Drift kinetic theory of neoclassical tearing mode physics[1]

HOWARD WILSON, York Plasma Institute, University of York, JACK CONNOR, Culham Centre for Fusion Energy, PETER HILL, KOKI IMADA, York Plasma Institute, University of York —
Orbit averaged equations for the particle responses to a small magnetic island are derived, expanding the drift kinetic equation in the ratio of island width to tokamak plasma minor radius, assumed small. Analytic solutions demonstrate that the particles follow drift orbits which have the same geometry as the magnetic island flux surfaces, but are shifted radially by an amount that is proportional to the poloidal Larmor radius (in opposite directions for opposite signs of parallel velocity). The distribution function is flattened across these drift island structures, rather than across the magnetic island. Numerical solutions of our equations confirm the existence of the drift orbits. We employ a model momentum-conserving collision operator to evaluate the consequences for neoclassical tearing mode threshold physics, implementing numerical solutions to our orbit-averaged drift kinetic equations in a "Modified Rutherford Equation".

Howard Wilson
University of York

Date submitted: 13 Jul 2016   Electronic form version 1.4