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Applying Boundary Conditions Using a Time-Dependent Lagrangian for Modeling Laser-Plasma Interactions[1] JONATHAN REYES, B. A. SHADWICK, Univ of Nebraska - Lincoln — Modeling the evolution of a short, intense laser pulse propagating through an underdense plasma is of particular interest in the physics of laser-plasma interactions. Numerical models are typically created by first discretizing the equations of motion and then imposing boundary conditions. Using the variational principle of Chen and Sudan, we spatially discretize the Lagrangian density to obtain discrete equations of motion and a discrete energy conservation law which is exactly satisfied regardless of the spatial grid resolution. Modifying the derived equations of motion (e.g., enforcing boundary conditions) generally ruins energy conservation. However, time-dependent terms can be added to the Lagrangian which force the equations of motion to have the desired boundary conditions. Although some foresight is needed to choose these time-dependent terms, this approach provides a mechanism for energy to exit the closed system while allowing the conservation law to account for the loss. An appropriate time discretization scheme is selected based on stability analysis and resolution requirements. We present results using this variational approach in a co-moving coordinate system and compare such results to those using traditional second-order methods.

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