§34. Local Island Divertor (LID) II

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A local island divertor (LID) has been proposed for the edge plasma control of the Large Helical Device (LHD). Although the LHD edge plasma control will primarily be done by a closed full helical divertor, we also plan to use the LID as an alternative. The advantage of the LID over the helical divertor is technical ease of the hydrogen pumping because of its toroidally localized recycling.

The LID magnetic configuration uses an $m/n = 1/1$ island, formed at the edge region, and hence the core region is surrounded by the separatrix of the island. Thus, the outward heat and particle fluxes cross the island separatrix, and flow along the field lines to the back side of the divertor head, inserted into the island, where target plates are placed to receive the heat and particle loads. The particles recycled there are pumped away by a pumping system, and we have found that a closed divertor system with an overall pumping efficiency of > 30% can be obtainable. Such highly efficient pumping is the key in realizing a significant confinement improvement [1].

We have demonstrated numerically that two pairs of copper coils located above and under the torus are able to generate a magnetic configuration suitable for the LID, *i.e.*, a clean $m/n = 1/1$ island at the edge region. When a resonant perturbation field with the $m/n = 1/1$ component is simply added to the standard LHD magnetic configuration by these coils, an $m/n = 1/1$ island appears at $\iota\!\!-= 1$ surface, together with $m/n = 2/1$ islands, which appear due to the toroidal coupling at $\iota\!\!-= 0.5$ surface. These $m/n = 2/1$ islands can be, however, almost completely eliminated by a proper arrangement of the coil currents. A preliminary design work has shown that the divertor head can be well inserted into the generated $m/n = 1/1$ island as shown in Fig. 1, possibly guaranteeing its expected functions. It was also shown that the field lines in the outer island flux surfaces strike upon the back side of the divertor head, while those in the inner island flux surfaces, facing the main plasma, do not touch the divertor head. Preliminary designs of a movable divertor head structure, a hydrogen pumping system and divertor diagnostics systems have been done as shown in Fig. 2. The above studies, together with its theoretical consideration, have made us believe that the LID will suppress the impurity contamination and enhance the energy confinement in LHD.

In order to optimize the LID design in LHD and study the effect of LID on the edge plasma, we are planning to do the LID experiment in the Compact Helical System (CHS).

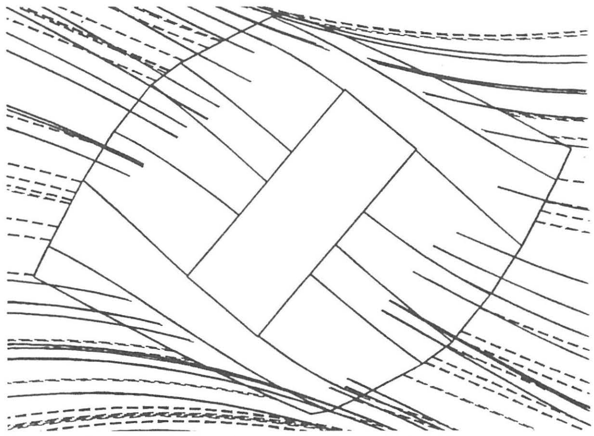

Fig. 1. A divertor head and field lines.

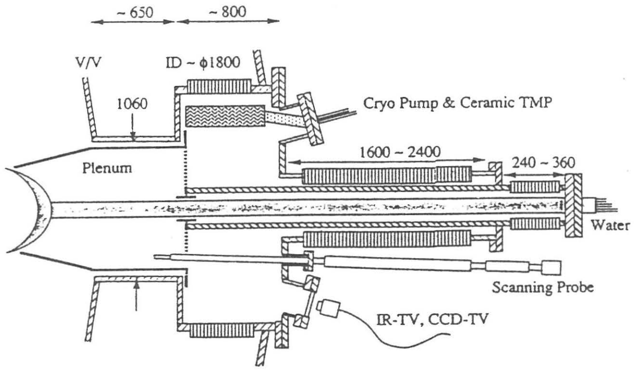

Fig. 2. Preliminary design of LID system.

References

[1] Ohyabu, N., *et al.*, in *Plasma Physics and Controlled Nuclear Fusion Research* 1992 (Proc. 14th Int. Conf. Würzburg, 1992), Vol. 2, p. 605.