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Generalized Phase-Space Tomography for Intense Beams[1]

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Many applications of accelerators, such as free electron lasers, pulsed neutron sources, and heavy ion drivers for warm dense matter experiments require good quality beams with high intensity, i.e., cold, high-current beams. At the low-energy end of such machines, collective interactions from space charge dominate the beam dynamics and the beam can be viewed as a nonneutral plasma capable of carrying waves. Consequently, the initial beam distribution significantly affects its downstream behavior and beam characterization at the source is an important requirement to understand its evolution. This work reports on a novel diagnostic for time-dependent beam phase space characterization by using tomographic techniques. Tomography here is the reconstruction of phase space from a number of projections onto configuration space. Application of tomography to beams with space charge is non-trivial since it involves assumptions about the beam distribution one is trying to measure.This talk will address this issue, as well as the implementation of this diagnostic to both solenoidal and quadrupole focusing lattices. Also discussed will be a series of proof-of-principle experiments conducted at the University of Maryland to test the diagnostic. The tomography is benchmarked both against self-consistent simulation using a particle-in-cell code and against a pinhole-scan direct experimental sampling of phase-space.

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