Status of BROND-3 library (April 2005)

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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 on formation of a new version of the BROND-3 library.

The following evaluations have been performed:

i) Files for separated molybdenum isotopes were re-evaluated. Because molybdenum relates to both structural materials and fission products, the require accuracies for evaluated inelastic scattering data are required for molybdenum isotopes 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, the (n,2n) reaction and the neutron radiative capture the new evaluations are compared in Fig. 1 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 (for example, Fig. 1 for ^{95}Mo).

ii) Revision of evaluations for most important fission products was continued. To the recent evaluations for Zr, Ru, Pd, Nd, and Sm isotopes the updated files of Ag-107, -109 and Eu-151, -152, -153 were added. Main modifications of all updated files relate to the inelastic scattering and (n,2n) cross sections, while the capture cross sections were adopted close to the previous BROND-2 evaluations. We are revising mainly nuclides related to the list of 50 fission products, which are the most important for fast reactors. Main attention we spent to the cases where our systematics of the inelastic scattering and the threshold reactions look contradictive to the recommendations of Subgroup 21. Examples of such cases are shown in Fig. 2 for Nd-145 and Sm-147. Updated files are testing now against some benchmark data available at IPPE. Examples of such data are shown in Figs. 3 and 4. We are going to finish main tests to the end of the year and send the updated BROND-3 files to the NNDC for comparison with other updated evaluations. For fission products behind the 50 most important we try to collaborate with the NNDC in accordance with the existing plans of Subgroup 23 and we plan to test some of updated files against the benchmarks available at the IPPE.

iii) We are working now on a revision of U-235, Pu-239 and Pu-241 files connected with the new recommended standards for the fission cross sections. Main problems relate to test of the revised files against the benchmarks available for fast reactors. We hope to finish such tests to the end of the year. Due to the standard changes we are induced to revise the uncertainties and corresponding covariance matrices for most important cross sections of these isotopes. The final conclusions about uncertainties will be done taking into account the benchmark testing results.

iv) Energy dependences of the delayed fission-neutron parameters was re-evaluated for plutonium and americium isotopes on the basis of the recent experimental data obtained at the IPPE. The eight-group representation was used instead the previous six-group one. These evaluations should be included in the corresponding BROND-3 files.

v) The BROND-3 high-energy file for Th-232 was re-evaluated in collaboration with the CERN on the basis of new neutron capture data obtained by the n-TOF collaboration. Due to new precise data increased essentially accuracy of the capture cross section estimation. The neutron total and elastic scattering data were revised in accordance with the recent LANL measurements. Uncertainties and the corresponding covariance matrix are estimated for most important cross sections. Unfortunately, the fission cross sections measured in the CERN did not processed finally yet and that prevents to the final conclusions on uncertainties of fission cross section evaluations.

vi) The high-energy file for Am-241 was completed during the last year. The same approaches were used for these evaluations as applied before for the files of U-238, Np-237, Pu-239 and Pu-240. This activity was supported by the ISTC Project-1732. We are going to prepare similar files for remaining plutonium and americium isotopes important for the analysis of minor actinides transmutation in accelerator-driven systems during of this and next years.

