRELL/18/. ADOPTED. REFERENCES 1) HOJUYAMA T.: PROC. '79 FALL MEET. OF A.E.S.J., TOKAI (1979) ERENCES HOJUYAMA T.: PROC. '79 FALL MEET. OF A.E.S.J.,TOKAI (1979) C43. TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979), BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982). WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981). BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129 (1989). MANERO F. AND KONSHIN V.A.: AT. ENERGY REV.,10, 637 (1972). HOWERTON R.J.: NUCL. SCI. ENG.,62, 438 (1977). MUGHABGHAB S.F. AND GARBER D.I.: BNL 325,3RD ED.,1,(1973). MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984). MUSGROVE A.R.DE L.: AAEC/E 277 (1973). GINDLER J.E. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV.,115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV., 115, 1271 (1959). MATSUNOBU H. ET AL.: PHYS. REV. 1000, 2) Ξí 4) 5) 6) 7) 8) 9) 10) 11) 12) 13) 14)15) 16) 17) 18)

MAT number = 9434 94-PU-238 MAPI,JAERI EVAL-MAR89 T.KAWAKITA, T.NAKAGAWA DIST-SEP89 REV2-JUN94 HISTORY HISTORY 79-03 NEW EVALUATION WAS MADE BY T.KAWAKITA (PNC). 89-03 RE-EVALUATION WAS MADE BY T.KAWAKITA (MAPI) AND T.NAKAGAWA(JAERI). 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * ***** MODIFIED PARTS FOR JENDL-3.2 *** (1,452), (1,455), (1,456) * * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/1/, BENEDETTI ET AL./2/ AND WALDO ET AL./3/ DECAY CONSTANTS WERE EVALUATED BY BRADY AND ENGLAND/4/. MT=456 PROMPT NEUTRONS PER FISSION THE THERMAL VALUE OF PROMPT NEUTRONS WAS BASED ON EXPERI-MENTAL DATA OF JAFFEY AND LERNER /5/, KROSHKIN ET AL./6/ AND HADDAD AND ASGHER/7/. THE ENERGY DEPENDENT TERM WAS ESTIMATED FROM HOWRTON'S FORMULA /8/. MF=2 RESONANCE PARAMETERS MT=151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA. ENERGY RANGE IS FROM 1.0E-5 EV TO 500 EV. PARAMETERS WERE TAKEN FROM THE FOLLOWING EXPERIMENTAL DATA. 49 RESONANCES ABOVE 10 EV : SILBERT /9/ 4 RESONANCES BELOW 10 EV : YOUNG /10/ THE PARAMETERS OF TWO NEGATIVE AND 2.9-EV RESONANCES WERE ADJUSTED TO THE THERMAL CROSS SECTIONS/11/. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/S RES. INTEG. TOTAL 586.7 B -ELASTIC 28.53 B -FISSION 17.89 B 32.7 B CAPTURE 540.3 B 154 B MF=3 NEUTRON CROSS SECTIONS THE ENERGY REGION BELOW 500 EV IS THE RESONANCE REGION. ABOVE 500 EV, THE CROSS SECTIONS WERE EVALUATED AS FOLLOWS. MT=1,2,4,51-78,91,102 TOTAL, ELASTIC AND INELASTIC SCATTERING, AND CAPTURE CROSS SECTIONS CALCULATED WITH OPTICAL AND STATISTICAL MODELS. CASTHY/12/ WAS USED FOR THE CALCULATION. CASTHY/12/ OPTICAL THE LEVEL SCHEME: TAKEN FROM REF. /14/. NO ENERGY(KEV) NO. G.S. SPIN-PARITY 0.0 44.08 145.98 0 + 2 + 4 + 2 + 303.4 514.0 605.1 6 8 1 + + -3 4 5 661.4 763.2 941.5 -6 7 8 3 5 0 + 9 10 962.77 968.2 1 -2 -2 + 983.0

11

985.5 1028.55 1069.95 1082.57 2234423022012121 13 + - + + - + + + + - + 1082.5 1125.8 1174.5 1202.7 1228.6 1264.2 1310.3 1426.6 1447.3 1458.5 1560.0 25 1560.0 1 -26 1596.5 2 + 27 1621.4 1 -28 1636.6 1 -CONTINUUM LEVELS ASSUMED ABOVE 1.65 MEV. THE LEVEL DENSITY PARAMETERS OF GILBERT AND CAMERON /15/. THE FISSION, (N,2N) AND (N,3N) CROSS SECTIONS WERE TAKEN INTO ACCOUNT AS THE COMPETING PROCESSES. FOR THE CAPTURE CROSS SECTION, THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM D-OBS = 9.5EV AND AVERAGE RADIATIVE WIDTH = 0.04 EV. MT=16,17 (N,2N) AND (N,3N) REACTION CROSS SECTIONS CALCULATION BASED ON THE PEARLSTEIN'S METHOD /16/. MT=18 FISSION CROSS SECTION EVALUATED MAINLY ON THE BASIS OF DATA MEASURED BY BUDTZ-JORGENSEN/17/. OTHER EXPERIMENTS /9, 18, 19, 22, 23, 24, 25/ WERE ALSO TAKEN INTO CONSIDERATION. MT=251 MU-BAR MT=251 MU-BAR 19, 20, 21, CALCULATED WITH OPTICAL MODEL. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-78,91 CALCULATED WITH OPTICAL MODEL. MT=16,17,18 ISOTROPIC IN THE LABORATORY SYSTEM. MF = 4MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM WAS ASSUMED. MT=18 MAXWELLIAN TYPE FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /26/. REFERENCES
1) R.J. TUTTLE: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
2) G. BENEDETTI ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
3) R. WALDO ET AL.: PHYS. REV. C23, 1113 (1981).
4) M.C. BRADY AND T.R. ENGLAND: NUCL. SCI. ENG., 103, 129 (1989).
5) A.H. JAFFEY AND J.L. LERNER: NUCL. PHYS., A145, 1 (1970).
6) N.I. KROSHKIN ET AL.: ATOMNAJA ENERGIJA, 29, 95 (1970).
= EXFOR40064007.
7) M. HADDAD AND M. ASGHAR: 1988 MITO, P.979 (1988).
8) R.J. HOWERTON: NUCL. SCI. ENG., 62, 438 (1977).
9) M.G. SILBERT ET AL.: NUCL. SCI. ENG., 52, 176 (1973).
10) T.E. YOUNG ET AL.: NUCL. SCI. ENG., 30, 355 (1967).
11) MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984).
12) S. IGARASI AND T. FUKAHORI: JAERI 1321 (1991).
13) T. MURATA: PRIVATE COMMUNICATION.
14) C.M. LEDERER ET AL.: TABLE OF ISOTOPES, 7TH ED. (1978).
15) A. GILBERT AND A.G.W. CAMERON: CAN. J. PHYS., 43, 1446 (1965).
16) S. PEARLSTEIN: NUCL. SCI. ENG., 23, 238 (1965).
17) C. BUDTZ-JORGENSEN ET AL.: 1982 ANTWERP, 206 (1983).
18) D.M. BARTON AND P.G. KOONTY: PHYS. REV., 162, 1070 (1967).
20) S.B. ERMAGAMBETOV AND G.N. SHIRENKIN: SOV. J. NUCL. PHYS., 25, 1364 (1968).
21) D.M. DRAKE ET AL.: LA-4420, P.101 (1970).
22) S.B. ERMAGAMBETOV ET AL.: SOV. J. NUCL. ENERGY, 29, 1190(1970).
23) E.F. FOMUSHKIN ET AL.: LA-4420, P.101 (1970).
24) D.L. SHPAK ET AL.: JETP LETTERS, 15, 228 (1972).
25) B. ALAM ET AL.: NUCL. SCI. ENG. 99, 267 (1988).
26) A.B. SMITH ET AL.: ANL/NDM-50 (1979).

MAT number = 9437 94-PU-239 NAIG EVAL-MAR87 M.KAWAI, T.YOSHIDA, K.HIDA DIST-SEP89 REV2-FEB93 HISTORY HISTORY 87-03 EVALUATION WAS MADE BY M.KAWAI AND K.HIDA(NAIG) : CROSS SECTIONS ABOVE RESONANCE REGION AND OTHER QUANTITIES, T.YOSHIDA(NAIG) : RESONANCE PARAMETERS AND BACKGROUND CROSS SECTIONS, DATA WERE COMPILED BY T.NAKAGAWA (JAERI). 88-08 PARTLY MODIFIED. NU-BAR, RESOLVED RESONS., (N,2N). 89-02 FP YIELDS WERE TAKEN FROM JNDC FP DECAY DATA FILE VERSION-2. 89-03 UNRESOLVED RESONANCE PARAMETERS WERE SLIGHTLY MODIFIED. 93-02 JENDL-3.2. RESONANCE PARAMETERS EVALUATED BY H.DERRIEN (JAERI)/1/. FISSION SPECTRA CALCULATED BY T.OHSAWA (KINKI UNIV.) COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA EVALUATED DATA BY TUTTLE /2/ WERE ADOPTED. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION STANDARD CF-252 SF NU-P WAS TAKEN TO BE 3.756. THERMAL NU-P WAS 2.8781 THAT WAS A MEAN VALUE OF EXPERIMENTAL DATA. THE ENERGY DEPENDENT NU-P WAS OBTAINED FROM BELOW 10 EV : REF./3/ MULTIPLIED BY 1.001 10 EV <EN< 500 EV: REF./3/ MULTIPLIED BY 1.001 ABOVE 500 KEV : REFS./5,6,7,8,9/ FACTORS ARE RATIOS OF 2.8781 AND THE EXPERIMENTS AT THERMAL ENERGY. ENERGY MF=2 RESONANCE PARAMETERS MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS RESOLVED RES. PARAMETERS FOR REICH-MOORE FORMULA: UP TO 2.5 KEV PARAMETERS WERE TAKEN FROM REF./1/ DETAILS OF EVALUATION ARE GIVEN IN APPENDIX. UNRESOLVED RESONANCES : FROM 2.5 TO 30 KEV. THE ENERGY DEPENDENT SO, S1 AND FISSION WIDTH WERE DETER-MINED SO AS TO REPRODUCE THE EVALUATED TOTAL, CAPTURE AND FISSION CROSS SECTIONS. 2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS. 200 M/S RES. INTEG. TOTAL 1025.7 B -ELASTIC 7.970 B -FISSION 747.4 B 302.6 B CAPTURE 270.3 B 181.6 B NEUTRON CROSS SECTIONS BELOW 2.5 KEV, CROSS SECTIONS WERE REPRESENTED WITH THE RESOLVED RESONANCE PARAMETERS. BETWEEN 2.5 AND 30 KEV, CROSS SECTIONS WERE REPLACED WITH UNRESOLVED RESONANCE PARAMETERS. MF=3MT=1 TOTAL BELOW 7 MEV, JENDL-2 EVALUATION WHICH WERE BASED ON THE EXPERIMENTS OF REFS./10.11,12,13,14/ WAS ADOPTED. ABOVE 7 MEV, EXPERIMENTAL DATA BY POENITZ /15/ WERE ADOPTED. 2 ELASTIC SCATTERING CALCULATED AS (TOTAL) - (PARTIAL CROSS SECTIONS). MT=2=4, 51-68, 91 INELASTIC SCATTERING THE DIRECT COMPONENT WAS CALCULATED WITH COUPLED CHANNEL CODE ECIS /16/. EIGHT STATES, MARKED WITH AN ASTERISK IN THE LEVEL SCHEME GIVEN BELOW, OF THE GROUND STATE ROTATIONAL BAND WERE COUPLED IN THE CALCULATION. DEFORMED OPTICAL POTENTIAL PARAMETERS WITH A DERIVATIVE WOODS-SAXON ABSORPTION TERM WERE TAKEN FROM REF./17/: V =46.2 - 0.3*EN (MEV) WV =-1.2 + 0.15*EN (MEV) WS = 3.6 + 0.4*EN (MEV), EN > 8 MEV WEV, EN < 7 MEV MT = 4

| 6.4 +
VSO = 6.2
R: RV = 1.26
A: AV = 0.615
BETA-2= 0.21,
THE COMPOUND COM
STATISTICAL MODE
LEVEL FLUCTUATIO
(N,2N) (N,3N),
COMPETING PROCES | 0.1*(EN-7)
, RS= 1.24
, AS= 0.50
, BETA-4= 0.0
PONENT WAS CA
L CODE CASTHY
N AND INTERFE
AND (N,4N) RE
SES. | (MEV), EN >
(MEV)
RSO= 1.12 (FM
ASO= 0.47 (FM
65
LCULATED WITH C
/18/, TAKING I
RENCE EFFECTS.
ACTIONS WERE CC | 7 MEV
PTICAL AND
NTO ACCOUNT
THE FISSION,
NSIDERED AS |
|---|---|--|--|
| THE NEUTRON TRAN
CHANNEL WERE GEN
CHANNEL WERE CAL
POTENTIAL PARAME
V = $40.72 - $
WS = $6.78 - $
VSO= 7.0
R = RSO= 1.3
A = $ASO = B = $
THE SURFACE ABSO
THE LEVEL SCHEME
NO.
G.S.
1
2
3
4
5
6
6
7
8
9
10
11
12
13
14
15
16
17
18 | SMISSION COEF
ERATED WITH E
CULATED WITH T
TERS ADOPTED
0.05*EN
2, RS =1.357
0.47
RPTION IS OF
WAS TAKEN FR
NERGY(KEV)
0.0
7.86
57.28
75.71
163.76
194.
285.46
317.
330.13
360.
387.41
391.6
435.
462.
469.8
488.
462.8
488.
462.1
505.5
511.84 | FICIENTS FOR TH
CIS, WHEREAS TH
CASTHY USING SP
FOR JENDL-2 EVA
(MEV)
(MEV)
(MEV)
(FM)
CFM)
CFM)
DERIVATIVE WOOD
OM REF./19/:
SPIN-PARITY COU
1/2 +
3/2 +
5/2 +
7/2 +
9/2 +
15/2 +
15/2 +
15/2 +
15/2 +
15/2 +
15/2 +
15/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 -
11/2 - | E INCIDENT
OSE FOR THE EXIT
HERICAL OPTICAL
LUATION:
S-SAXON TYPE.
PLED LEVEL
*
*
*
* |

CONTINUUM LEVELS WERE ASSUMED ABOVE 538 KEV.

MT= 16, 17, 37 (N,2N), (N,3N), AND (N,4N) CALCULATED WITH A MODIFIED VERSION OF GNASH /20/. THE NEUTRON TRANSMISSION COEFFICIENTS WERE GENERATED WITH ECIS /16/ AND OPTICAL MODEL CODE ELIESE-3 /21/, RESPECTIVELY, USING THE ABOVE-MENTIONED DEFORMED AND SPHERICAL POTENTIALS. THE LEVEL SCHEMES FOR PU-236, -237, -238, -239 AND -240 WERE TAKEN FROM REFS. /19,22,23,24,25/. THE GILBERT-CAMERON'S COMPOSITE FORMULA /26/ WAS USED TO REPRESENT THE LEVEL DENSITY. LEVEL DENSITY PARAMETERS WERE DETERMINED FROM THE OBSERVED S-WAVE RESONANCE SPACING /27/ AND THE LEVEL SCHEMES. THE SPIN CUT-OFF FACTORS IN THE CONSTANT TEMPERATURE MODEL WERE REPRESENTED BY GRUPPELAAR'S PRESCRIPTION /28/.

| A (1/MEV)
T (MEV)
C (1/MEV)
E-JOINT(MEV)
SIGMA*2
NO. LEVELS
E-MAX (MEV)
D-OBS (EV)
GAMMA-G(EV) | PU-236
25.50
0.442
3.06
4.71
8.63
4.0
0.307
0.395
0.043 | PU-237
28.00
0.416
14.5
4.09
8.18
19.0
0.4735
10.7
0.027 | PU-238
26.23
0.422
2.88
4.38
6.47
22.0
1.3103
0.383
0.043 | PU-239
29.44
0.398
15.0
3.97
11.6
19.0
0.5118
9.0
0.034 | PU-240
26.96
0.412
3.30
4.26
9.69
28.0
1.2621
2.3
0.043 |
|---|---|--|--|---|--|
| D-OBS OF PU-2
/27/, AND HEN
DETERMINED AS
A = 0.365
A = 0.655
WHICH WERE DE
-243, AND -22
WERE HARDLY (
IDENTICAL TO
TEMPERATURE F | 236, -237
NCE THE PA
SSUMING IT
5*A - 60.6
9*A - 128.
ERIVED BY
44 AS WELL
DBSERVED F
THAT OF P
PARAMETERS | AND -238 W
RAMETERS "
S LINEAR D
4 FOR
18 FOR
ANALYZING
AS PU-239
OR PU-236
U-238 TO D | ERE NOT A
A" FOR THE
EPENDENCE
EVEN-EVEN
ODD-MASS F
THE DATA C
AND -240.
AND IT WAS
ETERMINE T | VAILABLE FR
SE NUCLEI
ON THE MAS
PU ISOTOPES
OF PU-241,
LOW-LYING
ASSUMED T
HE CONSTAN | OM REF.
WERE
S A:
S
-242
LEVELS
O BE
T |

EVALUATED FISSION CROSS SECTION DESCRIBED BELOW WAS FED TO GNASH AS A COMPETING PROCESS/29/. THE PREEQUILIBRIUM PROCESS

WAS TAKEN INTO ACCOUNT. THOUGH THE PARAMETER F2 WAS ADJUSTED, THE CALCULATED (N,2N) CROSS SECTION FAILED TO WELL REPRODUCE THE MEASURED DATA. THEREFORE, THE MEASURED (N,2N) CROSS SECTION OF FREHAUT ET AL./30/ WAS ADOPTED IN PLACE OF THE CALCULATED ONE. FISSION MT = 18BĔLOW BELOW 50 KEV BASED ON MEASUREMENTS OF REF./31/ AND REF./32/. ABOVE 50 KEV ŚĪMUĽTANEOUS EVALUATION WAS PERFORMED BY KANDA ET AL./33/ MT=102 CAPTURE THE CROSS SECTION IN THE ENERGY RANGE BELOW 1 MEV WAS DERIVED AS A PRODUCT OF THE EVALUATED FISSION CROSS SECTION AND ALPHA VALUE. THE ALPHA VALUES ARE IDENTICAL TO THOSE OF JENDL-2. ABOVE 1 MEV THE RESULTS OF THE STATISTICAL MODEL CALCULATION WITH CASTHY /18/ LINKED WITH ECIS /16/ WERE ADOPTED. THE PHOTON STRENGTH FUNCTION WAS NORMALIZED IN THE CASTHY CALCULATION SO AS TO REPRODUCE THE CAPTURE CROSS SECTION OF 280 MB AT 100 KEV. MT=251 MU-BAR CALCULATED WITH OPTICAL MODEL. MF = 4=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-68,91 CALCULATED WITH ECIS /16/ AND CASTHY /18/. MT=16,17,18,37 ISOTROPIC IN THE LABORATORY SYSTEM. E=5 ENERGY DISTRIBUTIONS SECONDARY NEUTRONS MT=16,17,37,91 CALCULATED WITH THRESHOLD CROSS SECTION CALCULATION CODE PEGASUS /34/ ON THE BASIS OF PREEQUILIBRIUM AND MULTI-STEP EVAPORATION MODEL. MF = 5MT = 18■18 DISTRIBUTIONS WERE CALCULATED WITH THE MODIFIED MADLAND-NIX MODEL/35,36/. THE COMPOUND NUCLEUS FORMATION CROSS SECTIONS FOR FISSION FRAGMENTS (FF) WERE CALCULATED USING BECCHETTI-GREENLEES POTENTIAL/37/. UP TO 4TH-CHANCE-FISSION WERE CONSIDERED AT HIGH INCIDENT NEUTTRON ENERGIES. THE IGNATYUK FORMULA/38/ WERE USED TO GENERATE THE LEVEL DENSITY PARAME-TERS TERS. PARAMETERS ADOPTED: PARAMETERS ADOPTED: TOTAL AVERAGE FF KINETIC ENERGY = 176.02 - 177.87 MEV AVERAGE ENERGY RELEASE = 198.088 MEV AVERAGE MASS NUMBER OF LIGHT FF = 101 AVERAGE MASS NUMBER OF HEAVY FF = 139 LEVEL DENSITY OF THE LIGHT FF = 10.269 - 11.59 LEVEL DENSITY OF THE HEAVY FF = 11.124 - 12.27 RATIO OF NUCLEAR TEMPERATURE FOR LIGHT TO HEAVY FF = 0.85 NOTE THAT THE PARAMETERS VARY WITH THE INCIDENT ENERGY WITHIN THE INDICATED RANGE. 55 MT=455 TAKEN FROM SAPHIER ET AL./39/ E=8 FISSION PRODUCT YIELDS MT=454 INDEPENDENT YIELDS MT=459 CUMULATIVE YIELDS BOTH WERE TAKEN FROM JNDC FP DECAY DATA FILE VERSION-2/40/. MF = 8MF=12 PHOTON PRODUCTION MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS MT=16,17,37,91,102 (N,2N),(N,3N),(N,4N),INELASTIC SCATTERING TO THE CONTINUUM, AND CAPTURE DATA CALCULATED WITH GNASH /20/ WERE STORED UNDER OPTION-1 (MULTIPLICITIES). THE PHOTON BRANCHING DATA WERE TAKEN FROM REFS. /19/ AND /22,23,24,25/. SOME ASSUMPTIONS WERE MADE FOR LEVELS OF PU-237 AND -239 WHICH HAD NO INFORMATION ON BRANCHING: IF E1 TRANSITIONS WERE ALLOWED TO LOWER LEVELS, THE TRANSITION PROBABILITIES WERE EQUALLY SHARED AMONG THEM. IF NOT, EQUALLY SHARED COLLECTIVE E2 TRANSITIONS WERE ASSUMED. THE PHOTON STRENGTH FUNCTIONS WERE REPRESENTED BY THE BRINK-AXEL TYPE GIANT DIPOLE RESONANCE WITH CONVENTIONAL RESONANCE POSITIONS AND WIDTHS. THEY WERE NORMALIZED TO INPUT VALUES AT THE THERMAL ENERGY. THE PYGMY RESONANCE WAS INTRODUCED ONLY FOR PU-240. THE PARAMETERS WERE ASSUMED TO BE THE SAME AS THOSE OF U-238 /41/. 8 FISSION STORED UNDER OPTION-1 (MULTIPLICITIES). THE THERMAL NEUTRON INDUCED FISSION GAMMA SPECTRUM MEASURED BY VERBINSKI /42/ MT = 18

WAS ADOPTED AND USED UP TO 20 MEV NEUTRON. SINCE NO DATA WERE GIVEN FOR THE PHOTONS BELOW 0.14 MEV, IT WAS ASSUMED TO BE THE SAME AS THAT OF THE PHOTONS BETWEEN 0.14 AND 0.3 MEV. WAS 51-68 INELASTIC SCATTERING STORED UNDER OPTION-2 (TRANSITION PROBABILITY ARRAYS). DAT WERE TAKEN FROM REF./19/, AND THE SAME ASSUMPTIONS AS DESCRIBED ABOVE WERE APPLIED TO THE LEVELS TO WHICH NO DATA MT=51-68 DATA WERE GIVEN. 4 PHOTON ANGULAR DISTRIBUTIONS MT=16,17,18,37,51-68,91,102 MF = 14ISOTROPIC.

 MT=18
 EXPERIMENTAL DATA BY VERBINSKI /42/ WERE ADOPTED.

 REFFERENCES
 1) DERRIEN H.: J. NUCL. SCI. TECHNOL., 30, 845 (1993).

 2) TUTTLE R.J.: INDC(NDS)-107/6 + SPECIAL, 29 (1980).

 3) GWIN R. ET AL.: NUCL. SCI. ENG., 94, 365 (1986).

 4) FREHAUT J.: NEANDC(E)-238/L (1986).

 5) GWIN R. ET AL.: NUCL. SCI. ENG., 87, 381 (1984).

 6) SOLEILHAC M. ET AL.: 70 HELSINKI .2, 145 (1970).

 7) SOLEILHAC M. ET AL.: 1. NUCL. ENERGY. 23. 257 (1969).

 8) WORODIN K.E. ET AL.: AT. ENERGIYA. 33, 199 (1975).

 9) VORODIN K.E. ET AL.: AT. ENERGIYA. 33. 901 (1972).

 10) UTTELY C.A.: EANDC (UK)-40 (1964).

 11) SCHWARTZ R.B. ET AL.: J. NUCL. ENERGY 27, 317 (1973).

 12) FOSTER D.G.JR. AND GLAGOW D.W.: PHYS. REV., C3, 576 (1971).

 13) SMITH A.B. ET AL.: J. NUCL. ENERGY 27, 317 (1973).

 14) NADOLNY ET AL.: CO0-3058-39, 33 (1973).

 15) POENITZ W.P. ET AL.: NUCL. SCI. ENG., 78, 333 (1981).

 16) RARASI S. AND FUKAHORI T.: JAERI 1321 (1991).

 17) ARTHUR E.D. ET AL.: NUCL. CI. ENG 3 (67 (1984).

 18) GARASI S.: JAERI-1224 (1972).

 20) SCHMORAK M.R.: NUCL. DATA SHEETS, 40, 1 (1983).

 20) YOUNG P G. ET AL.: LA-6947 (1977).

 21) GARASI S.: JAERI-1224 (1972).

 22) SCHMORAK M.R.: NUCL. DATA SHEETS, 36, 277 (1983).

 23) SHURSHIKOV E.N.: ET AL.: CANN 37) BLOGHLTTP. AND SALE PHYS., 29, 450 (1979).
38) IGNATYUK A.V.: SOV. J. NUCL. PHYS., 29, 450 (1979).
39) SAPHIER D. ET AL.: NUCL. SCI. ENG., 62, 660 (1977).
40) TASAKA K. ET AL.: JAERI 1320 (1990).
41) HIDA K.: JAERI-M 85-035, 166 (1985).
42) VERBINSKI V.V. ET AL.: PHYS. REV., C7, 1173 (1973). APPENDIX RESONANCE DATA THE PRESENT FILE CONTAINS THE RESONANCE PARAMETERS OBTAINED FROM A SAMMY FIT ANALYSIS OF HIGH RESOLUTION EXPERIMENTAL DATA, PERFORMED AT ORNL(OAK RIDGE NATIONNAL LABORATORY,USA) BY H.DERRIEN AND G.DE SAUSSURE AND AT JAERI(TOKAI-MURA RESEARCH ESTABLISHMENT, JAPAN) BY H.DERRIEN. THE FILE CONTAINS THREE INDEPENDANT SECTIONS: 1/ THE FIRST CORRESPONDS TO THE ENERGY RANGE 0 KEV TO 1 KEV. THE CORRESPONDING SET OF RESONANCE PARAMETRES CONTAINS 398 RESO-NANCES IN THE ENERGY RANGE 0 KEV TO 1 KEV, 4 FICTICIOUS NEGATIVE ENERGY RESONANCES AND 3 FICTICIOUS RESONANCES ABOVE 1 KEV; 2/ THE SECOND CORRESPONDS TO THE ENERGY RANGE 1 KEV TO 2 KEV. THE CORRESPONDING SET OF RESONANCE PARAMETERS CONTAINS 435 RESON-ANCES IN THE ENERGY RANGE 0.980 KEV TO 2.02 KEV, 3 FICTICIOUS RESONANCES BELOW 0.9 KEV AND 3 FICTICIOUS RESONANCES ABOVE 2.02

KEV; 3/ THE THIRD CORRESPONDS TO THE ENERGY RANGE 2 KEV TO 2.5 KEV. THE CORRESPONDING SET OF RESONANCE PARAMETERS CONTAINS 218 RESO-NANCES IN THE ENERGY RANGE 1.98 KEV TO 2.53 KEV, 3 FICTICIOUS RESONANCES BELOW 1.98 KEV AND 3 FICTICIOUS RESONANCES ABOVE 2.53 KEV. IN ALL SECTIONS THE FICTICIOUS RESONANCE PARAMETERS TAKE INTO ACCOUNT THE CONTRIBUTION OF ALL THE EXTERNAL TRUNCATED RESONANCES IN SUCH A WAY THAT NO TOTAL, SCATTERING, FISSION AND CAPTURE SMOOTH FILES ARE NEEDED IN THE CORRESPONDING ENERGY RANGES FOR THE REPRODUCTION OF THE CROSS SECTIONS WITHIN THE EXPERIMENTAL ERRORS. THE FOLLOWING EXPERIMENTAL DATA BASE HAS BEEN USED IN THE SAMMY FITS: KEV FITS: -ABSORPTION AND FISSION FROM R.GWIN ET AL./1,2/; -FISSION FROM R.GWIN ET AL./3,4/, J.BLONS/5/, L.W.WESTON ET AL./6,7/; -TRANSMISSION FROM R.R.SPENCER ET AL./8/, J.A.HARVEY ET AL./9/ PRIOR TO THE FITS THE EXPERIMENTAL FISSION AND ABSORPTION CROSS SECTIONS WERE NORMALISED, DIRECTLY OR INDIRECTLY TO THE 0.0253 EV VALUES OBTAINED BY THE ENDF/B-VI STANDARD EVALUATION GROUP/10/. THE TRANSMISSION DATA WERE CONSIDERED AS ACCURATE ABSOLUTE MEASU-REMENTS(R.R.SPENCER TOTAL CROSS SECTION AT 0.0253 EV IS 1025.0 B IN EXCELLENT AGREEMENT WITH THE 1027.3 B STANDARD VALUE). DETAILS ON THE ANALYSIS ARE FOUND IN REFERENCES/11,12,13/ FITS COMMENTS ON THE THERMAL AND LOW ENERGY RANGES THE THERMAL CROSS SECTION VALUES CALCULATED AT 293 K BY THE RESONANCE PARAMETERS OF THE FIRST SECTION ARE GIVEN IN THE FOLLO-WING TABLE: SAMMY RESENDD PROPOSED 293 K (BARN) STANDARD VALUES(BARN)/10/ FISSION747.64747.90747.99+-1.87CAPTURE271.10270.73271.43+-2.14SCATTERING7.977.997.88+-0.97TOTAL1026.711026.621027.30+-5.00 ONE SHOULD NOTE THAT THE 293 K CROSS SECTIONS CALCULATED AT 0.0253 EV DEPEND ON THE WAY THE DOPPLER BROADENING CALCULATION IS PERFORMED. FOR INSTANCE USING A GAUSSIAN BROADENING FUNCTION WILL GIVE A FISSION CROSS SECTION ABOUT 2.5 BARNS LARGER THAN THE ONE OBTAINED FROM THE ACCURATE CALCULATION WHICH CONSERVES THE 1/V SHAPE OF THE THERMAL CROSS SECTION. THE VALUES GIVEN IN THE TABLE ABOVE WERE OBTAINED FROM SAMMY (LEAL-HWANG METHOD)/14,15/ AND FROM RESENDD WITH 0.1% FOR THE INTERPOLATION ACCURACY/16/. THE FOLLOWING TABLE SHOWS EXPERIMENTAL CROSS SECTIONS AVE-RAGED OVER THE ENERGY RANGES 0.02 EV TO 0.06 EV AND 0.02 EV TO 0.65 EV, COMPARED TO THE CALCULATED VALUES: AVERAGE CROSS-SECTIONS (BARN) REFERENCES(1-10) 0.02 TO 0.06 EV 0.02 TO 0.65 EV EXP 631.41 631.41 631.41 CALC (293K) CALC (293K) EXP
 EXP
 CAI

 GWIN71
 FISS
 631.41

 GWIN76
 FISS
 631.41

 GWIN76
 FISS
 631.41

 GWIN76
 FISS
 631.41

 GWIN76
 FISS
 631.41

 DERUYTER70
 FISS
 631.41

 WAGEMANS80
 FISS
 631.41

 WAGEMANS88
 FISS
 631.41

 GWIN71
 CAPTURE
 243.84
 243

 GWIN76
 ABSORPT(*)
 875.90
 874

 SPENCER84
 TOT(*)
 883.20
 882
 EXP 843.71 838.39 837.18 859.43 862.56 631.75(+0.05%) 838.69(+0.18%) 841.80 841.80 243.22(-0.25%) 524.75 518.13(-1.26%) 874.29(-0.18%) 1359.96 1357.14(-0.21%) 882.86(-0.04%) 1361.69 1367.6 (+0.43%) (*)THESE DATA HAD THE LARGIEST WEIGHT IN THE THERMAL FIT. THE VA-LUES BETWEEN THE PARENTHESES GIVE THE PERCENTAGE DEVIATION BETWEEN THE CALCULATED DATA AND THE EXPERIMENTAL DATA.

