§13. Temporal Behaviors of Potential and Fluctuation at L/H Transition on JFT-2M

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Radial electric field (E_r) is related to the formation of a transport barrier. The most credible theory [1] predicts that the gradient of E_r (dE_r/dr) reduces the anomalous radial transport caused by turbulence. One of ways to verify the model is to clarify the causality among the formation of E_r, the suppression of density(n_e) fluctuation and the formation of the transport barrier. Therefore, the temporal behaviors of the potential and ne and/or temperature(T_e) fluctuation at L/H transition are measured with a heavy ion beam probe(HIBP) in the JFT-2M plasmas.

Figure 1 show the temporal behaviors in a typical shot. In this case, the potential decreases step by step with sawteeth crashes from 731 ms. Although the chord integrated SX intensities from plasma edge and core(Fig. 1 (a)) increase, D_α (Fig. 1 (c)) intensity and the SX intensity from the scrape off layer (SOL)(Fig. 1 (b)) decrease step by step. They indicate the confinement is improved step by step with sawteeth crashes accompanied with the decrease of the potential. However, the bursting fluctuation appears with the repetition frequency of 2-4 kHz. It suggests the transport barrier is not firm and its formation and collapse repeat. After the sawtooth crash at 751.8 ms, the burst disappears and the potential, D_α and SOL SX intensities start to decrease slowly. It is interesting that the potential drops spontaneously and the n_e and/or T_e fluctuation is suppressed at 754 ms. D_α and SOL SX intensities and the secondary beam intensity, which reflects n_e and/or T_e in SOL, also drop quickly with the similar time scale at same time. It suggests that the change of the potential, density and temperature, and the suppression of the fluctuation closely connected. It does not contradict the theoretical model referred above.

Figure 2 shows the change of E_r and dE_r/dr profiles in a similar shot. The profiles closely correlate with the improvement of the confinement. Assuming that dE_r/dr is the key to formation of the transport barrier and a criterion exists, the criterion is $dE_r/dr > (1.2 \pm 0.4) \times 10^3$ kV/m^2. In period [C] which corresponds to the period from 731 ms to 751.8 ms in Fig. 1, the region where the dEr/dr profile exceeds the criterion is narrow. It may be a reason why the improvement of the confinement is not sufficient.

The experimental results does not show a clear causality among the formation of E_r, the suppression of n_e fluctuation and formation of transport barrier, but they can be explained with the theoretical model proposed in ref.[1] qualitatively.

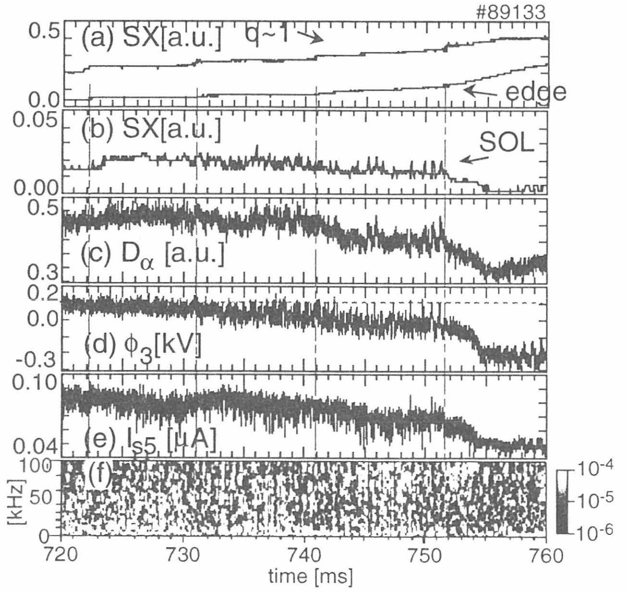

Fig. 1 Temporal behaviors of potential and n_e/T_e fluctuation at L/H transition.The vertical lines indicate sawteeth crashes. (a) SX intensities from core and edge, (b)SX intensity from SOL, (c) Dα intensity, (d) Potential (ds = -0.4 cm, where ds means the distance from the separatrix and the negetive sign indicates the inside of the separatrix.). The dotted line indicates the L-mode level. (e) Secondary beam intensity (ds = +0.1 cm), (f) Power of the fluctuation of secondary beam intensity of (e).

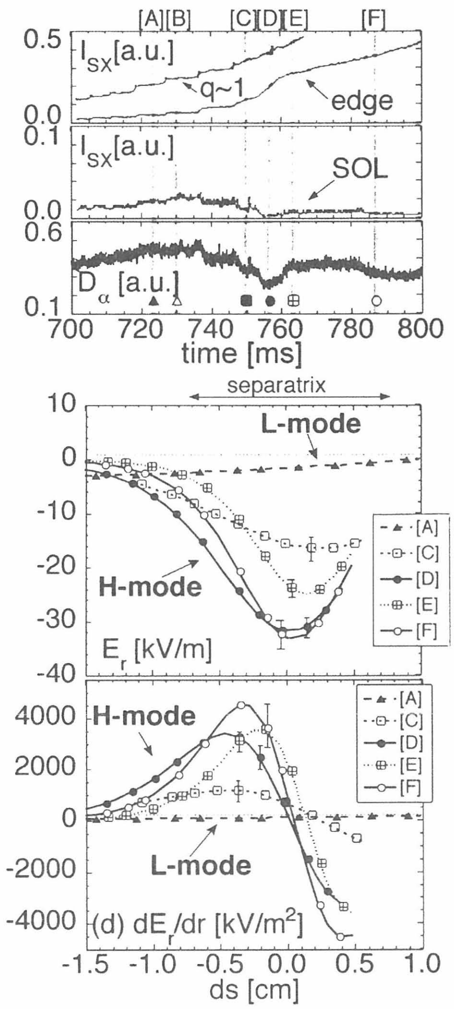

Fig. 2 (a) Line integrated SX intensities from core (q~1), edge, and SOL, and Dα intensities. The hatched periods of [A] - [G] show the timing of the profile measurement. (b) Radial electric field (E_r) profiles. (c) Gradient of the E_r .

REFERENCE

[1]Bigrali, H., et al, Phys. Fluids B 2, 1(1990)