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Ionization-induced injection in laser-plasma accelerators[1] MIN CHEN, ERIC ESAREY, CAMERON GEDDES, CARL SCHROEDER, WIM LEEMANS, Lawrence Berkeley National Laboratory — Ionization injection into a laser plasma accelerator is studied analytically and by particle-in-cell (PIC) simulations. Details of the injection mechanism, and the dependence of electron injection number and beam quality on the gas and laser parameters are analyzed. Simulations show low energy spread beams can be generated using a short region of gas mixture (H and N) to trap electrons, followed by a region of pure H, that is injection-free, for acceleration. Effects of gas mix parameters, including species, concentration, and length of the mixture region, on the final electron injection number and beam quality are studied. Regimes where injection number linearly increases with the gas length or saturates are found. In the linearly increasing regime, the final beam energy spread is found to be proportional to the gas length. Laser polarization effects on injection number and final electron emittance are studied. Two-dimensional PIC simulations have been used to study the ionization injection process in the bubble regime. With proper injection parameters, tens of pC, mono-energetic electron beams with energy spread less than 1% can be produced in a mixed gas.

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