§7. MHD Bursts Observed in a Detached Plasma Sustained by the *m/n* = 1/1 RMP Field in LHD

Ming, T.F., Ohdachi, S., Suzuki, Y., Akiyama, T., Kobayashi, M.

Operation with a detached plasma supplies a positive option for reducing the peak heat load and particle flux to divertor plates to a tolerated value below the engineering limit. However, it is difficult to maintain a steady state detached plasma since the mechanism of plasma detachment is complex and the control of the radiation position is difficult. In LHD, the steady-state detachment can be sustained by the $m/n = 1/1$ RMP island due to its stabilizing effect on the radiation region[1]. Fig.1 shows the plasma waveform in a discharge with steady-state detachment.

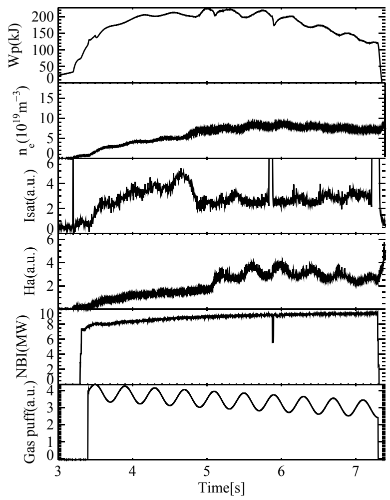

Fig. 1: Plasma waveform of a steady-state detached plasma.

The detachment occurs at about 4.88s. However, ELM-like bursty behavior is observed after it enters the detached phase. Particle flux incident onto the divertor plate is enhanced during each bursty cycle. And about 1% degradation on plasma stored energy is also observed. In the low heat loading case, it is benefit to the ejection of impurity particles. As the heat loading increases, potential risk of the erosion on the divertor plate may exist. Therefore, attention should be paid to this phenomena.

Different edge density behaviors appear in the initially and later detached phases, as shown in Fig.2. (Here, the 'initially' and 'latter' are employed to denote the periods from about 4.88s to 5.03s and after 5.03s, respectively). As the detachment enters the later phase, a rapid increase on the H_α signal is observed due to the increase of density. In each bursty cycle, three phases exist. In the initially detached phase, the $m/n = 2/3$ mode is excited, while in the later phase, both the $m/n = 2/3$ and 2/1 modes coexist. As the excitation of the $m/n = 2/1$ mode, the plasma has been affected globally. And these results are qualitatively consistent with that observed by the tangentially viewing VUV imaging system, as shown in Fig.3. By comparing the experimental measured images and synthetic images with plausible assumed profiles, it can be concluded that the first fluctuating component U1 in the initially and later detached phases are due to the modification on the emission profiles at the edge($\rho \sim 1.2$) and core region($\rho \sim 0.7$), respectively. Detailed analysis is needed to understand the mechanism on the excitation of such MHD instability in a detached plasma.

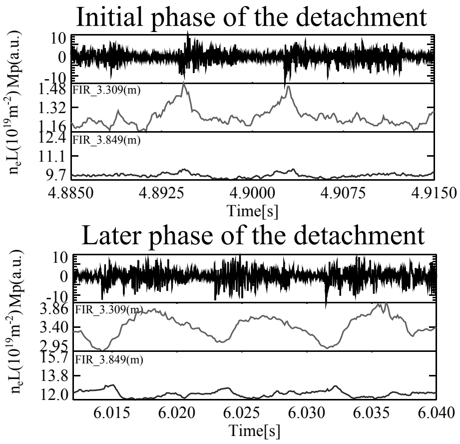

Fig. 2: Different edge density behaviors in the initially and later detached phase, respectively.

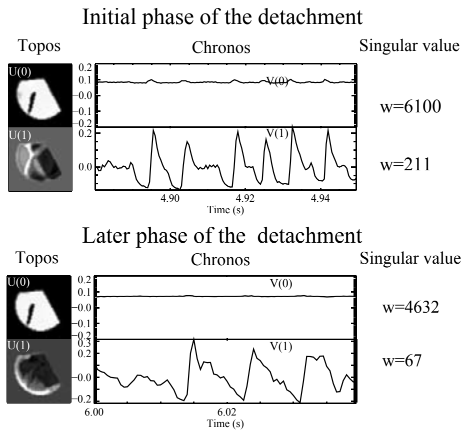

Fig. 3: The first two components of the Topos and Chronos of the imaging data measured during the initially and later detached phases, respectively

1) M. Kobayashi et al, "Control of 3D edge radiation structure with resonant magnetic perturbation fields applied to the stochastic layer and stabilization of radiative divertor plasma in LHD ", Nuclear Fusion 53 (2013) 093032.