§39. Particle Flux Profiles on the LID Head

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Particle flux profiles on the LID head were investigated using Langmuir probe arrays in relatively low input power (~ 2 MW) discharges with LID configuration. Langmuir probe arrays consist of 10 electrodes (dome type; ϕ3mm). Distance between electrodes is about 10 mm. To measure the particle flux profiles on the head, position scan of the head was conducted shot by shot with center and edge line-averaged densities, $n_{e,bar}$ and $n_{e,bar,edge}$ (at R=4.119m in vertically elongated cross-section) of 2.1-3.4 $\times 10^{19}$m^{-3} and 0.6 ~1 $\times 10^{19}$m^{-3}, respectively. In Figs. 1 (a) and (b), the reconstructed ion saturation current profiles along top and left Langmuir probe arrays normalized by $n_{e,bar,edge}$ are shown with closed circles. Horizontal axes are the vertical distance from probe-electrodes to the calculated outer separatrix of m/n=1/1 island under the vacuum condition on the cross-sections along the respective probe arrays. In both profiles, peaks positions are about 5 mm out of the calculated separatrix positions. It is not clear that difference between peak position of ion saturation current profile and the calculated separatrix position is caused by mechanical positioning error or something physical process. Half widths of both profiles are about 20mm, and characteristic lengths of slopes are about 10mm both in and out of the island. In higher density discharges ($n_{e,bar,edge}$ = 1.6 $\times 10^{19}$m^{-3} and 2.3 $\times 10^{19}$m^{-3}), particle flux profiles changed. In Figs. 1(a) and (b), changed profiles are also plotted with open circles and squares. The head was not largely scanned in these discharges, and only parts of the profiles are shown. At both top and left probe arrays, normalized ion saturation current decreases largely near the separatrix, especially at top array. These changed profiles looks like partial detachment. Unfortunately, it is not clear that plasma pressure conservation was violated or not because of lack of n_e and T_e data on the head. As shown in Fig. 2 (a), the shoulder position of changed profile at top probe array is #5 electrode (head position, r_{head}= -98mm). To survey the onset condition of this profile change, onset is defined as $I_{is\#1}$ / $I_{is\#5}$ < 1. Figure 2 (b) shows $n_{e,bar,edge}$ and T_e at the outer separatrix, $T_{e,edge}$, at onset of the profile change as a function of absorbed heating power, P_{abs} with closed and open circles, respectively. In this P_{abs} range, both parameters were almost constant. Closed triangle in Fig. 2 (a) is onset $n_{e,bar,edge}$ for the discharge after a series of CH$_4$ puffing experiment. $T_{e,edge}$ is ~30eV. Onset $n_{e,bar,edge}$ largely decreased in this discharge. In Fig. 2 (c), ΔT values at all divertor tiles in which embedded thermocouples are compared between with and without the particle profile change discharges (#41669 and #41696, respectively). While time integrated P_{abs} in these shots are almost same, ΔT in former shot is smaller than in later shot except a divertor tile (T-2#3) and pumping duct. Radiation power from main plasma monitored by bolometer is almost same

in these shots. It suggests that radiation power in pumping duct increased.
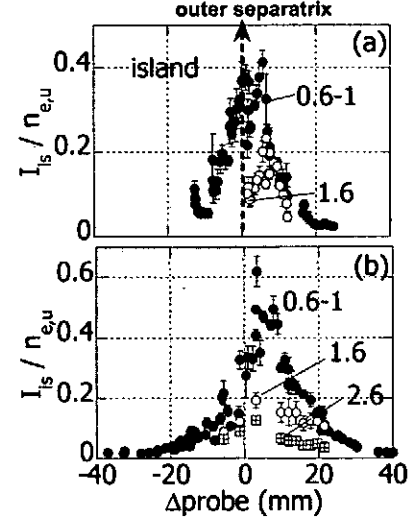

Fig.1: Normalized ion saturation current profiles on the LID head at top (a) and left (b) probe arrays. Closed circle; $n_{e,bar,edge}$= 0.6-1$\times 10^{19}$m^{-3}. Open circle; $n_{e,bar,edge}$= 1.6$\times 10^{19}$m^{-3}. Square; $n_{e,bar,edge}$= 2.6$\times 10^{19}$m^{-3}
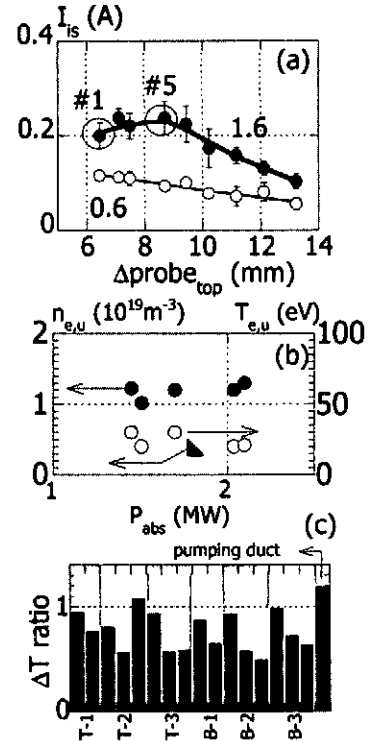

Fig.2: (a) Ion saturation current profiles on top probe array. (The head was standard position.) Open and closed circles are $n_{e,bar,edge}$= ·0.6 and 1.6 $n_{e,bar,edge}$= 1.6$\times 10^{19}$m^{-3}. (b) Edge density and temperature at onset of the particle flux profile change. Horizontal axis is absorbed heating power. Closed circles: $n_{e,bar,edge}$, Open circles: $T_{e,u}$, Triangle: $n_{e,bar,edge}$ after a series of CH$_4$ puffing discharges. (c) Divertor plates ΔT ratios between with and without the particle flux profile change discharges. ΔT ratio $\equiv$ ΔT(w/ profile change) / ΔT(w/o profile change). Horizontal axis shows the position of the divertor plates.