Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Pushing Particles with Exponential Integrators[1] TRI NGUYEN, University of California, Merced, ILON JOSEPH, Lawrence Livermore National Laboratory, MAYYA TOKMAN, University of California, Merced, JOHN LOFFELD, Lawrence Livermore National Laboratory — A key component in particle simulation models of plasma is solving for the trajectories of charged particles in electromagnetic fields. For strongly magnetized plasmas, this so-called particle pushing problem presents numerical difficulties due to the wide disparity in time scales between the fast timescale gyromotion and the long timescale macroscopic behavior, such as drift waves, which are the actual focus of interest in computational simulations. In other words, the problem is numerically stiff. Exponential integration is a lesser known time integration technique with excellent accuracy and numerical stability properties, and hence, offers a promising alternative to standard numerical particle pushers. For the specific case of E x B drift problems, we found that exponential integrators outperform the Boris and Buneman algorithms in terms of accuracy and computation time, even in the presence of an electric field gradient. We also discuss our current work on exploring the Hamiltonian formulation of the problem and in the development of symplectic and approximately symplectic exponential integrators for these problems.

[1]Prepared for US DOE by LLNL under Contract DE-AC52- 07NA27344

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Date submitted: 29 Jun 2020 Electronic form version 1.4