AKBP 3: Diagnostics

Time: Monday 15:00–16:30 Location: SCH/A117

AKBP 3.1 Mon 15:00 SCH/A117

Broadband Cavity BPM Design for MESA — •Robin Wolf — Institut für Kernphysik, Mainz, Germany

The MESA accelerator's Energy Recovery Linac (ERL) mode requires a fast and sensitive beam position monitor (BPM) capable of distinguishing between accelerated and decelerated electron bunches in diagnostic pulse mode. This talk will present the design of the proposed cavity BPM for the MESA requirements.

The proposed design is an adaptation of the SACLA BPM, optimised for operation at 2.6GHz (the 2nd harmonic of MESA's 1.3GHz RF frequency) for increased sensitivity and smaller physical size. The tailored cavity design integrates a monopole-mode cavity (for phase and intensity measurements) with an dipole-mode cavity (for position measurements). Key enhancements include the splitting of the X and Y planes with implementation of mode separators, which maximises orthogonal plane decoupling. Furthermore, integrated waveguides are employed in the dipole-part to suppress the monopole-mode, while offering increased freedom in antenna coupling to the dipole field.

AKBP 3.2 Mon 15:15 SCH/A117

Compact Beam Position Monitor using a Segmented Toroidal Coil — •Lars Festring — RWTH Aachen University, Germany

A compact beam position monitor based on a segmented toroidal coil surrounding a charged particle beam has been investigated (F. Abusaif et al., Rev. Sci. Instrum. 1 March 2025; 96 (3): 033302, https://doi.org/10.1063/5.0240076).

It uses the induced voltages in the windings. We theoretically investigate the response of the coils to a bunched particle beam based on a lumped-element model and a Gaussian beam model. Then, we compare the model to measurements taken in the laboratory and the storage ring COSY. In addition, we devise a way to measure the covariance of the transversal beam profile and test it via a simulation. The resonant behavior in the coils' frequency response may be exploited to further increase the sensitivity of the device.

The resolution of the position measurement presently achieved is about 5 μm in a 1 s time interval for a beam current of 0.5 mA.

AKBP 3.3 Mon 15:30 SCH/A117

Design, installation and commissioning of an optical real-time diagnostic system for the BESSY II Injection LINAC — •Pauline Ahmels — Helmholtz-Zentrum Berlin, Hahn-Meitner-Platz 1, 14109 Berlin — Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin

In order to improve the present LINAC injection line diagnostic system at BESSY II, a non-destructive source point imaging system is being developed.

Until now, these source point imaging have primarily relied on retractable fluorescence screens (FOMs),which are inherently destructive due to the direct imaging of the electron beam. This talk presents the conceptual design, including technical requirements, simulation results, mechanical integration and commissioning of an optical diagnostic instrument for real-time monitoring at the injection line.

The design aims to ensure beam quality during operation using synchrotron radiation emitted from the dipole magnet. The primary components of this beamline are a CCD camera and a lens system designed to operate under high vacuum conditions. To enable precise positioning, the optical system is equipped with a motorized linear feed through. A basic, fixed focal length setup is initially employed to experimentally validate the simulation results, using the same CCD camera as in the final beamline setup. This new setup must be adapted to the spatial constraints, make use of existing materials as much as possible, and be simple to construct and install.

AKBP 3.4 Mon 15:45 SCH/A117

Error investigations of longitudinal phase space measurements using tomography — •Marc P. Kerstan, Christopher J. Richard, and Namra Aftab — Deutsches Elektronen-Synchrotron DESY, Zeuthen, Germany

The Longitudinal Phase Space (LPS) characterization is important in beam dynamics, especially in Free-Electron Lasers (FELs), where the slice energy spread is a key parameter to evaluate lasing performance and brightness.

The Photo Injector Test facility at DESY in Zeuthen (PITZ) is a test stand to condition and characterize electron sources for EuXFEL and FLASH. Measurement of the LPS directly after the electron source at PITZ is not possible due to unavailability of a dedicated diagnostics setup. Alternatively, the LPS can be measured 2.33 m from the cathode using tomography with the booster cavity as a rotating element. The aim of this project is to better understand the measured reconstructed LPS by refining the simulation model to better represent the measurement process. The current model is simplified. It only consists of a drift space with the correct length and does not include a dispersive element or many of the systematic error sources, that contribute to the real measurement.

Presented here are the results of an updated beamline model including a dipole and transverse focusing elements. This improved model allows for studies of the systematic errors on the reconstructed LPS including noise cuts and measurement camera resolution.

AKBP 3.5 Mon 16:00 SCH/A117

Compton Polarimetry with a Timepix3 ASIC at ELSA — •Tobias Schiffer, Michael Switka, Dennis Proft, and Klaus Desch — Physikalisches Institut der Universität Bonn, Bonn, Germany

The Electron Stretcher Facility (ELSA) in Bonn can provide spin polarized electrons to its users. During acceleration depolarising resonances have to be crossed reducing the achievable degree of polarization.

For a non-destructive in situ measurement of the beam polarization in the storage ring a Compton polarimeter is available. It utilizes a high intensity cw-laser beam scattering off the electron beam. The back scattered photon profile is measured with a detector. Depending on the polarization of the laser and the electron beam a vertical shift of the intensity profile can be observed. This is currently measured with a in-house custom-built silicon strip sensor.

However, to improve the detector setup and to obtain 2D information, a detector using a pixelized readout chip (Timepix3) with a 500 μm thick silicon sensor is in development.

The current status of the detector and first results of the performance are presented.

AKBP 3.6 Mon 16:15 SCH/A117

Automated In-Situ Ion Beam Characterization During Ion Implantation — •Ali Kosari Mehr, René Heller, Oliver Steuer, and Slawomir Prucnal — Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstr 400, 01328 Dresden, Germany

Ion implantation is a key technique for materials modification, especially in semiconductor processing. However, high-current industrial implanters often struggle to distinguish ion species and energies when projectiles have similar mass-to-charge ratios, such as Al and N*. Because industrial implantation relies on fast throughput and simple mass-analysis stages, ambiguous beam composition can compromise process reliability. This motivates the development of an automated in-situ diagnostic tool. A compact apparatus combining Rutherford backscattering spectrometry and ionoluminescence was therefore developed. It is inserted into the beam path for only a few seconds before implantation and comprises a beam-entry aperture, a dummy target of known composition, an RBS detector, and an ionoluminescence module with mirrors, optical fibres, and a miniature spectrometer. The dual-modality concept enables cross-checked identification of ion species, energies, and molecular fractions. For automated beam-quality decisions, a machine-learning evaluation scheme based on an artificial neural network was implemented and trained on simulated RBS spectra. The optimised model reliably distinguishes target ions under realistic noise and intensity fluctuations, enabling real-time ion beam characterisation.