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Calculation of the neutron spectrum shape that has formed in the neutron generator target by taking into account fluctuations of ionization losses and multiple scattering of D and T ions on the target atoms.

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The d(t,n)4He neutron production reaction model was created in Geant4 by reason of the work on the study of modern neutron generators properties. The study of the created model showed a discrepancy between the data on the specified reaction cross sections in Geant4 with the real values that are given by ENDF databases. It was also found that Geant4 tools do not allow to take into account the slowing down process of D and T ions in the generator target.

In this regard, an analytical model was developed and created that allows calculating the neutron spectrum shape, and taking into account the main processes of interaction of D and T ions with the neutron generator target substance (fluctuation of ionization losses, multiple ion scattering, energy dependence of the nuclear reaction cross section). This model is a program code in C ++ and can be used with any programming environment. In this case, the Clion environment from JetBrains was used.

Comparison of the results that given by created model with the results obtained in [1, 2] showed good data convergence. In [1,2], similar results were obtained using such specialized programs as SRIM-2013 (The Stopping and Range of Ions in Matter) and MCNP (Monte Carlo N-Particle Transport Code). With this in mind, we can say that the created analytical model allows one to obtain sufficiently accurate data of the neutron spectrum at the exit of a neutron generator target, without using specialized and hard-to-reach programs.

In the future, it is planned to use the developed analytical model for solving problems of monitoring parameters of neutron generators. In particular, it is supposed to use this model in the task of analyzing the fine structure of the neutron spectrum at the exit of the neutron generator target. To solve this problem, detectors based on a diamond single crystal are currently used. The model created in this work has been improved and now also allows to obtain theoretical forms of the responses of a diamond detector to neutrons from the d(t,n)4He reaction. It should be noted that this model allows to obtain the response shape of a diamond detector only for the spectral region, which corresponds to the reaction 12C (n, a) 9Be.

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2. D. Rigamonti et al Neutron spectroscopy measurements of 14 MeV neutrons at unprecedented energy resolution and implications for deuterium–tritium fusion plasma diagnostics Meas. Sci. Technol. 29, 2018;

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