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Modeling of 14.1 MeV neutrons scattering on carbon

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Reactions with 14.1 MeV neutrons are interest for fundamental research in nuclear physics. Due to the compactness and prevalence of modern neutron generators, reactions with neutrons of these energies have found wide application in applied work, for example, in elemental analysis. To perform such studies and plan new experiments, the complete and accurate databases of nuclear data are needed. On the other hand, on the basis of experimental data obtained in the study of neutron-nuclear reactions, the parameters of theoretical models can be refined, which can subsequently be used to calculate the properties of other processes. However, the use of available experimental data to optimize model parameters is hampered by the fact that they are in a format that is inconvenient for automation.

In the Frank Laboratory of Neutron Physics, the international project TANGRA is being implemented to study the scattering of tagged neutrons on atomic nuclei. For the purposes of the theoretical part of the project, the TALYS program is used. It has wide functionality, and also contains nuclear structure database and set of the nuclear reaction models parameters, based on the RIPL-3 library. The results of calculations usually have good agreement with experiment. To simplify access to the calculation results and the TALYS database, as well as ENDF and EXFOR databases, TalysLib is being developed.

TalysLib is a ROOT-based C++ object-oriented library. It can be used for:
1) Generating TALYS input files,
2) Reading data on the structure of the nucleus from the TALYS database,
3) Converting data to a form convenient for use in the program,
4) Launching TALYS with the given parameters,
5) Selection of model parameters using the MINUIT minimizer,
6) Visualization and saving data using the ROOT software environment.

At the moment, the library has been successfully used to select optical potentials on nuclei ^{12}C [1], ^{24}Mg, ^{28}Si, ^{56}Fe [2]. Currently, we working on adding the ability to work with EXFOR and ENDF data focusing on ^{12}C optical parameters optimization. Information about the features of TalysLib, examples of applications and plans for future developments will be presented.

1. Dashkov I.D., Fedorov N.A., Grozdanov D.N et al., Bulletin of the Russian Academy of Sciences: Physics, 86 (2022) 893.
2. Fedorov N.A. PhD Thesisis. MSU, Moscow, 2021.

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