8. Annual MT Meeting

Report of Abstracts

https://indico.desy.de/e/mt2022

Abstract ID : **15**

Status of Beam-Based Feedback Research and Development for the Linear Accelerator ELBE

Content

The superconducting linear accelerator ELBE at Helmholtz-Zentrum Dresden-Rossendorf is a versatile light source operated in a continuous wave (CW) mode. The CW allows flexible electron bunch repetition rates and high average current, thus enabling experiments that would otherwise be impossible to perform, hence the versatility.

Time resolved pump-probe experiments place higher demands on the beam stability. To address this requirement the existing digital LLRF control is complemented by a beam-based feedback scheme. In particular, the new scheme includes a bunch arrival time monitor and a beam-based feedback regulator. The latter is designed to reduce the bunch arrival time jitter.

In this contribution we give an overview of the new control scheme. Specifically, we present the main points of the design and implementation of the beam-based feedback regulator. Finally, we show the results of a recent ELBE machine study that demonstrated a reduction of the bunch arrival time jitter.

Primary authors: MAALBERG, Andrei (Helmholtz-Zentrum Dresden-Rossendorf); KUNTZSCH, Michael (HZDR); ZENKER, Klaus (Helmholtz-Zentrum Dresden-Rossendorf)

Co-author: Prof. PETLENKOV, Eduard (Tallinn University of Technology)

Presenter: MAALBERG, Andrei (Helmholtz-Zentrum Dresden-Rossendorf)

Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **MAALBERG, Andrei** on **Tuesday, July 26, 2022**

Abstract ID : **16**

Design considerations of the corrugated structures in a vacuum chamber for impedance studies at KARA

Content

Two parallel, corrugated plates will be installed at the KIT storage ring KARA (KArlsruhe Research Accelerator). This impedance manipulation structure can be used to study and eventually control the electron beam dynamics and the emitted coherent synchrotron radiation (CSR) at KARA.
In this contribution, we present the design of the impedance manipulation structure with corrugated plates, simulation results showing the influence of different corrugation parameters on its impedance, and the impact of this additional impedance source on the temporal changes in the emitted CSR in the presence of the microbunching instability.

Primary authors: Mr MAIER, Sebastian (KIT); MOCHIHSHI, Akira (Karlsruhe Institute of Technology); BROSI, Miriam (KIT); Dr CHA, Hyuk Jin (Karlsruher Institut für Technologie (KIT)); MUELLER, Anke-Susanne (KIT); NASSE, Michael (Karlsruhe Institute of Technology); SCHWARZ, Markus (KIT)

Presenter: Mr MAIER, Sebastian (KIT)

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **Mr MAIER, Sebastian** on **Tuesday, August 9, 2022**

Abstract ID : **34**

MALTA: A monolithic active pixel sensor for radiation harsh environments

Content

MALTA is a depleted monolithic active pixel sensor developed in the Tower 180 nm CMOS imaging process. Monolithic CMOS sensors offer advantages over current hybrid imaging sensors both in terms of increased tracking performance due to lower material budget but also in terms of ease of integration and construction costs due to the integration of read-out and active sensor into one chip. Current research and development efforts are aimed towards radiation hard designs up to 100 Mrad in Total Ionizing Dose (TID) and >1x1015 1 MeV neq/cm^2 in Non-Ionizing Energy Loss (NIEL). The design of the MALTA sensors was specifically chosen to achieve radiation hardness up to these requirements and satisfy current and future collider constraints. The current MALTA pixel architecture employs small electrodes which provide overall smaller noise, higher voltage signal and better power performance ratio. To counteract loss of efficiency in pixel corners, modifications to the Tower process have been implemented. The MALTA sensors have been tested during the 2021 SPS CERN Test Beam in the MALTA telescope. Additional characterization of MALTA2 samples will also take place during the 2022 campaign. The telescope ran for the whole duration of the beam and took data in order to characterize the novel MALTA2 variant and the performance of irradiated samples in terms of efficiency and cluster size. These campaigns aim to show that MALTA is an interesting prospect for HL-LHC and beyond collider experiments, providing both very good tracking capabilities and radiation hardness in harsh radiation environments.

Primary author: BERLEA, Vlad Dumitru (Z_DET (Detektorentwicklung))

Presenter: BERLEA, Vlad Dumitru (Z_DET (Detektorentwicklung))

Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **BERLEA, Vlad Dumitru** on **Friday, August 12, 2022**

Abstract ID : **35**

Development of Segmented LGAD with small pixels and high Fill-Factor

Content

Low Gain Avalanche Diodes (LGADs) have gained great interest in particle tracking and timing applications. Besides HEP detectors, LGADs have the potentiality of replacing standard silicon sensors in almost every application, with the added advantage of providing larger signals avoiding at the same time the additional noise affecting standard APDs.
Within Helmholtz DTS program and in synergy with Tangerine, a new generation of LGAD technology, based on based TI-LGAD (Trench Isolated LGAD), has been designed, fabricated tested and characterized at KIT.
In this contribution, an overview of the sensor technology with a deep focus on the layout design rules and the recent performances achieved are presented. The aforementioned layout design rules enable the unique opportunity to develop pixel and microstrip detectors with a spatial and time resolution < 20 µm and 20 ps, respectively.
Thanks to this work, the "DTS-2" milestone, which aims for the availability of sensors with high spatial (20 µm) and time resolution (20 ps) for charged particles and photon sciences, has been fully accomplished and the results will be reported in this contribution. Moreover, the accomplishment of the DTS-2 milestone aligns the Helmholtz research activities to the European detector roadmap.

Primary authors: CASELLE, Michele (KIT); KOPMANN, Andreas (Karlsruhe Institute of Technology (KIT)); PATIL, Meghana Mahaveer (KIT); TRIFONOVA, Ekaterina (KIT); Prof. WEBER, Marc (KIT)

Presenter: CASELLE, Michele (KIT)

Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **CASELLE, Michele** on **Wednesday, August 17, 2022**

Abstract ID : **36**

Development of Bump-bonding technology for ADAM (Advanced Detectors for x-ray Astronomy Missions) pixel detector

Content

High energy radiation from astrophysical objects is among the most useful messengers to study the behaviour of matter under the extreme conditions of gravity, density and magnetism, that cannot be replicated on earth. The Pixelated silicon Drift Detector (PixDD) is a two-dimensional multi-pixel X-ray sensor based on the technology of Silicon Drift Detectors, designed to solve the dead time and pile-up issues of photon-integrating imaging detectors. Read out by a two-dimensional self-triggering Application-Specific Integrated Circuit named RIGEL, to which the sensor is bump-bonded, it operates in the 0.5 to15 keV energy range and is designed to achieve single-photon sensitivity and good spectroscopic capabilities even at room temperature thanks to extreme low-noise performance.

The PixDD sensor design takes advantage of the lateral depletion mechanism used in Silicon Drift Detectors to reduce the size of the collecting anode, which translates into a smaller detector capacitance. This is a paramount requirement to be able to perform soft X-ray spectroscopy with Fano-limited energy resolution. To keep very low-noise performance, the PixDD sensor and their RIGEL front-end ASIC need to be connected by a special and very low-noise bump-bonding technology.

This contribution focus on the development of a low-cost and application-specific bump-bonding technology based on gold-stud bonding developed at KIT. This technique is able to produce metal bumps with diameters down to 30 μm without photolithography processes.
The small passivation opening implemented on both sensor and front-end die requires a bump diameter not large than 40 μm with a placement accuracy of only a few micrometers. After the gold-stud bumping deposition the flip-chip bonding is performed by a thermo-compression bonding process. The pick-and-place accuracy of less than one micrometer between sensor and readout circuit combined with the optimized value of the bond force, temperature and time result in high mechanical strength and excellent electrical performance.

Special precautions have been applied to avoid any damage to the thin oxide layer present on the x-ray back entrance windows. Any damage will result in a dramatic increase in the shot noise contribution.

Thanks to this technology, the production of the PixDD detector has been fully accomplished at KIT. In the contribution, the technical details, results and production yield will be discussed.

Primary authors: CASELLE, Michele (KIT); KOPMANN, Andreas (Karlsruhe Institute of Technology (KIT))

Presenter: CASELLE, Michele (KIT)

Track Classification: Detector Technologies and Systems

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **CASELLE, Michele** on **Wednesday, August 17, 2022**

Abstract ID : **37**

Status of a monitor design for single-shot electro-optical bunch profile measurements at FCC-ee

Content

At the KIT electron storage ring KARA (Karlsruhe Research Accellerator) an electro-optical (EO) near-field monitor is in operation performing single-shot, turn-by-turn measurements of the longitudinal bunch profile using electro-optical spectral decoding (EOSD). In context of the Future Circular Collider Innovation Study (FCCIS), a similar setup is investigated with the aim to monitor the longitudinal bunch profile of each bunch for dedicated top-up injection at the future electron-positron collider FCC-ee.
This contribution presents the status of a monitor design adapted to cope with the high-current and high-energy lepton beams foreseen at FCC-ee.

Supported by the Doctoral School KSETA.

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FCCIS is funded by the EU's Horizon 2020 research and innovation programme under grant No 951754.

Primary author: REISSIG, Micha (Karlsruher Institut für Technologie (KIT))

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Presenter: REISSIG, Micha (Karlsruher Institut für Technologie (KIT))

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **REISSIG, Micha** on **Friday, August 19, 2022**

Abstract ID : **38**

Split Boot - True network-based booting on heterogeneous MPSoCs

Content

In the context of the High-Luminosity (HL) upgrade of the LHC, many custom ATCA electronics boards are being designed containing heterogeneous system-on-chip (SoC) devices, more specifically the Xilinx Zynq UltraScale+ (ZUS+) family. While the application varies greatly, these devices are regularly used for performing board management tasks, making them a fundamental element in the correct operation of the board. The large number of hundreds of SoC devices planned for the HL upgrade in 2027 creates significant challenges in their firmware deployment, maintenance, and accessibility.

Even though U-Boot on ZUS+ devices supports network boot through the preboot execution environment (PXE), the standard ZUS+ boot process contains application-specific information at earlier boot steps, particularly within the first stage boot loader (FSBL). This prevents the initialization of several devices from a universal image.

