TOTAL KINETIC ENERGIES IN ^{232}Th(n,F) AND ^{238}U(n,F)

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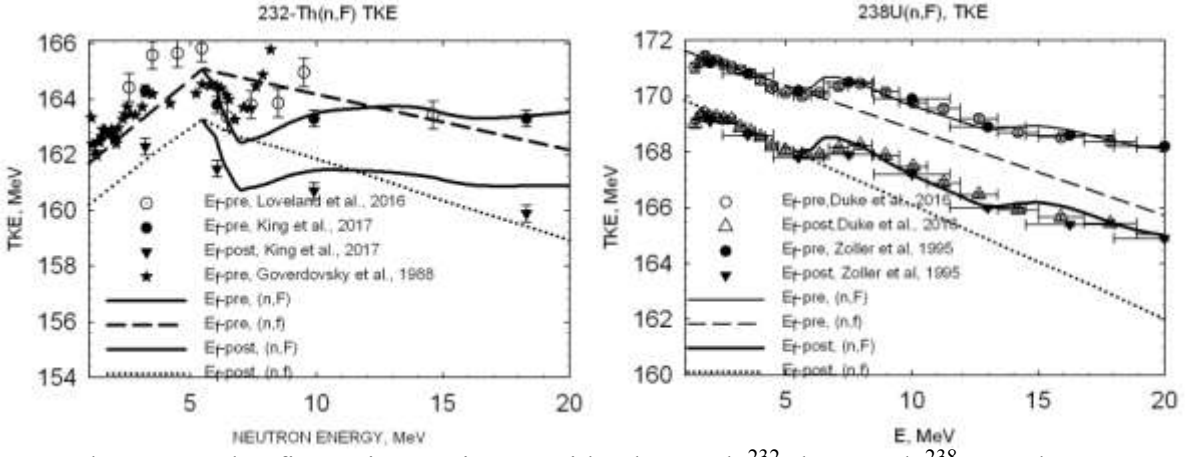
Local minimum in TKE of fission fragments in ^{232}Th(n,F) around ^{232}Th(n,nf) threshold was first observed by Goverdovsky et al. in 1988. In 1995 Zoller et al. observed local maxima in TKE in ^{238}U(n,F) reaction around ^{238}U(n,xnf) thresholds. These variations are due to pre-fission (n,xnf) neutrons, which are pronounced in observed cross sections, prompt fission neutron spectra (PFNS) and mass distributions as well. Contribution of the (n,xnf) reaction to the $\sigma_{n,F}$ of ^{232}Th(n,F) around E_n ~7 MeV is ~1.5 higher than in case of ^{238}U(n,F), which is pronounced in TKE also. Partial contributions of (n,xnf) were fixed in [1–3] and seem to reproduce TKE variations. TKE values E_f^{pre} (E_f^{post}) before (after) prompt neutron emission from fission fragments were calculated as

$$E_f^{pre}(E_n) = \sum_{x=0}^{X} E_{fx}^{pre}(E_{nx}) \cdot \sigma_{n,xnf} / \sigma_{n,F}, \qquad E_{nx} = E_n + B_n - \sum_{x=0,1\le j\le x}^{X} \left(\left\langle E_{n,xnf}^{j} \right\rangle + B_x \right).$$

TKE E_f^{post} were de-defined as $E_f^{post} \approx E_f^{pre}\left(1 - \nu_{post} / \left(A - \nu_{pre}\right)\right), \nu_p = \nu_{post} + \nu_{pre}$. Components ν_{post} and ν_{pre} of ν_p are defined via ν_p and PFNS analysis at E_n ~2–20 MeV. Assuming $E_f^{pre}(E_n)$ for $^{233\text{-x}}$Th, $^{238\text{-x}}$U are similar to those of ^{233}Th and ^{239}U (note TKE of ^{232}Th(γ,F)) we obtained TKE shown on the figure.



TKE shown on the figure is consistent with observed ^{232}Th+n and ^{238}U+n data on cross sections and PFNS. Straight lines are approximations of TKE values for non-emissive fission. The (n,xnf) neutrons influence on TKE values E_f^{pre} and E_f^{post} is much more pronounced in case of ^{232}Th(n,F) reaction. That is due to the transition states structure of ^{232}Th and competition of ^{232}Th(n,nγ) and ^{232}Th(n,nf) at $E_n \le 6.5$ MeV. For both ^{232}Th(n,F) and ^{238}U(n,F) (n,nf) neutrons influence on PFNS at E_n ~6.5 MeV and E_n ~7 MeV are quite different, which is due to the (n,2n) reaction neutrons competition to the (n,nf) reaction.

1. V.M. Maslov, Yu.V. Porodzinskij, M. Baba, et al., Phys. Rev., C**69**, 034607 (2004).
2. V.M. Maslov, Physics of Atomic Nuclei, vol. **71**, No. 1, 9 (2008).
3. V.M. Maslov, Nucl. Phys. A**743**, 236 (2004).