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Nonlinear phase velocity of relativistic plasma waves driven by intense lasers[1] CARL SCHROEDER, CARLO BENEDETTI, ERIC ESAREY, WIM LEEMANS, Lawrence Berkeley National Laboratory, BRADLEY SHADWICK, University of Nebraska — The nonlinear phase velocity of a plasma wave driven by a relativistically intense short-pulse laser propagating in a cold underdense plasma is investigated. The nonlinear laser intensity transport velocity, the plasma wave phase velocity, and the evolution of the plasma wave amplitude are calculated and compared to solutions of Maxwell equations coupled to the plasma fluid. The plasma wave phase velocity is shown to be approximately the laser intensity velocity in the linear regime, and is significantly reduced in the nonlinear regime owing to laser evolution. Laser evolution (frequency red-shifting and pulse steepening) is shown to further decrease the nonlinear phase velocity as the laser propagates. In a laser-plasma accelerator, the plasma wave phase velocity determines the dephasing length of the plasma accelerating structure, and therefore the energy gain of the accelerated particle beam.

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