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D-D反応生成ヘリウム3に起因したイオンサイクロトロン放射のトロイダル波数と励起

Relation between toroidal wavenumber and excitation of ion cyclotron emission due to DD fusion product helium3

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Ion Cyclotron Emissions (ICEs) are spontaneously excited in the frequency range slight below the ion cyclotron frequency and its higher harmonics at the outer midplane edge of the plasma. The ICEs are driven by fast ions from neutral beams (NBs) and fusion-produced ions, and detected in several tokamak and helical devices. It is considered that the ICEs are magneto-acoustic waves and the Doppler shifted ion cyclotron resonance condition is the key to their excitations [1]. The ICE is expected as a passive diagnostic tool for getting information of fast ions such as the NB ions and the fusion produced ions in future burning plasma experiments. Understanding the dispersion relations and the excitation mechanisms of the ICEs is important toward their applications to the passive fast ion diagnostics.

On JT-60U, toroidal wavenumbers of the ICEs were successfully measured with Ion Cyclotron Range of Frequency (ICRF) antennas as multiple pick-up loops [2]. Recently, we analyzed the temporal behavior of the toroidal wavenumber of the ICEs in several discharges. Figure 1 shows the temporal evolution of (a) positive-ion-based NB (PNB) powers, (b) a neutron emission rate, (c) electrostatic and/or electromagnetic fluctuations measured with the ICRF antenna, and (d) phase differences of the fluctuations between two ICRF antenna straps in the toroidal direction in the discharge of #45333. Tangential-PNBs (tang-PNBs) and perpendicular-PNBs (perp-PNBs) to the magnetic field are injected from 2.55 sec and 3.05 sec, respectively. The increase of the neutron emission rate indicates that the Deuterium-Deuterium (DD) fusion reactions begin to increase just after the tang-PNBs injections. A fundamental ^{3}He ion cyclotron frequency (ω_{c3He}) at the outer midplane edge of the plasma is indicated by a dashed line in Fig.1(c). A strong fluctuation appears in the frequency range slightly below the ω_{c3He} from the beginning of the increase of the neutron emission. The observed strong fluctuation is interpreted as the ICE due to DD fusion produced ^{3}He ions (ICE(^{3}He)). The distance in the toroidal direction between two antenna straps used for the measurement of the phase differences is 0.44 m. Positive phase differences indicate the toroidal wavenumber in the counter-current direction. It is clearly shown that the toroidal wavenumber of the fundamental ICE(^{3}He) becomes large in the counter direction. In this study, we investigate correlations between the toroidal wavenumber and plasma parameters for understanding the excitation characteristics of the ICEs(^{3}He).

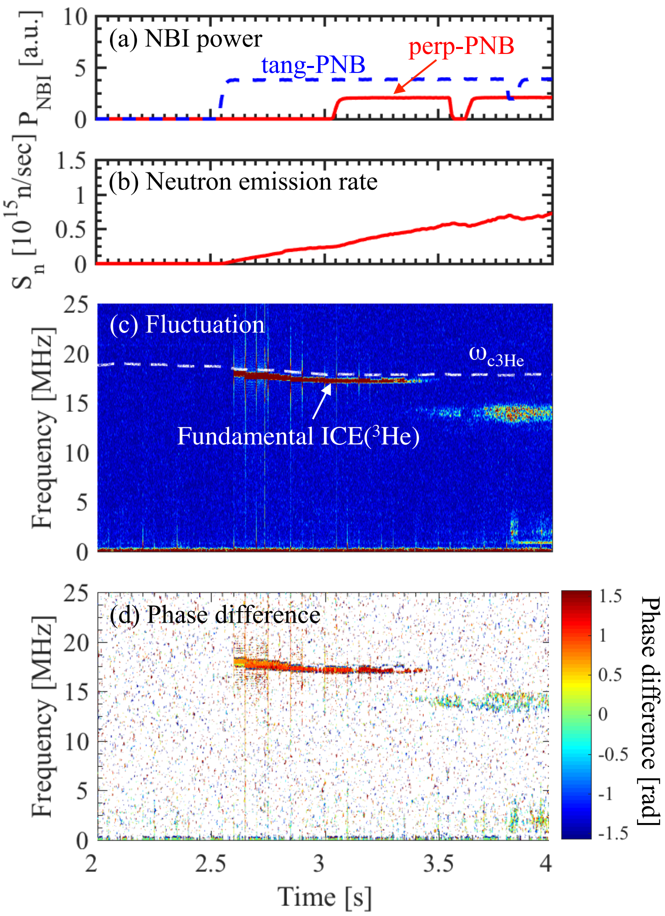

Figure 1. Temporal evolutions of (a) powers of tangential (a dashed line) and perpendicular PNBs (a solid line), (b) a neutron emission rate, (c) a fluctuation spectrum and (d) phase differences (#45333).

[1] R.O. Dendy *et al.*, Phys. Plasmas, **1** 1918 (1994).
[2] M. Ichimura *et al.*, Nucl. Fusion, **48**, 035012 (2008).