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High-dimensional and ultra-sensitive diagnostics for electron beams

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Detailed knowledge of particle beam properties is of great importance to understand and push the performance of existing and next generation accelerators. This includes full knowledge of the particle distribution but also the characterization of femtocoulomb (fC) charge beams. We recently proposed a new phase space tomography method to reconstruct the full 5-dimensional (5D) phase space, i.e., the charge density distribution in all three spatial directions and the two transverse momenta. In this contribution, we first present the experimental demonstration of the method at the FLASHForward facility at DESY. This includes the reconstruction of the full 5D phase space distribution of an electron bunch, the use of this measured phase space to create a particle distribution for highly-realistic simulations, and the extraction of the 4D slice emittance. In a second part, we address the characterization of fC charge beams and present a diagnostic device based on silicon strip sensors that is able to measure the profile, time structure, and charge of beams with low charge density. The device demonstrates the applicability of silicon sensors as versatile beam instrumentation devices and can extend the capabilities of existing diagnostic devices to a new charge range.

Footnotes

Funding Agency

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Yes

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