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High-performance modeling of plasma-based acceleration using the full PIC method

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Numerical simulations have been critical in the recent rapid developments of plasma-based acceleration concepts. Among the various available numerical techniques, the Particle-In-Cell (PIC) approach is the method of choice for self-consistent simulations from first principles. We report on several recent advances in PIC related algorithms that are of interest for application to plasma-based accelerators, including: (a) detailed analysis of the numerical Cherenkov instability and remediation for the modeling in laboratory and Lorentz boosted frames [1], (b) analytic pseudo-spectral electromagnetic solvers in Cartesian and cylindrical (with azimuthal modes decomposition) geometries [2,3], (c) arbitrary-order finite-difference and generalized pseudo-spectral Maxwell solvers [4], (d) novel analysis of Maxwell's solvers'stencil variation and truncation, in application to domain decomposition strategies and implementation of Perfectly Matched Layers in high-order and pseudo-spectral solvers [5,6].
[1]B. B. Godfrey, J.-L. Vay, J.Comput.Phys. 267 (2014)
[2]J.-L. Vay, I. Haber, B. B. Godfrey, J.Comput.Phys. 243 (2013)
[3]R. Lehe et al. (in preparation)
[4]J.-L. Vay et al. (in preparation)
[5]P. Lee, J.-L. Vay, Comp.Phys.Comm. 94 (2015)
[6]H. Vincenti et al. (in preparation)

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