

§27. Fabrication of Folded Waveguide Antenna for Large Helical Device

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We report on the fabrication of folded waveguide (FWG) antenna, which is scheduled to be installed in LHD in 1998. We have developed the FWG antenna for LHD since 1992 in collaboration with Oak Ridge National Laboratory[1]. It can launch radio frequency (RF) power in ion cyclotron range of frequency (ICRF) in an accessible size of fusion experimental device. The FWG antenna is designed to launch an ion Bernstein wave (IBW) and to produce the plasma in various strength of magnetic field. Direct launched IBW will also be used to heat the LHD plasma.

Figure 1 is a schematic drawing of side view of the FWG antenna system and LHD. The size of waveguide is 1050 mm in width, 428 mm in height, and 3950 mm in length. This antenna will be installed from the LHD horizontal vacuum port as shown in the Fig. 1. The antenna is built in a cylindrical vacuum container 1300 mm in diameter. The antenna position is changeable in a range of 1150 mm and the antenna can be drawn back to be housed in the extended vacuum container when it is not used.

Figure 2 is a three-dimensional sketch of the front of the FWG antenna. The opening is incompletely divided by 23 vanes and forms a waveguide having 24 folds. The slant of the antenna is 38.9° to be parallel to a line of magnetic force at the X point. The front surface of the antenna is formed to fit with the shape of the LHD plasma. Water cooled carbon protectors are furnished on both sides of the antenna. RF power is supplied through a coaxial transmission line from the upper part at back end of the waveguide. The inner conductor is connected to 2nd vane from center by movable electrode. Impedance matching is obtained by adjusting the RF power feeding point. The RF emitting pattern can be changed by the combination of polarization plates in front of the antenna.

Figure 3 shows relation between antenna length and resonant frequencies in various mode; $m=1, 2, 3, 4$. The resonant frequency increases in higher mode number. Marks in the figure indicate the points of waveguide length (3950 mm). The resonant frequencies are determined to be 24.2, 35.6, 49.0, 64.0 MHz for 1.5T operation.

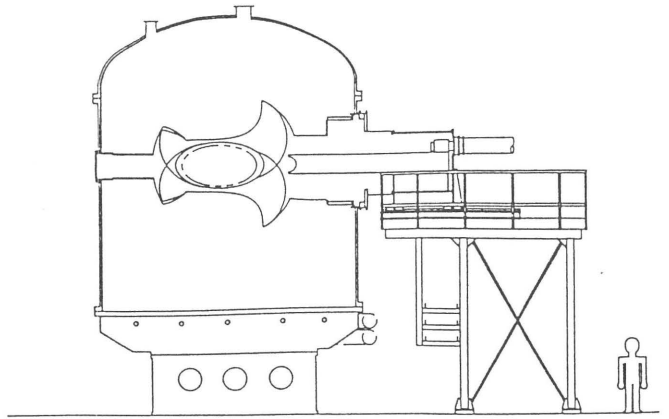


Fig.1. Side view of FWG antenna and LHD.

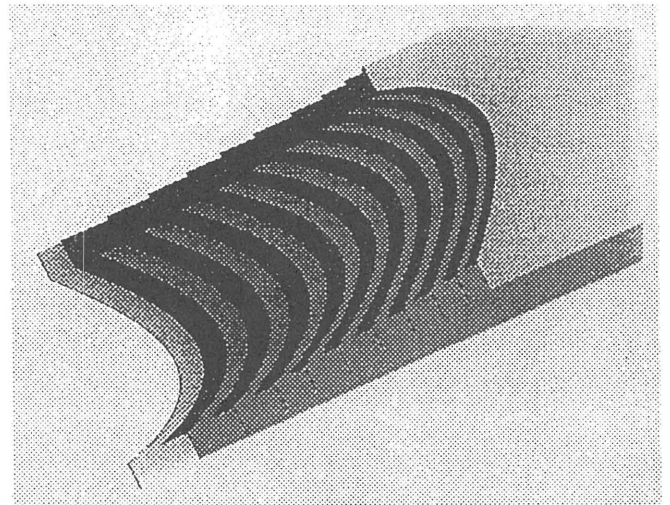


Fig.2. Three-dimensional sketch of the front of the FWG antenna.

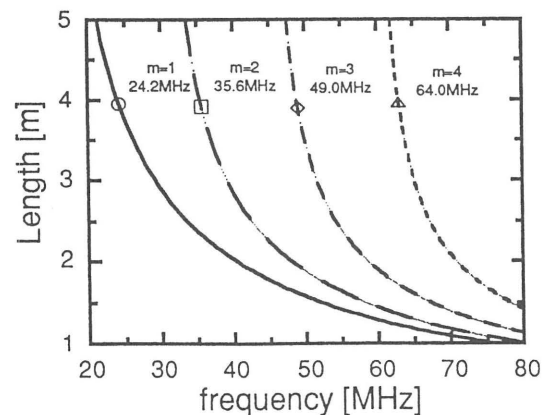


Fig.3. Relation between antenna length and resonant frequencies in mode number, $m=1, 2, 3, 4$.

Reference

- 1) Kumazawa, R., et al. : Ann. Rep. NIFS(1995-1996)96.