Contribution ID: **200** Type: **Contributed Oral**

Optical mode filtering and electron injection in multi-GeV laser wakefield acceleration

Tuesday, 8 November 2022 13:30 (20 minutes)

Recent experiments [1] have demonstrated acceleration of electron bunches up to 5 GeV in long (20 cm) low density (~10^17 cm^-3) ionization-injected plasma waveguides [2]. The spectra of the recorded electron bunches showed multiple quasi-monoenergetic peaks with resolution limited energy spreads ~15%. For eventual development of a 10 GeV laser wakefield acceleration (LWFA) module for a staged electron accelerator, it is essential that the lower energy peaks in the spectra be eliminated. Analysis of the results in [1] suggests that the multiple peaks correspond to localized injection enhancement (or suppression), exacerbated by fluctuations in the drive laser pointing and longitudinal waveguide variations, both of which strongly affect the guided mode evolution. Here, we present experimental results and particle-in-cell simulations detailing the linear and non-linear effects contributing to guided mode evolution and electron injection. We discuss how the early part of a meter-scale plasma waveguide can be used as a 'mode filter' to ensure controllable electron injection in multi-GeV LWFAs.

[1] B. Miao et al., "Multi-GeV electron bunches from an all-optical laser wakefield accelerator", arXiv:2112.03489 (2021).

[2] L. Feder et al., "Self-waveguiding of relativistic laser pulses in neutral gas channels", Phys. Rev. Res. 2, 043173 (2020).

Acknowledgments

This work was supported by the US Department of Energy (DESC0015516, LaserNetUS DE-SC0019076 / FWP#SCW1668, and DE-SC0011375), and the National Science Foundation (PHY1619582 and PHY2010511).

Primary authors: SHROCK, Jaron (University of Maryland); MIAO, Bo; Ms ROCKAFELLOW, Ela (University of Maryland, College Park); Dr MILCHBERG, Howard (University of Maryland, College Park)

Co-authors: PICKSLEY, Alexander (LBNL); HOLLINGER, Reed (Colorado State University); Dr WANG, Shoujun (Colorado State University); ROCCA, Jorge (Colorado State University)

Presenter: SHROCK, Jaron (University of Maryland)

Session Classification: WG1: Laser-Plasma Wakefield Acceleration

Track Classification: Working Group Parallel Sessions: WG1 Oral: Laser-Plasma Wakefield Acceleration