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Energy stablization of high-charge electron bunches from Plasma Wakefield Acceleration

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Plasma Wakefield Acceleration (PWA) promises to reduce the scales of advanced light sources and high-energy colliders due to its ultrahigh accelerating gradients. However, the relatively large energy jitter and energy spread (typically 1~10% level) of the electron bunches generated by PWAs remain a major obstacle for practical applications. In this work, we propose two independent schemes: 1) a combination of a laser-driven active plasma dechirper and a passive plasma dechirper with two magnetic chicanes; and 2) a beam-driven active plasma dechirper integrated with a magnetic chicane. The simulation results demonstrate that these schemes can reduce both energy jitter and energy spread of PWA-generated electron beams with charges ranging from hundreds of pC to several nC from the 1% level to 0.1% or lower. In addition, we preliminarily study the transverse coordinate offsets induced by the coherent synchrotron radiation effect in chicanes, as well as the feasibility and experimental design of these schemes.

Footnotes

Funding Agency

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Yes

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