§53. Observation of the Interchange-like Mode Structure Using ECE

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Some magnetohydrodynamic (MHD) modes, including the interchange-type instability, excited in the edge region of a torus plasma is often enhanced in the high-beta regime [1]. In Large Helical Device (LHD), it is not considered that they lead to disruptive discharge termination. Nevertheless, the instability must have the relation with the decision mechanism of the achieved high beta values. When the operation for oriented high beta discharge, it is important issue to obtain the basic information of MHD instability, i.e. amplitude, structure, to control the MHD mode. Particularly, the location of the fluctuation has been identified by electron cyclotron emission measurement (ECE) [2], which is easy to identify the measurement point. In this paper, the relation between the mode width and enhanced location are reported.

The experiment is conducted in the condition of $R_{\mathrm{ax}} = 3.75$ m, $B_{\mathrm{ax}} = 1.5$ T. In a discharge heated by tangential neutral beam injection (NBI), the interchange mode-like instabilities were observed as soft-Xray emission fluctuation, magnetic fluctuation and electron temperature fluctuation, whose frequency is around 1.7kHz. The order of the mode is estimated as m/n = 1/1. Figure 1(a) is the development of displacement amplitude (ξ) profile calculated from the electron temperature fluctuation. The location of fluctuation transits from $r_{\mathrm{eff}} \sim 0.34$ to $r_{\mathrm{eff}} \sim 0.23$ at $t = 3.87$s, where r_{eff} is effective miner radius. While the line integral density is gradually increasing, the pressure profile change from hollow to peaking profile. Fig. 1(b1-4) is pressure profile measured by Thomson scattering. At each time slice, the mode width can be analyzed as the half bandwidth of the Gaussian fitting of ξ profile. The location of MHD fluctuation is shown as the highlighted zone, which width is associated with the calculated mode width. Furthermore, it is interesting to note that the fluctuations do not always enhance at the negative pressure gradient area. In figure 2, the characteristics of the mode structure are summed up. The amplitude of fluctuation, position and width clearly change after changing the pressure profile, even though the fluctuation is in almost the same range. These facts indicate that the mechanism of instability would be different.

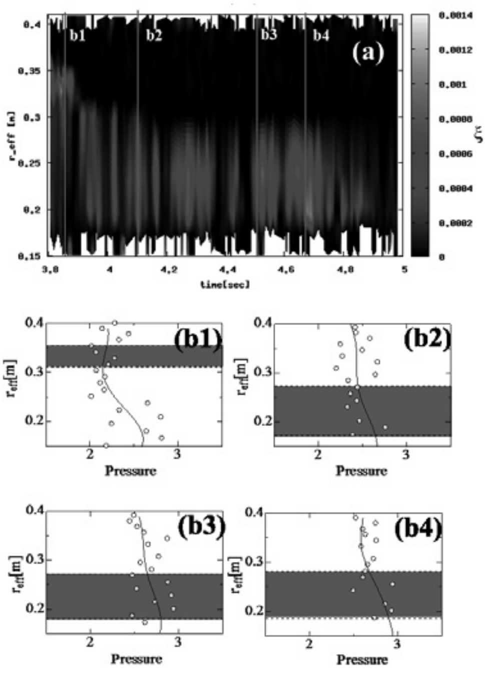

Fig. 1: (a)The ξ profile development calculated by electron temperature fluctuation. (b1-4) The pressure profile at the time slice shown as b1, b2, b3 and b4 in the upper figure. The circle points are the observational point, and the solid line is fitting curve. The highlighted zone in each figure is the mode width calculated from the ξ profile. The unit of horizontal axis is arbitrary.

1) K. Y. Watanabe, S. Masamune, Y. Takemura *et al.*, Phys. Plasmas **18**, 056119 (2011).

2) Tsuchiya, H. *et. al.*, Annual Report of NIFS April 2010-March 2011, p64

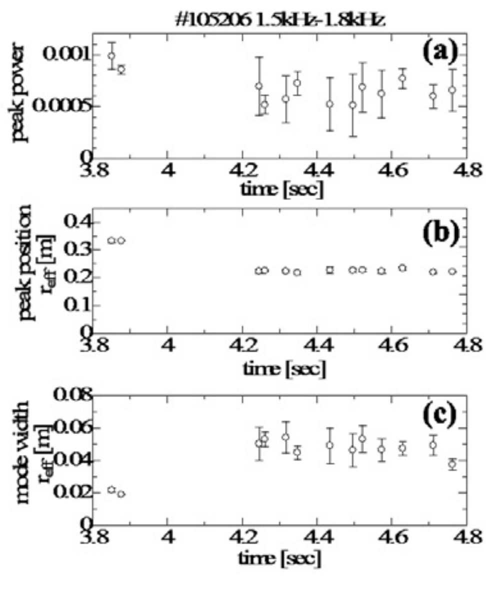

Fig. 2: The summary of the transition of the mode structure. (a) the peak power of the 1.5 - 1.8kHz electron temperature fluctuation. (b) the peak position. (c) the mode width calculated from the ξ profile.