Drift-Kinetic Simulations of Neoclassical Transport *

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We present results from numerical studies of neoclassical transport for multi-species plasmas. The code, NEO, provides a first-principles based calculation of the neoclassical transport coefficients directly from solution of the distribution function by solving a hierarchy of equations derived by expanding the fundamental drift-kinetic equation in powers of ρ_{*i}, the ratio of the ion gyroradius to system size. It extends previous studies by including the self-consistent coupling of electrons and multiple ion species and strong toroidal rotation effects. Systematic calculations of the second-order particle and energy fluxes and first-order plasma flows and bootstrap current and comparisons with existing theories are given for multi-species plasmas. The ambipolar relation $\sum_a z_a \Gamma_a = 0$, which can only be maintained with complete cross-species collisional coupling, is confirmed. The effects of plasma shaping are also explored.

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