Validation Studies of Gyrofluid and Gyrokinetic Predictions of Transport and Turbulence Stiffness Using the DIII-D Tokamak

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Abstract. A series of carefully designed validation experiments conducted on DIII-D to rigorously test gyrofluid and gyrokinetic predictions of transport and turbulence stiffness in both the ion and electron channels have provided an improved assessment of the experimental fidelity of those models over a range of plasma parameters. The first set of experiments conducted was designed to test predictions of H-mode core transport stiffness at fixed pedestal density and temperature. In low triangularity lower single null plasmas, a factor of 3 variation in neutral beam injection (NBI) heating was obtained, with modest changes to pedestal conditions that slowly increased with applied heating. The measurements and trends with increased NBI heating at both low and high injected torque are generally well-reproduced by the quasilinear TGLF transport model at the lowest heating levels, but with decreasing fidelity (particular in the electron profiles) as the heating power is increased. Complementing these global stiffness studies, a second set of experiments was performed to quantify the relationship between the local electron heat flux Q_e and electron temperature gradient by varying the deposition profile of electron cyclotron heating (ECH) about a specified reference radius in low density, low current L-mode plasmas. Modeling of these experiments using both TGLF model and the nonlinear gyrokinetic GYRO code yields systematic underpredictions of the measured fluxes and fluctuation levels.