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Modified Corrugated Plasma Waveguide for Low Energy Electron Trapping in Direct Laser Acceleration[1] SUNG JUN YOON, JOHN PALASTRO, Institute of Research in Electronics and Applied Physics, University of Maryland, College Park, DANIEL GORDON, Plasma Physcs Division, Naval Research Laboratory, Washington DC, THOMAS ANTONSEN, HOWARD MILCHBERG, Institute of Research in Electronics and Applied Physics, University of Maryland, College Park — A laser pulse propagating in a corrugated plasma channel is composed of spatial harmonics whose phase velocities can be subluminal. The subluminal spatial harmonics can be phase matched to relativistic electrons resulting in linear energy gain over the interaction length. However, phase matching over extended acceleration lengths requires large initial electron energies. With a density ramp in the plasma channel, the phase velocity of the spatial harmonic can be gradually increased to c keeping low energy electrons in the accelerating phase over the entire interaction length. Here we examine the self-consistent interaction of the laser pulse and electron beam and low energy electron trapping in quasi-phase matched direct laser acceleration using particle-in-cell simulations. For low electron beam densities, we find that the ponderomotive force of the laser pulse pushes plasma channel electrons towards the propagation axis, causing a deflection of beam electrons. When the beam density is high, the space charge force of the beam drives the channel electrons off axis, providing collimation of the beam. In addition, by using a density ramp in the channel, the trapping energy for a normalized vector potential of $a_0 = 0.1$ is reduced from a relativistic factor $\gamma_0 = 170$ to $\gamma_0 = 10$.

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