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Possibility of identifying the virtual component in scission neutrons

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Experimental measurements of angular and energy distributions of fission neutrons $n(\theta, E)$ per fission event were carried out in [1-4] assuming that $n(\theta, E) = n_{ev}(\theta, E) + n_{sc}(\theta, E)$, where E is asymptotic kinetic energy of a neutron, θ is angle between the directions of the outgoing neutrons and the light fission fragment, $n_{ev}(\theta, E)$ is number of prompt neutrons evaporated from light and heavy fission fragment, $n_{sc}(\theta, E)$ is number of scission neutrons. These measurements corresponded to the cases of spontaneous fission of the ^{252}Cf nucleus and thermal neutron-induced fission of ^{233}U, ^{235}U and ^{239}Pu target nuclei. Also, in these papers a theoretical calculation of the prompt neutron distributions $n_{ev}(\theta, E)$ was carried out. The value $B(\theta, E) = \frac{n(\theta,E)}{n_{ev}(\theta,E)} = 1 + \frac{n_{sc}(\theta,E)}{n_{ev}(\theta,E)}$ was further constructed, and it can be used to calculate $n_{sc}(\theta, E)$ by the formula $n_{sc}(\theta, E) = \frac{(B(\theta,E)-1)n(\theta,E)}{B(\theta,E)}$.
Unfortunately, the approaches used for calculations $n_{sc}(\theta, E)$ require a certain adjustment, since at definite angles θ they lead to $B(\theta, E) < 1$, which corresponds to $n_{sc}(\theta, E) < 0$,which is impossible due to the positive definition of $n_{sc}(\theta, E)$.

In the present paper, for all studied nuclei, the appearance of a peak for $n_{sc}(\theta, E)$ in the vicinity of the angle $\theta = 90^\circ$ for $50^\circ \leq \theta \leq 125^\circ$ is demonstrated, which is a direct indication of the emission of scission neutrons from the neck of a compound fissile nucleus. At the same time the energy spectrum $n_{sc}(\theta, E)$ in the specified range of angles corresponds to the energies of neutrons lying in the range of $0 \leq E \leq 1$ MeV. Since these neutrons are emitted from neutron states of a compound fissile nucleus corresponding to binding energies about (- 6) MeV, so the appearance of these neutrons in continuous spectrum states with positive energies $0 \leq E \leq 1$ MeV
and emission angles in the vicinity of the angle $\theta = 90^\circ$ can be explained [5] by considering the emission of these neutrons from the neck of a compound fissile nucleus analogously to the light particle emission in ternary nuclear fission.

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