AKBP 10: Instrumentation and Beam Diagnostics II

Time: Wednesday 17:00–19:00 Location: E 020

Group Report AKBP 10.1 Wed 17:00 E 020
Overview of the accelerator magnet systems developments at the Karlsruhe Institute of Technology — •Julian Gethmann[2], Falastine Abusaif[2], Axel Bernhard[2], Samira Fatehi[1], Andreas Grau[2], Bennet Krasch[2], David Saez de Jauregui[2], Erik Bründermann[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

A key strategic approach to making accelerator-driven light sources more energy efficient and sustainable is to employ superconductivity.

At Karlsruhe Institute of Technology (KIT) there is a successful experience in developing and enhancing superconducting magnet systems for accelerators.

That includes the design and fabrication of low and high-temperature superconducting technologies, high-field undulators with long/short periodic lengths as well as novel miniature high-strength magnets.

This contribution gives an overview of the previous achievements and ongoing projects at KIT related to superconducting undulators and magnets.

AKBP 10.2 Wed 17:30 E 020
Gobau-Line Measurements for In-Vacuum Undulators — •Paul Volz — Helmholtz-Zentrum Berlin, Berlin — Johannes Gutenberg-Universität, Mainz

The in-vacuum elliptical undulator, IVUE32, is being developed at Helmholtz-Zentrum Berlin. The 2.5 m long device with a period length of 32 mm and a minimum gap of about 7 mm is to be installed in the BESSY II storage ring. The proximity of the undulator structure to the electron beam makes the device susceptible to wakefield effects which can influence beam stability. A complete understanding of its impedance characteristics is required prior to installation and operation. To understand and measure the IVU's impedance characteristics a Goubau-Line test stand is being designed. A Goubau-line is a single wire transmission line for high frequency surface waves with a transverse electric field resembling that of a charged particle beam out to a certain radial distance. Time domain reflectometry measurements of IVUE32 taper components will be presented. Together with a capability analysis of the Goubau-Line test stand.

AKBP 10.3 Wed 17:45 E 020
Development of an Active Beam Stabilization System for Electrofission Experiments at the S-DALINAC — •Dominic Schneider, Michaela Arnold, Uwe Bonnes, Adrian Brauch, Manuel Dutine, Ruben Grewe, Lars Jürgensen, Norbert Pietralla, Felix Schliessmann, and Gerhart Steinhilber — Technische Universität Darmstadt, Institute for Nuclear Physics, Darmstadt, Germany

The r-process fission cycle terminates the synthesis of heavy elements in binary neutron-star mergers. Fission processes of transuranium nuclides will be studied in electrofission reactions at the S-DALINAC. Due to the minuscule fissile target, the experimental setup requires an active electron-beam-stabilization system with high accuracy and a beam position resolution in the submillimeter range. Requirements and concepts for this system regarding beam diagnostics elements, feedback control and readout electronics will be presented. The usage of a cavity beam position monitor and optical transition radiation screens to monitor the required beam parameters will be discussed in detail. Additionally, various measurements performed at the S-DALINAC to assess requirements and limits for the beam-stabilization system will be presented. Finally, the option to use advanced machine learning methods, such as neural networks and agent-based reinforcement learning, will be discussed.

Work supported by DFG (GRK 2128), BMBF (05H21RDRB1), the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006) and the LOEWE Research Group Nuclear Photonics.

AKBP 10.4 Wed 18:00 E 020
Status and Perspectives of the Laser-Compton Backscattering Source at the S-DALINAC* — •Alexander Smushkin[1], Michaela Arnold[1], Vincent Bagnoud[2,3], Joachim Enders[1], Maximilian Meier[1], and Norbert Pietralla[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Institut für Angewandte Physik, TU Darmstadt, Germany — [3]GSI, Darmstadt, Germany

Quasi-monochromatic highly polarized MeV-ranged photon beams can be provided for a variety of applications by Compton scattering of a laser beam off ultra-relativistic electrons through a restricted aperture. The energy of the scattered photons is highest for backscattering, i.e. a scattering angle of 180°. In order to provide a high-flux Laser-Compton backscattering (LCB) light source with narrow energy bandwidth, a high-power laser with high stability and high repetition rate needs to be precisely synchronized with an ultra-relativistic electron beam. Such a source has been designed and constructed at the Superconducting Darmstadt Linear Accelerator S-DALINAC. The LCB source will be capable to provide photons with high brilliance and energies around 0.1 MeV. It is envisaged to be used as diagnostics tool for on-line beam-energy and energy-spread measurements, as well as a future experimental setup in the three-turn Energy Recovery Linac (ERL) mode of the S-DALINAC. This contribution will present the current status and perspectives of the LCB source.

