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Theoretical Description of Fragment Angular Anisotropy in Neutron-Induced Fission of Even-Even Nuclei 232Th, 238U, 240Pu at Energies up to 200 MeV

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During the past few years, we have measured the angular distributions of fragments in neutron-induced fission of a number of isotopes at energies of 1–200 MeV. The studies were performed at the NRC "Kurchatov Institute"–PNPI using a TOF neutron spectrometer GNEIS at the 1 GeV proton synchrocyclotron (see [1] and references therein). Now we are adding to previously studied nuclei 209Bi, Pb (nat), 232Th, 233U, 235U, 238U, 237Np, 239Pu (see [2] and references therein) the isotope 240Pu. For energies above 20 MeV, the results are obtained for the first time, their analysis is presented in a separate report. In the region of intermediate energies exceeding 20 MeV, similar data on the angular anisotropy of fission fragments of 232Th, 235U, 238U nuclei were also obtained in [3-6].

We developed a method for theoretical description of the angular distribution of fragments as function of the energy of incident neutrons. Our approach is based on the use of the modified TALYS program [7] and is applicable in a wide range of energies, including the interval of 1–200 MeV. In [2] the results of calculations were presented for the 237Np (n,f) reaction. It was shown that even with the use of some simplifying assumptions; the method correctly describes the gross structure of the energy dependence of the angular anisotropy of fission fragments.

In this work, we apply our method to the theoretical description of the angular anisotropy of fission fragments of even-even nuclei 232Th, 238U, 240Pu by low and intermediate-energy neutrons. The first two isotopes are of particular interest. First, in the intermediate energy region, we use not only our data, but also the results of other authors [3-5]. Secondly, just for 232Th and 238U, only an estimate [3] of the energy dependence of angular anisotropy above 20 MeV was previously performed. Generally, our results confirm that data on the angular anisotropy of fission fragments are a valuable source of information on both the transition states at the barriers and the role of pre-equilibrium processes.

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