Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

Physics-based preconditioners for two-fluid electrostatic and electromagnetic models with charge separation[1] C. LEIBS, UC-Boulder, L. CHACON, D.A. KNOLL, LANL — Recently, fluid acceleration of a fully implicit kinetic particle-in-cell (PIC) simulation has been successfully demonstrated.[2,3] Central to these algorithms is robust preconditioning of the fluid system. In the context of kinetic simulations, the fluid system features conservation equations for both ions and electrons, plus field evolution equations, and must allow for charge separation effects. In this work, we concern ourselves with electrostatic and electromagnetic two-fluid models in multiple dimensions. Electromagnetic fields are prescribed via the Darwin approximation to project out spurious light-wave time scales.[4] Disparate time scales remain among the abundance of supported plasma waves. The resulting nonlinear, stiff hyperbolic PDE systems are effectively preconditioned using physics-based preconditioning ideas,[5] whereby their linearized form is transformed into parabolic PDEs that target the fast wave behavior. These elliptic systems can be efficiently inverted by multigrid methods.[6] We will demonstrate the effectiveness of the approach via numerical experiments.

[1]Work funded by LANL LDRD program.
[2]Taitano et al., SISC, 2013
[3]Chen et al., JCP, submitted.
[4]Nielson and Lewis, Meth. Comput. Phys., 1976.
[5]Knoll and Keyes., JCP 2004.
[6]Brandt., Math. Comp., 1977

Luis Chacon
LANL

Date submitted: 03 Jul 2013 Electronic form version 1.4