Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

Minimization of the numerical phase velocity error in Particle-In-Cell simulations for relativistic charged particle systems[1] MICHAEL MEYERS, CHENGKUN HUANG, B.J. ALBRIGHT, Los Alamos National Laboratory — The microbunching instability arises when GeV electrons interact with their coherent synchrotron radiation (CSR). Accurate particle-in-cell (PIC) modeling of this instability requires a method where the numerical phase velocity of light is very close to its physical value. This is also advantageous for mitigating the effects of Numerical Cherenkov Radiation (NCR), arising when simulating highly relativistic particles in astrophysical and high energy density laboratory settings. It has been shown that the use of a weighted stencil when calculating fields from the Ampere and Faraday laws affords a solver with a tunable phase velocity [1]. A numerical dispersion relation appropriate to the PIC algorithm with the 3D FV24 scheme has been derived. Stencil weights that minimize the phase velocity error for the CSR and NCR problems will be presented along with simulations demonstrating the comparative advantages of this approach.

[1] Mohamed F. Hadi, A Finite Volume-Based 3-D Low Dispersion FDTD Algorithm, IEEE Transactions on Antennas and Propagation, Vol. 55, No. 8, (2007)

[1]Work performed under the auspices of DOE by LANL and supported by LDRD.

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Date submitted: 12 Jul 2013 Electronic form version 1.4