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Modification of the divertor particle flux induced by a coherent mode in the HL-2A tokamak

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In order to mitigate the transient heat flux and particle flux on the divertor target, it is necessary to understand the edge and divertor physics. The radial transport mechanism modulated by various instabilities in the pedestal is investigated widely. However, its effect on the distribution of the divertor particle flux is reported rarely in the experiments. In KSTAR tokamak, coherent perturbation (CP) induced by a coherent mode (CM) in the pedestal propagates to the SOL and arrives to the divertor target, which influences the distribution of the divertor particle flux[1]. Divertor particle flux modulated by CM in the pedestal is also observed in EAST[2, 3]. Recently, CM with low frequency (f = 13 – 20 kHz) is identified in the pedestal of HL-2A tokamak, and a CP on divertor target is observed firstly with the upgraded divertor Langmuir probe arrays, which has a strong correlation with the CM. The CM induces the outward transport of the electron density and influences the distribution of the particle flux on the divertor target. The preliminary analysis shows the CM natures are much similar to the BAE mode discussed in the reference[4].

Fig. 1(c) shows that the density gradient grows quickly when the CP is weak, and it recovers slowly when the CP is strong, which is accompanied by an obvious increase of the D_α emission, as shown during the time window with shadow. What is more, the statistical result in Fig. 1(d) shows that there is a linear increase of D_α versus the power of the CP on the

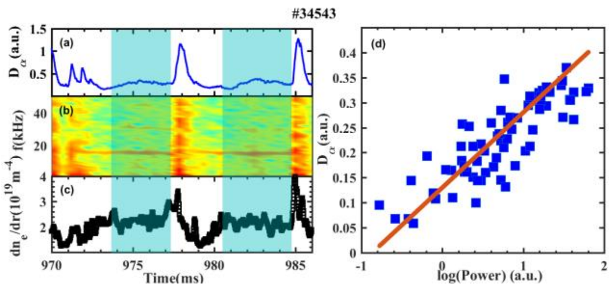

Fig. 1. (a) D_α signal in the lower divertor, (b) the frequency spectrum of the J_{sat} on the divertor target, (c) the density gradient in the pedestal, (d) the amplitude of the D_α versus the power logarithm of the CP on the divertor target plate.

divertor target, which suggests plenty of particles are induced outward due to the CM in the pedestal, and the recovery of density gradient is thus limited during the inter-ELM when the CM is strong.

The profile of divertor particle flux with CP is compared with that without CP in Fig. 2, which are shown by the solid curves with triples and circles, respectively. The root-mean-square (RMS) of the J_{sat} (bandpass-filtered f=14-16kHz) on the divertor target is shown with the dotted curve with the cross symbols, which represents the structure of the CP on the outer divertor target. As we can see, the CP peak, which deviates from the strike point, is located at the dip between the two peaks of the particle flux, so it results in an obvious increase of the particle flux (about 23%) at local position, as shown by the dotted line with diamonds. As we can see, the distribution of the particle flux increment is consistent with that of the CP.

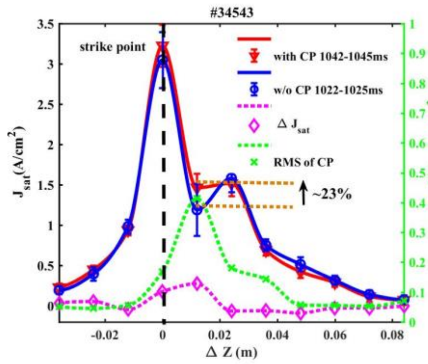

Fig. 2. The effect of the CP on the distribution of the particle flux: Left Y-axis: The profiles of saturate ion current density J_{sat} on the divertor target with and without CP; Right Y-axis: the RMS of $J_{sat,CP}$ on the outer divertor target and the increment of the J_{sat}.

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