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Multi-dimensional, fully implicit, exactly conserving electromagnetic particle-in-cell simulations in curvilinear geometry GUANGYE CHEN, LUIS CHACON, LANL — We discuss a new, conservative, fully implicit 2D3V Vlasov-Darwin[1] particle-in-cell algorithm in curvilinear geometry for non-radiative, electromagnetic kinetic plasma simulations. Unlike standard explicit PIC schemes, fully implicit PIC algorithms are unconditionally stable and allow exact discrete energy and charge conservation.[2] Here, we extend these algorithms to curvilinear geometry. The algorithm retains its exact conservation properties in curvilinear grids. The nonlinear iteration is effectively accelerated with a fluid preconditioner for weakly to modestly magnetized plasmas, which allows efficient use of large timesteps, $O(\sqrt{\frac{m_i}{m_e}}\frac{c}{v_{eT}})$ larger than the explicit CFL. In this presentation, we will introduce the main algorithmic components of the approach, and demonstrate the accuracy and efficiency properties of the algorithm with various numerical experiments in 1D (slow shock) and 2D (island coalescense).

[1]Nielson and Lewis, *Methods Comput. Phys.* 16, p.367 (1976)
[2]Chen, Chacón, and Barnes, *J. Comput. Phys.* 230, p.7018 (2011); Chen and Chacón, *Comput. Phys. Commun.* 185, p.2391 (2014); Chen and Chacón, *Comput. Phys. Commun.*, submitted

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