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Nonlinear pulse propagation and phase velocity of laser-driven plasma waves[1] CARLO BENEDETTI, Lawrence Berkeley Natl Lab, FRANCESCO ROSSI, Department of Physics and Astronomy, University of Bologna, Bologna, Italy, CARL SCHROEDER, ERIC ESAREY, WIM LEEMANS, Lawrence Berkeley Natl Lab — We investigate and characterize the laser evolution and plasma wave excitation by a relativistically intense, short-pulse laser propagating in a preformed parabolic plasma channel, including the effects of pulse steepening, frequency redshifting, and energy depletion. We derived in 3D, and in the weakly relativistic intensity regime, analytical expressions for the laser energy depletion, the pulse self-steepening rate, the laser intensity centroid velocity, and the phase velocity of the plasma wave. Analytical results have been validated numerically using the 2D-cylindrical, ponderomotive code INF&RNO. We also discuss the extension of these results to the nonlinear regime, where an analytical theory of the nonlinear wake phase velocity is lacking.

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Carlo Benedetti
Lawrence Berkeley Natl Lab

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