THE VALUE OF 631.4 BARNS FOR ALL THE AVERAGED EXPERIMENTAL FISSION CROSS SECTIONS IN THE ENERGY RANGE 0.02 EV TO 0.06 EV CORRESPONDS TO THE RENORMALISATION OF THE FISSION EXPERIMENTS TO 748.0+-1. BARNS AT 0.0253 EV. ORNL DATA ARE CONSISTENT WITHIN 0.8% OVER THE ENERGY RANGE 0.02 EV TO 0.65 EV (I.E. OVER THE 0.3 EV RESONANCE). DERUYTER 1970 AND WAGEMANS 1980 DATA ARE ABOUT 2.5% LARGER AND WERE NOT INCLUDED IN THE SAMMY FIT. WHEN NORMALIZED ON THE STANDARD VALUE AT 0.0253 EV, GWIN 76 ABSORPTION AGREES WITH THE ABSORPTION OBTAINED FROM SPENCER TOTAL CROSS SECTION WITHIN 0.7% OVER THE 0.3 EV RESONANCE. THE PRESENT EVALUATION IS ESSENTIALLY THE RESULT OF A CONSISTENT SAMMY ANALYSIS OF ALL THE AVAILABLE ORNL DATA WITH A LARGER WEIGHT ON GWIN 1984 FISSION, GWIN 1976 ABSORPTION AND SPENCER TRANSMISSION DATA. AFTER RENORMALIZATION OF THE CALCULATED FISSION CROSS SECTION ON THE PRELIMINARY 1991 WESTON AND TOD FISSION DATA(SEE NEXT SECTION) A SLIGHT ADJUSTMENT OF THE NEGATIVE RESONANCE PARAMETERS WAS PERFORMED TO KEEP THE VALUES CALCULATED AT 0.0253 EV IN CLOSE AGREEMENT WITH THE STANDARD VALUES. THE 1988 DATA OF WAGEMANS ET AL./17/ AGREE WITHIN 0.4% WITH THE CALCULATED VALUES OVER THE ENERGY RANGE FROM 0.02 EV TO 0.65 EV AFTER ADJUSTMENT OF THE ENERGY SCALE TO THE ONL SCALE (THE DIFFERENCE WAS 0.27 EV AT 20 EV BETWEEN 1988 WAGEMANS AND ORNL SAMMY FIT ENERGY SCALES).

COMMENTS ON THE O KEV TO 1 KEV ENERGY RANGE.

COMMENTS ON THE 0 KEV TO 1 KEV EMERGY RANGE. AT THE END OF 1987, AN ANALYSIS WAS COMPLETED UP TO 1 KEV. IN A PRELIMINARY STEP, A CORRELATED FIT OF HARVEY TRANSMISSION DATA, WESTON 84 FISSION DATA AND BLONS FISSION DATA WAS PERFORMED, WITH POSSIBLE ADJUSTMENT OF THE NORMALIZATION COEFFICIENTS AND OF THE BACKGROUND CORRECTIONS. THIS PRELIMINARY STEP HAS SHOWN THAT THIS ADJUSTMENT WAS NOT NECESSARY TO HAVE CONSISTENCY BETWEEN HARVEY DATA AND WESTON DATA. BLONS DATA NEEDED A LARGE READJUSTMENT OF THE BACKGROUND AND OF THE NORMALIZATION. THEREFORE, THE FINAL FIT WAS PERFORMED ONLY ON HARVEY TRANSWISSION DATA, WWIT NO BACKGROUND AND NORMALISATION ADJUSTMENT, BLONS DATA, WHICH HAVE BETTER RESOLUTION THAN WESTON 84 DATA WERE USED ONLY TO OBTAIN MORE ACCURATE FISSION WIDTHS OF SOME NARROW RESONANCES IN THE HIGH ENREGY RANGE. IN 1989 PRELIMINARY RESULTS OF THE 1988 WESTON FISSION MEASUREMENT/7/ WERE INCLUEDED IN THE SAMMY FYFOLMENTAL DATA BASE. ONE EXPECTED FROM THIS MEASUREMENT, WORPARABLE TO THE RESOLUTION OF HARVEY TRANSMISSION AC CONFIRMATION OF THE EXCLUSION WEASUREMENT/7/ WERE INCLUEDED IN THE SAMMY FYFOLMENTAL DATA BASE. ONE EXPECTED FROM THE MEASUREMENT, A CONSISTENT SAMMY FIT OF HARVEY TRANSMISSION, WESTON 84 FISSION DATA. AND WEEL MINARY WESTON 88 FISSION WAS RESTARTED FROM THE PARAMETER AND COVARIANCE FILES OBTAINED IN 1987. IT APPEARED THAT LARGE BACKGROUND AND NORMALISATION CORRECTIONS WERE NEEDED ON THE NEW WESTON FISSION TO OBTAIN CONSISTENCY WITH HARVEY TRANSMISSION DATA. AND WERE NOT UNDERSTOOD BY TRANSMISSION AND WESTON 84 FISSION COVARIANCE FILES ORACINON SWEREY COMPARABLE TO THOSE FOUND ON BLONS DATA AND WERE NOT UNDERSTOOD BY THE AUTHORS OF THE EXPERIMENT. THE LAST SAMMY RUNS WERE PERFORMED BY NOT ALLOWING BACKGROUND AND NORMALIZATION VARIATIONS ON HARVEY TRANSMISSION AND WESTON AS A FISSION ON SES DOTAL A. NEW SETO FISSION MEASUREMENT. THE CACCULATE AVERAGE FISSION CROSS SECTION IN THE ENERGY RANGE FROM 0.1 KEV TO 1.0 KEV WAS 3.7% SMALLER THAN THE VALUES ON MARE TRAN

RESONANCES; 2/ ADJUSTMENT OF THE NEUTRON WIDTH OF THE 0+ RESONANCES BY A REFIT OF THE TRANSMISSION DATA AND OF THE RENORMALIZED WESTON AND TODD 1984 DATA IN ENERGY RANGES WHERE THE CONTRIBUTION OF THE 0+ RESONANCES IS DOMINANT, AND INCREASE OF THE OTHER(SMALL) 0+ NEUTRON WIDTHS BY 3%. NO SEVERE INCONSISTENCY WAS OBSERVED BETWEEN THE TRANSMISSION DATA AND THE NEW FISSION DATA OVER THE DOMINANT 0+ RESONANCES; THE DIFFERENCES BETWEEN THE 1989 FITS OF THE TRANS-MISSION AND THE NEW FITS WERE CONSISTENT WITHIN THE EXPERIMENTAL ERROR BARS. THE FOLLOWING TABLE SHOWS THE FISSION CROSS SECTIONS CALCULA-TED FROM THE RESONANCE PARAMETERS, THE EXPERIMENTAL VALUES AND THE RESULTS OF THE ENDF/B-VI STANDARD EVALUATION GROUP AVERAGED IN THE

SAME ENERGY INTERVALS. WESTON 1991 DATA ARE PRELIMINARY. WESTON 1984 DATA ARE NORMALIZED ON PRELIMINARY WESTON 1991:

| * * * * * * * * * * * * | ******CR0 | SS-SECTIO | NS(BARN) | * * * * * * * * * * | |
|--|---|--|---|---------------------------------------|--|
| ENERGY
(EV) | CALCUL | WESTON
1991 | WESTON
1984 | STANDARD | |
| $\begin{array}{c} 0.010-10.\\ 9-20\\ 20-40\\ 40-60\\ 60-100\\ 100-200\\ 200-300\\ 300-400\\ 400-500 \end{array}$ | $\begin{array}{c} 80.12\\ 94.74\\ 17.52\\ 50.64\\ 54.42\\ 18.63\\ 17.85\\ 8.31\\ 9.59\end{array}$ | 79.98
94.91
17.76
50.90
54.38
18.59 | 17.97
50.87
54.33
18.56
17.89
8.34
9.58 | 18.66
17.88
8.43
9.57 | |
| 200-500 | 11.92 | 11.93 | 11.93 | 11.96 | |
| 500 - 600
600 - 700
700 - 800
800 - 900
900 - 1000 | 15.39
4.37
5.51
4.84
8.33 | | 15.57
4.30
5.53
4.89
8.38 | 15.86
4.46
5.63
4.98
8.30 | |
| 500-1000 | 7.69 | 7.73 | 7.73 | 7.79 | |
| 20-1000 | 13.09 | . 13.11 | 13.11 | * * * * * * * * * * * | |
| 1971 <u>AND 1976</u> | ABSORPTI | ON DATA V | ERE NOT I | NCLUDED IN T | |

GWIN 1971 AND 1976 ABSORPTION DATA WERE NOT INCLUDED IN THE SAMMY FIT IN THE ENERGY RANGE ABOVE 1 EV. ACCURATE ABSORPTION CROSS SECTIONS SHOULD BE CALCULATED FROM THE PARAMETERS OBTAINED FROM THE ANALYSIS OF THE TRANSMISSION AND FISSION DATA. THE FOLLO-WING TABLE SHOWS THE CALCULATED AVERAGE VALUES OF THE CAPTURE, AB-SORPTION AND ALPHA COMPARED TO GWIN 1971 AND GWIN 1976 DATA. THE CALCULATIONS WERE PERFORMED WITH RESENDD, 1.0 % ACCURACY:

| CROSS-SECTIONS(BARN) |
|--|
| ENERGY(EV) CALC. VALUES (293K) GWIN DATA |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| IF ONE EXCEPTS THE ENERGY RANGE 37.5-50 EV, THE CALCULATED AB-
SORPTION VALUES AGREE WELL WITH GWIN EXPERIMENTAL DATA; THEY ARE
ON AVERAGE 1.2% LOWER IN THE ENERGY RANGE FROM 50 EV TO 1000 EV. |
| COMMENTS ON THE 1 KEV TO 2 KEV ENERGY RANGE |
| PRELIMINARY RESONANCE PARAMETERS WERE OBTAINED IN 1989 FROM THE
ANALYSIS OF THE HARVEY THICK SAMPLE TRANSMISSION DATA AND OF THE
PRELIMINARY RESULTS OF WESTON 88 FISSION MEASUREMENT. DUE TO LACK
OF TIME, THE MEDIUM AND THIN SAMPLE TRANSMISSION DATA WERE NOT
INCLUDED IN THE SAMMY DATA BASE, AND THE CONTRIBUTION OF THE
TRUNCATED EXTERNAL RESONANCES WAS NOT CAREFULLY INVESTIGATED.
NEVERTHELESS, THE RESULTS WERE USED IN THE ENDF/B-VI FILE, ALONG
WITH A SMOOTH FILE IN ORDER TO AGREE WITH THE AVEAGE VALUES OF A
PREVIOUS ENDF/B-VI EVALUATION (THIS PRELIMINARY SET OF PARAMETERS
WAS CONSIDERED AS MORE USEFUL THAN THE STATISTICAL PARAMETERS IN
THE ENERGY RANGE 1 KEV TO 2 KEV FOR THE CALCULATION OF THE SELF- |

SHIELDING FACTORS). THE ANALYSIS WAS RESTARTED IN APRIL 1991 AT JAERI(TOKAI RESEARCH ESTABLISHMENT) WITH AN UPDATED VERSION OF SAMMY ADAPTED BY T.NAKAGAWA TO THE FACOM 780. THE PRELIMINARY SET OF PARAMETERS OBTAINED AT OAK RIDGE IN 1989 WAS USED AS PRIOR INFORMATIONS TO START THE SAMMY CALCULATIONS. ALSO PRIOR TO THE ANALYSIS, THE CON-TRIBUTION OF THE EXTERNAL RESONANCES WAS CALCULATED BY USING THE SET OF THE O KEV TO 1 KEV KNOWN RESONANCES, SHIFTED IN THE ENERGY RANGES -1 KEV TO 0 KEV, 2 KEV TO 3KEV AND 3 KEV TO 4 KEV; EQUIVA-LENT CONTRIBUTION WAS OBTAINED BY USING 3 FICTICIOUS RESONANCES BELOW 1 KEV AND 3 FICTICIOUS RESONANCES ABOVE 2 KEV(SEE DETAILS IN REF./13/). THE ANALYSIS WAS PERFORMED ON THE THICK AND MEDIUM SAMPLE TRANSMISSIONS OF HARVEY DATA (THE THIN SAMPLE DATA WAS NOT USEFUL IN THE HIGH ENERGY RANGE) AND ON THE 1988 FISSION DATA RE-LEASED BY WESTON AT THE BEGINNING OF 1991/7/. THE DEFINITIVE SAMMY FITS WERE PERFORMED IN APRIL 1992 AFTER RENORMALIZATION OF THE 1988 DATA OF WESTON ON THE ENDF/B-VI STANDARD VALUES BETWEEN 1 KEV AND 2 KEV, IN AGREEMENT WITH THE 1991 NEW MEASUREMENTS OF WESTON AND TODD. THE AVERAGE CROSS SECTIONS CALCULATED FROM THE RESONANCE PARAMETERS ARE COMPARED TO THE EXPERIMENTAL VALUES IN THE FOLLO-WING TABLE:

CROSS-SECTIONS(BARN) TOTAL FISSION CAPTURE ENERGY KEV CALC(A) EXP(B) CALC(A) EXP(C) CALC(A) EXP(D) 4.06 1.0-2.0 21.63 21.92 4.442 4.446 3.752 3.79 (A) TOTAL, FISSION AND CAPTURE CROSS SECTIONS CALCULATED BY RESENDD FROM THE RESONANCE PARAMETERS.
(B) EXPERIMENTAL TOTAL CROSS SECTIONS FROM REFERENCE/19/.
(C) WESTON AND TODD 1988 HIGH RESOLUTION FISSION CROSS SECTIONS FROM REFERENCE/7/ NORMALIZED TO ENDF/B-VI STANDARD IN THE ENERGY RANGE FROM 1.0 KEV TO 2.0 KEV.
(D) GWIN 1971 EXPERIMENTAL DATA NORMALIZED TO GWIN 1976 DATA. THE DIFFERENCE OF 1.3% BETWEEN THE AVERAGE CALCULATED TOTAL CROSS SECTION AND THE AVERAGE EXPERIMENTAL CROSS SECTION IN THE ENERGY RANGE FROM 1.0 KEV AND 2.0 KEV IS MAINLY DUE TO THE METHOD OF EVALUATING THE TOTAL CROSS SECTION FROM THE EFFECTIVE CROSS SECTION IN REFERENCE/19/. THE ACCURACY OF THE SAMMY FIT OF THE EXPERIMENTAL TRANSMISSION DATA IS BETTER THAN 0.5% ON THE CROSS SECTION. THE CALCULATED FISSION CROSS SECTIONS ARE IN VERY GOOD AGREEMENT WITH THE EXPERIMENTAL DATA. THE CAPTURE DATA /1/ ARE AVERAGE VALUES OBTAINED FROM THE DATA AVAILABLE IN THE EXFOR FILE AND NORMALIZED TO GWIN 1976 AVERAGE VALUES; THERE ARE LARGE DIFFERENCES BETWEEN THE CALCULATED DATA AND THE EXPERIMENTAL DATA AVERAGED OVER 0.1 KEV INTERVALS; BUT ON THE INTERVAL FROM 1.0 KEV TO 2.0 KEV THE AVERAGE VALUES ARE CONSISTENT WITHIN 1.0%. COMMENTS ON THE 2.0 KEV TO 2.5 KEV REGION THIS ENERGY RANGE WAS ALSO ANALYSED AT JAERI /13/. NO PRELIMINARY SET OF RESONANCE PARAMETERS WAS AVAILABLE PRIOR TO THE ANALYSIS. MORE THAN 90% OF THE RESONANCES, COMPARED TO THE LOW ENERGY RANGE, COULD STILL BE IDENTIFIED IN THE TRANSMISSION DATA BETWEEN 2 KEV AND 2.5 KEV. THEREFORE THE CORRELATED SAMMY ANALYSIS OF HARVEY TRANSMISSIONS AND WESTON FISSION WAS STILL FEASIBLE IN THIS ENERGY RANGE. THE RESONANCE PARAMETERS OBTAINED ARE CONSISTENT AND HAS NEARLY THE SAME STATISTICAL PROPERTIES AS THOSE OF THE RESONANCES IN THE 0 TO 2 KEV ENERGY RANGE. A QUITE GOOD FIT OF THE TRANSMISSION AND FISSION DATA WAS OBTAINED WITHOUT BACKGROUND AND NORMALISATION ADJUSTMENT. HOWEVER, THE CALCULATED FISSION CROSS SECTIONS ARE, ON AVERAGE, 1.4% LOWER THAN THE EXPERIMENTAL VALUES. THIS DIFFERENCE, WHICH HOWEVER IS NOT LARGER

| THAN THE SYSTEMATIC ERRORS ON TH
TO THE DIFFICULTIES OF IDENTIFYI
EXPERIMENTAL DATA, BECAUSE THE E
RESOLUTION AND DOPPLER WIDTHS. F
FISSION DATA OF WESTON AND TODD
NORMALIZED TO THE ENDF/B-VI STAN
KEV TO 2 KEV. | HE EXPERIMENTAL DATA, COULD BE DUE
ING THE WIDE J=0+ RESONANCES IN THE
EFFECTS OF THE INCREASING
PRIOR TO THE SAMMY FITS, THE
(1988 HIGH RESOLUTION DATA) WERE
NDARD IN THE ENERGY RANGE FROM 1 |
|--|--|
| AND AVERAGED OVER 0.1 KEV INTERV
TABLE: | ALS, ARE GIVEN IN THE FOLLOWING |
| ************************************** | ************************************** |
| ENERGY TOTAL | FISSION CAPTURE |
| 2.0-2.1 17.34 17.30
2.1.2.2.2.0.27 10 80 | 2.034 2.062 3.223
2.040 2.000 4.51 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |
| 2.0-2.5 19.65 19.60 | 2.989 3.031 3.473 |
| (A) TOTAL, FISSION AND CAPTURE
RESENDD, 1% ACCURACY, AT 3
TERS. | E CROSS SECTIONS CALCULATED BY
300 K,FROM THE RESONANCE PARAME- |
| (B) AVERAGE TOTAL CROSS SECTION EXPERIMENTAL EFFECTIVE CROSS (C) 1988 HIGH RESOLUTION DATA TO ENDF/B-VI STANDARD IN 1 | DNS OBTAINED FROM THE AVERAGE
DSS SECTIONS IN REFERENCE/19/.
OF WESTON AND TODD NORMALIZED
THE ENERGY RANGE FROM 1 KEV TO |
| 2 KEV.
************************************ | * |
| FISSION AND CAPTURE RESONA | ANCE INTEGRALS |
| THE FISSION AND CAPTURE RESONANC
JENDL-3 DATA IN THE FOLLOWING TA | CE INTEGRALS ARE COMPARED TO
ABLE: |
| ************************************** | * * * * * * * * * * * * * * * * * * * |
| JENDL-3
0.5 - 5.0 85.725
5.0 - 10.0 25.081 | PRESENT JENDL-3 PRESENT
84.879 28.651 28.723
25.147 19.059 18.950 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 99.715
77.181
74.686
41.552
25.930
25.376 |
| 100.0 - 301.0 19.677 301.0 - 1000.0 10.047 1000.0 - 2000.0 3.484 | 20.252 17.952 17.729 10.317 8.348 8.418 3.206 2.840 2.634 |
| 2000.0 -2.E+07 17.783
TOTAL 299.132 | |
| THE JENDL-3 RESONANCE PARAMET | TERS ARE THOSE OBTAINED IN 1987 IN |
| THE ENERGY RANGE O KEV TO 1 KEV.
THOSE PUBLISHED IN 1989. THAT EX
SERVED BETWEEN JENDL-3 AND THE F | . THEY ARE SLIGTHLY DIFFERENT FROM
(PLAINS THE SMALL DIFFERENCES OB-
PRESENT RESULTS IN THIS ENERGY RAN- |
| GE. IN THE ENERGY RANGE 1 KEV TO
RANGE. THE FISSION AND CAPTURE
FROM ENDF/B-V AND THOSE FOUND IN |) 2 KEV JENDL-3 IS UNRESOLVED
RESONANCE INTEGRALS CALCULATED
N BNL-325 ARE THE FOLLOWING: |
| ENDF/B-V FISSION: 302.
BNL-325 FISSION: 310+ | .13 B CAPTURE: 194.10 B
⊦-10 B CAPTURE: 200+-20 B |
| THE CONSEQUENCE OF CHANGING F
PARAMETERS (ENDF/B-V AND PREVIOUS | FROM THE OLD SETS OF RESONANCE
S SETS) TO THE NEW SET IS THAT |
| THE CAPTURÈ RESONANCE INTEGRAL W
WITH ENDF/B-V VALUE. | VILL DÉCREASE BY 6.7% COMPARED |
| REFERENCES OF APPENDIX
1) R.GWIN ET AL., NUCL.SCI.ENG.,
2) R.GWIN ET AL., NUCL.SCI.ENG.,
3) R.GWIN ET AL., NUCL.SCI.ENG.,
4) R.GWIN ET AL., NUCL.SCI.ENG., | ,45,25(1971)
,59,79(1976)
,61,116(1976)
,88,37(1984) |

6) L.W.WESTON ET AL., NUCL.SCI.ENG.88,567(1984)
7) L.W.WESTON ET AL., TO BE PUBLISHED(HIGH RESOLUTION 1988 DATA)
8) R.R.SPENCER ET AL., NUCL.SCI.ENG.,96,318(1987)
9) J.A.HARVEY, MITO 1988, PAGE 115
10) A. CARLSON ET AL., PRELIMINARY RESULTS OF THE ENDF/B-6 STANDARD EVALUATION(SEPT 8 1987)
11) H.DERRIEN AND G. DE SAUSSURE, ORNL-TM-10986(1988)
12) H.DERRIEN ET AL., NUCL.SCI.ENG., 106, 434(1990)
13) H.DERRIEN, J.NUCL>SCI.TECHNOL., 30, 845(1993).
14) N.M.LARSON ET AL., ORNL/TM-7485, ORNL/TM-9179, ORNL/TM-9719/R1
15) L.LEAL AND R.N.HWANG, TRANS.AM.NUC.SOC., 55, 340(1987)
16) T.NAKAGAWA, RESENDD A JAERI VERSION OF RESEND, JAER=-M 84-192 (1984).
17) C.WAGEMANS ET AL., MITO 1988, PAGE 91
18) L.W.WESTON, PRIVATE COMMUNICATION(1992)
19) H.DERRIEN, J.NUCL.SCI.TECHNOL., 29, 794(1992).

MAT number = 9440 94-PU-240 NAIG+ EVAL-MAY87 T.MURATA, DIST-SEP89 REV2-AUG93 A.ZUKERAN HISTORY 87-05 EVALUATION WAS MADE BY T.MURATA (NAIG) : CROSS SECTIONS ABOVE RESONANCE REGION AND OTHER QUANTITIES, A.ZUKERAN(HITACHI): RESONANCE PARAMETERS. 88-06 MT'S=16, 17, 37 AND 102 WERE MODIFIED. 89-02 FP YIELDS WERE TAKEN FROM JNDC FP DECAY FILE VERSION-2. COMPILATION WAS MADE BY T. NAKAGAWA (JAERI). 90-07 FP YIELD DATA WERE MODIFIED. 90-10 MF=5, MT=16, 17, 91: MODIFIED AT THRESHOLD ENERGIES. 93-08 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY ***** MODIFIED PARTS FOR JENDL-3.2 *** (1,452), (1,455) MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455(DELAYED NEUTRONS) AND MT=456(PROMPT NEUTRONS). MT=455 DELAYED NEUTRON DATA BELOW 5 MEV, NU-D OF 0.00911 MEASURED BY BENEDETTI ET AL. /1/ WAS ADOPTED. ABOVE 6 MEV, 0.0067 WAS GIVEN ON THE BASIS OF TUTLE'S SYSTEMATICS /2/. DECAY CONSTANTS WERE TAKEN FROM EVALUATION BY BARDY AND ENGLAND /3/. MT=456 NUMBER OF PROMPT NEUTRONS LINEAR LEAST-SQUARES FITTING TO THE EXPERIMENTAL DATA OF FREHAUT ET AL. /4/ RENORMALIZED TO CF-252 NU-P=3.756. MF=2 RESONANCE PARAMETERS
MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS
1) RESOLVED RESONANCES FOR MLBW FORMULA (1.0E-5 TO 4 KEV) PARAMETERS OF A NEGATIVE AND THE 1.057-EV RESONANCES WERE REVISED ON THE BASIS OF RECOMMENDATION BY MUGHABGHAB /5/. NEUTRON AND CAPTURE WIDTHS OF OTHER LEVELS WERE BASED ON THE EXPERIMENTAL DATA BY HOCKENBURY ET AL. /6/ IN THE ENERGY RANGE FROM 20 TO 500 EV, AND KOLAR AND BOECKHOFF /7/ FROM 500 EV TO 4 KEV. THE AVERAGE CAPTURE WIDTH OF 29.5 MILLI-EV WAS ASSUMED FOR THE RESONANCES WHOSE CAPTURE WIDTHS WERE UNKNOWN. BELOW 610 EV, THE SUB-THRESHOLD FISSION WIDTHS WERE CALCULATED FROM THE AREA DATA BY WESTON AND TODD /8/. ABOVE 610 EV, THEY WERE TAKEN FROM THE DATA BY AUCHAMPAUGH AND WESTON /9/.
2) UNRESOLVED RESONANCES (4 TO 40 KEV) ENERGY DEPENDENT PARAMETERS WERE DETERMINED TO REPRODUCE THE EVALUATED CROSS SECTIONS IN THIS ENERGY REGION. FISSION WIDTHS WERE ADJUSTED TO AVERAGE CROSS SECTIONS MEASURED BY WESTON AND TODD /8/. CALCULATED 2200-M/SEC CROSS SECTIONS AND RES. INTEGERALS. 2200-M/SEC RES. INTEG. TOTAL 291.13 B ELASTIC 1.644 B -FISSION 0.0588 B 8.94 B CALCULATED 2200-M/SEC CROSS SECTIONS AND RES. INTEGERALS. TOTAL ELASTIC FISSION CAPTURE B B 8110. 289.4 MF=3 NEUTRON CROSS SECTIONS BELOW 4 KEV: BACKGROUND CROSS SECTIONS ARE GIVEN TO THE CAPTURE CROSS SECTION. ABOVE 4 KEV: EVALUATED AS FOLLOWS. IN THE ENERGY RANGE FROM 4 TO 40 KEV, THE CROSS SECTIONS ARE REPRESENTED WITH THE UNRESOLVED RESONANCE PARAMETERS, AND THE BACK-GROUND CROSS SECTIONS ARE GIVEN IN MF=3. TOTAL EVALUATED WITH SPLINE FITTING TO THE EXPERIMENTAL DATA OF SMITH FT AL./10/, KAEPPELER ET AL./11/ AND POENITZ ET MT = 1AL./12 ELASTIC SCATTERING OBTAINED BY SUBTRACTING THE OTHER CROSS SECTIONS FROM TOTAL CROSS SECTION. MT=2MT=4 TOTAL INELASTIC SCATTERING SUM OF PARTIAL INELASTIC SCATTERING CROSS SECTIONS (MT=51 TO MT=91). MT=51-78, 91 PARTIAL INELASTIC SCATTERING

| BELOW 3 MEV, THE RESULTS OF STATISTICAL AND COUPLED-CHANNEL
CALCULATION MADE BY LAGRANGE ET AL. /13/ WERE ADOPTED. FOR
SOME LEVELS, FOR WHICH SMITH'S EXPERIMENTAL DATA /14/ WERE
AVAILABLE, THE CALCULATED RESULTS WERE NORMALIZED (FOR 1ST,
2ND, 3RD, 5TH AND 9 TO 11TH LEVELS). |
|---|
| LEVEL SCHEME
NO. ENERGY(MEV) SPIN-PARITY
G.S. 0.0
1 0.04285 2 +
2 0.14169 4 +
3 0.29431 6 +
4 0.4976 8 +
5 0.59736 1 -
6 0.64889 3 -
7 0.74232 5 -
8 0.8607 0 +
9 0.90032 2 +
10 0.93807 1 -
11 0.95887 2 -
12 0.9924 4 +
13 1.0018 3 -
14 1.0306 3 +
15 1.0375 4 -
16 1.0764 4 +
17 1.0895 0 +
18 1.1155 5 -
19 1.1370 2 +
20 1.1615 6 -
19 1.1370 2 +
20 1.1615 6 -
19 1.1370 2 +
21 1.1778 3 +
22 1.2230 2 +
23 1.2325 4 +
24 1.2408 2 -
25 1.2621 3 +
26 1.2820 3 -
27 1.30873 5 -
28 1.41079 0 +
LEVELS ABOVE 1.4108 MEV WERE ASSUMED TO BE CONTINUUM. |
| <pre>MT=16,17,37 (N,2N),(N,3N) AND (N,4N)
CALCULATED FROM NEUTRON EMISSION CROSS SECTION AND BRANCHING
RATIO TO EACH REACTION CHANNEL. NEUTRON EMISSION CROSS
SECTION WAS OBTAINED BY SUBTRACTING THE FISSION AND CAPTURE
CROSS SECTIONS FROM COMPOUND NUCLEUS FORMATION CROSS SECTION
CALCULATED WITH SPHERICAL OPTICAL MODEL. BRANCHING RATIO
WAS OBTAINED FROM FORMALISM GIVEN BY SEGEV ET AL. /15/</pre> |
| <pre>MT=18 FISSION
BELOW 100 KEV: AVERAGE VALUES OF FISSION CROSS SECTION
MEASURED BY WESTON AND TODD /8/ WERE NORMALIZED TO THE
VALUE AT 100 KEV OF THE SIMULTANEOUS EVALUATION.
ABOVE 100 KEV: SIMULTANEOUS EVALUATION WAS MADE BY TAKING
ACCOUNT OF EXPERIMENTAL DATA OF FISSION RATIO AND ABSOLUTE
CROSS SECTIONS OF U-235, U-238, PU-239, PU-240 AND PU-241,
AND CAPTURE CROSS SECTION OF AU-197 /16/.</pre> |
| <pre>MT=102 CAPTURE
BELOW 350 KEV: BASED ON THE EXPERIMENTAL DATA OF HOCKENBURY ET
AL. /6/, WESTON AND TODD /17/ AND THE RATIO DATA OF WISSHAK
AND KAEPPELER /18/ WITH THE CAPTURE CROSS SECTION OF AU-197
/16/. AS A GUIDE LINE, STATISTICAL MODEL CALCULATION WAS
MADE WITH CASTHY CODE /19/.
ABOVE 350 KEV: THE STATISTICAL MODEL CALCULATION WAS
NORMALIZED TO THE VALUE AT 350 KEV. DIRECT AND COLLECTIVE
CAPTURE WAS INCLUDED IN HIGH ENERGY REGION ADOPTING THE
VALUE FOR U-238 GIVEN BY KITAZAWA ET AL. /20/.</pre> |
| THE SPHERICAL OPTICAL POTENTIAL PARAMETERS
V = 40.6 - 0.05*EN, WS = 6.5 + 0.15*EN (MEV)
VSO= 7.0 (MEV)
R = RSO =1.32, RS = 1.38 (FM)
A = AS = ASO =0.47 (FM)
LEVEL DENSITY PARAMETERS WERE DETERMINED TO REPRODUCE THE
RESONANCE LEVEL SPACINGS AND STAIRCASES OF DISCRETE LEVELS. |
| <pre>MT=251 MU-BAR
THE SAME AS JENDL-1 /21/ EXCEPT FOR 20 MEV.
MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2
TAKEN FROM JENDL-1 /21/.
MT=16,17,18,37,91</pre> |

ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM. MT=51-78 FOR THE 1ST AND 2ND LEVELS, RESULTS OF LAGRANGE ET AL. /13/ WERE ADOPTED. FOR OTHERS, STATISTICAL AND DWBA CALCULATIONS WERE MADE. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 CALCULATED WITH PRE-COMPOUND AND MULTI-STEP EVAPORATION THEORY CODE PEGASUS /22/. MT=37 EVAPORATION SPECTRUM WAS GIVEN. MT=18 FISSION SPECTRA CALCULATED FROM MADLAND-NIX FORMULA /23/. AVERAGE ENERGY RELEASE TOTAL AVERAGE FF KINETIC ENERGY = 177.53 MEV AVERAGE MASS NUMBER OF LIGHT FF = 101 AVERAGE MASS NUMBER OF HEAVY FF = 140 LEVEL DENSITY PARAMETER = A/10.0 MT=455 DELAYED NEUTRON SPECTRA ASSUMED TO BE THE SAME AS PU-239 WHICH WERE TAKEN FROM THE EVALUATION BY SAPHIER ET AL. /24/. MT=37 MF=8 FISSION PRODUCT YIELDS MT=454 INDEPENDENT YIELDS MT=459 CUMULATIVE YIELDS BOTH WERE TAKEN FROM JNDC FP DECAY FILE VERSION-2/25/. REFERENCES

BENEDETTI G., ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
TUTTLE R.J.: INDC(NDS)-107/G-SPECIAL, P.29 (1979).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989).
FREHAUT J., ET AL.: CEA(R) 4626 (1974).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984).
HOCKENBURY R.W. ET AL.: NUCL. SCI. ENG., 49, 153 (1972).
KOLAR W. AND BOECKHOFF K.H.: J. NUCL. ENERGY, 22, 299 (1968).
WESTON L.W. AND TODD J.H.: NUCL. SCI. ENG., 88, 567 (1984).
AUCHAMPAUGH G.F. AND WESTON L.E.: PHYS. REV., C12, 1850 (1975). a) WESTON L.W. AND TODD J.H. NUCL. SCI. ENG., 88, 587 (1984).
A) AUCHAMPAUGH G.F. AND WESTON L.E.: PHYS. REV., C12, 1850 (1975).
SMITH A.B. ET AL.: NUCL. SCI. ENG., 47, 19 (1972).
KAEPPLER F., ET AL.: PROC. OF MEETING ON NUCLEAR DATA OF HIGHER PU AND AM ISOTOPES FOR REACTOR APPLICATION, HELD AT BNL, P.49 (1978).
POENITZ W.P., ET AL.; NUCL. SCI. ENG., 78, 333 (1981), AND ANL/NDM-80 (1983).
LAGRANGE CH. AND JARY J.: NEANDC(E) 198"L" (1978).
SEGEV M., ET AL.: ANNALS OF NUCL. ENERGY, 5, 239 (1978).
SEGEV M., ET AL.: 1985 SANTA FE, 2, 1567 (1986).
WESTON L.W. AND TODD J.H.: NUCL. SCI. ENG., 63, 143 (1977).
WISSHAK K. AND KAEPPELER F.: NUCL. SCI. ENG., 66, 363 (1978) AND NUCL. SCI. ENG., 66, 363 (1978) AND NUCL. SCI. ENG., 66, 363 (1978)
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
KITAZAWA H., ET AL.: JAERI 1261 (1979).
IGARASI S., ET AL.: JAERI 1261 (1979).
IJIMA S., ET AL.: JAERI 1261 (1979).
IJIMA S., ET AL.: JAERI 1261 (1979).
KITAZAWA H., ET AL.: JAERI 1261 (1979).
KADLAND D.G. AND NIX J.R.: NUCL. SCI. ENG., 61, 213 (1982).
SAPHIER D., ET AL.: JAERI 1320 (1990).
MAT number = 9443 94-PU-241 JAERI EVAL-OCT87 Y.KIKUCHI,N.SEKINE,T.NAKAGAWA DIST-SEP89 REV2-MAY93 HISTORY 79-10 NEW EVALUATION WAS MADE BY Y.KIKUCHI (JAERI) AND N.SEKINE (HEC) /1/. DATA OF JENDL-1 /2/ WERE SUPERSEDED. 79-12 FILES 2, 3 AND 4 WERE RELEASED AS JENDL-2B /3/. 87-03 THE FISSION CROSS SECTION WAS REVISED BY ADOPTING RESULTS OF SIMULTANEOUS EVALUATION /4/ FOR JENDL-3. 89-02 FP YIELDS WERE ADDED. 90-07 FP YIELDS WERE ADDED. 90-07 FP YIELD DATA WERE MODIFIED. 93-05 JENDL-3.2. RESOLVED RESONANCE PARAMETERS EVALUATED BY DERRIEN AND DE SAUSSURE/5/ (ADOPTED IN ENDF/B-VI) WERE MODIFIED BY H.DERRIEN (JAERI)/6/. COMPILED BY T.NAKAGAWA (NDC/JAERI) HISTORY MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA DATA OF BENEDETTI+ /7/ MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION DATA OF BOLDEMAN AND FREHAUT /8/ FOR THERMAL FISSION WERE ADOPTED AT LOW ENERGIES BY ASSUMING NU-P(CF-252 SPONTANEOUS FISSION) = 3.753 FOR JENDL-2. FOR JENDL-3, DATA WERE INCREASED BY A FACTOR OF 3.756/3.753. AN ENERGY DEPENDENT TERM WAS BASED ON FREHAUT+ /9/ MF=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES : 1 - 300 EV (REICH-MOORE FORMULA) PARAMETERS WERE EVALUATED BY DERRIEN AND DE SAUSSURE/5/, AND MODIFIED BY DERRIEN /6/. DETAILS OF THE MODIFICATION ARE GIVEN IN APPENDIX. UNRESOLVED RESONANCES : 300 EV - 30 KEV OBTAINED BY FITTING EVALUATED FISSION AND CAPTURE CROSS SECTIONS. ENERGY DEPENDENT PARAMETERS : SO, S1 AND GAM-F. FIXED PARAMETERS : R=9.8 FM , GAM-G = 0.040 EV, D-OBS = 0.85 EV 2200-M/SEC CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. 1384.9 B -1384.9 B 11.35 B 1012.0 B 361.53 B ÉLÁSTIC FISSION CAPTURE 572.6 B 179.9 B F=3 NEUTRON CROSS SECTIONS ABOVE 300 EV, SMOOTH CROSS SECTIONS WERE GIVEN AS FOLLOWS. BETWEEN 300 EV AND 30 KEV, CROSS SECTIONS WERE REPRESENTED WITH THE UNRESOLVED RESONANCE PARAMETES. MF = 3SPIN-PARITY 5/2 + 7/2 + 9/2 + 1/2 + NO G.S. 41.8 94.0 161.5 123 $\frac{1}{2} + \frac{3}{2} + \frac{3}{2} + \frac{9}{2} + \frac{9}{2} + \frac{7}{2} + \frac{11$ 170.8 223.1 230.0 4 56 242.7 7 8 300 9/2 + 335 9

10 368 13/2 + 11 445 11/2 -CONTINUUM LEVELS ASSUMED ABOVE 490 KEV. THE LEVEL DENSITY PARAMETERS: GILBERT AND CAMERON /13/. MT=16, 17, 37 (N,2N), (N,3N), (N,4N) CALCULATED WITH EVAPORATION MODEL. FISSION ABOVE 70 KEV, SIMULTANEOUS EVALUATION WITH U-235, U-238, PU-240, PU-241 /4/ WERE ADOPTED. THE EXPERIMENTAL DATA TAKEN INTO ACCOUNT ARE THOSE BY SZABO+ /14,15/, CARLSON+ /16,17/, FURSOV+ /18/AND KEAPPELER+ /19/. BELOW 45 KEV, JENDL-2 WAS ADOPTED. THESE TWO SETS OF DATA WERE CONNECTED SMOOTHLY BETWEEN 45 AND 70 KEV. MT = 18CAPTURE BASED ON THE DATA OF ALPHA BY WESTON+ /20/ UP TO 250 KEV. CALCULATED WITH CASTHY ABOVE 250 KEV. THE GAMMA-RAY STRENGTH FUNCTION WAS DETERMINED SO THAT THE CAPTURE CROSS SECTION WAS 269 MB AT 250 KEV. MT=102 MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2, 51-61 : CALCULATED WITH CASTHY. MT=16,17,18,37,91 : ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,18,37,91 CALCULATED WITH PRE-EQUILIBRIUM AND MULTI-STEP EVAPORATION CODE PEGASUS/21/. MT=18 PROMPT FISSION NEUTRON SPECTRUM. DETERMINED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /22/. MT=455 DELAYED NEUTRON SPECTRUM. EVALUATION BY SAPHIER ET AL. /23/ WAS ADOPTED. MF=8 FISSION PRODUCT YIELDS MT=454 INDEPENDENT YIELDS MT=459 CUMULATIVE YIELDS BOTH WERE TAKEN FROM JNDC FP DECAY FILE VERSION-2/24/. REFERENCES 1) KIKUCHI Y. AND SEKINE N.: JAERI-M 84-111 (1984). 2) KIKUCHI Y.: J. NUCL. SCI. TECHNOL., 14, 467 (1977). 3) KIKUCHI Y. ET AL.: J. NUCL. SCI. TECHNOL., 17, 567 (1980). 4) KANDA Y. ET AL.: 1985 SANTA FE, 2, 1567 (1986). 5) DERRIEN H. AND DE SAUSSURE G.: NUCL. SCI. ENG., 106, 415 berkien H.: AND DE SAUSSURE G.: NUCL. SCT. ENG., 106, 415 (1990).
DERRIEN H.: JAERI-M 93-251 (1994).
BENEDETTI G. ET.AL.: NUCL. SCI. ENG., 80, 379 (1982).
BOLDEMAN J.W. AND FREHAUT J.: NUCL. SCI. ENG., 76, 49 (1980).
FREHAUT J. ET.AL.: CEA-R-4626 (1974).
MATSUNOBU H. ET.AL.: 1979 KNOXVILLE CONF., P.715, NBS SPECIAL PUBLICATION 594 (1980).
IABRASI S. AND FUKAHORI T.: JAERI 1321 (1991).
LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES, 7TH ED. (1978) 12) LEDERER U.M. AND SHITLEL T.C.L. (1978).
13) GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 14.
14) SZABO I. ET.AL.: CONF-701002, P.257 (1971).
15) SZABO I. ET.AL.: 1973 KIEV CONF, VOL.3, P.27 (1973).
16) CARLSON G.W. ET AL.: NUCL. SCI. ENG., 63, 149 (1977)
17) CARLSON G.W. AND BEHRENS J.W.: NUCL. SCI. ENG., 68, (1078) PHYS., 43, 1446(1965). 128 (1978). FURSOV B.I. ET.AL.: SOV. AT. ENERGY, 44, 262 (1978). KAEPPELER F. AND PFLETSCHINGER E.: NUC. SCI. ENG., 51, 124 18) (1973).
(1973).
(20) WESTON L.W. AND TODD J.H.: NUCL.SCI.ENG., 65, 454 (1978).
21) IIJIMA S. ET AL.: JAERI-M 87-025, 337 (1987).
22) SMITH A. ET AL.: ANL/NDM-50 (1979).
23) SAPHIER D. ET AL.: NUCL. SCI. ENG., 62, 660 (1977).
24) TASAKA K. ET AL.: JAERI 1320 (1990). APPENDIX REVISED RESONANCE DATA , JAERI MAY 1993 REVISION OF THE 241PU REICH-MOORE RESONANCE PARAMETERS BY COMPARISON WITH RECENT FISSION CROSS SECTION MEASUREMENTS. HERVE DERRIEN JAPANESE ATOMIC ENERGY RESEARCH INSTITUTE

I-INTRODUCTION.

I-INTRODUCTION. THE RESONANCE PARAMETERS OF THE NEUTRON CROSS SECTIONS OF 241PU WERE OBTAINED BY DERRIEN AND DE SAUSSURE/1/ IN THE ENERGY RANGE FROM THERMAL TO 300 EV BY A BAYESIAN FIT OF SELECTED EXPERIMENTAL EFFECTIVE TOTAL CROSS SECTIONS. FISSION AND CAPTURE CROSS SECTIONS BY USING THE REICH-MOORE FITTING CODE SAMMY/2/. THE RESULTS OF THIS WORK WERE USED IN THE ENDF/B-VI EVALUATED DATA FILE. SOME DIFFICULTIES WERE ENCOUNTERED IN THE NORMALIZATION OF THE EXPERIMENTAL FISSION CROSS SECTIONS DUE TO THE DISCREPANCIES IN THE SHAPE OF THE AVAILABLE EXPERIMENTAL DATA BOTH IN THERMAL AND HIGH ENERGY RANGES. THE CONSISTENCY AMONG THE EXPERIMENTAL DATA BASE COULD NOT BE OBTAINED WITHOUT LARGE RENORMALIZATION AND BACKGROUND CORRECTION PARAMETERS IN THE SAMMY FITS. PARTICULARLY, IT WAS SHOWN THAT THE DISCREPANCY BETWEEN THE FISSION CROSS SECTIONS IN THE THERMAL ENERGY RANGE WAS DUE TO A DEVIATION FROM THE 1/V SHAPE BELOW ABOUT 0.05 EV. NEW FISSION CROSS SECTION MEASUREMENTS WERE RECENTLY PERFORMED BY WAGEMANS ET AL./3.4/ IN THE ENERGY RANGE FROM 0.002 EV TO 20 EV IN ORDER TO CHECK THE SHAPE OF THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE FISSION CROSS SECTION WAS CLEARLY COMPATIBLE WITH THE 1/V LAW. IN CONTRADICTION TO ALL THE PREVIOUS MEASUREMENTS REPORTED IN THE EXPR

II-COMMENTS ON ENDF/B-VI EVALUATION.

II-COMMENTS ON ENDF/B-VI EVALUATION. IN THE ENERGY RANGE FROM 0.01 EV TO 3 EV THE NEW DATA OF WAGEMANS ET AL. ARE ON AVERAGE 2.2 % SMALLER THAN ENDF/B-VI. THIS DIFFERENCE IS MAINLY DUE A DIFFERENCE OF 3% BETWEEN THE 1976 DATA OF WAGEMANS ET AL. // AND THE NEW VALUES OF WAGEMANS ET AL. THE 1976 DATA OF WAGEMANS ET AL. WERE USED IN THE EVALUATION OF DERRIEN AND DE SAUSSURE IN THE LOW ENERGY REGION. IN THE INTERMEDIATE ENERGY RANGE FROM 3 EV TO 12 EV. THE AVERAGE FISSION OF ENDF/B-VI IS IN EXCELLENT AGREEMENT WITH THE NEW DATA OF WAGEMANS ET AL. IN THIS ENERGY RANGE, THE SAMMY FITS OF DERRIEN AND DE SAUSSURE WERE PERFORMED ON THE FISSION CROSS SECTION OF WESTON AND TODD/67. OF BLONS/77 AND OF MIGNECO ET AL./8/ WITH AN ADJUSTMENT OF THE NORMALIZATION FACTOR AND OF THE BACKGROUND CORRECTION PARAMETERS OF ALL THE EXPERIMENTAL DATA; THE AGREEMENT BETWEEN THE NEW DATA OF WAGEMANS ET AL. AND ENDF/B-VI SHOWS THAT, AT LEAST IN THIS ENERGY RANGE, SAMMY PERFORMED ON THE DATA OF WESTON AND TODD A RENORMALIZATION EQUIVALENT TO THAT RECOMMENDED BY WAGEMANS ET AL./4/. IN THE HIGHER RANGE UP TO 300 EV, THE SAMMY FITS RELIED MAINLY ON THE HIGH RESOLUTION MEASUREMENTS OF BLONS AND OF MIGNECO ET AL. FOR THE ACCURATE DETERMINATION OF THE RESONANCE PARAMETERS. QUITE LARGE NORMALIZATION COEFFICIENTS AND BACKGROUND CORRECTION. PARAMETERS WERE ALSO NEEDED IN THIS ENERGY RANGE TO OBTAIN THE CONSISTENCY BETWEEN THE CALCULATED CROSS SECTIONS AND THE EXPERIMENTAL DATA. HOWEVER, THE RESULT OF THE FITS WAS IN QUITE GOOD AGREEMENT WITH THE DATA OF WESTON AND TODD NORMALIZED TO THE 1976 DATA OF WAGEMANS ET AL. IN THE LOW ENERGY RANGE TO BATA OF WAGEMANS ET AL./9/. SINCE THE EARLIER DATA OF WESTON AND THE CONSISTENCY BETWEN THE CALCULATED CROSS SECTIONS AND THE EXPERIMENTAL DATA. HOWEVER, THE RESULT OF THE FITS WAS IN QUITE GOOD AGREEMENT WITH THE DATA OF WESTON AND TODD NORMALIZED TO THE 1976 DATA OF WAGEMANS ET AL. IN THE LOW ENERGY REGION, WHICH IS ALSO EQUIVALENT TO THE NORMALIZATION TO THE PAS DATA OF WAGEMANS

III-REVISION OF THE RESONANCE PARAMETERS.

AN ACCURATE UP-DATING OF THE 241PU RESONANCE PARAMETERS COULD BE OBTAINED BY RENORMALIZING THE FISSION EXPERIMENTAL DATA BASE ACCORDING TO THE NEW DATA OF WAGEMANS ET AL. AND BY RESTARTING THE SAMMY FITS OF THE NEW EXPERIMENTAL DATA BASE. INCLUDING THE HIGH RESOLUTION TRANSMISSION DATA OF HARVEY AND SIMPSON/10/. DUE TO LACK OF TIME A NEW SAMMY ANALYSIS WAS PERFORMED ONLY IN THE ENERGY RANGE FROM 0.002 EV TO 3 EV. IN THE ENERGY RANGE ABOVE 3 EV THE UP-DATING WAS PERFORMED BY APPLYING SOME SMALL CORRECTIONS TO THE RESONANCE PARAMETERS. THE SAMMY ANALYSIS OF THE NEW WAGEMANS ET AL. DATA WAS PERFORMED ALONG WITH THE TOTAL CROSS SECTION OF YOUNG AND SMITH/11/ IN THE ENERGY RANGE FROM 0.002 EV TO 3 EV. BY STARTING WITH THE ENDF/B-VI RESONANCE PARAMETERS. ONLY THE PARAMETERS OF THE 3+ RESONANCES AT -0.122 EV AND AT 0.265 EV WERE ADJUSTED IN

THIS ENERGY RANGE. THE VALUES OF THE CROSS SECTIONS CALCULATED AT 0.0253 EV ARE COMPARED TO THE STANDARD DATA/12/ IN TABLE 1. THE AVERAGE TOTAL, FISSION AND CAPTURE CROSS SECTIONS CALCULATED WITH THE NEW RESONANCE PARAMETERS ARE DISPLAYED ON TABLES 2, 3 AND 4 WITH THE CORRESPONDING EXPERIMENTAL DATA AND THE VALUES OBTAINED FROM ENDF/B-VI. ONE SHOULD POINT OUT THAT AN ENERGY SHIFT OF DE/E=+0.00384 WAS APPLIED TO THE DATA OF YOUNG AND SMITH IN ORDER TO ACHIEVE A GOOD CONSISTENCY WITH THE ENERGY SCALE OF THE FISSION DATA OF WAGEMANS ET AL. OVER THE RESONANCE AT 0.0265 EV. IN THE ENERGY RANGE ABOVE 3 EV THE SMALL CORRECTIONS APPLIED TO THE RESONANCE PARAMETERS RESULT IN A DECREASE OF THE AVERAGE FISSION CROSS SECTION AND IN AN INCREASE OF THE AVERAGE CAPTURE CROSS SECTION, WITH A VARIATION OF THE AVERAGE TOTAL CROSS SECTION SMALLER THAN THE ERRORS OF THE EXPERIMENTAL DATA OF HARVEY AND SIMPSON. THE AVERAGE VALUES OF THE FISSION AND CAPTURE CROSS SECTIONS CALCULATED WITH THE NEW RESONANCE PARAMETERS ARE SHOWN IN TABLE 5 AND 6 ALONG WITH THE NEW RESONANCE PARAMETERS ARE SHOWN IN TABLE 5 AND 6 ALONG WITH THE NEW RESONANCE PARAMETERS ARE SHOWN IN

IV-CONCLUSION.

THE RESULTS OF THE RECENT MEASUREMENT OF THE 241PU FISSION CROSS SECTION IN THE ENERGY RANGE FROM 0.002 EV TO 4 EV OF WAGEMANS ET AL. WERE USED IN A NEW EVALUATION OF THE RESONANCE PARAMETERS. THE ACCURACY OF THE CALCULATED CROSS SECTIONS WAS GREATLY IMPROVED IN THE RESONANCE AT 0.265 EV. THE CROSS SECTIONS AVERAGED OVER THIS RESONANCE SHOULD HAVE THE SAME ACCURACY THAN THE STANDARD VALUES AT 0.0253 EV. IN THE HIGH ENERGY REGION UP TO 300 EV THE SAMMY ANALYSIS OF THE NEW EXPERIMENTAL DATA BASE OBTAINED BY THE RENORMALIZATION OF THE EXPERIMENTAL DATA IS RECOMMENDED IN ORDER TO IMPROVE THE CORRECTIONS TO THE RESONANCE PARAMETERS PERFORMED IN THE PRESENT WORK.

| TABLE 1 | CROSS | SECTIONS | ΑT | 0.0253 | ΕV |
|---------|-------|----------|----|--------|----|
| | | | | | |

| | PRESENT RESULTS | ENDF/B-VI STANDARD/12/ |
|------------|-----------------|------------------------|
| FISSION | 1012.50(-0.0%) | 1012.68+-6.58 |
| CAPTURE | 361.52(+0.1%) | 361.29+-4.95 |
| SCATTERING | 11.36(-7.1%) | 12.17+-2.62 |
| TOTAL | 1385.38(-0.1%) | 1386.14+-8.64 |

TABLE 2THE TOTAL CROSS SECTION INTEGRAL IN THE ENERGY RANGE
FROM 0.0021 EV TO 3 EV.

| ENERGY RANGE
(EV) | PRESENT WOR
(B*EV) | K ENDF/B-VI
(B*EV) | YOUNG AND SMITH/11/
(B*EV) |
|--|--|---|--|
| $\begin{array}{c} 0.0021 - 0.020\\ 0.0200 - 0.030\\ 0.0300 - 0.100\\ 0.1000 - 0.500\\ 0.5000 - 1.000\\ 1.0000 - 3.000 \end{array}$ | $\begin{array}{r} 43.54\\ 14.03\\ 65.09\\ 378.38\\ 29.74\\ 83.36\end{array}$ | 43.09(-1.0%)
14.02(-0.1%)
66.17(+1.7%)
385.27(+1.8%)
29.41(-1.1%)
83.92(+0.7%) | $\begin{array}{c} 43.25(-0.7\%)\\ 14.01(-0.1\%)\\ 64.99(-0.1\%)\\ 380.10(+0.4\%)\\ 31.19(+4.4\%)\\ 82.50(-1.0\%)\end{array}$ |
| 0.0021-3.000 | 614.14 | 621.88(+1.3%) | 616.04(+0.3%) |

TABLE 3 THE FISSION CROSS SECTION INTEGRAL IN THE ENERGY RANGE FROM 0.0021 EV TO 3 EV.

| ENERGY RANGE
(EV) | THIS WORK
(B*EV) | ENDF/B-VI
(B*EV) | WAGEMANS ET AL.
(B*EV)/4/ | WESTON AND TODD (B*EV)/6/ |
|--|---|---|---|---|
| 0.0021-0.020
0.0200-0.030
0.0300-0.100
0.1000-0.500
0.5000-1.000
1.0000-3.000 | 31.06
10.24
49.02
262.76
17.93
54.88 | 30.61(-1.5%)
10.22(-0.2%)
50.02(+2.0%)
270.84(+3.1%)
17.64(-1.6%)
55.62(+1.3%) | $\begin{array}{c} 31.09(+0.1\%)\\ 10.24(0.0\%)\\ 48.70(-0.6\%)\\ 264.58(+0.7\%)\\ 17.60(-1.8\%)\\ 54.40(-0.9\%)\end{array}$ | 262.53(-0.1%)
17.67(-1.4%)
55.06(+0.3%) |
| 0.0021-3.000 | 425.89 | 434.95(+2.1%) | 426.61(+0.2%) | |
| 0.1000-3.000 | 335.57 | 344.10(+2.5%) | 336.58(+0.3%) | 335.26(-0.1%) |

WESTON AND TODD EXPERIMENTAL DATA WERE NORMALIZED TO WAGEMANS ET AL./4/ IN THE ENERGY RANGE FROM 0.1 EV TO 12 EV (ORIGINAL EXFOR DATA MULTIPLIED BY 0.952).

THE CAPTURE CROSS SECTION INTEGRAL IN THE ENERGY RANGE FROM 0.0021 EV TO 3 EV. TABLE 4

| ENERGY RANGE
(EV) | PRESENT WORK
(B*EV) | ENDF/B-VI
(B*EV) | WESTON AND TODD/6/
(B*EV) |
|--|--|---|--|
| 0.0021-0.020
0.0200-0.030
0.0300-0.100
0.1000-0.500
0.5000-1.000
1.0000-3.000 | 12.25
3.67
15.28
110.58
5.90
7.30 | $\begin{array}{c} 12.28(+0.2\%)\\ 3.68(+0.3\%)\\ 15.39(+0.7\%)\\ 109.47(-1.0\%)\\ 5.87(-0.5\%)\\ 7.14(-2.2\%)\end{array}$ | 15.27(-0.1%)
110.49(-0.1%)
6.51
8.96 |
| 0.0021-3.000 | 154.98 | 153.83(-0.7%) | |
| 0.0300-3.000 | 139.06 | 137.87(-0.9%) | 141.29(+1.6%) |
| WESTON AND TOD
CULATED AVERA
0.264 EV(ORIGI
RANGE FROM 0.5
DUE TO LARGE C | D EXPERIMENTAL
GE CAPTURE CR
NAL EXFOR DATA
EV TO 3 EV TH
ORRECTIONS FOR | DATA WERE NORI
OSS SECTION OV
MULTIPLIED BY
E EXPERIMENTAL
THE IMPURITIES | WALIZED TO THE CAL-
ER THE RESONANCE AT
0.914): IN THE ENERGY
DATA ARE NOT ACCURATE
S. |

TABLE 5 THE FISSION CROSS SECTION INTEGRAL IN THE ENERGY RANGE FROM 3 EV TO 300 EV.

| ENERGY RANGE
(EV) | PRESENT WORK
(B*EV) | ENDF/B-VI
(B*EV) | WESTON AND TODD/6/
(B*EV) |
|---|---|--|--|
| 3-20
20-50
50-100
100-200
200-300 | 3038.63
1683.69
1971.15
2554.85
2741.23 | 3066.37(+0.9%)
1739.68(+3.3%)
2030.10(+3.0%)
2628.39(+2.9%)
2820.75(+2.9%) | 3036.23(-0.1%)
1705.50(+1.3%)
1931.50(-2.0%)
2531.00(-0.9%)
2747.00(+0.2%) |
| 3-300 | 11989.55 | 12285.29(+2.5%) | 11951.23(-0.3%) |
| WESTON AND TOD
AL./4/ IN THE
DATA MULTIPLIE | D EXPERIMENTAL
ENERGY RANGE FR
D BY 0.952). | DATA WERE NORMAL
OM 0.1 EV TO 12 | IZED TO WAGEMANS ET
EV (ORIGINAL EXFOR |

THE CAPTURE CROSS SECTION INTEGRAL IN THE ENERGY RANGE FROM 3 EV TO 300 EV. TABLE 6

| - | ENERGY RANGE F
(EV) | PRESENT WORK
(B*EV) | ENDF/B-VI
(B*EV) | WESTON AND TODD/6/
(B*EV) |
|---|---|---|--|---|
| - | 3 - 20
20 - 50
50 - 100
100 - 200
200 - 300 | 1213.07
330.34
605.40
609.83
684.97 | 1138.52(-6.5%)
307.48(-7.5%)
585.88(-3.2%)
581.77(-4.8%)
661.12(-3.6%) | $\begin{array}{c} 1192.90(-1.7\%)\\ 338.09(+2.3\%)\\ 594.83(-1.8\%)\\ 652.68(+7.0\%)\\ 700.53(+2.3\%)\end{array}$ |
| | 3-300 | 3443.36 | 3274.77(-5.1%) | 3479.04(+1.0%) |
| - | WESTON AND TODD
AVERAGE CAPTURE
(ORIGINAL EXFOR | EXPERIMENTAL
CROSS SECTION
DATA MULTIPL | DATA NORMALIZED
N OVER THE RESON/
IED BY 0.914). | TO THE CALCULATED
ANCE AT 0.265 EV |

REFERENCES OF APPENDIX

DERRIEN,H. AND DE SAUSSURE,G.:NUC. SCI. ENG. 106, 415(1990).
LARSON,N.M. AND PEREY,F.G.:ORNL/TM-9719(1985).
WAGEMANS,C., SCHILLEBEECKX,P., DERUYTTER,A. AND BARTHELEMY,R.: PROC. INT. CONF., PHYSOR 90, MARSEILLE, FRANCE, VOL.1, III-9(1990).
WAGEMANS,C., SCHILLEBEECKX,P., DERUYTTER,A. AND BARTHELEMY,R.: PROC. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, JUELICH 13-17 MAY 1991, P.35(1991).
WAGEMANS,C. AND DERUYTTER,A.: NUCL. SCI. ENG. 60, 44(1976).
WESTON,L.W. AND TODD,J.H.: NUCL. SCI. ENG. 65, 454(1978).

