§38. Edge Plasma Control by LHD

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Active edge plasma control by the local island divertor (LID) has been carried out on LHD. After the minor modification of the LID head from the 6th experimental campaign, various experiments with higher heating power could be performed and some basic functions of LID were experimentally confirmed in the 7th campaign.

Typical electron temperature T_e and index of the electron density I_{TS} profiles measured with the Thomson scattering system are presented in Fig. 1. It is clearly seen that the LID configuration is surely formed as expected, i.e. T_e rises from the inner separatrix of the island. The I_{TS} profile also changes its gradient at the inner separatrix of the island, to be sure, it is not clearly scraped off compared to T_e. Namely the dense and cold plasma exists in the island region. This can be explained that field lines connecting the boundary of the confinement region to the LID head along the island separatrix are long enough to confine such low temperature plasmas, although the parallel transport is still dominant for the energy flow.

In order to investigate the impurity shielding effect of the LID, neon (Ne) was injected to the hydrogen plasma. Fig. 2 shows the Ne density profiles measured with the charge exchange spectroscopy system for the helical divertor (HD) and LID configurations. The Ne densities in Fig. 2 are normalized by the Ne puffing rate, since the Ne gas puffing rate in the LID configuration is more than 10 times higher than that in the HD configuration. From the figure, it is obvious that the Ne density in the LID configuration is far lower than that in the HD configuration. Most of the injected Ne is shielded by the island and soon pumped out via the LID head. It is found that the LID is very effective for the impurity screening.

The preliminary trial in the outward shifted configuration of R_{ax} = 3.75 m was carried out at the final stage of the last experimental campaign. Fig. 3 shows the summary of the experiment, i.e. achieved plasma stored energy as a function of the line averaged density. It is surprising that the density range achieved is tremendously extended to ~ 1 x 10^{20} m^{-3} with the pellet injection, and following stored energy is achieved over 700 kJ, which are nearly two times higher than those in the standard configuration of R_{ax} = 3.60 m. Comparing with the ISS95 scaling law, the confinement property is found to be improved in the outward shifted configuration. Improvement is also seen in the gas puff shots. The reason for this improvement is thought to be a enhancement of the fueling efficiency due to the higher recycling at the LID head at R_{ax} = 3.75 m. The Hα signal actually shows the enhanced recycling at R_{ax} = 3.60 m. Further experiments are necessary to prove it.

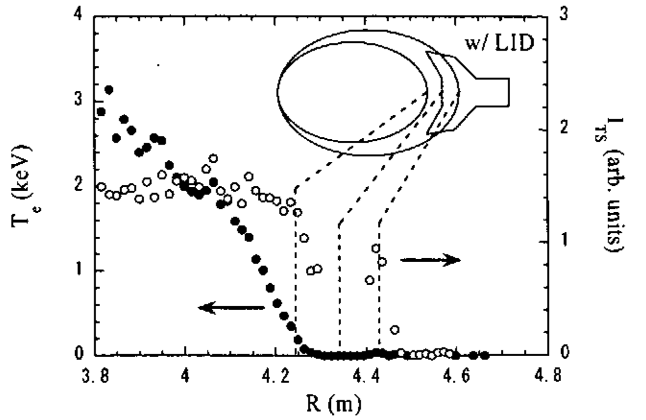

Fig. 1. Radial profiles of T_e and I_{TS} (index of n_e) in LID configuration.

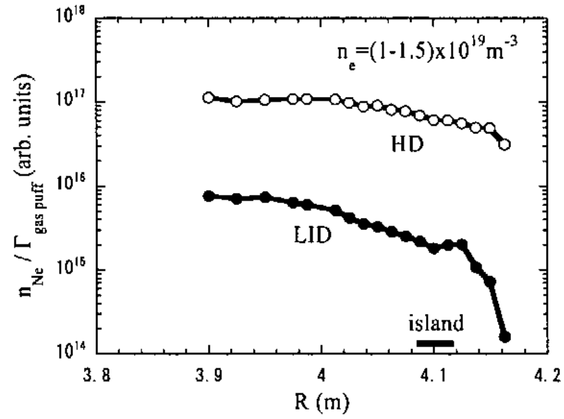

Fig. 2. Radial profiles of Ne density for HD and LID Configurations, normalized by Ne gas puffing rate.

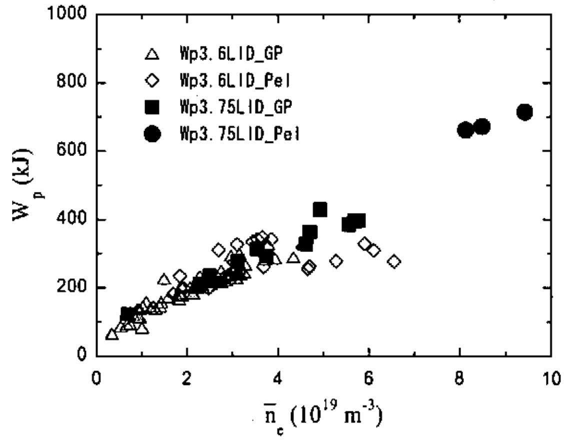

Fig. 3. Achieved stored energy in standard (R_{ax} = 3.60 m) and outward shifted (R_{ax} = 3.75 m) configurations, as a function of line averaged density.