Test of the E1 γ-ray strength function and level density models by the ^{155}Gd $(n,2\gamma)^{156}Gd$ reaction

V.A.Khitrov, A.M.Sukhovoj, A.V.Voinov
Joint Institute for Nuclear Research, 141980 Dubna, Russia

One of the main problems in the study of neutron radiation capture is evaluation of the radiative strength functions (RSF) for γ-transitions. The currently available experimental methods allow one to get such information mainly for the "hard" part of primary γ-transitions, for energies in the interval of B_n - ~(B_n-2) MeV, where B_n is the neutron binding energy. For evaluation of RSF in the wide energy interval (B_n - 0), one needs to know the level density of the nucleus in the same excitation energy interval. This follows from the fact that the main quantities measured in the (n,γ) reaction: neutron capture cross section, total radiative widths, γ-transitions spectra are integral values that include the level density and RSF as underlying functions. On the other hand, if the RSFs are known one can extract information about the level density of nuclei. The main problem of (n,γ) spectrometry is to extract the level density of nuclei and the radiative strength functions of γ-transitions, individually.

In the present work, information about the level density of the ^{156}Gd nucleus and strength functions of γ-transitions is extracted from two γ-cascade spectra of the $^{155}Gd(n,2\gamma)^{156}Gd$ reaction. The method of statistically simulating of γ-cascade intensities has been used for this purpose. Two models are used for the E1-RSF calculations: the standard Lorentzian model and a model with an energy-dependent damping width and nonzero limit for $E_\gamma \to 0$. As analysis shows, the cascade intensities calculated using the Fermi-gas model for the level density and the standard Lorentzian model for the E1-strength function are in good agreement with the experimental ones in the excitation energy interval up to ~ 3 MeV. At the excitation energies above 3 MeV, it is necessary to make assumptions about the decrease in the experimental level density in comparison with the calculated one. A possible explanation of the observed effect is discussed.

This work was supported by a grant N 95-02-03848 from RFBR.