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Advances in QuickPIC to Enable Efficient Simulations of Plasma Wakefield Acceleration[1] QIANQIAN SU, FEI LI, University of California Los Angeles, WEIMING AN, Beijing Normal University, JEFFREY LARSON, Argonne National Laboratory, YUJIAN ZHAO, LANCE HILDEBRAND, VIKTOR DECYK, University of California Los Angeles, STEFAN WILD, Argonne National Laboratory, ANN ALMGREN, Lawrence Berkeley National Lab, WARREN MORI, University of California Los Angeles — The PWFA has emerged as a promising technology for compact accelerator stages in future advanced light-source or linear colliders. Full scale 3D simulations based on the quasi-static particle-in-cell (PIC) method are an indispensable tool for efficiently simulating complex and nonlinear physics involved in PWFA. We describe recent advances for the code QuickPIC. These include the continued development and testing of a version of QuickPIC called QPAD that expands the fields in an expansion of azimuthal harmonics that is truncated at an arbitrary order. We also describe progress in adding mesh refinement to enable simulations using witness beams with spot sizes several orders of magnitude small than the accelerator structure. The quasi-static equations are solved self-consistently on both the refined region and the entire computational domain, and the field solutions are used to advance particles following the standard QuickPIC workflow. Preliminary results will be presented. We also describe how QuickPIC has been combined with POPAS, a parallel optimization toolbox developed at ANL, to efficiently find the optimal parameters for accelerator stages based on PWFA. Preliminary results show that the toolbox can find the optimal Twiss parameters to preserve the witness beam emittance in a PWFA stage.

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