DOI: 10.34854/ICPAF.52.2025.1.1.067

CALCULATIONS OF MULTIPASS EC ABSORPTION AT THE INITIAL STAGE OF DISCHARGE IN THE T-15MD TOKAMAK *)

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The experiments on the T-15MD tokamak during the autumn-winter campaign of 2023 with a steel first wall were conducted using a gyrotron with a frequency of 82.6 GHz for heating on the second harmonic of the extraordinary wave with wave injection from the low magnetic field side [1]. The analysis of experimental data for electron cyclotron heating (ECH) and EC current drive in these experiments is presented in [2]. According to the data from the bolometric system measurements, almost half of the total discharge time the absorbed power fraction was less than 40% [1]. The incomplete single-pass ECH absorption and the presence of a metal wall necessitate accounting for the effects of multipass ECH absorption at the initial stage of discharge: (1) radiation scattering throughout the entire tokamak chamber and (2) changes in EC wave polarization upon reflection from the wall.

This work is dedicated to calculations of multipass ECH absorption at the initial stage of discharge in the T-15MD tokamak using the Fast_mp_ECH_startup code [3] and the ECH_Multipass code [4, 5]. The Fast_mp_ECH_startup code simplifies for conditions of initial stage of discharge the methods used in existing ray-tracing codes for calculating ECH efficiency: it uses the approximation of straight-line ray trajectories, employs analytical absorption coefficients for EC waves in a low-density Maxwellian plasma. The EC-wave mode conversion upon wave reflection from the vacuum chamber wall is taken into account. The ECH_Multipass code uses a modified (for the case of injected radiation) analytical model of the CYNEQ code [6], [7] used to solve radiation transfer problem in a tokamak for the plasma-produced EC waves at moderate and high harmonics of the fundamental EC frequency. ECH_Multipass code accounts for multipass ECH absorption on all wave passes (considering mode conversion upon wave reflections from the wall) in the approximation of the isotropic mixing of radiation inside the vacuum chamber.

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*) abstracts of this report in Russian