Inspired by the PXE boot, a novel boot method tailored to the specific needs of the ZUS+ is proposed. All application-specific ZUS+ configuration is moved to a network storage and automatically fetched during the boot process. Initially, the ZUS+ loads a partial configuration file that is stored locally and does not contain any application-specific information. Afterwards, it retrieves and applies the complete device configuration from the network.

For seamless integration, the entire process is considered, from firmware and software development to binary distribution in a large-scale system. As a result, the proposal consists of a mechanism for applying the device configuration and a highly automated framework for creating the necessary files that integrates with the standard Xilinx development toolset workflow.

Primary authors: FUCHS, Marvin (KIT); ARDILA, Luis (KIT-IPE); MEHNER, Torben; SANDER, Oliver (KIT)

Presenter: FUCHS, Marvin (KIT)

Track Classification: Detector Technologies and Systems

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **FUCHS, Marvin** on **Monday, August 22, 2022**

Abstract ID : **39**

HELIPORT - An Integrated Research Data Lifecycle

Content

HELIPORT is a data management solution that aims at making the components and steps of the entire research experiment's life cycle discoverable, accessible, interoperable and reusable according to the FAIR principles.
Among other information, HELIPORT integrates documentation, scientific workflows, and the final publication of the research results - all via already established solutions for proposal management, electronic lab notebooks, software development and devops tools, and other additional data sources. The integration is accomplished by presenting the researchers with a high-level overview to keep all aspects of the experiment in mind, and automatically exchanging relevant metadata between the experiment's life cycle steps.
Computational agents can interact with HELIPORT via a REST API that allows access to all components, and landing pages that allow for export of digital objects in various standardized formats and schemas. An overall digital object graph combining the metadata harvested from all sources provides scientists with a visual representation of interactions and relations between their digital objects, as well as their existence in the first place. Through the integrated computational workflow systems, HELIPORT can automate calculations using the collected metadata.
By visualizing all aspects of large-scale research experiments, HELIPORT enables deeper insights into a comprehensible data provenance with the chance of raising awareness for data management.

Primary authors: Dr KNODEL, Oliver (Helmholtz-Zentrum Dresden-Rosendorf); Mr PAPE, David (Helmholtz-Zentrum Dresden-Rosendorf); Dr GRUBER, Thomas (Helmholtz-Zentrum Dresden-Rosendorf); Mr VOIGT, Martin (Helmholtz-Zentrum Dresden-Rosendorf); Dr KELLING, Jeffrey (Helmholtz-Zentrum Dresden-Rossendorf); Mr LOKAMANI, Mani (Helmholtz-Zentrum Dresden-Rossendorf); Dr MUELLER, Stefan (Helmholtz-Zentrum Dresden-Rossendorf); Dr JUCKELAND, Guido (Helmholtz-Zentrum Dresden-Rossendorf); Mr KESSLER, Alexander (Helmholtz-Institut Jena); Dr HEIN, Joachim (Helmholtz-Institut Jena); Dr LEE, Chien-Li (Helmholtz-Institut Jena); Prof. KALUZA, Malte (Helmholtz-Institut Jena); Dr SCHULLER, Bernd (Forschungszentrum Jülich)

Presenter: Dr KNODEL, Oliver (Helmholtz-Zentrum Dresden-Rosendorf)

Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **KNODEL, Oliver** on **Tuesday, August 23, 2022**

Abstract ID : **40**

dCache integration with CERN Tape Archive (CTA)

Content

The ever increasing amount of data that is produced by modern scientific facilities like EuXFEL or LHC puts a high pressure on the data management infrastructure at the laboratories. This includes poorly shareable resources of archival storage, typically, tape libraries. To achieve maximal efficiency of the available tape resources a deep integration between hardware and software components are required.

The CERN Tape Archive (CTA) is an open-source storage management system developed by CERN to manage LHC experiment data on tape. Although today CTA's primary target is CERN Tier-0, the data management group at DESY considers the CTA as a main alternative to commercial HSM systems.

dCache has an flexible tape interface which allows connectivity to any tape system. Together with the CERN Tape Archive team we are working on seamless integration of CTA into dCache.

This presentation will show the design of dCache-CTA integration, current status and first test results at DESY.

Primary authors: MKRTCHYAN, Tigran (IT (IT Scientific Computing)); VOSS, Christian (DESY); CHODAK, Jacek (IT (IT Scientific Computing)); GASTHUBER, Martin (IT (IT Scientific Computing)); KARIMI, Mwai (IT (IT Scientific Computing)); LUEKEN, Ralf (IT (IT Information Fabrics)); MEYER, Svenja (IT (IT Scientific Computing)); SUCHOWSKI, Peter (IT (IT Information Fabrics))

Presenter: KARIMI, Mwai (IT (IT Scientific Computing))

Track Classification: Data Management and Analysis

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **MKRTCHYAN, Tigran** on **Wednesday, August 24, 2022**

Abstract ID : **42**

Status and Powering Test Results of HTS Undulator Coils at 77 K for Compact FEL Designs

Content

The production of low emittance positron beams for future linear and circular lepton colliders, like CLIC or FCC-ee, requires high-field damping wigglers. Just as compact free-electron lasers (FELs) require high-field but as well short-period undulators to emit highly energetic, coherent photons. Using high-temperature superconductors (HTS) in the form of coated ReBCO tape superconductors allows higher magnetic field amplitudes at 4 K and larger operating margins as compared to low-temperature superconductors, like Nb-Ti. This contribution discusses the development work on superconducting vertical racetrack (VR) undulator coils, wound from coated ReBCO tape superconductors. The presented VR coils were modularly designed with a period length of 13 mm. Powering tests in liquid nitrogen of multiple vertical racetrack coils were performed at CERN. The results from the measurements are presented for three VR coils and compared with electromagnetic simulations.

Primary author: RICHTER, Sebastian (Karlsruhe Institute of Technology (KIT))

Co-authors: Dr BALLARINO, Amalia (CERN); Dr BERNHARD, Axel (KIT); NES, Thomas (CERN); Dr SCHOERLING, Daniel (CERN); Prof. MÜLLER, Anke-Susanne (KIT)

Presenter: RICHTER, Sebastian (Karlsruhe Institute of Technology (KIT))

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **RICHTER, Sebastian** on **Friday, August 26, 2022**

Abstract ID : **43**

Status and first test results of a prototype HTS helical undulator coil for compact FELs

Content

A superconducting helical undulator is not only very compact but also more effective in terms of synchrotron radiation production and free-electron laser (FEL) amplification compared to other undulator geometries. Furthermore, the superconductor is used very efficiently in a helical geometry with respect to the undulator field generation and the produced circular polarized photons are suitable for the majority of experiments performed at FEL facilities. To realize more compact FELs, a combination of short-period and high-field undulators are required. We investigate the application of high-temperature superconductors (HTS) to reach higher magnetic fields at 4.2 K and larger operating margins as compared to low-temperature superconductors.

This contribution discusses the development work done on a superconducting helical undulator prototype with a period length of 13 mm, wound in a bifilar winding scheme from coated REBCO tape conductor. Electro-magnetic simulations predict a peak field amplitude of up to 2.8 T for a 5 mm gap at 4.2 K.

Primary author: RICHTER, Sebastian (Karlsruhe Institute of Technology (KIT))

Co-authors: Dr BALLARINO, Amalia (CERN); Dr BERNHARD, Axel (KIT); Prof. MÜLLER, Anke--Susanne (KIT)

Presenter: RICHTER, Sebastian (Karlsruhe Institute of Technology (KIT))

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Comments:

Presented at IPAC'22.

Status: ACCEPTED

Submitted by **RICHTER, Sebastian** on **Friday, August 26, 2022**

Abstract ID : **44**

Automated FAIR4RS software publication with HERMES

Content

Software as an important method and output of research should follow the RDA "FAIR for Research Software Principles". In practice, this means that research software, whether open, inner or closed source, should be published with rich metadata to enable FAIR4RS.

For research software practitioners, this currently often means to follow an arduous and mostly manual process of software publication. HERMES (https://software-metadata.pub), a project funded by the Helmholtz Metadata Collaboration, aims to alleviate this situation by developing configurable, executable workflows for the publication of rich metadata for research software, alongside the software itself.

These workflows, following a push-based approach, use existing continuous integration solutions, integrated in widespread code platforms like GitHub or GitLab, to harvest, to unify and collate software metadata that already exists in source code repositories and via code platform APIs. They include curation processes for the unified metadata and take care of the actual deposit on publication platforms, based on deposition requirements and curation steps defined by a targeted publication platform, the depositing institution, or a software management plan.

In addition, the HERMES project works to make the widely-used publication platforms InvenioRDM and Dataverse "research software ready", i.e., able to ingest software publications with rich metadata, and represent software publications and their respective metadata in a usable manner that supports findability, assessability and accessibility of the published software versions.

Beyond the open source workflow software, HERMES will openly provide templates for different continuous integration solutions, extensive documentation, and training material. Thus, researchers are enabled to adapt automated software publication quickly and easily.

Primary authors: Mr BERTUCH, Oliver (Forschungszentrum Jülich GmbH); Mr DRUSKAT, Stephan (German Aerospace Center (DLR e. V.)); Dr KNODEL, Oliver (Helmholtz-Zentrum Dresden - Rossendorf (HZDR)); Dr KELLING, Jeffrey (Helmholtz-Zentrum Dresden - Rossendorf (HZDR)); Mr MEINEL, Michael (German Aerospace Center (DLR e. V.)); Dr JUCKELAND, Guido (Helmholtz-Zentrum Dresden - Rossendorf (HZDR)); Mr SCHLAUCH, Tobias (German Aerospace Center (DLR e. V.))

