Electron Particle Transport on DIII-D: Testing Theory-Based Models and Implications for ITER*

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A series of experiments on the DIII-D tokamak show peaked (non-flat) density profiles which are invariant as a function of collisionality, with experimental measurements in good agreement with theory-based predictions by TGLF and GYRO. The experiments were designed to test the ν* scaling of particle transport, a key issue for ITER, with measurements of perturbative transport and complete turbulence data sets. In both L- and H-mode experiments, similarity scan techniques were employed to vary collisionality (ν*) by a factor of 3–5, while holding other dimensionless parameters constant. No change was observed in either case in the measured density profiles and density profile peaking, in contrast to published H-mode database results in which density peaking clearly scales with ν*. The experiments were also specifically designed to compare measured particle diffusion coefficients (D) and particle pinch velocities (v), as well as turbulence characteristics, with TGLF and GYRO. The experimental results are in qualitative agreement with GYRO predictions of little change in particle transport across the collisionality range probed. Detailed GYRO analysis of the actual experimental discharges is underway in order to assess quantitative behavior. We have also compared the experimental results to TGLF modeling in three separate ways, including a significant new capability to directly compare experimental perturbative particle transport measurements with the predictions of TGLF modeling. The first such comparisons, presented here, show good agreement for perturbative particle transport rates. TGLF modeling is also in good agreement with experimental measurements for equilibrium density profile and density fluctuation response as a function of collisionality. Neutral particle modeling has been performed with SOLPS5, which can replicate the core density response to perturbative gas puffing.

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