



Contribution ID: 42

Type: **Talk**

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

Friday 27 June 2025 09:40 (20 minutes)

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 for the first time. The Very Large Acceptance compact Storage Ring (VLA-cSR) is also filled by a second injector that delivers ultra-short bunches from the Ferninfrarot Linac- Und Test-Experiment (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.

From this transport, the bunch develops pronounced non-Gaussian tails; nevertheless, near the injection point, it is crucial to ensure matching to both the dynamic aperture and the periodic solutions of the storage ring dynamics. With a total of 25 quadrupoles, conventional optimization methods become impractical. This contribution presents the development of the magnet optics to meet these extreme requirements. The optimization task was divided into two parts: longitudinal compression was partially addressed using a surrogate model, while transverse matching is currently being pursued with Bayesian optimization.

Summary

Primary author: SCHÄFER, Jens (KIT IBPT)

Co-authors: HAERER, Bastian (Karlsruhe Institute of Technology (KIT)); Dr XU, Chenran (Argonne National Laboratory); SCHUH, Marcel (KIT - ANKA); SCHWARZ, Markus (KIT); FUCHS, Matthias; Dr RUPRECHT, Robert (IBPT)

Presenter: SCHÄFER, Jens (KIT IBPT)

Session Classification: Beam Dynamics

Track Classification: Beam dynamics