Presenter: Dr KNODEL, Oliver (Helmholtz-Zentrum Dresden - Rossendorf (HZDR))

Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **KNODEL, Oliver** on **Friday, August 26, 2022**

Abstract ID : **45**

Polarised electron beams from laser plasma acceleration and their polarimetry

Content

In recent years, Laser Plasma Acceleration (LPA) has become a promising alternative to conventional RF accelerators. However, so far, it has only been theoretically shown that generating polarized LPA beams is possible. The LEAP
(Laser Electron Acceleration with Polarization) project at DESY aims to demonstrate this experimentally for the first time, using a pre-polarized plasma target.
The electron polarization will be measured with photon transmission polarimetry, which makes use of the production of circularly polarized bremsstrahlung
during the passage of the electron beams through a suitable converter target.
The photon polarization is then measured with the aid of transmission asymmetry arising from reversing the magnetization direction of an iron absorber.
In this contribution an overview of the LEAP project is presented, detailing the
generation of the polarized electron beams along with the design and simulation
studies of the polarimeter.

Primary authors: POPP, Jennifer (FTX (FTX Fachgruppe SLB)); STEHR, Felix Paul Georg (FTX); BOHLEN, Simon (MPA4 (PAs for Industrial and Health Applicatio)); LIST, Jenny (FTX (FTX-SLB)); MOORTGAT-PICK, Gudrid (University of Hamburg / DESY); OSTERHOFF, Jens (DESY); PODER, Kristjan (MPA4 (PAs for Industrial and Health Applicatio))

Presenter: POPP, Jennifer (FTX (FTX Fachgruppe SLB))

Track Classification: Matter and Technologies

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **POPP, Jennifer** on **Friday, August 26, 2022**

Abstract ID : **46**

Nonlinear demodulation of flux ramp modulated µSQUID multiplexers

Content

Groundbreaking experiments such as QUBIC, which seeks to measure the Cosmic Microwave Background (CMB) radiation, employ highly sensitive superconducting detectors thanks to its very low noise contribution. To readout these detectors, complex cryogenic circuits which involves rf-SQUIDs coupled to microwave resonators and make use of frequency multiplexing technique in order to transmit hundreds and up to thousands superconducting detector signals on the same line are becoming more and more relevant. In order to accomplished it, flux ramp modulation (FRM) technique is fundamental to help reduce the number of cables inside the cryostat. A periodic magnetic flux is generated across all the SQUIDs in the multiplexer. In consequence, each SQUID produce a carrier waveform to which a quasi-constant detector signal phase will be added. Afterall, the detector signal has to be recovered through a phase demodulator. The quadrature demodulation technique for detecting a variation in the signal phase is a well-known and widely used method for flux ramp demodulation. However, in multirate signal processing systems, the inherent nonlinear characteristics of the mixers produce high-frequency components that affect the signal if they are not removed. A mathematical description of this phenomenon is treated in this work and validated with simulations and measurements. A method to overcome this has also been proposed and implemented.

Primary author: SALUM, Juan Manuel (ITeDA-KIT)

Presenter: SALUM, Juan Manuel (ITeDA-KIT)

Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **SALUM, Juan Manuel** on **Friday, August 26, 2022**

Abstract ID : **47**

Detector Challenges of the Strong-field QED Experiment LUXE at the European XFEL

Content

The LUXE experiment is an experiment, still in the planning stage, which aims to observe then characterise strong-field quantum electrodynamics interactions by colliding the high-quality high-energy EU.XFEL electron beam with a powerful LASER. Colliding LASER pulses with bunches of 1.5 × 10^9 electrons / 1 × 10^8 photons at 1Hz, this high-statistics environment presents an opportunity to probe rare interactions in new parameter-space of a novel regime. To do this requires a unique array of detectors to measure three types of particles, at highly varying fluxes dependent on LASER interaction parameters. The detectors measure electrons, positrons, or photons, and balance sensitivity with high dynamic range and hardness to radiation damage. The technologies, design, and reconstruction methods of each of these detectors are presented in this poster.

Primary author: HALLFORD, John Andrew (FLC (Forschung an Lepton Collidern))

Presenter: HALLFORD, John Andrew (FLC (Forschung an Lepton Collidern))

Track Classification: Detector Technologies and Systems

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **HALLFORD, John Andrew** on **Friday, August 26, 2022**

Abstract ID : **48**

RFSoC Gen 3 Data Converters Characterization for the Read-Out System of Superconducting Bolometers.

Content

QUBIC ("Q & U Bolometric Interferometer for Cosmology") is a project which focuses on studying vestiges of gravitational waves from the B-polarization mode present in the Cosmic Microwave Background, a product of the Big-Bang. The required sensitivity of the polarization temperature anisotropies of the CMB requires around 2048 ultra-sensitive detectors working at cryogenic temperatures. The instrument is equipped with a multiplexed system able to read them out without degrading their intrinsic sensitivity. In the second stage of QUBIC, a Microwave SQUID Multiplexer was proposed. In this configuration, each detector is coupled to a single-resonant-frequency resonator and a transmission line. The status of each bolometer can be determined by interrogating each resonator individually, needing just a pair of coaxial lines to the cryostat.

The readout system requires the generation and acquisition of multitone signals, typically in the range between 4 and 8GHz. To achieve this, Software Defined Radio (SDR) systems are generally used. The FPGA is coupled to a set of high-speed DACs and ADCs along with analog filters to translate these signals to the required band. Recently, Xillinx released the latest generation (Gen3) of the Radio Frequency System on a Chip (RFSoC) processing platforms, which integrate powerful FPGAs and processors together with up to 16 high-speed ADCs and DACs in a single RFSoC device. This kind of device could potentially improve system integration while reducing power consumption and cost.

This work presents the characterization of high-speed data converters of the RFSoC Gen3 under the conditions of the QUBIC experiment. The results were compared with the experimental requirements and with previous versions of the readout electronics using discrete components. Various operating limits were identified, and the viability of using the RFSoC was assessed. It has been shown that the RFsoc is suitable for the readout of superconducting detectors, that it reduces system complexity, and that it in fact increases system integration.

Primary author: GARCIA REDONDO, Manuel (ITeDA-KIT)

Presenter: GARCIA REDONDO, Manuel (ITeDA-KIT)

Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Comments:

Affiliations: 1 For the QUBIC Collaboration 2 Instituto de Tecnologías en Detección y Astropartículas 3 Karsruher Institute of Technology

Status: ACCEPTED

Submitted by **GARCIA REDONDO, Manuel** on **Friday, August 26, 2022**

Abstract ID : **50**

Real-time data processing for serial X-ray crystallography at PETRA III

Content

We have implemented a system for fully real-time data processing during a serial X-ray diffraction experiment, with (in principle) no need to store image data on disk. Using the CrystFEL software in combination with the ASAP::O data framework, frames from a 16 megapixel Dectris EIGER2 X detector were searched for peaks, indexed and integrated at the maximum full-frame readout speed of 133 frames per second. The pipeline produced un-merged Bragg reflection intensity measurements which could be directly scaled and merged in order to solve the structure.

By carefully optimizing the analysis software and processing parameters, we have been able to reduce the amount of CPU power needed to keep up with the data flow. Whereas around 1,800 cores were needed on our first attempt, now only around 24 are required. This contribution will discuss what we learnt from this process, and touch on the possible implications for experimental design.

Primary author: Dr WHITE, Thomas (FS-SC)

Co-authors: SCHOOF, Tim (DESY); TOLSTIKOVA, Aleksandra (FS-SC Photon Science Scientific Computing); YAKUBOV, Sergey (IT (IT Scientific Computing)); Dr MARIANI, Valerio (LCLS); HENKEL, Alessandra (FS-CFEL-1 (Forschung mit Photonen Experimente 1)); KLOPPROGGE, Bjarne (FS-CFEL-1 (Forschung mit Photonen Experimente 1)); PRESTER, Andreas (Universitätsklinikum Hamburg-Eppendorf); Mr DE GRAAF, Stijn (CFEL); GALCHENKOVA, Marina (FS-CFEL-1 (Forschung mit Photonen Experimente 1)); YEFANOV, Oleksandr (FS-CFEL-1 (Forschung mit Photonen Experimente 1)); MEYER, Jan (FS-CFEL-1-BMX (FS-CFEL-1 Fachgruppe BMX)); POMPIDOR, Guillaume (DESY); HANNAPPEL, Juergen (IT (IT Scientific Computing)); OBERTHÜR, Dominik (DESY); HAKANPAEAE, Johanna (FS-PETRA-D (FS-PET-D Fachgruppe P11)); GASTHUBER, Martin (IT (IT Scientific Computing)); BARTY, Anton (FS-SC (Scientific computing))

Presenter: Dr WHITE, Thomas (FS-SC)

Track Classification: Data Management and Analysis

Contribution Type: Poster with possible speed talk

Comments:

This is a follow-on from my talk at the 7th MT meeting in February 2021. That was before we had any experimental results. Now, we have lots of data and improvements to talk about.

I'm not sure whether the work is directly funded by MT or not (no-one seems able to give me a clear answer!), but it is certainly relevant. The MT-DMA people are the closest thematic "friends" I've found within Helmholtz.

Status: ACCEPTED

Submitted by **Dr WHITE, Thomas** on **Monday, August 29, 2022**

Abstract ID : **51**

Microwave SQUID multiplexing of magnetic microcalorimeters

Content

Magnetic microcalorimeters (MMCs) are energy dispersive, low-temperature particle detectors that combine an intrinsically fast signal rise time, an excellent energy resolution, a huge dynamic range, a quantum efficiency close to 100% as well as an almost ideal linear response. For these reasons, MMCs are nowadays actively used in a wide field of applications. But although microfabrication technologies are technically mature and meanwhile allow producing large-scale detector arrays with virtually identical detectors, the readout of such arrays remains ambitious using established technologies that had been developed for single-channel readout in most cases. As a consequence, multiplexing techniques are currently under active development, whereas microwave SQUID multiplexing appears to be most promising.

