Observation of a 3 kHz standing wave in the presence of the quasi-static magnetic island on J-TEXT

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The Quasi-Static Modes (QSMs) is frequently observed on the J-TEXT tokamak. In this work, we focus on a type of QSMs with a frequency of ~ 10 Hz and the co-existence of a 1/1 mode and a 2/1 magnetic island, which is identified via the ECE measurement.

A 3 kHz low frequency mode is observed via magnetic probes and ECE signals accompanying with the QSM. The magnetic perturbation of this 3 kHz mode shows a standing wave (SW) structure both poloidally and toroidally, with the nodes of perturbed poloidal magnetic field (δB_θ) locating at the O- and X- point of 2/1 island. The ECE perturbation of this 3 kHz mode is around zero inside the island, and large around the island boundary, showing a significant dependence on the 2/1 magnetic island structure.

The relationship between the 3 kHz standing wave and the magnetic island is similar to two kinds of phenomena observed previously on J-TEXT: (*a*) the forced oscillation of the island phase due to the application of a RMP field rotating at a few kHz (e.g. 1~6 kHz) [1]; (*b*) the BAE structure observed with a locked or rotating island [2]. Nevertheless, clear differences exist. There is no 3 kHz rotating RMP or error field applied in this wok; The frequency of BAE is much higher, typically from 20 to 50 kHz. Understanding the structure and trigger mechanism might be helpful for understanding other standing wave structures.

Reference

[1] Nengchao Wang *et al,* Plasma response to rotating resonant magnetic perturbations with a locked mode in the J-TEXT tokamak, *Nucl. Fusion* 59 (2019) 026010

[2] Linzi Liu *et al.*, Beta-induced Alfvén eigenmodes destabilized by resonant magnetic perturbations in the J-TEXT tokamak. *Nucl. Fusion* 59 (2019) 126022

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