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Progress Towards Measurement of Shaped Electron Bunch at the Argonne Wakefield Accelerator using Phase Diversity Electro-Optic Sampling

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Longitudinally shaped electron bunches are useful in wakefield acceleration, allowing for transformer ratios greater than 2. Electro-optic sampling can provide an accurate and non-destructive determination of the electron bunch current profile by measuring the transverse terahertz electric field of the electron bunch. Specifically, electro-optic sampling using the phase diversity reconstruction algorithm has been shown to provide an accurate picture of ultra-short bunch profiles, as well as long bunches and bunch trains requiring long data acquisition windows. In addition bunch profile monitoring, this setup can also be used to measure bunch arrival-time and bunch charge. In this paper, we discuss our work on designing and engineering an electro-optic sampling setup employing phase diversity at the Argonne Wakefield Accelerator (AWA). This includes a tabletop measurement of a THz pulse created via optical rectification using a regenerative amplified Titanium Sapphire laser pulse, a beamline measurement of the electron beam current profile using transition radiation, and a design for a beamline measurement of the electron bunch Coulomb field. We also include finished simulations of shaped electron beam reconstructions using the phase diversity algorithm using different crystal species, crystal thicknesses, and laser bandwidths from first principles.

Working group

WG5 : Beam sources, monitoring and control

Primary author: KELHAM, Spencer (Northern Illinois University)

Co-authors: PIOT, Philippe (Argonne); HA, Gwanghui (ANL); Dr YANG, Yawei (Argonne National Lab)

Presenter: KELHAM, Spencer (Northern Illinois University)

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