§51. Development of Optics of Microwave Imaging in LHD

Nagayama, Y., Yamaguchi, S., Inagaki, S., Sugito, S., Kogi, Y., Mase, A. (KASTEC, Kyushu Univ.)

Microwave is one of the best electromagnetic wave to observe plasmas, because the plasma with the electron density higher than the cutoff density corresponding to the microwave frequency reflects the microwave and the electron cyclotron emission (ECE) from the plasma is also microwave. Therefore microwave imaging is one of the most promising plasma diagnostics. In LHD, the microwave diagnostics have been developed with the collaboration between Kyushu University and NIFS. The ECE imaging (ECEI) is mainly developed by Kyushu University and the microwave imaging reflectometry (MIR), which is useful to observe the density fluctuation, is developed by NIFS.

In 2006, the imaging system was significantly improved. The schematic view of the MIR and ECEI is shown in Fig. 1. The main concave mirror is installed in the LHD vacuum vessel, and is remotely manipulated by the use of ultrasonic motors (USMs). ECE and the reflected wave are separated by a dichroic plate (DP). In MIR, the illumination beam and the reflected beam are separated by the plexiglass beam splitter (BS).

In MIR, the main improved points are as follows: (1) the optics is installed in an aluminum enclosure; (2) the illumination optics and the receiving optics are separated; (3) the microwave sources are installed 15 m far from LHD. Inside the enclosure microwave absorbing forms (Eccosorb) was installed. Because of microwave absorbers and beam separation, the leakage of the illumination wave to the receiver is significantly reduced, so that the background level in the signal is drastically reduced.

The microwave sources (IMPATT oscillators) used to be installed 5 m far from LHD. However, the normal operation of the microwave sources was interfered by the leakage of the magnetic field. Actually, the output power of the microwave sources reduces as the magnetic field increases, and finally no output power is observed. After enclosing in 5 mm thick soft-iron shield case, the power was dropped by 30 %. Therefore the microwave sources are installed 15 m far from LHD and the microwave is transferred using oversized rectangular waveguides (X-band, WR-90) and 90 degree H bends.

As the results, clear MIR signals are obtained after adjusting the main mirror. Using this system, novel MHD modes are observed in the case of low density.

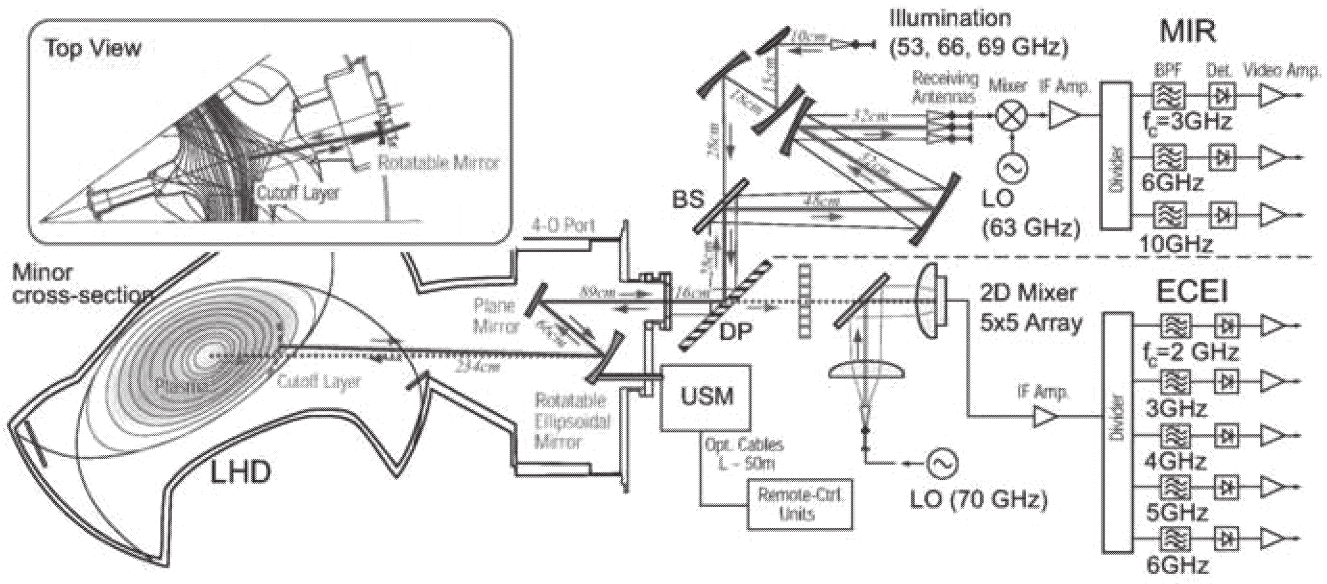

Fig. 1 Schematic view of the microwave imaging system in LHD.