

ヘリオトロンJにおけるAMマイクロ波反射計を用いた電子密度揺動解析 Analysis of Electron Density Fluctuations with AM Reflectometer in Heliotron J

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Transport property of fusion plasmas is expected to be influenced by fluctuations which are caused by various instabilities. In this study, we have developed an Amplitude Modulation (AM) reflectometer for measuring electron density fluctuations in a helical-axis heliotron device, Heliotron J. In the AM reflectometer, we use a voltage controlled oscillator (VCO) which can sweep the output carrier frequency. The microwaves are injected at O-mode, and the carrier frequency ranges 24.75-42 GHz, corresponding to the cutoff density of $0.76\text{-}2.2 \times 10^{19} \text{ m}^{-3}$. The intermediate frequency (IF) of 100 MHz is created by amplitude modulation with a PIN switch, and an I/Q detector is used for phase detection.

Density fluctuations are measured with the AM reflectometer. Figure 1 shows the time evolutions of line-averaged electron density, VCO input signal and measured I/Q signals. The plasma is heated by ECH and NBI, and the maximum line-averaged electron density is $1.6 \times 10^{19} \text{ m}^{-3}$.

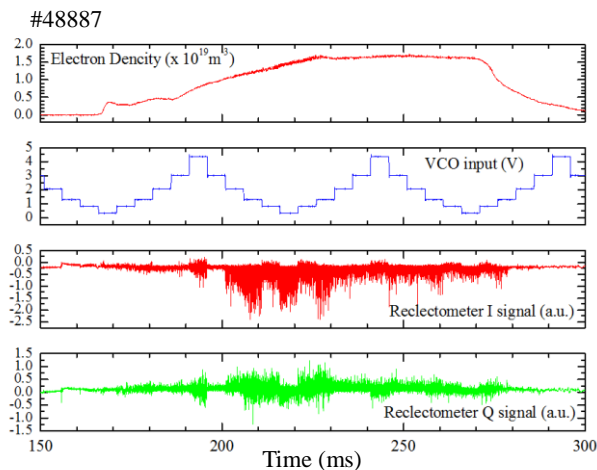


Fig. 1 Time evolutions of I and Q signals

The frequency was stepped from 25.4 GHz to 41.3 GHz in 6 steps at 25 ms intervals. The phase of the IF signal is calculated from the I/Q signals, and then FFT analysis is applied. Figure 2 shows the results of the time evolutions of fluctuation spectra measured with the reflectometer and a magnetic probe in the same discharge. In the spectrum of the reflectometer signal, a coherent mode of 50 kHz is observed, but those of other frequencies are hardly observed although several coherent modes are observed in the magnetic probe spectrum. Since the coherent modes are observed more clearly at low density, this may be due to the fact that background broadband fluctuations hide coherent MHD modes. Coherence between the reflectometer signal and other measurement signal such as the magnetic probe and a beam emission spectroscopy are under investigation to identify the MHD modes in the reflectometer signals.

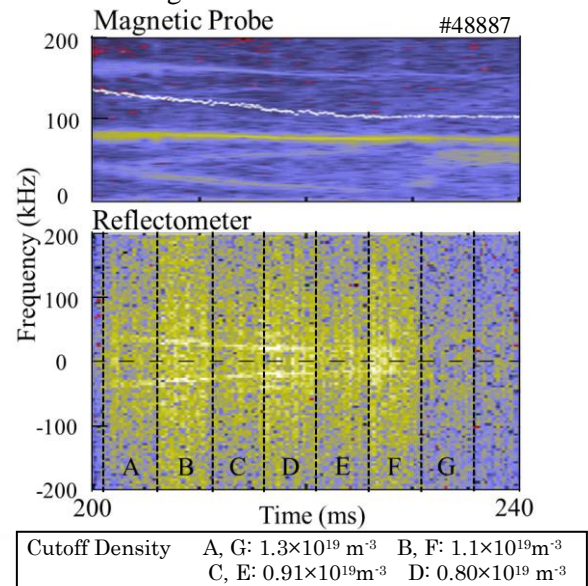


Fig. 2 Time evolutions of fluctuations spectra