

# Physics and Applications of High Brightness Beams



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## **SEALab's Superconducting Radio-Frequency Photoinjector: Enabling Advanced Accelerator Research for Ultrafast Scattering and Sustainable Accelerator Technology**

The SEALab accelerator test facility is currently commissioning the superconducting radio-frequency photoelectron injector (SRF photoinjector), which has the potential to cover a wide range of beam parameters. With the ability to accelerate electron bunches from femtoseconds to picoseconds in length, with a charge range from femtocoulombs to nanocoulombs, the SRF photoinjector can produce beam energies of up to a couple of MeV at MHz repetition rates. Leveraging the legacy of the energy-recovery linac (ERL) test facility bERLinPro, which is the foundation of SEALab, the SRF photoinjector can be operated at a very high repetition rate with energy recovery (ERL), providing a sustainable platform for fundamental accelerator research into novel, energy-efficient electron accelerators. This paper details the preparatory work for two applications, the first being the use of the SRF photoinjector as a direct beam source for ultrafast scattering experiments with high six-dimensional (6D) coherence, and the second being experiments towards an ERL application for high-energy physics at high average current.

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