AKBP 13: Diagnostics, Control and Instrumentation 2

Time: Thursday 14:00–15:45 Location: AKBP-H13

AKBP 13.1 Thu 14:00 AKBP-H13

Concept of a Beam Diagnostics System for the Multi-Turn ERL Operation at the S-DALINAC* — •Manuel Dutine, Michaela Arnold, Ruben Grewe, Lars Jürgensen, Norbert Pietralla, Felix Schliessmann, and Manuel Steinhorst — Institut für Kernphysik, TU Darmstadt

The S-DALINAC is a thrice-recirculating electron accelerator operating in cw-mode at a frequency of 3 GHz. Due to the implementation of a path-length adjustment system capable of a 360° phase shift, it is possible to operate the accelerator as an Energy-Recovery LINAC [1]. The multi-turn ERL operation has been demonstrated in 2021 [2]. While operating the accelerator in this mode, there are two sets of bunches, the still-to-be accelerated and the already decelerated beam, with largely different absolute longitudinal coordinates in the same beamline. For this mode, a non-destructive, sensitive beam diagnostics system is necessary in order to measure the position of both beams simultaneously. The status of a 6 GHz resonant cavity beam position monitor (BPM) will be given together with the results of a wire scanner measurement of the multi-turn ERL beam.

[1] M. Arnold et al., Phys. Rev. Accel. Beams 23, 020101 (2020)

[2] Pressemitteilung des Informationsdienst Wissenschaft (idw), "Technoligischer Durchbruch bei Energieeffizienten Teilchenbeschleunigern", MI-NR. 63/2021, acc/feu.

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AKBP 13.2 Thu 14:15 AKBP-H13

Detection of single monoenergetic ion bunches using ionoacoustics — •Sonja Gerlach[1], Felix Balling[1], Anna-Katharina Schmidt[1], Florian-Emanuel Brack[2], Leon Kirsch[1,3], Florian Kroll[2], Marvin Reimold[2], Walter Assmann[1], Ulrich Schramm[2], Christina Trautmann[3], Karl Zeil[2], Katia Parodi[1], and Jörg Schreiber[1] — [1]Ludwig-Maximilians-Universität München, München, Deutschland — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Deutschland — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Ionoacoustics is an innovative method that employs the acoustic wave emitted by pulsed ion beams slowing down in water. We present the newly developed I-BEAT detector that determines ion bunch properties on a single bunch basis: the I-BEAT detector (Ion-Bunch Energy Acoustic Tracing). Relativistic ions are stopped in a water phantom surrounded by up to four ultrasound transducers for three-dimensional reconstruction of the dose deposited by the ion bunch. As the detector is radiation hard and electromagnetic pulse resistant, it is especially suited to fill the lack of reliable online detection methods for laser-accelerated ions. Additionally, we recently demonstrated that ionoacoustic beam monitoring is also possible in transmission mode. We discuss our results obtained with laser- and conventionally accelerated ion bunches being especially interesting for ion bunch position and intensity monitoring. This work was supported by the German Research Foundation (DFG) within the Research Training Group GRK 2274 and the BMBF under project 05P21WMFA1.

AKBP 13.3 Thu 14:30 AKBP-H13

Observation of BIF at the electron-cooler test-bench at HIM — •Thomas Beiser — Helmholtz-Institut Mainz, Mainz, Deutschland

Wavelength-resolved studies of beam-induced fluorescence have been made at the electron cooler teststand at HIM. As a new feature a low-noise, cooled sCMOS-camera was utilized. Beam-current dependence of the fluorescence has been recorded. Data evaluation is imminent and options for further experiments will be discussed.

AKBP 13.4 Thu 14:45 AKBP-H13

Longitudinal phase space (LPS) characterization of high brightness electron beams at PITZ — •Namra Aftab[1], Zakaria Aboulbanine[1], Gowri Adhikari[1], Prach Boonpornprasert[1], Maria-Elena Castro-Carballo[1], Georgi Georgiev[1], James Good[1], Matthias Gross[1], Andreas Hoffmann[1], Christian Koschitzki[1], Mikhail Krasilnikov[1], Xiangkun Li[1], Osip Lishilin[1], Anusorn Lueangaramwong[1], David Melkumyan[1], Raffael Niemczyk[1], Anne Oppelt[1], Houjun Qian[1], Frank Stephan[1], Grygorri Vashchenko[1], Tobias Weilbach[1], and Wolfgang Hillert[2] — [1]DESY, Zeuthen, Germany — [2]University of Hamburg, Germany

Methodological studies to improve the LPS tomography of space-charge dominated electron beams were carried out at the Photo Injector Test facility at DESY in Zeuthen (PITZ). In the experimental procedure, initially, a 200 μm-wide horizontal slit was introduced before the booster to cut the beam to strongly reduce space charge effects. Next, the signal resolution of this truncated beam was improved by careful beta function control at the reference screen of momentum measurements. A combination of both steps enabled accurate measurement of minimum energy spread and better control of beam phase advance during booster phase scan, i.e. control of booster amplitude and phase scan range. After optimization of the experimental conditions, the momentum projections were fed to a tomographic reconstruction algorithm to obtain the reconstructed LPS. Finally, the noisy artifacts in LPS were addressed to further improve the results.

