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LATE 装置における電子バーンスタイン波の直接測定に関する実験結果
Experimental result on direct measurement of electron Bernstein waves in LATE

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1 Background

Electron Bernstein waves (EBWs), which have no density limits, are very suitable for heating and driving currents in high-beta spherical tokamak plasmas, in contrast to conventional electromagnetic waves. The purpose of this research is to experimentally study the whole process of EBW excitation, propagation and absorption, through direct two-dimensional (2-D) measurement of wave pattern by probe antenna on LATE device.

2 Wave detection

The wave signal is detected by a five-pin probe antenna and processed in a homodyne-type mixer circuit. The probe antenna measures potential difference (electric field, equivalently) of small distance (about 1mm) at four different positions and directions. The mixer circuit converts time-dependent wave signals to time-independent Inphase/Quadrature (I/Q) signals, which contain amplitude and phase information.

3 Experimental result

In the experiment, 2.45 GHz heating microwave (about 500W) is used to generate target ECR plasma which is overdense for 1.5GHz detecting microwave (about 15W). Typical discharge waveform and I/Q signals are shown in Fig. 1.

The 2-D map of phase and amplitude for both O-mode and X-mode injection have been measured through multiple discharges. For O-mode injection, wave pattern of long wavelength (about 10cm) and short wavelength (about 2mm) are observed in a wide region before UHR, and in a narrow region near UHR, respectively, which is shown in Fig. 2 (uncertainty of UHR position is several cm). Probe antenna direction change (toroidal to radial) and phase velocity direction change (forward to backward) indicate mode conversion from electromagnetic waves to electron Bernstein waves. For X-mode injection, wave pattern is much different and no short wavelength signals are observed.

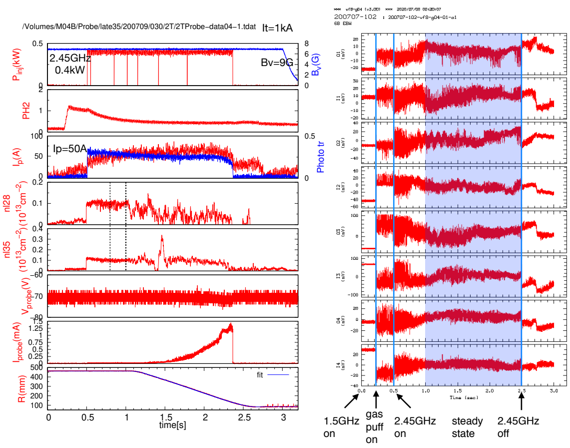

Fig. 1: Typical discharge waveform and I/Q signals.

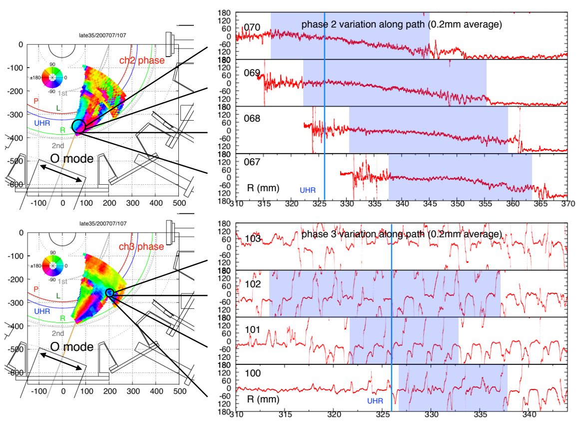

Fig. 2: Wave pattern of long and short wavelength.