§13. Effect of the RMP on the ELM-like Activities Observed in the High-beta H-mode

Ohdachi, S., Sakakibara, S.

Formation of the edge transport barrier is the key to achieve high confinement plasma in Tokamak plasmas. H-mode transition in the Large Helical Device (LHD) was also realized in relatively low beta condition, beta up to 2.5%, with the vacuum magnetic location Rax = 3.6m~3.9m [1]. In the last experimental campaign, operational regime in more inward shifted configurations, e.g., Rax = 3.56m and gamma = 1.254, is investigated, H-mode transition with higher beta = 3.0% (1T) ~3.5% (0.75T) was clearly observed in this regime and this transition is necessary to achieve plasmas with good confinement. With the transition, the rapid increase in the electron density is observed in the very peripheral region. That region is definitely outside the plasma boundary or the last closed flux surface of the vacuum magnetic field. After the transition, strong ELM-like edge MHD instabilities localized in the magnetic stochastic layer are activated from the increase of the pressure gradient, as shown in Fig. 1. The increase of the stored energy is limited by this excitation of the edge MHD instabilities. Coherence between the magnetic fluctuations (m/n = 3/4 (~6kHz), 2/3 (~4kHz), 1/2 (~2kHz)) and the fluctuating component of the ion saturation currents measured at the divertor plate also suggests that the ELM-like activities are responsible for enhancing the transport in the peripheral region. Application of the m/n = 1/1 RMP field is performed for controlling the ELM-like activities. In the low beta experiments, it was found to be quite effective to the bursting instabilities observed in the magnetic stochastic region[2]. While the interval between the burst becomes longer, the peak value of the each burst is reduced. These two effects reduce the averaged amplitude of the MHD activities localized in the magnetic stochastic layer. However, in the high-beta H-mode plasma cases, this effect on the amplitude of the MHD activities is not clearly seen. A reduction of the fluctuating component of the particle flux onto the divertor is observed (fig. 2). When the applied RMP field is large so that m/n = 1/1 island is formed, the H-mode cannot be achieved. Detailed change in the magnetic instabilities will be investigated further.

1) Toi K. , et. al., Fusion Sci. Tech., **58** (2010), 61
2) Ohdachi, S. et. al., "Pressure Driven MHD Instabilities in Intrinsic and Externally Enhanced Magnetic Stochastic Region of LHD", in Proc. 25th IAEA Fusion Energy Conference, 13-18 Oct. 2015, St. Petersburg, EX/P6-29

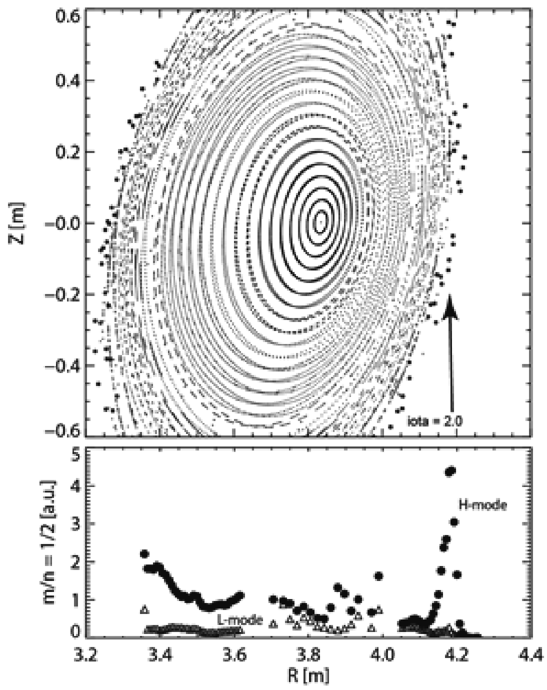

Fig. 1: Poincare map of the magnetic field estimated by HINT2 and the fluctuation amplitude of the m/n = 1/2 MHD instabilities measured by the CO2 laser imaging interferometer.

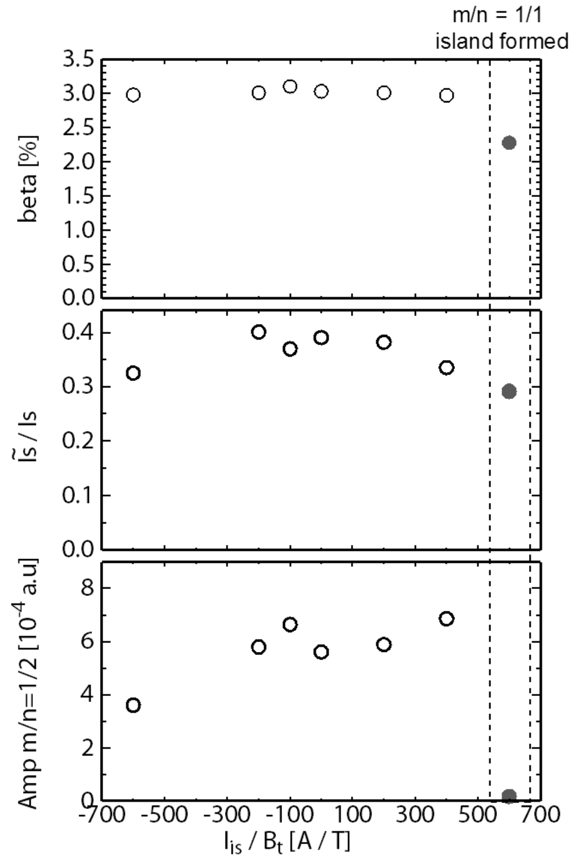

Fig. 2 Change of the averaged beta, fluctuating component of the ion saturation current measured on the divertor and the m/n = 1/2 mode amplitude.