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Improved Particle Pusher Performance 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 — Simulating charged particle dynamics (particle pushing) has applications in plasma and accelerator physics and is a key component of particle-in-cell methods. In a magnetized plasma, fast oscillatory motion at the gyrofrequency imposes a severe restriction on the maximum allowable time step for standard numerical time integrators. For standard explicit methods the time steps must be smaller than the gyroperiod in order to be numerically stable. Standard implicit methods allow larger time steps but tend to dampen the oscillatory motion, thus they still need to take time steps at the scale of the gyroperiod or smaller if resolving the oscillatory gyromotion is required for accuracy. We developed a new approach to numerical time integration that has desirable numerical stability properties using exponential integrators to simulate charged particle trajectories in a strong magnetic field. Numerical experiments demonstrate accurate time integration at time steps larger than the gyroperiod with significant computational savings compared to standard numerical methods.

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