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New set of optical parameters for neutron scattering on ^{12}C nuclei

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The project TANGRA is devoted to study of nuclear reactions induced by 14.1-MeV tagged neutrons. Several measurements of γ-quanta angular distributions were conducted, including the experiment with carbon sample [1]. At the moment it is planned to measure angular distributions of the neutrons scattered on carbon, the results will require model description. An optical model [2] will be used in the analysis of experimental data.

Optical potentials are often used with other methods: the coupled-channel approach (CC) can be used with various nuclear deformations and approaches to handle excited states of the nucleus. In our case, an oblate shape was adopted for ^{12}C, and the first excited state at 4.44 MeV (2^+_1) was considered rotational in CC, as it was proposed in some works. The estimation of ^{12}C deformation is somewhat ambiguous, the quadrupole deformation parameter β_2, apparently, depend on type and energy of the probing particle used [3].

To determine the correct optical parameters and β_2 for ^{12}C, we developed a specially designed ROOT library, which can iteratively run TALYS [4] calculations and process their results. The potential parameters were obtained by minimizing the deviation of the differential cross sections for elastic and inelastic neutron scattering calculated in TALYS from the experimental data.

The obtained optical potential was used to calculate integral and differential cross sections of the most probable processes occurring in the interaction of 14.1 MeV neutron with ^{12}C nucleus. The calculated values were compared with experimental data.

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