

## §5. Edge Density Profile Measurement of ETB Plasma by Lithium Beam Probe

Nakamura, K., Iguchi, H., Narihiro, Z. (Nagoya Univ.)

In CHS, H-mode is found first for the plasma with co-direction ohmic current in 1993. It was also found about the same time in Wendelstain 7-AS. These are the first observations of H-mode in stellarator type devices and are recognized as a start point of the studies of various improved confinement modes in stellarators. Recently in LHD, H-mode discharge is also found in the low magnetic field. The main topic of the improved confinement study in CHS is the neoclassical internal transport barrier (N-ITB) which is a unique feature of stellarator type devices. The edge transport barrier (ETB) is the next topic for the total confinement improvement. The ETB for the particle transport is found recently in the NBI heated plasmas. This ETB is characterized by the clear drop of  $H\alpha$  emissions and the appearance of the back transition when the heating power decrease below the power threshold. No ohmic current drive is necessary. Its transition and back transition are controlled by the heating power [1].

Edge electron density profiles are measured in the discharges with the ETB formation by a neutral lithium beam probe (LiBP). Figure 1 shows the discharge scenario. ECH is applied from  $t = 20$  ms to 50 ms to produce plasma. Then NBI#1 is injected into the ECH target plasma from  $t = 32$  ms to 132 ms and the secondary NBI#2 is added from  $t = 72$  ms to 102 ms. The  $H\alpha$  emission signal drops several ms after the NBI#2 injection. The increase of the edge density at the transition is confirmed by means of YAG laser Thomson scattering, indicating the formation of ETB similar to the standard H-mode discharges.

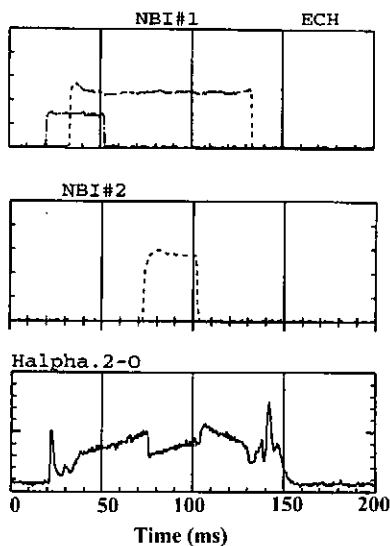


Fig. 1 Traces of plasma heating scenario and  $H\alpha$  emission signal.

Figure 2 shows the emission intensity profiles along the neutral lithium beam. It shows clearly that emission intensity profiles shift outward during the ETB formation.

Figure 3 shows the electron density profiles before ( $t = 70$  ms) and after the transition ( $t = 80$  ms) as a function of the average minor radius  $\rho$ . The electron densities are reconstructed from the emission profiles. It is shown that density profiles become steep during the ETB formation just inside the LCFS. The characteristic scale length of the electron density gradient at the LCFS is reduced to 80 % of the original one.

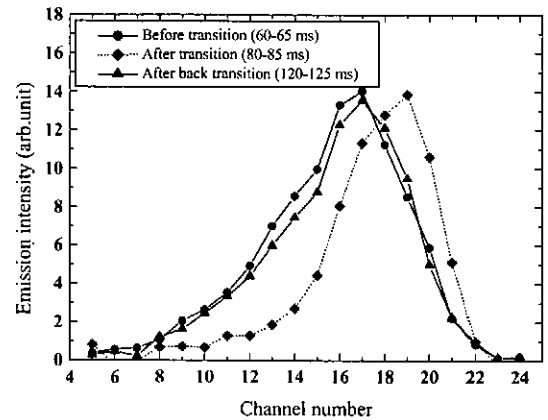


Fig.2 Emission intensity profiles along the lithium beam. The position of LCFS is around channel No.20.

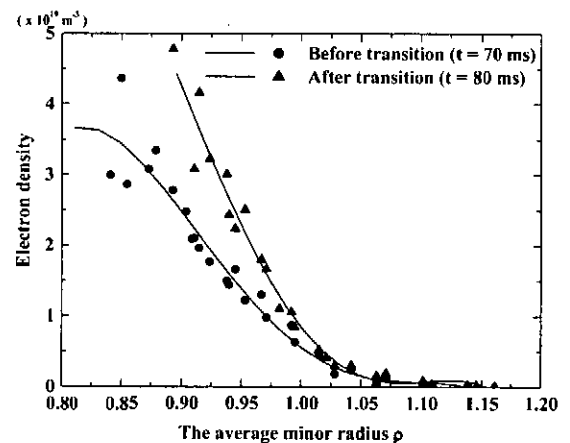


Fig. 3 The density profiles before and after transition.

### Reference

- 1) S. Okamura et.al, J. Plasma Fusion Res. 79 (2003) 977