RESEARCH OF NEOCLASSICAL TEARING MODES USING THE DOPPLER BACKSCATTERING METHOD DURING THE DISRUPTION OF THE PLASMA DISCHARGE IN TOKAMAK GLOBUS-M2 [[1]](#footnote-1)\*)

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On the spherical tokamak Globus-M/M2 magnetohydrodynamic (MHD) modes that significantly affect the plasma during a discharge were observed (see, for example, [1]). In fact, these MHD modes could lead to a deterioration in plasma confinement, such as the transition from the H-mode back to L-mode, or even to disruptions. One of the most dangerous MHD modes is the neoclassical tearing mode (NTM), which leads to the formation of magnetic islands in the plasma and thus imposes limits on plasma parameters, in particular the plasma pressure. The width and velocity of the formed islands [2] are the key parameters determining the island’s impact on confinement.

Early experiments on Globus-M2 demonstrated that the Doppler backscattering (DBS) method can be used to detect and study NTMs [3]. In particular, this diagnostic can be successfully used to determine their width and localization. On the spherical tokamak Globus-M2, the DBS method was applied together with a series of magnetic probes to study the NTM, which significantly influences the plasma characteristics. At the same time, three multi-frequency DBS systems with 18 to 26 GHz sounding frequencies, 20 to 48 GHz and 50 to 75 GHz [4-5] were used. The use of such systems allowed simultaneous measurements from half of the small radius of the plasma to the separatrix (ρ = 0.5-1.1). In addition to detecting the tearing modes themselves, the DBS method has been used to observe the deterioration in plasma confinement or a turbulence behavior during transition from H-mode.

In this paper, the results of the study of the NTM that lead to a transition out of the H-mode or a disruption on the tokamak Globus-M2 are demonstrated. The results of analysis of data of monitor diagnostics for the purpose of identification of characteristic features of plasma discharge during the development of such NTMs are presented. Their characteristics were obtained, such as their mode numbers, as well as frequency. In addition, the DBS diagnostics determined the area of their localization. The obtained parameters of the MHD mode were compared to reveal the differences between the NTM leading to just the transition out of the H-mode and the NTM leading to the disruption of the plasma discharge. Comparative analysis of the influence of different plasma parameters on the development of different types of tearing modes was conducted.

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References

1. Kurskiev, G.S. et al 2011 Tech. Phys. Lett. **37** 1127–1131
2. Waelbroeck F.L. 2009 Nucl. Fusion **49** 104025
3. Yashin A.Yu. et al «The study of neoclassical tearing modes using Doppler backscattering in the Globus-M2 tokamak» 49th ICPPCF, March 14 – 18, 2022, Zvenigorod
4. Bulanin V.V. et al 2021 Rev. Sci. Instrum. **92** 033539
5. Yashin A.Y. et al 2022 JINST **17** C01023
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/CD-Yashin.docx) [↑](#footnote-ref-1)