

High-Quality Electron Beams from Ionization-Induced Self-Trapping in the Strong Blow-out Regime of Beam-Driven Plasma Wakes.

Wednesday, June 5, 2013 7:00 PM (15 minutes)

A new strategy for controlled ionization-induced trapping of electrons in beam-driven plasma wakes is proposed.

The method exploits the strong wakefields excited by a longitudinally asymmetric ultra-relativistic electron-beam driver operating in a strong blow-out regime in order to selectively tunnel-ionize and trap electrons from a dopant species of high ionization potential. This work demonstrates the injection mechanism by means of 3D particle-in-cell simulations using the code OSIRIS. In these simulations an electron beam with a triangular current profile propagates through a precreated plasma of density $5 \times 10^{17} \text{ cm}^{-3}$ and excites strong wakefields. When these wakes cross a thin plasma column of $1000 \mu\text{m}$ doped with neutral helium, they trigger ionization and trapping of 3.8 pC of electrons in a 700 attoseconds long region of the wakefields phase-space.

The trapped electron bunch is subsequently accelerated within a distance of 75.2 mm to energies of up to 4 GeV with a relative energy spread of 1% , normalized transverse emittances of $1 \mu\text{m}$ and a peak current of 3 kA .

Primary author: Dr MARTINEZ DE LA OSSA, Alberto (DESY)

Co-authors: Dr BEHRENS, Christopher (DESY); Dr OSTERHOFF, Jens (Deutsches Elektronen-Synchrotron DESY); Dr GREBENYUK, Julia (DESY); Mr MEHRLING, Timon (DESY)

Presenter: Dr MARTINEZ DE LA OSSA, Alberto (DESY)

Session Classification: WG1+6

Track Classification: WG1+6