

§26. Design and Fabrication of the ICRF Fast Wave Antenna for LHD

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One set of the ICRF fast wave antenna for the LHD has been designed and fabricated. The first antenna set consisting of two antenna loops will be installed at the ports No.3- U and 3-L on the LHD. These fast wave antennas are designed for steady state of over 30 minutes and high power of over 1MW per each antenna loop. The basic design was tested and developed at the R&D antenna set in the ICRF test stand. In the R&D antenna, the steady state operation of RF current of 800 A(0-peak) was achieved during 30 minutes. The LHD antenna has principally same electrical and cooling structures as the R&D antenna.

The fast wave antenna inside the LHD chamber is shown in Fig.1. The cross sections of feedthrough, transmission line and antenna loop are shown in the figure. Antennas are installed from the top and from the bottom ports and they are almost symmetrical on the equatorial plane. The structures inside the chamber can be moved to change the clearance between plasma surface and the antenna Faraday screen from 0 to 15 cm. This movement is caused by the pivot motion with the fixed point just inside the feedthroughs. The length from the antenna top to the pivot point is

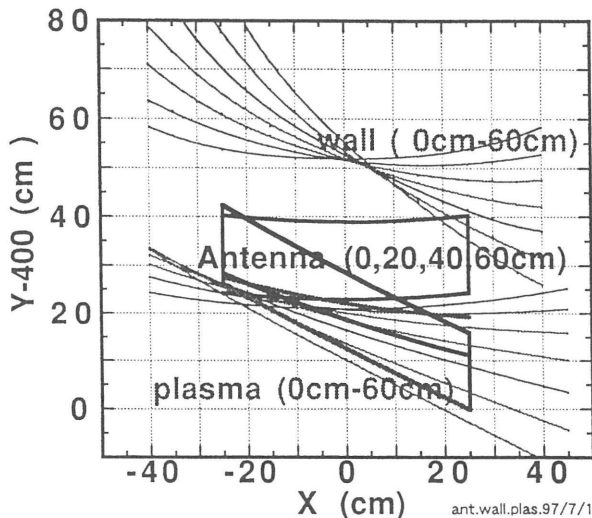


Fig.2 Horizontal cross sections of the antenna, plasma surfaces and vacuum chamber wall at different constant Z planes.

about 3.2m, so the changing angle of the bellow section remains very small. This motion will give us several advantages by controlling the antenna position to fit the LHD experimental plans.

The most unique feature of the LHD antenna is the shape of the loop section. The cross sections of the antenna, the plasma surface and the vacuum chamber wall are shown in Fig.2 at different constant Z plane. The loop section is twisted to fit the helically deformed LHD plasma. The configurations of the LHD magnetic surfaces can be changed by controlling the poloidal magnetic field. But the changes of the outer most closed magnetic surface especially on the high field side are small. So the close fit of the antenna shape is kept over a wide range of the configurations.

The width of the current strap is 30cm and the width including the protectors is 46cm. The vertical length of the loop section is 60cm. The antenna is designed so that circulating water flow can remove the dissipated RF loss and the plasma heat load from all parts. The water flows on the path of a so-called "single stroke of the brush" to eliminate complicated piping structures outside.

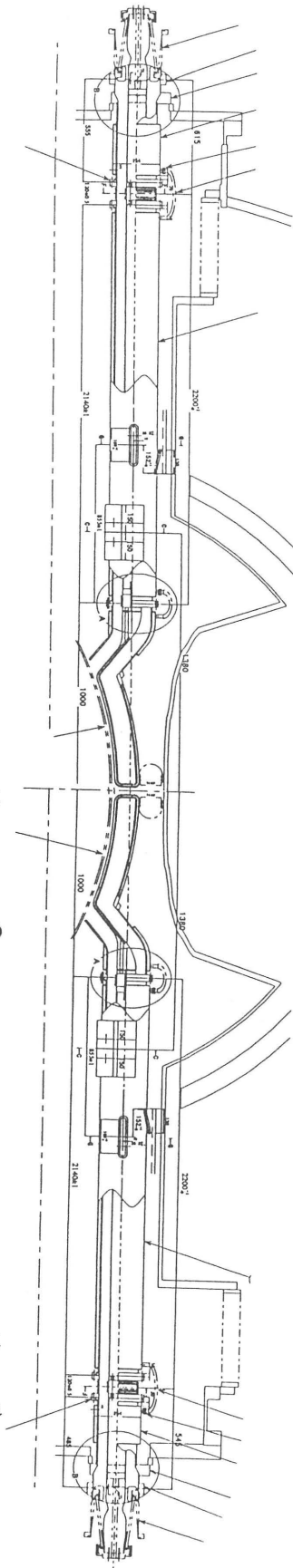


Fig. 1 Drawing of the ICRF fast wave antenna for the LHD. Left side of the loop section having arc shape is LHD plasma.