Abstract Submitted
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Stable boosted-frame simulations of laser-wakefield acceleration using Galilean coordinates[1] REMI LEHE, Lawrence Berkeley National Laboratory, MANUEL KIRCHEN, University of Hamburg, BRENDAN GODFREY, Lawrence Berkeley National Laboratory, ANDREAS MAIER, University of Hamburg, JEAN-LUC VAY, Lawrence Berkeley National Laboratory — While Particle-In-Cell (PIC) simulations of laser-wakefield acceleration are typically very computationally expensive, it is well-known that representing the system in a well-chosen Lorentz frame can reduce the computational cost by orders of magnitude. One of the limitation of this "boosted-frame" technique is the Numerical Cherenkov Instability (NCI) – a numerical instability that rapidly grows in the boosted frame and must be eliminated in order to obtain valid physical results. Several methods have been proposed in order to eliminate the NCI, but they introduce additional numerical corrections (e.g. heavy smoothing, unphysical modification of the dispersion relation, etc.) which could potentially alter the physics. By contrast, here we show that, for boosted-frame simulations of laser-wakefield acceleration, the NCI can be eliminated simply by integrating the PIC equations in Galilean coordinates (a.k.a comoving coordinates), without additional numerical correction. Using this technique, we show excellent agreement between simulations in the laboratory frame and Lorentz-boosted frame, with more than 2 orders of magnitude speedup in the latter case.

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