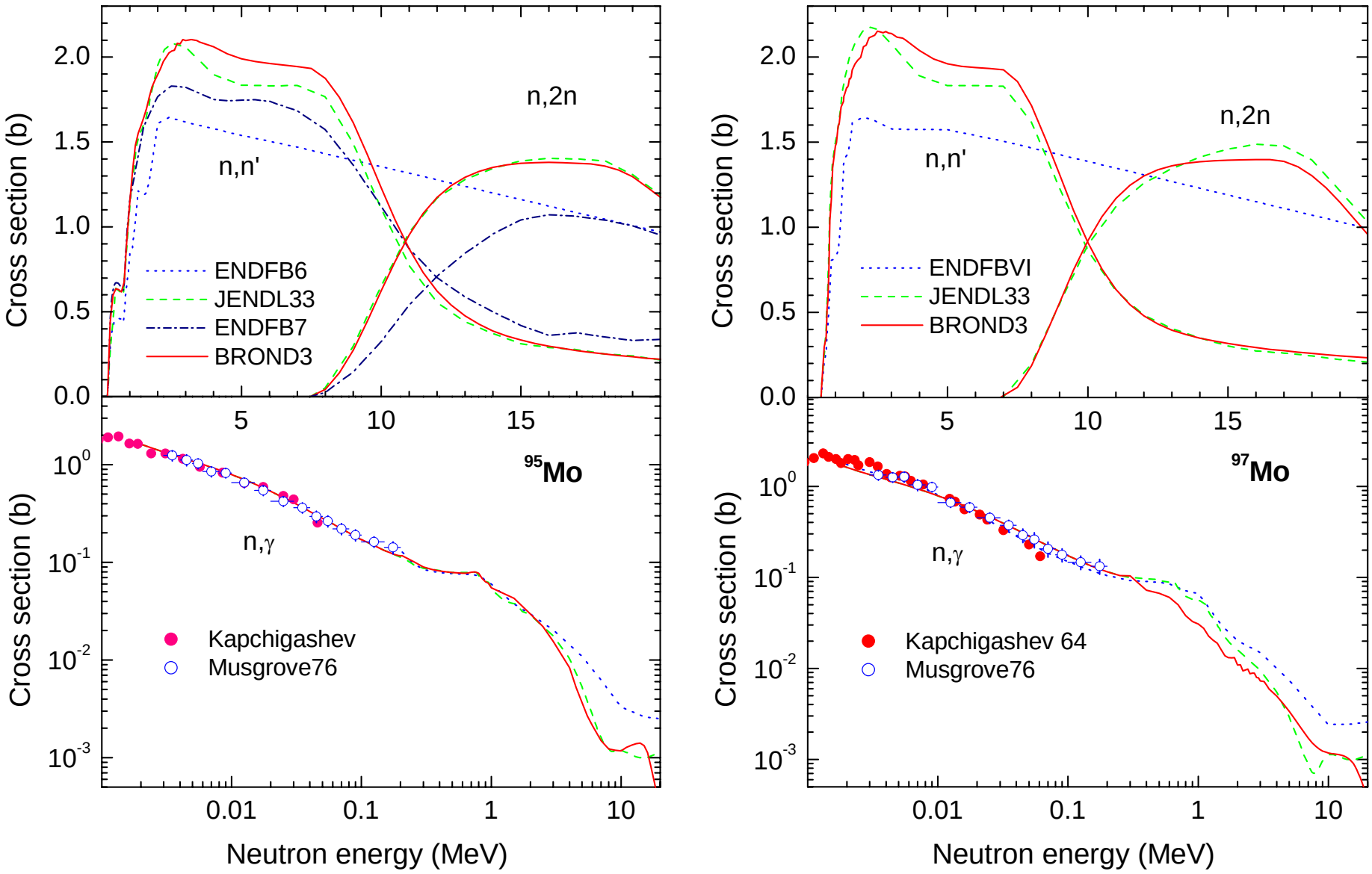

Fig. 1. Evaluations of the inelastic scattering, (n,2n) and neutron capture cross sections for ^{95}Mo and ^{97}Mo in comparison with the available experimental data

