§5. Bursty Behavior during the Detachment in the LHD Plasma with a Perturbation Field Applied

Akiyama, T., Tanaka, H., Kobayashi, M.,
Masuzaki, S., Tamura, N.,
Ohno, N. (Nagoya Univ.)

Considering future fusion reactors, the heat load to a divertor have to be mitigated. One of the ideas to do this is a dissipation of the heat flux to the divertor as a radiation at an edge plasma and stabilization of the radiation region is an important issue. Formation of magnetic island outside the last closed magnetic surface can stabilize the radiation region at the X-point [1]. During the radiation enhancement, particle expelling is observed and its characteristics are studied.

Figure 1 shows intermittent signals in the line density along edge (R=3.309 m) and central (R=3.669 m) chords of the far-infrared interferometer, the ion saturation current of the divertor Langmuir probe, a signal of a Mirnov coil, AXUVD and line densities of a CO_2 laser interferometer. During the phase named "①", the magnetic fluctuations is quite small and the line integrated density along the edge and central chord of the far-infrared interferometer decreases and increases, respectively. The temporal evolution of the ion saturation current is almost the same as that of the edge density chord. Due to reduction of the edge density, the radiation from the edge region decreases. As shown with the CO_2 laser interferometer, whose measurement plane is close to that of the far-infrared interferometer, the edge density gradient becomes steeper during this phase. From the density profile measured with a Thomson scattering measurement, the density gradient is also found to be steeper during this phase at the edge stochastic region outside the LCFS. However, the magnetic fluctuation suddenly appears when the edge density gradient reaches to the certain value. Then, the density is expelled to the outside and the density gradient becomes moderate during the phase "②". Since the edge density recovers, the edge radiation also recovers. During this phase, the edge density deceases and finally the magnetic fluctuations disappear. Then the plasma enter the phase ① again and this cycle is repeated. In this way, the intermittency seems to be preferable for radiation enhancement: it prevent the edge density becomes small and to maintain the edge radiation enhanced.

Figure 2 shows the results of mode analyses of the radiation enhanced discharge. After onset of the radiation enhancement at t = 5 s, instability of m/n=2/3 becomes dominant. Due to island formation formation of m/n=1/1, the pressure gradient outside the island where the $\iota/2\pi$ = 1.5 surface locates would increased and the mode would be excied. Since the instability is observed at the high field side with the multi-channel interferometer, it does not seem that the instabilities are the ballooning mode. The MHD mode is expected to be interchange.

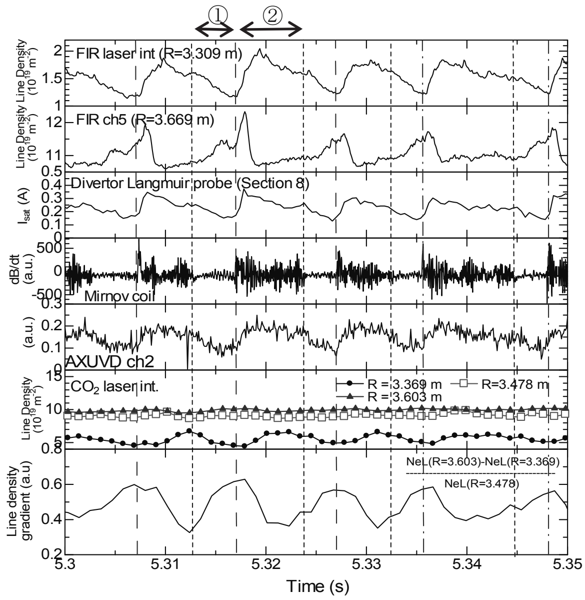

Fig. 1: The line integrated densities, the ion saturation current, dB/dt, AXUVD signal (radiation) and the line density gradient during bursty behabiour after radiation enhancement.

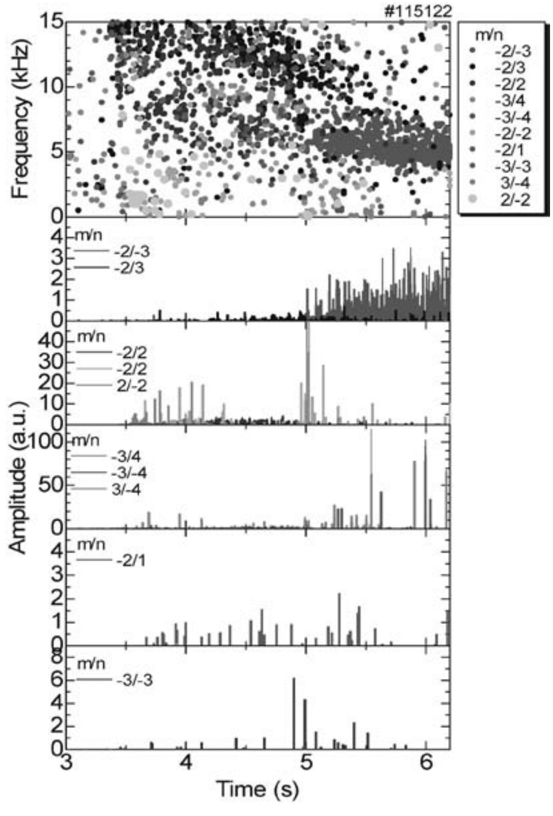

Fig.2 : Mode analyses of radiation enhanced discharge. Onset of the radiation enhancement is t = 5 s.

1) Kobayashi, M et. al.: Phys. Plasmas **17**, 056111 (2010).