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Abstract: GO08.00004 : Direct Laser Acceleration of Electrons using a Shaped Tilted Ponderomotive Mirror*

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While there has been success in Wakefield acceleration of electrons, there are a number of applications that could benefit from acceleration to modest energy (~MeV) by the laser field, for example, ultrafast electron diffraction and injection into higher-energy laser-driven accelerators. Here we outline our scheme for ponderomotive acceleration of electrons (and in principle, positrons) in which we control the group velocity of ultrafast pulses through pulse front tilt. Provided the intensity is above the threshold for capture of electrons, the leading part of the pulse front effectively acts like a moving mirror whose shape is controlled by the spatio-temporal topology of the intensity profile. Our analytic models of the propagation of spatially-chirped beams, simple relativistic single-particle models of the laser-electron interaction and our implementation of these beams in particle-in-cell simulations help to predict the output electron energy and direction.

We are preparing experiments on the ALEPH laser system at Colorado State University in which we will use the diagnostic techniques that we have developed to align our scaled-up design of a high-energy pulse compressor that will deliver spatially chirped pulses.

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