§15. Edge Plasma Density Profiles in the L-H Transition

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The simultaneous measurement of radial profiles of the electron density and its fluctuations was performed in CHS with a thermal neutral lithium beam probe (LIBP) to investigate edge plasma behavior in the L-H transition. The beam probe is useful for transition measurement, because it can obtain the time evolution of edge density profile in one shot.

The experiment was carried out on deuterium plasmas, heated by co-injected neutral beams (NBI). A small ohmic heating (OH-) current was induced to increase the external rotational transform[1].

Figure 1 shows the beam signals at z =12.0 cm and 13.3 cm. Here, z is the distance between a measuring point and the equatorial plane along the lithium beam. The last closed flux surface (LCFS) is considered to be located between these two measuring points. In this region, the beam signal represents the local electron density itself, since the attenuation of the lithium beam is negligible. In the deuterium plasmas, the very clear change of the density profile is observed in the L-H transition, as shown in Fig.1. The electron density at z = 13.3 cm outside the LCFS decreases at t = 96.5 msec, while that at z = 12.0 cm inside the LCFS increases. The transition occurs within 0.2 msec. The H_α signal is also found to reduce in the transition. Figure 2 shows the time evolution of radial profiles of the electron density. The density profiles were reconstructed using the 10 channel signals. It is clear that the electron density decreases in the region z > 12.5 cm and the density gradient becomes steep after the transition. This suggests the formation of the transport barrier, that is, the reduction of particle flux across the magnetic field. In this shot, the H-mode plasma goes back to the L-mode plasma at t = 98.5 msec, and is reestablished stably within a few msec from the L-mode, as shown in Fig.1 and 2. The H_α signal shows the same behavior as the beam signal. This phenomena is very similar to the "dithering transition" observed in tokamaks.

Now we study the relationship between L-H transition and density fluctuations.

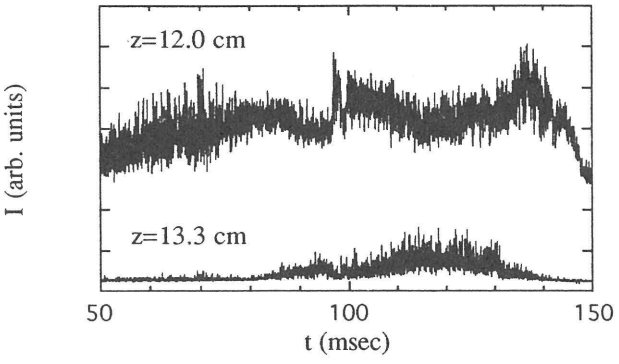

Fig.1 Beam probe signals at z=12.0 cm and 13.3 cm. The L-H transition occurred at t = 96.5 msec.

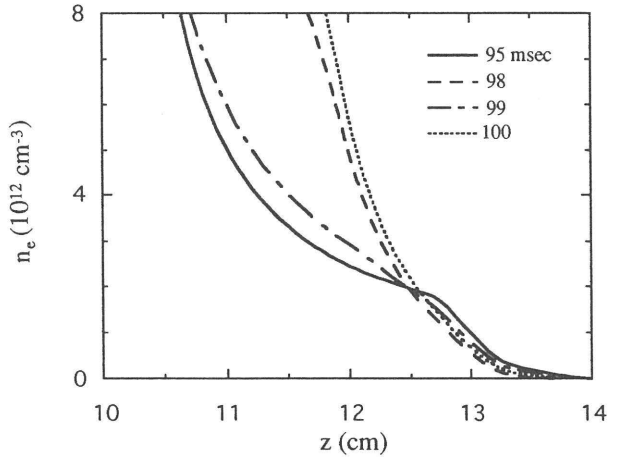

Fig.2 Time evolution of radial electron density profiles in the transition. The profiles at 95 msec and 99 msec are obtained in the L-mode and those at 98 msec and 100 msec are in the H-mode, respectively.

References

1) Toi, K., et al., in Plasma Physics and Controlled Nuclear Fusion Research 1994 (Proc. 15th Int.Conf. Seville, 1994), IAEA-CN-60/A6/C-P-3.