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Extended phase space tomography for EOSD simulation considering crystal geometry effects

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This theoretical study presents an advanced method for longitudinal phase space tomography in electron storage rings, focusing on reconstructing phase space densities from electro-optical spectral decoding (EOSD) measurements that incorporate crystal geometry effects. The EOSD crystal geometry significantly impacts the measurement signal due to signal integration along its length and interference from wake fields and Cherenkov diffraction radiation (ChDR). These effects add challenges to reconstructing the original phase space density from experimental data.
To address these challenges, we integrate two theoretical frameworks. First, we employ the Vlasov-Fokker-Planck equation to model the turn-by-turn evolution of the charge density distribution. Second, CST simulations of the bunch profile characterize the electric field inside the crystal, enabling a tailored simulation for the EOSD system at the Karlsruhe Research Accelerator (KARA). By combining these approaches, we propose a refined tomography method that more accurately reconstructs the longitudinal phase space from sensor data, effectively capturing the interplay between bunch dynamics and the EOSD system configuration.

Footnotes

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Europe

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