

Status of BROND-3 library (April 2007)

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Main Russian activity on nuclear data in the last years was concentrated on a revision of most important neutron data for advanced nuclear reactors and a compilation of a new version of the BROND-3 library.

The following evaluations were performed during the last year:

- i) Files for U-235, U-238, Pu-239 and Pu-241 were revised taking into account the new standards recommended for the fission cross sections of the uranium isotopes. Main problems relate to an estimation of uncertainties for new evaluations and to test of the revised files against the available benchmarks. The present standards have some unrealistic fluctuations for both the cross sections and uncertainties of such fluctuations should be certainly removed from the final version of the standards. The updated files for the above isotopes should be prepared to the end of the year. The final conclusions about uncertainties and the corresponding covariance matrices will be done on the basis of the available microscopic experimental data and the benchmark testing results.
- ii) The available data for Pu-238 were analyzed on the basis of the same approaches that used in the previous BROND-3 evaluations for actinides and new evaluations were performed for the most cross sections. The obtained total, inelastic scattering and fission cross sections are compared in Fig. 1 with other evaluations and the available experimental data. Improvements for the total and inelastic scattering cross sections look very important.
- ii) The BROND-3 files for zirconium and molybdenum isotopes were revised and updated. Because these isotopes relate to both structural materials and fission products, the require accuracies for evaluated inelastic scattering data are required for them with higher accuracy than for most fission products. Particularly, the double-differential neutron spectra (MF=6) and gamma-ray production data were included into the new evaluations. For the inelastic scattering and the neutron radiative capture the new evaluations are compared in Fig. 2 with previous ones, including the recent ENDF/B-VII. Optical model parameters used in our evaluations were fitted to the recent experimental data on the neutron total cross sections and the (n,2n) cross sections were tested against some phenomenological systematics, so the BROND-3 evaluations look preferable for cases where contradictions with other evaluations are observed.
- iii) A revision of the previous evaluations for most important fission products was continued. Main attention was spent to a comparison with the recent ENDF/B-VI evaluations and a search of criteria for the evaluation selection in the case of scanty experimental data. The evaluations for Sm-151 can be considered as an example of available disagreements. The results of the recent measurements of the capture cross section for this isotope, performed on the nTOF-spectrometer at CERN, compared in Fig. 3 with the evaluations. The BROND-2, JEFF-3.1 and ENDF/B-VI evaluations, which have been made many years before the measurements, agree reasonably with the experimental data at the region of unresolved resonances (<100 keV). Of course, the BROND-3, that takes into account these data, looks preferable for the whole energy region. Other libraries will be adjusted soon to these data. However, the main questions with a selection between evaluations arise for the inelastic scattering (Fig. 3), where there

are no experimental data and there is no a hope to obtain them at a reasonable time. Nevertheless, main conclusions about preferable evaluations can be done on the basis of the cross-section systematics for neighboring nuclei. From this point of view agreement the BROND-3, CENDL-3, and ENDF/B-VII should be considered as acceptable ones for the energies above 100 keV, but other evaluations look definitely wrong. A more difficult question relates to the inelastic scattering cross section below 100 keV. Differences between evaluations relate to the optical model description of the total and absorption cross sections for low energies.

iv) The analysis of recent evaluations was performed for about 40 of the most important fission products. The benchmark experiments on the BFS (IPPE) assemblies were included into consideration. The preference of the new ENDF/B-VII evaluations over the previous ones was confirmed for a half of the analyzed nuclei, while for other the updated BROND-3 evaluations were preferred.

