Towards predictions of fission cross section on the basis of microscopic nuclear inputs

Hilaire S.
CEA, DAM, DIF, F-91297, Arpajon, France

Goriely S.
*Institut d'Astronomie et d'Astrophysique, Universtié Libre de Bruxelles,
Campus de la Plaine CP226, 1050 Brussels, Belgium*

Koning A.J.
Nuclear Research and Consultancy Group, P.O. Box 25, NL-1755 ZG Petten, The Netherlands

Sin M.
*Nuclear Physics Department, University of Bucharest,
P.O. Box MG-11, Bucharest-Magurele, Romania*

Capote R.
International Atomic Energy Agency, Nuclear Data Section, A-1400 Vienna, Austria
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Almost all the evaluations of the neutron-induced fission cross section for nuclei involved in nuclear applications rely on phenomenological ingredients. For instance, the shapes of the fission barriers are usually approximated by inverted parabolas with specified heights and widths, and the required nuclear level densities are also based on highly-parameterized phenomenological expressions. If such approaches enable to fit available experimental data, their predictive power is clearly poor, and they can not be recommended for applications requiring a proper description of fission for nuclei far from stability.

In contrast, microscopic Hartree-Fock-Bolgolyubov (HFB) calculation can provide all the nuclear ingredients required to describe the fission path from the equilibrium deformation up to the nuclear scission point with, in principle, a higher predictive power. The aim of this contribution is to test such microscopic informations to calculate neutron-induced fission cross sections on selected actinide nuclei. This approach includes not only the details of the energy surface along the fission path, but also the estimate of the nuclear level density derived within the combinatorial approach on the basis of the same HFB single-particle properties, in particular at the fission saddle points.

It is shown that a satisfactory estimate of the fission cross section for non-energy applications can be achieved with a global renormalization of the barrier heights and the microscopic nuclear level densities at the fission saddle points. Good agreement with experimental data can be obtained if both the fission barrier heights and level densities are independently renormalized.