## §20. Development of the Combined Electron Cyclotron Emission (ECEI) and Microwave Imaging Reflectometer (MIR) System for LHD Plasmas Experiment

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A new diagnostic tool for simultaneously measuring turbulent temperature and density fluctuations is under development at National Institute for Fusion Science. The design of this combined Electron Cyclotron Emission Imaging (ECEI) and Microwave Imaging Reflectometer (MIR) system is a joint research with the Advanced Science and Technology Center for Cooperative Research, Kyushu University. The main aim of this diagnostic is to extend the range and detail of turbulence measurement capability in fusion plasmas. Both the MIR and ECEI techniques take advantage of large aperture optics to form an image of the reflecting/emitting layer onto an array of detectors located at the image plane, enabling localized sampling of small plasma areas.

Based on LHD plasma parameters the proposed MIR part of the system will utilize V-band of microwaves for the probing at multiple frequencies from 60 to 69 GHz with X-mode polarized radiation. The basic schematic view of the MIR part of the system is depicted in the Fig. 1 (it is emphasized with the yellow area). The focusing elements

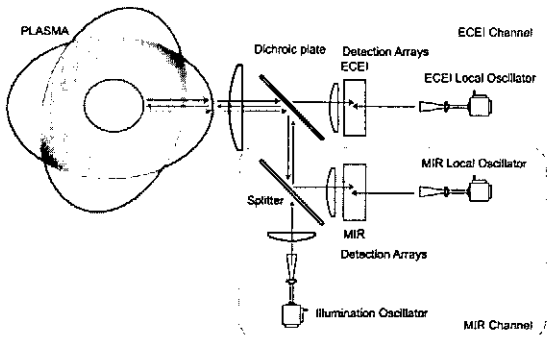


Fig. 1: Schematic layout of the combined MIR and ECEI system

of the microwave imaging system are consisting of main focusing elliptical mirror and one plane reflector. Both mirrors are located inside the LHD vacuum chamber. For the test run the MIR system was exclusively occupied the LHD 4O-CC01 diagnostic port.

In spite of not optimal plasma conditions (low electron plasma density) the system shows the strong reflected signal from the LHD plasmas. Because of using the heterodyne receiving technique for signal detection with combination of high powered launching oscillators the test run shows the capability of the receiving system to acquire the plasma reflected signals in the range of -45 to -50 dB. The trace of the detected from the horizontally elongated plasma is shown at the Fig. 2. The com-

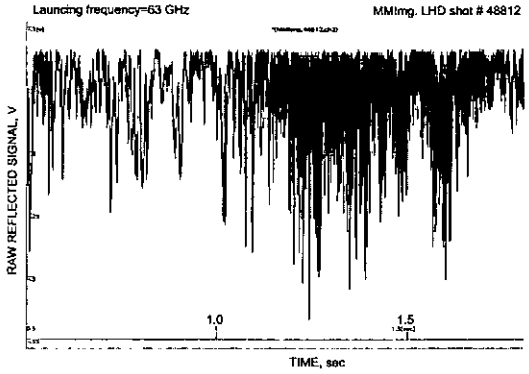


Fig. 2: View of the detected reflected signal from the LHD plasmas

bined system has to utilize the diagnostic port for the both reflectometer and ECEI parts (Figure 1). For this purposes the dichroic plate has to be used in order to separate the two frequency bands. Typically filters consist of a metal plate dotted with a large number of equidistant holes. These holes function essentially as circular waveguides with a cutoff frequency defined by the selected geometry. The frequency dependence of the transmission is determined by the hole diameter, the hole spacing distance, and the plate's thickness. For frequencies below the cutoff one ($f_c$), the dichroic filter acts as a plane mirror with a very low leakage rate. The designed dichroic plate will reflect the microwave radiation with frequencies less than $f_c$=70.2 GHz. This filter will perfectly separate the operational bands for MIR (53-69 GHz) and ECEI (70-80/70-120 GHz) subsystems.

Detector arrays are under development at KASTEC, Kyushu University. For 2004-2005 year LHD campaign MIR will operate as 3-channel system. The channels will be focusing at three different plasma locations, which are separated in radial, azimuthal and toroidal directions. The correspondent components of density fluctuation spectra will be obtained.