DOI: 10.34854/ICPAF.52.2025.1.1.020

FIRST RESULTS OF MODELING PLASMA HEATING IN THE ION CYCLOTRON FREQUENCY RANGE IN THE T-15MD TOKAMAK *)

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The ion-cyclotron resonance heating (ICRH) method is widely used in tokamaks around the world (ASDEX-Upgrade [1], JET [2]) and considered as a standard tool for increasing the ion temperature in plasma, particularly in the ITER reactor tokamak [3]. The T-15MD tokamak is the leading tokamak installation in the Russian Federation. Implementing the ion-cyclotron heating method on this tokamak would significantly enhance plasma discharge parameters and elevate the level of research conducted to meet global standards.

This study presents the first simulation of plasma heating in the ion-cyclotron frequency range across various discharge regimes of the T-15MD tokamak, with magnetic field values ranging from 1 T to 2 T. To address this task, a one-dimensional numerical code was developed that solves the wave equation in a cylindrical coordinate system, incorporating a dielectric tensor with thermal corrections based on kinetic analysis [4]. Within the framework of this cylindrical model, calculations were performed for the coupling of a multi-loop antenna with the plasma, and the resulting spectrum of fast magnetosonic (FMS) waves radiated into the plasma was determined for different antenna loop phasings.

The planned operating regimes of the T-15MD tokamak involve both hydrogen and helium plasma compositions. This study specifically analyzes a non-standard heating scenario on the first cyclotron harmonic of a small admixture of a heavy impurity (He-4) in a hydrogen plasma. Additionally, simulations were conducted for heating on the first harmonic of hydrogen as a small admixture in helium plasma and on the second harmonic of hydrogen. A key advantage of the latter mode is its reduced sensitivity to light and heavy impurities, which are anticipated in T-15MD, minimizing their impact on the heating process. The study also examines a heating scenario for the electron component of the plasma using ion-cyclotron range waves, with an assessment of the current generated by these waves depending on the phasing of the multi-loop antenna. Based on the analysis, practical recommendations were made regarding the selection of heating scenarios for T-15MD, including generator frequencies and antenna phasing.

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*) abstracts of this report in Russian