A drift-kinetic approach to neoclassical transport theory for plasmas with large toroidal rotation

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A formulation of the neoclassical transport theory for tokamak plasmas with large toroidal velocities that can be comparable to the ion thermal velocity is presented using the drift kinetic equation. In this formulation, the motion of the guiding centers is the same as in the small rotation theory, but the radial electric field is considered stronger: the ordering $E_r / B_\theta \sim \bar{v}_i$ is adopted where B_θ is the poloidal magnteic field and $\bar{v}_i$ the ion thermal velocity. A complete set of transport coefficients for both electrons and ions is calculated in the large-aspect-ratio limit in the banana regime for flux surfaces of arbitrary shape. The calculation utilizes a recently developed method of matched asymptotic expansions for particle and energy fluxes and a regular perturbation for the angular momentum flux.

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