Advances in Validating Gyrokinetic Turbulence Models in L and H mode Plasmas*

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Robust validation of predictive turbulent transport models requires quantitative comparisons to experimental measurements at multiple levels, over a range of physically relevant conditions. Towards this end, a series of carefully designed validation experiments has been performed on the DIII-D tokamak to obtain comprehensive multi-field, multi-point, multi-wavenumber fluctuation measurements and their scalings with key dimensionless parameters. In this talk we present the results of two representative validation studies: an elongation scaling study performed in beam heated L-mode discharges, and a T_e/T_i scaling study performed in quiescent H-mode discharges. Key experimental observations to be tested include a 50% increase in energy confinement time tau_E when the elongation kappa was increased by 50% in the L-mode discharges, with accompanying decrease in fluctuation levels, and measured QH-mode fluctuation scalings and 30% decrease in tau_E when on-axis T_e/T_i is varied from 0.55 to 1.2 via application of ECH heating, all of which are consistent with initial linear growth rate calculations with TGLF. Transport predictions from both the quasilinear TGLF model and nonlinear GYRO simulations are presented and compared to power balance analysis, as well as direct comparisons of GYRO-predicted and measured fluctuation levels. A set of simple metrics is presented and used to quantify the absolute and relative agreement between TGLF, GYRO, and experiment.

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