Reexamining intermediate resonant structures in the ^{242}Pu fission cross section

Carole Chatel*
CEA, DES, IRESNE, DER, SPRC, Physics Studies Laboratory, Cadarache, F-13108 Saint-Paul-lez-Durance, France and Univ. Bordeaux, CNRS, CENBG, UMR 5797, F-33170 Gradignan, France

Olivier Bouland, Gilles Noguère and Maria Diakaki
CEA, DES, IRESNE, DER, SPRC, Physics Studies Laboratory, Cadarache, F-13108 Saint-Paul-lez-Durance, France

Ludovic Mathieu and Mourad Aïche
Univ. Bordeaux, CNRS, CENBG, UMR 5797, F-33170 Gradignan, France

Peter Möller
P. Moller Scientific Computing and Graphics, 1888 Kalakaua Ave, Suite 3104, Honolulu, HI 96815

The neutron fission cross section of the ^{242}Pu target nucleus is being studied both experimentally and theoretically since at least five decades. Past studies include early measurements and derived resonance analyses as those by Auchampaugh *et al.* [1] and Weigmann *et al.* [2] and, since 2008, date of a renewed High Priority Request List demand according to the fission experimental data, a new series of high-resolution measurements was carried out that started in 2009 by the comprehensive work by Tovesson *et al.* [3]. However no very specific analysis of the resonant structures observed in the ^{242}Pu fission cross section was recently performed; likely because of the fertile character of this nucleus that makes it less important for neutron reactor applications. The present talk is revisiting the topic by methodically analysing and modeling the observed fluctuations in the fission cross section over the neutron energy range from thermal to 3 MeV. This objective was achieved using complementary features of three codes, meaning the CONRAD code[4] offering the capability to treat with a Lorentzian penetrability possibly observed class-II states in the resolved resonance range, the TALYS-ECIS06 system[5] of codes (Cadarache version) to treat the unresolved resonance structures above 1.5 keV in the same spirit and, finally the combinatorial Quasi-Particle-Vibrational-Rotational Level Density (QPVRLD) method [6] implemented in the AVXSF-LNG computer program. The latter approach was intensively used in this work to simulate the most plausible level densities according to the inner and outer fission barriers of the ^{243}Pu compound nucleus as well as for the density of (class-II) states in the second well of the fission barrier. We will conclude this talk by arguing on a sizeable structure observed around 1.1 MeV neutron energy, with in particular bringing some explanation according to its origin. The Figure 1 displays the modeling dedicated to this broad structure using the TALYS code and QPVR-based level densities using the single-particle orbital database made available by P. Möller [7].

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*Electronic address: carole.chatel09@gmail.com

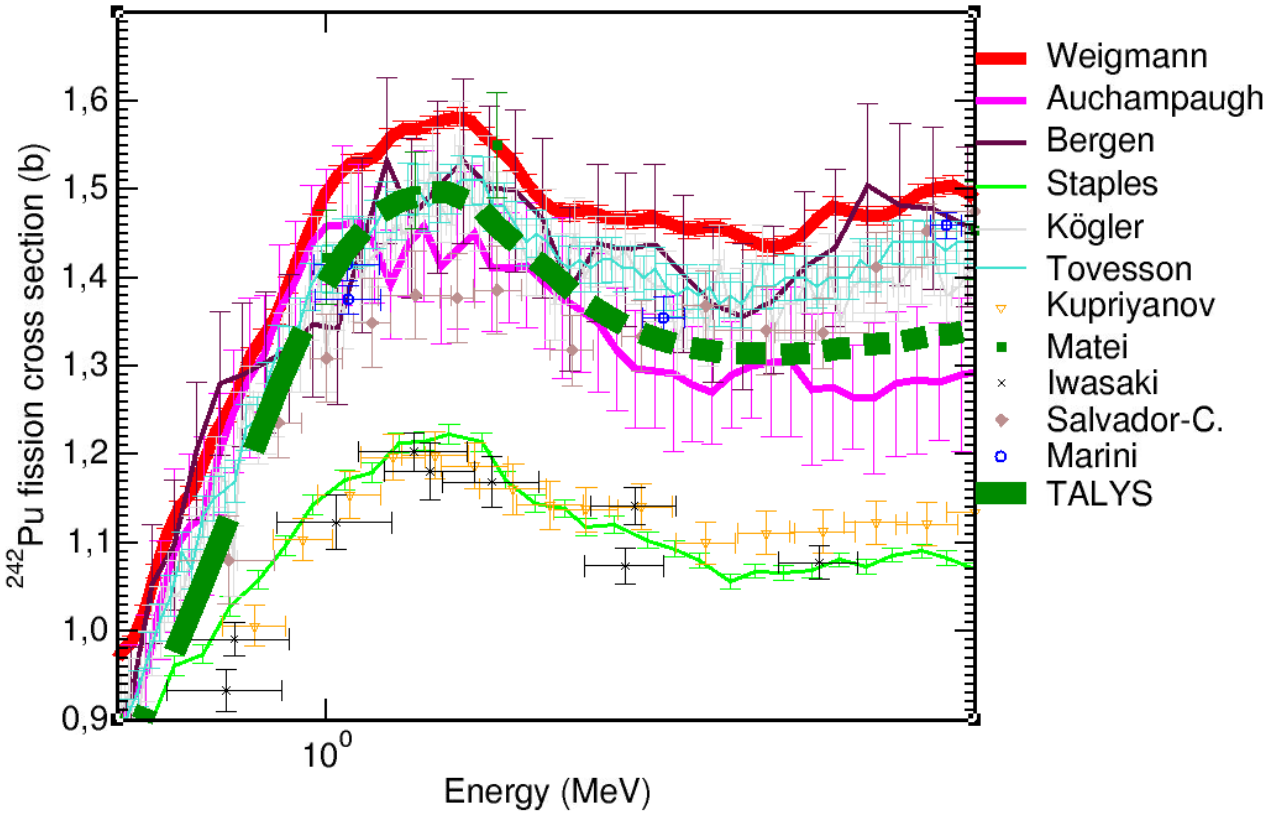

FIG. 1: Comparison of present modeled neutron fission cross section for the ^{242}Pu target nucleus (TALYS curve) with the experimental data available over the fission energy threshold region.