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Towards controlled laser acceleration of electrons in laser-plasma coupling regimes relevant to fast ignition[1] FEIYU LI, CHENGKUN HUANG, PRASHANT SINGH, SASIKUMAR PALANIYAPPAN, Los Alamos National Laboratory, Los Alamos, NM 87545 — Direct laser acceleration (DLA) underpins many laser-plasma coupling processes when an intense laser pulse channels through plasma and encloses under its envelope a portion of comoving relativistic electrons. It may play an important role in generating hot electron beams for fast ignition. However, DLA, in general, requires matching between the laser and beam conditions and is therefore vulnerable to the evolving nature of laser-plasma interactions. It often leads to divergent electron beams, significantly reducing the beam coupling efficiency in fast ignition. Here we propose to systematically investigate the underlying physics of DLA in order to control the process to generate desired beam qualities. To this end, we build a simplified model that can describe the evolution of the electron phase-space dynamics. The differences between linear and circular laser polarizations are identified. The onset criteria of DLA and the weighting of DLA over plasma acceleration are analyzed. Key properties of the resulting electron beams when DLA dominates are presented. Potential ways to manipulate the DLA beams towards desired qualities are explored. These results are augmented by particle-in-cell simulations that address the non-ideal initial conditions as well as the effects of evolving laser-plasma dynamics. The implications for near-term experiments under design are also discussed.

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