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POSSIBILITIES OF THE TWODIMENSIONAL METHOD FOR DELAYED NEUTRON SPECTRA MEASUREMENTS

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Abstract: The conseptions of the twodimensional method for delayed neutron spectra measurements, when the neutron count rate is registered depending on energy and time, is repoted. The main results, obtained by this method (time and energy spectra, the spectra of individual precursors of delayed neutrons) for the thermal neutron fission of U-235 are presented.

Introduction

The sens of twodimensional method consist in simultaneously recording change counting rate of delayed neutron (DN) depending from the energy and time after turning-off neutrons source wich give rise a fission in a given substance (fig.1). As a matter of fact measurements of the DN spectra in distinguishingly time intervals realized with a ^{3}He detector on the base his spectrometrical property. Switching over time intervals give sequencies those spectra in a time. In a given interval ΔE we have sum of exponents from the pure precursors. Then all decay curves are the source of information about time and energy distributions of DN.

The least square method (LSM) is ordinary employed to the analysis complex decay curves. It gives six-group discription DN parameters in the case of all-waves detector. Employing this method to all decay curves we receive yields of DN in all interval of energy. The totality of this yields for every group give corresponding spectra. The sum of this spectra is equilibrium spectra.

Employing method Tarasko M.Z. /1/ for analysis of decay curves in all interval of energy we receive more information than in case LSM: it may become spectra DN from some of pure precursors $^{87,88,89}Br$, $^{137,138}I$.

These analysis methods of the data twodimensional countings DN give possibilities to determing:

a) the change DN spectra and his average energy with a time after turning-out the sourse wich give rise a fission;
b) the group spectra of DN, their relative yields and average energies;
c) equilibrium spectra of DN;
d) spectra DN from several pure precursors, their relative yields and average energies.

Information from decay curves of DN with LSM gives us spectra from ^{87}Br (the first group) for different substancies. After a time from the end of fission we have also pure spectra of ^{87}Br (when all precursors with a short lifetime had died). Also the spectra of the first group is the spectra from pure ^{87}Br when the decay curves were analysed with /1/. And all this spectra from ^{87}Br can be compared with a spectra measured after mass- spectrometer.

Thou we have an inner control method and control with a different methods. This is also justice for average energies of group and pure precursors and relative yields of DN.

From a point of view for practic this method give the change of the spectra directly independently knowlige of mathematic way of grouping pure precursors DN according to their relative yields and time of life. The group is mathematical but no physical conseption. The six-group representation is combination from the yields of about 60 precursors. And we do not know in that a way.

Results

These possibilities of twodimensional method can be illustrated with a DN time and energy distributions for ^{235}U thermal fission.

We had use 256 channels for energy registration ($\Delta E \sim 3,5$ keV/channel) and 64 time intervals with a width from 1 to 16 s (all time 642 s). The time of flight of sample from activation to registered position was 2 s, then we have define spectra of four groups of DN.

Change of the spectra with increasing of time (from top to down) is illustrated on fig.2. On fig.3 is shown change of the average energy DN, where time of registration spectra on fig.2 marked with a dark points. It is evident that average energy is diminished and after ~ 200 s is constant. This is dew to that spectra is from precursor ^{87}Br.

The spectra $^{87,88,89}Br$ and $^{137,138}I$ are shown on fig.4 (after analysis with a method /1/). On fig.4 also shown spectrum of the first group when the data were analysed with a LSM.

In total we have 64 spectra in energy intervals 0-700 keV.

Table 1 give relative yields of DN Br and I precursors from the results analysis spectra DN and from measuring this the all-waves detector.

Table 2 give relative yields of group and their average energies from our and another data.

Table 1. The relative yields DN from Br and I precursors

Precursor	This work			Work /2/	
	T,s	Y	E(keV)	T,s	Y
^{87}Br	55,6 ± 0,1	1,0	195	55,67 ± 0,11	1,0
^{137}I	24,5 ± 0,1	3,78	441	24,62 ± 0,17	3,656 ± 0,092
^{88}Br	16,0 ± 0,2	3,05	268	15,88 ± 0,11	2,833 ± 0,09
^{138}I	6,13± 0,2	2,46	294	6,05 ± 0,12	2,42 ± 0,13
^{89}Br	4,38± 0,03	3,84	378	4,55 ± 0,9	3,155 ± 0,83

Table 2. The yields and average energies of groups

N	T	Yields		Average energies	
gr.	s	Our data	Data /3/	Our data	Data /4/
1	55,6	1	1	209 ± 40	250 ± 20
2	22,7	6,17 ± 0,25	6,65 ± 0,65	370 ± 80	460 ± 40
3	6,2	6,41 ± 0,32	5,95 ± 0,89	289 ±100	405 ± 20
4	2,3	11,8 ± 0,6	12,0 ± 1,3	349 ±100	450 ± 20

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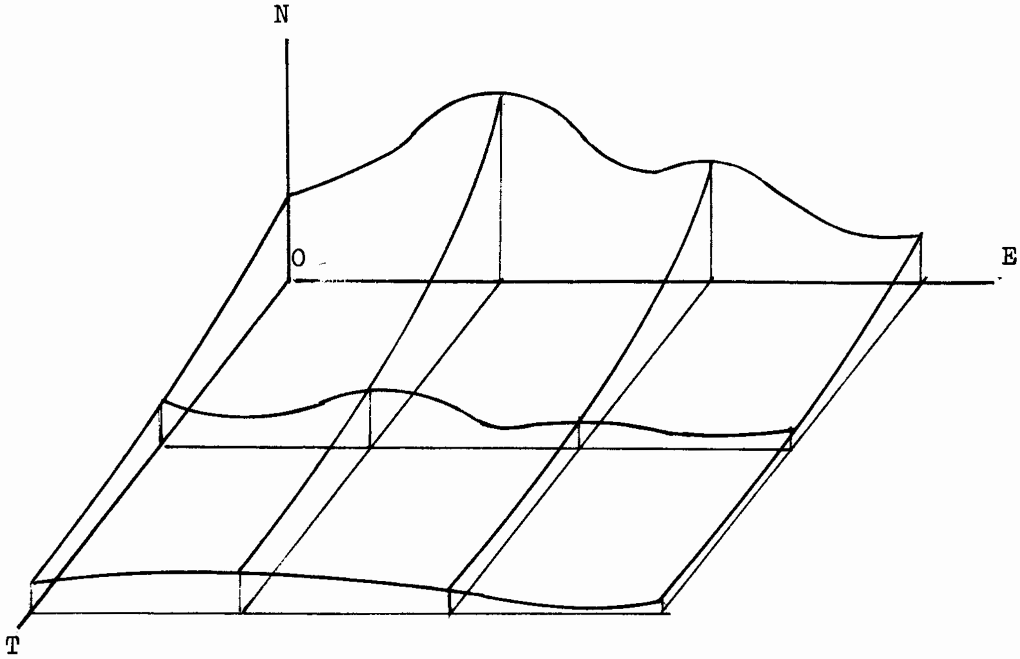

