Anisotropy in pre-fission and (n,n'γ) neutron spectra of ^{239}Pu+n

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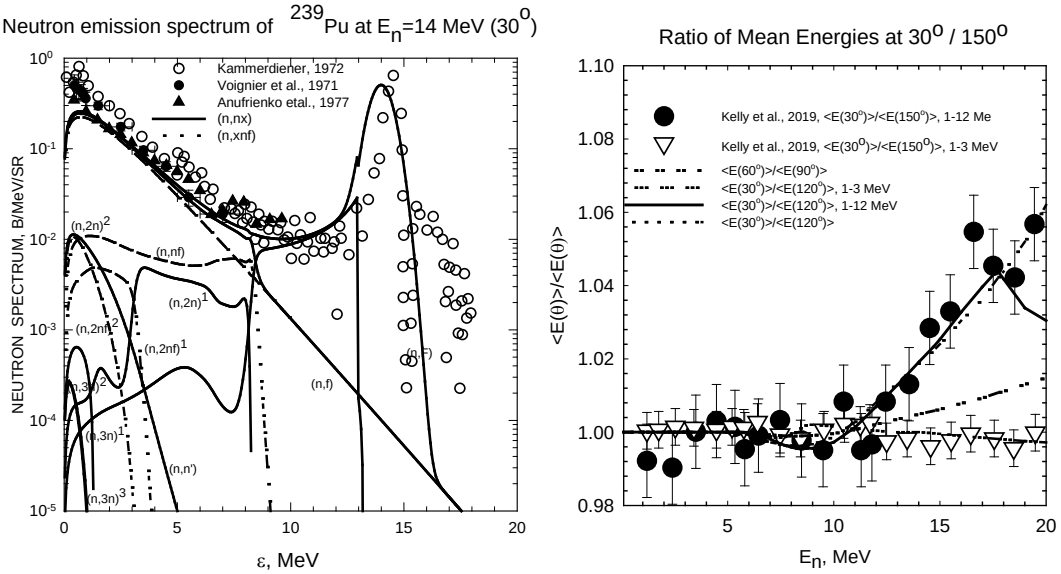
Strong anisotropic component was observed [1] in ^{239}Pu(n,F) pre-fission neutron spectra at E_n~12–20 MeV. Neutron emission spectra of n+^{239}Pu interaction at E_n~14 MeV are strongly anisotropic, while residual nuclide ^{239}Pu excitations are 1~6 MeV [2–4]. These peculiarities could be attributed to the pre-equilibrium/semi-direct emission of the 1st neutron, which is tuned to reproduce (n,F) and (n,xn) reaction cross sections and neutron emission spectra consistently. The angular dependence was approximated as $d\sigma^1_{nnx}/d\varepsilon \approx d\tilde{\sigma}^1_{nnx}/d\varepsilon + \sqrt{\frac{\varepsilon}{E_n}}\frac{\omega(\theta)}{E_n-\varepsilon}$. The exclusive spectra of (n,nf) and (n,2n)^1 [5–8] reaction appear to be angle-dependent as well. Because of data [2] scattering the approach was tuned on similar data description of ^{238}U+n, where collective levels up to 1.2 MeV were included [9]. The partial neutron spectra for the neutron emission at angle of ~30^o are shown on figure below. The angular dependence of (n,nf) neutron spectra is the strongest, it influences the observed prompt fission neutron spectra and its average energies, The ratio of calculated $\langle E \rangle$ for forward and backward emission of (n,xnf)-neutrons is compatible with measured data [1]. Ratio of $\langle E \rangle$ depends on the averaging range, at low angles ^{239}Pu(n,xnf) neutrons at E_n >18 MeV are harder.



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