§44. Fluctuation Measurements by Using Microwave Reflectometer

Tokuzawa, T., Kawahata, K., Inagaki, S., Tamura, N.

For fluctuation measurement in the core plasma we have been developing three channel heterodyne fixed frequency reflectometer. This system uses a conventional reflectometer technique and is easy to operate routinely. By using the extraordinary polarized wave, we can measure the corresponding value to the combined fluctuation with the electron density and the magnetic field in the plasma core region even if the radial electron density profile is flat.

The schematic of three channel heterodyne reflectometer system is shown in Fig. 1. Three Gunn oscillators with fixed frequencies of 78, 72, 65 GHz are used as sources. Power combined microwaves are traveling to/from the LHD by using a corrugated waveguide for avoiding the transmission loss. In this frequency range some gyrotrons are used for ECRH. To reduce the effect that the gyrotron power affects our reflectometer system, Notch filter which the center frequency is 83.35 GHz and band width is 5.0 GHz is used. For the receiver system the super heterodyne detection technique is used.

One purpose of this reflectometeric measurement is core localized fluctuation observation. Figure 2 shows the power spectrum of the reflectometer signal of 78 GHz. The fluctuation appears with the frequency of ~ 1 kHz and its doubler. This fluctation is identified the m/n=2/1 mode by the magnetic probe analysis. The fluctuation of m/n=2/1 mode is expected to excite in the region where the iota is around 0.5. This fluctuation is observed in the area where $\rho < 0.8$. In this way the reflectometric direct core plasma measurement is utilized to understand the configuration of the fluctuation. Another example of the fast phenomenon in the plasma is shown in Fig. 3. In this shot at $t = t_0$ TESPEL [1] injects into the plasma. Just after TESPEL injection, the electron temperature in the core region rises rapidly in response to the edge cooling. This phenomenon can not be interpreted by the conventional transport theory and has not been identified now. At that time in the core region the reduction of the reflectometer signal power is observed. This rapid reduction might trigger the change of the transport. On the other hand in the edge region the decrease is not clear and also low frequency oscillation starts slightly late. The reduction of the reflectometer signal is not caused by the refractive effect in passing. Therefore understanding more detail of this interesting phenomenon, we need to upgrade the reflectometer system and compare with other diagnostics.

Reference
[1] S. Sudo *et al.*, Plasma Phys. Control. Fusion **45**, A425 (2003)

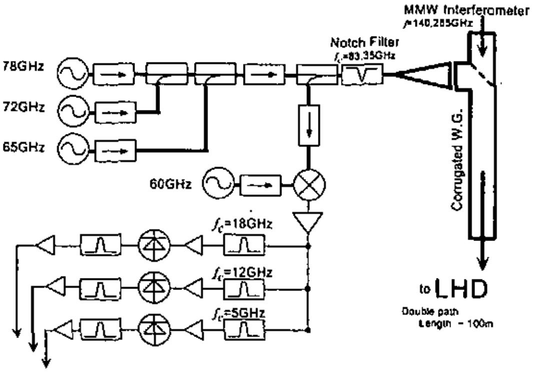

Fig. 1. Schematic of three channel fixed frequency CW heterodyne reflectometer

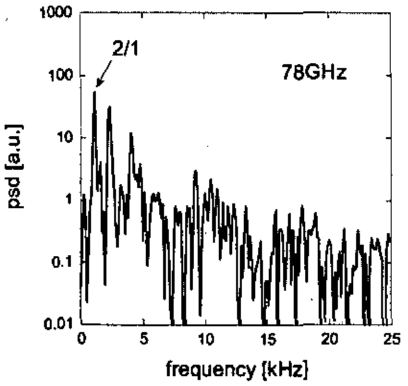

Fig. 2. Power spectrum density of 78GHz reflectometer signal. The cut-off layer of this frequency is located around ρ=0.6.

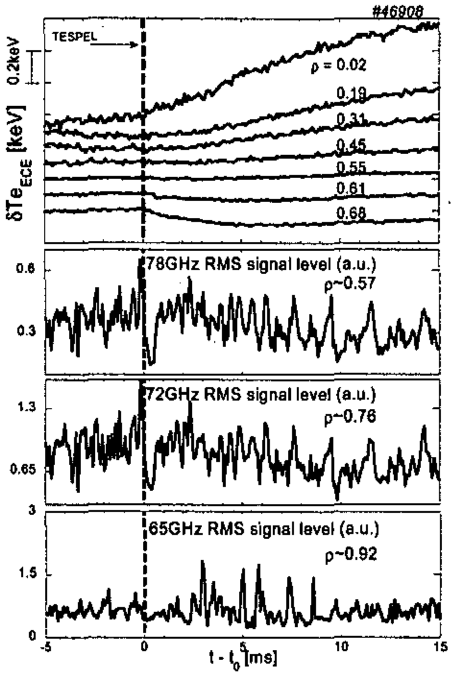

Fig. 3. Temporal behaviour of the difference of the electron temperature and each reflectometer signal power