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Tilted Snowplow Ponderomotive Electron Acceleration with Ultrafast Laser Pulses[1] ALEX WILHELM, CHARLES DURFEE, Colorado School of Mines — Using simultaneous spatial and temporal focusing (SSTF), ultrafast laser pulses can be generated which are fully compressed only at the focal plane and which exhibit a tilted spatio-temporal intensity envelope. We propose a novel technique for ponderomotively accelerating electrons in free space using SSTF pulses where the laser effectively acts as a snowplow. The pulse front tilt (PFT) lengthens the interaction time the pulse has with the electrons which allows them to accelerate from rest while staying on the pulse. Non-relativistic and relativistic single particle analyses are presented in the adiabatic ponderomotive approximation for idealized infinitely wide pulses as well as finite width pulses. These analyses show that the acceleration intensity threshold is a function of the PFT angle and that the final electron energy is equal to four times the ponderomotive energy. We confirm the basic scheme using full-field, many particle 2D OSIRIS 4.0 particle-in-cell simulations and show how further tailoring the pulse's spatio-temporal profile enhances the electron bunch characteristics. We are currently working to implement this scheme in our lab to experimentally verify the predictions of our analyses. This ponderomotive snowplow scheme shows promise as a laboratory scale MeV-level accelerator with narrow energy and angular spreads which has applications in ultrafast electron diffraction and accelerator injection.

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