In this contribution, we present the design and the performance of the most recent version of our lumped element microwave SQUID multiplexer (LEMUX), which will consist of 400 readout channels in the frequency range between 4 GHz and 8 GHz in the final stage. Each LEMUX channel consists of a superconducting lumped element microwave resonator with a bandwidth of 1 MHz and a power consumption below 10 pW. The non-hysteretic rf-SQUID, which is inductively coupled to the resonator, is based on four washers building a first-order parallel gradiometer and is impedance matched for optimal detector readout. The characterization of the LEMUX shows a very good agreement between measured data and multiplexer model, as well as device parameters very close to design values. Using this LEMUX device, we demonstrate a reliable post-processing method for fine-adjusting the resonator resonance frequencies, which ultimately allows for a resonance frequency spacing of 10 MHz within the system bandwidth of 4 GHz.

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Presenter: WEGNER, Mathias (KIT)

Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **WEGNER, Mathias** on **Tuesday, August 30, 2022**

Abstract ID : **52**

Electro-Optical Diagnostics at KARA

Content

Electro-optical (EO) methods are well-proven diagnostic tools, which are utilized to detect THz fields in countless experiments. The world's first near-field EO sampling monitor at an electron storage ring was developed and installed at the KIT storage ring KARA (Karlsruhe Research Accelerator) and optimized to detect longitudinal bunch profiles. This experiment with other diagnostic techniques builds a distributed, synchronized sensor network to gain comprehensive data about the phase-space of electron bunches as well as the produced coherent synchrotron radiation (CSR). Furthermore, a far-field EO setup to measure the THz spectrum of the CSR in single-shot is currently implemented. In this contribution, we will give an overview of current EO activities at KARA.

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Presenter: WIDMANN, Christina (KIT)

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **WIDMANN, Christina** on **Tuesday, August 30, 2022**

Abstract ID : **53**

Towards direct detection of the shape of CSR pulses with fast THz detectors

Content

Coherent synchrotron radiation (CSR) is emitted when the emitting structure is equal to or smaller than the observed wavelength. Consequently, these pulses are very short and most detectors respond with their impulse response, regard- less of the pulse length and shape. Here we present single- shot measurements performed at the Karlsruhe Research Accelerator (KARA) using a fast real-time oscilloscope and Schottky barrier detectors sensitive in the sub-THz range. The time response of this setup to CSR pulses emitted by electron bunches during the microbunching instability is shown to be sensitive to the shape of the electron bunch. Our results show how, in the future, the shape of electron bunches can be directly measured using a straightforward setup.

Primary author: STEINMANN, Johannes (Karlsruhe Institute of Technology (KIT), IBPT)

Co-authors: MOCHIHASHI, Akira (Karlsruhe Institute of Technology); BRUENDERMANN, Erik (KIT); MÜLLER, Anke-Susanne (KIT)

Presenter: STEINMANN, Johannes (Karlsruhe Institute of Technology (KIT), IBPT)

Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **STEINMANN, Johannes** on **Tuesday, August 30, 2022**

Abstract ID : **73**

Prototype Room Temperature Quadrupole Chamber with Cryogenic Installations

Content

The FAIR complex at the GSI Helmholtzzentrum will generate heavy ion beams of ultimate intensities. To achieve this goal, low charge states have to be used. However, the probability for charge exchange in collision with residual gas particles of such ions is much higher than for higher charge states. In order to lower the residual gas density to extreme high vacuum conditions, 65% of the circumference of SIS18 are already coated with NEG, which provides high and distributed pumping speed. Nevertheless, Nobel and Nobel-like components, which have very high ionization cross sections, do not get pumped by this coating. A cryogenic environment at moderate temperatures, i.e. at 50-80K, provides high pumping speed for all heavy residual gas particles. The only typical residual gas particles that cannot be pumped at this temperature is Hydrogen. With an additional NEG coating the pumping will be optimized for all residual gas particles. The installation of cryogenic installations in the existing room temperature synchrotron SIS18 at GSI has been investigated. A prototype quadrupole chamber with cryogenic installations, measurements at different temperatures and simulations of the adapted accelerator, are presented.

Primary authors: AUMÜLLER, Simone (GSI); BOZYK, Lars (GSI); SPILLER, Peter (GSI); Dr BLAUM, Klaus (Max-Planck-Institut für Kernphysik)

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **AUMÜLLER, Simone** on **Monday, September 5, 2022**

Abstract ID : **74**

Cryogenic Surfaces in the Room Temperature SIS18 Ion Catcher

Content

The heavy ion synchrotron SIS100 at the FAIR facility, which is currently built at the GSI Helmholtzzentrum in Darmstadt, will provide heavy ion beams of highest intensities, 5e11 Uranium particles per pulse. For FAIR operation, the existing heavy ion synchrotron SIS18 at GSI will be used as a booster synchrotron for SIS100. Four injections of 1.25e11 will be accumulated in SIS100 for further acceleration. In order to reach the intensity goals, medium charge state heavy ions have to be used. Unfortunately, such ions have very high ionization cross sections in collisions with residual gas particles. This yields in beam loss and subsequent pressure rise via ion impact stimulated gas desorption. Such, self-amplification up to complete beam loss can evolve. To reduce the desorption yield and thereby the dynamic vacuum, room temperature ion catchers which provide low desorption surfaces have been installed in SIS18. This measure shifts the intensity limit for heavy ion operation in SIS18 to higher number of particles.
Heavy ion operation with medium charge states can be simulated using the StrahlSim code. Dynamic vacuum simulations with cryogenic surfaces show, that their high sticking probability prevents the vacuum system from pressure built-ups during operation with heavy ions. This can stabilize the operation with heavy ion beams at higher intensities, than solely with NEG-coated room temperature surfaces.
A prototype ion catcher containing cryogenic surfaces has been developed and built. The surfaces are cooled by a commercial cold head, which easily allows this system being integrated into the room temperature synchrotron. The cold head can be removed without breaking the UHV system, such that a vacuum-bakeout and activation of NEG-surfaces is possible. The development and first laboratory tests of this system are presented.

Primary author: BOZYK, Lars (GSI)

Co-authors: AUMÜLLER, Simone (GSI); SPILLER, Peter (GSI)

Presenters: BOZYK, Lars (GSI); AUMÜLLER, Simone (GSI)

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **BOZYK, Lars** on **Monday, September 5, 2022**

Abstract ID : **75**

Energy Compression and Stabilization of Laser-Plasma Accelerators

Content

Laser-plasma accelerators (LPAs) outperform current radiofrequency technology in acceleration strength by orders of magnitude. Yet, enabling them to deliver competitive beam quality for demanding applications, particularly in terms of energy spread and stability, remains a major challenge. Here, we report on a recently published method that combines bunch decompression and active plasma dechirping for drastically improving the energy profile and stability of beams from LPAs. Realistic start-to-end simulations demonstrate the potential of these post-acceleration phase-space manipulations for simultaneously reducing an initial energy spread and energy jitter of ~1–2 % to ⊠0.1 %, closing the beam-quality gap to conventional acceleration schemes.

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Presenter: FERRAN POUSA, Angel (MPA (Plasma Accelerators))

Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **FERRAN POUSA, Angel** on **Tuesday, September 6, 2022**

Abstract ID : **76**

High current accelerator systems for future HBS: HBS Innovationpool Project

Content

Hi-current compact accelerator-based neutron sources (Hi-CANS) offer a promising alternative to small and medium reactor and spallation based neutron research facilities. They do not require research reactors or high-energy spallation sources as they efficiently utilize nuclear processes at low acceleration energies. For the research and development of the various components and areas relevant to establish a high brilliance accelerator based neutron source the Innovation Pool project on "High current accelerator systems for future HBS" has been set up within the Research Field Matter of the Helmholtz Association starting in 2019.
Research and development in this project deal with i) linear pulsed proton accelerator cavities, (GSI HI Mainz), ii) fast proton beam multiplexing and beam dynamics (FZJ), iii) neutron target- and moderator development (FZJ), iv) neutron beam extraction and instrumentation (HZG) and v) neutron imaging and irradiation experiments (HZDR). The current status of the project and recent results of the work done so far will be presented.

Primary authors: BAGGEMANN, Johannes (Forschungszentrum Jülich GmbH); BARTH, Winfried (GSI); BRÜCKEL, Thomas (Forschungszentrum Jülich GmbH); FACSKO, Stefan (Helmholtz-Zentrum Dresden-Rossendorf); FELDEN, Olaf (Forschungszentrum Jülich GmbH); FENSKE, Jochen (Hereon); GEBEL, Ralf (Forschungszentrum Jülich); GUTBERLET, Thomas (Forschungszentrum Jülich GmbH); LEHRACH, Andreas (Forschungszentrum Jülich, RWTH Aachen University); LI, Jingjing (Forschungszentrum Jülich GmbH); LIEUTENANT, Klaus (Forschungszentrum Jülich GmbH); MAUERHOFER, Eric (Forschungszentrum Jülich GmbH); RÜCKER, Ulrich (Forschungszentrum Jülich GmbH); SCHWAB, Alexander (JCNS-2, Forschungszentrum Jülich GmbH); VOIGT, Jörg (Forschungszentrum Jülich GmbH); ZAKALEK, Paul (Forschungszentrum Jülich GmbH)

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **GUTBERLET, Thomas** on **Tuesday, September 6, 2022**

Abstract ID : **77**

Spin-Tracking simulations in a COSY model using Bmad

Content

The matter-antimatter asymmetry might be understood by investigating the EDM (Electric Dipole Moment) of elementary charged particles. A permanent EDM of a subatomic particle violates time reversal and parity symmetry at the same time and would be, with the currently achievable experimental accuracy, an indication for further CP violation than established in the Standard Model.

The JEDI-Collaboration (Jülich Electric Dipole moment Investigations) in Jülich has performed a direct EDM measurement for deuterons with the so called precurser experiments at the storage ring COSY (COoler SYnchrotron).

In order to understand the measured data and to disentangle an EDM signal from systematic effects, spin tracking simulations in an accurate simulation model of COSY are needed. Therefore a model of COSY was implemented using the software library Bmad. Systematic effects were considered by including element misalignments, effective dipole shortening, longitudinal fields and steerer kicks. These effects rotate the invariant spin axis additional to the EDM and have to be analyzed and understood. The most recent spin tracking results as well as the methods to find the invariant spin axis will be presented.

