



Contribution ID: 217

Type: **Contributed Oral**

Wakefield-based afterburner for increasing the spectral range of X-FELs

Thursday, 10 November 2022 11:30 (15 minutes)

Advanced accelerator techniques based on collinear wakefield accelerations have demonstrated the capability of achieving very high accelerating fields. These schemes are based on passing a high charge driver electron beam in a plasma or near field structure which results in high rate energy extraction. In this process a strong wakefield is left behind that can be used for high gradient acceleration of a properly injected trailing electron bunch. Generation of tunably spaced high energy bunches is in fact common in modern XFEL beamlines which strive to provide pump and probe and multi-color capabilities to the most advanced X-ray users. In this paper, we propose to leverage some of these developments and take advantage of the many shaping techniques developed at FEL beamlines to generate a bunch pair suitable to be injected into a collinear wakefield-based high gradient acceleration section. This will result in a significant boost in the beam energy of the trailing beam which can be used to ease lasing (and increase the radiated power) at very short wavelengths or even to extend the spectral reach of current XFELs.

Acknowledgments

DOE grant No. DE-SC0009914

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Session Classification: WG4: Beam-Driven Acceleration

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