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Plasma wave phase velocity and density tapering in laser-plasma accelerators[1] CARL SCHROEDER, ERIC ESAREY, WIM LEEMANS, Lawrence Berkeley National Laboratory, WOLF RITTERSHOFER, FLORIAN GRÜNER, Ludwig-Maximilians University of Munich, BRADLEY SHADWICK, University of Nebraska, Lincoln — In a laser-plasma-based accelerator, the laser-driven plasma wave phase velocity (determined in part by the intensity transport velocity and evolution of the short-pulse drive laser) sets the dephasing length of the plasma accelerating structure and, hence, the energy gain of an accelerated particle beam. The phase velocity of a plasma wave driven by a relativistically-intense, short-pulse laser propagating in a cold underdense plasma is investigated, as well as the drive laser evolution. A relativistic beam may be phase-locked to the plasma wave using a plasma density taper, increasing the single-stage energy gain. The expression for the density taper in a plasma channel to maintain a relativistic beam at a constant plasma wave phase is presented. The optimal laser pulse duration for maximizing energy gain in a tapered plasma channel is calculated. Novel quasi-periodic plasma tapering schemes are considered.

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