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Single-Ion Hall-MHD Formulation and Highly-Coupled Numerical Implementation into Hybrid Particle-in-Cell Code[1] CARSTEN THOMA, DALE WELCH, ROBERT CLARK, Voss Scientific, LLC, COMPUTATIONAL PHYSICS GROUP TEAM — The rudiments of a particle-based single-fluid two-temperature magnetohydrodynamic (MHD) algorithm have been outlined in C. Thoma, et al., Phys. of Plasmas 20, 082128 (2013). The extension of this algorithm to include the effect of Hall physics is described. An implicit leapfrog version of the algorithm, which allows timesteps large compared to the resistive decay time and other relevant timescales, has recently been added to the hybrid particle–in–cell code Chicago. In standard MHD the Hall term in the generalized Ohm's law can be neglected when the Hall parameter is small. This term must, however, be retained in regimes where it is non-negligible. A highly-coupled implicit Hall-MHD formalism is presented, in which displacement current can either be retained or neglected. A comparison of numerical and analytic dispersion analysis demonstrates the feasibility of this approach and establishes relevant constraints to assure numerical stability. The implementation of the algorithm into Chicago is described, and some preliminary simulation results in 1D and 2D in the high Hall parameter regime are given.

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