§21. Measurements of Electron Density Fluctuations in CHS Plasmas by a YAG Laser Imaging Method

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We applied a novel technique of a YAG laser imaging method to obtain information on electron density fluctuations, including spatial distributions in CHS plasmas. In this fiscal year, we advanced the optical system for the purpose of improving the SNR and extending the measurement capabilities to include wavenumbers.

Figure 1 shows the optical system for CHS plasmas. The YAG laser (λ_i= 1.064 μm 1W) beam is transported through the SM optical fiber near the CHS plasma under study. The radiation beam from the SM fiber is expanded and collimated by the beam expander and passes through the plasma. The probe beam is then transmitted through focusing lens L1 and imaging lens L2 and through a phase mirror. Next, it is received by the optical fiber (or 16-fiber array) connected to the low-noise detector. In experiments, the measurable frequency range determined by the frequency response of the detector was 2 kHz to 1 MHz. The measurable wavelength range determined by the beam width and number of detector channels was from 2 mm to 47 mm. Furthermore, the spatial resolution around the plasma edge was estimated to be about 20 mm at k=1mm^{-1}.

In the experiments in this fiscal year, lens L1 with small aberrations was adopted to improve the strain of the beam concerning the extension in the measurement capabilities to include wavenumbers. As a result, it was possible to make the strain into an ideal beam profile on the phase mirror plane. In addition, the noise stabilizer was improved to increase the SNR.

In this study, a noise stabilizer was applied to reduce the light noise. It was possible to decrease the noise level to as much as (1/2～1/3) before applying the noise stabilizer by improving the optical feedback system. A

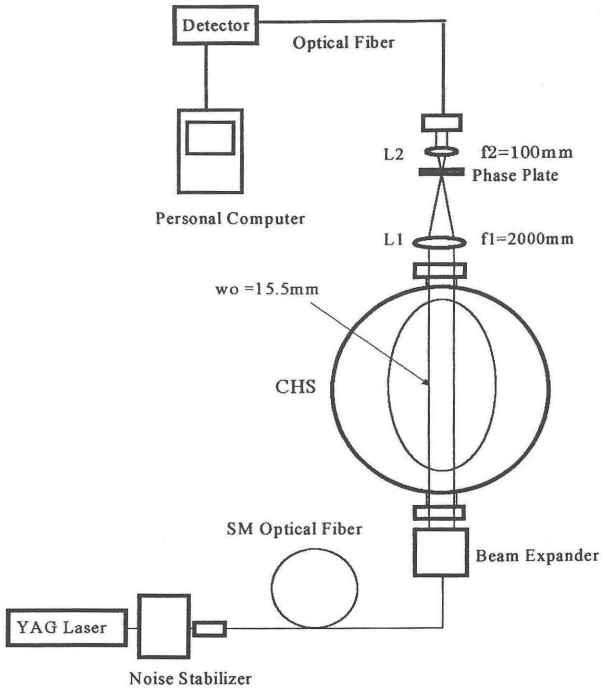

Fig. 1 Laser Imaging System for CHS plasmas

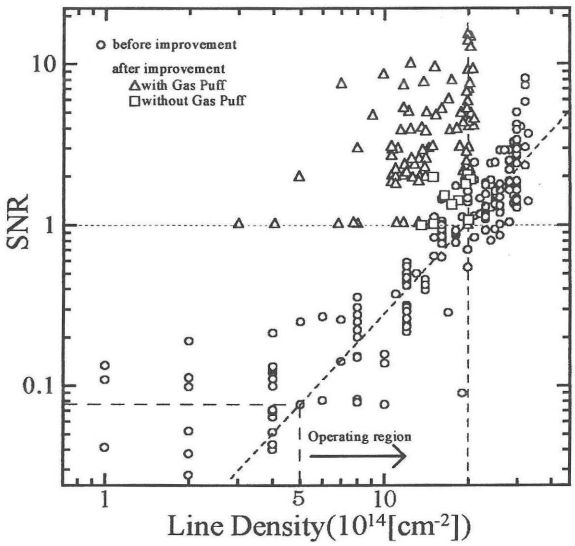

Fig. 2 Relation between SNR and line density

comparison of the density dependence of the SNR before/after the improvement is shown in Fig. 2. The figure shows that the minimum detectable intensity decreases with decreasing noise level and that the SNR is improved even with the same density. In the next fiscal year, we plan to measure the spatial distribution of the spectrum by a high power laser and multichanneling of the detector.

1) NIFS Workshop on Development and Improvement of Fluctuation Diagnostics in Plasmas (2000)