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Fast and accurate simulations of 10 GeV-scale Laser Plasma Accelerators[1] ESTELLE CORMIER-MICHEL, BENJAMIN COWAN, NEDA NASERI, ERIC HALLMAN, JOHN R. CARY, Tech-X Corporation, CAMERON G.R. GEDDES, ERIC ESAREY, CARL B. SCHROEDER, WIM P. LEEMANS, LBNL, DAVID L. BRUHWILER, University of Colorado, Boulder — Because of their ultra-high accelerating gradient, laser plasma based accelerators are contemplated for the next generation of high energy colliders and light sources. The BELLA project will explore acceleration of electron bunches to 10 GeV in a meter long plasma, where a wakefield is driven by a PW-class laser. Particle-in-cell simulations provide guidance to experimental setup in order to improve efficiency and beam quality. Simulating low energy spread, low emittance bunches over long distances is challenging because of high frequency numerical noise that arises in those simulations. We demonstrate that using a Poisson solve to describe the bunch self-fields can reduce particle noise dramatically, enabling simulations at reasonable resolution. In addition, simulations are challenging because of the disparity of length scale between the laser wavelength (∼1 micron) that needs to be resolved and the simulation length (∼1 m). We report on recent developments of the Laser Envelope Model that has previously demonstrated orders of magnitude speedup. In particular, we present the implementation of the model in cylindrical coordinates, allowing for quite rapid prototyping of laser acceleration stages. We discuss benefits and trade-offs of this model.

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Estelle Cormier-Michel
Tech-X Corporation

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