Abstract Submitted
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An unconditionally-stable numerical method for laser-plasma interactions[1] JONATHAN REYES, B.A. SHADWICK, University of Nebraska - Lincoln — We have previously presented results surveying various numerical methods for solving the one-dimensional, cold Maxwell-fluid equations in a co-moving coordinate system [1]. Here we present an unconditionally-stable, second-order implicit method that permits a much larger time step than is allowed with a stability-constrained explicit method of the same order and accuracy. As one example, for a laser with frequency $\omega = 20\omega_p$, the implicit method allows a time step 80000 times larger than the largest permissible time step of the explicit method; the size of the time step scales linearly with the wave number. The extra cost in solving implicit equations is negligible compared to the gain in computational performance. Analysis based on the linearized case shows that the dynamics of a forwards propagating mode is faithfully reproduced, while a backwards propagating mode is poorly resolved. This latter mode is inconsequential for studying the physics of laser-plasma accelerators. We assess the accuracy of this method through detailed comparisons with an existing fully-explicit method. We discuss extending this method to higher dimensional problems.

[1] J. Paxon Reyes and B. A. Shadwick, AIP Conf. Proc. 1299, pp. 256-261

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