7) BLONS, J.: NUCL. SCI. ENG. 51, 130(1973).
8) MIGNECO, E., THEOBALD, J.P. AND WARTENA, J.A.: PROC. CONF. NUCL. DATA FOR REACTORS, HELSINKI, FINLAND, JUNE 15-19, 1970, VOL.I, P.437, IAEA(1970).
9) WAGEMANS, C. AND DERUYTTER, A.: PROC. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, ANTWERP, BELGIUM, 69(1983).
10) HARVEY, J.A. AND SIMPSON, O.D.: OAK-RIDGE NATIONAL LABORATORY(1973), UNPUBLISHED.
11) YOUNG, T.B. AND SMITH, J.R.: WASH-1093, P.60(1968).
12) CARLSON, A. ET AL.: ENDF/B-VI STANDARD EVALUATION, PRIVATE COMMUNICATION FROM PEELLE, R.W. (1987).

MAT number = 9446 94-PU-242 NAIG EVAL-MAR87 T.MURATA, DIST-SEP89 REV2-JUN94 M.KAWAI HISTORY HISTORY 87-05 EVALUATION WAS MADE BY T.MURATA (NAIG): CROSS SECTIONS ABOVE RESONANCE REGION AND OTHER QUANTITIES, M.KAWAI (NAIG): RESONANCE PARAMETERS. 89-02 FP YIELDS WERE ADDED. COMPILATION WAS MADE BY T. NAKAGAWA (JAERI). 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION BASED ON THE EXPERIMENTAL DATA BY EVANS ET AL./1/, AND SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS FOR MLBW (1.0E-5 EV TO 1.15 KEV) EVALUATION FOR JENDL-2 WAS MODIFIED ON THE BASIS OF FISSION CROSS SECTION MEASUREMENTS BY WEIGMANN ET AL. /8/ RES. ENERGIES = BNL 325 (3RD) /9/ NEUTRON AND CAPTURE WIDTHS = POORTMANS ET AL. /10/, AUCHAMPAUGH ET AL./11/ FISSION WIDTHS = WEIGMANN ET AL. /8/ R = 9.9 FM AVERAGE CAPTURE WIDTH = 0.0242 EV TWO NEGATIVE RESONANCES WERE ADDED TO REPRODUCE 2200-M/S CROSS SECTIONS RECOMMENDED BY MUGHABGHAB /12/ UNRESOLVED RESONANCE PARAMETERS (1.15 TO 40 KEV) PARAMETERS WERE DETERMINED TO REPRODUCE CROSS SECTIONS EVALUATED AS DESCRIBED BELOW. CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/S(B) TOTAL 27.11 27.11 27.11 ELASTIC FISSION CAPTURE 8.32 0.00256 18.79 5.58 113Ŏ MF=3 NEUTRON CROSS SECTIONS BELOW 40 KEV, REPRESENTED WITH RESONANCE PARAMETERS. MT=1 SIG-TOT BELOW 6 KEV : EXPERIMENTAL DATA OF YOUNG AND REEDER /13/ WERE AVERAGED OVER SOME KEV ENERGY INTERVAL. ABOVE 6 KEV : SPLINE FITTING TO EXPERIMENTAL DATA OF KAEPPELER ET AL. /14/ AND MOORE ET AL. /15/ MT=2 SIG-EL OBTAINED BY SUBTRACTING OTHER CROSS SECTIONS FROM TOTAL. MT=4 SIG-INEL SUM OF PARTIAL INELASTIC CROSS SECTIONS MT=51-91 PARTIAL SIG-INEL BELOW 3 MEV : THE RESULTS OF STATISTICAL AND COUPLED CHANNEL CALCULATION OF LAGRANGE ET AL./16/ WERE ADOPTED. ABOVE 3 MEV : EXTRAPOLATION OF THE VALUES WAS MADE BASED ON DWBA CALCULATION. LEVEL SCHEME ENERGY(MEV) ÑŌ. G.S SPIN-PARITY 0.0 0.04285 0 + 2 + 1 ż 4 ÷ 0.141685

| | LEVELS | 3456789011234567890111234567890111234567890
1112345678902223456780
AB | /Ε 1. | CC
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC
CC | 299
499
599
64
496
40
498
499
499
499
499
400
403
403
403
403
403
403
403
403
403 | 4314
766
8232
2072
807
807
807
807
807
807
807
807
807
807 | ERE | ASS | UME | | 63-1-3-5-0-2-1-2-1-3-3-1-1-0-2-5-3-2-1-1-3-3-5-0-0-
63-1-3-5-0-2-1-2-1-3-3-1-1-0-2-5-3-2-1-1-3-3-5-0-0-0-
HEE | COL | NTIN | IUUM | | |
|--------------------|---|---|--|--|---|---|--|--|--|---|---|--------------------------------------|--|--------------------------------------|---|----------------|
| MT=16, | 17,37
GIVEN
AND BR
CROSS
CAPTUR
CALCUL
RATIO
AL./17 | SIGMA
BY MU
ANCHI
SECTI
E CRC
ATED
WAS C
/ | AS OF
JLTIP
NG R
ON W
OSS S
WITH
CALCU | (N,
ATIC
ASC
ECTI
SPH
LATE | 2N)
TIOI
BTA
ONS
IERIC | , (N
EAC
INED
FRO
CAL
ITH | ,3N)
NEU
H RE
BY
M RE
OPTI
THE |) AN
UTRO
EACT
SUB
EACT
ICAL
FOR | D (
N E
ION
TRA
ION
MO
MAL | N,4N
MISS
CTIN
CRC
DEL.
ISM | N)
SION
FHE
NG F
OSS
T
GIV | CRO
NEU
ISS
SEC
HE
EN | OSS
TRON
ION
TION
BRAN
BY S | SEC
EM
AND
CHIN
EGE | TION
ISSIC
NG
V ET | N |
| MT=18 | SIG-FI
BELOW
AREA
THE
ABOVE
EXPE
U-23 | SS
100 K
DATA
VALUE
100 K
RIMEN
5 FIS | (EV :
OF
EV :
ITAL
SION | SHA
AUCH
HIGH
FIS
DATA
CRC | APE
IAMP
IER
ISON
SON
OSS | OF S
AUGH
ENER
RAT
BEH
SECT | IG-F
ET
GY F
IO T
RENS | FISS
AL.
REGI
FO U
S ET
/20 | DE
/18
ON
-23
AL
/. | TERN
/ 1
5 W/
./19 | AINE
THEN
AS D
9/ A | D OI
NOI
ETEI
ND I | N TH
RMAL
RMIN
MULT | IZEI
IZEI
IED (
IPL | ISSIC
D TO
ON TH
IED E |)N
IE
SY |
| MT=102
EN
0T | 2 SIG-C
IERGY R
EXPERI
KAEPPE
HER EN
CASTHY
6 TO 2
INCLUD
GIVEN | AP
EGION
MENTA
LER /
ERGY
CODE
10 KE
ED IN
BY KI | I OF
L DA
22/.
REGI
/23
V. D
I HIG
TAZA | 6 KE
TAC
ON:
/WA
IREC
H EN
WAE | ST
ST
ST
S
S
S
S
S
S
S
S
S
S
S
S
S
S
S | O 21
OCHE
ORMA
ORMA
ND C
Y RE
L./2 | 0 KE
NBUF
LIZE
OLLE
GIOM
4/ | EV :
RY E
ED T
ECTI
N US | DE
T A
ALC
O S
VE
ING | TERN
L./2
ULA1
IG-C
CAP1
THE | AINE
21/
CION
CAP
FURE
E VA | D OI
AND
RES
IN
PRO | N TH
WIS
SULT
THE
OCES
OF | E BA
SHAP
REG
SES
U - 2: | ASIS
KAND
TH
ION C
WERE
38 | OF
F |
| ** F | PARAMET
SPHER
V=
R=
LEVEL
RESON | ERS F
ICAL
40. 1
1.32
AS=AS
DENS
ANCE | OR T
OPTI
-0.0
0=0.
0
ITY
LEVE | HE C
CAL
5EN
47
PARA
L SP | ASTI
POTI
RS=
METI
ACII | HY C
ENTI
S=6.
1.38
ERS
NGS | ODE
AL F
5+0 | CAL
PARA
15E
DE
LEV | CUL
MET
RSÖ
TER
EL | ATIC
ERS
VSC
=1.3
MINE
SCHE | DN
D=7.
32
ED T
EME | 0
O RI
SUM | (MEV
(FN
(FN
EPRC
STA | ()
)
 DUCE | E THE
ASES. | |
| MT=2 | | ED TC |) BE | THE
TION | SAMI | E AS | TH/ | AT 0 | F P | U-24 | 40. | MED | WH | псы | WEDE | : |
| MT=2 | DETER
2 DSIG- | MÏNEČ
El | AS | FOLL | .0WS | | | - 2 - 0 | | | 1000 | MLD | , | TON | WENLE | |
| MT=5 | 51 TO 9
FOR T
LAGRA
ADOPT
LATIO | 1 DS
HE 1S
NGE E
ED.
NS WE | GIG-I
GT AN
ET AL
FOR
ERE M | NEL
D 2N
./16
OTHE
ADE. | ID LI
5/ AI
R LI | EVEL
RE A
EVEL | S TH
VAIL
S, S | HE R
LABL
STAT | ESU
E A
IST | LTS
ND 1
ICAL | OF
THEI
PL | CAL(
R RI
US I | CULA
ESUL
DWBA | TION
TS V
CAI | N OF
WERE
LCU- | |
| MF=5 E
MT=1 | NERGY
6,17 A
DISTR | DISTR
ND 91
IBUTI | RIBUT
ONS | IONS
WERE | OF
CAI | SEC
LCUL | OND/
ATE | ARY
Dwi | NEU
TH | TROM
PEGA | NS
ASUS | /25 | / | | | |
| | | | | | | | | | | | | | | | | |

MT=37 WT=18 TAKEN FROM JENDL-2. TEMPERATURE WAS ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /26/
MT=454 INDEPENDENT YIELDS MT=459 CUMULATIVE YIELDS MT=450 COMULATIVE YIELS YIELDS MT=450 COMULATIVE YIELS YIELDS MT=450 COMULATIVE YIELS YIELDS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS MT=450 COMULATIVE YIELS YIELS YIELS YIELS YIELS YIELS MT=450 COMULATIVE YIELS YIELS YIELS YIELS YIELS YIELS YIELS YIELS YIELS YIELS YIELS YIELS YI MAT number = 9543 95-AM-241 JAERI JAERI-M 89-008 HISTORY EVAL-MAR88 T.NAKAGAWA DIST-SEP89 82-03 EVALUATION FOR JENDL-2 WAS MADE BY Y.KIKUCHI (JAERI) /1/ 88-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY T.NAKAGAWA (JAERI) /2/. GENERAL INFORMATION 451 COMMENT AND DICTIONARY 452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). 455 DELAYED NEUTRON DATA ESTIMATED WITH SEMI-EMPIRICAL FORMULA BY TUTTLE /3/. 456 NUMBER OF PROMPT NEUTRONS EXPERIMENTAL DATA OF JAFFEY AND LERNER /4/. MF=1 GE MT=451 MT=452 MT = 455MT=456 F=2.MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 - 150 EV DATA OF DERRIEN AND LUCAS /5/ WERE ADOPTED AND 5 NEGATIVE RESONANCES WERE ADDED. VALUES OF TOTAL SPIN J WERE REPLACED WITH ARBITRARILY ASSUMED VALUES. MF=2UNRESOLVED RESONANCES : 150 EV - 30 KEV PARAMETERS WERE DETERMINED BY USING ASREP/6/ SO AS TO REPRODUCE THE CAPTURE CROSS SECTION MEASURED BY VANPRAET ET AL. /7/ AND THE FISSION CROSS SECTION BY DABBS ET AL. /8/. B/. ENERGY INDEPENDENT PARAMETERS: R=9.37 FM, GAM-G=0.044 EV, ENERGY DEPENDENT PARAMETERS: DOBS=0.4 EV AT 150 EV: S0= 1.08E-4, S1=2.72E-4, WF=0.24 MILLI-EV AT 30 KEV: S0= 0.79E-4, S1=1.99E-4, WF=0.30 MILLI-EV CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. INT. TOTAL 614.6 B -ELASTIC 11.13 B -FISSION 3.018 B 13.9 B CAPTURE 600.4 B 1300 B 60Ŏ.4 MF=3 NEUTRON CROSS SECTIONS .S BY USING WERE OBTAINED /(MĖV) (MEV) (MEV) (MEV) (FM) MT=4,51-66,91 INELASTIC SCATTERING CROSS SECTIONS OPTICAL AND STATISTICAL MODEL CALCULATION WITH CASTHY CODE /9/. THE LEVEL SCHEME WAS TAKEN FROM REF. /12/ NO ENERGY(KEV) SPIN-PARITY NL PAR 5/2 -7/2 -9/2 -11/2 -5/2 + 9/2 11/2 3/2 5/2 1/2 3/2 3/2 1/2 G.S. Ò 41.176 1 93.65 158.0 205.883 235.0 272.0 234567890112 112 272.0 320.0 471.81 504.448 549.0 623.1 636.861 652.089 653.23 670.24 6821/2 -3/2 + 3/2 + 13 14 15 16 CONTINUUM LEVELS ASSUMED ABOVE 732 KEV. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS QE NUMBER OF EXCITED LEVELS/13/ AND RESONANCE LEVEL SPACING/14/. AM-242 AM-241 A(1/MEV) T(MEV) C(1/MEV) 29.6 0.342 22.98 29.0 0.367 9.95

E-X(MEV) 2.323 3.122 SPIN-CUTOFF(1/MEV*0.5) 30.85 30.45 PAIRING E(MEV) 0.0 0.43
MT=16,17 (N.2N) AND (N.3N) REACTION CROSS SECTIONS ADOPTED.
MT=18 FISSION CROSS SECTION EVALUATED ON THE BASIS OF THE DATA BY DABBS ET AL./8/
MT=102 CAPTURE CROSS SECTION EVALUATED ON THE BASIS OF THE MEASURED DATA OF VANPRAET ET AL./7/ IN THE UNRESOLVED RESONANCE REGION. ABOVE 30 KEV, CALCULATION WITH CASTHY WAS ADOPTED. THE GAMMA-RAY STRENGTH FUNCTION WAS DETERMINED SO THAT THE CROSS SECTION WAS 1.7 BARNS AT 60 KEV.
MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2.51-66.91 CALCULATED WITH CASTHY. WT=16,17,18 ISOTROPIC IN THE LAB SYSTEM.
MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,31 EVAPORATION SPECTRUM. MT=16,17,91 WAX DETERMINED SO THAT THE PREATURE WAS ESTIMATED FROM Z**2/A VALUES /15/.
MF=5 ISOION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA MT=455 ENERGY DISTRIBUTIONS GI SPECIAL P.29 (1979).
S) DERRIEN H. AND LUCAS B.: 1975 WASHINGTON, P.637, NBS-SP-425 (1975).
KIKUCHI Y.: PRIVATE COMMUNICATION. YVANPRAET C. ET AL.: NUCL. SCI. ENG. 83 .22 (1983).
GARASI S.: J. NUCL. SCI. TECHNOL. 12.67 (1976).
JAFFEY A.H. AND HOWE R.E.: NUCL. CI. ENG. 63 .75 (1979).
JAFFEY A.H. AND HOWE R.E.: NUCL. SCI. ENG. 63 .75 (1979).
JAFFEY A.H. AND HOWE R.E.: NUCL. SCI. ENG. 63 .75 (1979).
JAFFEY A.H. AND HOWE R.E.: NUCL. SCI. ENG. 63 .75 (1979).
JAFFEY A.H. AND HOWE R.E.: NUCL. SCI. TECHNOL. 12.67 (1975).
JAFFEY A.H.

MAT number = 9546 95-AM-242 JAERI JAERI-M 8903 (1980) HISTORY EVAL-MAR80 T.NAKAGAWA, S.IGARASI DIST-SEP89 80-03 NEW EVALUATION WAS MADE BY T.NAKAGAWA AND S.IGARASI(JAERI). DETAILS ARE GIVEN IN REF. /1/. 87-04 FORMAT WAS TRANSLATED TO ENDF-5 FORMAT. 88-03 SINCE NO RECENT EXPERIMENTAL DATA WERE AVAILABLE, THE DATA OF JENDL-2 WERE ADOPTED FOR JENDL-3. GENERAL INFORMATION 451 COMMENT AND DICTIONARY 452 NUMBER OF NEUTRONS PER FISSION SUM OF PROMPT AND DELAYED NEUTRONS. 455 DELAYED NEUTRON DATA ESTIMATED FROM TUTTLE'S SEMI-EMPIRICAL FORMULA /2/. 456 NUMBER OF PROMPT NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY HOWERTON /3/ NU-P= 3.268 + 0.172*E(MEV). MF = 1MT=451 MT=452 MT=455 MT=456 MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS 2200M/S CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL ELASTIC FISSION CAPTURE 7611.44 B 11.44 B 2100.0 B 5500.0 B 1260 B 391 B MF=3 NEUTRON CROSS SECTIONS MT=1,2,4,51-72,91,102,251 SIG-T,SIG-EL,SIG-IN,SIG-C,MU-BAR BELOW 0.225 EV: 1/V FORM WAS ASSUMED FOR FISSION AND CAPTURE CROSS SECTIONS. EFFECTIVE SCATTERING RADIUS OF 9.54 FM WAS USED FOR ELASTIC SCATTERING CROSS-SECTION CALCULATION. ABOVE 0.225 EV: OPTICAL AND STATISTICAL MODELS WERE USED. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV, FM) : V= 42.0 - 0.107*E , R= 1.282 , A= 0.6 WS= 9.0 - 0.339*E + 0.0531*E**2 , R= 1.29 , A= 0.5 VS0= 7.0 , R= 1.282 , A= 0.6 STATISTICAL MODEL CALCULATION WITH CASTHY CODE /4/. COMPETING PROCESSES : FISSION, (N, 2N) AND (N, 3N). LEVEL FLUCTUATION CONSIDERED. GAM-G = 0.05 EV AND D = 0.45 EV USED FOR CAPTURE CROSS SECTION CALCULATION THE LEVEL SCHEME TAKEN FROM THE COMPILATION BY ELLIS AND HAESE /5/. NO. ENERGY(MEV) SPIN-PARITY G.S. 0.00 1 -G.Ş. 0.044 0.049 1 1 2 Ò 3 0.049 0.074 0.113 3 4 5 5 2 6 -0.148 0.148 0.190 6 7 9 10 4 5 7 $\begin{array}{c} 0.242\\ 0.263\\ 0.263\\ 0.288\\ 0.288\\ 0.325\\ 0.341\\ 0.372\\ 0.410\\ 0.430\\ 0.488\\ 0.500 \end{array}$ 3 _ 67 -11 -4 -23 13 -5 ž 16 -17 6 -18 19 57 -2Õ 6 21 0.581 21 0.581 / -22 0.679 8 -OVERLAPPING LEVELS ARE ASSUMED ABOVE 0.681 MEV. THE LEVEL DENSITY PARAMETERS OF GILBERT AND CAMERON /6/. MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED WITH THE EVAPORATION MODEL BY PEARLSTEIN /7/. MT=18 FISSION CROSS SECTION THE EMPIRICAL FORMULA USED FOR THE AM-242M DATA WAS APPLIED BY SHIFTING THE ENERGY ORIGIN TO -49 KEV. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS 2 LEGENDRE COEFFICIENTS ARE GIVEN BY THE OPTICAL AND MF = 4 $M\dot{T}=2$

STATISTICAL MODEL CALCULATIONS. MT=16,17,18,91 ISOTROPIC DISTRIBUTIONS IN THE CENTER-OF-MASS SYSTEM. MT=51-72 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM MT=18 FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /8/ BY ASSUMING E(CF-252) = 2.13 MEV.

REFERENCES
1) T. NAKAGAWA AND S. IGARASI : JAERI-M 8903 (1980), IN JAPANESE.
2) R.J. TUTTLE : INDC(NDS)-107/G+SPECIAL, 29 (1979).
3) R.J. HOWERTON : NUCL. SCI. ENG., 62, 438 (1977).
4) S. IGARASI : J. NUCL. SCI. TECHNOL., 12, 67(1975).
5) Y.A. ELLIS AND R.L. HAESE : NUCL. DATA SHEETS 21, 615 (1977).
6) A. GILBERT AND A.G.W. CAMERON : CAN. J. PHYS., 43, 1446
(1965).
7) S. PEARLSTEIN : NUCL. SCI. ENG., 23, 238 (1965).
8) A.B. SMITH ET AL. : ANL/NDM-50 (1979).

MAT number = 9547 95-AM-242MJAERI JAERI-M 89-008 HISTORY EVAL-MAR88 T.NAKAGAWA DIST-SEP89 80-03 NEW EVALUATION WAS MODE BY T.NAKAGAWA AND S.IGARASI (JAERI). DETAILS ARE GIVEN IN REF. /1/. 88-03 RE-EVALUATION WAS MADE FOR JENDL-3 BY T.NAKAGAWA (JAERI)/2/. ERAL INFORMATION COMMENT AND DICTIONARY NUMBER OF NEUTRONS PER FISSION SUM OF PROMPT AND DELAYED NEUTRONS. DELAYED NEUTRON DATA ESTIMATED FROM TUTTLE'S SEMI-EMPIRICAL FORMULA /3/. NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON THE RELATIVE MEASUREMENTS /4,5/ TO THE U-235 DATA, AND ON THE EMPIRICAL FORMULA BY HOWERTON /6/. MF = 1GENERAL $M\dot{T} = 451$ MT=452 MT=455 MT=456 MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS : BELOW 20 EV PARAMETERS FOR 48 LEVELS DEDUCED BY BROWNE ET AL./7/ AND THE SINGLE LEVEL BREIT-WIGNER FORMULA WERE ADOPTED. UNRESOLVED RESONANCE PARAMETERS : 20 EV - 30 KEV PARAMETERS WERE DETERMINED SO AS TO REPRODUCE THE FISSION CROSS SECTION OF BROWNE ET AL./7/. BACKG SIG WAS GIVEN TO THE FISSION AT LOW ENERGIES. AVERAGE WG = 0.05 EV, AVERAGE WF = 1.28 EV, D-OBS = 0.4 EV, S0 = 1.07E-4, S1 = E-DEPENDENT, R = 9.59 FM BACKGROUND CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 7969. B -ELASTIC 5.667 B -FISSION 6409. B 1560 B CAPTURE 1254. B 246 B CAPTURE В 246 B 1254. MF=3 NEUTRON CROSS SECTIONS BELOW 30 KEV: CROSS SECTIONS WERE REPRESENTED WITH THE RESONANCE PARAMETERS. ABOVE 30 KEV: TOTAL AND ELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE MT=1,2CALCOLATED WITH STITLE CASTHY/8/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV, FM) : V= 42.0 - 0.107*E , R= 1.282 , A= 0.6 WS= 9.0 - 0.339*E + 0.0531*E**2 , R= 1.29 , A= 0.5 VSO= 7.0 , R= 1.282 , A= 0.6 MT=4,51-72,91 INELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH CASTHY/8/. THE LEVEL SCHEME WAS TAKEN FROM THE COMPILATION BY ELLIS AND HAESE /9/, WITH SHIFTED ENERGY ORIGIN AT -49 KEV. NO. ENERGY(MEV) SPIN-PARITY G.S. -0.049 1 -1 -0.005 0 0.0 0.0 (META STABLE) 0.025 0.064 0.099 23 3 5 ž ž 56789 6 4 5 7 0.099 0.141 -0.193 Ś -0.214 0.214 0.239 0.239 0.276 0.292 1 Ŏ 6 7 -_ 11 12 4 13 2 3 5 14 -15 -0.323 0.361 0.381 4 16 -17 6 5 7 -18 19 0.439 _ 20 21 22 0.451 6 7 0.532 22 0.630 OVERLAPPING LEVELS WERE ASSUMED ABOVE 0.632 MEV. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE

BASIS OF NUMBER OF EXCITED LEVELS/10/ AND RESONANCE LEVEL SPACING/11/. AM-243 AM-242 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) 31.3 0.355 11.71 3.278 29.6 0.342 22.98 2.323 31.81 0.5 30.85 0.0 MT=16,17 (N,2N) AND (N,3N) CROSS SECTIONS TAKEN FROM JENDL-2 CALCULATED WITH THE EVAPORATION MODEL BY PEARLSTEIN /12/. MT=18 FISSION CROSS SECTION DETERMINED BY CUBIC SPLINE-FITTING TO THE DATA MEASURED BY BROWNE ET AL./7/ MT=102 CAPTURE CROSS SECTION CALCULATED WITH CASTHY/8/. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM WG=0.05 EV AND D-0BS=0.4 EV. MT=251 MU-L BAR CALCULATED WITH CASTHY/8/. MF = 4ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-72,91 LEGENDRE COEFFICIENTS WERE GIVEN BY THE OPTICAL AND STATISTICAL MODEL CALCULATIONS. MT=16,17,18 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM. F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM WITH NUCLEAR TEMPERATURE CALCULATED FROM LEVEL DENSITIES. MT=18 FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /13/ BY ASSUMING E(CF-252) = 2.13 MEV. MF = 5

MAT number = 9549 95-AM-243 JAERI JAERI-M 89-008 HISTORY EVAL-MAR88 T.NAKAGAWA DIST-SEP89 HISTORY
77-03 NEW EVALUATION WAS MADE BY S.IGARASI AND T.NAKAGAWA (JAERI). DETAILS ARE GIVEN IN REF. /1/.
82-03 COMPLETE REEVALUATION FOR JENDL-2 WAS MADE BY Y.KIKUCHI (JAERI). DETAILS ARE GIVEN IN REF. /2/.
88-03 REEVALUATED FOR JENDL-3 WAS MADE BY T.NAKAGAWA (JAERI)/3/. MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA ESTIMATED WITH SEMI-EMPIRICAL FORMULA BY TUTTLE /4/. MT=456 NUMBER OF PROMPT NEUTRONS ESTIMATED FROM SYSTEMATICS. SAME AS PREVIOUS EVALUA-TION (11) ŦĬŎŇ /1/. MF=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 - 215 EV. JENDL-2 EVALUATION/2/ WAS BASED ON THE DATA OF SIMPSON ET AL./5/. THE FISSION WIDTHS WERE MODIFIED FOR JENDL-3 ON THE BASIS OF KNITTER AND BUDTZ-JORGENSEN/6/. VALUES OF TOTAL SPIN WERE ASSUMED ARBITRARILY. UNRESOLVED RESONANCES : 215 EV - 30 KEV PARAMETERS OF JENDL-2 WERE ADOPTED. OBTAINED FROM OPTICAL MODEL CALCULATION: S0=0.93E-4, S1=2.44E-4, R=9.34 FM ESTIMATED FROM RESOLVED RESONANCES: DOBS=0.67 EV, WG=0.039 EV, WF=0.00012 EV CALCULATED 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. INT. TOTAL 86.10 B -ELASTIC 7.483 B -FISSION 0.1161 B 7.59 B CAPTURE 78.50 B 1830 B E=3 NEUTRON CROSS SECTIONS BELOW 30 KEV: CROSS SECTIONS WERE REPRESENTED WITH THE RESONANCE PARAMETERS. MF=3ABOVE 30 KEV: MT=1,2 TOTAL AND ELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/7/. OPTICAL POTENTIAL PARAMETERS WERE OBTAINED /8/ BY FITTING THE DATA OF PHILLIPS AND HOWE /9/ FOR AM-241: V = 43.4 - 0.107*EN WS= 6.95 - 0.339*EN + 0.0531*EN**2 (MEV) VSO = 7.0 (MEV) (MĒV) (FM) (FM) MT=4,51-59,91 INELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH CASTHY/8/. THE LEVEL SCHEME WAS TAKEN FROM REF. /10/ SPIN-PARITY 5/2 -7/2 -5/2 + 9/2 -7/2 + 9/2 + 11/2 + 3/2 -ENERGY(KEV) NO 0 42.2 G.S. 1 2 3 84.0 **96.4** 109.3 143.5 189.3 4 5 THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBER OF EXCITED LEVELS/11/ AND RESONANCE LEVEL SPACING/12/. AM-244 30.3 0.340 26.47 2.373 31.39 0.0 AM-243 31.3 0.355 11.71 3.278 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) 31.81 0.5

MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS TAKEN FROM JENDL-2 CALCULATED WITH THE EVAPORATION MODEL. FISSION CROSS SECTION 30 KEV - 100 KEV : SMOOTH CORVE CONNECTING THE DATA IN THE UNRESOLVED RESONANCE REGION AND ABOVE 100 KEV 100 KEV - 10 MEV : SPLINE-FITTING TO KANDA ET AL./13/, FURSOV ET AL./14/ AND KNITTER AND BUDTZ-JORGENSEN/6/. 10 MEV - 20 MEV : SHAPE WAS ESTIMATED ON THE BASIS OF BEHRENS AND BROWNE/15/ MT = 18MT=102 CAPTURE CROSS SECTION CALCULATED WITH CASTHY/8/. THE GAMMA-RAY STRENGTH FUNCTION WAS DETERMINED TO REPRODUCE THE CROSS SECTION OF 2.2 B AT 30 KEV/16/. MT=251 MU-L BAR CALCULATED WITH CASTHY/8/. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-59,91 LEGENDRE COEFFICIENTS WERE GIVEN BY THE OPTICAL AND STATISTICAL MODEL CALCULATION. MT=16,17,18,37 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM. MF = 4F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRUM WITH NUCLEAR TEMPERATURE CALCULATED FROM LEVEL DENSITIES. ME = 5MT = 18MAXWELLIAN FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL./17/. F=8 FISSION PRODUCT YIELD DATA MT=454 FISSION PRODUCT YIELD DATA TAKEN FROM ENDF/B-IV AND RENORMALIZED TO 2.0. MF = 8REFERENCES ERENCES IGARASI S. AND NAKAGAWA T.: JAERI-M 7174 (1977). KIKUCHI Y.: JAERI-M 82-096 (1982). NAKAGAWA T.: JAERI-M 89-008 (1989). TUTTLE R.J. : INDC(NDS)-107/G+SPECIAL , P.29 (1979). SIMPSON O.D. ET AL. : NUCL.SCI.ENG.,55,273(1974) KNITTER H.-H AND BUDTZ-JORGENSEN C.: 85 SANTA FE, 1, 413 1) 2) 3) 4) 5) 6) KNITTER H.-H AND BUDTZ-JORGENSEN C.: 85 SANIA FE, 1, 413 (1986).
IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IGARASI S. AND NAKAGAWA T.: JAERI-M 8342 (1979).
PHILLIPS T.W. AND HOWE R.E. : NUCL. SCI. ENG., 69, 375 (1979).
ELLIS-AKOVALI Y.A.: NUCL. DATA SHEETS, 33, 79 (1981).
ENSDF, EVALUATED NUCLEAR STRUCTURE DATA FILE (1988).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS, INC. (1984).
KANDA K. ET AL.: J. NUCL. SCI. TECHNOL., 24, 423 (1987).
FURSOV B. ET AL.: 85 SANTA FE, 1, 641 (1986).
BEHRENS J.W. AND BROWNE J.C.: NUCL. SCI. ENG., 77, 444 (1981).
WESTON L.W. AND TODD J.H.: NUCL. SCI. ENG., 91, 444 (1985).
SMITH A.B.: ANL/NDM-50 (1979). 7) 8) 9) 10) 12) 13) 14) 15) 16)

MAT number = 9552 95-AM-244 JAERI JAERI-M 89-008 HISTORY EVAL-MAR88 T.NAKAGAWA DIST-SEP89 88-03 EVALUATED FOR JENDL-3 WAS MADE BY T.NAKAGAWA (JAERI)/1/. MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA ESTIMATED FROM SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. MT=456 NUMBER OF PROMPT NEUTRONS ESTIMATED FROM SEMI-EMPIRICAL FORMULA BY HOWERTON/3/. MF=2,MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 2912 B -RES. INT. TOTAL ELASTIC FISSION CAPTURE 11.62 B 2300. B 1260 В Ē 316 Ē 600. MF=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTIONS BELOW 0.07 EV, SUM OF PARTIAL CROSS SECTIONS. ABOVE 0.07 EV, CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/. THE SAME OPTICAL POTENTIAL PARAMETERS AS THOSE FOR AM-242 WHICH WERE OBTAINED /5/ BY FITTING THE DATA OF PHILLIPS AND HOWE /6/ FOR AM-241, AND MODIFIED A LITTLE. V = 42.0 - 0.107*EN WS= 9.0 - 0.339*EN + 0.0531*EN**2 (MEV) VSO = 7.0 R = RSO = 1.282, RS = 1.29 (FM) A = ASO = 0.60, B = 0.5 (FM) MT=2 ELASTIC SCATTERING CROSS SECTION CALCULATED WITH CASTHY/4/. MT=4,51-75,91 INELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH CASTHY/4/. THE LEVEL SCHEME WAS TAKEN FROM REF. /7/ ŃÓ ENERGY(KEV) SPIN-PARITY G.Š. 0 6 88.0 1 2 3 1 2 3 + $\begin{array}{c} 100.309\\ 123.281\\ 148.283\\ 175.657\\ 183.595\\ 228.299\\ 261.699\\ 272.289\\ 272.299\\ 2658\\ 325.650\\ 348.403\\ 348.403\\ 344.655\\ 344.85\\ 377.398\\ 7439\\ 418.957\\ 398.7439\\ 418.957\\ 420.132\\ 42$ + + 4 4 + 56789 -5232 2 -10 11 12 13 14 15 16 17 18 4 --1 Ś -5 -Õ -3 4 --32 + 19 20 21 22 23 0 + 4 + 25 420.131 2 + 421.204 3 -LEVELS ABOVE 435 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBER OF EXCITED LEVELS/8/ AND RESONANCE LEVEL SPACING/9/. 24 AM-245 AM-244 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) AM-245 31.3 0.360 18.06 3.265 31.98 0.39 30.3 0.340 26.47 2.373 31.39 0.0

MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL.

MT=18

FISSION CROSS SECTION BELOW 0.07 EV, 1/V SHAPED CROSS SECTION WAS NORMALIZED TO 2300 +- 300 B AT 0.0253 EV/9/. ABOVE 0.07 EV, THE CROSS SECTION WAS ASSUMED TO BE THE SAME AS THAT OF AM-242G (MAT=3952 OF JENDL-3).

MT=102 CAPTURE CROSS SECTION BELOW 0.07 EV, 1/V CROSS SECTION WAS NORMALIZED TO 600 B AT 0.0253 EV THAT WAS ESTIMATED BY ASSUMING THE SAME CROSS SECTION RATIO AS HIGHER ENERGY REGION. ABOVE 0.07 EV, CALCULATED WITH CASTHY/4/. THE GAMMA-RAY STRENGTH FUNCTION WAS DETERMINED FROM D-0BS=0.13 EV CALCULATED FROM LEVEL DENSITY PARAMETERS AND WG=0.05 EV.

MT=251 MU-L BAR CALCULATED WITH CASTHY/4/.

ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4

MT=2,51-75,91 LEGENDRE COEFFICIENTS WERE GIVEN BY THE OPTICAL AND STATISTICAL MODEL CALCULATION.

MT=16,17,18,37 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS

MT=16,17,37,91 EVAPORATION SPECTRUM WITH NUCLEAR TEMPERATURE CALCULATED FROM LEVEL DENSITIES. MT = 18

MAXWELLIAN FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL./10/.

REFERENCES

- REFERENCES

 NAKAGAWA T.: JAERI-M 89-008 (1989).
 TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
 HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
 IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IGARASI S.: AND NAKAGAWA T.: JAERI-M 8342 (1979).
 PHILLIPS T.W. AND HOWE R.E.: NUCL. SCI. ENG., 69, 375 (1977).
 SHURSHIKOV E.N.: NUCL. DATA SHEETS, 49, 785 (1986).
 ENSDF, EVALUATED NUCLEAR STRUCTURE DATA FILE (1988).
 MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS, INC. (1984).

 SMITH A.B.: ANL/NDM-50 (1979). 375 (1979).

MAT number = 9553 95-AM-244MJAERI JAERI-M 89-008 HISTORY EVAL-MAR88 T.NAKAGAWA DIST-SEP89 88-03 EVALUATED FOR JENDL-3 WAS MADE BY T.NAKAGAWA (JAERI)/1/. MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P (MT=456) AND NU-D (MT=455). MT=455 DELAYED NEUTRON DATA ESTIMATED FROM SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. MT=456 NUMBER OF PROMPT NEUTRONS ESTIMATED FROM SEMI-EMPIRICAL FORMULA BY HOWERTON/3/. MF=2,MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 2012 B -RES. INT. TOTAL ELASTIC FISSION CAPTURE 11.62 B 1600. B 1260 В Ē 316 Ē 400. MF=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 0.07 EV, SUM OF PARTIAL CROSS SECTIONS. ABOVE 0.07 EV, CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/4/. THE SAME OPTICAL POTENTIAL PARAMETERS AS THOSE FOR AM-242 WHICH WERE OBTAINED /5/ BY FITTING THE DATA OF PHILLIPS AND HOWE /6/ FOR AM-241, AND MODIFIED A LITTLE. V = 42.0 - 0.107*EN WS= 9.0 - 0.339*EN + 0.0531*EN**2 (MEV) VSO = 7.0 R = RSO = 1.282, RS = 1.29 (FM) A = ASO = 0.60, B = 0.5 (FM) MT=2 ELASTIC SCATTERING CROSS SECTION CALCULATED WITH CASTHY/4/. MT=4,51-75,91 INELASTIC SCATTERING CROSS SECTIONS CALCULATED WITH CASTHY/4/. THE LEVEL SCHEME WAS TAKEN FROM REF. /7/ AND SHIFTED BY 88 KEV. NO ENERGY(KEV) SPIN-PARITY 1 - 88.0 6 -6 -1 + 2 + 3 + - 88.0 0.0 12.309 35.281 60.283 87.657 95.511 109.295 140.299 173.699 173.692 TÁRGET S. 2 3 4 4 + 56789 -5232 2 - $\begin{array}{c} 173.696\\ 184.202\\ 201.212\\ 208.658\\ 234.751\\ 247.575\\ 254.650\\ 255.658\\ 260.405\\ 273.838\\ 289.057\\ \end{array}$ 10112345678901223 4 -1 -Ś -5 -Ō -3 4 32 + 273.838 289.057 302.028 310.743 326.689 330.957 332.131 0 + 4 + 25 332.131 2 + 25 333.204 3 -LEVELS ABOVE 447 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBER OF EXCITED LEVELS/8/ AND RESONANCE LEVEL SPACING/9/. 24 AM-245 AM-244 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) AM-245 31.3 0.360 18.06 3.265 31.98 0.39 30.3 0.340 26.47 2.373 31.39 0.0

MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL.

MT=18

FISSION CROSS SECTION BELOW 0.07 EV, 1/V SHAPED CROSS SECTION WAS NORMALIZED TO 1600 +- 300 B AT 0.0253 EV/9/. ABOVE 0.07 EV, THE CROSS SECTION WAS ASSUMED TO BE THE SAME AS THAT OF AM-242G (MAT=3952 OF JENDL-3).

MT=102 CAPTURE CROSS SECTION BELOW 0.07 EV, 1/V CROSS SECTION WAS NORMALIZED TO 400 B AT 0.0253 EV THAT WAS ESTIMATED BY ASSUMING THE SAME CROSS SECTION RATIO AS HIGHER ENERGY REGION. ABOVE 0.07 EV, CALCULATED WITH CASTHY/4/. THE GAMMA-RAY STRENGTH FUNCTION WAS DETERMINED FROM D-0BS=0.13 EV CALCULATED FROM LEVEL DENSITY PARAMETERS AND WG=0.05 EV.

MT=251 MU-L BAR CALCULATED WITH CASTHY/4/.

ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4

MT=2,51-75,91 LEGENDRE COEFFICIENTS WERE GIVEN BY THE OPTICAL AND STATISTICAL MODEL CALCULATION.

MT=16,17,18,37 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS

MT=16,17,37,91 EVAPORATION SPECTRUM WITH NUCLEAR TEMPERATURE CALCULATED FROM LEVEL DENSITIES. MT = 18

MAXWELLIAN FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL./10/.

REFERENCES

- REFERENCES

 NAKAGAWA T.: JAERI-M 89-008 (1989).
 TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
 HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
 IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 IGARASI S.: AND NAKAGAWA T.: JAERI-M 8342 (1979).
 PHILLIPS T.W. AND HOWE R.E.: NUCL. SCI. ENG., 69, 375 (1977).
 SHURSHIKOV E.N.: NUCL. DATA SHEETS, 49, 785 (1986).
 ENSDF, EVALUATED NUCLEAR STRUCTURE DATA FILE (1988).
 MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS, INC. (1984).

 SMITH A.B.: ANL/NDM-50 (1979). 375 (1979).

MAT number = 9628 96-CM-241 JAERI EVAL-MAR89 T.NAKAGAWA DIST-SEP89 HISTORY 89-03 EVALUATION FOR JENDL-3 WAS MADE BY T. NAKAGAWA(JAERI)/1/. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456 MF = 1SUM OF MI=455 AND MI=450 155 DELAYED NEUTRON DATA ESTIMATED FROM THE SYSTEMATICS BY TUTTLE /2/. 156 NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON THE EMPIRICAL FORMULA BY HOWERTON /3/. MT=455 MT = 456MF=2 RESONANCE PARAMETERS MT=151 NO RESONANCE PARAMETERS WERE GIVEN. CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/SEC 851.9 B 11.9 B RES. INTEG. TOTAL ELASTIC FISSION CAPTURE - - -700.0 B 140.0 B 969 B 160 B MF=3 NEUTRON CROSS SECTIONS BELOW 1 EV THIS ENERGY RANGE WAS ASSUMED TO BE THE THERMAL REGION, AND FISSION AND CAPTURE CROSS SECTIONS WITH 1/V SHAPE WERE GIVEN AND ELASTIC SCATTERING WITH A CONSTANT VALUE. THE TOTAL CROSS SECTION IS A SUM OF THEM. ABOVE 1 EV: MT=1,2,4,51-54,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE STHY/4/ CASTHY/4/ THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =42.0-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VS0=7.0, RS0=1.282, AS0=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /5/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /6/, AND A REAL PART WAS MODIFIED A LITTLE TO GIVE A SLIGHTLY HIGH REACTION CROSS SECTIONS IN A LOW ENERGY REGION. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N) AND (N,3N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-241 WAS TAKEN FROM THE COMPILATION BY ELLIS-AKOVALI /7/: NO. ENERGY(MEV) SPIN-PARITY G S 0 0 1/2 + G.S. 0.0 1/2 + 1 0.0530 3/2 + 2 0.103 5/2 + 3 0.157 7/2 + 4 0.255 9/2 + OVERLAPPING LEVELS WERE ASSUMED ABOVE 0.35 MEV. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBERS OF EXCITED LEVELS. CM-242 CM-241 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) 28.0 0.40 2.5771 4.3163 30.00 0.15 28.57 0.378 5.287 3.560 30.22 0.72 AVERAGE RADIATIVE WIDTH = 0.040 EV AND D = 6.6 EV OBTAINED FROM THE LEVEL DENSITY PARAMETERS WERE USED FOR THE CAPTURE CROSS SECTION CALCULATION. 17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED WITH THE EVAPORATION MODEL BY PEARLSTEIN /8/. NEUTRON EMISSION CROSS SECTION WAS ASSUMED TO BE (COMPOUND NUCLEUS FORMATION CROSS SECTION CALCULATED WITH OPTICAL MT=16, MODEL - FISSION).

MT=18 FISSION CROSS SECTION

THE SAME CROSS SECTION AS CM-243 /1/ WAS ASSUMED. BELOW 1 KEV, STRUCTURE WAS REPLACED WITH A SMOOTH CURVE.

MF = 4

F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-54,91 LEGENDRE COEFFICIENTS CALCULATED WITH THE OPTICAL AND STATISTICAL MODELS WERE GIVEN. MT=16,17,18 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM.

MF = 5

F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM. MT=18 ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /9/, ASSUMING E(CF-252) = 2.13 MEV.

- REFERENCES
 1) NAKAGAWA T.: TO BE PUBLISHED AS JAERI-M REPORT.
 2) TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979).
 3) HOWERTON R.J.: NUCL. SCI. ENG. 62, 438 (1977).
 4) IGARASI S.: J.NUCL.SCI.TECHNOL. 12, 67 (1975).
 5) IGARASI S. AND NAKAGAWA T.: JAERI-M 8342 (19879).
 6) PHILLIPS T.W. AND HOWE R.E.: NUCL. SCI. ENG., 69, 375 (1979).
 7) ELLIS-AKOVALI Y.A.: NUCL. DATA SHEETS, 44, 407 (1985).
 8) PEARLSTEIN S.: J. NUCL. ENERGY 27, 81 (1973).
 9) A.B. SMITH ET AL. : ANL/NDM-50 (1979).

MAT number = 9631 96-CM-242 JAERI EVAL-MAR89 T.NAKAGAWA DIST-SEP89 HISTORY 79-03 EVALUATION FOR JENDL-2 WAS MADE BY S.IGARASI AND T.NAKAGAWA (JAERI) /1/. 89-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY T.NAKAGAWA(JAERI)/2/. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 DELAYED NEUTRON DATA ESTIMATED FROM THE SYSTEMATICS BY TUTTLE /3/. MT=452 NUMBER OF NEUTRONS PER FISSION BASED ON THE EMPIRICAL FORMULA BY HOWERTON /4/. MF = 1BASED ON THE EMPTRICAL FORMULA BY HOWERION 747. RESONANCE PARAMETERS =151 RESONANCE REGION : 1.0E-5 EV TO 275 EV. RESONANCE ENERGIES = ALTAMONOV ET AL. /5/, NEUTRON WIDTHS = ALTAMONOV ET AL. /5/, RADIATIVE WIDTHS = 0.040 EV. FISSION WIDTHS = ALAM ET AL. /6/ FOR THE LOW-LYING 4 LEVELS, AND THE AVERAGE VALUE OF 0.004 EV FOR OTHER LEVELS. SCATTERING RADIUS = 9.38 FM. A NEGATIVE RESONANCE WAS ADDED AT -3.45 EV, AND ITS PARAMETERS WERE ADJUSTED SO AS TO REPRODUCE WELL THE THERMAL CROSS SECTIONS/7/. BACKGROUND CROSS SECTION WAS GIVEN TO THE FISSION CROSS SECTION. UNRESOLVED RESONANCE PARAMETERS : 275 EV - 40 KEV PARAMETERS WERE DETERMINED WITH A FITTING CODE ASREP /8/ SO AS TO REPRODUCE THE FISSION CROSS SECTION MEASURED BY ALAM ET AL./6/, AND TOTAL CROSS SECTION AT 40 KEV. ENERGY INDEPENDENT PARAMETERS : R =9.093 FM, SO = .92E - 4, S2 = 0.97E - 4, WG = 0.04 EV. ENERGY DEPENDENT PARAMETERS AT 1 KEV: S1 = 3.04E - 4, WF = 0.093 EV, D = 17.16 EV. CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS MF=2MT=151 CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 32.57 B ---ELASTIC 11.61 B ---ELASTIC FISSION CAPTURE 5.064 B 15.90 B 20.0 B Ē 109 NEUTRON CROSS SECTIONS BELOW 40 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. MF=3 1,2,4,51-53,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/9/ MT = 1CASTHY/9/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =43.4-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VS0=7.0, RS0=1.282, AS0=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /1/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /10/. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N) AND (N,3N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-242 WAS TAKEN FROM ENSDF /11/: ____NQ. ENERGY(MEV) SPIN-PARITY ENERGY(MEV) 0.0 G.S. 0 + ŏ.ŏ4213 2 + 2 0.138 4 + 3 0.284 6 + OVERLAPPING LEVELS ARE ASSUMED ABOVE 0.35 MEV. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBERS OF EXCITED LEVELS/11/. CM-243 CM-242 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) 28.0 0.40 7.5405 3.8863 28.0 0.40 2.5771 4.3163 30.00 30.08

PAIRING E(MEV) 0.72 0.15

AVERAGE RADIATIVE WIDTH = 0.040 EV AND D = 18 EV OBTAINED FROM THE LEVEL DENSITY PARAMETERS WERE USED FOR THE CAPTURE CROSS SECTION CALCULATION.

MT=16, 17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED WITH THE EVAPORATION MODEL BY PEARLSTEIN /12/. NEUTRON EMISSION CROSS SECTION WAS ASSUMED TO BE (COMPOUND NUCLEUS FORMATION CROSS SECTION CALCULATED WITH OPTICAL MODEL - FISSION).

MT=18 FISSION CROSS SECTION BELOW 1 MEV, CROSS SECTION WAS DETERMINED ON THE BASIS OF DATA MEASURED BY ALAM ET AL./6/ AND VOROTNIKOV ET AL./13/. ABOVE 1 MEV, JENDL-2 EVALUATION WAS ADOPTED, WHICH WAS BASED ON THE SHAPE OF CM-244 /14/ AND THE EMPIRICAL FORMULA ON THE FISSION-CROSS-SECTION SYSTEMATICS AROUND 4 MEV BY BEHRENS AND HOWERTON /15/.

MF = 4

F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-53,91 LEGENDRE COEFFICIENTS CALCULATED WITH THE OPTICAL AND STATISTICAL MODELS WERE GIVEN. MT=16,17 18

17,18 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM.

MF = 5

F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM. MT=18 ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /16/, ASSUMING E(CF-252) = 2.13 MEV.

REFERENCES

IGARASI S. AND NAKAGAWA T.: JAERI-M 8342 (1979).
NAKAGAWA T.: TO BE PUBLISHED AS JAERI-M REPORT.
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979).
HOWERTON R.J.: NUCL. SCI. ENG. 62, 438 (1977).
ARTAMONOV V.S. ET AL.: PROC. OF 4TH ALL UNION CONF. ON NEUTRON PHYSICS, KIEV (1977), VOL. 2, 257.
ALAM B. ET AL.: NUCL. SCI. ENG., 99, 267 (1988).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL. 1, PART B", ACADEMIC PRESS (1984).
KIKUCHI Y.: PRIVATE COMMUNICATION.
IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
PHILLIPS T.W. AND HOWE R.E.: NUCLI SCI. ENG. 69, 375 (1979).
ENDF, EVALUATED NUCLEAR STRUCTURE DATA FILE, AS OF JAN. 1989.
PEARLSTEIN S.: J. NUCL. ENERGY 27, 81 (1973).
VOROTNIKOV P.E. ET AL.: SOV. J. NUCL. PHYS., 40, 726 (1984).
IGARASI S. AND NAKAGAWA T.: JAERI-M 7175 (1977).
BEHRENS J.W. AND HOWERTON R.J.: NUCL. SCI. ENG., 65, 464 (1978).

16) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9634 96-CM-243 JAERI EVAL-MAR89 T.NAKAGAWA DIST-SEP89 HISTORY 81-03 EVALUATION FOR JENDL-2 WAS MADE BY T.NAKAGAWA AND S.IGARASI (JAERI) /1/. 89-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY T.NAKAGAWA (JAERI)/2/. MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 DELAYED NEUTRON DATA ESTIMATED FROM THE SYSTEMATICS BY TUTTLE /3/. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON THE EXPERIMENTAL DATA AT THERMAL ENERGY BY JAFFEY AND LERNER /4/, AND ZHURAVLEV ET AL. /5/, AND ON THE EMPIRICAL FORMULA BY HOWERTON /6/. Emitted formula by HOWERTON /6/. F=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW): 1.0E-5 EV TO 70 EV. RESONANCE ENERGIES = ANUFRIEV ET AL. /7/ NEUTRON WIDTHS = ANUFRIEV ET AL. /7/ (ASSUMING 2G=1) RADIATIVE WIDTHS = 0.040 EV (ASSUMED) FISSION WIDTHS = TOTAL WIDTH /7/ - (WN+WG) SCATTERING RADIUS = 10 FM. A NEGATIVE RESONANCE WAS ADOPTED SO AS TO REPRODUCE WELL THE THERMAL CROSS SECTIONS/8/. UNRESOLVED RESONANCE PARAMETERS : 70 EV - 40 KEV PARAMETERS WERE DETERMINED WITH A FITTING CODE ASREP/9/ SO AS TO REPRODUCE THE FISSION CROSS SECTION BASED ON SILBERT /10/, AND THE TOTAL CROSS SECTION CALCULATED WITH OPTICAL MODEL. ENERGY INDEPENDENT PARAMETERS: MF=2 DUEL. ENERGY INDEPENDENT PARAMETERS: R=9.810 FM, S2=1.70E-4, WG=0.04 EV, WF=1.481 EV ENERGY DEPENDENT PARAMETERS AT 1 KEV: S0=1.32E-4, S1=1.06E-4, D=0.799 EV. CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 757.5 B TOTAL ELASTIC FISSION 9.926 B 617.4 B 130.2 B 1560 B ĊĂPŤŪŔE 199 B MF=3 NEUTRON CROSS SECTIONS BELOW 40 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. MT=1,2,4,51-63,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/11/ SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =41.0-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) THE (DERIVATIVE WOODS-SAXON FORM) NSO=7.0, THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /12/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /13/, AND A REAL PART WAS MODIFIED A LITTLE TO GIVE A SLIGHTLY LARGE STRENGTH FUNCTION IN A LOW ENERGY REGION. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N), (N,3N) AND (N,4N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-243 WAS TAKEN FROM THE COMPILATION BY ELLIS-AKOVALI /14/: NO. ENERGY(MEV) SPIN-PARITY 0.0 0.042 0.0874 5/2 7/2 1/2 G.S. 2 9/2 3/2 7/2 0.094 0.094 0.133 3 4 5 + + 0.133 0.153 0.164 0.219 0.228 0.260 11/2 9/2 13/2 11/2 9/2 67 + ÷ 8 + q 10 + 15/211 0.530

12 0.729 1/2 -13 0.769 3/2 -OVERLAPPING LEVELS ARE ASSUMED ABOVE 0.82 MEV. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBERS OF EXCITED LEVELS/15/ AND RESONANCE LEVEL SPACING/8/. CM-244 CM-243 A(1/MEV) 28.0 28.0 T(MEV) 0.395 0.40 C(1/MEV) 1.8807 7.5405 E-X(MEV) 4.2893 3.8863 SPIN-CUTOFE(1/MEV* 0.5) 30 17 30.08 A(1/MEV) T(MEV) C(1/MEV) E-X(MEV) SPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) 30.17 30.08 0.72 AVERAGE RADIATIVE WIDTH = 0.040 EV AND D = 0.809 EV /7/ WERE USED FOR THE CAPTURE CROSS SECTION CALCULATION. MT=16,17,37 (N,2N) (N,3N) AND (N,4N) CROSS SECTIONS CALCULATED WITH THE EVAPORATION MODEL BY PEARLSTEIN/16/. NEUTRON EMISSION CROSS SECTION WAS ASSUMED TO BE (COMPOUND NUCLEUS FORMATION CROSS SECTION CALCULATED WITH OPTICAL MODEL - FISSION). MT=18 FISSION CROSS SECTION BELOW 10 KEV : TAKEN FROM JENDL-2 EVALUATION BASED ON SILBERT /10/. 10 KEV - 3 MEV: DETERMINED FROM FOMUSHKIN ET AL. /17/. ABOVE 3 MEV : ESTIMATED. ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MF = 4MT=2,51-63,91 LEGENDRE COEFFICIENTS CALCULATED WITH CASTHY /11/. 17,18,37 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM. MT=16,17 F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRUM. MT=18 FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /18/ BY ASSUMING E(CF-252) = 2.13 MEV. MF = 5REFERENCES

NAKAGAWA T. AND IGARASI S.: JAERI-M 9601 (1981).
NAKAGAWA T.: TO BE PUBLISHED AS JAERI-M REPORT.
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979).
JAFFEY A.H. AND LERNER J.L.: NUCL. PHYS., A145, 1 (1970).
ZHURAVLEV K.D. ET AL.: PROC. 2ND NAT. SOVIET CONF. ON NEUT. PHYS., VOL.4, 57 (1974).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
ANUFRIEV V.A. ET AL.: SOV. AT. ENERGY, 51, 736 (1982).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, PART B", ACADEMIC PRESS (1984).
KIKUCHI Y.: PRIVATE COMMUNICATION.
SILBERT M.G.: LA-6239 (1976).
IGARASI S.: AND NAKAGAWA T.: JAERI-M 8342 (1979).
PHILLIPS T.W. AND HOWE R.E.: NUCL. SCI. ENG. 69, 375 (1979).
EUSDF, EVALUATED NUCLEAR STRUCTURE DATA FILE, AS OF JAN. 1989.
PEARLSTEIN S.: J. NUCL. ENERGY 27, 81 (1973).
FOMUSHKIN E.F. ET AL.: SOV. AT. ENERGY, 62, 337 (1987).
A.B. SMITH ET AL.: ANL/NDM-50 (1979). REFERENCES

