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**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.\(^1\) The Vlasov-Darwin model avoids radiative noise issues, but is elliptic and renders explicit time integration unconditionally unstable.\(^2\) Absolutely stable, fully implicit, charge and energy conserving PIC algorithms for both electrostatic and electromagnetic regimes have been recently developed in 1D.\(^3,4\) In this study, we build on these recent successes to develop a multi-D, fully implicit PIC algorithm for the Vlasov-Darwin model.\(^5\) 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.

\(^2\)Nielson, Lewis (1976)
\(^3\)Chen, Chacón, and Barnes, *JCP* **230** p.7018 (2011)
\(^4\)Chen and Chacón, *CPC* **185** p.2391 (2014)

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