4Pp24

JT-60Uの高ベータプラズマにおけるMHD不安定性の空間構造
Spatial structure of MHD instabilities in high beta plasmas of JT-60U

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It is important to understand and control MHD instabilities for realizing economical fusion reactors, because MHD instabilities can degrade the plasma confinement. In particular, measurement of mode structures and mode frequencies provides us information such as relationships between modes and rational surfaces or effects by modes on bulk plasmas.

In high beta plasmas of JT-60U, n=1 MHD modes with low mode frequencies, which are smaller than 20 Hz typically, have been observed (n: toroidal mode number). It is also observed that the MHD modes can degrade confinement of plasmas. Therefore, excitation conditions and effects on plasmas should be studied on the MHD modes. In this presentation, the characteristics of the MHD modes focusing on the mode structures and the mode frequencies are explained in detail.

Before the MHD mode is excited, the precursor is usually observed. When the precursor of the MHD mode is excited, it is observed that the mode frequency decreases as the mode amplitude increases. Figure 1 shows the precursor of the MHD mode and the decrease of the mode frequency with the growth of the precursor. It is also observed that the toroidal flow velocity decreases as the mode frequency decreases and the low toroidal velocity is kept during the existence of the MHD mode. Because the phases in fluctuation components of soft X-ray (SX) signals viewing around the q = 2 surface are inverted, the observed precursor may be excited on the q = 2 surface (q: safety factor).

When the MHD mode is excited after the precursor, coherent oscillations on magnetic fluctuations and signals from various diagnostics such as SX, charge exchange recombination spectroscopy (CXS), and motional Stark effect (MSE) diagnostics are observed. Because the ion temperatures measured by CXS oscillate between ρ~0.2 and ρ~1, the whole region of the plasma seems to oscillate. In addition, the structure with odd m is observed by MSE and electron cyclotron emission measurement in the core region. Snake-like structure is also observed in SX emission profiles as shown in figure 2, which indicates the existence of the odd m structure. These observations suggest that the whole plasma oscillates with the MHD mode.

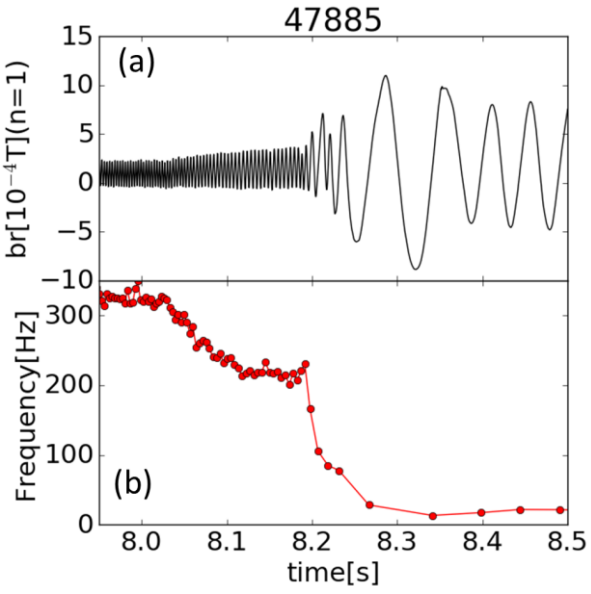

Fig 1. (a) Magnetic fluctuations and (b) its frequency.

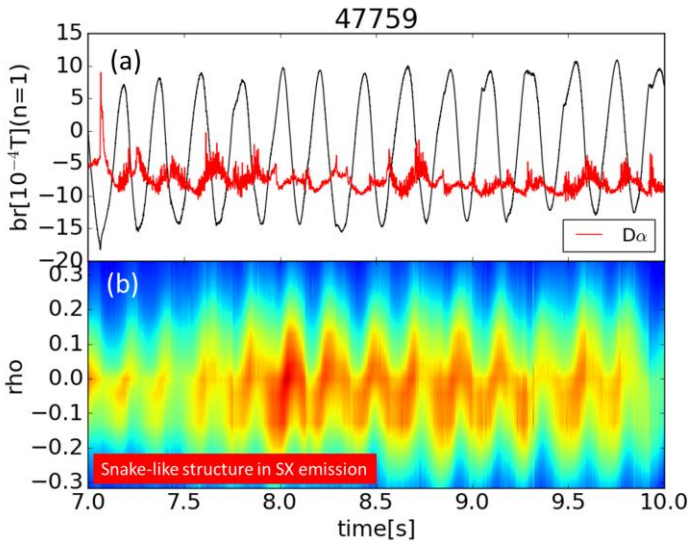

Fig 2. (a) Magnetic fluctuations (black line), and Dα signals. (b) Time-space plot of SX amplitudes. Snake-like structure is observed.