

GAMMA 10における2次元電子密度分布計測のための位相イメージング干渉計の改良

Improvements of phase imaging interferometer for 2D electron density measurements in GAMMA 10

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A 16 channel interferometer is installed to measure two dimensional (2D) plasma density distributions by using a phase imaging method at the west plug cell in the tandem mirror GAMMA 10, where the plasma is confined by the magnetic mirror and the electrostatic potential. The 2D plasma image analysis is important to study mechanisms of plasma confinement improvement by formation of the electrostatic potential.

The phase imaging interferometer employs a heterodyne system using two IMPATT oscillators (frequencies of 69.85 and 70 GHz, and output power of 500 mW). As shown in Fig. 1, a probe beam is expanded by an off-axis parabolic mirror which is installed inside the vacuum vessel to cover upper-half of the plasma. After passing through the plasma, the beam is focused onto 16-channel detector array by an ellipsoidal mirror, a flat mirror and polyethylene lenses. The imaging array uses beam-lead GaAs Schottky barrier diodes bonded to 2D (4×4) bow-tie antennas. Channels are arranged in vertical and axial directions of GAMMA 10, respectively. A phase shift between a transmission wave that is modulated by plasma density and a reference wave is detected by phase detection circuits, which output two signals for each channel; “I” proportional

to cosine and “Q” proportional to sine of the phase shift. Amplitudes of I and Q are adjusted to be equal to each other by a variable resistance attenuator. The signals of I and Q have DC offsets, which cause large phase errors in this system. For this purpose, we propose a calibration method which can conveniently eliminate the DC offsets on the analysis software.

This system has been reconstructed in order to measure electron density distributions more stably and accurately. We will show an offset calibration method and the results of the density distributions measured by the interferometer.

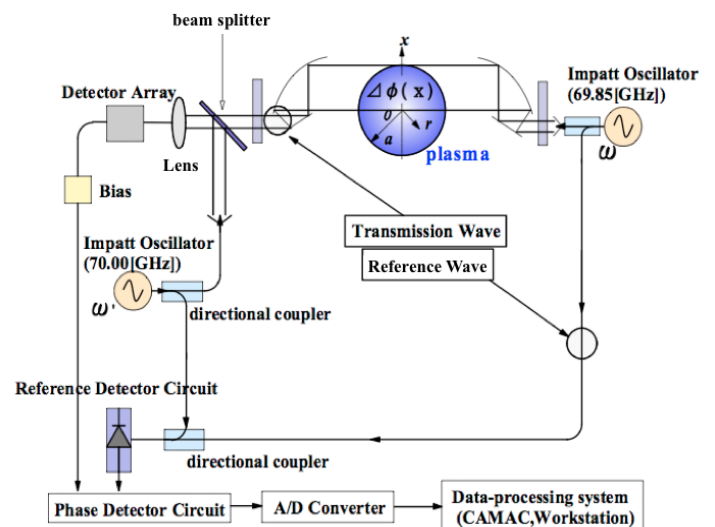


Fig. 1. Schematic diagram of phase imaging measurement system.