Primary author: VITZ, Max (Forschungszentrum Jülich, RWTH Aachen)

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **VITZ, Max** on **Thursday, September 8, 2022**

Abstract ID : **78**

Ab initio path integral Monte Carlo simulations of hydrogen snapshots at warm dense matter conditions

Content

We combine ab initio path integral Monte Carlo (PIMC) simulations with fixed ionic configurations, obtained by DFT-MD simulations, in order to solve the electronic problem for hydrogen under warm dense matter conditions. To solve the divergence problem in the Ewald-sum for attractive potentials we employ the pair-approximation. This approach is compared against the much simpler Kelbg pair-potential. We find very favorable convergence behavior towards the former. Since PIMC does not require any further assumptions regarding exchange and correlations of the many-body system, we then compare electronic densities obtained from our snapshot PIMC calculations with DFT calculations in the metallic regime. Furthermore, we investigate the manifestation of the resulting fermionic sign problem in our snapshot PIMC simulations. This gives us the unique capability to study the properties of warm dense hydrogen from ab initio simulations without any further assumptions, like the functional form of the exchange-correlation effects or fixed fermionic nodes. Thus, snapshot PIMC enables us to obtain the exact density response of warm dense hydrogen. This is extremely valuable to both experiments, like X-Ray Thomson scattering, as well as the development of new XC-functionals.

Primary authors: BOEHME, Maximilian (Helmholtz-Zentrum Dresden-Rossendorf); MOLDABEKOV, Zhandos (Helmholtz-Zentrum Dresden-Rossendorf, Center of Advanced Systems Understanding); VORBERGER, Jan (HZDR); DORNHEIM, Tobias (HZDR/CASUS)

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **BOEHME, Maximilian** on **Friday, September 9, 2022**

Abstract ID : **79**

Terahertz Sampling Rates With Photonic Time-Stretch for Electron Beam Diagnostics

Content

To understand the underlying complex beam dynamics in electron storage rings often large numbers of single-shot measurements must be acquired continuously over a long period of time with extremely high temporal resolution. Photonic time-stretch is a measurement method that is able to overcome speed limitations of conventional digitizers and enable continuous ultra-fast single-shot terahertz spectroscopy with rates of trillions of consecutive frames. In this contribution, a novel ultra-fast data sampling system based on photonic time-stretch is presented and the performance is discussed. THERESA (TeraHErtz REadout SAmpling) is a data acquisition system based on the recent ZYNQ-RFSoC family. THERESA has been developed with an analog bandwidth of up to 20 GHz and a sampling rate of up to 90 GS/s. When combined with the photonic time-stretch setup, the system will be able to sample a THz signal with an unprecedented frame rate of 8 Tf/s. Continuous acquisition for long observation times will open up new possibilities in the detection of rare events in accelerator physics.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **Ms MANZHURA, Olena** on **Friday, September 9, 2022**

Abstract ID : **80**

A first glance at radiative characteristics of the hosing instability

Content

We present the results and analyses of radiation spectra expected to be produced by highly relativistic particle beams propagating through a plasma medium and experiencing the hosing instability. Coherent and incoherent contributions to the spectra are determined in-situ for all simulated particles (>10^9) of the particle cloud and ambient plasma for over 400 detectors covering 5/4 octants of a solid angle.
Our particle-in-cell code allows us to distinguish radiation emitted by plasma particles from that of the bunch, thereby enabling us to infer the origin of the spectral features.
In the simulation campaign, conducted at the JUWELS Booster cluster at JSC, we consider linear and non-linear regimes of the instability for highly relativistic electron beams impacting a homogeneous electron plasma.
We show an updated analysis of the data relating observed characteristics of the spectra to the features of the bunch and ambient plasma, thereby identifying first features indicative of the hosing instability.
A goal of these studies is to open up new experimental avenues for better understanding the beam instability evolution by identifying quantitative radiation signatures of the instability that can be measured in experiments.

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Track Classification: Matter and Technologies

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **LEBEDEV, Anton** on **Friday, September 9, 2022**

Abstract ID : **81**

The PUNCH4NFDI Science Data Platform SDP

Content

The PUNCH4NFDI Consortium in the German NFDI has as its central deliverable the so-called science data platform SDP, in which complex workflows can be executed on digital research products in a transparent, automatised and FAIR way. The SDP consists of several ingredients that are more or less far advanced in their development and the interplay and interfacing of which is now being implemented. In this poster, we endeavour to visualise the main ingredients and function of the SDP, and we highlight recent achievements.

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Presenter: SCHOERNER-SADENIUS, Thomas (DESY)

Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **SCHOERNER-SADENIUS, Thomas** on **Sunday, September 11, 2022**

Abstract ID : **82**

Performance portability with alpaka

Content

The alpaka library is a header-only C++17 abstraction library for development across hardware accelerators (CPUs, GPUs, FPGAs). Its aim is to provide performance portability across accelerators through the abstraction (not hiding!) of the underlying levels of parallelism. In this poster we will show the concepts behind alpaka, how it is mapped to the various underlying hardware models, and show the features introduced over the last year. In addition, we will also present the software ecosystem surrounding alpaka.

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **STEPHAN, Jan** on **Sunday, September 11, 2022**

Abstract ID : **83**

NFDI@DESY

Content

The German National Research Data Infrastructur (Nationale Forschungsdaten-Infrastruktur, NFDI e.V.) was founded to promote open data in the german research system under consideration of the FAIR principles ("findable, accessible, interoperable and reusable"). The implementation is performed in consortia which represent different areas in science. At DESY, we house two NFDI consortia: DAPHNE4NFDI focuses on research with photons and neutrons at large-scale research facilities; PUNCH4NFDI focuses on particle, astroparticle, astro-, hadron and nuclear physics. Both consortia deal, for example, with the definition of extendable catalogues of metadata and the conservation of research workflows to improve the findability and reusability of data. Here, we present NFDI, DAPHNE4NFDI and PUNCH4NFDI.

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **SCHNEIDE, Christiane** on **Sunday, September 11, 2022**

Abstract ID : **84**

Longitudinal Bunch Diagnostic at the KARA Booster Synchrotron

Content

At the KARA accelerator, after the electron bunches are per-accelerated by a 3 GHz microtron, a booster synchrotron operating at 500 MHz is used to increase the energy of the electrons from 50 MeV to 500 MeV, before they are injected into the storage ring. Due to various effects, the injection efficiency from to the ring is rather low. To investigate these inefficiencies and remedy them, fast beam diagnostics are needed.
Currently the sum signal from a beam position monitor and an oscilloscope are used to measure an average longitudinal beam profile over many turns, which is insufficient to observe e.g. the injection period.
Therefore, we propose to replace the oscilloscope with a high-speed digitizer with the appropriate trigger capabilities and to deploy a photodiode at the synchrotron light port of the booster synchrotron.
Doing so enables turn-by-turn and bunch-by-bunch diagnostic needed to investigate events that differ over a few turns, as well as instabilities in-between the electron bunches.

Primary author: NOLL, Marvin (KIT)

Co-authors: EL KHECHEN, Dima (KIT, Karlsruhe Institute of Technology); STEINMANN, Johannes (Karlsruhe Institute of Technology (KIT), IBPT); Mr HUTTEL, Erhard (KIT); SCHUH, Marcel (KIT - ANKA); MÜLLER, Anke-Susanne (KIT)

Presenter: NOLL, Marvin (KIT)

Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **NOLL, Marvin** on **Sunday, September 11, 2022**

Abstract ID : **85**

openPMD – F.A.I.R. Scientific I/O at the Exascale

Content

This poster presents openPMD, an open and F.A.I.R. standard for particle-mesh data, and its impact in heterogeneous scientific workflows.
Particle accelerator codes need to span various time and length scales, leading to data processing pipelines consisting of multiple heterogeneous codes.
Standardization of physical data helps bridging the different models with a commonly-understood markup, creating interoperable and flexible workflows.

The openPMD standard is made accessible to scientific software via the openPMD-api, a library for the description of scientific data.
The backend implementations of the openPMD-api are based on established I/O framworks such as HDF5 and ADIOS2, and also include a scalable streaming backend for HPC workflows, provided by ADIOS2.
The poster gives an insight into the existing ecosystem of openPMD and describes basic concepts of the data markup.

It shortly illuminates recent trends in large-scale I/O and their impact on scientific compute workflows. While traditional attempts at counteracting such trends, e.g. through compression, remain available in the openPMD-api, we propose loose coupling and online analysis via streaming workflows as a sustainable solution that avoids parallel filesystem bottlenecks.

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Co-author: HUEBL, Axel (LBNL)

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **POESCHEL, Franz** on **Monday, September 12, 2022**

Abstract ID : **86**

HOM Damping of 3rd Harmonic Copper Cavities for Active Operation in the BESSY II Storage Ring

Content

BESSY II third generation light source is a 1.7 GeV storage ring. It delivers high intensity 15ps pulses in standard user optics and shorter pulses in low alpha optics with reduced intensity. The integrated 3rd harmonic copper cavities (so called Landau cavities) are operated in passive mode and enable lifetime improvement of the storage ring. Currently a new type of 3rd harmonic cavity is under development for active operation in the storage ring for precise phase-amplitude control of the cavity voltage. The stable operation of those cavities in the storage ring requires strong HOM damping to avoid coupled bunch instabilities. This requires careful analyses of the HOM dampers and HOM power levels for the BESSY II fill pattern at 300mA current. Hence, as part of the cavity design, the appropriate absorbers are designed to extract the HOM power from the system. The analyses of HOM power levels and the integration of ferrite absorbers will be presented.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **TSAKANIAN, Andranik** on **Monday, September 12, 2022**

Abstract ID : **87**

Timing Upgrades for the Test Beam Telescopes

Content

Timing is becoming more and more critical for particle physics. The EUDET telescopes only provide minimal timing and require an upgrade to keep up with the demands. Currently, two upgrade projects are pursued at DESY. Firstly the TelePix project to provide an ns timestamp combined with a flexible region of interest trigger as well as an LGAD layer for the ultimate time resolution. Both concepts and first results are presented together with an outlook on future developments.

Finally, the application of a timing layer to provide beam diagnostics is showcased to highlight potential synergies within MT.