AKBP 13.5 Thu 15:00 AKBP-H13

Low Gain Avalanche Detector for beam monitoring — •Vadym Kedych[1], Wilhelm Krueger[1], Adrian Rost[1,4], Jerzy Pietraszko[2], Tetyana Galatyuk[1,2], Sergey Linev[2], Jan Michel[3], Michael Traxler[2], Michael Traeger[2], and Christian Joachim Schmidt[2] — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI GmbH, Darmstadt, Germany — [3]Goethe-Universität, Frankfurt, Germany — [4]FAIR GmbH, Darmstadt, Germany

Linacs suffer from high power consumption for particle acceleration when high energies are desired. Because of this there is a huge interest to accelerators with idea of energy recovery. ERL allow to recirculate beam to the main linac second time with a phase shift of 180° which cause to deceleration of the beam and returning energy to RF cavities. The S-DALINAC at TU Darmstadt allows the possibility to operate it in an ERL mode. Optimization of the acceleration and deceleration processes are extremely important for efficiency operation S-DALINAC in ERL mode. For these purposes setup based on LGAD are being developed. LGAD is a silicon detector optimized for 4D-tracking with timing precision below 50ps thanks to internal low gain which makes it an ideal candidate for precise timing monitoring at S-DALINAC.

In this contribution we present the results from the first (October 2021) LGAD test at S-DALINAC (TU Darmstadt).

This work has been supported by DFG under GRK 2128.

AKBP 13.6 Thu 15:15 AKBP-H13

Intensity monitoring of pulsed ion beams: Absolute calibration of the I-BEAT detector — •Ina Hofrichter, Sonja Gerlach, Felix Balling, Jonathan Bortfeldt, Leonard Doyle, Lotta Flaig, Jens Hartmann, Veronika Kratzer, Alexander Prasselsperger, Thomas Rösch, Anna Schmidt, Katia Parodi, and Jörg Schreiber — LMU München, München, Deutschland

The unique properties of laser-accelerated ion bunches - like their high particle flux accompanied by a strong electromagnetic pulse (EMP) - make beam monitoring challenging for well-established diagnostic systems with immediate feedback. The I-BEAT (Ion-Bunch Energy Acoustic Tracing) detector (cf. DOI: s41598-019-42920-5, DOI: 12.2592415) overcomes these difficulties by making use of the ionoacoustic principle: The energy deposited by ions stopping in water generates an acoustic wave from which the ion bunch properties can be reconstructed. The experimental setup consists of a water reservoir surrounded by ultrasonic transducers. Ions enter the detector through a Kapton entrance window. To enable quantitative assessment of the particle number and accordingly the absorbed dose, proper calibration of the detector is required. For that, we propose to use the signal generated in the entrance window, exploiting that its amplitude increases with growing ion number. We have set up a theoretical model to describe this signal and performed first experimental tests to validate our approach with an ionization chamber. This work was supported by the German Research Foundation (DFG) within the Research Training Group GRK 2274 and the BMBF under project 05P21WMFA1.

AKBP 13.7 Thu 15:30 AKBP-H13

Bunch Length Measurement Systems at S-DALINAC — •A. Brauch, M. Arnold, J. Enders, L. Jürgensen, N. Pietralla, and S. Weih — Technische Universität Darmstadt, Darmstadt, Deutschland

Precision experiments at the superconducting Darmstadt electron linear accelerator S-DALINAC require a high-quality beam. Next to other important beam parameters, an optimization of the bunch length to typical values of 0.7 to 2 ps is performed. This is accomplished by inducing a linear momentum spread on the bunch in one of the accelerating cavities. The bunch length can be measured with a target in a dispersive section downstream. This method is time consuming and can provide only an upper limit of the bunch length. Therefore, two new setups for bunch length measurements are introduced. They will improve the optimization process significantly. A new diagnostic beam line is set up in the low energy beam area. It includes a deflecting copper cavity used for measuring the bunch length by rotating the bunch and projecting its length on a target. A streak camera placed at different positions downstream the injector and the main accelerator will be used to measure the bunch length in the future. The device will analyse optical transition radiation from an aluminium coated kapton target. The pulse length of the emitted light is equal to the length of the bunch creating it. This contribution will present the layout of both systems, their current status and design considerations.