

## §52. 3D Microwave Imaging Reflectometry (MIR) Image of Edge Harmonic Oscillation (EHO)

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Edge plasma affects both the heat flux to the plasma facing component and the plasma confinement. EHO appears near the plasma edge and has equally separated many harmonics of the baseband of a few kHz. If EHO enhances particle transport to allow sustained particle control with no change to the edge pressure profile, serious problems due to ELM could be solved by EHO. So EHO would be important phenomena, but EHO has not been well investigated, yet.

We have investigated EHO by using MIR<sup>1,2)</sup> in LHD. Fig. 1 shows plasma parameters and FFT spectrum of MIR signal when EHO appears. Fig. 2 is the power spectrum in frequency and wavenumber. In LHD, EHO appears in medium density plasmas with standard operation without H-mode. At  $t=9$  s, more than 10 harmonics of the baseband of 3 kHz are observed. The electron temperature and density profiles are shown in Fig. 1(c) and (d), respectively. The cutoff densities of probe waves are determined by<sup>2)</sup>

$$n_{cut-off} = \frac{f_R^2 - f_R f_{ce}}{806.4} \quad (1)$$

where  $f_R$  and  $f_{ce}$  are the R cutoff and electron cyclotron frequencies, respectively. The cutoff surfaces of probe microwaves with the frequency of 61.81 GHz and 63.01 GHz are close to the equilibrium boundary.

Figure 3 shows color contour plot of MIR amplitude. Here, each pixel corresponds to 2 cm in the plasma. Narrow red region along the field line can be seen during EHO. The width of this structure is 6 cm in the poloidal direction and the thickness is 2 cm in the radial direction. This structure is localized at the surface  $iota=1.5$  in this case. This structure does not always appear during EHO. Since the frequency is the same as that of EHO, this structure might be a different mode associated with EHO.

- 1) Yoshinaga, T., et al: Rev. Sci. Instrum **81** (2010) 10D915.
- 2) Nagayama, Y., et al.: J. Soc. Plasma, Fusion **87** (2011) 359. (in Japanese)

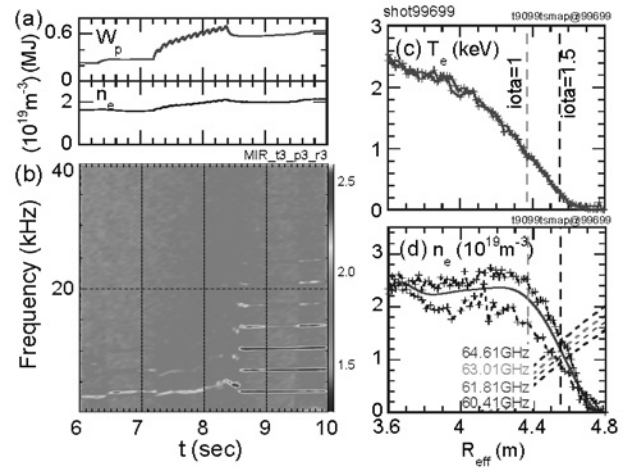


Fig. 1. (a) Time evolution of internal plasma energy, line averaged electron density. (b) FFT spectrum of MIR signal. Profiles of (c)  $T_e$  and (d)  $n_e$  at  $t=9.1$  s.

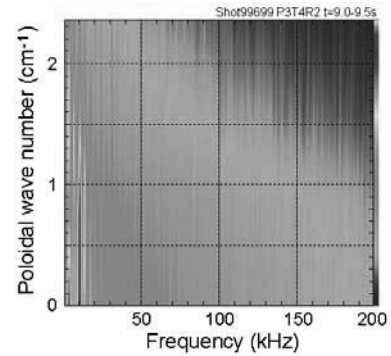


Fig. 2. Power spectrum in frequency and wavenumber.

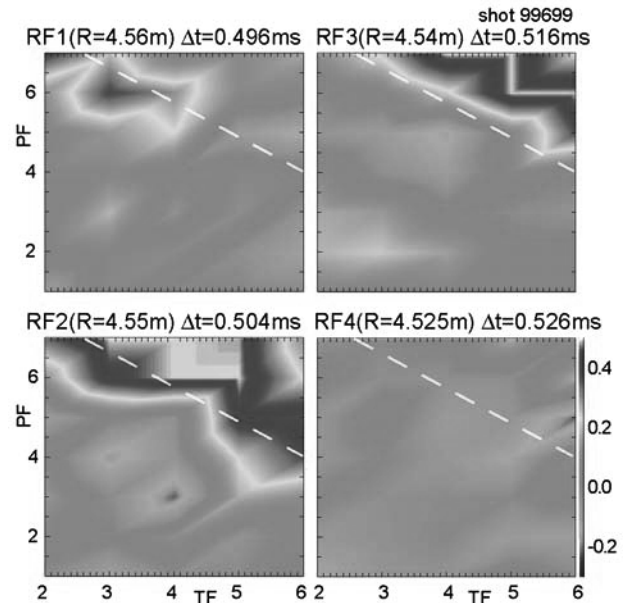


Fig.3 2D MIR images of narrow structure associated with EHO on four reflection layers. Here white broken line indicates direction of magnetic field lines, and  $\Delta t = t - 9100$ .