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Turbulence-Flow Coupling and Poloidal Main-Ion Flow Acceleration Preceding the L-H Transition

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Understanding flow drive and damping across the relevant ion collisionality range is crucial for connecting the L-H transition trigger physics to the macroscopic L-H power threshold scaling. This is of utmost importance for minimizing the auxiliary heating power required for H-mode access in burning plasmas. It is shown here for the first time that the main-ion poloidal flow acceleration is quantitatively consistent with Reynolds-stress-driven shear flow amplification across the entire edge shear layer, leading to the observed dipolar shear layer structure inside the last closed flux surface (LCFS). The poloidal flow damping rate is found to be consistent with the neoclassical plateau regime at intermediate density n=3x10ˆ19 mˆ-3. This work in He plasmas substantially extends previous work on L-H transitions induced by limit cycle oscillations (LCO), and on fast (regular) L-H transitions, [1-3]. We present direct, high resolution measurements of the poloidal and toroidal main ion flow during the trigger phase of the L-H transition, using He main-ion CER. The measured E×B velocity modulation at the start of the LCO is in phase with the local ion poloidal velocity modulation, indicating flow in opposite directions just inside the LCFS and near the bottom of the E_r well. In contrast, the laboratory frame toroidal velocity is not significantly modulated during LCO. It is demonstrated that (i) the Reynolds stress gradient changes sign across the shear layer, consistent with the observed poloidal flow propagation in opposite directions; (ii) the measured Reynolds stress drive is quantitatively balanced by the ion flow acceleration and damping terms. This data presents compelling quantitative evidence that the L-mode-LCO transition is triggered via E×B shear flow amplification mediated by the perpendicular Reynolds stress gradient. Long-range toroidal E×B flow correlation in the LCO peaks at intermediate plasma density around the L-H power threshold minimum.

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[1] L. Schmitz, et al., Phys. Rev. Lett. 108, 155002 (2012).
[2] G. Tynan et al., Nucl. Fusion 53, 073053 (2013).
[3] Z. Yan, et al., Phys Rev. Lett. 107, 055004 (2014).

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