Effect of multipass absorption of external Electron Cyclotron radiation at initial stage of discharge IN ITER

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Due to technological issues, the ohmic breakdown and plasma start-up in tokamak-reactor ITER is only possible over a narrow range of plasma pressure and magnetic field configuration parameters. For the reliable plasma start-up in ITER, it is planned to use the electron cyclotron (EC) resonance heating (ECH-assisted start-up), which already showed to be an effective tool for the discharge start-up in tokamaks [1-4].

In this paper, we simulate the evolution of the spatial distributions of the main plasma parameters at the initial stage of the discharge in ITER, taking into account the multipass absorption of the injected EC radiation. In the full-scale simulation of the non-inductive current ramp-up phase of the discharge, the transport code DINA uses an updated version of the numerical code ECH\_Multipass for calculating the multipass absorption of the EC radiation [5]. The calculation of the absorption of the EC power is performed in the model of the semi-analytical approach of the CYNEQ code [6, 7], taking into account the following processes: (a) multiple reflection of the radiation of the injected ordinary EC wave from the walls of the vacuum chamber; (b) conversion of the ordinary EC wave into the extraordinary EC wave due to reflection from the wall; (c) full absorption (i.e. on the first pass) of the extraordinary EC wave.

The simulation of the initial stage of the discharge with DINA code allowed us to find the threshold for the power of EC heating required to overcome the radiation barrier in ITER. In the case of beryllium concentration at the level of 2% of the electron density the required level of injected EC power at the initial stage of the discharge should be not less than 3 MW.

References

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