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Resolution requirements for modeling of laser wakefield accelerators using particle-in-cell codes[1] ESTELLE MICHEL, University of Nevada, Reno (UNR), BRADLEY A. SHADWICK, CARL B. SCHROEDER, CAMERON G.R. GEDDES, Lawrence Berkeley National Laboratory (LBNL), ERIC ESAREY, WIM P. LEEMANS, LBNL and UNR, HARTMUT RUHL, TOM COWAN, UNR
— We investigate the spatial resolution required in particle-in-cell (PIC) codes for modeling laser-driven plasma-based accelerators. The grid size needed to reduce numerical noise in the PIC simulations, which manifests as macro-particle phase-space error, is determined. We show that the laser period must be resolved in the transverse direction as well as in the longitudinal direction to represent correctly the motion of the electrons in the plasma. The transverse resolution requirement is significantly higher than typically used (e.g., resolution of the transverse laser pulse shape), but is necessary to resolve the electron quiver motion in two- and three-dimensional simulations. The impact of the spatial resolution used in the PIC simulations on the momentum spread and subsequent spurious trapping in a plasma wave is investigated. This is a critical issue, since trapping of plasma electrons in laser-driven plasma wakefields is routinely modeled with PIC codes.

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