DOI: 10.34854/ICPAF.52.2025.1.1.098

NUMERICAL MODELING OF LOWER HYBRID CURRENT DRIVE AT THE T-15MD TOKAMAK *)

Troshin G.A., Teplova N.V., Gusakov E.Z., Irzak M.A., Kryzhanovsky A.K., Novikov D.S., Baranov Yu.F., T-15MD Team

Ioffe Institute, St. Petersburg, Russia, g.troshin@mail.ioffe.ru

The paper presents the results of numerical simulations of lower hybrid (LH) current drive in the plasma of the T-15MD tokamak. The aim of the study is to evaluate the achievable values of the driven current and its efficiency under various scenarios on the T-15MD tokamak.

The calculations were performed using the upgraded numerical code FRTC [1-4], integrated into the ASTRA code [5]. For modeling the two-dimensional spectrum of initial phase velocities of the electromagnetic wave launched into the plasma, the Grill3D code [6] was used, taking into account the antenna geometry and the electron density profile in the peripheral region of the tokamak plasma. When calculating the one-dimensional spectrum of parallel velocities, the two-dimensional spectra are integrated along the binormal direction perpendicular to the total magnetic field. The FRTC code allows for calculations with both one-dimensional and two-dimensional spectra.

Simulations were conducted to analyze the absorption of LH radio-frequency waves and the generation of non-inductive current in various operational regimes of the T-15MD tokamak. Additionally, different types and characteristics of multiwaveguide slow wave structures in the LH frequency range were studied. The optimal range of initial parallel velocities for the most efficient LH current drive in the T-15MD tokamak was determined. The study also identified the optimal type and parameters of multiwaveguide slow wave emitters and the required input power levels.

The modeling results provide quantitative assessments of the efficiency of LH current drive generation and predict achievable current values in the plasma of the T-15MD tokamak.

This work was supported by State Task No. FFUG-2024-0028.

References

[1]. A.R. Esterkin and A.D. Piliya, Nucl. Fusion 36 1501 (1996)
[2]. A.D. Piliya, A.N. Saveliev, JET Joint Undertaking, Abingdon, Oxfordshire, OX14 3EA, (1998)
[3]. A.N. Saveliev, EPJ Web of Conferences 157, 03045 (2017)
[4]. N.V. Teplova et al., 51st International Zvenigorod Conference on Plasma Physics and Controlled Fusion, March 18–22, 2024, ICPAF-2024, DOI: 10.34854/ICPAF.51.2024.1.1.086.
[5]. G.V.Pereverzev and P.N. Yushmanov, Automated System for TRansport Analysis IPP-Report IPP 5/98, (2002).
[6]. M.A. Irzak and O.N. Shcherbinin, Nucl. Fusion 35, 1341 (1995)

*) abstracts of this report in Russian