Contribution ID: **21** Type: **Contributed Oral**

Stabilization and manipulation of laser-driven plasma acceleration with a weak auxiliary laser pulse

Monday, 7 November 2022 14:10 (20 minutes)

We show that uncontrolled phase fluctuations within an outer annulus of the near-field profile of a laser-wakefield drive pulse are primarily responsible for shot-to-shot fluctuations in the energy, charge, and pointing of wakefield-accelerated electrons. When a mask removes this unstable annulus, RMS fluctuations decrease by more than half without compromising average electron energy substantially. When light from the removed annulus is re-shaped into a co-polarized pulse that peaks on axis and co-propagates at controlled delays -120 < Δt < 120 fs with respect to the 10× more intense drive pulse, fluctuations in electron and betatron x-ray properties reappear, peaking in amplitude when the weak pulse overlaps either the drive pulse (Δt = 0) or accelerating electrons and the tail of the drive pulse (Δt ≈ 30 fs). In the latter case, a net increase in average electron energy is observed. The results suggest the possibility of precisely and widely tuning the properties of laser-wakefield-accelerated electrons using a comparatively weak auxiliary pulse with a stable, independently controlled carrier envelope phase.

Acknowledgments

U.S. Dept. of Energy Grant DE-SC0011617; Helmholtz Association under program Matter & Technology, topic Accelerator R & D; U.S. Dept. of Energy grants DE-SC0007889 and DE-SC0010622.

Primary authors: Dr BOWERS, Brant (The University of Texas at Austin); RUDZINSKY, Ross (The University of Texas at Austin); MAX, LaBerge (The University of Texas at Austin); DOWNER, Michael (The University of Texas at Austin); Dr COUPERUS-CABADAG, Jurjen (Helmholtz-Zentrum Dresden-Rossendorf); Dr CHANG, Yen-Yu (Helmholtz-Zentrum Dresden-Rossendorf); Dr IRMAN, Arie (Helmholtz-Zentrum Dresden-Rossendorf); PÜSCHEL, Thomas (Helmholtz-Zentrum Dresden-Rossendorf); UFER, Patrick (Helmholtz-Zentrum Dresden-Rossendorf); Prof. SCHRAMM, Ulrich (Helmholtz-Zentrum Dresden-Rossendorf); Dr WANG, Tianhong (Cornell University); Prof. SHVETS, Gennady (Cornell University)

Presenter: DOWNER, Michael (The University of Texas at Austin)

Session Classification: WG5: Beam Sources, Monitoring, and Control

Track Classification: Working Group Parallel Sessions: WG5 Oral: Beam Sources, Monitoring, and Control