Collisional effects in gyrokinetic particle simulation

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An electrostatic split-weight gyrokinetic particle simulation scheme [1] in two-dimensional shearless slab geometry is used to study the effect of electron-ion collisions (pitch-angle scattering) on drift instabilities and steady-state transport. Previously published results [2] indicate that the nonlinear saturation amplitude of drift modes can be greatly enhanced by (relatively weak) collisional effects, with the dominant physical mechanism underlying the saturation of the modes being the $\mathbf{E} \times \mathbf{B}$ nonlinearity. We show that this behavior can be simulated in the gyrokinetic split-weight formalism, and that one-dimensional modes (whose saturation levels are determined by the parallel velocity nonlinearity [3]) also exhibit enhanced growth rates and saturation levels in the presence of collisions. Some effects of collisions on the steady-state transport properties of the plasma are also presented, including an exploration of the balance between particle flux, collisional dissipation, and entropy production.

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