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Investigating the Transverse Trapping Condition in Beam-Induced-Ionization-Injection in Plasma Wakefield Accelerators

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Plasma wakefield accelerators (PWFA) have demonstrated acceleration gradients of tens of GeV per meter. For injecting high-quality electron beams, a method called beam-induced ionization injection (B-III) is proposed. In this method, the drive beam field increases as its slice envelope oscillates to its minimum value due to the betatron oscillations and releases impurity plasma electrons that are then injected. Controlling the trailing beam qualities requires an understanding of a transverse trapping mechanism. In this poster, we will present our research based on the injection of the ultrashort, femtosecond electron beams using B-III.
To investigate the formation of a trailing beam, we will track ionized electron motions in the Particle-In-Cell(PIC) simulation field maps using our eTracks code. The trailing beam quality will be shown based on the simulation results. We will also present that a critical Hamiltonian has to be satisfied for the trapped electrons. This critical condition can also be noticed as a transverse trapping condition in the transverse phase space. We are investigating the formalism for the threshold Hamiltonian value or the critical condition in transverse phase space.

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