Dynamic lower hybrid current drive modeling for the FT-2 tokamak

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Experimental study of the lower hybrid (LH) wave interaction with plasma is one of the main tasks of the FT2 tokamak project. The FT-2 tokamak is a small machine with high magnetic field (\(R=0.55\) m, \(a=0.08\) m, \(B_t \leq 3\) T, \(I_p=19\div40\) kA). The LH waves are excited at frequency 920 MHz from the low field side in the FT-2 plasma by a two- waveguide antenna (grill) using different grill phasing [1]. During last years the FT-2 experiments were focused on studies of mechanisms affecting the lower hybrid current drive (LHCD) efficiency at different plasma parameters and excitation conditions for the LH waves. This paper is devoted to a dynamic modeling of LHCD plasma shots at rather low plasma densities \(<n_e> = 0.5 \div 2\cdot10^{19} \text{ m}^{-3}\), when role of runaway electrons is significant at the FT-2 conditions.

In the LHCD simulations we used an Automated System for Transport Analysis (ASTRA) coupled with a LH Fast Ray-Tracing Code (FRTC) [2, 3] modified to include inductive electric field. The spectrum of LH waves excited in the plasma by the two-waveguide antenna was calculated using a self-consistent antenna coupling code GRILL3D [4]. At given ASTRA time steps the FRTC reads equilibrium and plasma parameters from ASTRA, calculates LH driven current and power absorption density profiles and returns them into ASTRA as external current and heat sources, which are used then by ASTRA for equilibrium and plasma parameters recalculation. So, the whole scheme provides self-consistent simulations of plasma shots, which can be compared with experimental results.

It is shown in the paper that the above modeling scheme can explain the main features of the analyzed plasma shots in the FT-2 tokamak.

References