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JT-60Uにおける電子サイクロトロン加熱のイオン系及び電子系の輸送に与える影響

Responses of ion and electron channels to electron cyclotron heating in JT-60U

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Wave injection in electron cyclotron range of frequency (ECRF) works on plasma heating, current profile control, MHD stabilization, impurity pumpout and so on. Also ECRF wave injection changes plasma profiles: profiles of the electron density (n_e), the electron and ion temperatures (T_e and T_i) and the toroidal rotation velocity (V_ϕ). Temporal and spatial responses for the physical quantities need to be specified to deepen understanding of the mechanism of the changes in the quantities and provide practical uses of ECRF in future devices.

In this study, the temporal and spatial responses of electron channels and ion channels to central electron cyclotron heating (ECH) have been investigated in positive shear H-mode plasmas and weak shear plasmas with internal transport barriers (ITBs) on JT-60U [1]. Core electron density decreases with ECH when the density profile is peaked before ECH injection. On the other hand, the electron density with relatively flat n_e profile does not decrease. The flattening of n_e profile is observed after the increase in T_e in the core region. Linear gyrokinetic stability analyses predict that the growth rate of the trapped electron modes, which increase outward particle flux, becomes more pronounced during ECH. Ion temperature decreases with ECH in both H-mode and ITB plasmas. Ion temperature around the ITB foot rapidly reduces and the increase in T_e precedes the reduction in T_i. From the observations and theoretical analyses, the reduced T_i can be interpreted as the decrease in the critical temperature gradient for the ion temperature gradient mode with ECH. The counter intrinsic rotation with ECH is identified on H-mode plasmas with small torque input where co-current NBs and counter-current NBs are simultaneously injected with the same power. The counter intrinsic rotation is generated after the increase in the electron temperature and correlates to the change in the electron temperature with ECH around the EC deposition. On the other hand, the responded region and the time scale are different; The radial region where the counter intrinsic rotation is observed is wider than the radial region where T_e varies with ECH; Time scale of the change in V_ϕ is longer than that of the change in T_e and T_i (Fig. 1). It is likely that the counter intrinsic rotation around the EC deposition is driven by the change in T_e and propagates to the outer region according to the transport.

[1] M. Yoshida, *et al., Nucl. Fusion* **53** (2013) 083022.

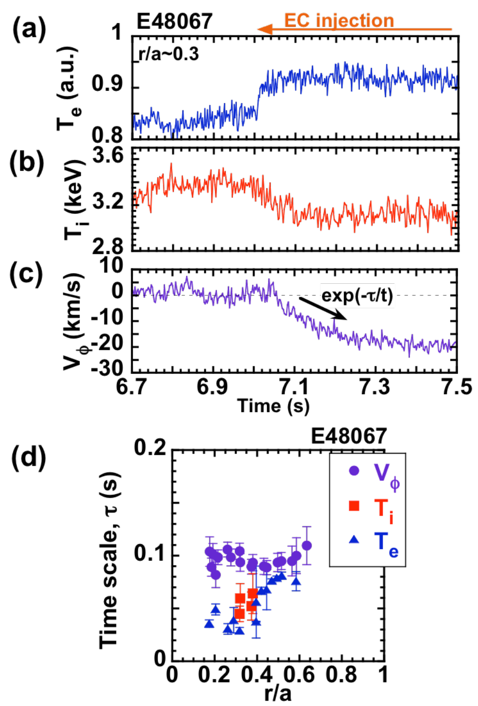

Fig. 1. Waveforms of (a) T_e; (b) T_i; and (c) V_ϕ in the H-mode plasma with small torque input (I_p=1.0 MA, B_T=1.9 T, P_{EC}=2.6 MW). (d) Radial profiles of the time scales in T_e, T_i and V_ϕ.