Measuring the Angular Distributions of 14.1-MeV Neutrons' Scattering on Carbon Nuclei

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The study of neutron-induced nuclear reactions on carbon is of interest both from the point of view of improving experimental data on its excitation levels and for determining the parameters of the model used to describe the mechanism of neutron-nuclear interactions. According to F. Hoyle, carbon plays an important role in the process of nucleosynthesis in the Universe and, in particular, that life on Earth is possible due to the existence of a level in carbon with energy of 7.65 MeV [1].

As part of the TANGRA project [2, 3], using the Tagged Neutron Method (TNM), we measured the angular distributions of 14.1-MeV neutrons scattered on a carbon sample. To apply the TNM, we used an ING-27 neutron generator with a built-in 256-pixel alpha particle detector (APD). The sample used was a graphite plate measuring 44×44×2 cm, located at a distance of 27 cm from the front end of the neutron source. The neutron flux from ING-27 incident on the sample was determined by counting alpha particles from the d(t, α)n reactions using the APD. Scattered neutrons with energy of 14.1 MeV were measured using 20 plastic scintillation detectors located around the sample at a distance of ~2 m from it. The energy of scattered neutrons was determined by the time-of-flight (TOF) method. The angular distributions of elastically scattered neutrons, as well as inelastically scattered neutrons for excited states of the carbon nucleus at energies of 4.44 MeV, 7.65 MeV, 9.64 MeV, 10.33 MeV and 10.84 MeV were measured. The data obtained are compared with the results of previous experiments on the scattering of neutrons with energy of 14.1 MeV on ^{12}C.

The work was carried out with support from the Russian Science Foundation grant №23-12-00239.

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