Contribution ID: **148** Type: **Contributed Oral**

Plasma-based longitudinal phase space manipulation

Tuesday, 8 November 2022 14:45 (15 minutes)

High-brightness electron beams are crucial for tremendous scientific applications, such as linear colliders, free-electron lasers (FEL) and accelerator-based coherent terahertz (THz) radiation sources. For these applications, precise manipulation of the beam longitudinal phase space (LPS), namely shaping the beam temporal and energy profiles, is of great importance. Here we present a novel method for tailoring the beam LPS by means of self-generated plasma wakefields. Physically, the passage of the beam through a plasma section excites a strong longitudinal wakefield that acts to remove or imprint any time-energy correlation. Based on this solution, we experimentally demonstrate that a plasma-based passive "dechirper" can be utilized to remove the beam's linear energy chirp, leading to a tenfold reduction in the beam energy spread. Additionally, we demonstrate that by properly adjusting the density, the plasma can also act as a tunable "linearizer" to significantly compensate for the nonlinear energy chirp imprinted on the beam, resulting in a fourfold reduction in energy spread. Furthermore, we propose that a plasma-based "modulator" can also imprint a sawtooth periodic energy modulation on the beam. Such energy modulation is then effectively converted into the beam density modulation by means of magnetic optics, forming micro-bunches with tunable picosecond spacing and a bunching factor as high as 0.8, which can be used to produce narrowband THz radiation with energies ranging from mJ to 10 mJ. These plasma-based advanced LPS manipulation techniques will significantly improve the performance of accelerator-based scientific facilities.

Acknowledgments

Primary authors: WU, Yipeng (UCLA); Ms HUA, Jianfei (Tsinghua University); Mr ZHOU, Zheng (Tsinghua University); Mr ZHANG, Jie (Tsinghua University); Mr LIU, Shuang (Tsinghua University); Mr PENG, Bo (Tsinghua University); Mr FANG, Yu (Tsinghua University); NIE, Zan (UCLA); ZHANG, Chaojie (UCLA); Mr DU, Yingchao (Tsinghua University); LU, Wei (Tsinghua Univeristy); MORI, Warren (UCLA); JOSHI, Chan (UCLA)

Presenter: WU, Yipeng (UCLA)

Session Classification: WG4: Beam-Driven Acceleration

Track Classification: Working Group Parallel Sessions: WG4 Oral: Beam-Driven Acceleration