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Track Classification: Matter and Technologies

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **HUTH, Lennart** on **Monday, September 12, 2022**

Abstract ID : **88**

H-Mode RF-cavity developments for the HBS-linac

Content

Neutron research in Europe is mainly based on various nuclear reactors that will be successively decommissioned over the next years. This means that despite the commissioning of the European Spallation Source ESS, many neutron research centers, especially in the medium flux regime, will disappear. In response to this situation, the Jülich Center for Neutron Science (JCNS) has begun the development of a scalable, compact, accelerator-based High Brilliance neutron Source (HBS). A total of three different neutron target stations are planned, which can be operated with a 100 mA proton beam of up to 70 MeV and a duty cycle of up to 6%. The driver Linac consists of an Electron Cyclotron Resonance (ECR) ion source followed by a LEBT section, a 2.5 MeV double Radio-Frequency Quadrupole (RFQ) and 35 normal conducting (NC) Crossbar H-Mode (CH) cavities. The development of the cavities is carried out by the Institute for Applied Physics (IAP) at the Goethe University Frankfurt am Main. Due to the high beam current, all cavities as well as the associated tuners and couplers have to be optimized for operation under high thermal load to ensure safe operation. In general, the continuous wave linear accelerator HELIAC is an ideal test environment to develop and benchmark H-mode drift tube cavities with high thermal load. Two alternating phase focusing interdigital H-Mode cavities have been developed and are currently tendered to test key components such as high-performance couplers and tuners. They will be used to demonstrate and explore the operation of H-mode cavities under realistic conditions, prior to the operation of the HBS-linac.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **LAUBER, Simon** on **Monday, September 12, 2022**

Abstract ID : **89**

KINGFISHER: A Framework for Fast Machine Learning Inference for Autonomous Accelerator Systems

Content

Modern particle accelerator facilities allow new and exciting beam properties and operation modes. Traditional real-time control systems, albeit powerful, have bandwidth and latency constraints that limit the range of operating conditions currently made available to users. The capability of Reinforcement Learning to perform self-learning control policies by interacting with the accelerator is intriguing. The extreme dynamic conditions require fast real-time feedback throughout the whole control loop from the diagnostic, with novel and intelligent detector systems, all the way to the interaction with the accelerator components. In this contribution, the novel KINGFISHER framework based on the modern Xilinx Versal devices will be presented. Versal combines several computational engines, specifically combining powerful FPGA logic with programmable AI Engines in a single device. Furthermore, this system can be natively integrated with the fastest beam diagnostic tools already available, e.g. KAPTURE and KALYPSO.

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Track Classification: Matter and Technologies

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **SCOMPARIN, Luca** on **Monday, September 12, 2022**

Abstract ID : **90**

Transverse and Longitudinal Modulation of Photoinjection Pulses at FLUTE

Content

To generate the electrons to be accelerated, a photoinjection laser is used at the linac-based test facility FLUTE (Ferninfrarot Linac- Und Test Experiment) at the Karlsruhe Institute of Technology (KIT). The properties of the laser pulse, such as intensity, laser spot size or temporal profile, are the first parameters to influence the characteristics of the electron bunches. In order to control the initial parameters of the electrons in the most flexible way possible, the laser optics at FLUTE are therefore supplemented by additional setups that allow transverse and longitudinal laser pulse shaping by using so-called Spatial Light Modulators (SLMs). In the future, the control of the SLMs will be integrated into a Machine Learning (ML) supported feedback system for the optimization of the electron bunch properties. In this contribution the first test experiments and results on laser pulse shaping at FLUTE on the way to this project are presented.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **NABINGER, Matthias** on **Tuesday, September 13, 2022**

Abstract ID : **91**

Surrogate Modelling of the FLUTE Low-Energy Section

Content

Numerical beam dynamics simulations are essential tools in the study and design of particle accelerators, but they can be prohibitively slow for online prediction during operation or for systematic evaluations of new parameter settings. Machine learning-based surrogate models of the accelerator provide much faster predictions of the beam properties and can serve as a virtual diagnostic or to augment data for reinforcement learning training. In this paper, we present the first results on training a surrogate model for the low-energy section at the Ferninfrarot Linac- und Test-Experiment (FLUTE).

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **XU, Chenran** on **Tuesday, September 13, 2022**

Abstract ID : **92**

Precision X-Ray Spectroscopy of He-like Uranium using Metallic Magnetic Calorimeters

Content

Recent developments regarding metallic magnetic calorimeters (MMCs) have resulted in a new class of detectors for precision X-ray spectroscopy, for example the maXs series of detectors [1] (cryogenic microcalorimeter arrays for high resolution X-ray spectroscopy), which have been developed within the SPARC collaboration. These detectors are based on the following measurement principle: The energy deposition of an incident X-ray photon leads to a measurable temperature rise of an absorber. At operation temperatures below 50 mK this leads to a change in the magnetisation of a paramagnetic sensor which can be measured by a superconducting quantum interference device (SQUID) [2] resulting in outstanding features of MMCs. These detectors combine a very high energy resolution (better than 100 eV FWHM at 100 keV) comparable to crystal spectrometers, with the broad bandwidth acceptance of semiconductor detectors (0.1 − 100 keV) [3].

These detectors are especially well suited for X-ray spectroscopy of highly charged ions. Helium-like ions, for example, are the simplest atomic multibody systems and their study along the isoelectronic sequence provides a unique testing ground for the interplay of the effects of electron–electron correlation, relativity and quantum electrodynamics. However, for high-Z ions with nuclear charge $Z > 54$, where inner-shell transition energies reach up to 100 keV, there is currently no data available with high enough resolution and precision to challenge state-of-the-art theory [4]. We report on the first application of MMC detectors for high-resolution x-ray spectroscopy at the electron cooler of the low-energy storage ring CRYRING@ESR at GSI, Darmstadt. Within the presented experiment, the x-ray emission associated with radiative recombination of stored hydrogen-like uranium ions and cooler electrons was studied. Two maXs-100 detectors were placed at observation angles of 0° and 180° with respect to the ion beam axis. Special emphasis will be given to the achieved spectral resolution of better than 90 eV at x-ray energies close to 100 keV enabling for the first time to resolve the substructure of the K_1 and K_2 lines.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **PFAEFFLEIN, Philip** on **Tuesday, September 13, 2022**

Abstract ID : **93**

Laser cooling of bunched relativistic ion beams at the FAIR SIS100

Content

The heavy-ion synchrotron SIS100 is the core machine of the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. It is capable of accelerating a large range of ions, produced by the injector (the upgraded GSI facility), up to highly relativistic velocities and extracting them for unique experiments, e.g. APPA/SPARC. In order to cool such intense beams of relativistic heavy highly charged ions, laser cooling of bunched ion beams was preferred. Therefore, the laser cooling pilot facility at the SIS100, being also the only in-ring experiment, is currently being realized. We will present this project and give an update of its current status. We will also give an overview of the laser and detector systems that will be used.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **KLAMMES, Sebastian** on **Wednesday, September 14, 2022**

Abstract ID : **94**

HV-CMOS Sensors for the Mu3e Experiment Searching for Lepton-Flavor Violation

Content

Mu3e is going to search for the lepton-flavor violating decay of a positive muon into two positrons and an electron. This decay is possible within the Standard Model, but it is suppressed to O(1050). However, there is a number of suggested extensions of the Standard Model, introducing particles that render this decay path much more likely. Therefore, any observation of this decay would be proof of physics beyond the Standard Model. Unfortunately, there are background processes that could be mistaken for the wanted process, e.g. the decay of a muon to three electrons and two neutrinos or the superposition of several muon decays.

Mu3e is currently under construction at Paul-Scherrer-Institut (Switzerland). It will be able to analyze the decays of 109 muons per second, avoid pileup and detect the emerging particles with a sufficient momentum resolution, so that no neutrino can escape unnoticed. This requires a time resolution < 100 ps, a vertex resolution of < 200 µm and a momentum resolution < 0.5 MeV/c.

These requirements have led to the design of a detector consisting of an inner pixel detector, a layer of scintillating fibers and an outer pixel layer. It is operated in a magnetic field to bend the particle's trajectories. This barrel-shaped detector is combined with similar adjacent detectors, tracing the recurling particles. For optimal momentum resolution, the particles have to pass the detector several times, which limits the material budget to the absolute minimum.

Several iterations of monolithic active HV-CMOS chips for the pixel detector have been designed and produced to fulfill these requirements. They are called MuPix. These approximately 2 x 2 cm^2 large sensors are thinned to less than 100 µm and combined in modules to form all layers of pixel detectors in Mu3e. 256 x 250 pixels per sensor with sensitivity close to 100% record the signals, smart electronics care for excellent time resolution and three gigabit links per sensor stream the encoded information out.

