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Phase velocity evolution in plasma waves driven by relativistically-intense short-pulse lasers[1] C.B. SCHROEDER, E. ESAREY, B.A. SHADWICK, W.P. LEEMANS, Lawrence Berkeley National Laboratory — The phase velocity of a plasma wave driven by an intense short-pulse laser is determined by the transport velocity of the laser in the plasma (which is dependent on the laser group velocity). In this work, we investigate the nonlinear transport velocity of a relativistically-intense short-pulse laser propagating in a cold underdense plasma. Expressions for the plasma wave phase velocity dependence on the relativistic laser intensity are derived in the adiabatic and quasi-static regimes. The relativistic laser evolution (energy depletion, frequency shifting, and intensity steepening) is also considered. In a laser-plasma-based accelerator, the plasma wave phase velocity excited by the laser pulse determines the dephasing length of the accelerating structure, and therefore the upper bound on the energy gain of the accelerated charged particle beam.

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Carl Schroeder
Lawrence Berkeley National Laboratory

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