§45. H-Mode-Like Discharge under the Presence of 1/1 Rational Surface at Ergodic Layer in LHD

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In LHD an H-mode-like discharge was found in high- plasmas (2%) with a low magnetic field (B_t<0.75T) at R_{ax}=3.60m (/2 (a)=1.56)[1]. The growth of m/n=2/3 modes appeared at the edge barrier region with the saturation of plasma performance. Recently, an H-mode-like discharge has been newly obtained in a full B_t field (B_t=2.5T) by shifting the R_{ax} outwardly (R_{ax}=4.00m)[2].

One of edge plasma features in LHD is characterized by the existence of m/n=1/1 rational surface which is located at =0.88 (in vacuum) in a standard configuration of R_{ax}=3.60m. The radial position of the 1/1 surface can be moved by shifting the R_{ax}. Figure 1 shows edge /2 profiles at a horizontally elongated position in R_{ax}=3.90, 4.00 and 4.10m. The positions of the 1/1 surface in R_{ax}=3.90 and 4.00m are located near the LCFS and outside of ergodic layer, respectively. No 1/1 surface exists substantially in R_{ax}=4.10m.

The H-mode-like transition was found in R_{ax}=4.00m by changing the NBI input power while maintaining a relatively high density. No transition was obtained in R_{ax}=3.90 and 4.10m. This result strongly suggests the importance of the 1/1 surface at the plasma edge for the H-mode-like discharge.

A typical waveform is shown in Fig.2. One of three NBIs is turned off at t=1.25s. After turning off the beam line, the H signal quickly drops in intensity and the density gradually rises, showing a clear turning point. ELM-like bursts appear in the H signal. Similar bursts are also observed in an electrostatic probe on the divertor plate and a magnetic probe. Enlarged signals are traced in Fig.3. Reduction of the magnetic fluctuation is seen after the H-mode-like transition.

This H-mode-like phase disappears after turning off the second NBI at t=2.1s. A narrow window exists in the NBI power. When the P_{NBI} is increased from one beam to two beams, the plasma behaves as in Fig.2. In addition, the H-mode-like phase cannot be obtained in low- and high-density ranges, appearing only in a density range of 4-8x10^{13}cm^{-3}. This fact indicates that this phenomenon is very sensitive to edge plasma parameters of density and temperature in relation to the /2 (a).

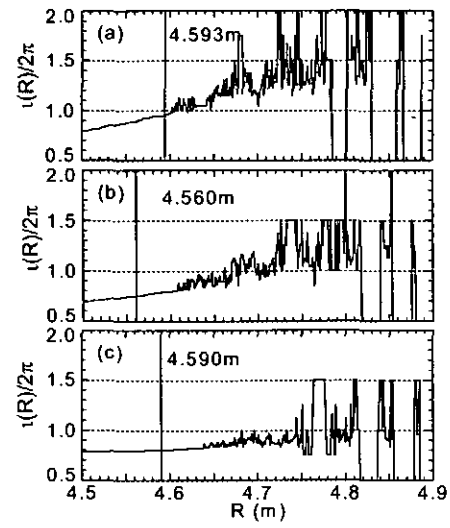

Fig.1 Rotational transform in (a) R_{ax}=3.90m, (b) 4.00m and (c) 4.10m. Solid lines show LCFS position.

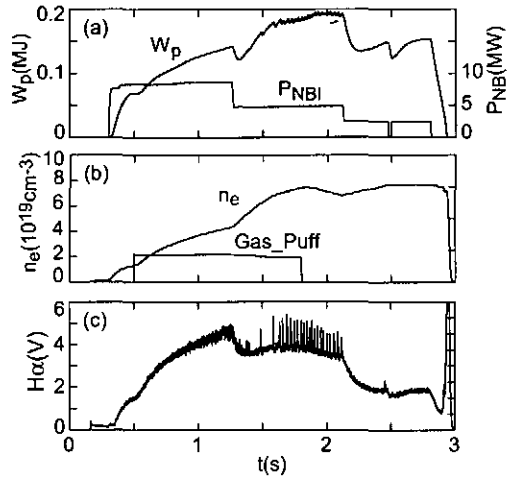

Fig.2 H-mode-like discharge obtained in R_{ax}=4.00m configuration; (a) plasma stored energy and NB power, (b) density and (c) H signal.

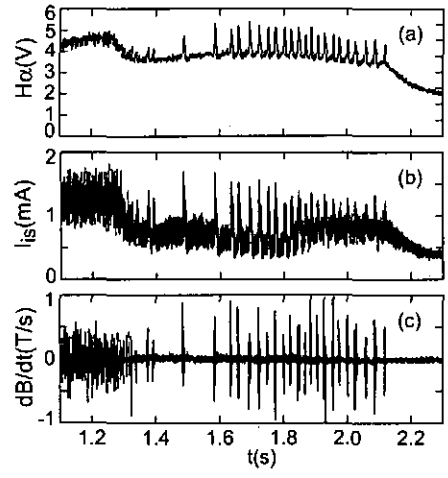

Fig.3 Enlarged signals of discharge shown in Fig.1; (a) H, (b) divertor ion saturation current and (c) magnetic fluctuation.

References

1) K.Toi *et al.*, Nucl. Fusion **44**, 217 (2004).

2) S.Morita et al., J.Plasma Fusion Res. **80** (2004) 279.