The new data on the cross-section of $^{16}O(n,\alpha)^{13}C$ reaction

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The reaction $^{16}O(n,\alpha)^{13}C$ plays a very important role in predicting the criticality of the nuclear power plants and assessing the accumulation of helium in structural materials under the fast neutrons irradiation. The cross section for the inverse reaction $^{13}C(\alpha,n)^{16}O$ plays a role as the background factor in measurements of geo-neutrinos and as a source of neutrons for the s-process in nuclear nucleosynthesis. The existing sets of the experimental data obtained both from the study of the direct reaction and from the measurements of the reverse reaction, differ significantly from each other in the entire range of neutron energies. The result of the work of the CIELO collaboration was the emergence of a new evaluation, which became the basis for the evaluation of the cross section of this reaction in the ENDF/B-VIII.0 library. However, there is no experimental data to support this evaluation.

The aim of the work carried out in IPPE was the experimental study the excitation function of the $^{16}O(n,\alpha_0)^{13}C$ reaction in a wide range of neutron energies with good energy resolution. For this, a method was chosen based on measuring the cross section of the reverse reaction $^{13}C(\alpha,n_0)^{16}O$ and then reconstructing the cross section of the forward reaction using the reciprocity theorem. The measurements were carried out using the digital time-of-flight neutron spectrometer based on the para-terphenyl single crystal. This approach made it possible to suppress the contribution of neutrons from the excited states of the residual nucleus, and, accordingly, to significantly expand the energy range of measurements. The thickness and characteristics of the ^{13}C target, as well as the state of the target during the measurements, were determined using nuclear microanalysis methods. The analysis of the influence of multiply-scattered neutrons on the measurement results is carried out. The obtained results showed that the cross section for the reaction $^{16}O(n,\alpha_0)^{13}C$ corresponds to the new evaluation of this reaction given in ENDF/B-VIII.0.