§14. High Power ICRF U-port Antenna for CHS

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For the ICRF heating program of LHD, antenna development is one of the key items for high power and steady state experiment. Especially experimental optimization in physics and engineering aspects is the most important point in the development. The new U-port antenna has similar features with the presently proposed LHD antenna. The antenna test in CHS gives us valuable information.

Newly designed antenna is placed at the vertically elongated poloidal section (U-port) in outward side of the toroid. This antenna location gives us a good situation to choose several suitable heating modes fitting to experimental purposes. The antenna size is 40cm length and 24cm width which are relatively large for small CHS plasma size. Especially the current strap has wide width of almost three times larger than that of the P-port antennas. P-port antennas are formerly designed ICRF antennas with a little modification to set in the slanted P-ports.

Several improvements are expected on the U-port antenna. One is the wide antenna width. To use the restricted space between the plasma surface and the CHS wall, the shape is three dimensionally deformed to fit the plasma and the wall. The wide width reduces the loop inductance and increases the coupling with the plasma. These are favorable factors for high power heating with limited RF stand-off voltage on the transmission line and vacuum feedthrough. The photograph of the CHS U-port antenna is shown in Fig.1.

The impurity suppression is a serious problem of ICRF heating. The Faraday shield is at the distance of 1.5cm from the plasma surface. This is a relatively large distance for the plasma size. To keep the good coupling, Faraday shield consists of single layer stainless steel stripes.

The stripes are carefully manufactured to be set on the parallel to the magnetic field. Figure 2 shows the front view of the Faraday shield and the crossing line with the mod-B surface. To eliminate the undesired resonance heating of the particles on the peripheral area, the emission area on the antenna front surface is covered by conductive material.

By using the U-port antenna, good performances were observed in some experimental conditions. Figure 3 shows the comparison of the oxygen impurity line intensity of the U-port antenna and the P-port antenna.

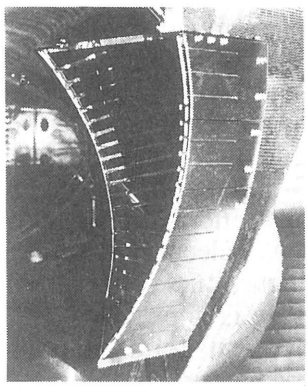

Fig. 1 Photograph of the U-port ICRF antenna set on the outward side of toroid in CHS vacuum chamber. RF is fed from upside.

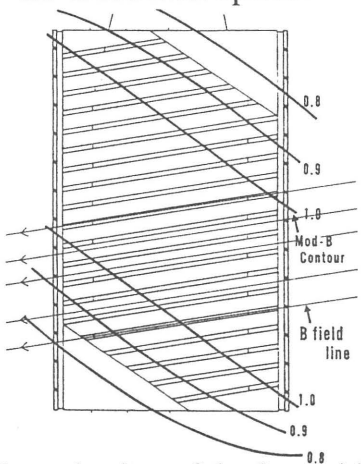

Fig.2 Schematic view of the front side of the U-port antenna. Faraday shield is designed to shield the parallel electric field to the magnetic field.

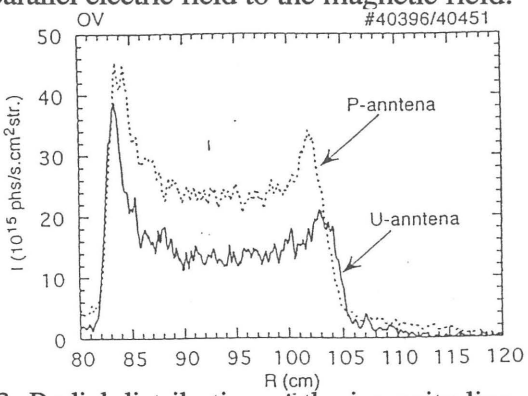

Fig.3 Radial distribution of the impurity line emissivity during the ICRF heating with U-port antenna and P-port antenna.