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Lattice Boltzmann simulations of Plasma Wakefield Acceleration

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We explore a novel simulation route for Plasma Wakefield Acceleration (PWFA) by using the computational method known as the Lattice Boltzmann Method (LBM). LBM is based on a discretization of the continuum kinetic theory while assuring the convergence towards hydrodynamics for coarse-grained fields (i.e., density, velocity, etc.). LBM is an established numerical analysis tool in computational fluid dynamics, able to efficiently bridge between kinetic theory and hydrodynamics, but its application in the context of PWFA has never been investigated so far. Our work takes a step forward to fill this gap. Results of LBM simulations for PWFA are discussed and compared with those of a code (Architect) implementing a Cold Fluid model for the plasma. In the hydrodynamic framework, we discuss the importance of regularization effects related to diffusion properties intrinsic of the LBM, allowing to go beyond the Cold Fluid approximations.

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