HEAVY ION BEAM PROBE DIAGNOSTICS FOR TOKAMAKS t-15md AND GLODUS-m2 [[1]](#footnote-1)\*)

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Heavy ion beam probe is a multipurpose plasma diagnostic for magnetic confinement fusion devices, which allows to measure plasma electrostatic potential and plasma turbulence parameters [1, 2].

HIBP was successfully used at circular tokamaks with high aspect ratio (A=R/a, where R and a are major and minor radius of a torus respectively) such as TM-4, TEXT, JIPPTII-U, T-10 and stellarators LHD, CHS and TJ-II. Preliminary calculations have shown that HIBP is applicable for D-shaped low aspect ratio tokamaks Compass-D and Globus [3], TCV [4] and MAST [5]. However, the diagnostic has never been installed on a D-shaped machine.

Studies of plasma electric fields and its effect on heat and particle transport across the magnetic field is an important task, so HIBP is proposed for new D-shaped tokamaks: T-15MD and Globus-M2. T-15MD is a medium-sized tokamak with R=1.48 m, а=0.67 m, А=2.2, toroidal magnetic field Btor ≤ 2 T, plasma current Ipl ≤ 2 MA which is under construction at National Research Center “Kurchatov Institute”, Moscow [6, 7]. Globus-M2 is a spherical tokamak with R=0.36 m, а=0.24 m, А=1.5, Btor ≤ 1 T, Ipl ≤ 0,5 MA which has recently been commissioned after the magnetic system upgrade at Ioffe Institute, St. Petersburg [8]. The HIBP design requires preliminary calculations of probing particles trajectories in the magnetic field of the fusion device considering the toroidal magnetic field, the magnetic field of the plasma current and the magnetic field of plasma-shaping coils.

The work describes the numerical solution of probing particles motion equations in magnetic fields of T-15MD [8] and Globus-M2, the probing scheme optimization, and the calculations of sample volumes positions and detector grids. Based on the calculations for both fusion devices the optimal positions of the primary and secondary beamlines were chosen, the plasma regions accessible for HIBP measurements were determined. The work shows the applicability of the HIBP diagnostic for T-15MD and Globus-M2 tokamaks.

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References

1. Jobes F.C. and Hickok R.L. Nucl. Fusion 1970, V. 10, P. 195-197.
2. Dnestrovskij Yu. et al. IEEE Trans. Plasma Sci. 1994, V. 22 (4), P. 310-331.
3. Melnikov A.V. et al. Rev. Sci. Instrum. 1997, V. 68 (1), P. 316-319.
4. Siegrist M.R. et al. Proc. 21st IEEE/NPS Symposium on Fusion Engineering SOFE, 26–29 September 2005, Knoxville, TN, USA.
5. Melnikov A.V., Perfilov S.V. and Sharapov S.E. Proc. 37th EPS Conference on Plasma Physics, 21–25 June 2010, Dublin, Ireland, ECA Vol. 34A, P5.120.
6. Khvostenko P. et al. Problems of Atomic Science and Technology, Ser. Thermonuclear Fusion 2019, V. 42 (1), P. 15-38.
7. Melnikov A.V. et al. Fusion Engineering and Design 2015, V. 96–97, P. 306–310.
8. Minaev V.B. et al. Nucl. Fusion 2017, V. 57 (6), P. 066047.
9. Ilin A.M., Khabanov P.O., Melnikov A.V. J. Phys.: Con. Ser. 2019, V. 1383, P. 012006.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Mu/ru/BJ-Habanov.docx) [↑](#footnote-ref-1)