MODELING OF HYDROGEN OPTICAL DIAGNOSTICS SIGNALS AT THE INITIAL STAGE OF DISCHARGE CURRENT RAMP-UP in the ITER PRE-FUSION OPERATION PHASE

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One of the important tasks to be solved at the ITER pre-fusion power operation phase, where the toroidal magnetic field is a half or a third of its value at the fusion power phase (B0 = 5.3 T), is the problem of increasing (ramp-up) of the current in the plasma at the initial stage of the discharge, which consists in overcoming the so-called radiation barrier by the necessary non-ohmic heating. The relevance of the problem is due to the fact that in the ITER, using an induction system, it is possible to create only a relatively low value of the toroidal electric field, E ≈ 0.3 V/m, which is predetermined, first of all, by the large size of the facility [1–3].

Simulation of the evolution of spatial distributions of main plasma parameters at the pre-fusion phase of ITER operation with a half magnetic field was carried out using the transport code DINA [4], taking into account the multi-pass absorption of the injected EC radiation (ECH\_Multipass module) [5]. Within the framework of predictive modeling the following tasks were solved:

- accounting for plasma heating by injection of EM-wave with parameters of the second harmonic of the "extraordinary " EC-wave in plasma (the X2 mode) [6],

- optimization of the current ramp-up scenario taking into account the existing limitations on the input parameters of the problem, namely the need to overcome the radiation barrier at a low initial density (relatively to fusion power operation phase) and a reduced efficiency of EC heating [7],

- investigation of the possibility of Russian Federation’s optical diagnostics in ITER (the Main chamber H-alpha and the Edge CXRS) to track the dynamics of plasma parameters at the stage of overcoming the radiation barrier in ITER.

It is shown that the radiation intensity in the Balmer-alpha lines at the observation chords from the Equatorial Port-Plug EP11 in the poloidal plane allows us to track the dynamics of the density of neutral atoms of hydrogen isotopes at the stage of overcoming the radiation barrier in ITER at pre-fusion phase with a half magnetic field.

References

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