5th Asia-Pacific Conference on Plasma Physics, 26 Sept-1Oct, 2021, Remote e-conference

Effect of neon seeding on divertor detachment and core-edge integration in EAST H-mode plasmas

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In the EAST 2018-2020 experimental campaigns, a large number of experiments were performed by seeding a mixture of neon and deuterium (Ne-D_2) for detachment and core-edge-divertor integration in H-mode plasmas.[1-2] The divertor partial detachment with high-confinement core plasma has been successfully achieved using neon seeding in EAST with ITER-like tungsten divertor (figure 1). Compared with the plasma parameters before impurity seeding, both the plasma stored energy and $H_{98,y2}$ >1 are maintained excellently, with the electron temperature, heat flux and the IR-camera measured surface temperature near the divertor strike point being all significantly reduced.

The difference between Ne-D_2 seeding at the SOL upstream and downstream has been also studied in detail. It is found that impurity seeding at SOL downstream is more beneficial to reduce the electron temperature and peak heat flux of the target plate. With comparison experiments using D_2 seeding, it is further demonstrated that gas seeding in the SOL downstream will enrich more particles around the strike point, while the seeding in the SOL upstream will influence the entire outer target more evenly.

Moreover, the impurity radiation ability is very sensitive to the relative location between the strike point and the gas-puff location in EAST. Based on the results of experiments and simulations, impurity seeding near the strike point will be more conducive to neon ionization and energy radiation.

In addition, the comparison of divertor detachment and plasma confinement between Ne-D_2 and Ar-D_2 seeding has been studied, where Ar-D_2 is the mixture of argon and deuterium. It is observed that there is less Ar-D_2 seeding needed for partial detachment onset than Ne-D_2 seeding, which shows that Ar is more efficient in the cooling of divertor electron temperature than Ne. However, Ar also always causes confinement degradation in the partial detachment state.[3] These results are of reference significance for detachment operation and core-edge-divertor integration in other tokamaks, including ITER.

The work was supported by National Key R&D Program of China (Nos. 2017YFE0301300), National Natural Science Foundation of China (Nos. 11922513, U19A20113, 11905255, 12005004, 12005257).

References

[1] L. Wang *et al* J. Fusion Energy **43**, 3 (2021)
[2] G.S. Xu *et al* Nucl. Fusion **60**, 086001 (2020)
[3] K.D. Li *et al* Nucl. Fusion **61**, 066013 (2021)

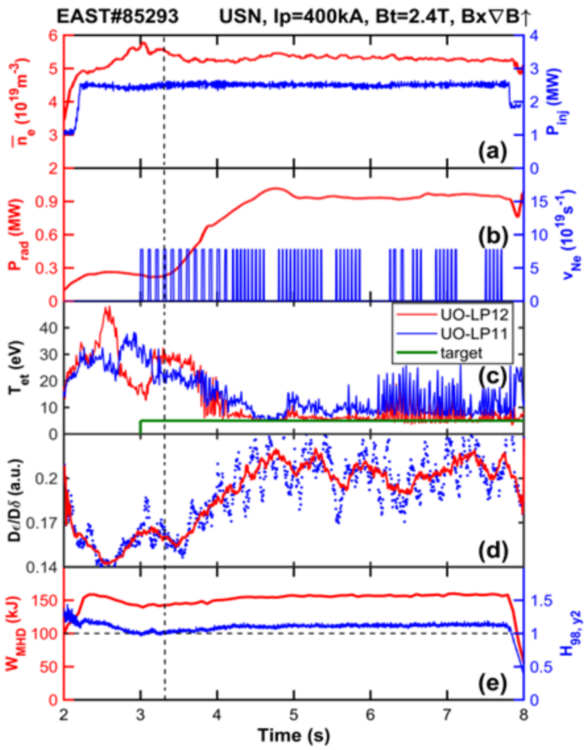

Figure 1. Time evolutions of the key plasma parameters in detached H-mode discharge with high core confinement. The panels from top to bottom represent line-averaged density and injected power (a), radiated power and seeding velocity of neon atoms (b), divertor electron temperatures for the actively controlled channel (UO-LP12) and the peak channel (UO-LP11) on the divertor plates (c), radio of D_ε to D_δ in Deuterium Balmer lines (d), plasma stored energy and confinement improvement factor (e). The vertical dashed line denotes the moment when the impurity starts to take effect.