Correlation Between Plasma Rotation and Electron Temperature Gradient Scale Length in LOC/SOC Transition at Alcator C-Mod*

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Understanding the mechanism governing the linear ohmic confinement (LOC) and the transition to saturated ohmic confinement (SOC) has long been a focus of tokamak research. It is commonly accepted that at low density, the confinement is dominated by electron-scale turbulence while at high density, the turbulence is dominated by ion temperature gradient. At Alcator C-Mod tokamak, the core rotation reversal was shown to be consistent with this ansatz.1 A recent study at AUG suggests that the intrinsic rotation behavior is rather determined by local plasma parameters regardless of the heating method or the confinement regime.2 This idea was explored and it was found that although the intrinsic rotation depends on the electron temperature gradient scale length ($L_{Te}$), ultimately this behavior is a function of the confinement regime. For this measurement, the high-resolution (1 µs, 7mm) electron cyclotron emission diagnostic at C-Mod (FRCECE) coupled with the $B_T$ jog technique allows direct $L_{Te}$ measurements. In the $B_T$ jog technique, a 1.5% change in the toroidal magnetic field scans the viewing volume of the ECE by ~1 cm, and the ratio of the average of the signal to the change in the signal during its ramp-up yields $L_{Te}$. Rice et al showed that there is a connection between some seemingly unrelated parameters: at the radius with the steepest gradient, the electron temperature is the same in the $T_e$ profiles of edge-cooled LOC or SOC discharges.3 Also at the radius with the steepest gradient, the toroidal rotation profiles have the same values in LOC or SOC discharges.1 Here we catalog another component to the phenomenological study: at this radius there exists a low frequency mode (~3 kHz) in the ECE spectrum, which vanishes above the LOC/SOC critical collisionality. As the density, and hence the collisionality increased into SOC regime, a new mode (~6 kHz) appears. The presence of these modes questions the role of MHD effects in LOC/SOC transition.

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1 Rice et al., Nucl. Fusion 53, 033004 (2013).
2 McDermott et al., Nucl. Fusion 54, 043009 (2014).