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Determining the matching codition of an electron beam to a plasma ion column

Tuesday, 23 September 2025 19:00 (1h 30m)

AWAKE aims to produce electron bunches with parameters suitable for fixed target experiments: 50-200GeV, percent level energy spread, and mm-mrad normalized emittance. The proton-driven plasma wakefield accelerator uses self-modulation of the long, narrow proton bunch to reach accelerating gradient of around 1GeV/m. To reach these parameters, the electron bunch must create its own blowout, i.e., its density must be larger than the plasma density. It must be matched to the focusing force of the ion column, and load wakefields driven by the proton bunch [1]. The plasma is created by ionization of a rubidium vapor by a backward-propagating laser pulse. We use numerical simulations to determine whether the matching condition could be determined experimentally, by measuring the energy spectrum of the bunch as a function of the relative timing between the bunch and laser pulse, without the proton bunch. Varying the delay, the bunch can enter the plasma focusing, at its waist, or defocusing. The beta function of the beam is around 4mm, delays of +/-60ps cover +/- two beta functions. Determining parameters for the matching condition would greatly simplify injection experiments in the presence of the proton bunch.

[1] V. K. Berglyd Olsen et al., PRAB 21, 011301 (2018)

Primary author: TURNER, Marlene (CERN)

Co-author: MUGGLI, Patric (Max-Planck-Institut für Physik)

Presenter: TURNER, Marlene (CERN)

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