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LATE 装置におけるモード変換と EBW 検証のための 2 次元波動パターン測定

Two-dimensional measurement of wave pattern for mode conversion and EBW verification in LATE

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1 Background

Electron Bernstein waves (EBWs) are very suitable for heating and driving currents in high-beta spherical tokamak plasmas, since they have no density limits and can achieve parallel refractive index much larger than one. By using a newly developed five-pin probe antenna and two-dimensional mechanical probe driving system, the 2-D wave pattern of phase and amplitude has been directly measured in Low Aspect ratio Torus Experiment, for an overdense ECR plasma with microwave obliquely injected.

2 Experimental results

In the case of O-mode injection (Fig. 1), an EBW-like wave pattern has been detected for the first time, in a localized region near the UHR layer. 1-D variation of phase shows that the pattern has a short wavelength of about 2 mm (Fig. 2), the pattern is backward as the phase velocity direction is opposite to the group velocity direction, and the pattern is electrostatic as the pin detection direction is nearly the same as the wave propagation direction (both almost radial). These characteristics suggest that EBW has been directly observed. The reason for localized observation of the EBW wave pattern is considered to be the critical requirement for achieving high O-X-B mode conversion efficiency, and high collisional damping rate of EBW.

In the case of X-mode injection, 2-D wave pattern is quite different from O-mode injection case and no short-wavelength wave pattern can be observed. Under present experimental conditions, the X-B mode conversion efficiency is at a very low level and EBW is not expected to be excited effectively.

By slightly adjusting the toroidal magnetic field, both the position and size of the localized EBW region have changed, in accordance with the efficient O-X-B conversion region (Fig. 2(b), (d)).

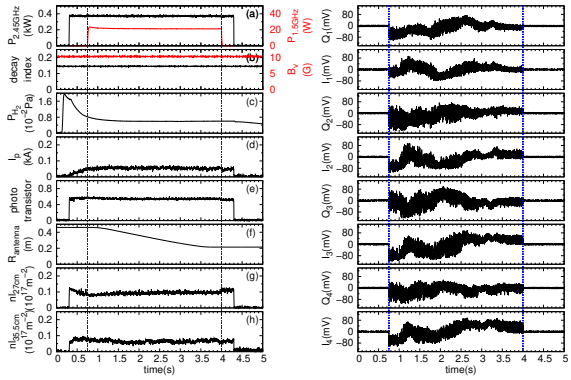

Fig. 1: Typical discharge waveform and I/Q signals for O-mode injection.

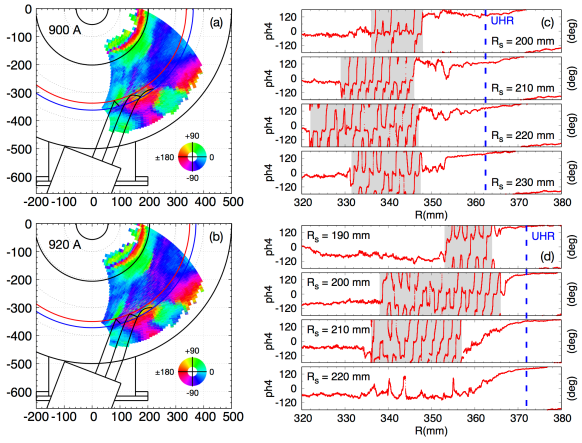

Fig. 2: Comparison of 2-D and 1-D wave pattern of phase for different toroidal magnetic field.