

Addressing the effect of $E \times B$ on closure divertor detachment onset by SOLPS

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Abstract

The closed divertor (such as small angle slot-SAS, C-Mod)[1] can well trap neutral (D, D₂) and carbon impurity from erosion particles in target region, so that the impurity and recycling neutral particles can radiate a large quantity of power[2]. As a result, the closed divertor very easily achieves detachment with relative small upstream density. However, experimental results in DIII-D and C-Mod [3] showed that the direction of Grad-B has very big influence on the closed divertor detachment onset. As we known, the electric drift- $E \times B$ is much related with the direction of Grad-B, and can drive a large number of particles from outer into inner target region along the poloidal flux tubes in private flux region when Grad-B toward divertor. The $E \times B$ strongly depends on the radial and poloidal gradients of electron temperature- T_e and static pressure- $n_e T_e$ [4]. Since the closed divertor can well screen impurity and neutral recycling particles, the poloidal gradients of T_e and $n_e T_e$ are much larger in closed divertor than that open divertor. Thus, the $E \times B$ may have a great effect on the detachment onset in closed divertor. In this work, we will employ the edge plasma code SOLPS to address the effect of $E \times B$ on the closed divertor detachment onset in HL-2M. The preliminary modeling results reveal that the effect of $E \times B$ on detachment onset in closed divertor is much larger than open divertor, and the closed divertor is very difficult to achieve detachment when Grad-B toward divertor when activating $E \times B$. This work will excite great interests in advancing scientific understanding of the interplay between $E \times B$ and impurity energy dissipation for detachment control in closed divertor.

References

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