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Generation of an attosecond FEL-quality beams in plasma wakefield accelerators

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Plasma wakefield accelerators (PWFA) have showcased remarkable acceleration gradients, reaching tens of GeV per meter. In this method, the accelerating structure is a highly nonlinear charge-density wave in a plasma, which is excited by an ultrarelativistic electron beam. Advancements in generating FEL-quality, attosecond electron beams represent the forefront of this field. In this work, we introduce a novel approach to inject a high-quality electron beam using beam-induced ionization injection with a driver-injector beam configuration. We will explain the physical underpinnings of this design using analytical plasma wakefield theory and present supporting Particle-In-Cell simulation results that show the potential for creating beam with ˜500 attosecond duration, hundreds of nanometer emittance, and less than 1% energy spread. We will present the prospects of realizing this beam experimentally at FACET II facility at SLAC. Finally, parameters of attosecond X-ray FEL driven by this beam and simulated by Genesis will be presented.

Footnotes

Funding Agency

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