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フラウンホーファー回折法を用いたGAMMA10セントラル部における密度揺動計測

Density fluctuation measurements by using Fraunhofer diffraction method in the GAMMA10 central cell

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Instabilities in plasmas are one of the major causes of plasma confinement degradation in nuclear fusion plasmas. Measurements of spatially and temporally resolved frequency and wave number spectra of those fluctuations are important. Microwave to infrared laser scattering techniques have been used for the purpose. There are two types of instabilities which are a rotationally driven mode with the lowest azimuthal mode number and a drift-wave mode with high azimuthal mode numbers. Fraunfoher diffraction (FD) method is one of the forward scattering methods. In this study, we applied FD method to measure the density fluctuations in the central cell of the GAMMA10 tandem mirror.

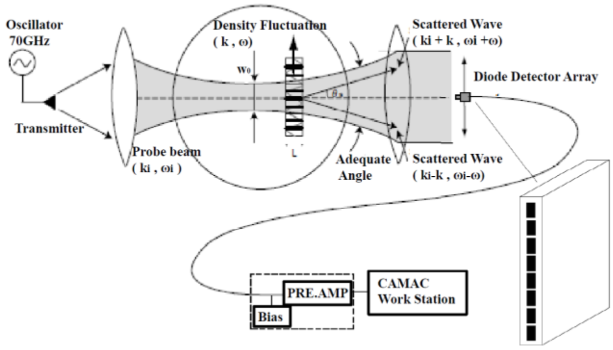

Fig.1 Schematic diagram of FD method system.

GAMMA10 is an effectively axisymmetrized minimum-B anchored tandem mirror with thermal barrier at both end-mirrors. The main plasma confined in GAMMA10 is produced and heated by ion cyclotron heating (ICH). The potentials are produced by means of electron cyclotron heating (ECH) at the plug/barrier region. Low frequency density and potential fluctuations in several kilohertz are excited in the central cell [1]. Typical plasma parameter of the electron and ion temperatures, electron density, and the plasma potential are about 40 eV, 5 keV, 2×10^{12} cm^{-3}, and 200 V, respectively. The electron and ion temperatures are measured by using the microwave interferometer system and the gold neutral beam probe (GNBP) system, respectively. Present studies show the suppression of low-frequency fluctuations of the density and the potential during axial confining potential formation with application of plug-ECH [2].

The FD system is located at the central cell of GAMMA10. In the FD system used in this study, a heterodyne detection is applied to the scattered and incident beams to detect them within the undeviated incident beam. The wave number spectrum is calculated by using the Bragg relation. This technique makes it possible to investigate long wavelength waves, which are considered to be relevant to anomalous transport.

We successfully obtained the wave number and phase velocity of the low frequency fluctuation. We observed the low frequency fluctuations in plasmas in detail by using the FD method system with changing the plasma heating sequence.

[1] M. Yoshikawa, et al., Rev. Sci. Instrum. 79, 10E706 (2008).
[2] M. Yoshikawa, et al., Plasma Fusion Res. 5 (2010) S2010, pp. 1-7