AKBP 8: Diagnostics, Control and Instrumentation II

Time: Wednesday 16:30–18:30 Location: AKBPa

AKBP 8.1 Wed 16:30 AKBPa

The application of deep learn on slit scan image processing and emittance predict — •Shuai Ma, André Arnold, Anton Ryzhov, Jana Schaber, Jochen Teichert, and Rong Xiang — Institute of Radiation Physics, HZDR, 01328 Dresden, Germany

For slit scan method, how to decrease the noise of beam-let images directly influences the accuracy of the emittance results. There are two kind noise in the images, random noise and dark current. The traditional method is to capture two groups of images, one with beam and the other one without beam as background. The images with beam subtract the background image respectively. Then using filter algorithm, such as Median filter and Gaussian filter, to decrease the random noise. The total time of these is usually 5 to 10 minutes and sometimes the images with beam at the beginning and ending are not very clear because of low signal ratio, which will contribute emittance to the results. To compress the processing time and improve accuracy, one deep learning method, sparse auto-encoder network is used to pre-process the images. To train the network, the slit scan simulation program based on Astra is built to create the image cases. The sparse auto-encoder network is used to filter random noise. During the training, the noise from the real images, background images, is added to increase the stability of the network. After the network, the negative signals, meaningless signals, in the images are set to zero. The other model, point cloud network is used to filter the dark current and gives the emittance from phase space directly. The error is lower than 10%.

AKBP 8.2 Wed 16:45 AKBPa

Detection of Laser-Accelerated Ions using the Ionoacoustic Approach: the I-BEAT Detector — •Sonja Gerlach[1], Felix Balling[1], Anna-Katharina Schmidt[1], Vincent Bagnoud[2], Florian-Emanuel Brack[3], Johannes Hornung[2], Florian Kroll[3], Ulrich Schramm[3], Karl Zeil[3], Bernhard Zielbauer[2], Katia Parodi[1], and Jörg Schreiber[1] — [1]Department of medical physics at the LMU München, München, Germany — [2]GSI, Darmstadt, Germany — [3]HZDR, Dresden, Germany

Laser-driven ion sources represent a promising particle acceleration option for many interesting fields in physics, chemistry and biology. The properties of laser-accelerated ion bunches - especially the short and intense particle pulses with a broad energy spectrum emitted in conjunction with a strong electromagnetic pulse - demand the development of suitable beam diagnostics. The innovative approach of measuring the acoustic signals of particles depositing their energy in water, referred to as Ion-Bunch Energy Acoustic Tracing (I-BEAT), was already demonstrated to be capable of reconstructing also complex energy spectra at the ion focus while being radiation and EMP resistant. Here, an extension of the set-up for multidimensional dose reconstruction is presented. First experimental tests show promising results as e.g. the determination of the lateral beam position with sub-millimetre accuracy.

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AKBP 8.3 Wed 17:00 AKBPa

4D Transverse Phase Space characterization of high brightness electron beams at PITZ — •Namra Aftab[1] and Mikhail Krasilnikov[2] — [1]Deutsches Elektronen-Synchrotron, Platanenallee 6, 15738 Zeuthen, Germany — [2]Deutsches Elektronen-Synchrotron, Platanenallee 6, 15738 Zeuthen, Germany

Photo Injector Test facility at DESY in Zeuthen (PITZ) utilizes slit scan technique as a standard tool for reconstruction of horizontal and vertical phase spaces because of its space charge dominated electron beams. A novel method for 4-dimensional transverse beam phase space measurement is proposed at PITZ known as Virtual Pepper Pot that can give insight to transverse beam phase space coupling. It utilizes the 2D slit scans to form pepper-pot like beamlets by careful crossing and post processing of the slit scan data. All elements of the 4D transverse beam matrix are calculated and used to obtain the 4D transverse emittance, 4D kinematic beam invariant and coupling factors. The proposed technique has been applied to the ASTRA simulated beams as well as the experimental data from the PITZ facility and compared with the 2D slit scan technique.

AKBP 8.4 Wed 17:15 AKBPa

Design of a Laser Compton Backscattering Source for Beam Diagnostics at the S-DALINAC* — •Maximilian Meier[1], Michaela Arnold[1], Vincent Bagnoud[2], Joachim Enders[1], Norbert Pietralla[1] und Markus Roth[1] — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany

