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Simulation-based optimization of the injection of ultrashort non-Gaussian electron beams into a storage ring

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The compact STorage ring for Accelerator Research and Technology (cSTART) project at the Karlsruhe Institute of Technology (KIT, Germany) aims to explore non-equilibrium electron beam dynamics and injection of laser-plasma accelerator (LPA) bunches. The Very Large Acceptance compact Storage Ring (VLA-cSR) is also filled by a second injector that delivers ultra-short bunches from the linear accelerator FLUTE Injection from FLUTE. Injection from FLUTE into the VLA-cSR is achieved via a complex 3D injection line featuring tilted deflections, negative dispersion, and extreme compression to femtosecond bunch lengths.

This contribution discusses the transverse fitting of strongly non-Gaussian beams into the VLA-cSR with a focus on distorted phase spaces. The effects of the optics of the injection line on the bunches and their matching to the periodic solution of the VLA-cSR, momentum acceptance (MA) and dynamic aperture (DA) are analyzed using elegant simulations. A complete 6D phase-space analysis is used to optimize the magnet optics in order to achieve ideal matching conditions in the storage ring.

Footnotes

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