DOI: 10.34854/ICPAF.52.2025.1.1.087

GLOBUS-M2 TOKAMAK MODELING USING SOLPS-ITER CODE WITH THE KINETIC MODULE EIRENE *)

[1,2]Kukushkin K.A., [1]Kaveeva E.G., [1]Rozhansky V.A., [1]Dolgova K.V., [1]Senichenkov I.Yu., [2]Mukhin E.E., [2]Ermakov N.V., [1,2]Zhiltsov N.S., [2]Kiselev E.O., [2]Kurskiev G.S., [2]Minaev V.B., [2]Petrov Yu.V., [2]Sakharov N.V., [2]Miroshnikov I.V., [2]Tukhmeneva E.A., [2]Gusev V.K., [1,2]Khromov N.A.

[1]*Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia,* *fusion_reactor@vk.com*

[2]*Ioffe Institute, St. Petersburg, Russia*

Numerical simulation using plasma codes, supported by experimental data from real devices with magnetic confinement, is a powerful tool for study of various physical processes in plasma and analysis of diagnostic data obtained during controlled fusion research.

This report presents the results of the discharge modeling of the Globus-M2 spherical tokamak with the SOLPS-ITER code. This code is used as the main code for edge plasma modeling in the ITER project, and is also used on most of the modern tokamaks for predictive modeling and experimental results interpretation, see, for example, works [1-2]. The simulation was performed for discharge #44644. The Monte-Carlo EIRENE code was used for the simulation of atoms and molecules, which significantly increased its accuracy compared with the previously used hydrodynamic approach [3]. In comparison with the previous work of the authors [4], carbon scattered by plasma from the divertor plates and the first wall during discharge was taken into account. The physical channel of the carbon sputtering was modeled according to the Roth-Bogdansky formula [5]. The chemical sputtering coefficient was assumed to be ~8%, which made it possible to align the calculated value of the effective charge at the inner boundary of the calculation region with the experimental data. Particle losses were modeled by a recycling coefficient less than one, which corresponded to plasma absorption by carbon plates of the divertor and the first wall. The simulation results were compared with experimental data from the corresponding discharge.

During the simulation, it was found that the experimental data demonstrate a significant asymmetry between the fluxes of particles and heat at the high magnetic field side and low field side in divertor region. Therefore, calculation options were used with the dependence of the anomalous transport coefficients on the magnitude of the magnetic field. Another result of the simulation is the appearance of a cold and dense plasma zone in divertor region at the high magnetic field side, the so-called HFSHD (High Field Side High Density).

This work was funded by the Ministry of science and high education of Russian Federation in the framework of the government contract in the field of science under project No. FSEG-2024-0005. Modeling results presented in the work were obtained at the Supercomputer Center of Peter the Great St. Petersburg Polytechnic University (SCC SPbPU).

References

[1]. Kaveeva E. et al, Nuclear Materials Energy, 2021, V.28. P. 101030.
[2]. Xu G.S. et al, Nuclear Fusion, 2021, V. 61. P. 126070.
[3]. E. Vekshina et al, Plasma Phys. Control. Fusion, 2019, 61, 125009
[4]. K.A. Kukushkin et al., Proc. 51th International (Zvenigorod) conference of plasma physics and controlled fusion, Zvenigorod, 2024.
[5]. Roth J., Garcia-Rosales C., Nuclear Fusion, 1996, V. 36, P. 1647.

*) abstracts of this report in Russian