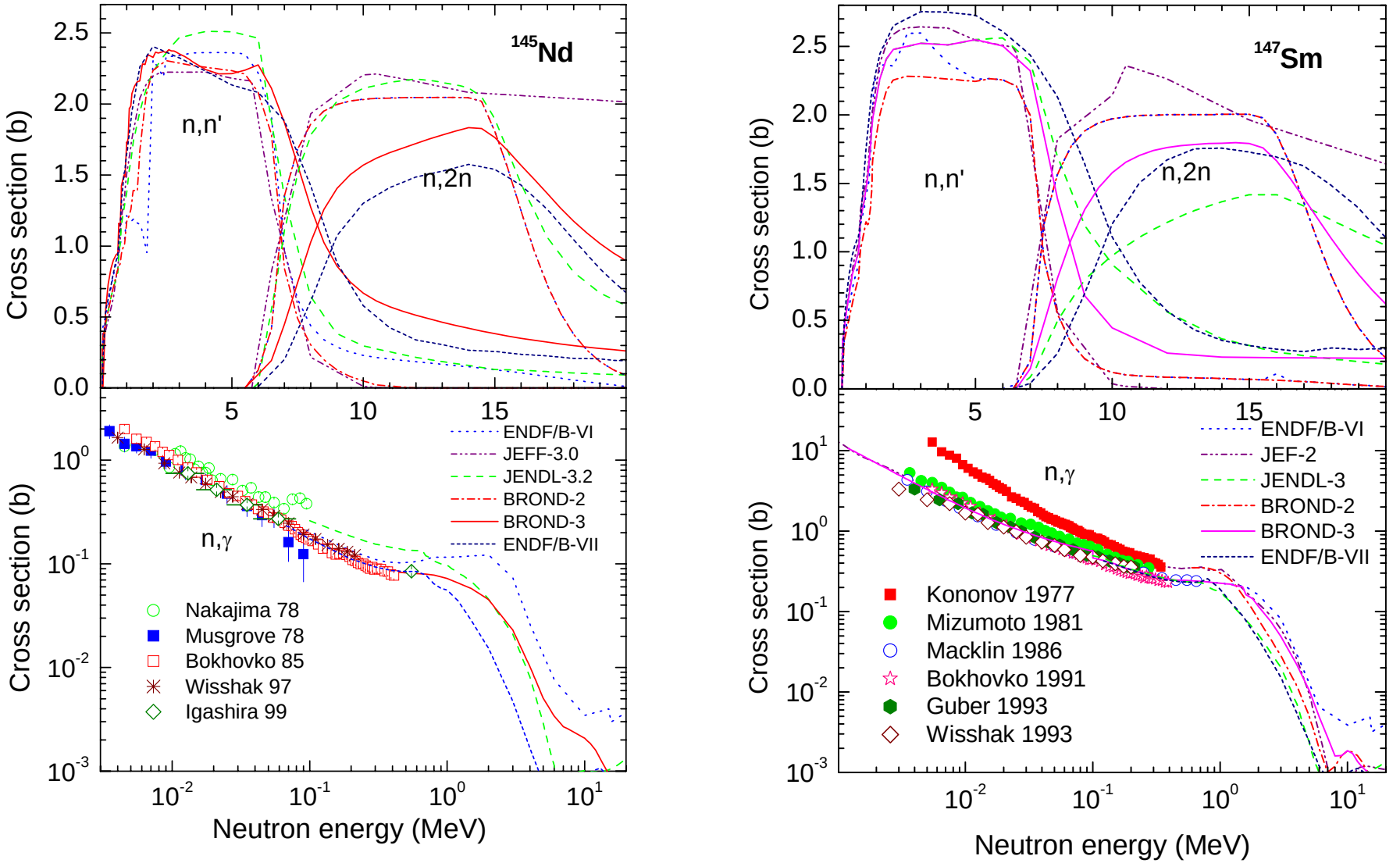

Fig. 2. Evaluations of the inelastic scattering, (n,2n) and neutron capture cross sections for ^{146}Nd and ^{147}Sm in comparison with the available experimental data

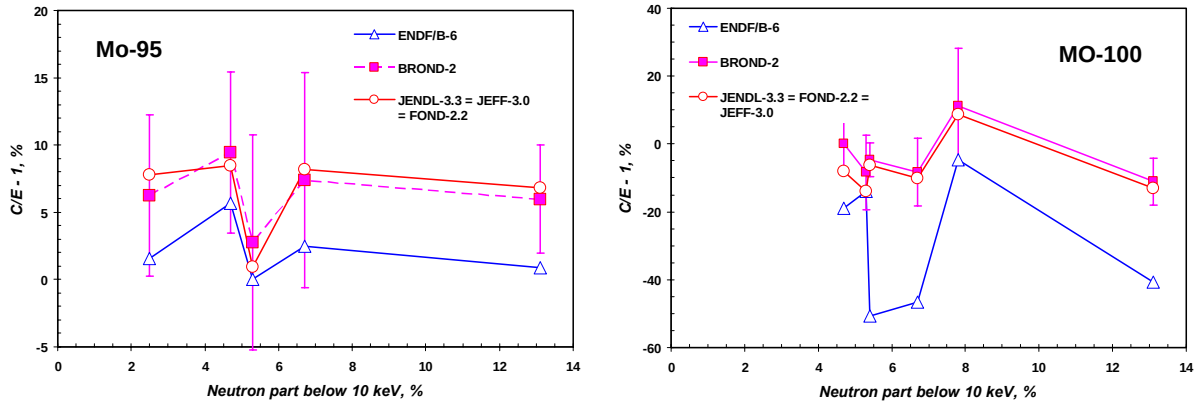

Fig. 3. Difference between experimental and calculated values of the reactivity coefficients for the BFS assemblies with the samples of ^{95}Mo and ^{100}Mo

