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LHDプラズマにおける高速イオン駆動アルヴェン固有モードの総合的MHDハイブリッドシミュレーション

Comprehensive MHD Hybrid Simulation of Fast Ion Driven Alfvén Eigenmodes in LHD Plasmas

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Alvén eigenmode (AE) bursts driven by fast ions have been observed in the Large Helical Device (LHD) experiments [1]. In the LHD shot #47645, two peaks appear in the magnetic fluctuation frequency spectrum at f~60kHz and 70kHz for t~0.58s. It is important to identify the two modes and to clarify the fast ion transport by the instabilities.

The multi-phase MHD hybrid simulation, which is a combination of classical simulation and the MHD hybrid simulation, has been developed to investigate the energetic particle distribution formation process with the interaction of the MHD instabilities in the collisional time scale [2]. In this work, we apply the multi-phase MHD hybrid simulation to the LHD shot #47645.

The time evolution of stored fast ion energy is shown in Fig. 1 for the classical and multi-phase MHD hybrid simulations with a combination of 4ms classical phase and 1ms hybrid phase. We see that stored fast ion energy is saturated at lower levels in the MHD hybrid simulation. We found two AEs with toroidal mode number $n=1$ in the MHD hybrid simulation. Figure 2 shows the spatial profiles of the AEs. The frequencies of the AEs are around 70kHz and 60kHz, respectively. They are candidates for the modes observed in the experiment. The mode with f~70kHz shown in Fig. 2(a) appears first, and the mode with f~60kHz shown in Fig. 2(b) appears later. We will present the time evolution and the fast ion redistribution, and compare the frequencies with the Alvén continuous spectra.

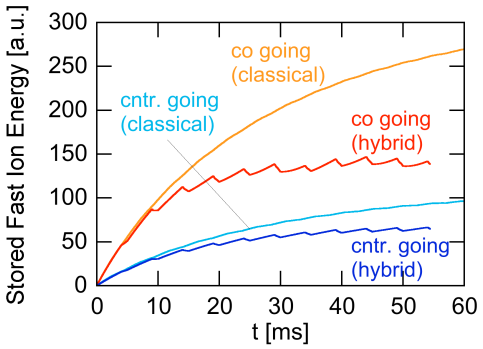

Fig. 1 Time evolution of stored fast ion energy in the classical and multi-phase MHD hybrid simulations.

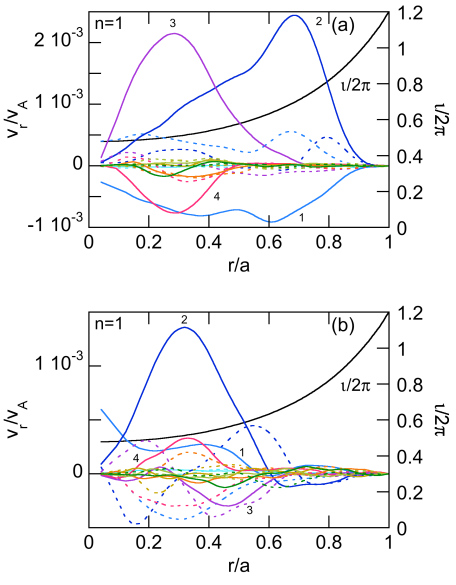

Fig. 2 Spatial profiles of AEs with $n=1$.

[1] M. Osakabe *et al.*, NF **46**, S911 (2006).
[2] Y. Todo *et al.*, NF **54**, 104012 (2014).