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Double-humped fission barrier and statistical mechanism of formation of angular anisotropy of fission fragments

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Fission of heavy nuclei induced by neutrons of low and intermediate energies (up to 100 MeV) typically occurs at relatively low angular momentum. As a result, the anisotropy of the angular distribution of fission fragments with respect to the direction of the incident neutron's motion is determined by the distribution of the projection K of the spin of the fissioning nucleus onto the axis of deformation [1,2]. This distribution is formed at the fission barrier. At sufficiently high excitation energies it is determined by a statistical mechanism [3] and depends on the deformation and temperature of the nucleus. However, studies of angular anisotropy have been performed on a limited scale due to experimental and theoretical difficulties. Therefore, in particular, the question of the role of the inner and outer humps of the fission barrier in the formation of the distribution by K remains unresolved.

In the last decade, our research group has performed measurements using a neutron time-of-flight spectrometer integrated with the GNEIS neutron complex on a 1 GeV proton synchrocyclotron at the Kurchatov Institute National Research Centre (Gatchina, PIAF). During these experiments, extensive data sets were obtained on fission cross sections and angular distributions of fission fragments in the energy range from low to intermediate. In addition, we have developed new methods for interpreting the data obtained [4-6]. In this work, we demostrate that within the statistical model framework, the angular distribution of fission fragments can be used to determine whether the internal or external hump of the fission barrier is responsible for the formation of the K quantum number distribution.

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