§45. A Candidate for LHD Divertor Upgrade Configuration

Ohyabu, N.

Development of the LHD divertor has been made on the basis of a belief that a closed divertor with high pumping efficiency could enhance the quality of the helical plasma substantially. However, the cost of the conventional closed divertor for the LHD is not small since the total length of the helical divertor leg is as long as 4 x 40 m. This fact has lead to development of the Local Island Divertor (LID), a closed divertor with high pumping efficiency (>30%). With LID operational, we expect a substantial enhancement of the plasma performance and will study the influence of the edge recycling control on the core helical plasma. Unfortunately, the LID cannot handle high input power (> 5 MW) since the heat and particle fluxes are localized to rather narrow region. What is required is a simplified closed divertor configuration with high power handling and efficient pumping.

The configuration depicted in Fig.1 may satisfy such requirements. Ten sets of divertor plate units are located radially at slightly inner side of the " X-point " and poloidally at the small major radius side of the torus ($135 < \theta < 225$). The majority of the outward flowing plasma particles are intersected by these divertor plates. The total area of the plate receiving the heat may be around 2 m^2, (a numerical calculation is planned to predict it more consistently) and thus may withstand 20 MW heating power. But the significant difference is that it extends helically only 10 x 2 m instead of 4 x 40 m and thus its cost is an order of magnitude lower. Moreover, the shape of this typed divertor unit is much simpler, the size of the unit is reasonably small, 0.3 m x 2.0 m and thus it can be designed to handle a steady state input power flux of 10 MWm^{-2}.

For high temperature divertor operation, pumping panels of the carbon sheet pump or the membrane pump are installed on the vacuum vessel wall near the divertor plate, as shown in Fig. 1. They will absorb the recycled hydrogen particles efficiently.

For the SHC boundary approach (Simultaneous achievement of H-mode like confinement and radiative Cooling), localization of the recycling in the open region is an important requirement. It can be realized because the width of the open plasma region in front of the divertor plate is greater than 10 cm and the expected plasma density at the last closed surface is $2 \times 10^{13} cm^{-3}$. Other conditions for the SHC approach, are met even in the present design ((i) a sharp separation between closed surface region and open region, (ii) constant pressure along the field line in the open region for separation of cold, high density radiative plasma and relatively low density and hot SOL plasma.

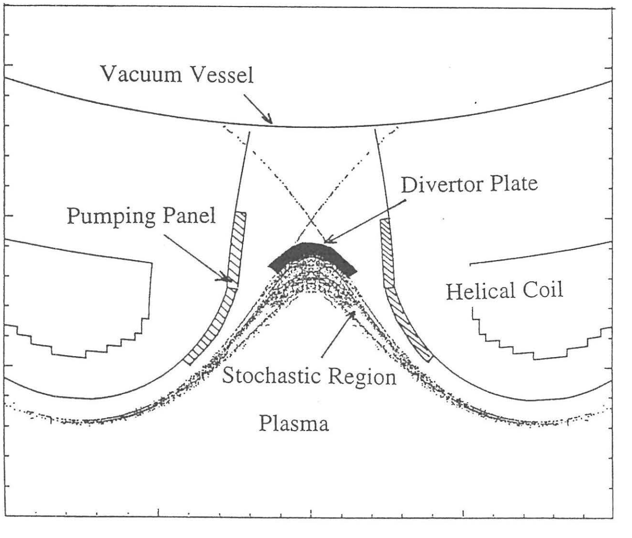

Fig. 1. A candidate for LHD divertor upgrade configuration, viewed along the helical direction at $\theta = 180^o$.