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The influence of full drifts on density shoulder formation at midplane and double peak density at target by numerical modeling

Authors: Xuele Zhao, Chaofeng Sang*, Ilya Yu. Senichenkov, Yilin Wang, Yanjie Zhang, Vladimir Rozhansky, Dezhen Wang[1]

[1]Key Laboratory of Materials Modification by Laser, Ion and Electron Beams (Ministry of Education), School of Physics, Dalian University of Technology, Dalian 116024, People's Republic of China

[2]Peter the Great St.Petersburg Polytechnic University, 195251, Polytechnicheskaya ul., 29, Saint Petersburg, Russia

†Email: sang@dlut.edu.cn

The density shoulder at midplane may influence core plasma confinement during H-mode discharge, thus affecting long-pulse steady-state discharge. The double peak electron density profile at target can affect the plasma-wetted area[1]. The drifts in the edge plasma play remarkable role in plasma transport and divertor operation regime, and they determine the density shoulder formation (DSF) at mid-plane and double peak density (DPD) distribution at divertor target [2]. In this work, the SOLPS-ITER code package [3,4] is used to evaluate the influence of full drifts on DSF and DPD. The cases of without drifts, with only E×B drifts in forward B_t, and with full drifts in both forward and reversed B_t are simulated for comparison. It is confirmed that the high upstream density promotes DSF when the drift is not considered, which has also been observed by various investigations. When the drifts are taken into account, the divertor in-out asymmetry (or upstream ionization source) is determined by the direction of B_t due to the variation of particle transport, thus the shoulder can be facilitated or suppressed. Two mechanisms of DSF with full drifts are elucidated as shown in Fig.1: (1) the E×B and B×∇B drifts promote DSF at IMP via raising ionization source in forward B_t; (2) the drifts contribute to DSF at OMP by enhancing the radial transport in reversed Bt. In high recycling regime, the ionization is the dominant term for DSF, while in low recycling regime the enhanced radial transport by B×∇B drift plays more important role in DSF. It is also found that the DPD disappears gradually with the increment of upstream density. The full drifts make the DPD more obviously compared with only considering E×B drift. Comprehensively understanding of DSF and DPD mechanisms is of great importance for the improvement of core-edge compatibility and broadening the particle deposition width at target for divertor radiation in the fusion reactor.

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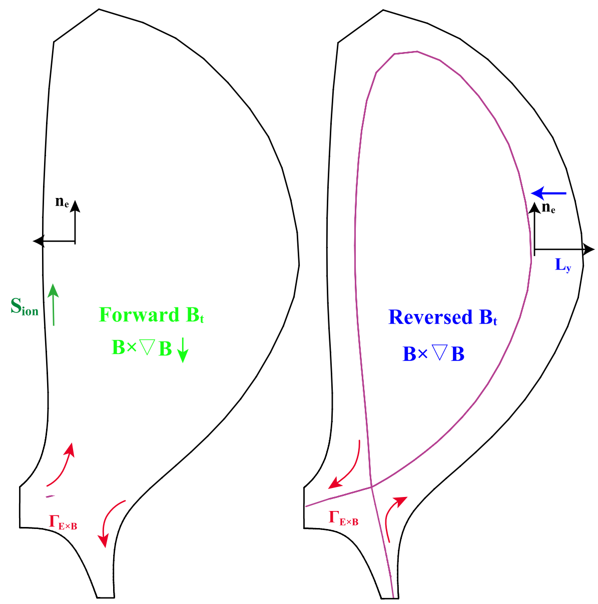

Figure 1 The sketch of DSF mechanism with full drifts in forward B_t with ID of high recycling regime (a) and reversed B_t with OD of low recycling regime (b).