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Study of the rates of photonuclear reactions in $^{\mathrm{nat}}\mathrm{Tb}$ nuclei at 130 MeV

Understanding the interaction between high-energy photons and atomic nuclei is essential for exploring nuclear structure and reaction mechanisms. Advances in accelerator technology now make it possible to simulate and analyze complex photonuclear processes under controlled laboratory conditions, enabling researchers to study a wide range of isotopes, including terbium.

The current experimental study was performed at the LINAC-200 linear electron accelerator [1], where bremsstrahlung gamma rays were produced using a tungsten converter (4.5 × 4.5 × 0.5 cm). The accelerated electrons used in this experiment had an energy of 130 MeV. Terbium (Tb) samples, with dimensions of 1.20 × 1.30 × 0.02 cm, were irradiated by placing them directly behind the converter.

The samples underwent irradiation for 15.5 minutes, with a pulse current of 50 mA. The pulse frequency and width were set to 10 Hz and 2 μs, respectively. After irradiation, the gamma-ray spectra of the Tb samples were measured using an HPGe detector. The recorded spectra were processed utilizing the DEIMOS32 software [2].

From the spectra analysis, photoneutron and photoproton reactions were identified, as well as inelastic photon scattering. Experimental yields $^{159}\mathrm{Tb}(\gamma, xn; x = 1-12)^{158-147}\mathrm{Tb}$, $^{159}\mathrm{Tb}(\gamma, pxn; x = 5; 7; 9-13)^{153,151,149-145}\mathrm{Gd}$, $^{159}\mathrm{Tb}(\gamma, 2pxn; x = 0; 1-3; 5; 7-12)^{157-154,152,150-145}\mathrm{Eu}$ and $^{159}\mathrm{Tb}(\gamma, xn; x = 1; 3; 5-10)^{155,154g,154m1,152g,152m1,152m2,150g,1}$ were measured at various bremsstrahlung end point energies and compared to theoretical values predicted with TALYS-2.0 code [3].

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