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Nonlinear laser-seeded modulation instability in a proton driver plasma wakefield accelerator CARL SIEMON, VLADIMIR KHUDIK, S. AUSTIN YI, University of Texas at Austin, ALEXANDER PUKHOV, Institut fur Theoretische Physik I, GENNADY SHVETS, University of Texas at Austin — A new method for seeding the modulation instability (MI) in a proton driver plasma wakefield accelerator (PDPWA) using a CO_2 laser pulse is presented. The proton beam's envelope equation is used to analytically compare the laser seed with previously suggested seeding methods. Simulations demonstrate that a laser pulse placed ahead of a proton beam with a realistic longitudinal density profile leads to peak accelerating gradients that are comparable to those produced by other seeding methods. The nonlinear BNS damping of the MI is analytically shown to lead to instability saturation. The envelope equation is Fourier expanded into a set of coupled, nonlinear equations that describe the evolution of the beam's Fourier components. Peak beam density and peak accelerating gradient during the beam's evolution are estimated.

Carl Siemon
University of Texas at Austin

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