Study on the mode structure of the low-n MHD instabilities observed in LHD

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An understanding of characteristics of pressure driven magneto-hydrodynamic (MHD) instabilities is a major concern for high-beta plasma production in heliotron configuration. The steady-state sustainment of the high-beta plasma with <β>~5% has been successfully achieved in the Large Helical Device. Where there is no disruptive instability terminating plasma, several low-n MHD modes excited in periphery with magnetic hill has been observed and sometimes lead to local flattening of the pressure profile around their resonant surfaces. Therefore, the quantitative estimation of the effects of the low-n modes on the profiles is required in order to realize higher-beta plasma. In this paper, we have investigated the characteristics of their modes by using internal and external measurements. Figure 1 shows the relationship between the width Δ of m/n = 1/1 mode identified by soft X-ray measurements and the amplitude of the mode measured with magnetic probe, where a_p is minor plasma radius. The solid line is the island width predicted by external field perturbation, which is square root of the amplitude of the mode. The obtained data seems to be close to the prediction. The previous results indicate that the amplitude of the m/n = 1/1 mode has clear dependence of the magnetic Reynolds number, S [1]. The relation $\tilde{b}_{11} \propto S^{-2/3}$ is consistent with that of linear growth rate of the resistive interchange mode. If this mode forms the magnetic island, the width is predicted as $\Delta \propto \tilde{b}_{11}^{-1/2}$, and the effect on the spatial structure is estimated as $\Delta \propto S^{-1/3}$. In order to clarify it, it is necessity to identify mode width in broader range of magnetic fluctuation level than that in Fig.1. Furthermore, the spatial resolution of the mode width by the SX measurement might have an error because SX signal corresponds to the integrated one on a sight line. In order to clarify the identification accuracy of the mode width, we will try to evaluate the mode width based on the local measurement like ECE. These are our important future subjects.

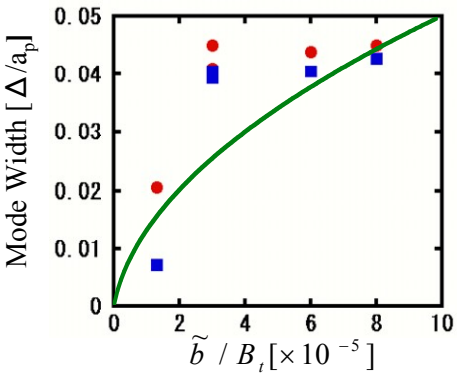

Figure 1. the dependence of normalized mode width of instability on magnetic fluctuation level

[1] S. Sakakibara et al., Plasma Phys. Control. Fusion 50 (2008) 124014.