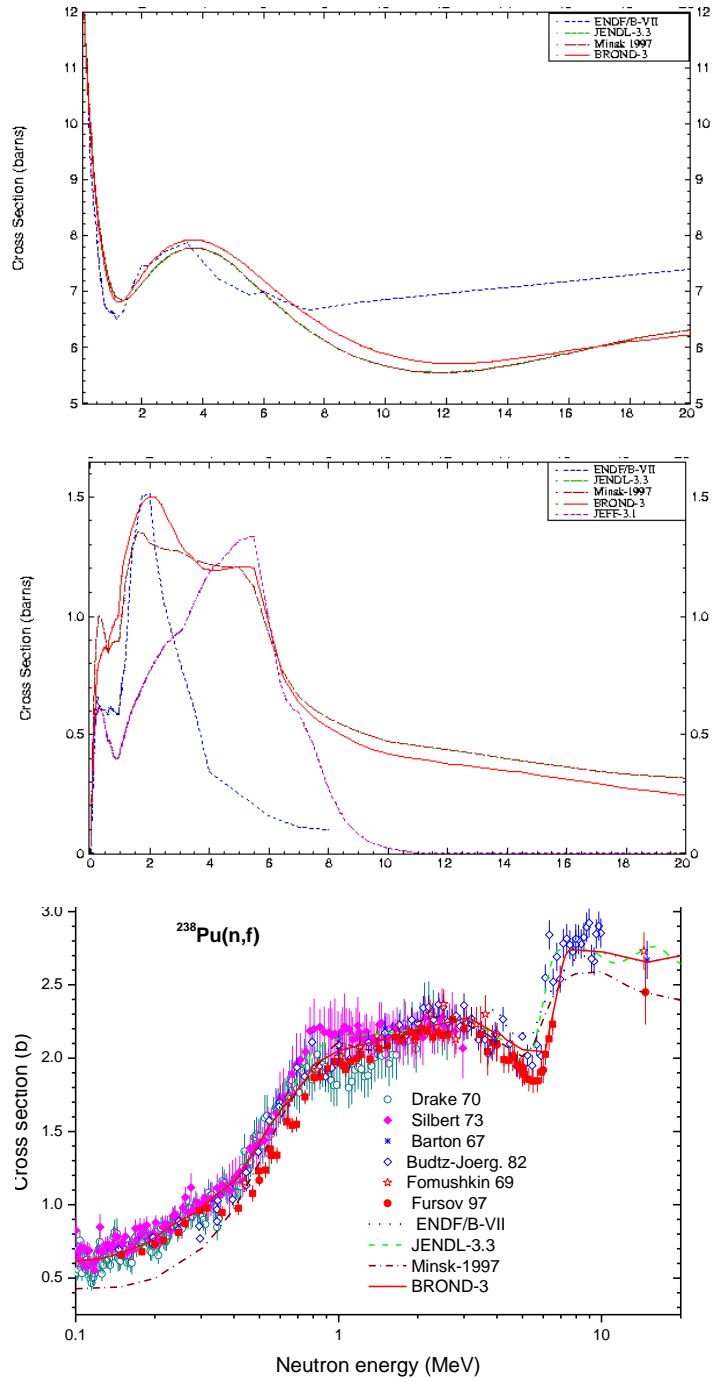


Fig. 1. Comparison of the total, inelastic scattering and fission cross-section evaluations for ^{238}Pu

