

§6. Microwave Reflectometer for NBI Interlock System on LHD

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A microwave reflectometer was designed for the interlock system to prevent the wall damage caused by the injection of neutral beam into low density plasma on LHD. When the electron density is higher than the cut off density of the incident microwave, it is reflected, and modulated in amplitude and phase by the electron density fluctuation on the cut off layer. On the other hand, when the electron density is lower than the cut off density, the incident microwave is reflected by the inner wall, but, its modulation is very small. Therefore, the modulated signal of the reflected microwave is a clear indicator of the cut off density and can be used as a source signal of the interlock.

The proof-of-principle experiments were done on CHS. Figures.1 show temporal evolutions of line density, the position of O mode cut off layer and root mean square (RMS) value of the amplitude of reflected signal. The RMS signals are components, which frequency is higher than 50 kHz. These are obtained from the plasmas, which were preionized by Ion Bernstein wave and further heated by Neutral Beam Injection (NBI). As shown in fig.1 (b) and (c), when the cut off layer appear in plasma, the RMS of reflected signals appear almost simultaneously. These RMS signals are clear indication of existence of the cut off layer.

For LHD, three channel system is designed (fig.2). The frequencies are 28.5GHz, 34.9GHz and 40.2GHz, and they are injected with O mode, therefore, corresponding cut off densities are $1 \times 10^{19} \text{m}^{-3}$, $1.5 \times 10^{19} \text{m}^{-3}$ and $2.0 \times 10^{19} \text{m}^{-3}$. Since these microwaves are injected simultaneously, qualitative measurements of radial correlation length of electron density fluctuations are also possible by using this system.

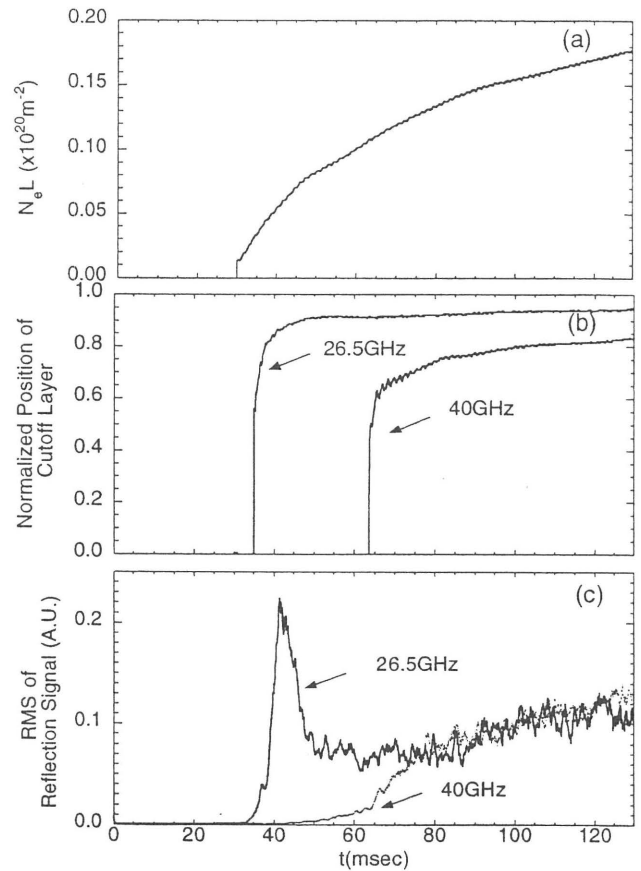


Fig.1 Temporal evolutions of (a) line density, (b) the position of the O mode cut off layer and (c) RMS value of the amplitude of reflected signal. Figure 1 (b) is obtained by the Abel inversion using the data of the multi channel interferometer.

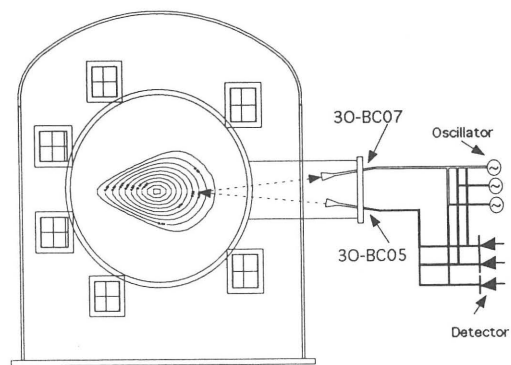


Fig. 2 The planned system of NBI interlock reflectometer on LHD