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A New Numerical Scheme to enforce Charge Conservation in Particle-in-Cells with Boltzmann Electrons[1] MOUTAZ ELIAS, DAVIDE CURRELI, University of Illinois at Urbana-Champaign, JAMES MYRA, Lodestar Research Corporation — Particle-In-Cell simulations of transient magnetized plasma sheaths including fully kinetic electrons and fully kinetic ions remain a big challenge due to the vast discrepancies in electron dynamics and ion transport timescales. Reduced electron models are typically necessary to bridge the time scale separation between the two species, the most employed being the Maxwell-Boltzmann electron approximation. However, using Boltzmann electrons typically requires to enforce global charge conservation in order to avoid spurious electrostatic oscillations. This is particularly challenging in time-dependent PIC simulations (like RF plasmas) or current-carrying plasmas, where ad hoc assumptions are typically necessary (Hagelaar, 2007). Here, we present a new numerical scheme to enforce charge conservation in Particle-in-Cells using Boltzmann electrons. The scheme is local in time, and provides the reference Boltzmann electron density at each time step in a self-consistent way. The scheme is applicable to both implicit and explicit Particle-In-Cell simulations using Boltzmann electrons. We report tests on magnetized Radio-Frequency plasma sheath as an example. Comparisons with fluid codes (J.Myra, 2015) for the same problem are also reported.

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