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Simulation study of the E×B drift effect on the transport of plasma and sputtered impurities in scrape-off layer

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It is essential to control the plasma flow onto the divertor targets to avoid unacceptable heat load and erosion, and the contamination due to the sputtered impurities to avoid the degradation of the performance of confined plasma. Thus, comprehensive understanding of the plasma and impurity transport in the scrape-off layer (SOL) is necessary for exploring the divertor solution for the future reactor. Recently, it has been demonstrated that the E×B drift can affect the plasma [1] and impurity [2] transport. For the purpose to improve the understanding for the effect of E×B drift effect on the SOL plasma transport as well as the sputtered impurities from the divertor targets, simulation studies [3,4] have been carried out using SOLPS-ITER [5] and DIVIMP [6] based on the EAST configuration.
For the main ion species, SOLPS-ITER simulations under favorable and unfavorable toroidal field (BT) are performed by scan of the PSOL and upstream density. Two boundary lines have been identified on the PSOL-ne,sep plane. Between the boundary lines, the double-peaked characteristic can be observed in the density profile at inner target for favorable BT and outer target for unfavorable BT. The appearance of the upper boundary is qualitatively consistent with the EAST experiment [7], and some evidence for the existence of the lower boundary can also be found in the experimental data. Regarding the appearance of the second peak, the synergetic effect of poloidal and radial E×B drifts is considered as the main mechanism. The radial E×B drift results in the effective particle sink in near-SOL region and the source in far-SOL region, and the effect is enhanced due to the obstruction to the plasma flow by the poloidal E×B drift in the near-SOL region. Furthermore, the simulations with neon seeding also performed. It is found that the impurity seeding affects the target density profile on the contrary way to PSOL.
Within the simulating background plasma with neon seeding, the transport of the sputtered tungsten impurities from the divertor targets is studied by DIVIMP. The E×B drift is included in the simulation by introducing the calculated drift velocities of the tungsten impurities. The E×B drift is found to enhance the core contamination of the tungsten impurity, and the effect is more significant under unfavorable BT. Detailed analysis of the effect of E×B drift on the transport of tungsten impurity will be presented in the conference.

Reference
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Speaker's Affiliation

University of Science and Technology of China, Hefei

Member State or IGO

China, People's Republic of

Primary author: MAO, Shifeng (University of Science and Technology of China)

Co-authors: Mr GUO, Jin (University of Science and Technology of China); Prof. YE, Minyou (University of Science and Technology of China)

Presenter: MAO, Shifeng (University of Science and Technology of China)

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