

New Algorithms for Cylindrical PIC Code - Application to Wakefield Accelerators

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Cylindrical coordinates are often used to simulate PWFA or LWFA with PIC codes, as it is much faster than using a 3D cartesian mesh while it gives similar results, thanks to the axial symmetry of the wakefield. We describe here recent advances in numerical algorithms for such PIC codes using cylindrical coordinates. First, we define new splines for macro-particles interpolation on the mesh. These splines should be specific to the cylindrical case and thus different from the standard splines used for cartesian mesh. Then, we present an adapted version to cylindrical geometry of the exact charge conservation scheme proposed by Esirkepov [1]. Finally, based on a new solver for Maxwell equations [2], we show that the numerical Cherenkov radiation can be removed, which greatly improves the accuracy of the electron beam parameters prediction. Simulations with the code CALDER-CIRC [3] are at last presented to show the effects and advantages of these new schemes.

[1] T. Zh. Esirkepov, Comp. Phys. Comm. 135, 144-153 (2001)

[2] R. Lehe et al., Phys. Rev. STAB 16, 021301 (2013)

[3] A. Lifschitz et al., J. Comp. Phys. 228, 1803-1814 (2009)

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