*Work supported by DFG (GRK 2128 „AccelencE", GRK 2891 and Inst163/308-1 FUGG) and HMWK (cluster project ELEMENTS, ID 500/10.006, and LOEWE research cluster „Nuclear Photonics")

AKBP 10.5 Wed 18:15 E 020
Bunch-Length Measurement System Downstream the Injector of the S-DALINAC* — •A. Brauch, M. Arnold, M. Dutine, J. Enders, R. Grewe, L. Jürgensen, N. Pietralla, F. Schliessmann, and D. Schneider — Technische Universität Darmstadt, Department of Physics, Institute for Nuclear Physics, Schlossgartenstr. 9, 64289 Darmstadt, Germany

The S-DALINAC is a thrice-recirculating electron accelerator with a continuous-wave beam at a frequency of 2.9972 GHz that can be operated [1] as a twice-recirculating energy-recovery linac. Optimization of the bunch length downstream the injector is necessary to improve beam quality in regular operation as well as in energy-recovery mode. Currently, measurements of this beam parameter are accomplished by using the radio-frequency zero-crossing method. Since this method is time consuming and inaccurate, a new setup for these measurements using a streak camera is developed. Optical transition radiation from an aluminum-coated Kapton target is used to map the bunch length information to a light pulse which enables a precise measurement compared to a scintillating screen. The light pulse can then be evaluated with the streak camera. The device will be prepared for being useable at two different measurement setups downstream the injector. This contribution will present the design and the current status of the measurement setup as well as its properties.

[1] F. Schliessmann et al., Nat. Phys. 19, 597-602 (2023).

*Work supported by the State of Hesse (Cluster Project ELEMENTS, Project ID 500/10.006) and by DFG (GRK 2128 AccelencE).

AKBP 10.6 Wed 18:30 E 020
Characterizing Optical Synchrotron Radiation in the Geometric Optical Phase Space and Optimizing the Energy Transport to a Photo Detector — •Marvin-Dennis Noll, Johannes Leonard Steinmann, Dima El Khechen, Erhard Huttel, Erik Bründermann, and Anke-Susanne Müller — IBPT, KIT, Karlsruhe

At the Karlsruhe Research Accelerator (KARA) facility, an electron beam is generated by a thermionic electron gun, pre-accelerated to 53 MeV by a microtron and then ramped up to 500 MeV in a booster synchrotron before being injected into the storage ring, where a final electron energy of 2.5 GeV is reached.

With a circumference of 26 m the booster synchrotron has similar size and revolution frequency as the proposed large momentum acceptance storage ring of the cSTART project at KIT. Both synchrotrons do not reach equilibrium conditions which emphasizes the need for fast bunch-by-buch resolved diagnostics.

Compared to a 2D camera, when using 1D photodetectors for synchrotron light based diagnostics, either directly or after a fiber optics segment, the optic design goal is to maximize the optical intensity at the photo detector, rather than to keep spacial coherence. In this field of non-imaging optics the emitter, optical setup and sink can be modelled in the optical phase space, with the etendue being the conserved quantity and position and angle the independent variables. In this contribution we describe the measurement setup and compare with measurments.

AKBP 10.7 Wed 18:45 E 020

Experiments on Single Electrons at the DELTA Storage Ring — •Zohair Usfoor[1], Shaukat Khan[1], Carsten Mai[1], Arjun Radha Krishnan[1], Wa'el Salah[1,2], and Vivek Vijayan[1] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany — [2]The Hashemite University, Zarqa, Jordan

The ability to generate a beam consisting of a single electron or a few electrons introduces novel experimental possibilities when contrasted with conventional accelerator physics. At DELTA, a 1.5-GeV synchrotron radiation source at TU Dortmund University, scraping the electron beam reduces the number of electrons in the storage ring while simultaneously counting the synchrotron radiation photons. Typically, synchrotron radiation is explained as an electromagnetic wave within the context of classical electrodynamics. However, the emission of photons by an individual electron exposes the quantum characteristics inherent in synchrotron light. The statistical attributes of these photons provide extra information that can be applied for purposes of beam diagnostics. Our experimental setup and first results are presented.