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Single-Shot Ionization-Based Monitor for Pulsed Electron Beams

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We present an experimental demonstration of a single-shot, non-destructive electron beam diagnostic based on detecting the ionized particles generated by the passage of the primary beam through a low density pulsed gas sheet.
Efficient detection of the ionization events, coupled with a flexible electrostatic column design, allows the retrieval of information on beam charge, centroid position, and transverse profile at the gas plane.
In our study, we used up to 100~pC, 7~MeV electron bunches from a radio frequency photoinjector, traversing through a localized nitrogen gas distribution. For varying electron beam parameters, the interaction with the N_2 gas produces a correlated signature in the ionized particle distribution, which is spatially magnified by a series of electrostatic lenses and recorded using a micro-channel-plate detector.
By adjusting the voltages on the electrostatic column, various modalities including point-to-point imaging and velocity mapping are explored for both ions and secondary electrons.

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