Contribution ID: **194** Type: **talk**

Measuring Transverse Displacement Between the Drive and Witness Beam for PWFA

Tuesday, 17 September 2019 18:20 (20 minutes)

Future beam-driven plasma wakefield accelerator (PWFA) experiments at the Facility for Advanced Accelerator Experimental Tests (FACET-II) will require several detectors monitoring a multitude of plasma and electron bunch parameters. We present simulations demonstrating the ability of an electro-optic sampling beam position monitor (EOS-BPM) to analyze the femtosecond electron bunches that will be employed at FACET-II. This diagnostic consists of two electro-optic crystal stationed on either side of the beamline. The electric fields co-propagating with the electron bunches induce a birefringence in the crystals which is probed via a chirped laser pulse allowing for a single, non-destructive measurement of the longitudinal profile of the bunches. In addition, the use of two EO crystals allows for determination of the relative transverse offset of the two bunches by leveraging the signal strength dependence on the proximity of each bunch to a given crystal. Utilizing the experimental parameter set for FACET-II, we study the optimal configuration for the laser and crystals and calculate the expected longitudinal and transverse resolution.

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Session Classification: WG5

Track Classification: WG5 - Plasma devices, plasma and beam diagnostics