U, Np, Pu and Am prompt fission neutron spectra

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Prompt fission neutron spectra (PFNS) components due to soft and hard pre-fission neutrons are evidenced in the shape of the measured PFNS data when interpreting prompt fission neutron spectra (PFNS) of ^{232}Th(n,F), ^{238}U(n,F), ^{235}U(n,F) and ^{239}Pu(n,F) reactions for $E_n \leq$20 MeV [1,2]. That approach seems to be quite grounded to predict the PFNS of the ^{237}Np(n,F) and ^{241}Am(n,F) reactions, the pre-fission neutrons contribution being based on the consistent description of ^{237}Np(n,F) and ^{237}Np(n,2n)^{236s}Np and ^{241}Am(n,F) and ^{241}Am(n,2n) [3] reaction cross sections, respectively. Exclusive spectra of (n,xnf) pre-fission reaction neutrons were calculated with a Hauser-Feshbach statistical model and are strictly correlated with the emissive fission contributions to the observed fission cross sections. The lowering of PFNS average energy at E_n ∼5 - 9 MeV, which is due to the pre-fission (n,nf) neutrons, is predicted to be correlated with emissive fission chances contribution. Similar dips are predicted for around E_n =10 - 15 MeV due to (n,2nf) pre-fission neutrons. Spectra of neutrons, evaporated from fission fragments, were approximated as a sum of two Watt' distributions. Though for major actinides PFNS $\langle E \rangle$ of previous and present approach may look similar (at least up to (n,2nf) reaction thresholds), our predictions of PFNS for ^{239}Pu(n,F) are drastically discrepant with previous estimates, in which pre-fission neutron emission was represented by simple evaporation from a highly excited compound nucleus. In general, $\langle E \rangle$ of PFNS of ^{232}Th(n,F), ^{238}U(n,F), ^{235}U(n,F) and ^{239}Pu(n,F) appear to be systematically shifted to higher values, so that Th fission fragments look least heated, while those of Pu - most heated. The average energy of the Th, U and Pu PFNS $\langle E \rangle$ appears to be rather dependent on E_n and is shown to be correlated with the emissive fission chances contributions to the observed fission cross sections. The contribution of pre-fission neutrons is least pronounced in case of ^{239}Pu(n,F), but most pronounced in case of ^{232}Th(n,F) reaction. The PFNS of ^{237}Np(n,F) at 7.8 MeV and 14.7 MeV are reproduced, PFNS of ^{241}Am(n,F) reaction are predicted.

[1] V.M. Maslov *et al.*, Phys. Rev. **C 69**, 034607 (2004).

[2] V.M. Maslov *et al.* Nucl. Phys. **A760**, 274 (2005).

[3] D.J. Vieira et al., Abstracts of Intern. Conf. Nucl. Data for Sci. Techn., April 22-27, 2007, Nice, France, p.31.