Dynamic and stationary modeling of lower hybrid current drive in the FT-2 and Globus-M2 tokamaks

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Experimental study of the LH wave interaction with plasma is one of the main tasks of the FT-2 and Globus-M2 tokamak projects. The FT-2 tokamak is a high aspect ratio machine with high magnetic field (R=0.55 m, a=0.08 m, $B_T \leq 3$T, I_p=19÷40 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]. The Globus-M2 is a spherical tokamak (ST) (R=0.36 m, a=0.24 m, $B_T \leq 1$T, $I_p \leq 0.5$ MA, vertical elongation k=1.6-2, LH operating frequency 2.45GHz). The well know problem of standard LHCD in STs where plasma central part is accessible only for waves with rather high parallel refractive indices due to comparatively low magnetic field can be solved by slowing down the initial spectrum of LH waves in the poloidal rather than the toroidal direction [2]. For small tokamaks as Globus-M2 and FT-2 the LH pulse duration is comparable or smaller than the time, at which the steady-state distribution function of fast electrons is reached. That makes the non-stationary LHCD simulation accounting for the transit phenomena mandatory task for these tokamaks.

In the present paper we present results of stationary and time-dependent simulations of lower hybrid current drive that combine transport (using ASTRA code [3]) and Fokker Planck simulations with a DC electric field and ray-tracing (using the Fast Ray Tracing Code (FRTC) [4,5]) analyses. The modeling is applied to the experiments at the FT-2 and Globus-M2 tokamaks. The Grill3D code [6] was used to calculate the spectrum of the longitudinal refractive index of a lower hybrid wave launched into the plasma by two-waveguide antennae.

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