Influence of Li source location on divertor SOL width and neutral radiation with EMC3-EIRENE modelling

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A good control of impurity radiation to a technically feasible level is most challenging issues for magnetic confinement fusion devices on the path to a reactor. Appropriate impurity radiation in the scrape-off layer (SOL) plasma of fusion device leads to heat flux reduction onto divertor plates, which can extend the using lifetime of plasma facing components (PFCs) due to economic consideration for the routine operation of fusion facilities. However, impurity emission would give rise to cooling main plasma in the confined region and then trigger a serious impurity contamination and degradation of energy confinement at the core plasma. Lithium injection is used as a valid method to mitigate or eliminate the edge-localized modes (ELMs) in order to decrease the high transient and periodic plasma loads to PFCs. Hence, the lithium injection experiments have been currently conducted on the EAST tokamak, which aims at the steady-state operation and high performance H-mode plasmas.

In order to obtain a better understanding of impurity transport behaviors, three dimensional (3D) edge fluid transport code EMC3-EIRENE has been employed to study lithium transport in the SOL of EAST with the toroidally-localized lithium source experiment[1,2]. Based on pervious work, impact of Li source location on divertor SOL width has been performed by the three-dimensional (3D) edge plasma and neutral fluid transport code package EMC3-EIRENE[3,4]. The neutral Li injection from outer midplane of EAST device is the most effective position to increase the divertor SOL width both at the lower inner and outer divertor targets, in comparison with other Li source position. Moreover, the resultant recycling at the lower divertor has also been comparatively analyzed on the various Li injection scenarios with EMC3-EIRENE modelling. The comparative study indicates that Li injected location from the upstream leads to the weakest recycling from the lower divertor region, which is attributed to the maximal divertor SOL width. Therefore, a smaller deuterium radiation distribution is found at lower divertor targets from the upstream Li injection scenario compared with downstream Li injection locations.