We present the status of the latest MuPix sensor – MuPix11 – in the context of the Mu3e experiment.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **EHRLER, Felix** on **Wednesday, September 14, 2022**

Abstract ID : **95**

A Confined Continuous-Flow Plasma Source For High-Average-Power Laser Plasma Acceleration

Content

High average power, kHz laser plasma acceleration (LPA) is an emerging technique which could supply few MeV, few femtoseconds electron bunches with high average current. Such electron beams can be transformative for many industrial applications, for ultrafast pump-probe studies as well as drivers for secondary sources. Tailoring the plasma profile is an essential part, allowing to control both the injection and the acceleration mechanism. Here a novel plasma source for high repetition rate, 10 MeV electron acceleration is presented, consisting of a steady-state flow capillary. It is able to supply a localized and confined gas region (~100µm) with sharp density gradients, which are a key feature for both coupling the laser into the gas and injecting electrons. Its tunability and the minimized gas load into the vacuum chamber make this new source a promising candidate for high average power LPA.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **FARACE, Bonaventura** on **Wednesday, September 14, 2022**

Abstract ID : **96**

Bayesian Optimization of Laser-Plasma Accelerators

Content

Laser-plasma accelerators (LPA) are one the verge of becoming drivers for real-world science applications. However, in order to be considered serious alternatives to conventional machines they need to be able to provide competitive quality and versatility of the electron beam parameters as requested by potential applications. As shown by numerous experiments in the past LPAs are in principle capable of doing so. However, specifically finding the configuration of machine parameters to satisfy the demands of an application remains a complex task that involves the optimization of a single or multiple, oftentimes competing, objectives. Bayesian optimization provides a framework that can help to efficiently tune a machine to provide beams individually tailored for each intended application.
Here we show our latest results on optimization of plasma accelerators both in the design phase using simulation and in real time at the LUX experiment and show a perspective of efficiently tuning the experiment to suit various applications.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **JALAS, Soeren** on **Wednesday, September 14, 2022**

Abstract ID : **97**

Surrogate Modeling of Laser-Plasma Acceleration

Content

Laser-plasma acceleration (LPA) promises compact sources of high-brightness electron beams for science and industry. However, transforming LPA into a technology to drive real-world applications remains a challenge. Machine learning techniques could prove decisive in further understanding and improving the performance of these machines. Here, we discuss the application of supervised learning to create surrogate models of the LPA process at LUX. Using simulated and experimental data, we train artificial neural networks to predict the electron beam quality as a function of the drive laser properties. Of the many potential applications of such models, we emphasize their use to study the influence of laser fluctuations on the electron beam stability.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **KIRCHEN, Manuel** on **Wednesday, September 14, 2022**

Abstract ID : **98**

Large energy depletion of a beam driver in a plasma-wakefield accelerator

Content

Beam-driven plasma-wakefield acceleration has the potential to reduce the building cost of accelerator facilities, with large accelerating fields that are orders of magnitude greater than those of radio-frequency cavities. Sustaining strong decelerating fields for the driver and strong accelerating fields for the trailing bunch across long plasma stages will be key to demonstrating high energy efficiency in this scheme, which is necessary to keep the running costs low for such a facility. We show first measurements at FLASHForward with a 500 MeV drive bunch depositing approximately half of its energy into a 20 cm long plasma.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **PEÑA, Felipe** on **Wednesday, September 14, 2022**

Abstract ID : **99**

Probing Ion-motion Recovery in a Beam-driven Plasma-wakefield Accelerator

Content

Beam-driven plasma-wakefield acceleration is a promising avenue for the future design of compact linear accelerators with applications in high-energy physics and photon science. Meeting the luminosity and brilliance demands of current users requires the delivery of thousands of bunches per second – many orders of magnitude beyond the current state-of-the-art of plasma-wakefield accelerators, which typically operate at the Hz-level. As recently explored at FLASHForward, a fundamental limitation for the highest repetition rate is the long-term motion of ions that follows the dissipation of the driven wakefield (R. D'Arcy, et al. Nature 603, 58–62 (2022)). Studying the dynamics of plasma recovery in greater detail is an essential first step in advancing beam-driven plasma-wakefield acceleration towards meaningful application in future high-energy-physics and photon-science facilities. Here we present the measurement methodology, the data processing, and discuss latest experimental results.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **BEINORTAITE, Judita** on **Wednesday, September 14, 2022**

Abstract ID : **100**

Planar fiber-chip-coupling using angle-polished polarization maintaining fibers

Content

We report on our latest developments of a planar fiber-chip-coupling scheme, using angle polished, polarization maintaining (PM) fibers. Most integrated photonic chip components are polarization sensitive and a suitable way to launch several wavelength channels to the chip with the same polarization is the use of PM fibers. Those impose several challenges at processing and handling to achieve a stable, permanent, and low-loss coupling.
We present the processing of the fibers in detail and experimental results for our planar and compact fiber-chip-coupling technique.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **SCHNEIDER, Marc** on **Wednesday, September 14, 2022**

Abstract ID : **101**

Concepts for High Average Power Ti:Sa Pulse Compressors

Content

With the development of kW-level average power Ti:Sapphire laser, thermal management becomes increasingly challenging. One key component, which currently limits the scaling towards higher average powers, is the final pulse compressor. Compressor gratings that provide sufficient spectral bandwidth to support few-10 femtosecond pulses – as required by many applications – are typically gold-coated. However, it is well-known that this final gold layer absorbs several percent of the incident laser energy, which then subsequently heats and deforms the grating substrate. The heat-induced deformation of the grating can severely degrade the spatio-temporal pulse quality [1] with dramatic consequences for applications such as laser-plasma acceleration.

Here, we discuss different concepts for compressor gratings, such as actively cooled gratings [2] and multi-layer dielectric gratings [3],[4] and their suitability as compressor gratings for the future KALDERA laser [5] at DESY.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **BRAUN, Cora Sophia Lara** on **Wednesday, September 14, 2022**

Abstract ID : **102**

Learning-based Optimisation of Particle Accelerators Under Partial Observability Without Real-World Training

Content

Reinforcement learning (RL) has enabled the development of intelligent controllers for complex tasks that previously required human intuition to solve. In the context of particle accelerators, there exist many such tasks and solving them with conventional methods takes away from scarce experiment time and limits the operability of accelerators. We demonstrate how to successfully apply RL to the optimisation of part of a linear particle accelerator under highly limited partial observability and without requiring expensive beam time for training on the real machine. Our method outperforms conventional optimisation algorithms in both the achieved result and time taken, and achieves close to human-level performance. In the future, RL-based controllers like ours will enable more challenging beam configurations and significantly reduce the time required to attain them, thereby increasing both quality and quantity of experimental output of accelerator facilities and consequently enable scientific advances in the research fields served by these machines.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **KAISER, Jan** on **Wednesday, September 14, 2022**

Abstract ID : **103**

Surrogate Modeling of Laser-Plasma-Based Ion Acceleration with Invertible Neural Networks

Content

The interaction of overdense and/or near-critical plasmas with ultra-intense laser pulses presents a promising approach to enable the development of very compact sources for high-energetic ions. However, current records for maximum proton energies are still below the required values for many applications, and challenges such as stability and spectral control remain unsolved to this day. In particular, significant effort per experiment and a high-dimensional design space renders naive sampling approaches ineffective. Furthermore, due to the strong nonlinearities of the underlying laser-plasma physics, synthetic observations by means of particle-in-cell (PIC) simulations are computationally very costly, and the maximum distance between two sampling points is strongly limited as well. Consequently, in order to build useful surrogate models for future data generation and experimental understanding and control, a combination of highly optimized simulation codes (we employ PIConGPU), powerful data-based methods, such as artificial neural networks, and modern sampling approaches are essential. Specifically, we employ invertible neural networks for bidirectional learning of parameter and observables, and autoencoder to reduce intermediate field data to a lower-dimensional latent representation.

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **MIETHLINGER, Thomas** on **Wednesday, September 14, 2022**

Abstract ID : **104**

Control and Optimisation of Plasma Accelerators Using Machine Learning

Content

Plasma accelerators promise to revolutionise many areas of accelerator science. However, one of the greatest challenges to their widespread adoption is the difficulty in the control and optimisation of the accelerator outputs due to coupling between input parameters and the dynamic evolution of the accelerating structure. Here, we use machine learning techniques to automate a 100 MeV-scale accelerator, which optimised its outputs by simultaneously varying up to six parameters including the spectral and spatial phase of the laser and the plasma density and length. Most notably, the model built by the algorithm enabled optimisation of the laser evolution that might otherwise have been missed in single-variable scans. Subtle tuning of the laser pulse shape caused an 80% increase in electron beam charge, despite the pulse length changing by just 1% when characterised by standard metrics.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **SHALLOO, Rob** on **Wednesday, September 14, 2022**

Abstract ID : **105**

Ultra-fast line-camera KALYPSO for electron beam diagnostics

Content

Synchrotron light sources operate with bunch repetition rates in the MHz regime. The longitudinal and transverse beam dynamics of these electron bunches can be investigated and characterized by experiments employing linear array detectors. To improve the performance of modern beam diagnostics and overcome the limitations of commercially available detectors, we have developed KALYPSO, a detector system operating with an unprecedented frame rate of up to 12 MHz. To facilitate the integration in different experiments, a modular architecture has been utilized. Different semiconductor micro-strip sensors, based on Si, TI-LGAD, InGaAs, PbS, and PbSe with the quantum efficiency optimized at different photon energies, can be connected to the custom designed low noise front-end ASIC operating at megaframerates. The front-end electronics is integrated within a heterogeneous DAQ consisting of FPGAs and GPUs, which allows the implementation of real-time data processing. In this contribution, the performance results and the ongoing technical developments will be presented.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **PATIL, Meghana Mahaveer** on **Thursday, September 15, 2022**

Abstract ID : **106**

Impact of Quantum Noise on Training of QGANs

Content

Current noisy intermediate-scale quantum devices suffer from various sources of intrinsic quantum noise. Overcoming the effects of noise is a major challenge, for which different error mitigation and error correction techniques have been proposed.

In this paper, we conduct a first study of the performance of quantum Generative Adversarial Networks (qGANs) in the presence of different types of quantum noise, focusing on a simplified use case in high-energy physics.

In particular, we explore the effects of readout and two-qubit gate errors on the qGAN training process. Simulating a noisy quantum device classically with IBM's Qiskit framework, we examine the threshold of error rates up to which a reliable training is possible. In addition, we investigate the importance of various hyperparameters for the training process in the presence of different error rates, and we explore the impact of readout error mitigation on the results.

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **VERNEY-PROVATAS, Alexis-Harilaos** on **Thursday, September 15, 2022**

Abstract ID : **107**

Designing a prototype plasma lens as an adiabatic matching device

Content

When developing future accelerators the particle source is not the only challenge, but also the matching of particles is important. In this poster a new alternative to common matching devices will be presented, the tapered plasma lens.
As a first step a downscaled version of an already proposed plasma lens for the ILC positron source was designed. This process includes CFD simulations and CAD sketches to plan a set-up at DESY Hamburg for future experiments, such as plasma and current density measurements.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **HAMANN, Niclas** on **Thursday, September 15, 2022**

Abstract ID : **108**

Helmholtz Imaging

Content

Helmholtz Imaging's mission is to unlock the potential of imaging in the Helmholtz Association. Image data provide a substantial part of data being generated in scientific research. Helmholtz Imaging is the overarching platform to better leverage and make accessible to everyone the innovative modalities, methodological richness, outstanding expertise and data treasures of the Helmholtz Association.

