

Schemes of Electron Beam Loading in Blowout Regime in Plasma Wakefield Accelerators

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Many impressive experimental results in electron acceleration have been achieved using wakefields excited in a plasma. Plasma-wakefield acceleration provides high accelerating gradients and promises compact accelerators of high brightness and high-energy electron beams. Future applications of plasma-wakefield accelerators, in particular, particle colliders and free-electron lasers strongly benefit from or demand low energy spread beams, small emittances, high charge, large transformer ratios, and high-efficiency operation. The simultaneous achievement of these properties requires the formation of plateaus in both the accelerating field for witness bunches and the decelerating fields for driver bunches. Plateau formation is facilitated by controlled beam loading with carefully shaped current profiles. We demonstrate by numerical simulation optimal beam loading conditions in a blowout electron-driven plasma accelerator.

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