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Phase space dynamics of ionization injection in plasma based accelerators X.L. XU, J.F. HUA, F. LI, Tsinghua University, Beijing, W. LU, Tsinghua University, Beijing; University of California Los Angeles, P. YU, W. AN, W.B. MORI, C. JOSHI, University of California, Los Angeles — The evolution of beam phase space in ionization-induced injection into plasma wakefields is studied using theory and particle-in-cell (PIC) simulations. The injection process causes special longitudinal and transverse phase mixing leading initially to a rapid emittance growth followed by oscillation, decay, and eventual slow growth to saturation. An analytic theory for this evolution is presented that includes the effects of injection distance (time), acceleration distance, wakefield structure, and nonlinear space charge forces. Formulas for the emittance in the low and high space charge regimes are presented. The theory is verified through PIC simulations and a good agreement is obtained. This work shows how ultra-low emittance beams can be produced using ionization-induced injection.

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