Properties of anomalous ion heating in lower hybrid wave sustained plasmas


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Background and Objectives
- In the TST-2 spherical tokamak device, non-inductive start-up experiment by Lower-Hybrid waves (LHW) is conducted. \( T_e > 10 \text{ eV} \) and \( T_i \sim 10 \text{ eV} \) is observed.
- The LHW can couple with electrons, but not with ions due to the relation between particle velocities and wave phase velocity.
- Thus, the LHW can directly heat electrons, not ions.
- Because density is very low, the effect of collision with electrons is considered to be small.
- Power modulation experiment was conducted to investigate the response of ion temperature to LHW.

TST-2
Main parameter
- Major radius: \( R_0 = 0.36 \text{ m} \)
- Minor radius: \( a = 0.23 \text{ m} \)
- Toroidal filed: \( B_t = 0.16 \text{ T} \)
- Plasma current: \( I_p < 27 \text{ kA} \)
- Duration: \( r < 100 \text{ ms} \)
- Electron density: \( n_e < 1 \times 10^{18} \text{ m}^{-3} \)

There are two capacitively coupled combine antenna to excite LHW (200.1 MHz).

Visible spectroscopy
- Czerny-Turner spectrometer
- 16 CH PMT
- 0.2 nm/CH, Measurable: 200-500 nm
- I-V converter: < 0.01 ms
- 8 sights (\( R_{\text{map}} = 180 \text{-} 540 \text{ mm} \)) are available to measure to change them for each shot
- Impurity: C\( ^{2+} \) (CIII, 484.74 nm)

Profiles of electrons and ions
- Magnetic axis: center peak
- Density: center peak
- \( T_e : \) Hollow (10-50 [eV])
- \( T_i : \) Flat or hollow (~10 [eV])

Analyzed Waveforms
- Modulation period of LHW power is 6 ms.

Conclusion and Future work
- Ion temperature responds to LHW modulation at peripheral region, does not respond near magnetic axis.
- Collision with electrons is very weak to explain the experimental results, other ion heating mechanism is needed on peripheral region.
- PDI is one candidate for ion heating and investigating the correlation between them is future work.

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