NEUTRON PRODUCTION WITH NEUTRAL BEAM INJECTION IN THE FUSION NEUTRON SOURCE [[1]](#footnote-1)\*)

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Beam-plasma nuclear fusion is the main source of neutrons in fusion neutron source (FNS) plasma due to the high contribution of fusion reactions involving high-energy ions to the total neutron yield from tokamak plasma. The beam contribution depends on the relative proportion of hot ions (“suprathermal tails”) in the ion energy distribution function.

The NESTOR code, created at the NRC KI in 2021, makes it possible to calculate the intensity distribution of fusion reactions in the volume of the tokamak plasma, taking into account the powerful source of fast ions created by neutral beam injection (NBI) to the tokamak. The neutral beam (NB) in the NESTOR code is a large set of rays (up to 109) that reproduces in detail the spatial-angular distribution of the beam at the injector exit. The ionization of atoms (rays) of the beam and the probability of ion burnout are calculated by analytical methods, which makes it possible to quickly obtain the phase distributions of ions in a magnetized plasma, with virtually no restrictions on the shape of magnetic surfaces.

In this paper, we consider the influence of the geometry of toroidal plasma, plasma content, and kinetic profiles shape on the production rate of fusion neutrons involving the fast ions. The NB contribution to the total neutron yield from FNS plasma is studied. The fast ion losses and the associated neutron yield drop are estimated. The preliminary results are shown of NESTOR code application to neutronics studies for DEMO-FNS hybrid facility.

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References

1. Shpanskiy Yu.S. and DEMO-FNS Team. Progress in the design of the DEMO-FNS hybrid facility // Nucl. Fusion. 2019. Т. 59. № 7. С. 076014.
2. Dlougach E.D. and Shlenskii M.N., NESTOR software for volume source of nuclear fusion neutrons generation in FNS plasmas (Python). Certificate of Computer Code Registration № 2022610362, Record 11.01.2022, Russia
3. Wesson J., *Tokamaks*, 4th Edition, Oxford: Oxford University Press, 2011
4. E.D. Dlougach, B.V. Kuteev, Impact of Neutral Beam Parameters on Current Drive and Neutron Yield in Compact Tokamak, Plasma Physics Reports, 2022, Vol. 48, No. 10, pp. 1033–1041. DOI: 10.1134/S1063780X22600670
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/CC-Dlugach.docx) [↑](#footnote-ref-1)