Gyrokinetic Simulations with External Resonant Magnetic Perturbations: Island Torque and Nonambipolar Transport with Rotation[1]

R.E. WALTZ, GA, F.L. WAELBROECK, U Texas-Austin
— Static external resonant magnetic perturbations (RMPs) have been added to the δf gyrokinetic code GYRO. This allows nonlinear gyrokinetic simulations of the nonambipolar radial current flow j_r and the corresponding plasma torque (density) $R[j_r B_\theta/c]$, induced by islands that break the toroidal symmetry of a tokamak. This extends previous GYRO simulations for the transport of toroidal angular momentum (TAM) [1,2]. The focus is on full torus radial slice electrostatic simulations of induced q=m/n=6/3 islands with widths 5% of the minor radius. The island torque scales with the radial electric field E_r the island width w, and the intensity I of the high-n micro-turbulence, as $wE_rI^{1/2}$. The net island torque is null at zero E_r rather than at zero toroidal rotation. This means that there is a small co-directed magnetic acceleration to the small diamagnetic co-rotation corresponding to the zero E_r which can be called the residual stress [2] from an externally induced island. Finite-beta GYRO simulations of a core radial slice demonstrate island unlocking and the RMP screening.

[1] R.E. Waltz, et al., Phys. Plasmas **14**, 122507 (2007).
[2] R.E. Waltz, et al., Phys. Plasmas **18**, 042504 (2011).

R.E. Waltz
GA

Date submitted: 05 Jan 2012   Electronic form version 1.4