AKBP 2: Electron Accelerators and Sources II

Time: Monday 11:00–12:30 Location: SCH/A117

Topical Talk AKBP 2.1 Mon 11:00 SCH/A117

From ELBE to DALI - Superconducting Electron Accelerators in Dresden — •Andreas Wagner[1,2], Ulf Lehnert[1], Andre Arnold[1], Manfred Helm[3,4], Sebastian Mährlein[1,4], Raffael Niemczyk[1], and Rong Xiang[1] — [1]Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Institute of Radiation Physics — [3]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum D — [4]Dresden University of Technology, Dresden, Germany

The Helmholtz-Zentrum Dresden-Rossendorf successfully operates the superconducting ELBE (Electron LINAC with High Brilliance and Low Emittance) accelerator to produce a variety of secondary photon and particle beams. ELBE serves an international user community involved in fundamental studies in nuclear physics, radiation biology, solid-state physics, chemistry, materials science, detector characterisation, positron interactions with matter, and materials control using high-field THz radiation. Based on the experience of the existing user facility and after more than 20 years of operations, the DALI (Dresden Advanced Light Infrastructure) concept for a successor facility with an enhanced frequency range for high-field THz radiation ranging from 0.1 to 30 THz, a high intensity positron source, and ultra-fast electron diffraction has been developed. In 2025, DALI was promoted to the national shortlist of research infrastructures. This contribution will cover the scientific motivations, the implementation of the machine, and the proposed auxiliary instruments and end stations.

AKBP 2.2 Mon 11:30 SCH/A117

CW e- beam from SRF gun for multifunctional accelerator facility ELBE — •Rong Xiang, André Arnold, Andreas wagner, Stefan Gatzmaga, Petr Murcek, Raffael Niemczyk, Anton Ryzhov, Jochen Teichert, and Gowrishankar Hallilingaiah — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany

The ELBE center for high-power radiation sources is a compact, accelerator-based facility that provides a wide range of radiation types to its users, including gamma rays, IR- Free-Electron Lasers (FELs), THz radiation, positrons and electron beams, for various applications in materials science, medicine, and nuclear physics.

The development of new continuous-wave (CW) electron source with high bunch charges represents a significant advancement in enhancing the overall performance of ELBE. By combining the well-established radio-frequency (RF) with superconducting (SC) technology, it is able to realize CW operation at high gradient. The robust semiconductor photocathode Cs2Te shows a stably high quantum efficiency (QE) during the gun operation.

SRF Gun II has been routinely operated since 2018 for THz user experiments, delivering high bunch charges (200 pC at 100 kHz) with excellent stability and reliablity. In 2024, SRF Gun II achieved a record current of 0.6 mA in CW mode and drove the IR-FEL for a highly sensitive s-SNOM experiment. Recently the first ultrafast electron diffraction (UED) patterns of MoO3 sampple were obtained, demonstrating its outstanding stability and high beam quality.

AKBP 2.3 Mon 11:45 SCH/A117

Status and Perspectives of the Photo-CATCH Photocathode Test Stand* — •Maximilian Herbert, Joachim Enders, Markus Engart, Robin Petry, and Vincent Wende — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

TU Darmstadt's test stand for Photo-Cathode Activation, Testing and Cleaning using atomic-Hydrogen Photo-CATCH faciliates dedicated research on GaAs photocathodes for electron-beam production at accelerators. Recent results include successful tests of automatized activation [1] and improved photocathode lifetime using an enhanced Cs-O-Li surface layer [2,3]. This contribution will present the current status of Photo-CATCH and work planned in the near future.

[1] M. Herbert et al., PoS(PSTP2022), Vol. 433, p. 003 (2023).
[2] N. Kurichiyanil et al., J. Instrum. 14 (8), P08025 (2019).
[3] M. Herbert et al., Phys. Rev. Accel. Beams 28, 013401 (2025).

*Work supported by DFG (Project-ID 264883531 - GRK 2128 "AccelencE", and Project-ID 499256822 - GRK 2891 "Nuclear Photonics")

AKBP 2.4 Mon 12:00 SCH/A117

Status of the Hybrid Electron Gun Development at ELSA — •Samuel Kronenberg, Klaus Desch, Ben Simon Gatzsche, Philipp Hänisch, Dennis Proft, Yannick Schober, and Michael Switka — Physikalisches Institut, Universität Bonn

A redesign of the injector beamline for the S-band linac at ELSA is underway, including the replacement of the existing electron gun by a hybrid gun that combines thermionic emission and thermally assisted photoemission in a single setup. The goal is to offer a new single-bunch injection mode alongside the long pulse mode already provided by the current gun. Measurements have been conducted to verify this emission technique using caesium dispenser cathodes. The development of a dedicated test stand is currently being carried out to facilitate more detailed studies and serve as a prototype for the future injector section. Recent research has concentrated on the lattice and magnet design, as well as on evaluating suitable beam-diagnostic instrumentation.

AKBP 2.5 Mon 12:15 SCH/A117

First demonstration of MeV electron diffraction with the ELBE SRF Gun: towards an MeV-UED instrument — •Louis Stein[1,2], André Arnold[1], Michael Klopf[1], Raffael Niemczyk[1], Anton Ryzhov[1], Jochen Teichert[1], Ece Uykur[1], Andreas Wagner[1], Stephan Winnerl[1], Rong Xiang[1], and Sebastian Maehrlein[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden — [2]TU Dresden

Ultrafast electron diffraction (UED) is a unique technique for measuring structural and electronic dynamics with sub-picosecond time resolution in a pump-probe arrangement. In most state-of-the-art UED setups, beams with keV electron energy are utilized. The project presented here aims to step up to MeV electron beams with the help of a superconducting radio frequency photo electron injector (SRF gun). The most promising argument for MeV-UED is its ability to access higher-order diffraction, which provides high sensitivity to small atomic displacements. Using the current HZDR ELBE SRF electron gun in continuous wave (CW) operation with megahertz repetition rates, a first demonstration of an MeV electron diffraction is presented. This presentation will summarize the SRF gun parameters and shows the current status of the electron diffraction setup at the ELBE SRF Gun. In future, the combination of MeV-UED with high-intensity tunable THz pump beams will open up exciting new possibilities for time-resolved studies of types of light-driven ultrafast structural dynamics in quantum matter, correlated systems, and other types of complex matter.