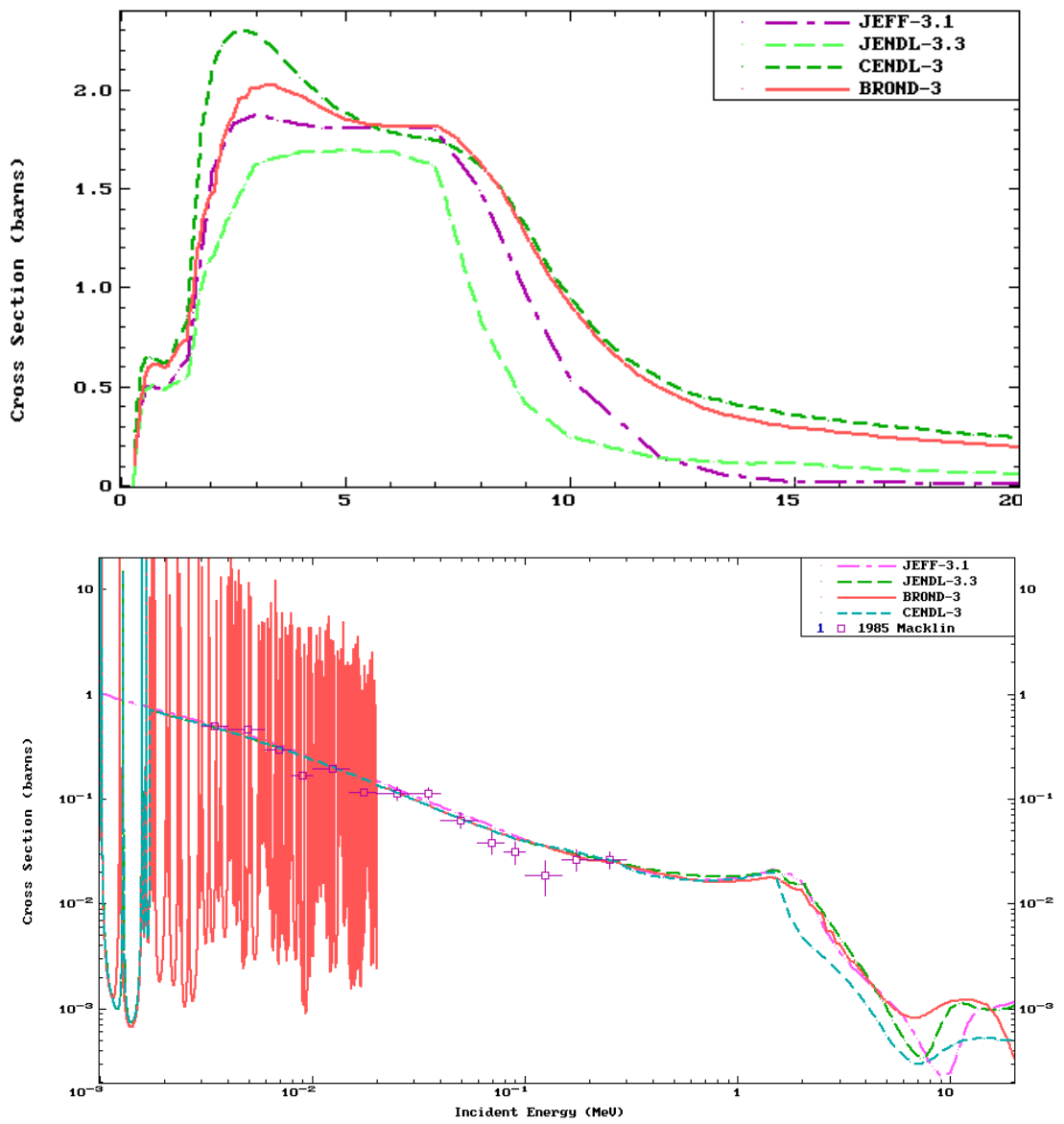


Fig. 2. Comparison of the inelastic scattering and capture cross-section evaluations for Zr-93

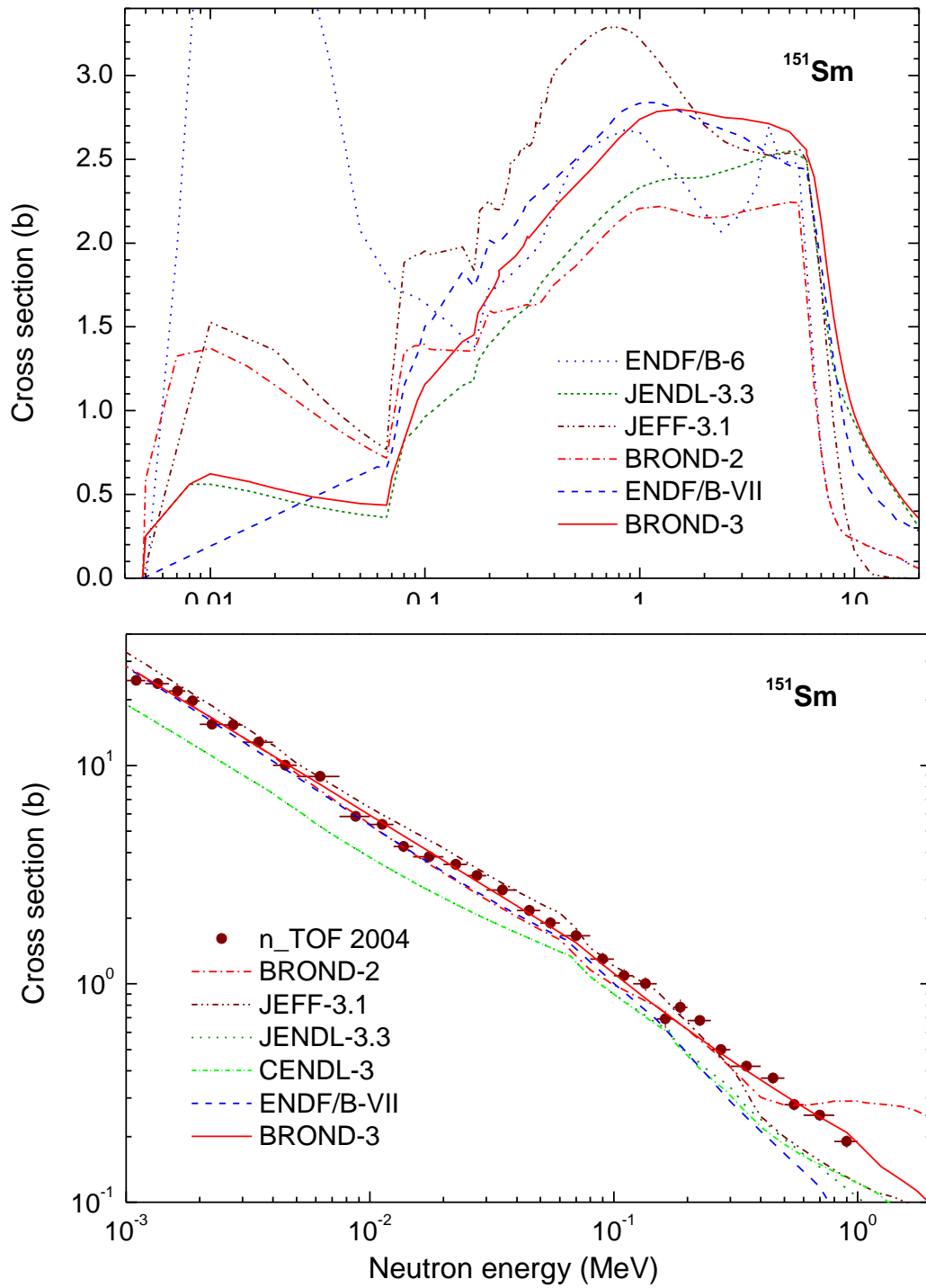


Fig. 3. Comparison of the inelastic scattering and capture cross-section evaluations for ^{151}Sm with the recent nTOF-data for the radiative capture