IAEA FEC 2014

Contribution ID: **535** Type: **Poster**

Effect of Multi-Pass Absorption of Electron Cyclotron Heating Wave on Initial Stage of Discharge in ITER-like Tokamak

Wednesday, October 15, 2014 8:30 AM (4 hours)

A model is suggested for calculating the efficiency of multi-pass absorption of EC heating wave in tokamaks at initial stage of discharge, and the effect on the start-up in ITER-like tokamak is analyzed. The single-pass absorption of injected EC wave is evaluated with the scaling obtained using the OGRAY code. The model for subsequent multi-pass absorption, after first reflection of the EC wave from the wall of vacuum chamber, assumes isotropy/uniformity of the respective EC radiation intensity in plasma. The model modifies the CYNEQ code approach developed for the plasma-produced EC radiation transport at high EC harmonics and verified in the benchmarking with other codes. We consider the following case: (a) multiple reflection of injected EC wave (O-mode) from the wall; (b) polarization scrambling in wall reflections; (c) full single-pass absorption of the X-mode. Our parametric analysis for typical electron temperature and density at initial stage of discharge in ITER-like tokamak shows strong dependence of multi-pass absorption efficiency on the O-X conversion in wall reflections. The multi-pass absorption model is incorporated in the 1-D simulations of plasma start-up with the DINA code that enables us to extend the results of previous simulations with the single-pass absorption model.

Paper Number

TH/P3-32

Country or International Organisation

Russian Federation

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Session Classification: Poster 3