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Nonlinear magnetic island dynamics and neoclassical toroidal viscosity in quasi-symmetric configurations[1] C.C. HEGNA, University of Wisconsin — In a general 3-D magnetic confinement device, singular Pfirsch-Schlüter currents arise at rational surfaces in the plasmas due to pressure gradients and resonant components of $1/B^2$. These singular currents can be resolved by allowing magnetic islands to form. Additionally, 3-D magnetic fields produce net radial particle drifts that give rise to viscous forces on the plasma. These effects are included in an analytic calculation for isolated magnetic islands using drift kinetic theory for magnetic configurations that are quasi-symmetric, i. e., $|B| = B_o[1-\epsilon_h \cos(M\theta - N\zeta)] + \delta B(\psi, \theta, \zeta)$ where $M\theta - N\zeta$ denotes the dominant helical symmetry angle and the 3-D helical sidebands are assumed small ($\delta B/B_o \ll \epsilon_h$). The viscous force produces contributions to the island dynamics that have both 'inertial' and 'dissipative' components. The dissipative component yields non-ambipolar particle transport and torques on the plasma in the symmetry direction that influence the island rotation properties. The inertial contribution produces no net torque but does produce a localized current that may partially oppose the singular Pfirsch-Schlüter current and reduces its effect on the self-consistent magnetic island width.

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C. C. Hegna
University of Wisconsin

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