Exploring low-n gyrokinetic simulations

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Standard continuum delta-f local gyrokinetic codes like GS2, GYRO, GENE, and GKW are written in a field line following high-n ballooning mode eikonal representation for the amplitudes: $\delta f_n(r,\theta)\exp(in\alpha)$ where $\alpha=\phi-q(r)\theta$ is the field line angle, ϕ the toroidal angle, θ the poloidal angle, n the toroidal mode number, q(r) the safety factor, and r the minor radius flux surface. $\delta f_n(r,\theta)$ is assumed to have a slow variation in θ. When operating on $\delta f_n(r,\theta)$, the parallel field gradient is $(1/Rq)d/d\theta$ with R the major radius , and the radial cross field gradient is d/dr + $(inq/r)s\theta$ with s=r(dq/dr)/q the magnetic shear. Most importantly the cross field gradient in the flux surface (inq/r) + $(1/r)d/d\theta$ drops the latter slow θ-variation term in the standard high-n gyrokinetic approximation. For nq >> 1 modes, the neglected "low-n" small rho-star term brakes local gyroBohm scaling and is not expected to matter. But what about the n=0 radial (zonal flows and GAM) modes which are known to control the nonlinear saturation of the finite-n drift wave turbulence and transport? The neglected low-n gradient terms for the linear and nonlinear ExB motion have been added to GYRO and novel linear and non-linear low-n gyrokinetic simulations are explored. The n=0 radial modes are now linearly driven (damped?) by the density and temperature gradients and nonlinearly self-coupled. Is the resulting transport higher or lower when the low-n terms are included?