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Relativistic Modeling Capabilities in PERSEUS Extended MHD Simulation Code for HED Plasmas[1] NATHANIEL HAMLIN, CHARLES SEYLER, Cornell University — We discuss the incorporation of relativistic modeling capabilities into the PERSEUS extended MHD simulation code for high-energy-density (HED) plasmas, and present the latest simulation results. The use of fully relativistic equations enables the model to remain self-consistent in simulations of such relativistic phenomena as hybrid X-pinches and laser-plasma interactions. A major challenge of a relativistic fluid implementation is the recovery of primitive variables (density, velocity, pressure) from conserved quantities at each time step of a simulation. This recovery, which reduces to straightforward algebra in non-relativistic simulations, becomes more complicated when the equations are made relativistic, and has thus far been a major impediment to two-fluid simulations of relativistic HED plasmas. By suitable formulation of the relativistic generalized Ohm's law as an evolution equation, we have reduced the central part of the primitive variable recovery problem to a straightforward algebraic computation, which enables efficient and accurate relativistic two-fluid simulations. Our code recovers expected non-relativistic results and reveals new physics in the relativistic regime.

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