equilibrium free-boundary calculations of spherical torus plasmas at globus-m2 with kinetic pressure [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.074

KiselevE*.*O*.*, BalachenkovI*.*M*.*, BakharevN*.*N*.*, VarfolomeevV*.*I*.*, GusevV*.*K*.*, KhromovN*.*A*.*, KurskievG*.*S*.*, MinaevV*.*B*.*, MiroshnikovI*.*V*.*, PatrovM*.*I*.*, PetrovYu*.*V*.*, SakharovN*.*V*.*, ShchegolevP*.*B*.*, SkrekelO*.*M*.*, TelnovaA*.*Yu*.*, TkachenkoE*.*E*.*, TokarevV*.*A*.*, TukhmenevaE*.*A*.*, Zhiltsov N*.*S.

Ioffe Institute, St. Petersburg, Russia

Reconstruction of experimental axisymmetric magnetohydrodynamic (MHD) equilibria is an important part of tokamak data analysis, plasma boundary calculations, magnetic field geometry calculations, etc. Also, it allows to simulate various processes in tokamak.

The free-boundary equilibrium reconstruction solver is developed for advanced study of tokamak equilibra. The Grad–Shafranov equation is solved using python code with Green function integration. The poloidal flux stream throughout the entire rectangular computational domain is obtained through a Picard iteration technique. The most computationally expensive part of the code has been optimized using the numba library for transcompiling code into llvm. A set of basis functions is used to specify *p′* (plasma pressure gradient) and *ff′* (polodal current function) [3]:

*A1, B0, B1* – free plasma parameters, – normalized poloidal magnetic flux. *A1, B0, B1* used to allow the self-consistent solution of the equilibrium constraint and simultaneous mimimization of *χ2* – a difference of calculated and experimental data. Globus-M2 reconstructions typically utilize data from 21 magnetic flux loops, diamagnetic loop and plasma pressure (calculated from Thomson Scattering data and ion temperature from CXRS).

The paper presents the results of equilibrium calculations for several series of discharges in the Globus-M2 tokamak with neutral particles injection in a wide range of electron densities from 0.5 1019 m-3 to 13 1019 m-3, magnetic field of 0.8 and 0.9 T, and plasma current from 300 kA to 400 kA. The equilibrium calculation data are compared with existing experimental measurements – the right leg divertor position obtained using thermographic camera, etc. The diamagnetic flux and plasma energy content is also compared with the equilibrium calculation, where only magnetic loop measurements are used.

References

1. Y.M. Jeon et al 2015 Journal of the Korean Physical Society 67, 843–853.
2. L.L. Lao et al 1985 Nucl. Fusion 25 1421
3. S.A. Sabbagh et al 2001 Nucl. Fusion 41 1601

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