

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

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We have applied a novel technique of a YAG laser imaging method for obtaining information on electron density fluctuations, including the spatial distribution in CHS plasmas. The $S(k,f)$ spectra of the fluctuations were measured by making the detector into a multi-channel version in this fiscal year.

Figure 1 shows the optical system for CHS. The YAG laser ($\lambda_l = 1.064 \mu\text{m}$, 1.2 W) beam is transported by an SM optical fiber near the CHS plasma. A radiation beam from the SM fiber is expanded and collimated by a beam-expander and passes through the plasma. The probe beam is then transmitted through focusing and imaging lenses and a phase mirror, and received by a single or 16-fiber array connected to low noise detectors. In addition to frequency measurements made last year, wave-number spectra were measured by making the detector into a 16-channel detector this fiscal year. 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 2 mm to 47 mm. Furthermore, a spatial resolution of about 20 mm at $k=1 \text{ mm}^{-1}$ around the plasma edge was estimated.

The data from the multi-channel detector was analyzed in the two-dimensional FFT to obtain the $S(k,f)$ spectra. Figure 2 shows an example of measured $S(k,f)$ spectra as contour lines. Plasma is initially produced and heated by ECH and further heated by NBI. The spectrum distributes broadly between 20 kHz - 300 kHz, and decreases as frequency increases as observed in other confinement devices. Also, Fig. 2 shows that it is

possible to investigate spectral line broadening (in relation with correlation length and correlation time) and the dispersion relation by using this system.

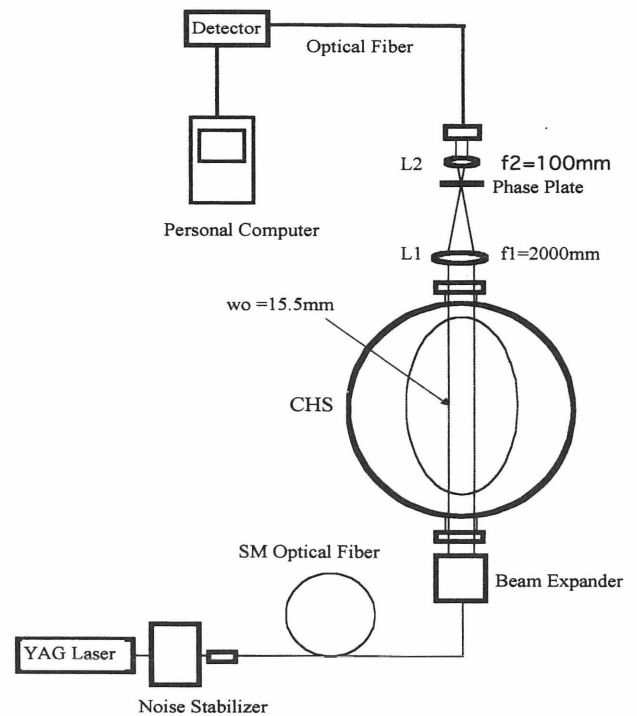


Fig. 1 Laser Imaging System for CHS.

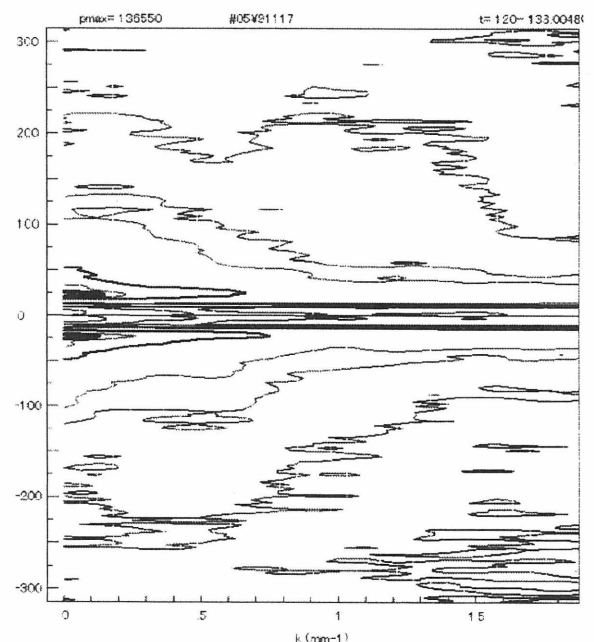


Fig. 2 An example of $S(k,f)$ spectra. The maximum value and minimum value of contour lines are different by 100 times. The vertical axis indicates the frequency (kHz), and the horizontal axis indicates the wave-number.