

Modelling of the current flows in the Scrape-off layer of ASDEX-Upgrade tokamak

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The understanding of the physical processes in the Scrape-off layer is required for the precise determination of its parameters, in particular, the power decay length. The most reliable method for studying processes on the periphery of a tokamak is a numerical simulation, since it can give the most complete physical picture. In present work, numerical simulation of the edge plasma of four discharges of ASDEX Upgrade tokamak is performed by the two-dimensional SOLPS-ITER code. The simulation is based on the experimental data available. Good agreement with the experiment is obtained for all the studied discharges by the varying of the anomalous transport coefficients. Based on the simulation results, a thorough analysis of the current flows in the Scrape-Off layer was performed. As a result, the current structure in the edge plasma of a tokamak is presented and mechanisms of current closure are put-forward. It is shown that the poloidal currents in the edge plasma can be considered as a combination of several currents. The Pfirsch-Schlueter currents close the vertical ∇B current in the Scrape-off layer above the X-point. The thermoelectric current is associated with the temperature asymmetry of the divertor plates and flows from a hotter plate to a colder one – both in the private region and in Scrape-off layer. In addition, there are Plate Closing currents, which flow to/from the divertor plates. The first type of Plate Closing currents close the ∇B current below the X-point. Moreover, in the private region such a current is subtracted from the thermoelectric current, and in the Scrape-off layer it is added to the thermoelectric current. The Plate Closing current of the second type closes the radial currents in the Scrape-off layer above the X-point. The suggested structure is supported by the results of the simulations and the probe measurements for the ASDEX Upgrade tokamak. The results obtained give a good understanding of the current structure in the edge plasma of a tokamak.

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