experimental verification of the calculation of fast neutron flux attenuation by iter constructional materials [[1]](#footnote-1)\*)

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A significant power of the neutron radiation of the tokamak-reactor ITER leads to high requirements for protective constructional materials, both in terms of attenuation of the direct neutron flux and in the context of long-term activation of materials. The use of the newest and expensive equipment (for example, for diagnostics) leads to the need for its maintenance, which means that the task of minimizing long-term activation is extremely relevant for such a large plant as ITER.

The work on verification of the neutron flux attenuation was carried out to confirm the properties of the constructional materials of the ITER thermonuclear reactor under construction – stainless steel SS316L-IG and bronze BrKHTSr.

The interaction of the neutron radiation with the construction, the characteristics of the radiation fields, and the rates of nuclear reactions in the tokamak-reactor volume are currently calculated using the MCNP software [1]. The need to obtain the most accurate results when determining the neutron flux by theoretical modeling makes a benchmark-experiment with realistic sources and materials a crucially important reference measurement.

A series of physical experiments on the neutron flux attenuation was carried out at the neutron diagnostics stand of SRC TRINITI. The ionizing radiation was generated by the neutron generators ING-07D (En ~ 2.5 MeV) and ING-07T (En ~ 14 Mev). As a barrier material that weakens the neutron radiation, the following samples of the ITER structural materials were used: polyethylene, SS316L-IG stainless steel and BrKHTSr bronze. The thickness of the barrier was taken to vary from 4 cm to 24 cm. As a monitor of the direct flow of neutrons, measuring the distribution of the neutron energies, a scintillation detector based on the crystal paraterphenyl was used. The analysis of the obtained experimental data allowed us to validate the nuclear constants for the considered materials.

Using the MCNP-based modeling, the fast neutron spectra (2.5 MeV and 14.7 MeV) were obtained for passing through the barriers of various thicknesses; and the experimentally obtained detector responses were compared with the model ones.

On the basis of the performed experiments and constructed models, conclusions were drawn about the compliance of the properties of the materials with those declared. The technique of conducting a benchmark-experiment on the neutron flux attenuation has been developed, which could readily be adjusted for verifying the properties of other materials.

References

1. J.T. Goorley *et al.*, “Initial MCNP6 Release Overview - MCNP6 version 1.0,” Los Alamos, NM (United States), Jun. 2013. doi: 10.2172/1086758.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/E/ru/IL-Fridrihsen.docx) [↑](#footnote-ref-1)