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A spectral, quasi-cylindrical and dispersion-free Particle-In-Cell algorithm[1] REMI LEHE, LBNL, MANUEL KIRCHEN, DESY, Germany, IGOR ANDRIYASH, LOA, France, BRENDAN GODFREY, University of Maryland, JEAN-LUC VAY, LBNL — Particle-In-Cell (PIC) codes are widely used today for laser-wakefield acceleration and other laser-plasma interactions. However, these codes remain very computationally intensive and still suffer from a number of numerical artifacts, especially due to numerical dispersion. These two short-comings have been addressed in two separate manner, in the context of laser-wakefield acceleration. On the one hand, the computational time can be strongly reduced in the situations with close-to-cylindrical symmetry, by using a quasi-cylindrical computational grid. On the other hand, some numerical artifacts can be suppressed by the use of pseudo-spectral analytical PIC codes, which have no numerical dispersion at all. Here we present a PIC code that combines these two advantages. The code uses of a quasi-cylindrical grid to strongly reduce the computational time, and solves the Maxwell equations in spectral space, through the use of Hankel and Fourier transforms. We show that this type code performs better than standard finite-difference PIC codes in a number of physical situations.

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