Search for the Missing L-mode Edge Transport and Possible Breakdown of Gyrokinetics*

R.E. Waltz, General Atomics

While GYRO simulations of typical core (0<r/a<0.7) DIII-D L-modes seem to be in good agreement with experiment, simulated low-\(k\) (\(k\rho_i<1\)) transport and turbulence intensity is more than 5-fold lower than experimentally inferred levels in the near edge L-mode (r/a=0.7–0.95) DIII-D shot 128913 [1]. Global edge slice GYRO simulations of this and the well-studied discharge 101391 [2] are presented here to document the shortfall. TGLF transport code simulations over a large L-mode database indicate this shortfall is not atypical so that L-mode edges transit to H-like pedestal profiles contrary to experiment. High edge e-i collisionality stabilizes the TEM modes so that diffusivities (\(\chi\)) decrease like \(T^{7/2}/n\) to the cold edge. The very high magnetic shear and density gradients stabilize the ITG despite the very high temperature gradient drive and high \(q\). High-\(k\) ETG can make-up for the shortfall in the electron but increases ion transport very little. Near L-edge transport is highly local. Focusing on local simulations at \(r/a=0.9\), the ion channel shortfall can exceed 10-fold. An artificial 10-fold increase in collisionality is needed to reach the expected resistive g-mode scaling with \(\chi\) increasing like \(nT^{1/2}\). Identical GYRO drift kinetic ion simulations (suppressing the gyroaverage) are close to experiment levels suggesting a possible breakdown of low-frequency gyrokinetics. Formulation of a nonlinear theory of 6D drift-cyclotron kinetics following the fast time scale of the gyrophase to test the breakdown of 5D gyrokinetics with reduced model simulations is presented.


*Supported by the US DOE under DE-FG02-95ER54309.