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The coupling effects of divertor configuration and drift on detachment in EAST new lower tungsten divertor for long-pulse operation

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The new lower tungsten divertor with horizontal and vertical targets has already been developed and installed in EAST for high-power and long-pulse operation in a full metal wall environment. The flexible magnetic configurations allow the position of lower outer strike point located on either horizontal or vertical target with different divertor configurations. Preliminary experimental results show that the outer strike point on the horizontal target near the coroner(<2cm) can maintain easily the divertor detachment with a lower upstream separatrix density.

In this work, the coupling effects of different divertor configurations with outer strike point on the horizontal or vertical target and different E×B drift patterns on detachment in EAST are systemically investigated by the SOLPS-ITER code. The preliminary modeling results show that when the outer strike point is on the horizontal target near the corner, the vertical target can help reflect neutrals to the scrape-off layer to trap more neutrals in the divertor region. Therefore, the detachment can be achieved at a lower upstream separatrix density. In addition, E×B drift with different B×∇B directions can redistribute ions in the divertor region to either strengthen or weaken the corner effect on the detachment onset. With the B×∇B away from the X-point (rev. Bt), the E_r×B drift causes ion flows from the inner divertor area to the outer divertor area crossing the private flux region (PFR). In the outer target region, radial ion drift velocity E_θ×B pushes ions outer of PFR into the SOL. Therefore, the E×B drift with reversal Bt can strengthen the corner effect to achieve the divertor detachment with much lower separatrix density. However, when the B×∇B towards the X-point, the E×B drift will weaken the corner effect.

A more closed divertor, V-shape divertor has also been proposed as a candidate for the future EAST divertor upgrade, which will reduce the effect of different drift patterns on detachment. Compared to the present divertor configuration with the right angle, V-shape divertor configuration with both toroidal field directions directs the recycling neutrals toward the separatrix from both the SOL and PFR and focuses recycling neutrals on the V-end. This means that V-shape divertor can achieve detachment at a much lower upstream separatrix density with two different drift patterns compared to the present right angle divertor configuration in EAST.

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