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EX/P5-29: First Results of Closed Helical Divertor Experiment in LHD

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The edge plasma control with divertor is a crucial issue for fusion research. Especially in reactors, excess neutrals including helium ash and impurities have to be pumped out efficiently to sustain the edge pedestal and burning plasma in steady-state. In addition, sufficient cooling for plasma before reaching target plates is strongly required from the engineering point of view. Thus it is prerequisite for efficient pumping to increase neutral pressure in the divertor region with closed configurations. In helical devices, closed divertor experiments have been conducted using magnetic islands surrounding the plasma, e.g. local island divertor (LID) in LHD. However, due to the small wetted area of LID, it cannot accommodate steady-state and/or high power operations. Hence the helical divertor (HD) which is intrinsically built in the heliotron configuration is a solution to prospect future helical devices.

The baffle-structured closed HD is being constructed in LHD. The closed HD consists of ten discrete modules which are partially installed on the inboard side of the torus, where ˜ 88 % of diverted particles flow into. Each module consists of a pair of vertical target plates and a "dome"structure. At this stage, two of ten modules have been installed. The geometrical optimization of the target plates and the dome was carried out with numerical simulations to maximize the neutral compression in the closed HD region. It was demonstrated that the neutral pressure in closed HD can be increased ˜ 13 times higher than that in open HD.

Experiments were carried out with neutral beam (NB) heated hydrogen discharges. Neutral pressures in open and closed HDs were measured with ASDEX-style fast ion gauges installed under the dome. During the discharge with continuous gas puffing, neutral pressures in both open and closed HDs increased monotonically with increase in electron density. It was clearly observed that neutral pressure in closed HD was more than 10 times higher than that in open HD. This result agrees quantitatively well with that obtained with numerical simulations. Consequent increase of recycling flux was also observed in Langmuir probes measurements in closed HD, while little difference in global plasma parameters could be seen with present two closed HD modules. Active pumping in closed HD is planned in the near future.

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