MAT number = 9637 96-CM-244 JAERI EVAL-MAR89 T.NAKAGAWA DIST-SEP89 HISTORY 77-03 EVALUATION FOR JENDL-2 WAS MADE BY S.IGARASI AND T.NAKAGAWA (JAERI) /1/. 89-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY T.NAKAGAWA(JAERI)/2/. F=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 NUMBER OF DELAYED NEUTRONS PER FISSION ESTIMATED FROM SEMI-EMPIRICAL FORMULA BY TUTTLE /3/. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION DETERMINED FROM SEMI-EMPIRICAL FORMULA BY HOWERTON /4/. MF = 1DETERMINED FROM SEMI-EMPIRICAL FORMULA BY HOWERION 747. RESONANCE PARAMETERS =151 RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW) : 1.0E-5 TO 1 KEV ABOVE 20 EV, PARAMETERS BY MOORE AND KEYWORTH 757 WERE ADOPTED ASSUMING NEUTRON WIDTH OF 0.2 EV FOR 646.9, 759.7, 914.0 AND 971.5-EV LEVELS, AND BELOW 20 EV, EVALUATION BY BENJAMIN ET AL. 767. THE FISSION WIDTHS OF LOW-LYING 4 LEVELS WERE REPLACED WITH THOSE BY MAGUIRE ET AL. 777. RADIATIVE WIDTH = 0.037 EV (ASSUMED) SCATTERING RADIUS = 11.2 FM (ADJUSTED TO 11.6 B AT 0.0253 EV 787. A NEGATIVE RESONANCE AT -1.48 EV WAS ADOPTED AND ITS PARAMETERS WERE ADJUSTED SO AS TO REPRODUCE WELL THE THERMAL CROSS SECTIONS/87. UNRESOLVED RESONANCE PARAMETERS : 70 EV - 40 KEV PARAMETERS WERE DETERMINED WITH A FITTING CODE ASREP/97 SO AS TO REPRODUCE THE FISSION CROSS SECTION OF MAGUIRE ET AL. 777. AND THE TOTAL AND CAPTURE CROSS SECTIONS CALCU-LATED WITH OPTICAL AND STATISTICAL MODELS. ENERGY INDEPENDENT PARAMETERS AT 1 KEV: S1=3.06E-4, WF=0.00244 EV, D=11.98 EV. CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS MF=2MT = 151CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 M/SEC RES. INTEG. TOTAL 27.20 B -ELASTIC 11.06 B -ÉLASTIC FISSION CAPTURE 1.06 B 1.037 B 11.06 13.2 B 661 15.10 В R NEUTRON CROSS SECTIONS BELOW 40 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. MF = 31,2,4,51-62,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE MT = 1CASTHY/10/ THE SPHERI CASTHY/10/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =43.4-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VS0=7.0, RS0=1.282, AS0=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /11/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /12/. THE STRENGTH FUNCTION OF 0.91E-4 CALCULATED WITH THIS OMP IS IN VERY GOOD AGREEMENT WITH EXPERIMENTS/8/. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N) AND (N,3N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-244 WAS TAKEN FROM THE COMPILATION BY SHURSHIKOV /13/: NO. ENERGY(MEV) SPIN-PARITY GÖŠ 0.0 0 0.04297 0.14235 0.29621 2 1 2 3 4 + 6 + 0.50179 82022 + 56 ÷ 0.98491 + 7 8 9 1.0208 1.038 + 1.0402 +

10 1.0842 1 + 11 1.1059 1 -12 1.187 2 + OVERLAPPING LEVELS ARE ASSUMED ABOVE 1.2 MEV. THE LEVEL DENSITY PARAMETERS WERE DETERMINED ON THE BASIS OF NUMBERS OF EXCITED LEVELS/14/ AND RESONANCE LEVEL SPACING/8/. CM-245 CM-244 A(1/MEV) 30.0 28.0 T(MEV) 0.391 0.395 C(1/MEV) 11.288 1.8807 4.0295 4.2893 30.17 ŠPIN-CUTOFF(1/MEV**0.5) PAIRING E(MEV) 4.0295 31.31 0.72 4.2893 30.17 1.22 AVERAGE RADIATIVE WIDTH = 0.037 EV AND D = 12 EV WERE USED FOR THE CAPTURE CROSS SECTION CALCULATION. 17 (N,2N) AND (N,3N) CROSS SECTIONS CALCULATED WITH THE EVAPORATION MODEL BY PEARLSTEIN /15/. NEUTRON EMISSION CROSS SECTION WAS ASSUMED TO BE (COMPOUND NUCLEUS FORMATION CROSS SECTION CALCULATED WITH OPTICAL MODEL - FISSION). MT=16,17 MT=18 FISSION CROSS SECTION BELOW 100 KEV: SMOOTH CURVE BASED ON MAGUIRE ET AL. /7/. 100 - 800 KEV: JENDL-2 WAS ADOPTED, WHICH WAS OBTAINED BY FITTING A SEMI-EMPIRICAL FORMULA TO THE EXPERIMENTAL DATA OF REF. /5/. 0.8 - 8 MEV : ESTIMATED FROM EXPERIMENTAL DATA/5,16,17/ ABOVE 8 MEV : THE SAME AS JENDL-2. F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-62,91 LEGENDRE COEFFICIENTS WERE GIVEN BY THE OPTICAL AND STATISTICAL MODEL CALCULATIONS. MT=16,17,18 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM. MF = 4F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM MT=18 FISSION SPECTRUM ESTIMATED FROM Z**2/A SYSTEMATICS BY SMITH ET AL. /18/ BY ASSUMING E(CF-252) = 2.13 MEV. MF = 5REFERENCES

IGARASI S. AND NAKAGAWA T.: JAERI-M 7175 (1977).
NAKAGAWA T.: TO BE PUBLISHED AS JAERI-M REPORT.
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
MOORE M.S. AND KEYWORTH G.A.: PHYS. REV., C3, 1656 (1971).
BENJAMIN R.W. ET AL.: NUCL. SCI. ENG. 47, 203 (1972).
MAGUIRE JR.H.T. ET AL.: NUCL. SCI. ENG. 47, 203 (1972).
MAGUIRE JR.H.T. ET AL.: NUCL. SCI. ENG. 89, 293 (1985).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, PART B", ACADEMIC PRESS (1984).
KIKUCHI Y.: PRIVATE COMMUNICATION.
IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
IGARASI S.: AND MAKAGAWA T.: JAERI-M 8342 (1979).
SHURSHIKOV E.N.: NUCL. DATA SHEETS, 49, 785 (1986).
PHILLIPS T.W. AND HOWE R.E.: NUCLU SCI. ENG. 69, 375 (1979).
SHURSHIKOV E.N.: NUCL. SCI. ENG., 23, 238 (1965).
FOMUSHKIN E.F. ET AL.: SOV. J. NUCL. PHYS., 31, 19 (1980).
VOROTNIKOV P.E. ET AL.: SOV. AT. ENERGY, 57, 504 (1985).
SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9640 96-CM-245 JAERI EVAL-MAR89 T.NAKAGAWA DIST-MAR89 REV2-SEP92 HISTORY 78-03 EVALUATION WAS MADE BY S.IGARASI AND T.NAKAGAWA (JAERI)/1/. 89-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY T.NAKAGAWA(JAERI)/2/. 90-07 SPIN IN MF2,MT151 WAS CORRECTED. 92-09 JENDL-3.2. COMPILED BY T.NAKAGAWA (NDC/JAERI) (1,452), (1,456) MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 NUMBER OF DELAYED NEUTRONS PER FISSION ESTIMATED FROM THE SYSTEMATICS PROPOSED BY TUTTLE /3/. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION EYPERIMENTAL RESULTS OF KHOKHLOV ET AL./4/ WERE ADOPTE EXPERIMENTAL RESULTS OF KHOKHLOV ET AL./4/ WERE ADOPTED. RESONANCE PARAMETERS =151 RESONANCE PARAMETERS RESOLVED RESONANCE REGION (SLBW) : 1.0E-5 TO 60 EV PARAMETERS FOR REICH-MOORE FORMULA BY MOORE AND KEYWORTH /5/ WERE ADOPTED ABOVE 20 EV, AND THOSE BY BROWNE ET AL. /6/ BELOW 20 EV WITH A LITTLE MODIFICATION OF A NEGATIVE RESONANCE SO THAT THE THERMAL CROSS SECTION COULD BE IN AGREEMENT WITH THE EXPERIMENTAL DATA. THE DIFFERENCES BETWEEN REICH-MOORE AND SINGLE-LEVEL B-W FORMULAS ARE TREATED AS THE BACKGROUND CROSS SECTIONS. RADIATIVE WIDTH = 0.04 EV SCATTERING RADIUS = 10.0 FM UNRESOLVED RESONANCE PARAMETERS : 60 EV - 40 KEV PARAMETERS WERE DETERMINED WITH A FITTING CODE ASREP/7/ SO AS TO REPRODUCE THE FISSION CROSS SECTION OF MOORE AND KEYWORTH /5/, AND THE TOTAL AND CAPTURE CROSS SECTIONS CALCULATED WITH OPTICAL AND STATISTICAL MODELS. ENERGY INDEPENDENT PARAMETERS: R=9.43 FM, SO=1.02E-4, S1=2.24E-4, S2=0.9E-4, WG=0.04 EV. ENERGY DEPENDENT PARAMETERS AT 1 KEV: WF=2.01 EV, D=1.397 EV. MF=2 RESONANCE PARAMETERS MT = 151AND CALCULATED 2200M/S CROSS SECTIONS AND RESONANCE INTEGRALS. 2200 2359. в 11.59 В TOTAL ELASTIC FISSION CAPTURE Ē 2001. B 346.4 B 801 B 110 B MF=3 NEUTRON CROSS SECTIONS BELOW 40 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. =1.2.4.51-73,91.102.251 TOTAL ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/8/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =42.7-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VSO=7.0, RSO=1.282, ASO=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /9/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /10/. THE STRENGTH FUNCTION OF 1.02E-4 CALCULATED WITH THIS OMP IS IN GOOD AGREEMENT WITH 1.18E-4/11/. MT = 1IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N), (N,3N) AND (N,4N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-245 WAS TAKEN FROM THE COMPILATION BY ELLIS-AKOVALI /12/: NO. ENERGY(MEV) SPIN-PARITY G S 0 7/2 + G.Ş. 7/2 + 9/2 + 11/2 + 0.0 0.0 0.0548 0.1215 0.1974 1 2 13/2 + 3

| 4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
OVERLAPPING LEVE
WITH HIGHER SPIN
NEGLECTED. THE
ON THE BASIS OF
RESONANCE JEVEL | 0.25285
0.2958
0.35086
0.35595
0.3615
0.3883
0.4167
0.4188
0.431
0.4429
0.498
0.5091
0.532
0.555
0.63365
0.6435
0.66155
0.7018
0.722
0.741
LS ARE ASSUMED ABO'
THAN 13/2 OR WHOS
LEVEL DENSITY PARA
NUMBERS OF EXCITED
SPACING /11 / | 5/2 +
7/2 +
9/2 +
1/2 +
3/2 +
9/2 -
11/2 +
5/2 +
5/2 +
11/2 -
13/2 +
13/2 -
9/2 +
11/2 -
13/2 -
9/2 +
11/2 -
5/2 -
9/2 -
7/2 -
5/2 -
9/2 -
7/2 +
1/2 +
VE 0.82 MEV. LEVELS
E SPIN WAS UNKNOWN WERE
WETERS WERE DETERMINED
LEVELS/13/ AND |
|--|---|---|
| A (
C (
E-
SPIN-CUTOFF (1/MEV
PAIRING | CM-246
1/MEV) 27.7
T(MEV) 0.395
1/MEV) 2.2560
X(MEV) 4.1307
**0.5) 30.17
E(MEV) 1.11 | CM-245
30.0
0.391
11.288
4.0295
31.31
0.72 |
| AVERAGE RADIATIV
WERE USED FOR TH | E WIDTH = 0.040 EV
E CAPTURE CROSS SE | AND D = 1.4 EV /11/
CTION CALCULATION. |
| MT=16,17,37 (N,2N). (
CALCULATED WITH
NEUTRON EMISSION
NUCLEUS FORMATIC
MODEL - FISSION) | N,3N) AND (N,4N) C
THE EVAPORATION MO
CROSS SECTION WAS
N CROSS SECTION CA | ROSS SECTIONS
DEL BY PEARLSTEIN /14/.
ASSUMED TO BE (COMPOUND
LCULATED WITH OPTICAL |
| MT=18 FISSION CROSS SE
BELOW 100 KEV: J
E
ABOVE 100 KEV: B | CTION
ENDL-2 WAS ADOPTED
ITTING A SEMI-EMPI
XPERIMENTAL DATA O
ASED ON THE EXPERI
ND BROWNE /15/. | , WHICH WAS OBTAINED BY
RICAL FORMULA TO THE
F REF./5/.
MENTAL DATA OF WHITE |
| MF=4 ANGULAR DISTRIBUTI | ONS OF SECONDARY N | EUTRONS |
| MT=2,0LEGENDRE COEFFIC
STATISTICAL MODE
MT=16,17,18,37
ISOTROPIC DISTRI | IENTS WERE GIVEN B
L CALCULATIONS.
BUTIONS IN THE LAB | Y THE OPTICAL AND
DRATORY SYSTEM. |
| MF=5 ENERGY DISTRIBUTIC
MT=16,17,37,91 EVAPORA
MT=18 FISSION SPECT
SMITH ET AL./ | NS OF SECONDARY NE
TION SPECTRUM
RUM ESTIMATED FROM
16/ BY ASSUMING E(1 | UTRONS
Z**2/A SYSTEMATICS BY
CF-252) = 2.13 MEV. |
| REFERENCES
1) IGARASI S. AND NAKAG
2) NAKAGAWA T.: JAERI-M
3) TUTTLE R.J.: PROC. C
PROPERTIES, 1973 VIE | AWA T.: JAERI-M 77:
90-101 (1990).
ONSULTANTS' MEETIN
NNA, 29, ALSO INDC | 33 (1978).
G ON DELAYED NEUTRON
(NDS)-107/G+SPECIAL |
| (19/9). 4) KHOKHLOV YU.A. ET AL
WITH NUCLEI, 1992 DU 5) MOORE M.S. AND KEYWC 6) BROWNE J.C. ET AL. : 7) KIKUCHI Y.: PRIVATE 8) IGARASI S. AND FUKAH 9) IGARASI S. AND FUKAH 9) IGARASI S. AND NAKAG 10) PHILLIPS T.W. AND HC 11) MUGHABGHAB S.F.: "NE
ACADEMIC PRESS (1984) 12) ELLIS-AKOVALI Y.A.: 13) ENSDF, EVALUATED NUCL 14) PEARLSTEIN S.: NUCL. 15) WHITE R.M. AND BROWN 16) SMITH A.B. ET AL.: A | .: INT. SEMINAR ON
BUNA, NO.5.5 (1992
RTH G.A.: PHYS. RE'
NUCL. SCI. ENG., COMMUNICATION.
ORI T.: JAERI 1321
AWA T.: JAERI-M 83
WE R.E.: NUCL. SCI
UTRON CROSS SECTION
).
NUCL. DATA SHEETS,
LEAR STRUCTURE DATA
SCI. ENG., 23, 23
E J.C.: 1983 ANTWEI
NL/NDM-50 (1979). | INTERACTION OF NEUTRONS
).
(1991).
(1991).
(1991).
(1979).
ENG. 69, 375 (1979).
NS, VOL.1, PART B",
(1965).
RP, 218 (1983). |

MAT number = 9643 96-CM-246 JAERI EVAL-MAR87 Y.KIKUCHI, T.NAKAGAWA DIST-SEP89 HISTORY 87-03 NEW EVALUATION WAS MADE BY Y.KIKUCHI (JAERI) /1/. 89-03 RE-EVALUATION FOR JENDL-3 WAS MADE BY T.NAKAGAWA(JAERI) /2/. ME = 1MF=1 MF=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 NUMBER OF DELAYED NEUTRONS SEMI-EMPIRICAL FORMULA BY TUTTLE /3/. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY HOWERTON /4/. RESONANCE PARAMETERS =151 RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW) : 1.0E-5 TO 330 EV EVALUATION WAS BASED ON THE EXPERIMENTAL DATA /5-9/ AS FOLLOWS: MF=2MT=151)LLOWS: RESONANCE ENERGIES = REFS. 6 AND 8. NEUTRON WIDTHS = REFS. 5, 6 AND 7. RADIATIVE WIDTHS = REFS. 6 AND 8, AND AVERAGE WIDTH OF 0.031 EV WAS ASSUMED. FISSION WIDTHS = REFS. 8 AND 9. WF OF 4.315-EV LEVEL WAS ADJUSTED TO THE THERMAL CROSS SECTION LEVEL WAS ADJUSTED TO THE THERMAL CROSS SECTION. SCATTERING RADIUS = 9.85 FM. (ADJUSTED TO 11.1 B AT 0.0253 EV/10/) 1/V BACKGROUND DATA WERE GIVEN TO FISSION CROSS SECTION. UNRESOLVED RESONANCE REGION : 330 EV TO 30 KEV OBTAINED FROM OPTICAL MODEL CALCULATION: S0=0.94E-4, S1=3.17E-4, S2=0.88E-4, R=9.15 FM. ESTIMATED FROM RESOLVED RESONANCES: D-0BS=31.7 EV, WG=31 MILLI-EV. WF OBTAINED BY FITTING THE DATA OF STOPA ET AL./9/. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/SEC RES. INTEG. TOTAL 12.51 B -ELASTIC 11.08 B -FISSION 0.14 B 9.90 B CAPTURE 1.291 B 113 B MF=3 NEUTRON CROSS SECTIONS BELOW 30 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. MT=1,2,4,51-79,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/11/ CASTHY/11/ THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =43.4-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VS0=7.0, RS0=1.282, AS0=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /12/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /13/. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N), (N,3N) AND (N,4N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-246 WAS TAKEN FROM REF./14/. ENERGY(KEV) 0 42.85 NÒ. SPIN-PARITY G.Š. 0 -2 + 141.99 295.5 500.0 ++ 2 3 4 4 68234 + 841.7 876.4 923.3 5 6 7 --2 8 9 10 981.0 1051 561223 -1079 1105 1124 11 -12 + 1128 13

| THE LEVI
CAMERON
DEDUCED | 14
15
16
17
18
20
21
22
23
24
25
26
27
28
29
CONTINUUM LEVEL
EL DENSITY PARAM
/15/. THE GAMM
FROM RESONANCE | 1129
1165
1175
1179
1211
1220
1250
1289
1300
1318
1349
1367
1379
1452
1478
1509
S. ASSUMED ABOVE 1
IETERS WERE TAKEN
IETERS WERE TAKEN
IA-RAY STRENGTH FL
PARAMETERS. | 7 -
3 +
0 +
8 -
2 +
4 +
1 -
0 +
3 -
2 +
1 -
2 -
4 +
1 -
2 -
4 +
1 -
2 -
4 +
1 -
2 -
4 +
1 -
2 -
526 KEV.
FROM GILBERT AND
JNCTION OF 9.76E-4 |
|---|--|--|--|
| MT=16,17,37
CALCULA | (N,2N), (N,3N),
TED WITH EVAPORA | (N,4N) REACTION C | CROSS SECTIONS |
| MT=18 FISSIO
EVALUATI
AL./9/ | N
ED ON THE BASIS
AND FOMUSHKIN ET | OF THE MEASURED D | DATA BY STOPA ET |
| MF=4 ANGULAR D
MT=2,51-79,91
LEGENDRI
STATIST
MT=16,17,18,3
ISOTROP | ISTRIBUTIONS OF
E COEFFICIENTS W
ICAL MODEL CALCU
7
IC DISTRIBUTIONS | SECONDARY NEUTRON
VERE GIVEN BY THE
VLATIONS.
S IN THE LABORATOR | NS
OPTICAL AND
RY SYSTEM. |
| MF=5 ENERGY DIS
MT=16,17,37,9
MT=18 FISS
TEMPERA
ZHURAVL/ | STRIBUTIONS OF S
1 EVAPORATION SP
ION SPECTRUM
FURE OF 1.48 MEV
AV ET AL. /18/ F | ECONDARY NEUTRONS
ECTRUM
WAS ESTIMATED FF
OR CM-245 AND CM- | S
ROM DATA OF
247. |
| REFERENCES
1) KIKUCHI Y.:
2) NAKAGAWA T.
3) TUTTLE R.J.
4) HOWERTON R
5) BERRETH T.R.
6) BENJAMIN R
7) BELANOVA T.S
8) MOORE M.S
9) STOPA C.R.S
MAGUIRE JR.
10) MUGHABGHAB S
ACADEMIC PRI
11) IGARASI S.:
12) IGARASI S.:
13) PHILLIPS T
14) LEDERER C.M
(1978).
15) GILBERT A.
16) PEARLSTEIN S.
17) FOMSHKIN E.S
17) FOMSHKIN E.S
18) ZHURAVLEV K | JAERI-M 83-236
: TO BE PUBLISHE
: INDC(NDS)-107/
J.: NUCL. SCI.E
: ET AL.: NUCL.
: ET AL.: NUCL.
: ET AL.: SOV.
AND KEYWORTH G.A
: ET AL.: 1982 K
H.T. ET AL.: NU
S.F.: "NEUTRON C
ESS (1984).
J. NUCL. SCI.T
AND NAKAGAWA T.:
V. AND HOWE F.R.
. AND SHIRLEY V.
AND CAMERON A.G.
S.: NUCL. SCI.E
. ET AL.: SOV.
.D. ET AL.: 1973 | (1984).
D AS JAERI-M REPO
G+SPECIAL, 29 (19
SNG., 62, 438 (1977
SCI. ENG., 49, 14
SCI. ENG., 55, 4
AT. ENERGY, 39, 1
AT. PHYS. REV., C3
TAMESHA, 1090 (19
CL. SCI. ENG., 89
CROSS SECTIONS, VC
ECHNOL., 12, 67 (
JAERI-M 8342 (19
SROSS SECTIONS, VC
ECHNOL., SCI. ENG.
S.: TABLE OF ISOT
W.: CAN. J. PHYS.
SNG., 23, 238 (196
J. NUCL. PHYS., 57
KIEV, VOL.4, 57 | ORT.
079).
15(1972).
440(1974).
1020(1975).
3, 1656(1971).
022), AND
0, 293 (1985).
0, 293 (1985).
0, 293 (1975).
0, 293 (1975).
10, 19, 1980).
(1973).
0, 1973). |

MAT number = 9646 96-CM-247 JAERI EVAL-MAR89 T.NAKAGAWA, Y.KIKUCHI DIST-MAR89 HISTORY 83-03 EVALUATION WAS BY Y.KIKUCHI(JAERI)/REF.1/. 89-03 RE-EVALUATION WAS MADE FOR JENDL-3 BY T.NAKAGAWA(JAERI)/2/. ⁵=1 GENERAL INFORMATION MT=451 DESCRIPTIVE DATA MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456.
 MT=455 NUMBER OF DELAYED NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY TUTTLE /3/.
 MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION THERMAL VALUE OF ZHURAVLEV ET AL./4/ AND ENERGY DEPENDENT TERM OF HOWERTON /5/. MF = 1RESONANCE PARAMETERS =151 RESONANCE PARAMETERS RESOLVED RESONANCE REGION (MLBW) : 1.0E-5 TO 60 EV EVALUATION WAS BASED ON THE EXPERIMENTAL DATA OF MOORE AND KEYWORTH /6/ AND BELANOVA ET AL./7/. THE PARAMETERS OF 1.25-EV LEVEL WERE TAKEN FROM MUGHAGGHAB /8/. RADIATIVE WIDTHS = 0.040 EV WAS ASSUMED. SCATTERING RADIUS = 9.14 FM. A NEGATIVE RESONANCE WAS ADDED AT -0.3 EV. UNRESOLVED RESONANCE REGION : 60 EV TO 30 KEV PARAMETERS WERE DETERMINED WITH A FITTING CODE ASREP/9/ SO AS TO REPRODUCE THE FISSION CROSS SECTION OF MOORE AND KEYWORTH /6/, AND THE TOTAL AND CAPTURE CROSS SECTIONS CALCULATED WITH OPTICAL AND STATISTICAL MODELS. ENERGY INDEPENDENT PARAMETERS: R=9.386 FM, S2=0.86E-4, WG=0.04 EV. WF(4-)=0.0534 EV, WF(5-)=0.5 EV, WF(3+)=0.08 EV, WF(4+)=0.68 EV, WF(5+)=0.05 EV, WF(6+)=0.47 EV. WF (4+)=0.68 EV, WF(5+)=0.05 EV, WF(6+)=0.47 EV. WF (4+)=0.68 EV, WF(5+)=0.05 EV, WF(6+)=0.47 EV. WF (4+)=0.68 EV, WF(5+)=0.05 EV, WF(6+)=0.47 EV. WF ESTIMATED BY SYSTEMATIC SURVEY /10/ ENERGY DEPENDENT PARAMETERS AT 0.9 KEV: S0=0.774E-4, S1=2.89E-4, D=1.397 EV. MF=2MT=151 AND CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/SEC RES. INTEG. TOTAL 147.8 B -ELASTIC 8.775 B -FISSION 81.79 B 612 B CAPTURE 57.20 B 535 B MF=3 NEUTRON CROSS SECTIONS BELOW 30 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. MT=1,2,4,51-60,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/11/ SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =43.4-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) THE VSO=7.0, THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /12/ T REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /13/. Τ0 IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N), (N,3N) AND (N,4N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-247 WAS TAKEN FROM REF./14/. ÉNERGY(KEV) SPIN-PARITY NO. G.S 1 9/2 11/2 Ò 6Ĭ.5 13/2 5/2 7/2 133 2 3 4 227 266 + + 7/2 9/2 9/2 285 317 342 5 + 6 7 + + 8 404 1/2 + 3/2 5/2 ğ 433 10 449 CONTINUUM LEVELS ASSUMED ABOVE 479 KEV. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM GILBERT AND CAMERON/15/. THE GAMMA-RAY STRENGTH FUNCTION OF 2.29E-2

WAS DEDUCED FROM RESONANCE PARAMETERS.

MT=16,17,37 (N,2N) (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL/16/.

MT = 18

FISSION EVALUATED ON THE BASIS OF THE MEASURED DATA BY MOORE AND KEYWORTH /6/ BELOW 50 KEV. ABOVE THIS ENERGY, THE DATA OF FOMUSHKIN ET AL./17/ WERE ADOPTED.

MF = 4

F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-60,91 LEGENDRE COEFFICIENTS WERE GIVEN BY THE OPTICAL AND STATISTICAL MODEL CALCULATIONS.

MT=16,17,18,37 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM.

MF = 5

F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRUM MT=18 FISSION SPECTRUM TEMPERATURE OF 1.47 MEV WAS ESTIMATED FROM DATA OF ZHURAVLEV ET AL. /4/.

REFERENCES

KIKUCHI Y.: JAERI-M 83-236(1984).
NAKAGAWA T.: TO BE PUBLISHED AS JAERI-M REPORT.
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979).
ZHURAVLEV K.D. ET AL.: 1973 KIEV, VOL.4, 57 (1973).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438(1977).
MOORE M.S. AND KEYWORTH G.A.: PHYS. REV., C3, 1656(1971)
BELANOVA T.S. ET AL.: SOV. AT. ENERGY, 47, 772(1979).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, PART B", ACADEMIC PRESS (1984).
KIKUCHI Y.: PRIVATE COMMUNICATION.
KIKUCHI Y.: AND AN S.: J. NUCL. SCI. TECHNOL., 7, 157 (1970).
IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
GRASI S. AND NAKAGAWA T.: JAERI-M 8342 (1979).
PHILLIPS T.W. AND HOWE F.R.: NUCL. SCI. ENG., 69, 375(1979).

14) (1978).
15) GILBERT A. AND CAMERON A.G.W. : CAN. J. PHYS., 43, 1446(1965).
16) PEARLSTEIN S.: NUCL. SCI. ENG., 23, 238 (1965).
17) FOMUSHKIN E.F. ET AL.: SOV. AT. ENERGY, 62, 340 (1987).

