Advances in Comprehensive Gyrokinetic Simulations of Transport in Tokamaks

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Abstract. A continuum global gyrokinetic code GYRO has been developed to comprehensively simulate core turbulent transport in actual experimental profiles and enable direct quantitative comparisons to the experimental transport flows. GYRO not only treats the now standard ion temperature gradient (ITG) mode turbulence, but also treats trapped and passing electrons with collisions and finite β, equilibrium $E\times B$ shear stabilization, and all in real tokamak geometry. Most importantly the code operates at finite relative gyroradius (ρ_*) so as to treat the profile shear stabilization and nonlocal effects which can break gyroBohm scaling. The code operates in either a cyclic flux-tube limit (which allows only gyroBohm scaling) or a globally with physical profile variation. Bohm scaling of DIII-D L-mode has been simulated with power flows matching experiment within error bars on the ion temperature gradient. Mechanisms for broken gyroBohm scaling, neoclassical ion flows embedded in turbulence, turbulent dynamos and profile corrugations, plasma pinches and impurity flow, and simulations at fixed flow rather than fixed gradient are illustrated and discussed.