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Theoretical Description of Angular Distribution of Gamma Radiation of Neutron-Nuclear Reaction Products

Within the framework of the TANGRA (TAgged Neutrons and Gamma RAys) project at the Frank Laboratory of Neutron Physics (JINR, Dubna), systematic measurements of cross-sections and angular distributions of gamma quanta in reactions with fast neutrons are being conducted. Over the course of its existence, the collaboration has accumulated a large dataset on angular distributions and cross-sections of gamma-ray emission in reactions with 14.1 MeV neutrons, which requires theoretical investigation [1-3].

When neutrons scatter on nuclei, excited states of the reaction products are formed. They decay through the emission of gamma quanta of various multipolarities. The angular distributions obtained in such processes can be theoretically described using the formalism outlined in work [4]. The formula for the angular distributions of gamma quanta includes elements of the scattering S-matrix, which are related to the population of nuclear levels during inelastic neutron scattering. These S-matrix elements in this work were obtained from calculations using the ECIS code [5], which allows for the computation of differential neutron scattering cross-sections and scattering S-matrix elements on nuclei using the optical model, coupled-channel methods, and DWBA. From the data on angular distributions of gamma quanta, important characteristics of excited nuclear states, such as spin-tensor orientation of the nucleus and the ratios of matrix elements for mixed transitions, can be extracted [6]. This work is devoted to the theoretical description of angular distributions of gamma quanta in (n,n’ γ) reactions for various incident neutron energies and different multipolarity of gamma radiation.

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