FIRST NITROGEN SEEDING EXPERIMENTS FOR THE DIVERTOR THERMAL LOAD REDUCTION ON THE GLOBUS-M2 TOKAMAK AND COMPARISON WITH THE MODELING BASED PREDICTIONS [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2022.49.1.031

1Khromov N.A., 1Bakharev N.N., 2Vekshina E.O., 1Gusev V.K., 2Dolgova K.V., 1Zhiltsov N.S., 1Kiselev E.O., 1Kurskiev G.S., 1Minaev V.B., 2Molchanov P.A., 1Petrov Yu.V., 2Rozhansky V.A., 1Sakharov N.V., 1Telnova A.Yu., 2Timokhin V.M., 1Tokarev V.A., 1Tukhmeneva E.A., 1Shchegolev P.B.

1Ioffe Institute, Saint-Petersburg, Russia, [Nikolay.Khromov@mail.ioffe.ru](mailto:Nikolay.Khromov@mail.ioffe.ru)  
2SPbPU, Saint-Petersburg, Russia, [vekshina\_eo@spbstu.ru](mailto:vekshina_eo@spbstu.ru)

The values of the power flux density on the divertor plates in modern and projected tokamaks can exceed 10 MW/m2. Such heat loads on plasma-facing components make stationary operation of a reactor impossible. The most promising way to solve this problem is considered to be the divertor detachment regime [1]. In this regime, most of the energy carried by charged particles from the confined plasma is converted into radiation, which prevents excessive heating of the divertor plates. Under these conditions, significant pressure gradients are observed along the magnetic field lines in the near-wall plasma, and the electron temperature near the divertor plates decreases down to a value of the order of eV. Divertor detachment is usually achieved either by increasing the plasma density or by radiating impurity seeding. For tokamaks with an open divertor, as Globus-M2 [2], the second method seems to be more reliable [3].

Preliminary modeling [4] showed the possibility of reducing the heat load on the divertor plates of the Globus-M2 tokamak with nitrogen seeding. About 65% of the discharge power was radiated in the computational domain of the code, the value of the energy flux density on the lower outer divertor plate dropped several times, while the value of the effective charge inside the separatrix did not exceed 4.

The experiments were performed in deuterium discharges with a lower active X-point, the value of toroidal magnetic field was 0.7 T, the plasma current was in the range of 200–250 kA. Additional heating was carried out by a deuterium neutral beam with an energy of 28 keV. The parameters of the divertor plasma were determined using an array of flush-mounted Langmuir probes [5]. The nitrogen seeding rate was selected in such a way that its effect on the plasma parameters in the central region was insignificant. At the same time, the electron temperature and heat flux density near the strike-point on the outer target decreased several times.

The experiments were carried out at the Unique Scientific Facility "Spherical Tokamak Globus‑M", which is incorporated in the Federal Target Program "Materials Science and Diagnostics in Advanced Technologies". The work of collaborators of SPbPU was supported by the Ministry of science and higher education of Russian Federation (project No. 0784-2020-0020).

References

1. Loarte A. et al, Nucl. Fusion, 2007, 47, S203–S263
2. Minaev V.B. et al, 2017, Nucl. Fusion, 57, 066047
3. Leonard A.W. , 2018, Plasma Phys. Control. Fusion, 60, 044001
4. Sorokina D.S. et al, 2018, Physics of Plasmas, 25, 122514
5. Khromov N.A. et al, 2021, Technical Physics, 66, 409

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Mu/ru/AZ-Khromov.docx) [↑](#footnote-ref-1)