03aE56P

逆磁場ピンチプラズマにおける磁場揺動および静電揺動とトロイダル磁場の逆転との相関性

Correlation of Magnetic and Electrostatic Fluctuations and Reversal of Toroidal Field in RFP Plasma

山家清之，小口治久[1]，榊田　創[1]，平野洋一[1]，木山　学[1]
Kiyoyuki YAMBE, Haruhisa KOGUCHI[1], Hajime SAKAKITA[1], Yoichi HIRANO[1], Satoru KIYAMA[1]

新潟大，産総研[1]
Niigata Univ, AIST[1]

The reversed-field pinch (RFP) is a magnetic confinement system used in nuclear fusion research [1]. The characteristics of the RFP plasma are indicated by the pinch and the reversal parameters. These values strongly affect the magnetohydrodynamic behavior of RFP plasma and hence its confinement properties. For example, the improved high theta mode on the TPE-1RM20 device demonstrates high beta and improved energy confinement [2]. The RFP confinement is related to the details of the RFP configuration, a more comprehensive understanding of RFP confinement is required by studying the characteristics of the magnetic and electrostatic fluctuations in the discharges with different values of the pinch and reversal parameters. In this work, the magnetic and electrostatic fluctuations have been measured in the Toroidal Pinch Experiment - RX (TPE-RX) reversed-field pinch plasma at the plasma surface r/a = 1.00. TPE-RX has the extensive magnetic measurement system (MMS) and the complex edge probe (CEP). The MMS measures the magnetic fluctuations less than 10 kHz and the CEP measures the magnetic fluctuations more than 5 kHz and the electrostatic probe potential [3]. The electrostatic fluctuation is indicated from the probe potential. In Fig. 1, the electrostatic fluctuation exhibits a large decrease after 50 ms but the magnetic fluctuation does not decrease. The raw signal of electrostatic probe potential shows negative spikes. Fast electrons with energy comparable to or slightly higher than the core electron temperature are observed as many spikes in the electrostatic probe signal. During the period of mild deepening of the reversal of the edge toroidal field, a significant reduction in the spike signal, increases in electron density and soft x-ray radiation, and a decrease in the Dα line radiation are observed, even though the reduction in magnetic fluctuations is not significant during the same period. The reversal of the toroidal field can improve the confinement of fast electrons inside the reversal surface.

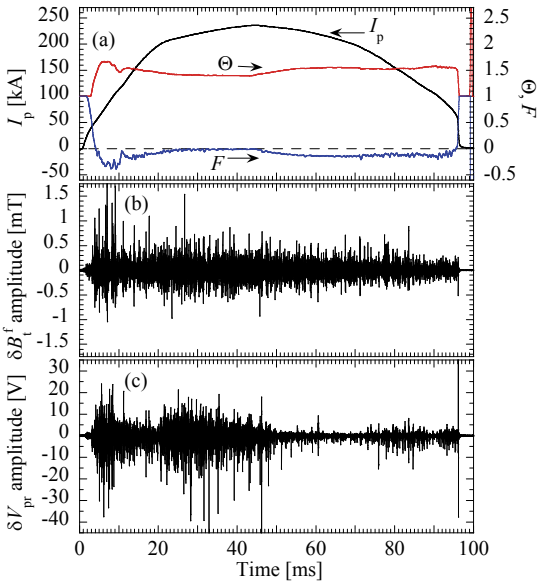

Fig. 1. Time evolutions of (a) plasma current I_p, pinch parameter Θ, and reversal parameter F, (b) fast toroidal magnetic field fluctuation amplitude δB_t^f measured with CEP, and (c) electrostatic probe potential fluctuation amplitude δV_{pr}.

[1] H. A. B. Bodin, A. A. Newton, Nuclear Fusion 20, 1255 (1980).

[2] Y. Hirano *et al*, Nuclear Fusion 36, 721 (1996).

[3] K. Yambe *et al*, Physics of Plasmas 18, 064505 (2011).