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

Matsuo, K. (Fukuoka Institute of Technology),
Iguchi, H., Okamura, S., Matsuoka, K.

We applied a novel technique of a YAG laser imaging method for obtaining information on the electron density fluctuations, including the spatial distribution in CHS plasmas. In this fiscal year, spectral resolution could be improved by applying a maximum entropy method (MEM) in polar coordinates to the stored fluctuation data. By using the MEM, spectral and spatial analysis of the density fluctuations were performed to the CHS discharge which edge transport barrier (ETB) was formed in.

Figure 1 shows the optical system for the CHS. The YAG laser (λ_i= 1.064 μm, 1.2 W) beam is transported by a PM optical fiber near the CHS plasma. A radiation beam from the fiber is expanded and collimated by a beam-expander, and injected into the plasma. Transmitted beam is reflected by a mirror with λ/4 waveplate and passes through the plasma again. This beam penetrates a polarizer toward imaging optics. The beam is then transmitted through focusing and imaging lenses along with a phase mirror, and then received by a one-dimensional 16-fiber array connected to low noise detectors. In addition to the one-dimensional spatial measurements, two-dimensional spatial measurements at the detecting plane were performed by making the detector array to rotate a shot by shot under the condition of fixed operation to observe 2D image equivalently. The measurable frequency range determined by the frequency response of the detector is 20 kHz to 1 MHz. The measurable wavelength determined by the beam width and number of detector channels ranges 2 mm to 47 mm.

Plasma was initially produced and heated by ECH and further heated by NBI. The ETB was observed in the NBI plasma on the CHS. The spectrum of the density fluctuation distributes broadly between 20 kHz – 200 kHz. In Fig. 2(a) and (b), frequency spectra are shown before and after the ETB formation (t=57ms), respectively. Fig.2 (a) and (b) show the spectra at upper and lower edges of the plasma cross section. In Fig.2(a), f<0 and f>0 represent ion- and electron-diamagnetic direction. On the contrary in Fig2(b), f<0 and f>0 represent the electron- and ion-diamagnetic direction. The fluctuation propagating to the ion-diamagnetic direction is suppressed with the generation of the ETB. On the other hand, the fluctuation propagating to the electron-diamagnetic direction does not decrease almost. It is possible to also confirm the symmetry of the phenomenon in the spectra at upper and lower edges.

In the near future, distribution of density fluctuation would be obtained by the improved analysis based on spatial resolution and the structure of the magnetic filed. Especially, the analysis related to the transportation barrier will be advanced.

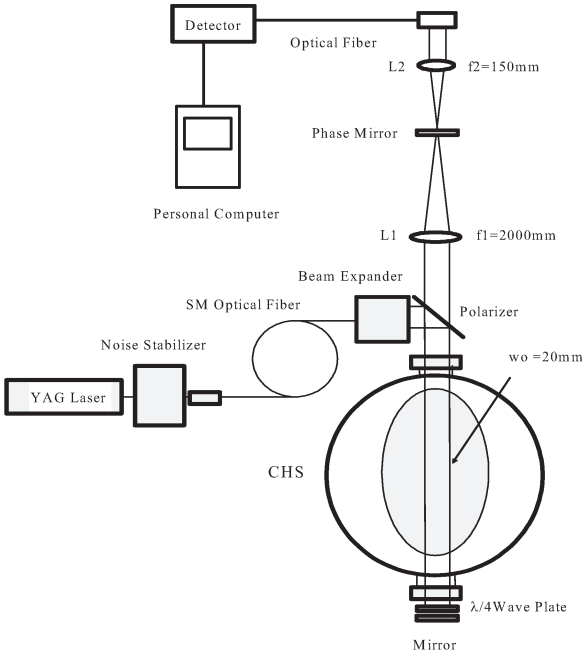
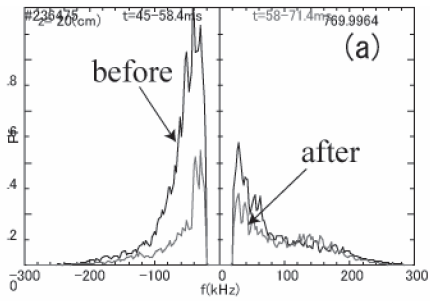


Fig. 1 Laser Imaging System for CHS.



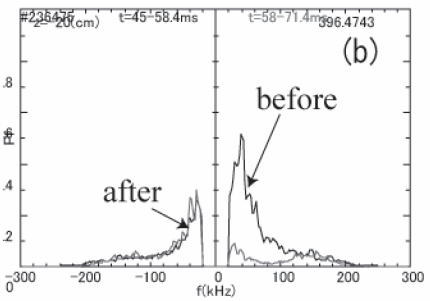


Fig.2(a),(b) Frequency Spectra before and after the generation of the ETB. (a) shows at upper edge (z=+20cm) and (b) shows at lower edge (z=-20cm).

1)24th JSPF Meeting 2007,28aB22P