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Characteristics of Doubly Peaked Particle Deposition at Divertor Target Plate in EAST tokamak

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The expansion of heat & particle deposition area on the divertor target plates is regarded as an effective way to reduce the extremely high heat load with deposition width in the order of millimetre for future tokamak fusion devices[1]. Recently, the doubly peaked distribution (DPD) behavior of the particle deposition at the divertor target plates has been widely observed in the experimental advanced superconducting tokamak (EAST), which can dramatically broaden the deposition width of the heat & particle fluxes, and was also presented in other tokamak devices[2,3].

We found that the DPD behavior occurs not only in the lower hybrid wave (LHW) heating plasma but also with the electron cyclotron resonance heating (ECRH) or the neutral beam injection (NBI) heating alone, which is a new finding and an enrichment based on our previous studies[4]. In addition, the DPD shows an obvious in-out asymmetry on the divertor target plates, which is strongly depended on the toroidal field direction, i.e. distinctly appeared on the outer divertor plate in an unfavorable B_t case, while shifted to the inner divertor plate with the favorable B_t. Meanwhile, the transition between the single peaked distribution (SPD) and the DPD usually happens when the plasma discharge parameter is changed, especially for the plasma density n_e and the heating power. The statistical results show that the DPD behavior is significantly affected by both the plasma density and the heating power. The lower ratio of the electron density to the heating power, the DPD behavior occurs more likely, with also the contribution from the higher plasma stored energy. Besides, it is also found that the impurity injection can reduce or even eliminate the DPD phenomenon, such as the impurities of argon, neon, boron and lithium.

Finally, the physical mechanism behind it is also discussed, suggesting that the electric field drifts may also exhibit a strong influence on the DPD behavior. Thus, Ref [3] presents a simple model based on the ExB drifts near the divertor target to show the relationship between such a DPD behavior and the ExB drifts, which may be considered as a new way to reveal the formation mechanism of DPD behavior.

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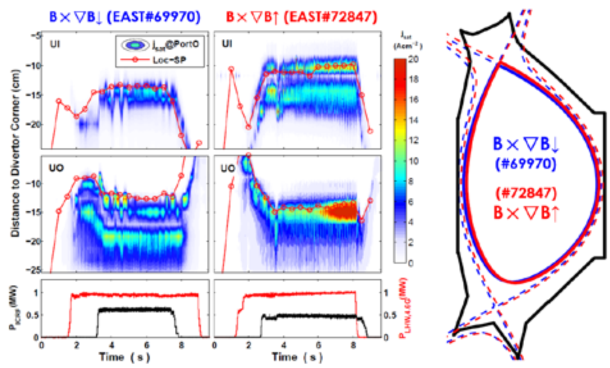

Figure 1 (Left) Contours of j_{sat} at the UI and UO divertor targets for two discharges with the ion ∇B drift towards bottom (B×∇B ↓ , EAST#69970) and top (B×∇B ↑ , EAST#72847), respectively. The red circled dotted lines (Loc-SP) represent the locations of strike point on the UI and UO divertor targets, which are inversed by EFIT. The time traces of 4.6GHz LHW and ICRF heating power for the two discharges are shown below. (Right) The USN divertor configurations at t=4.8s for the two discharges.