Development of 2-D Antenna Array for Microwave Imaging Reflectometry in LHD

D. kuwahara, S. Tsuji-Iio, Y. Nagayama [a], T. Yoshinaga [a], Z. B. Shi [b], S. Yamaguchi [c], S. Sugito [a], Y. Kogi [d] and A. Mase [d]

Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku 152-8550, Japan

[a] *National Institute for Fusion Science, 322-6 Oroshi-cho, Toki 509-5292, Japan*

[b] *SOKENDAI, 322-6 Oroshi-cho, Toki 509-5292, Japan*

[c] *Kansai University, 3-3-35 Yamate-cho, Suita 564-8680, Japan*

[d] *KASTEC, Kyushu University, 6-1 Kasuga Koen, Kasuga 816-8580, Japan*

e-mail address of submitting author (kuwahara.d.aa@m.titech.ac.jp)

The Microwave Imaging Reflectometry (MIR) is a method of electron density diagnostics by the use of microwave radar techniques to obtain 2-D/3-D images of electron density fluctuations for the investigation of micro-turbulence and magneto-hydrodynamic instabilities in magnetically confined plasmas. The MIR has been developed for the Large Helical Device (LHD). The former system uses probe waves at frequencies of 53, 66 and 69 GHz in X-mode by using three IMPATT oscillators, and three commercially available v-band horn antennas as receiving antennas. By using the former MIR system, we obtained signals which were similar to magnetic probe signals and HIBP signals in LHD. However, the following things turned out from the analysis; to obtained the fluctuation mode number, k-toroidal, k-poloidal and k-radial it is necessary to use four or more frequencies as probe waves and four or more antennas as toroidal and poloidal directions. From these requirements, we developed wide-band 2-D antenna array. The 2-D antenna array has four key devices. The antenna element required compactness and flat frequency response at frequency range of 50 – 75 GHz. We developed the pyramidal horn antenna, and employed this for antenna element. A surface mounted Schottky diode is located in horn antenna elements. It works as mixer diode and it downconverts reflected waves to intermediate frequency (IF) signals. The Low-Pass filter rejects the ECRF heating power leakage. It is made by microstrip-line technology. The IF amplifiers amplify the IF signals with low noise. The IF amplifiers are low-cost GaAs microwave monolithic ICs with the frequency range of DC to 10 GHz and the 13 dB. This work is supported by the National Institute for Fusion Science (Grant No. NIFS07ULPP525) and the National Institute of Natural Sciences (Grant No. NIFS07KEIN0021).