Contribution ID: **85** Type: **not specified**

Generation of an ultrashort beam using Beam-Induced Ionization Injection in PWFAs

Thursday, 25 July 2024 13:50 (20 minutes)

Plasma wakefield accelerators (PWFA) have showcased remarkable acceleration gradients, reaching tens of GeV per meter. Advancements in generating high-quality beams via self-injection schemes and pursuing 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 (B-III) with a driver-injector beam configuration. In B-III, the field of a particle beam intensifies as its slice envelope oscillates towards its minimum value due to the betatron oscillation, whereby it further ionizes electrons of an impurity element for subsequent injection. We will explain the physical underpinnings of this design using analytics plasma wakefield theory and present supporting Particle-In-Cell (PIC) simulation results that show the potential for creating an injected beam with ~500 attosecond duration, hundreds of nanometer emittance, and less than 1% energy spread. Furthermore, we will present the prospect of realizing this beam experimentally at FACET II, where the desired driver-injector beam configuration would be attained by control over compression and selection of the beam phase space using a collimator. This technique is routinely performed for generating two beams in drive-trailing PWFA experiments at FACET II. Results from Lucretia, a physics toolbox simulating electron beam through FACET-II transportation line, will be presented to demonstrate the feasibility of generating the required drive-injector beam. Finally, we will present the potential application of the injected beam in generating attosecond Free Electron Laser (FEL).

Working group

WG3 : Beam-driven plasma acceleration

Primary authors: YAN, Jiayang (Stony Brook University); VAFAEI-NAJAFABADI, Navid (Stony Brook University); ZHANG, Xuan (Stony Brook University)

Co-authors: LITVINENKO, Vladimir (Stonybrook University); JING, Yichao (BNL); WANG, Gang (Brookhaven National Laboratory)

Presenter: YAN, Jiayang (Stony Brook University)

Session Classification: WG3