MAT number = 9649 96-CM-248 JAERI JAERI-M 84-116 HISTORY EVAL-MAR84 Y.KIKUCHI AND T.NAKAGAWA DIST-SEP89 84-03 NEW EVALUATION FOR JENDL-3 WAS MADE BY Y.KIKUCHI AND T.NAKAGAWA (JAERI). DETAILS ARE GIVEN IN REF. /1/. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456. MT=455 NUMBER OF DELAYED NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. MT=456 NUMBER OF NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. SEMI-EMPIRICAL FORMULA BY HOWERTON /3/.
MF=2 RESONANCE PARAMETERS
MT=151 RESONANCE PARAMETERS
RESOLVED RESONANCE REGION (MLBW) : 1.0E-5 TO 1.5 KEV
RESONANCE ENERGIES, NEUTRON AND RADIATIVE WIDTHS WERE
TAKEN FROM THE EXPERIMENTAL DATA OF BENJAMIN ET AL./4/.
FOR RESONANCES WHOSE RADIATIVE WIDTH WAS UNKNOWN, THE
AVERAGE VALUE OF 0.026 EV /4/ WAS ADOPTED. FISSION WIDTHS
AND THE AVERAGE FISSION WIDTH OF 0.0013 EV WERE ADOPTED
FROM MOORE AND KEYWORTH /5/. THE AVERAGE FISSION WIDTH
WAS USED FOR ALL RESONANCES OF WHICH FISSION WIDTH HAD NOT
BEEN MEASURED. R=9.1 FM WAS ASSUMED TO REPRODUCE THE
POTENTIAL SCATTERING CROSS SECTION OF 10.4 BARNS ASSUMED
BY BENJAMIN ET AL./4/. THE NEUTRON WIDTH OF THE FIRST
RESONANCE WAS SLIGHTLY ADJUSTED TO REPRODUCE THE CAPTURE
CROSS SECTIONS WERE GIVEN ONLY FOR THE FISSION AND TOTAL
CROSS SECTIONS BY ASSUMING THE FORM OF 1/V. THE THERMAL
CROSS SECTIONS TO BE REPRODUCED WERE ESTIMATED FROM
AVAILABLE EXPERIMENTAL DATA.
UNRESOLVED RESONANCE REGION : 1.5 KEV TO 30 KEV
OBTAINED FROM OPTICAL MODEL CALCULATION:
S1=3.32E-4, S2=0.844E-4, R=8.88 FM.
ESTIMATED FROM OPTICAL MODEL CALCULATION:
D-0BS=40.0 EV, GAM-G=26 MILLI-EV, S0=1.2E-4
GAM-F OBTAINED BY FITTING THE DATA OF STOPA ET AL./6/.
CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCES INTEGRALS CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS TOTAL ELASTIC FISSION CAPTURE 9.455 6.514 0.370 B B В 17.5 В 260. 2.570 В B NEUTRON CROSS SECTIONS BELOW 30 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. MF = 3MT=1,2,4,51-58,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE STHY/7 CASTHY/7/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =43.4-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VS0=7.0, RS0=1.282, AS0=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /8/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /9/. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N), (N,3N) AND (N,4N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-248 WAS TAKEN FROM REF./10/ ÉNERGY(KEV) NÔ. SPIN-PARITY G.S. 43.40 02 + 1 + 143.6 297 510 2 4 + 34 6 8 + + 1048 5 2 + 6 7 1050 1 1084 0 + 8 CONTINUUM LEVELS ASSUMED ABOVE 1126 KEV. THE LEVEL DENSITY PARAMETERS : GILBERT AND CAMERON /11/.
GAMMA-RAY STRENGTH FUNCTION OF 6.5E-4 DEDUCED FROM RESONANCE PARAMETERS. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL/12/. MT=18 FISSION EVALUATED ON THE BASIS OF THE MEASURED DATA BY STOPA ET AL./6/ AND FOMUSHKIN ET AL./13/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-58 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37,91 ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRUM. MT=18 WAYNELLIAN FISSION SPECTRUM. MT=18 THEY AND NAKAGAWA T.: JAERI-M 84-116 (1984). 2 TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979). 3 HOWERTON R.J.: NUCL. SCI. ENG. 62, 438(1977). 4 BENJAMIN R.W. ET AL.: NUCL. SCI. ENG., 55, 440(1974). 5 MOORE M.S. AND KEYWORTH G.A.: PHYS. RÉV., C3, 1656(1971) 6 STOPA C.R.S. ET AL.: 1982 KIAMESHA, 1090 (1962), AND MAGUIRE JR. H.T. ET AL.: NUCL. SCI. ENG., 69, 293 (1985). 7) IGARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). 8) IGARASI S.: J. NUCL SCI. TECHNOL., 12, 67 (1975). 8) IGARASI S.: J. NUCL SCI. TECHNOL., 12, 67 (1975). 8) IGARASI S.: J. NUCL SCI. TECHNOL., 28, 749(1979). 9) PHILLIPS T.W. AND HOWE F.R.: NUCL. SCI. ENG., 69, 375(1979). 10) LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES , 7TH ED. (1978). 11) GLIBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446(1965). 12) PEARLSTEIN S.: NUCL. SCI. ENG., 23, 238 (1965). 13) FOMUSHKIN E.F. ET AL.: SOV. J. NUCL, PHYS., 31, 19(1980). 14) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9652 96-CM-249 JAERI JAERI-M 84-116 HISTORY EVAL-MAR84 Y.KIKUCHI AND T.NAKAGAWA DIST-SEP89 REV2-SEP92 04-03 NEW EVALUATION FOR JENDL-3 WAS MADE BY Y.KIKUCHI AND T.NAKAGAWA (JAERI). DETAILS ARE GIVEN IN REF. /1/. 92-09 JENDL-3.2 COMPILED BY T.NAKAGAWA * MODIFIED PARTS FOR JENDL-3.2 (5,18) VALUE OF ZA WAS CORRECTED. GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456.
 MT=455 NUMBER OF DELAYED NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY TUTTLE /2/.
 MT=456 NUMBER OF NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. MF = 1MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS 1/V REGION : 1.0E-5 TO 4.15 EV NO RESOLVED RESONANCES WERE GIVEN. UNRESOLVED RESONANCE REGION : 4.15 EV TO 30 KEV OBTAINED FROM OPTICAL MODEL CALCULATION: SO=1.08E-4, S1=3.95E-4, S2=1.04E-4, R=8.8 FM. ESTIMATED FROM LEVEL DENSITY PARAMETERS AND SYSTEMATICS D-OBS=8.3 EV, GAM-G=40 MILLI-EV GAM-F OBTAINED BY FITTING THE ESTIMATED FISSION CROSS SECTION(SEE BELOW). 2200 M/S CROSS SECTIONS AND CALCULATED RESONANCE INTEGRALS 2200 M/S VALUE RES. INT. TOTAL 13.22 B -ELASTIC 10.80 B -COMPARENT -TOTAL ELASTIC FISSION 0.820 R 139 В CAPTURE 1.600 В 215 В NEUTRON CROSS SECTIONS BELOW 4.15 EV, POINTWISE CROSS SECTIONS WERE GIVEN AS FOLLOWS: MF = 3FOLLOWS: MT=1(TOTAL) : SUM OF PARTIAL CROSS SECTIONS, MT=2(ELASTIC SCAT.): 10.8 B CALCULATED WITH OPTICAL MODEL, MT=18(FISSION) : 1/V SHAPE(0.82 B AT 0.0253 EV ESTIMATED FROM RATIO OF FISSION AND CAPTURE CROSS SECTIONS IN UNRESOLVED RESONANCE REGION), MT=102(CAPTURE) : 1/V SHAPE (1.6 B AT 0.0253 EV OBTAINED FROM MEASUREMENTS BY DIAMOND/4/) BETWEEN 4.15 EV AND 30 KEV, CROSS SECTIONS WERE REPRESENTED WITH RESONANCE PARAMETERS. 1,2,4,51-57,91,102,251 TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE CROSS SECTIONS AND MU-L CALCULATED WITH OPTICAL AND STATISTICAL MODEL CODE CASTHY/5/ MT = 1CASTHY/5/. THE SPHERICAL OPTICAL POTENTIAL PARAMETERS (MEV,FM): V =43.4-0.107*EN, R =1.282, A =0.60 WS =6.95-0.339*EN+0.0531*EN**2, RS =1.29, B =0.50 (DERIVATIVE WOODS-SAXON FORM) VS0=7.0, RS0=1.282, AS0=0.60 THIS SET OF POTENTIAL PARAMETERS WAS DETERMINED /6/ TO REPRODUCE WELL THE TOTAL CROSS SECTION OF AM-241 BY PHILLIPS AND HOWE /7/. IN THE STATISTICAL MODEL CALCULATION, COMPETING PROCESSES OF FISSION, (N,2N), (N,3N) AND (N,4N), AND LEVEL FLUCTUATION WERE CONSIDERED. THE LEVEL SCHEME OF CM-249 WAS TAKEN FROM REF./8/ NO. ENERGY(KEV) SPIN-PARITY ĖNERGY(KEV) 26.22 42.4 52.18 1/2 + 3/2 + 5/2 + G.S 1 ż 3 7/2 +9/2 7/2 4 110 + 5 110.1 9/2 3/2 6 146 + 208 CONTINUUM LEVELS ASSUMED ABOVE 220 KEV.

| THE LEVEL DENSITY PARAMETERS : GILBERT AND CAMERON /9/.
GAMMA-RAY STRENGTH FUNCTION OF 4.8E-4 DEDUCED FROM
UNRESOLVED RESONANCE PARAMETERS. |
|---|
| MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS
CALCULATED WITH EVAPORATION MODEL/10/. |
| MT=18 FISSION
ESTIMATED AS 0.95 * SIG-F(CM-247) BY USING SYSTEMATICS OF
BEHRENS AND HOWERTON /11/. |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-57 CALCULATED WITH OPTICAL MODEL.
MT=16,17,18,37,91 ISOTROPIC IN THE LABORATORY SYSTEM. |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,37,91 EVAPORATION SPECTRUM.
MT=18 MAXWELLIAN FISSION SPECTRUM.
TEMPERATURE ESTIMATED FROM SYSTEMATICS OF
SMITH ET AL./12/. |
| REFERENCES
1) KIKUCHI Y. AND NAKAGAWA T.: JAERI-M 84-116 (1984).
2) TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, 29 (1979).
3) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438(1977).
4) DIAMOND H. ET AL.: ANL-7330 (1967).
5) IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
6) IGARASI S. AND NAKAGAWA T.: JAERI-M 8342 (1979).
7) PHILLIPS T.W. AND HOWE F.R.: NUCL. SCI. ENG., 69, 375 (1979).
8) LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES, 7TH ED. |
| (1978). 9) GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446(1965). 10) PEARLSTEIN S.: NUCL. SCI. ENG., 23, 238 (1965). 11) BEHRENS J.W. AND HOWERTON R.J.: NUCL. SCI. ENG., 65,464(1978). 12) SMITH A.B. ET AL.: ANL/NDM-50 (1979). |

MAT number = 9655 96-CM-250 TIT EVAL-AUG87 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY 87-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY TIT) /1/. 89-08 CROSS SECTIONS WERE MODIFIED BELOW 90 EV. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 * (1,452), (1,455), (1,456) MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF CM-245 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION BASED ON SYSTEMATICS BY MANERO AND KONSHIN/6/, AND BY HOWERTON/7/. MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 11.20 B -ELASTIC 10.80 B -RES. INT. TOTAL ELASTIC FISSION CAPTURE 6.86 B 8.23 B 0.002 B 0.40 B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 90 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 90 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/8/. THE POTENTIAL PARAMETERS/9/ USED ARE AS MF = 3 $M\tilde{T}=1$ (MFV (MEV) (FM) ζЕЙ ELASTIC SCATTERING CROSS SECTION BELOW 90 EV, THE CONSTANT CROSS SECTION OF 10.8 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-52,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/8/. THE LEVEL SCHEME WAS TAKEN FROM REF./10/. NO ENERGY(KEV) SPIN-PARITY 0 43 G.Š. 0 + 2 + MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION THE CROSS SECTION WAS ASSUMED TO BE 0.1 BARN AT 0.0253 EV FROM THE SYSTEMATICS OF PRINCE/12/, AND ASSUMED THE FORM OF 1/V BELOW 90 EV. AT ENERGIES ABOVE 90 EV, THE SHAPE OF THE CM-248 FISSION CROSS SECTION WAS ADOPTED, AND IT WAS NORMALIZED TO THE SYSTEMATICS OF BEHRENS AND HOWERTON/13/. MT = 18MT=102 CAPTURE CROSS SECTION THE CROSS SECTION WAS ASSUMED TO BE 20 BARNS AT 0.0253 EV FROM THE SYSTEMATICS OF PRINCE/12/ AND THE CORRELATION OF THERMAL CROSS SECTIONS WITH NUMBER OF EXCESS NEUTRON. TH THF

1/V FORM WAS ASSUMED BELOW 90 EV. ABOVE 90 EV, THE CROSS SECTION WAS CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 180 EV.

MT=251 MU-L CALCULATED WITH CASTHY.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-52,91 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37 ISOTROPIC IN THE LAB SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS.

MT = 18

MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/14/.

REFERENCES

REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129(1989).
MANERO F. AND KONSHIN V.A.: AT. ENERGY REV., 10, 637 (1972).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991),
IGARASI S. AND NAKAGAWA T.: JAERI 13221 (1991).
SCHMORAK M.R.: NUCL. DATA SHEETS, 32, 87 (1981).
GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
PRINCE A.: PROC. CONF. ON NUCL. CROSS SECTIONS AND TECHNOL., WASHINGTON D.C., 4-7 MARCH, (1968), NBS SPECIAL PUBLICATION 299, 2, 951 (1968)
BHRENS J.W. AND HOWERTON R.J: NUCL. SCI. ENG., 65, 464(1978).
SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9752 97-BK-249 JAERI JAERI-M 85-138 HISTORY EVAL-MAR85 Y.KIKUCHI AND T.NAKAGAWA DIST-SEP89 85-03 NEW EVALUATION FOR JENDL-3 WAS MADE BY Y.KIKUCHI AND T.NAKAGAWA (JAERI). DETAILS ARE GIVEN IN REF. /1/. 88-02 DATA WERE CHECKED AND COPIED INTO JENDL-3. RAL INFORMATION COMMENTS AND DICTIONARY NUMBER OF NEUTRONS PER FISSION SUM OF MT'S =455 AND 456. DELAYED NEUTRON DATA SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. DELAYED NEUTRON DATA SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. MF = 1GENERAL $M\dot{T} = 451$ MT=452 MT = 455MT=456 F=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 EV TO 60 EV RESONANCE ENERGIES, NEUTRON AND RADIATIVE WIDTHS WERE TAKEN FROM THE EXPERIMENTAL DATA OF BENJAMIN+ /4/. FOR RESONANCES WHOSE RADIATIVE WIDTH WAS UNKNOWN, THE AVERAGE VALUE OF 0.0357 EV /4/ WAS ADOPTED. FISSION WIDTH OF 0.0002 EV WAS ESTIMATED FROM THE THERMAL FISSION CROSS SECTION, WHICH WAS ESTIMATED FROM THE SYSTEMATICS OF CAPTURE TO FISSION RATIO BY PRINCE/5/. THE PARAMETERS OF THE NEGATIVE RESONANCE WERE ADJUSTED SO AS TO REPRODUCE THE THERMAL CROSS SECTIONS. NO BACKGROUND CORRECTION WAS APPLIED. UNRESOLVED RESONANCES : 60 EV - 30 KEV OBTAINED FROM OPTICAL MODEL CALCULATION: S1=3.0E-4, S2=0.83E-4, R=9.07 FM. ESTIMATED FROM RESOLVED RESONANCES: DOBS=1.16 EV, GAM-G=35.7 MILLI-EV, S0=1.13E-4 GAM-F=0.2 MILLI-EV. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. INT. TOTAL 717.5 B TOTAL ELASTIC FISSION CAPTURE B B 3.93 12.1 B 1130 B 3.96 R 709.6 B F=3 NEUTRON CROSS SECTIONS MT=1,2,4,51-68,91,102,251 SIG-T,SIG-EL,SIG-IN,SIG-C,MU-BAR CALCULATED WITH OPTICAL AND STATISTICAL MODELS. OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING THE TOTAL CROSS SECTION OF PHILLIPS AND HOWE /6/ FOR AM-241: V = 43.4 - 0.107*EN WS= 6.95 - 0.339*EN + 0.0531*EN**2 (MEV) WV = 0 . VSO = 7.0 (MEV) MF=3WV= 0 - 0.339*EN + 0.0531*EN**2 WV= 0 , VS0 = 7.0 R = RS0 = 1.282 , RS = 1.29 A = AS0 = 0.60 , B = 0.5 TISTICAL MODEL CALCULATED 5 $\begin{array}{c} \kappa = RS0 = 1.282 \\ A = AS0 = 0.60 \\ COMPETING PROCESSES \\ LEVEL FUCTUATION CONSIDERED. \\ THE LEVEL SCHEME TAKEN FROM REF. /8/. \\ NO. \\ 1 \\ COMPATING PROCESSES \\ COMPATIN$ IN-PAR 7/2 -5/2 -9/2 + 7/2 -11/2 13/2 13/2 15/2 15/2 15/2 $\begin{array}{c} 8.8\\ 39.6\\ 41.8\\ 82.6\\ 93.74\\ 137.7\\ 155.84\\ 204.6\\ 229.3\\ 283.0\\ 313.0\\ 372.8\\ 377.6\\ 379.2\\ 410.6\end{array}$ 1 3 4 5 6 7 8 9 10 11 15/2 1/2 5/2 12 13 14 + + 3/2 5/2 7/2 410.6 421.3 428.9 15 + 16 17 + 428.9 7/2 + 18 474.9 9/2 + CONTINUUM LEVELS ASSUMED ABOVE 519 KEV. THE LEVEL DENSITY PARAMETERS : GILBERT AND CAMERON /9/. GAMMA-RAY STRENGTH FUNCTION OF 3.2E-2 DEDUCED FROM RESONANCE PARAMETERS.

MT=16,17,37 (N,2N),(N,3N) (N,4N) CALCULATED WITH EVAPORATION MODEL. MT=18 FISSION EVALUATED ON THE BASIS OF THE MEASURED DATA BY SILBERT/10/, VOROTONIKOV+/11/ AND FOMUSHKIN+ /12/. MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-68 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37,91 ISOTROPIC IN THE LABORATORY SYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRUM. MT=18 MAXWELLIAN FISSION SPECTRUM. MT=18 AXWELLIAN FISSION SPECTRUM. TEMPERATURE ESTIMATED FROM SYSTEMATICS OF SMITH+/13/.

MAT number = 9755 97-BK-250 JAERI JAERI-M 88-004 EVAL-MAR87 T.NAKAGAWA DIST-SEP89 HISTORY 87-03 NEW EVALUATION WAS MADE BY T.NAKAGAWA (JAERI). DETAILS ARE DESCRIBED IN REF. /1/. =1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION MF = 1SUM OF MT=455 AND MT=456 DELAYED NEUTRON DATA BASED ON SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. MT = 455MT = 456MF=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCE PARAMETERS (MLBW) : 1.0E-5 EV TO 100 EV RESONANCE PARAMETERS WERE HYPOTHETICALLY GENERATED ADOPTING THE FOLLOWING AVERAGE VALUES. D-OBS = 2.09 EV (FROM LEVEL DENSITY PARAMETERS) SO, S1= 0.83E-4, 3.37E-4 (FROM OPTICAL MODEL CALC.) RADIATIVE WIDTH = 0.035EV (SAME AS CF-252) FISSION WIDTH = 0.095 EV (ASSUMED THAT THE RATIO OF FISSION TO RADIATIVE WIDTH IS EQUAL TO CROSS SECTION RATIO) THE ENERGY OF FIRST LEVEL WAS ADJUSTED TO REPRODUCE THE 2200-M/S CROSS SECTIONS OF 350 BARNS /4/ AND 960 BARNS /5/ FOR CAPTURE AND FISSION, RESPECTIVELY. UNRESOLVED RESONANCES BY ADOPTING PARAMETERS USED FOR RESOLVED RESONANCE GENERATION AS INITIAL VALUES, THEY WERE ADJUSTED TO REPRODUCE THE EVALUATED FISSION AND CAPTURE CROSS SECTIONS BY USING ASREP /6/. FINAL VALUES OF THE PARAMETERS ARE, SO = 0.82E-4, S1 = 3.9E-4, D-OBS = 2.09 EV, RADIATIVE WIDTH = 0.104 EV AT 100 EV, 0.208 EV AT 30 KEV. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. INT. TOTAL 1325.0 B -ELASTIC 12.22 B -FISSION 959.3 B 517. B 517. CAPTURE 353.4 В 199. В MF=3 NEUTRON CROSS SECTIONS -----ISOTOPE 247 248 249 250 251 249 34.2 33.79 0.903 0.366 12.2 4.30 - - - - - - - - - - $\begin{array}{c} 28.1\\ 30.47\\ 0.39\\ 0.364\\ 2.90\\ 7.97\end{array}$ A(1/MEV) SPIN-CUTOFF FACT PAIRING E(MEV) TEMP.(MEV) C(1/MEV) 30.0 31.82 0.865 0.385 30.05 31.76 0.340 24.6 2.34 6.56 ÈX(MEV) 1.85 4.05 - - - - - - - - -BELOW 30 KEV, CROSS SECTIONS ARE REPRESENTED WITH RESONANCE PARAMETERS. MT=1,2 TOTAL AND ELASTIC SCATTERING THE OPTICAL MODEL CALCULATION WAS ADOPTED. MT = 4

IT=4, 51 TO 59 AND 91 INELASTIC SCATTERING THE LEVEL SCHEME WAS TAKEN FROM REF. /11/.

| | NO. | ENERGY(KEV) | SPIN-PARI | ТҮ |
|---|--|---|---|---|
| | GROUU
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18 | ND 0.0
34.5
35.6
78.1
86.4
97.0
104.1
125.4
129.0
131.9
157.0
167.0
167.0
175.4
191.0
211.8
237.0
242.0
248.0
270.0 | +++-
23457512638617223974 | |
| | LEVEL | S ABOVE 296 KEV | WERE ASSUMED TO I | BE OVERLAPPING. |
| MT=1
CA
NU | 16, 17 AI
Alculatei
Joleus Fo | ND 37 (N,2N), (
D WITH EVAPORATIO
ORMATION CROSS S | N,3N) AND (N,4N)
ON MODEL BY TAKII
ECTION CALCULATE | NG THE COMPOUND
D WITH OPTICAL MODEL. |
| MT=1
SH
AN | I8 FIS
HAPE OF
ND MULTII | SION
THE CF-251 FISSI
PLIED BY THE FAC | ON CROSS SECTION
TOR OF 0.84. | /12/ WAS ADOPTED |
| MT=1
C <i>A</i>
E\ | 102 RADIA
ALCULATEI
/ AND S-V | ATIVE CAPTURE
D WITH CASTHY.
WAVE LEVEL SPACI | THE AVERAGE RADIA
NG OF 2.09 EV WEI | ATIVE WIDTH OF 0.035
RE ASSUMED. |
| MT=2
CA | 251 MU-BALCULATE | AR
D WITH CASTHY. | | |
| MF=4
MT=2
MT=1 | ANGULAR
2,51-59
16,17,18
SYSTEM | DISTRIBUTIONS O
CALCULATE
,37,91 ISOTROPIC
WERE ASSUMED. | F SECONDARY NEUT
D WITH OPTICAL MU
DISTRIBUTIONS II | RONS
DDEL.
N THE LABORATORY |
| MF=5
MT=1
MT=1 | ENERGY
 6,17,37
 8 | DISTRIBUTIONS OF
91 EVAPORATIO
MAXWELLIAN
TEMPERA
SMITH E | SECONDARY NEUTR
N SPECTRUM ASSUM
FISSION SPECTRU
TURE ESTIMATED F
T AL./13/. | ONS
ED.
W.
ROM SYSTEMATICS OF |
| REFERE
1) N/
2) TU
3) HC
5) DI
6) IC
9) PH
10) GI
112) S/
13) SM | ENCES
AKAGAWA,
JTTLE, R
DWERTON,
JGHABGHAI
CADEMIC
IAMOND,
IAMOND,
IAMOND,
GARASI,
SARASI,
SARASI,
SARASI,
SARASI,
SARASI,
ALLIPS,
ILBERT A
CHMORAK,
ALTH, A.I | T.: JAERI-M 88-
.J.: INDG(NDS)-1
R.J.: NUCL. SCI
B. S.F.: NEUTRON
PRESS (1984)
H., ET AL.: J. I
S.: J. NUCL. SCI
Y.: PRIVATE COMM
S. AND NAKAGAWA
T.W. AND HOWE,
. AND CAMERON A.
M.R.: NUCL. DAT
T. JAERI-M 86-0
B. ET AL.: ANL/N | 004 (1987).
07/G+SPECIAL, P.:
CROSS SECTIONS,
NORG. NUCL. CHEM
. TECHNOL., 12, UNICATION.
T.: JAERI-M 8342
F.R.: NUCL. SCI.
G.W. : CAN. J. PI
A SHEETS, 32, 87
86 (1986).
DM-50 (1979). | 29 (1979).
(1977).
VOL.1, PART B,
., 30, 2553 (1968).
67 (1975).
(1979).
ENG., 69, 375(1979).
HYS., 43, 1446(1965).
(1981). |

MAT number = 9852 98-CF-249 JAERI JAERI-M 85-138 HISTORY EVAL-MAR85 Y.KIKUCHI AND T.NAKAGAWA DIST-SEP89 85-03 NEW EVALUATION FOR JENDL-3 WAS MADE BY Y.KIKUCHI AND T.NAKAGAWA (JAERI). DETAILS ARE GIVEN IN REF. /1/. 88-02 DATA WERE CHECKED AND ADOPTED FOR JENDL-3. RAL INFORMATION COMMENTS AND DICTIONARY NUMBER OF NEUTRONS PER FISSION SUM OF MT'S = 455 AND 456. DELAYED NEUTRON DATA SEMI-EMPIRICAL FORMULA BY TUTTLE /1/. NUMBER OF PROMPT NEUTRONS PER FISSION SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. MF = 1GENERAL $M\dot{T} = 451$ MT = 452MT = 455MT=456 F=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR MLBW FORMULA : 1.0E-5 EV TO 70 EV RESONANCE ENERGIES, NEUTRON AND FISSION WIDTHS WERE TAKEN FROM THE EXPERIMENTAL DATA OF BENJAMIN+ /4/. THE RADIATIVE WIDTH WAS ASSUMED TO BE 0.04 EV ACCORDING TO DABBS+ /5/. A NEGATIVE RESONANCE WAS ADDED SO AS TO REPRODUCE THE THERMAL CROSS SECTIONS. NO BACKGROUND CORRECTION WAS APPLIED. UNRESOLVED RESONANCES : 70 EV - 30 KEV OBTAINED FROM OPTICAL MODEL CALCULATION: S1=3.15E-4, S2=0.83E-4, R=9.08 FM. ESTIMATED FROM RESOLVED RESONANCES: DOBS=1.16 EV, GAM-G=40 MILLI-EV ,S0=1.06E-4 FISSION WIDTHS WERE ESTIMATED FROM THE CHANNEL THEORY OF FISSION /6/. S0, S1 AND S2 VALUES WERE ADJUSTED S0 AS TO REPRODUCE THE FISSION CROSS SECTION MEASURED BY DABBS+ /5/. CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE TOTAL 2176.7 B 6.22 ELASTIC FISSION CAPTURE В 2220 1666 В В

 CAPTURE
 504.5
 D

 MF=3
 NEUTRON CROSS SECTIONS
 SIG-T,SIG-EL,SIG-IN,SIG-C,MU-BAR

 CALCULATED
 WITH OPTICAL AND STATISTICAL MODELS.
 OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING THE

 TOTAL CROSS SECTION OF PHILLIPS AND HOWE /7/ FOR AM-241:
 V = 43.4 - 0.107*EN
 (MEV)

 WS= 6.95 - 0.339*EN + 0.0531*EN**2
 (MEV)

 WV=0
 , VS0 = 7.0
 (MEV)

 R = RS0 = 1.282
 , RS = 1.29
 (FM)

 A = ASO = 0.60
 , B = 0.5
 (FM)

 STATISTICAL MODEL CALCULATION WITH CASTHY CODE /8/.
 COMPETING PROCESSES : FISSION, (N, 2N), (N, 3N), (N, 4N).

 LEVEL FLUCTUATION CONSIDERED.
 THE LEVEL SCHEME TAKEN FROM REF. /9/.
 NO.

 NO.
 ENERGY(KEV)
 SPIN-PARITY
 6.S.

 0
 9/2 1
 62.47
 11/2

 2
 136.2
 13/2 3
 145.0
 5/2 +

 4
 188.0
 7/2 +
 219.0
 15/2
 504.5 Ē 695 Ē 'IN-PAR-9/2 - -113/2 - + 13/2 - + 13/2 -19/2 -13/2 -19/2 -13/2 -19/2 -19/2 -13/2 -19/2 -1 234567 143.0 188.0 219.0 243.1 379.5 89 416.6 440.0 443.0 460.0 500.6 10 11 12 13 9/2 +CONTINUUM LEVELS ASSUMED ABOVE 520 KEV. THE LEVEL DENSITY PARAMETERS : GILBERT AND CAMERON /10/. GAMMA-RAY STRENGTH FUNCTION OF 3.3E-2 DEDUCED FROM RESONANCE PARAMETERS. MT=16,17,37 (N,2N),(N,3N),(N,4N) CALCULATED WITH EVAPORATION MODEL. FISSION MT = 18EVALUATED ON THE BASIS OF THE MEASURED DATA BY SILBERT/11/, DABBS+ /5/ AND KUPRIYANOV+ /12/.

| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=2,51-63 CALCULATED WITH OPTICAL MODEL.
MT=16,17,18,37,91 ISOTROPIC IN THE LABORATORY SYSTEM. |
|---|
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,37,91 EVAPORATION SPECTRUM.
MT=18 MAXWELLIAN FISSION SPECTRUM.
TEMPERATURE ESTIMATED FROM SYSTEMATICS OF
SMITH+/13/. |
| REFERENCES
1) KIKUCHI Y. AND NAKAGAWA T.: JAERI-M 85-138 (1985).
2) TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
3) HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
4) BENJAMIN R.W. ET AL.: NUCL. SCI. ENG., 85, 261 (1983).
5) DABBS J.W.T. ET AL.: ORNL-4973, P.181 (1974).
6) KIKUCHI Y. AND AN S.: J. NUCL. SCI. TECHNOL., 7, 157 (1970).
7) PHILLIPS T.W. AND HOWE F.R.: NUCL. SCI. ENG., 69, 375 (1979) |

16 ARASI S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
9) LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES, 7TH ED.
10) GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446(1965).
11) SILBERT M.G.: NUCL. SCI. ENG., 51, 376 (1973).
12) KUPRIYANOV V.M. ET AL.: SOV. ATOM. ENERGY, 55, 472 (1984).
13) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9855 98-CF-250 JAERI JAERI-M 86-086 HISTORY EVAL-MAR86 T.NAKAGAWA DIST-SEP89 86-03 NEW EVALUATION WAS MADE BY T.NAKAGAWA (JAERI). DETAILS ARE DESCRIBED IN REF. /1/. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456 MT=455 DELAYED NEUTRON DATA BASED ON SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. MF=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR SLBW FORMULA : 1.0E-5 EV TO 150 EV HYPOTHETICAL RESONANCE LEVELS WERE GENERATED, AND THEIR PARAMETERS WERE DETERMINED FROM THE ASSUMED AVERAGE PARAMETERS D-0 = 16 EV, RADIATIVE CAPTURE WIDTH = 0.0369 EV, S-0 = 1.0E-4, FISSION WITH = 0.0001 EV, R = 9.252 FM. PARAMETERS OF THE NEGATIVE AND FIRST POSITIVE LEVELS WERE ADJUSTED SO AS TO REPRODUCE THE THERMAL CROSS SECTIONS AND RESONANCE INTEGRALS. UNRESOLVED RESONANCES RESUNANCE INTEGRALS. UNRESOLVED RESONANCES : 150 EV TO 30 KEV S-0 = 1.0E-4, S-1 = 3.3E-4, D-0=16 EV, R = 9.11 FM, RADIATIVE WIDTH = 0.0369 EV, FISSION WIDTH = 0.0001 EV. THE SCATTERING RADIUS WAS ADJUSTED SLIGHTLY. TOTAL ELASTIC FISSION CAPTURE 4.09 27.8 B 8420 B R Ē F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL MT=2 ELASTIC SCATTERING MT=4, 51 TO 79 AND 91 INELASTIC SCATTERING MT=102 RADIATIVE CAPTURE MT=251 MU-BAR MF=3 T=251 MU-BAR CALCULATED WITH THE PROGRAM CASTHY /4/ BASED ON THE OPTICAL AND STATISTICAL MODELS. OPTICAL POTENTIAL PARAMETERS WERE OBTAINED /5/ BY FITTING THE TOTAL CROSS SECTION OF PHILLIPS AND HOWE /6/ FOR AM-241: V = 43.4 - 0.107*EN (MEV) WS= 6.95 - 0.339*EN + 0.0531*EN**2 (MEV) WV= 0, VSO = 7.0 (MEV) WV= 0, SSO = 1.282, RS = 1.29 (FM) A = ASO = 0.60, B = 0.5 (FM) IN THE STATISTICAL CALCULATION, LEVEL FLUCTUATION AND COMPETING PROCESS (FISSION, (N,2N) AND (N,3N)) WERE TAKEN INTO ACCOUNT. THE LEVEL SCHEME WAS TAKEN FROM REF. /7/. NO. ENERGY(KEV) J-PARITY NO. ENERGY(KEV) J-PARITY GROUND 0.0 0 + 15 1209.98 2 -0.0 0 + 1209.98 GROUND 15 2 -42.722 141.886 296.25 871.64 1209.98 1211. 1244.51 1255.47 1266.65 1296.64 1311.07 -1 16 3 2 4 17 23 + 18 ž 19 0 2 5 3 + + -905.90 952.07 56789 20 21 22 23 24 25 27 26 27 1335. 1377.83 1008.6 1031.85 õ 1070. 1071.38 1123. 1154.23 1175.52 1385.49 1396.16 1411.34 1426.86 1457.83 (1 5 (1 3 +) 1Ŏ -11 12 +) -1 -2 + 13 28 6 14 1189.40 29 1478.45 -5 LEVELS ABOVE 1.50 MEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE DERIVED FROM RESONANCE LEVEL SPACINGS AND LOW LAYING EXCITED LEVELS ON THE BASIS OF GILBERT-CAMERON'S FOUMULA /8/. THE AVERAGE RADIATIVE CAPTURE WIDTH OF 0.0369 EV AND S-WAVE LEVEL SPACING OF 16 EV WERE ASSUMED.

