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An Unconditionally-Stable Numerical Method for the Maxwell-fluid equations[1] J. PAXON REYES, B.A. SHADWICK, University of Nebraska-Lincoln — There is much interest in studying the evolution of a short, intense laser pulse propagating through an underdense plasma for applications in X-ray lasers, fast-ignitor fusion research, and accelerator physics. In certain circumstances, the dynamics are well-modeled by the cold, Maxwell-fluid equations. However, solving these equations using conventional second-order explicit methods in three dimensions is computationally expensive due to severe stability constraints limiting the size of the discrete time step to be a fraction of the spatial grid size. We have investigated the 1D fluid equations and identified an implicit numerical method of second order which eliminates the coupling between the time and space discretization, preserving numerical accuracy while allowing time steps to be more than a factor of 10^5 larger than the maximum time step permissible with the explicit method. We present a 2D numerical method based on this new, unconditionally-stable implicit method. We consider a pulse propagating in a pre-formed channel and examine the computational performance of the algorithm.

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