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Studies of Beam-Channel Misalignment in the Hollow Channel Plasma Accelerator in Nonlinear Regime

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Hollow plasma has been demonstrated in favor of beam quality preservation in the proton-driven plasma wakefield accelerators, where the transverse wakefields acting on the accelerated beam vary in radius and time in uniform plasma even in the nonlinear regime. With hollow plasma, there is completely no transverse plasma wakefields. However, this scheme requires perfect beam-channel alignment. Otherwise asymmetric and non-zero transverse wakefields along the axis are induced, which could distort the driving bunch and ruin the witness beam quality. In this paper, by means of particle-in-cell simulations, we examine the transverse wakefields and potential detrimental effects on the witness bunch induced by the driving beam-channel offset and initial driver tilt. By analyzing the beam dynamics, we propose and assess corresponding solutions to such misalignment issues.

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