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The simulations of SOL width with helical current filaments in ELMy H-mode

T Y Xia
Institute of Plasma Physics, Chinese Academy of Sciences, China

The EAST ELMy H-mode discharges with different plasma current (Ip) and geometries are applied to study the scaling law of scrape-off layer (SOL) width. The similar trend of the SOL width λq with Ip is reproduced by the simulations. The simulated SOL width is only half of the EAST measurements, but agrees well with the multi-machine Eich's Scaling law because there is no radio frequency (RF) heating scheme in the simulations, which is effective to change the boundary topology and increases the flux expansion. In order to prove the topology change effects of LHW in SOL region, a modeled helical current filament (HCF) in SOL is added as the force-free form into the 6-field 2-fluid module of BOUT++. The amplitude of HCF is chosen to be the same as that observed in the EAST experiments. The radial magnetic field induced by this HCF could be much smaller than the perturbed field, but it is able to force the perturbations with the same toroidal mode number to grow up at the start of the linear phase. This forced mode is effective to compete with the spontaneous fluctuations and change the linear properties, which leads to the obvious suppression of the divertor heat flux and the broadening of SOL width. The preliminary results show that the HCF is able to increase the SOL width by ~25%, and the peak parallel heat flux towards divertor target is decreased by 32%. The particle flux on divertor target clearly shows the secondary striate filaments, similar to the splitting of the strike point which is found by the divertor probes.

xiaty@ipp.ac.cn