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ヘリオトロンＪにおける高速イオン励起MHD不安定性発現時の周辺プラズマ応答
Edge Plasma Response to Fast-Ion Driven Instability in Heliotron J

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Fast-ion driven instabilities such as Alfvén Eigenmodes (AE) have been highlighted since these instabilities can cause loss of alpha particles and the resultant degradation of fusion plasma. Moreover, the possibilities of influence of these instabilities on the bulk plasma confinement have been indicated experimentally and theoretically. For instance, energetic particle driven MHD activity can be a trigger of internal transport barrier to produce negative magnetic central shear plasma and generate poloidal flow shear through redistribution process of energetic particles[1].

In this study, edge potential response synchronized with a fast-ion driven MHD fluctuation at ~ 60 kHz was discovered in a helical-axis heliotron device, Heliotron J [2]. Figures 1(a) and (b) show band-pass filtered signals of magnetic probe in the frequency range from 30-100 kHz and the floating potential from 0 to 8 kHz around last closed flux surface (LCFS). The periodic MHD bursts seen here were reproduced every ~ 1 ms accompanying rapid chirping up of the oscillation frequency. Clearly, slow potential variation synchronized with the burst events can be observed at ~ 1 kHz. This characteristic behavior is observed only when cyclic, intermittent MHD bursts appear. From the measurement of triple probe, this response does not appear in electron temperature, suggesting the response corresponds to the change of space potential. From the correlation measurement among different probes located at different sections, it was found that the potential changes symmetrically in toroidal and poloidal direction.

Typical structural change of potential around LCFS on each burst is shown in Figs. 2 (a) and (b), which is obtained by radial array probe. Basically, the floating potential deepens more negatively at the deeper location into the plasma. When the potential drop occurs, the potential become more negative inside LCFS, while becomes more positive outside LCFS. Around LCFS and at the location far from LCFS, the response becomes small.

A candidates to explain this potential response is the radial current due to anomalous fast ion loss resulting from the MHD bursts because the loss of fast ion should also be correlated with the growth and decay of the MHD behavior. Indeed, the existence of the fast ion loss linked with the MHD bursts was confirmed using directional probe measurement in other similar experiments in Heliotron J.

The details of the experiment and the characteristics of the response will be presented and discussed in this presentation.

[1] K. L. Wong *et al*, Nucl. Fusion, **45** 30 (2004)
[2] S. Ohshima, et al., 24th IAEA Fusion Energy Conference, San Diego, 2012, EX/P4-17

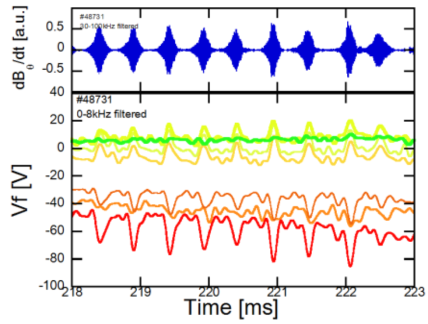

Fig.1 (a) Band-pass filtered signal of MP from 30 to 100 kHz inside #14.5 probe and low frequency potential responses at radially different positions measured with radial multi-channel probe at #8.5

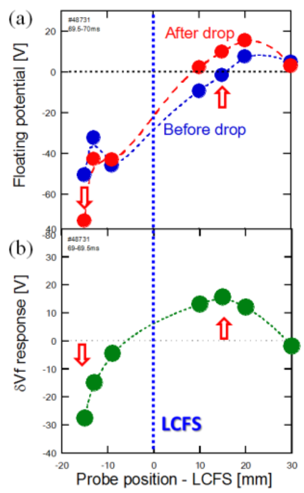

Fig. 2 (a) Structural change of potential profile and (b) perturbed potential profile at the timing of potential drop around LCFS.