MT=16 AND 17 (N,2N) AND (N,3N) CALCULATED WITH EVAPORATION MODEL.

| MT=18 | FISSION | |
|-------|---------|--|
| | | |

EVALUATED ON THE BASIS OF THE SYSTEMATICS.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-79 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,91 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,91 EVAPORATION SPECTRUM. MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE ESTIMATED FROM SYSTEMATICS OF SMITH ET AL./9/.

REFERENCES

| REFERENCES |
|---|
| 1) NAKAGAWA, T.: JAERI-M 86-086 (1986). |
| 2) TUTTLE, R.J.: INDC(NDS)-107/G+SPEC1AL, P.29 (1979). |
| 3) HOWERTÓN, R.J.: NUCL. SCI. ENG., 62, 438 (1977). |
| 4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975). |
| 5) IGARASI, S. AND NAKASAWA, T.: JAERI-M 8342 (1979). |
| 6) PHILLIPS, T.W. AND HOWE, F.R.: NUCL. SCI. ENG., 69, 375(1979). |
| 7) SCHMORAK, M.R.: NUCL. DATA SHEETS, 32, 87 (1981). |
| 8) GILBERT Å. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965). |
| 9) SMITH A.B. ET AL.: ANL/NDM-50 (1979). |
| o) omitin A.B. Et AET. Ane/Abm oo (Toro). |

MAT number = 9858 98-CF-251 JAERI JAERI-M 86-086 EVAL-MAR86 T.NAKAGAWA DIST-SEP89 HISTORY 86-03 NEW EVALUATION WAS MADE BY T.NAKAGAWA (JAERI). DETAILS ARE DESCRIBED IN REF. /1/. MF=1 GENERAL INFORMATION MT=451 COMMENTS AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF MT=455 AND MT=456 MT=455 DELAYED NEUTRON DATA BASED ON SEMI-EMPIRICAL FORMULA BY TUTTLE /2/. MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION BASED ON SEMI-EMPIRICAL FORMULA BY HOWERTON /3/. MF=2,MT=151 RESONANCE PARAMETERS RESOLVED RESONANCES FOR SLBW FORMULA : 1.0E-5 EV TO 150 EV HYPOTHETICAL RESONANCE LEVELS WERE GENERATED, AND THEIR PARAMETERS WERE DETERMINED FROM THE ASSUMED AVERAGE PARAMETERS D-0 = 6.3 EV, RADIATIVE CAPTURE WIDTH = 0.0435 EV, S-0 = 1.0E-4, FISSION WITH = 0.0746 EV, R = 9.253 FM. PARAMETERS OF THE NEGATIVE AND FIRST POSITIVE LEVELS WERE ADJUSTED SO AS TO REPRODUCE THE THERMAL CROSS SECTIONS AND RESONANCE INTEGRALS. UNRESOLVED RESONANCES : 150 EV TO 30 KEV PARAMETERS WERE ADJUSTED SO AS TO REPRODUCE THE ASSUMED FISSION AND RADIATIVE CAPTURE CROSS SECTIONS. S-0 = 0.843E-4, S-1 = 4.56E-4, R = 8.842 FM, D-0 = 6.3 EV, RADIATIVE WIDTH = 0.0435 EV, FISSION WIDTH = 0.281 EV (FOR L=0), = 0.551 EV (FOR L=1) CALCULATED 2200 M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200-M/S VALUE RES. INT. TOTAL 7889.4 B -ELASTIC 76.04 B -TOTAL ELASTIC FISSION 76.04 4935.4 B 2780. В

 Image: Construct the second CAPTURE 2877.9 В 1600. В LEVELS ABOVE 700 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE DERIVED FROM RESONANCE LEVEL SPACINGS AND LOW LAYING EXCITED LEVELS ON THE BASIS OF GILBERT-CAMERON'S FOUMULA /8/. THE AVERAGE RADIATIVE CAPTURE WIDTH OF 0.0435 EV AND S-WAVE LEVEL SPACING OF 6.3 EV WERE ASSUMEĎ. MT = 16

=16,17 AND 37 (N,2N), (N,3N) AND (N,4N) CALCULATED WITH EVAPORATION MODEL.

MT=18 FISSION EVALUATED ON THE BASIS OF THE SYSTEMATICS.

MF = 4

F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-73 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37,91 ISOTROPIC DISTRIBUTIONS IN THE LABORATORY SYSTEM WERE ASSUMED.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRUM. MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE ESTIMATED FROM SYSTEMATICS OF SMITH ET AL./9/.

- REFERENCES
 1) NAKAGAWA, T.: JAERI-M 86-086 (1986).
 2) TUTTLE, R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979).
 3) HOWERTON, R.J.: NUCL. SCI. ENG., 62, 438 (1977).
 4) IGARASI, S.: J. NUCL. SCI. TECHNOL., 12, 67 (1975).
 5) IGARASI, S. AND NAKASAWA, T. : JAERI-M 8342 (1979).
 6) PHILLIPS, T.W. AND HOWE, F.R.: NUCL. SCI. ENG., 69, 375(1979).
 7) SCHMORAK, M.R.: NUCL. DATA SHEETS, 32, 87 (1981).
 8) GILBERT, A. AND CAMERON, A.G.W.: CAN. J. PHYS., 43,1446(1965).
 9) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

| MAT number
98-CF-252
JAERI-M 8 | = 9861
JAERI
8-004 | EVAL-MAR
DIST-SEP | 87 T.NAKAGAW
89 | A | |
|--|---|--|---|--|--|
| HISTORY
87-03 NEW
DETA | EVALUATION | WAS MADE
SCRIBED IN | BY T.NAKAGAW
REF. /1/. | A (JAERI). | |
| MF=1 GENE
MT=451
MT=452
MT=455
MT=456 | RAL INFORMA
COMMENTS A
NUMBER OF
SUM OF M
DELAYED NE
BASED ON
NUMBER OF
BASED ON | TION
ND DICTIO
NEUTRONS
T=455 AND
UTRON DAT
SEMI-EMP
PROMPT NE
SEMI-EMP | NARY
PER FISSION
MT=456
A
IRICAL FORMU
UTRONS PER F
IRICAL FORMU | LA BY TUTTL
ISSION
LA BY HOWEF | -E /2/.
RTON /3/. |
| MF=2, MT=15
RESOLVED
RESONA
ASSUMI
EV) AN
AT 1.4
CROSS
RADIUS
SCATTEA
UNRESOLV
PARAME
ADJUST
CROSS
ARE D-
WIDTHS | 1 RESONANCE
RESONANCE
NCE PARAMET
NG AN AVERA
D FISSION V
AND -3.5
SECTIONS AN
OF 9.23 FN
RING CROSS
L POTENTIAL
ED RESONANC
TERS WERE E
ED SO AS TO
SECTIONS BY
OBS = 27 EV
ARE AS FOL
ENERGY
1.0 KEV
30.0 | E PARAMET
PARAMETER
GE VALUE
(IDTH (0.0
ID RESONAN
WAS ESTI
SECTION C
PARAMETE
STIMATED
REPRODUC
V USING AS
V, R = 8.9
LOWS.
S0
1.22-4
1.22-4 | ERS
S (MLBW) : 1
TAKEN FROM M
OF RADIATIVE
35 EV). TWO
OPTED TO REP
CE INTEGRALS
MATED FROM T
ALCULATED WI
RS GIVEN BEL
FROM RESOLVE
E THE EVALUA
FM AND SO,
S1 CA
3.37-4
3.37-4 | .0E-5 EV TO
ORE EL AL
CAPTURE WI
HYPOTHETIC
RODUCE THE
/5,6/. SO
HE SHAPE EL
TH CASTHY /
OW.
TO 30 KEV
D RESONANCE
TED FISSION
LUES OF THE
S1, CAPTURE
PT-WIDTH F
0.035 EV
0.035 | 0 1 KEV
/4/ BY
IDTH (0.035
CAL RESONANCES
2200-M/S
CATTERING
ASTIC
/7/ FROM
S AND
N AND CAPTURE
E PARAMETERS
E AND FISSION
FISS-WIDTH
0.056 EV
0.096 |
| CALCULAT
TOTA
ELAS
FISS
CAPT | ED 2200 M/S
22
TIC
ION
URE | CROSS SE
200 M/S VA
64.77 B
11.04 B
33.03 B
20.71 B | CTIONS AND R
LUE | ESONANCE IN
RES. INT.
-
111. B
47.4 B | NTEGRALS |
| MF=3 NEUT
BELOW
PARAME
OPTICA | RON CROSS S
30 KEV, CRO
TERS. ABOV
L AND STATI | SECTIONS
SS SECTIO
/E 30 KEV,
STICAL MO | NS ARE REPRE
DATA WERE M
DELS. | SENTED WITH
AINLY CALCU | H RESONANCE
JLATED WITH |
| 1) THE OP
/7/
FITTIN
/10/ F | TICAL MODEL
OPTICAL POI
IG THE TOTAL
OR AM-241: | CALCULAT
ENTIAL PA
CROSS SE | ION WAS PERF
RAMETERS USE
CTION MEASUR | ORMED WITH
D WERE OBTA
ED BY PHILL | CODE CASTHY
AINED /9/ BY
IPS AND HOWE |
| 2) IN THE
AND (N
PROCES
3) THE LE | V = 43.4 -
WS= 6.95 -
WV= 0
R = RS0 =
A = AS0 =
STATISTICA
(,4N) CROSS
S CROSS SEC
VEL DENSITS | 0.339*EN
N THE DER
1.282 ,
0.60 ,
L CALCULA
SECTIONS
TIONS. | + 0.0531*EN
IVATIVE WOOD
VSO = 7.0
RS = 1.29
B = 0.5
TION, THE FI
WERE CONSIDE
RS WERE DEBI | **2
S-SAXON FOR
SSION, (N,2
RED AS THE | (MEV)
(MEV)
(MEV)
(FM)
(FM)
(N, 3N)
COMPETING
ESONANCE |
| GILBER | SPACINGS AN
T-CAMERON'S | ID LOW LAY
S FORMULA | NG EXCITED
/11/. | LEVELS | THE BASIS OF |
|
SPIN-
PAI | A (1/MEV)
CUTOFF FAC1
RING E (MEV)
TEMP. (MEV)
C (1/MEV)
EX (MEV) | 29.4
29.4
31.25
1.16
0.3693
1.625
3.954 | 250
31.2
32.36
1.673
0.4025 0
2.093
5.418 | 251
32.97
32.97
0.77
1.
3809
14.84
1.
4.204
5 | 252 253 31.6 32.2 2.74 33.14 635 0.77 3927 0.3322 .895 3.59 .233 3.226 |
| MT=1,2
THE OP | TOTAL AND E
TICAL MODEL | LASTIC SC
CALCULAT | ATTERING
ION WAS ADOP | TED. | |
| MT=4, 51
THE LE | TO 59 AND
VEL SCHEME | 91 INELAS
WAS TAKEN | TIC SCATTERI
FROM REF. / | NG
12/. | |
| | NO. ENE | RGY(KEV) | SPIN-P | ARITY | |

| GROUND
1
2
3
4
5
6
7
8
9 | $\begin{array}{c} 0.0\\ 45.75\\ 151.73\\ 804.82\\ 830.81\\ 845.72\\ 867.51\\ 900.3\\ 917.03\\ 969.83 \end{array}$ | 0 +
2 +
4 +
2 +
2 -
3 +
3 -
4 +
4 -
3 + | |
|--|--|---|---|
| LEVELS ABOV | E 1.03 MEV WEF | RE ASSUMED TO BE | OVERLAPPING. |
| MT=16, 17 AND 37
CALCULATED WITH
NUCLEUS FORMATI | (N,2N), (N,3N
EVAPORATION N
ON CROSS SECTI | N) AND (N.4N)
MODEL BY TAKING T
ION CALCULATED WI | HE COMPOUND
TH OPTICAL MODEL. |
| MT=18 FISSION
EVALUATED ON TH
/4/. | E BASIS OF EXF | PERIMENTAL DATA B | Y MOORE EL AL. |
| MT=102 RADIATIVE
CALCULATED WITH
EV AND S-WAVE L | CAPTURE
CASTHY. THE
EVEL SPACING (| AVERAGE RADIATIV
DF 27 EV WERE ASS | E WIDTH OF 0.035
UMED. |
| MT=251 MU-BAR
CALCULATED WITH | CASTHY. | | |
| MF=4 ANGULAR DISTR
MT=2,51-59
MT=16,17,18,37,91
SYSTEM WERE A | IBUTIONS OF SE
CALCULATED WI
ISOTROPIC DIS
SSUMED. | ECONDARY NEUTRONS
TH OPTICAL MODEL
STRIBUTIONS IN TH | Ė LABORATORY |
| MF=5 ENERGY DISTRI
MT=16,17,37,91
MT=18 | BUTIONS OF SEC
EVAPORATION SF
MAXWELLOAN FIS
TEMPERATURE
SMITH ET AL | CONDARY NEUTRONS
DECTRUM ASSUMED.
SSION SPECTRUM.
E ESTIMATED FROM
/13/. | SYSTEMATICS OF |
| REFERENCES
1) NAKAGAWA, T.: J
2) TUTTLE, R.J.: I
3) HOWERTON, R.J.:
4) MOORE, M.S., ET
5) HALPERIN, J., E
6) HALPERIN, J., E
6) HALPERIN, J., E
7) IGARASI, S.: J.
8) KIKUCHI, Y.: PR
9) IGARASI, S. AND
10) PHILLIPS, T.W.
11) GILBERT A. AND
12) SCHMORAK, M.R.:
13) SMITH A.B. ET A | AERI-M 88-004
NDG(NDS)-107/C
AL.: PHYS. RE
T AL.: NUCL. S
T AL.: ORNL 47
NUCL. SCI. TE
IVATE COMMUNIC
NAKAGAWA T.:
AND HOWE, F.R.
CAMERON A.G.W.
NUCL. DATA SF
L.: ANL/NDM-50 | (1987).
S+SPECIAL, P.29 (
NG., 62, 438 (197
EV., C4, 273 (197
SCI. ENG., 37, 22
706, 53 (1971).
ECHNOL., 12, 67 (
CATION.
JAERI-M 8342 (19
: NUCL. SCI. ENG
: CAN. J. PHYS.
HEETS, 32, 87 (19
) (1979). | 1979).
7).
1).
8 (1969).
1975).
79).
., 69, 375(1979).
. 43, 1446(1965).
81). |

MAT number = 9867 98-CF-254 TIT EVAL-AUG87 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY HISTORY 87-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 **** (1,452), (1,455), (1,456) * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE OF CF-252 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION CALCULATED FROM THE SEMI-EMPIRICAL FORMULA OF HOWERTON/6/. 2 RESONANCE PARAMETERS =151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. MF = 2MT=151 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 17.10 B -ELASTIC 10.60 B -FISSION 2.00 B 24.3 CAPTURE 4.50 B 6.5 RES. INT. 24.3 B 6.5 B F=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 120 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 120 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE POTENTIAL PARAMETERS/8/ USED ARE AS MF = 3FOLLOWS V = 43.4 - 0.107*EN WS= 6.95 - 0.339*EN + 0.0531*EN**2 WV= 0 , VS0 = 7.0 R = RS0 = 1.282 , RS = 1.29 A = AS0 = 0.60 , B = 0.5 (MEV) (MEV) (MEV) (FM) (FM) ELASTIC SCATTERING CROSS SECTION BELOW 120 EV, THE CONSTANT CROSS SECTION OF 10.6 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE LEVEL SCHEME WAS TAKEN FROM REF./9/. NO ENERGY(KEV) SPIN-PARITY G.S. LEVELS ABOVE 140 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./10/. G.Ş. MT=16,17,37 (N,2N) (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION THE THERMAL CROSS SECTION OF 2.0 BARNS WAS ESTIMATED FROM THE RATIO OF FISSION AND CAPTURE CROSS SECTIONS AT 1 EV AND MEASURED CAPTURE CROSS SECTION AT 0.0253 EV. THE FORM OF 1/V WAS ASSUMED BELOW 120 EV. FOR ENERGY ABOVE 120 EV, THE SHAPE OF CF-252 FISSION CROSS SECTION WAS ADOPTED AND IT WAS NORMALIZED TO THE SYSTEMATICS OF BEHRENS AND HOWERTON/11/. MT = 182 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 4.5 BARNS WAS TAKEN FROM REF./12/, AND 1/V FORM WAS ASSUMED BELOW 120 EV. ABOVE 120 EV, THE CROSS SECTION WAS CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA MT = 102

= 0.040 EV AND LEVEL SPACING = 240 EV. MT=251 MU-L CALCULATED WITH CASTHY. MF=4ANGULARDISTRIBUTIONSOFSECONDARYNEUTRONSMT=2,51,91CALCULATEDWITHOPTICALMODEL.MT=16,17,18,37ISOTROPICINTHELABSYSTEM. MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA. OBTAINED FROM LEVEL DENSITY PARAMETERS. MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/13/. MT = 18REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129 (1989).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
IGARASI S. AND NAKAGAWA T.: JAERI 1321 (1991).
IGARASI S. AND NAKAGAWA T.: JAERI 1321 (1991).
SCHMORAK M.R.: NUCL. DATA SHEETS, 32, 87 (1981).
GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
BEHRENS J.W. AND HOWERTON R.J: NUCL. SCI. ENG., 65, 464(1978).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS , PART B, Z=61-100", ACADEMIC PRESS (1984).
SMITH A.B. ET AL.: ANL/NDM-50 (1979). REFERENCES

MAT number = 9914 99-ES-254 TIT EVAL-AUG87 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY HISTORY 87-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 *** (1,452), (1,455), (1,456) * * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION CALCULATED FROM THE SEMI-EMPIRICAL FORMULA OF HOWERTON/6/. MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 2004.90 B -ELASTIC 10.60 B -ELASTIC 10.60 B -RÉS. INT. TOTAL ELASTIC FISSION CAPTURE 1966.00 B 28.30 B 1220 R 18.0 B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 5 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 5 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE POTENTIAL PARAMETERS/8/ USED ARE AS FOLLOWS, (MEV) MF=3 MT = 1LOWS, V = 43.4 - 0.107*EN WS= 6.95 - 0.339*EN + 0.0531*EN**2 WV= 0 , VS0 = 7.0 R = RS0 = 1.282 , RS = 1.29 A = AS0 = 0.60 , B = 0.5 (MEV) (MEV) (MEV) (FM) (FM) MT=2 ELASTIC SCATTERING CROSS SECTION BELOW 5 EV, THE CONSTANT CROSS SECTION OF 10.6 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=4,51-52,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE LEVEL SCHEME WAS TAKEN FROM REF./9/. NO ENERGY(KEV) SPIN-PARITY NO G.S. 1 78.0 7 + LEVELS ABOVE 503 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./10/. MT=16,17,37 (N,2N) (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 1966 BARNS WAS TAKEN FROM REF./11/. THE 1/V FORM WAS ASSUMED BELOW 5 EV. THE SHAPE OF CROSS SECTION NEAR 5 EV WAS ADJUSTED SO AS TO REPRODUCE THE MEASURED RESONANCE INTEGRAL OF 1200+-250 BARNS/11/. ABOVE 5 EV, THE CROSS SECTION SHAPE WAS ASSUMED TO BE THE SAME AS BK-250 FISSION CROSS SECTION AND IT WAS NORMALIZED TO SYSTEMATICS OF BEHRENS AND HOWERTON/12/. MT = 182 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 28.3 BARNS WAS TAKEN FROM REF./11/, AND 1/V FORM WAS ASSUMED BELOW 5 EV. THE CROSS SECTION NEAR 5 EV WAS ADJUSTED SO AS TO REPRODUCE THE MEASURED RESONANCE INTEGRAL OF 18.2+-1.5 BARNS/11/. MT = 102

ABOVE 5 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 2 EV.

MT=251 MU-L CALCULATED WITH CASTHY.

T=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-52,91 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37 ISOTROPIC IN THE LAB SYSTEM. MF = 4

F=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA OBTAINED FROM LEVEL DENSITY PARAMETERS. MF = 5

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/13/.

REFERENCES

REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL., 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129 (1989).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI 1321(1991).
IGARASI S. AND NAKAGAWA T.: JAERI 1321(1991).
SCHMORAK M.R.: NUCL. DATA SHEETS, 32, 87 (1981).
GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS, PART B, Z=61-100", ACADEMIC PRESS (1984).

BEHRENS J.W. AND HOWERTON R.J: NUCL. SCI. ENG., 65, 464 (1978);

13) SMITH A.B. ET AL.: ANL/NDM-50 (1979).

MAT number = 9915 99-ES-255 TIT EVAL-AUG87 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY HISTORY 87-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) ***** MODIFIED PARTS FOR JENDL-3.2 *** (1,452), (1,455), (1,456) * * * * * * * * * * * * * * * * MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ DECAY CONSTANTS WERE ASSUMED TO BE THE SAME AS THOSE FOR ES-254 EVALUATED BY BRADY AND ENGLAND/5/. MT=456 PROMPT NEUTRONS PER FISSION CALCULATED FROM THE SEMI-EMPIRICAL FORMULA OF HOWERTON/6/. 2 RESONANCE PARAMETERS =151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. MF = 2MT=151 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 79.03 B -ELASTIC 10.60 B -FISSION 13.43 B 93.3 RES. INT. TOTAL ELASTIC FISSION CAPTURE 93.3 B 55.00 B 278 MF=3 NEUTRON CROSS SECTIONS MT=1 TOTAL CROSS SECTION BELOW 2.47 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 2.47 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE POTENTIAL PARAMETERS/8/ USED ARE AS FOLLOWS V = 43.4 - 0.107*EN WS= 6.95 - 0.339*EN + 0.0531*E WV= 0 , VS0 = 7.0 R = RS0 = 1.282 , RS = 1.29 A = AS0 = 0.60 , B = 0.5 (MEV) (MEV) (MEV) (FM) (FM) 0.0531*EN**2 ELASTIC SCATTERING CROSS SECTION BELOW 2.47 EV, THE CONSTANT CROSS SECTION OF 10.6 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=2MT=4,51-53,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE LEVEL SCHEME WAS ASSUMED TO BE THE SAME AS THAT OF ES-253 TAKEN FROM REF./9/. NO ENERGY(KEV) SPIN-PARITY G.S. 0.0 7/2 + 1 48.0 9/2 + 2 500 3/2 -1 2 2 50.0 420.0 420.0 1/2 -420.0 7/2 -LEVELS ABOVE 500 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./10/. MT=16,17,37 (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 13.43 BARNS WAS TAKEN FROM REF./11/, AND 1/V FORM WAS ASSUMED BELOW 2.47 EV. ABOVE 2.47 EV, THE CROSS SECTION SHAPE WAS ASSUMED TO BE THE SAME AS CF-252 FISSION CROSS SECTION AND IT WAS NORMALIZED TO THE SYSTEMATICS BY BEHRENS AND HOWERTON/12/. MT = 182 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 55.0 BARNS WAS TAKEN FROM REF./11/, AND 1/V FORM WAS ASSUMED BELOW 2.47 EV. ABOVE 2.47 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY MT=102

STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 4.94 EV.

MT=251 MU-L CALCULATED WITH CASTHY.

F=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS MT=2,51-53,91 CALCULATED WITH OPTICAL MODEL. MT=16,17,18,37 ISOTROPIC IN THE LAB SYSTEM. MF = 4

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA. OBTAINED FROM LEVEL DENSITY PARAMETERS.

MT=18 MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/13/.

REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL. 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129 (1989).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI M 8342 (1979).
SCHMORAK M.R.: NUCL. DATA SHEETS, 34, 1 (1981).
GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS, PART B, Z=61-100", ACADEMIC PRESS (1984).
BEHRENS J.W., HOWERTON R.J: NUCL. SCI. ENG., 65, 464 (1978).

MAT number = 9936 100-FM-255 TIT EVAL-AUG87 N.TAKAGI DIST-SEP89 REV2-JUN94 HISTORY HISTORY 87-08 NEW EVALUATION WAS MADE BY N. TAKAGI (TOKYO INSTITUTE OF TECHNOLOGY, TIT) /1/. 94-06 JENDL-3.2. NU-P, NU-D AND NU-TOTAL WERE MODIFIED. COMPILED BY T.NAKAGAWA (NDC/JAERI) * * * * * * * * * * * * * * * * * ***** MODIFIED PARTS FOR JENDL-3.2 **** (1,452), (1,455), (1,456) MF=1 GENERAL INFORMATION MT=451 COMMENT AND DICTIONARY MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P NAD NU-D. MT=455 DELAYED NEUTRONS PER FISSION AVERAGE VALUES OF SYSTEMATICS BY TUTTLE/2/, BENEDETTI ET AL./3/ AND WALDO ET AL./4/ EVALUATION BY BRADY AND ENGLAND/5/ WAS ADOPTED FOR THE DECAY CONSTANTS. MT=456 PROMPT NEUTRONS PER FISSION CALCULATED FROM THE SEMI-EMPIRICAL FORMULA OF HOWERTON/6/. MF=2 RESONANCE PARAMETERS MT=151 RESONANCE PARAMETERS NO RESONANCE PARAMETERS WERE GIVEN. 2200-M/S CROSS SECTIONS AND RESONANCE INTEGRALS 2200 M/S VALUE RES. I TOTAL 3396.60 B -ELASTIC 10.60 B -TOTAL 10.60 B -ELASTIC 10.60 B -RÉS. INT. TOTAL ELASTIC FISSION CAPTURE 3360.00 B 26.00 B 1170 B 101 B NEUTRON CROSS SECTIONS 1 TOTAL CROSS SECTION BELOW 3.8 EV, CALCULATED AS SUM OF MT'S = 2, 18 AND 102. ABOVE 3.8 EV, OPTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE POTENTIAL PARAMETERS/8/ USED ARE AS FOLLOWS, MF=3 MT = 1LOWS, V = 43.4 - 0.107*EN WS= 6.95 - 0.339*EN + 0.0531*EN**2 WV= 0 , VSO = 7.0 R = RSO = 1.282 , RS = 1.29 A = ASO = 0.60 , B = 0.5 (MEV) (MEV) (MEV) (FM) MT=2 ELASTIC SCATTERING CROSS SECTION BELOW 3.8 EV, THE CONSTANT CROSS SECTION OF 10.6 BARNS WAS ASSUMED, WHICH WAS THE SHAPE ELASTIC SCATTERING CROSS SECTION CALCULATED WITH OPTICAL MODEL. ABOVE THIS ENERGY, OPTICAL MODEL CALCULATION WAS ADOPTED. MT=4,51,91 INELASTIC SCATTERING CROSS SECTIONS. OPTICAL AND STATISTICAL MODEL CALCULATION WAS MADE WITH CASTHY/7/. THE LEVEL SCHEME WAS TAKEN FROM REF./9/. NO ENERGY(KEV) SPIN-PARITY G.S. 1 LEVELS ABOVE 94 KEV WERE ASSUMED TO BE OVERLAPPING. THE LEVEL DENSITY PARAMETERS WERE TAKEN FROM REF./10/. $\text{MT}=16\,,17\,,37$ (N,2N), (N,3N) AND (N,4N) REACTION CROSS SECTIONS CALCULATED WITH EVAPORATION MODEL. FISSION CROSS SECTION MEASURED THERMAL CROSS SECTION OF 3360 BARNS WAS TAKEN FROM REF./11/, AND 1/V FORM WAS ASSUMED BELOW 3.8 EV. ABOVE 3.8 EV, THE SHAPE WAS ASSUMED TO BE THE SAME AS BK-250 FISSION CROSS SECTION AND IT WAS NORMALIZED TO SYSTEMATICS BY BEHRENS AND HOWERTON/12/. MT = 18THF 2 CAPTURE CROSS SECTION MEASURED THERMAL CROSS SECTION OF 26 BARNS WAS TAKEN FROM REF./11/, AND 1/V FORM WAS ASSUMED BELOW 3.8 EV. ABOVE 3.8 EV, CALCULATED WITH CASTHY. THE GAMMA-RAY STRENGTH FUNCTION WAS ESTIMATED FROM GAMMA-GAMMA = 0.040 EV AND LEVEL SPACING = 7.6 EV. MT=102

MT=251 MU-L

CALCULATED WITH CASTHY.

MF=4ANGULARDISTRIBUTIONSOFSECONDARYNEUTRONSMT=2,51,91CALCULATEDWITHOPTICALMODEL.MT=16,17,18,37ISOTROPICINTHELABSYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS MT=16,17,37,91 EVAPORATION SPECTRA. OBTAINED FROM LEVEL DENSITY PARAMETERS.

MAXWELLIAN FISSION SPECTRUM. TEMPERATURE WAS ESTIMATED FROM Z**2/A DEPENDENCE/13/. MT = 18

REFERENCES

TAKAGI N. ET AL.: J. NUCL. SCI. TECHNOL. 27, 853 (1990).
TUTTLE R.J.: INDC(NDS)-107/G+SPECIAL, P.29 (1979),
BENEDETTI G. ET AL.: NUCL. SCI. ENG., 80, 379 (1982).
WALDO R. ET AL.: PHYS. REV., C23, 1113 (1981).
BRADY M.C. AND ENGLAND T.R.: NUCL. SCI. ENG., 103, 129 (1989).
HOWERTON R.J.: NUCL. SCI. ENG., 62, 438 (1977).
IGARASI S. AND FUKAHORI T.: JAERI 1321 (1991).
IGARASI S. AND NAKAGAWA T.: JAERI -M 8342 (1979).
SCHMORAK M.R.: NUCL. DATA SHEETS, 34, 1 (1981).
GILBERT A. AND CAMERON A.G.W.: CAN. J. PHYS., 43, 1446 (1965).
MUGHABGHAB S.F.: "NEUTRON CROSS SECTIONS, VOL.1, NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS, PART B, Z=61-100", ACADEMIC PRESS (1984).

BEHRENS J.W. AND HOWERTON R.J: NUCL. SCI. ENG., 65, 464, (1978); D. ET AL.: ANI (NDM 50 (1979).

(1978). 13) SMITH A.B. ET AL.: ANL/NDM-50 (1979).