

Abstract Submitted  
for the DPP15 Meeting of  
The American Physical Society

**Fully implicit, energy-conserving electromagnetic particle-in-cell simulations in multiple dimensions** LUIS CHACON, GUANGYE CHEN, LANL  
— We discuss a new, implicit 2D-3V particle-in-cell (PIC) algorithm for non-radiative, electromagnetic kinetic plasma simulations, based on the Vlasov-Darwin model.<sup>1</sup> The Vlasov-Darwin model avoids radiative noise issues, but is elliptic and renders explicit time integration unconditionally unstable.<sup>2</sup> Absolutely stable, fully implicit, charge and energy conserving PIC algorithms for both electrostatic and electromagnetic regimes have been recently developed in 1D.<sup>3,4</sup> In this study, we build on these recent successes to develop a multi-D, fully implicit PIC algorithm for the Vlasov-Darwin model.<sup>5</sup> The algorithm conserves global energy, local charge, and particle canonical-momentum exactly. The nonlinear iteration is effectively accelerated with a fluid preconditioner, allowing the efficient use of large timesteps compared to the explicit CFL. We demonstrate the potential of the approach with various numerical examples in 2D-3V.

<sup>1</sup>Nielson and Lewis, *Methods Comput. Phys.* **16** p.367 (1976)

<sup>2</sup>Nielson, Lewis (1976)

<sup>3</sup>Chen, Chacón, and Barnes, *JCP* **230** p.7018 (2011)

<sup>4</sup>Chen and Chacón, *CPC* **185** p.2391 (2014)

<sup>5</sup>Chen and Chacon, *CPC*, submitted (2015)

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Date submitted: 10 Jul 2015

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