Laser Compton Backscattering (LCB [1]) provides quasi-monochromatic highly polarized beams on the X-ray and gamma-ray regime for a variety of applications. A powerful stable and well synchronized laser with a high repetition rate is essential for a high-flux Compton light source. A project at TU Darmstadt foresees to synchronize a high-repetition high-power laser with electrons from the Superconducting DArmstadt electron LINear ACcelerator (S-DALINAC [2]) to realize a LCB photon beam with energy up to 180 keV. The main goal in the first years will be to use LCB as an additional diagnostic tool for determining the electron beam energy and the energy spread of the S-DALINAC, with respect to the energy-recovery linac (ERL [3]) operation as well as the optimizing design considerations for a Compton light source. An overview over the design concept of the LCB Source at the S-DALINAC will be given, simulations on the layout and the estimated output will be presented.
[1] C. Bemporad et al., Phys. Rev. 138, B1546 (1965)
[2] N. Pietralla, Nucl. Phys. News 28(2), 4 (2018)
[3] M. Arnold et al., Phys. Rev. Accel. Beams 23, 020101(2020)
*Supported through the state of Hesse (LOEWE research cluster Nuclear Photonics) and DFG through GRK 2128 *AccelencE*.

AKBP 8.5 Wed 17:30 AKBPa

Application of KALYPSO as a diagnostic tool for beam and spectral analysis — •Meghana M Patil, Michele Caselle, Erik Bründermann, Gudrun Niehues, Benjamin Kehrer, Andreas Ebersoldt, Michael J Nasse, Stefan Funkner, Anke-Susanne Müller, and Marc Weber — Karlsruhe Institute of Technology

KALYPSO is a novel detector operating at frame rates up to 10 MHz developed and tested at the KIT synchrotron light source and its storage ring KARA. This detector can consist of a Si, InGaAs, PbS or PbSe line array sensor with spectral sensitivity from 350 nm to 5000 nm. Such a wide spectral sensitivity for Si is obtained by applying an anti-reflection coating optimized for these wavelengths as well as the modular capability of the detector to employ sensors with different spectral sensitivities. The unprecedented frame rate of this detector is achieved by a custom-designed ASIC readout. FPGA-readout architecture enables continuous data acquisition and real-time data processing. Such a detector has various applications in the fields of beam diagnostics and spectral analysis and is currently employed at various synchrotron facilities to study the longitudinal profile and energy spread of the electron beam, tuning of free-electron lasers, and in characterizing laser spectrum. This contribution will present an overview of results from the mentioned applications. This work is supported by BMBF project 05K19VKD STARTRAC (Federal Ministry of Education and Research) and by the DFG-funded Doctoral School Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology (KSETA).

AKBP 8.6 Wed 17:45 AKBPa

Bayesian optimization of injection efficiency at KARA using Gaussian processes — •Chenran Xu[1], Tobias Boltz[2], Akira Mochihashi[1], Andrea Santamaria Garcia[2], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

The injection at the KIT storage ring KARA (Karlsruhe Research Accelerator) is tuned by many parameters, such as the strength of various magnets and the RF frequency. The tuning process is currently performed manually by machine operators, which is time consuming and can get stuck in local optima. To address this, Bayesian optimisation is applied, i.e. a technique for optimising noisy black-box functions. Using Gaussian processes (GPs) for regression we obtain a probabilistic model, which allows the integration of prior knowledge about the physical process. The model can be queried during the optimization procedure to efficiently explore the given parameter space, leading to comparably fast convergence. In this contribution, we demonstrate

the implementation of Bayesian optimization to automate and optimize the injection process.

Chenran Xu acknowledges the support by the DFG-funded Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 8.7 Wed 18:00 AKBPa

Stability Investigation of long-term operations at FLUTE — •Thiemo Schmelzer for the FLUTE-Collaboration — LAS, KIT, Karlsruhe

At KIT the new compact and versatile linear-based test facility FLUTE (Ferninfrarot Linac- Und Test-Experiment) is operated. Its primary goal is to serve as a platform for a variety of accelerator R&D studies as well as to generate strong ultra-short THz pulses for photon science. For some studies, for example radiation exposure in material studies, the accelerator is best operated with a continuous and stable electron beam over several hours. In systematic measurements, several parameters of the electron beam were monitored to investigate their stability in different operation settings. The results as well as further optimization opportunities will be presented in this contribution. Thiemo Schmelzer acknowledges the support by the Doctoral School Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology.

AKBP 8.8 Wed 18:15 AKBPa

Impedance studies of a corrugated pipe for KARA — •Sebastian Maier[1], Miriam Brosi[2], Akira Mochihashi[2], Michael J. Nasse[2], Markus Schwarz[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

At the KIT storage ring KARA (KArlsruhe Research Accelerator) it is planned to install an impedance manipulation structure in a versatile chamber to study and eventually control the influence of an additional impedance on the beam dynamics and the emitted coherent synchrotron radiation. For this purpose the impedance of a corrugated pipe is under investigation. In this contribution, we present first results of simulations showing the impact of different structure parameters on its impedance and wake potential. This work is supported by the DFG project 431704792 in the ANR-DFG collaboration project ULTRASYNC. Sebastian Maier acknowledges the support by the DFG-funded Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology"