Nuclear Data Evaluation for JENDL High Energy File and its Benchmark*

Yukinobu Watanabe
Department of Advanced Energy Engineering Science, Kyushu University,
Kasuga, Fukuoka, 816-8580, Japan
watanabe@aees.kyushu-u.ac.jp

High-energy cross section data above 20 MeV are required for various applications involving high-energy neutrons and protons, such as accelerator-driven transmutation of nuclear waste and energy production, radiotherapy of cancer, and soft-error effects in microelectronics. In this report, an overview is presented of recent nuclear data evaluations performed for the JENDL High Energy File (JENDL/HE), in which neutron and proton cross sections for energies up to 3 GeV will be stored for whole 132 nuclides. The JENDL/HE file contains neutron total cross sections, nucleon elastic scattering cross sections and angular distributions, non-elastic cross sections, production cross sections and double-differential cross sections of secondary light particles and (n, p, d, t, ^{3}He, α, and π) and photons, isotope production cross sections, and fission cross sections. The current status of JENDL-HE file is that the evaluations for 66 nuclides among the entire 132 nuclides have been completed, and the evaluated cross section data have been tabulated in the ENDF-6 format and released as the JENDL/HE-2004 file.

The evaluations are performed on the basis of experimental data and theoretical model calculations. Since the experimental data are not enough in the incident energy region above 20 MeV, particularly for neutron-induced reactions, the nuclear model calculations play an important role in the high-energy cross section evaluations. A hybrid calculation code system has been developed using some available nuclear model codes and systematics-based codes. A major code used for the intermediate energy range below 150 to 250 MeV is the GNASH code based on statistical Hauser-Feshbach plus preequilibrium exciton models. Optical model calculation codes such as ECIS and OPTMAN are also employed. For higher incident energy range, we use a microscopic simulation code (either JQMD or JAM) based on the quantum molecular dynamics or the intra-nuclear cascade model for dynamical processes and the evaporation model for the following statistical decay processes. The systematics-based codes, TOTELA and FISCAL, are also used for total, elastic scattering and reaction cross sections and angular distributions of elastic scattering, and fission cross sections.

The evaluated cross sections are compared with available experimental data and the other evaluations. Preliminary results of some benchmark tests using the transport code MCNPX are also presented.

---

* This work has been performed by the members of High-Energy File Making Sub-WG in High-Energy Nuclear Data Evaluation WG, Japanese Nuclear Data Committee (JNDC):

S. Chiba, T. Fukahori, T. Hino, K. Ikeda, M. Kawai, N. Koori, K. Kosako, K. Maki, T. Murata, H. Nakashima, N. Odano, K. Shibata, N. Shigyo, N. Yamano, T. Watanabe, and Y. Watanabe