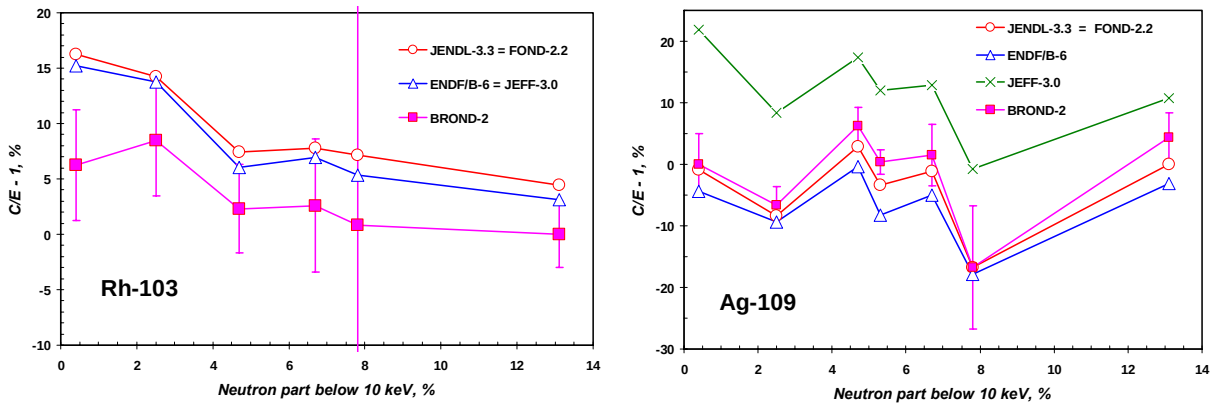

Fig. 4. The same as in Fig. 3 for the samples of ^{103}Rh and ^{109}Ag

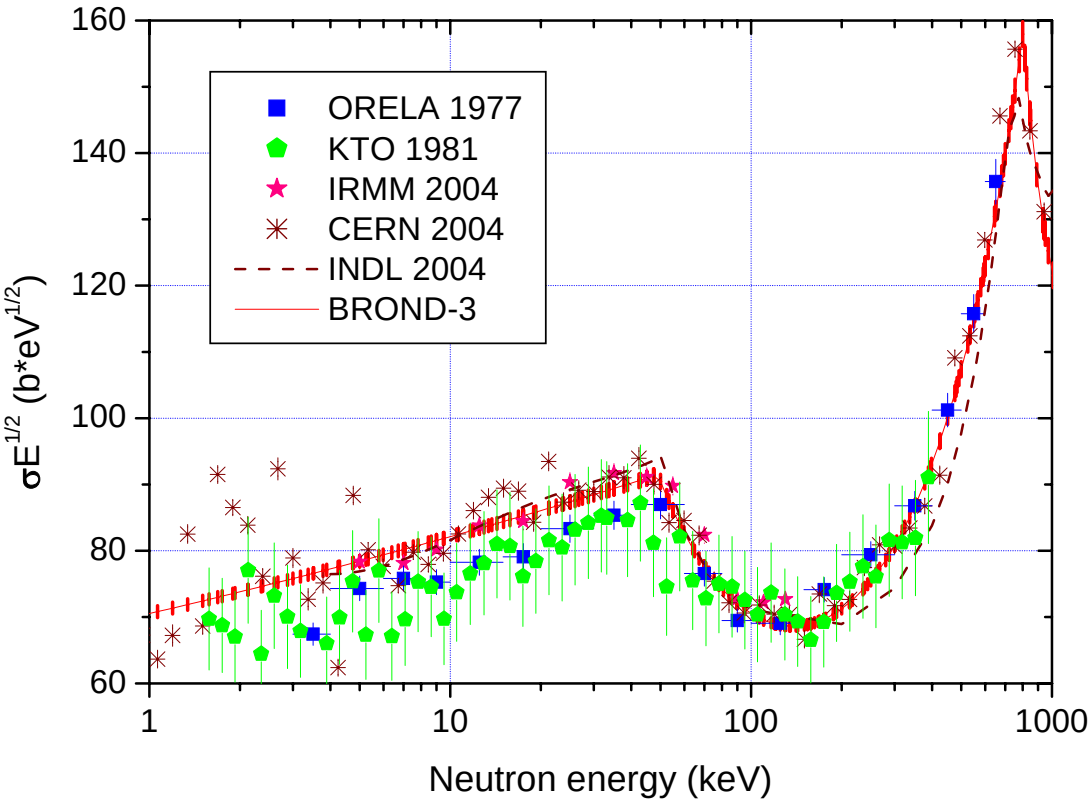

Fig. 5. Recent experimental data on the neutron capture cross section compared with new evaluations