Fig.1. The scheme of method

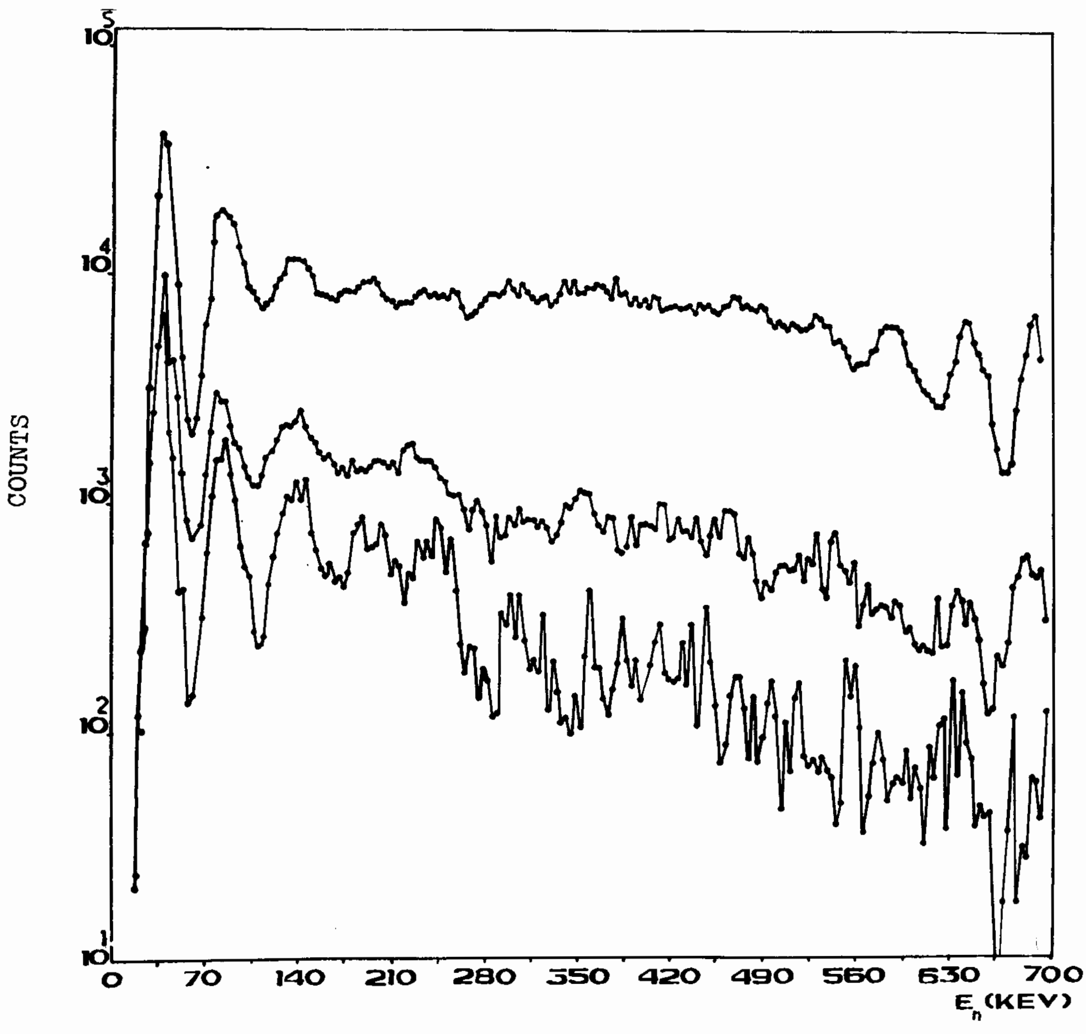

Fig.2. Change spectra with a time

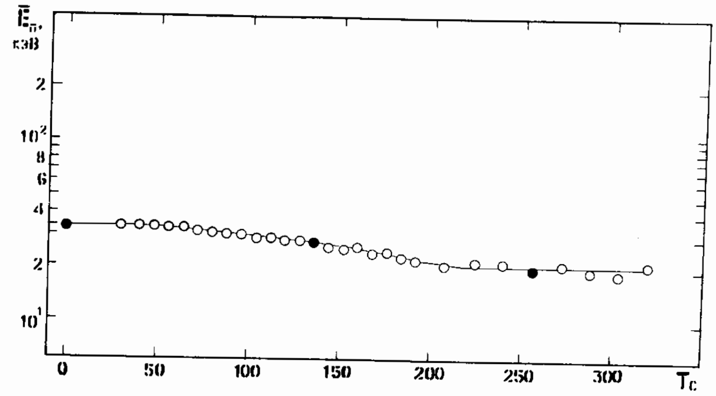

Fig.3. Change of the average energy of the spectra

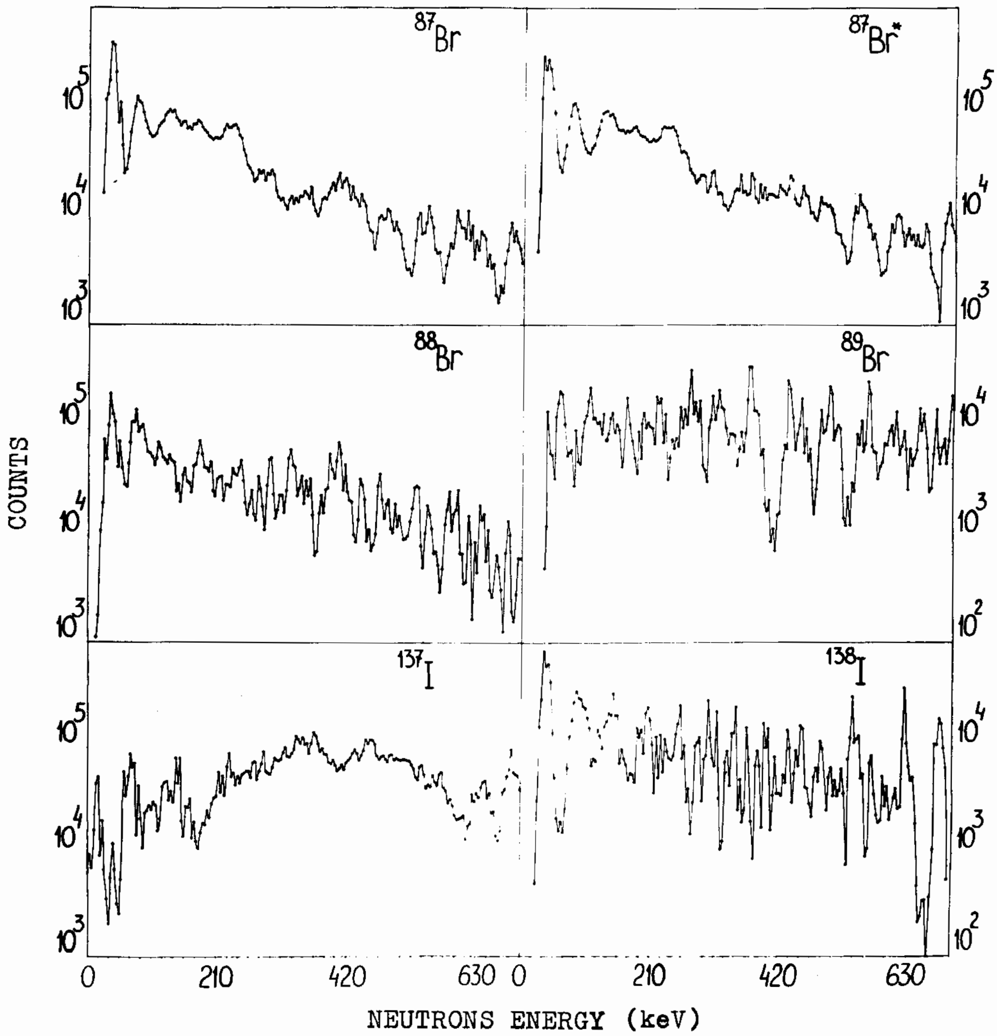

Fig.4. The spectra DN from pure precursors