§44. The Effect of Static Island on Density Profile Measurements Using Pulsed Radar Reflectometer

Tokuzawa, T., Kawahata, K.

Pulsed radar reflectometry measures the delay time of the pulsed microwave penetrating in the plasma. Because different frequency microwaves reflect at the corresponding cutoff layers, it can measure the density profile and the density fluctuation simultaneously. Using the extra-ordinary (X-) mode right-hand cutoff, reflectometer signal is affected by not only the electron density but also the magnetic field.

LHD has usually the m/n=1/1 static island in the edge region. In the static island the radial profile of the electron temperature is sometime flat, but the profile of the electron density is not clearly flat because the conventional diagnostics do not have sufficient spatial resolution.

Neutral beam start-up plasma is usually initiated in the core region then the plasma expands to the edge. Therefore the cutoff layer moves from core to edge. When microwave pulses with X-mode polarization launch the plasma on the operation that the magnetic axis is 3.75m and the magnetic field strength is 1.52T, the initial critical layer of the right-hand cutoff frequency of 39 GHz is located at R=4.0m and that of 33GHz is located at R=4.25m, where R is the major radius shown in Fig.1(b). Figure 1(a) shows the time evolutions of the averaged density. In the case of low density (Fig.1(c) and (f)) the measured delay time of reflected microwave pulse does not be seen strange behavior. In the middle and high density case the large time delay appears and also the reflect layer jumps to the edge region in the hatch region in figure. Especially in the middle density case the delay time keeps a large value until 2.2s (Fig. 1(g)).

These experimental results are probably explained below. In Figure 1(b) the hatch region is the estimated position of the static island. When the cutoff layer locates in the core region, the reflected pulse is not affected strongly by the island. However if the cutoff position is just in the island and the density gradient is small in this region, the group velocity of the microwave becomes slow and the delay time becomes large. Just after the electron density grows up and the cutoff layer moves to outside the island region, the delay time jumps.

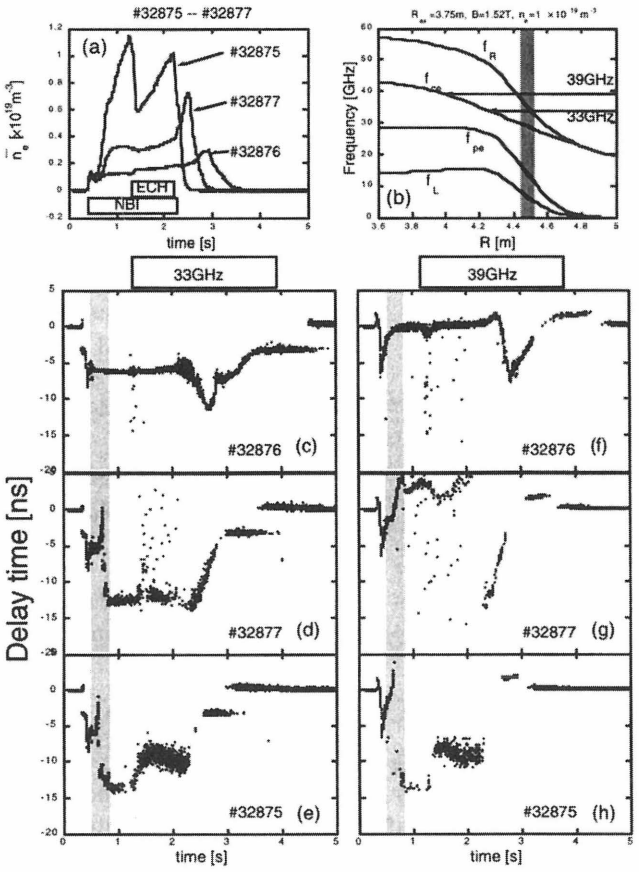

Fig. 1(a). The time evolution of the averaged electron density measured by FIR interferometer in three operations of low (#32876), middle (#32877), and high (#32875) density. (b) Radial profiles of characteristic frequencies assuming density profile. The estimated static island locates in the hatch region. The time evolution of the delay time of 33GHz (c-e) and 39GHz (f-h) pulsed microwave. The reflection from the opposite wall is used the standard point (which the delay time is zero). Negative value means that the cutoff layer moves to the edge.