

Novel Simulation Methods in the Particle-In-Cell Framework Warp*

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The Particle-In-Cell (PIC) Framework Warp [1] is being developed by the Heavy Ion Fusion Science Virtual National Laboratory (HIFSVNL) to guide the development of accelerators that can deliver beams suitable for high energy density experiments and implosion of inertial fusion capsules. It is also applied to the study and design of existing and next generation high-energy accelerators including the study of electron cloud effects, laser wakefield acceleration, coherent synchrotron radiation, etc. We will present a selection of original numerical methods that were developed by the HIFSVNL, including: PIC with adaptive mesh refinement (AMR) [2], a large-timestep mover for particles of arbitrary magnetized species [3], a new relativistic leapfrog particle pusher [4], simulations in Lorentz boosted frames [5,6], an electromagnetic solver with tunable numerical dispersion and efficient stride-based digital filtering [6]. Examples of applications of the methods to the abovementioned fields will also be given.

[1] D.P. Grote et al., *AIP Conference Proceedings*, **749**, 55-58 (2005)

[2] J.-L. Vay et al., *Phys. Plasmas* **11**, 5 (2004)

[3] R.H. Cohen et al., *Nucl. Inst. and Meth A* **577**, 52-57 (2007)

[4] J.-L. Vay, *Phys. Plasmas* **15**, 056701 (2008)

[5] J.-L. Vay, *Phys. Rev. Lett.* **98**, 130405 (2007)

[6] J.-L. Vay et al., *J. Comput. Phys.* **230**, 5908 (2011)

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