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Simulations of the Direct Laser Acceleration of Electrons Including the Use of a Customized Field Solver and Quasi-3D Geometry[1]

KYLE MILLER, FEI LI, XINLU XU, University of California, Los Angeles, NUNO LEMOS, FELICIE ALBERT, Lawrence Livermore National Laboratory, CHAN JOSHI, WARREN MORI, University of California, Los Angeles — There is interest in generating moderately relativistic electrons (10–100 MeV) to produce X-rays for the probing of hot, dense material. One way to produce such hot electrons involves using a _high-intensity picosecond laser, which generates relativistic plasma waves and goes unstable due to self-modulational and Raman scattering instabilities. In this configuration, energetic electrons are generated due to a combination of plasma wakefield acceleration and direct laser acceleration (DLA). The electrons then radiate X-rays due to their betatron motion. Recent work has shown that much of the energy contribution to hot electrons can be from the DLA mechanism, but properly determining this contribution is challenging due to numerical issues found in most particle-in-cell codes. We present a customized finite-difference field solver designed to minimize errors in the dispersion relation of light waves in vacuum and to take into account the time-staggered electric and magnetic fields. Single-particle tests show that the new solver is much more accurate when compared to theory. We present preliminary results on the acceleration mechanisms of electrons for a variety of laser pulse durations, using both three-dimensional and quasi-3D simulation geometries, with and without the new solver.

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