Neoclassical transport including collisional nonlinearity

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In the standard δf theory of neoclassical transport [F. Hinton and R. Hazeltine, Rev. Mod. Phys. **48**, 239 (1976)], the zeroth-order (Maxwellian) solution is obtained analytically via the solution of a nonlinear equation. The first-order correction, δf, is subsequently computed as the solution of a linear, inhomogeneous equation that includes the linearized Fokker-Planck collision operator. This equation admits analytic solutions only in extreme asymptotic limits (banana, plateau, Pfirsch-Schlüter), and so must be solved numerically for realistic plasma paramters. Recently, numerical codes have appeared which attempt to compute the total distribution, f, more accurately than in the standard ordering by retaining some nonlinear terms related to finite-orbit width, while simultaneously reusing some form of the linearized collision operator. In this work we show that higher-order corrections to the distribution function may be unphysical if collisional nonlinearities are ignored.

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