Helmholtz Imaging empowers and supports scientists in all aspects of imaging, on different occasions, at any point in their career and at all levels. Imaging-based research projects are encouraged to contact us for scientific or technical support, to enter into collaborations with our research groups, or to network with imaging experts from other Helmholtz programs.

Discover our portfolio and become a part of Helmholtz Imaging!

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Track Classification: Data Management and Analysis

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **HEUSER, Philipp** on **Thursday, September 15, 2022**

Abstract ID : **110**

Superconducting solenoid fields measurement and optimization

Content

To reduce the projected transverse beam emittance, a solenoid is usually used at normal conducting as well as superconducting radio frequency (SRF) photoinjectors. At the ELBE SRF Gun-II, a superconducting solenoid is located inside the gun´s cryomodule about 0.1 m far from the end of the gun cavity. The aberration of the solenoid field, such as the quadrupole component, will influence the beam symmetry and enlarge the projected transverse emittance. To analyze the multipole components of the solenoid field, a simple method is used and works well. The influence of the quadrupole field on emittance is studied, and the correctors have been used to cancel this multipole field.

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Track Classification: Matter and Technologies

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **MA, Shuai** on **Friday, September 16, 2022**

Abstract ID : **111**

Angular distribution in Rayleigh scattering of linearly polarized hard x-rays

Content

Rayleigh scattering is the dominant contribution to the elastic scattering of hard X-rays on atoms for photon energies below 1 MeV. It is the scattering of a photon on atomic electrons without gain or loss of energy. The angular distribution of Rayleigh scattering strongly depends on the polarization of the
incident photon beam [1]. Thus, determining the angular distribution of Rayleigh scattering of a highly linearly polarized photon beam allows for a sensitive test of the underlying theoretical calculations. Vice versa, relying on the calculations, this process allows for a precise determination of the linear polarization of the incident photon beam.

In an experiment at the synchrotron PETRA III at DESY we analyzed the angular distribution of Rayleigh scattering for a linearly polarized X-ray beam with a photon energy of 175 keV on a thin gold target. The scattered radiation was analyzed inside and out of the polarization plane with a Ge(i) detector and a 2D
sensitive Compton polarimeter. By relying on the theoretical calculations of the scattering process, we were able to determine the polarization characteristics of the incident synchrotron beam with high accuracy. In contrast to the common assumption of a fully linearly polarized synchrotron beam, we can
show a slight depolarization of the incident beam as seen already in a previous experiment [2].

[1] A. Surzhykov et al., Phys. Rev. A98, 053403 (2018)
[2] K. H. Blumenhagen et al., New J. Phys.18, 103034 (2016)

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Track Classification: Matter and Technologies

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Status: ACCEPTED

Submitted by **MIDDENTS, Wilko** on **Friday, September 16, 2022**

Abstract ID : **112**

Novel high-speed monolithic silicon detector for particle physics

Content

Progress in experimental physics relies often on advances and breakthroughs in instrumentation, leading to substantial improvements in measurement accuracy, efficiency, and speed, or even opening completely innovative approaches and methods. Such experiments push the requirements for sensors technologies in several characteristics like tracking precision, timing, material budget, radiation hardness and/or data rate. The Helmholtz initiative Tangerine (Towards Next Generation Silicon Detectors) driven by DESY, GSI and KIT concentrates on research and development for both, novel sensors, and front-end technologies/architectures.
To establish the availability of sensors with high spatial (20 μm) and time resolution (20 ps) for charged particles, a new concept of pixel detector is proposed. It is designed for 25 x 25 μm2 pixel pitch, time resolution less than 20 ps, charge sharing for improvement of spatial resolution and possibility to detect the impact angle of the track on the sensor. The proposed detector architecture consists of a monolithic LGAD sensor tightly integrated with a new analog front-end based on BiCMOS devices. To improve the in-pixel functionally while keeping a remarkably high granularity and simple integration concept, the monolithic sensor and analog SiGe front-end is AC-coupled to a digital ASIC developed in the recent CMOS process.
The first prototype of the monolithic sensor and the analog readout chain has been produced by the Leibniz Institute for High Performance Microelectronics (IHP) and is made in SG13G2 130nm BiCMOS technology (Pic 1). P-type bulk has epitaxial origins with a thickness of 50 μm. To increase in-pixel functionality and to fulfill the requirement to measure the position, time and energy, an improvement of both, readout architecture and ASICs technology are required. Within Tangerine project several design options are under investigation for the digital readout of 22 nanometer CMOS technologies in a fully depleted silicon-on-insulator (FDSOI) processes or 28 nm TSMC. Because each detected particle might provide information on position, time, energy and impact angle, the signal of neighboring pixels is on-chip processed by an artificial intelligence algorithm. The results are expected to be a perfectly accurate x-y-t reconstruction and at the same time might reduce the effective data rate. Both the sensor and the readout chip are attached using a thin glue layer and are AC-coupled. Such process simplifies the connection between the sensor and the front-end and has been successfully developed at KIT previously [1].
In this contribution, the first version of the monolithic sensor is presented, and the preliminary results are discussed. The main aim of the design was to study the trade-off between the charge sharing mechanism and the timing performance by a small active pixel area with an NWELL size of 10 μm by 10 μm. Collection time and charge sharing effects could be optimized for this sensor technology.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **TRIFONOVA, Ekaterina** on **Friday, September 16, 2022**

Abstract ID : **123**

Field enhanced compact S-band gun employing a pin cathode

Content

S-band RF-guns are highly developed for production of low emittance relativistic electron bunches, but need powerful klystrons for driving. Here, we present the design and first experimental tests of a compact S-band gun, which can accelerate electrons up to 180 keV powered by only 10 kW from a compact rack-mountable solid-state amplifier. A pin-cathode is used to enhance the RF electric field on the cathode up to 100 MV/m as in large-scale S-band guns. An electron bunch is generated through photoemission off a flat copper surface on the pin excited by a UV laser pulse followed by a focussing solenoid producing a low emittance bunch with 0.1 mm mrad transverse emittance for up to 100 fC bunch charge. We are currently in the conditioning phase of the gun and first experiments show good agreement with simulations. The compact gun will serve three purposes: (i) it can be used directly for ultrafast electron diffraction; (ii) as an injector into a THz booster producing 0.3MeV to 2 MeV electron bunches for ultrafast electron diffraction; (iii) The system in (ii) serves as an injector into a THz linear accelerator producing a 20 MeV beam for the AXSIS X-ray source project.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **BAZRAFSHAN DELIJANI, Reza** on **Sunday, September 18, 2022**

Abstract ID : **124**

First high-inductance Dual-core Cryogenic Current Comparators of the new CCC-Sm series

Content

Cryogenic Current Comparators (CCC) are presently used at CERN-AD (100 mm beamline diameter) and in the FAIR project at CRYRING (150 mm beamline diameter) for non-destructive absolute measurement of beam currents in the range of below 10 µA (current resolution 10 nA). Both sensor versions (CERN-Nb-CCC and FAIR-Nb-CCC-XD) use niobium as superconductor for the DC-transformer and magnetically shielding. The integrated flux concentrators have an inductance of below 100 µH at
4.2 Kelvin. The new Sm-series (Smart & Small) is designed for a beamline diameter of 63 mm and is using lead as superconductor. The first sensor (IFK-Pb-DCCC-Sm-200) has two core-based pickup coils (2x 100 µH at 4.2 K) and two SQUID units, to eliminate Barkhausen current jumps as part of the low frequency 1/f2-noise. During the construction some basic experiments on noise behavior (fluctuation– dissipation theorem, white noise below 2 pA/sqrt(Hz)) and magnetic shielding (core- inductance/meander-shielding-capacity resonance, additional mu-metal shielding) were undertaken, the results of which are presented here. Finally, a current resolution of 500 pA could be achieved in the laboratory.
Presented @ IBIC'22, 11th - 15th Sept. 2022, Krakow. Supported by the BMBF, project number 05P21SJRB1.

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Track Classification: Detector Technologies and Systems

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **TYMPEL, Volker** on **Monday, September 19, 2022**

Abstract ID : **125**

Generating synthetic shadowgrams with an in-situ plugin in PIConGPU

Content

Few-cycle shadowgraphy is a valuable diagnostic for laser-plasma accelerators for obtaining insight into the μm- and fs-scale relativistic plasma dynamics. To enhance the understanding of experimental shadowgrams, we developed a synthetic shadowgram diagnostic within the fully relativistic particle-in-cell code PIConGPU.

In the shadowgraphy diagnostic, the probe laser is propagated through the plasma using PIConGPU, and then extracted and propagated onto a virtual CCD using an in-situ plugin for PIConGPU based on Fourier optics. The in-situ approach circumvents performance limitations of a post-processing workflow, like storing and loading large output files that result from large-scale laser-plasma simulations.

This poster presents the in-situ plugin and first synthetic shadowgrams from laser wakefield accelerator simulations that are generated by the plugin.

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **CARSTENS, Finn-Ole** on **Monday, September 19, 2022**

Abstract ID : **126**

PIConGPU: Scaling high-fidelity plasma simulations up to exascale compute systems and a view on recent applications

Content

PIConGPU's latest release 0.6.0 in December 2021 brought a number of new features. Among these are an arbitrary-order Maxwell solver, the Higuera-Cary pusher, collisions, and incident field generation via the total field/scattered field technique enhancing its numerical stability and predictive capabilities.
Furthermore, there are various technical advances, most notably support of the HIP computational backend allowing to run on AMD GPUs. These advances are mainly driven by our participation in OLCF's Frontier Center for Accelerated Application Readiness providing access to the hardware platform of the Frontier exascale supercomputer scheduled for deployment later this year. We show performance data and present recent applications of PIConGPU profiting from these developments. To these applications belongs the advanced laser-plasma accelerator scheme Traveling-wave electron acceleration (TWEAC), providing scalability to energies beyond 10 GeV while avoiding staging. We further present simulation campaigns modeling and delivering valuable insight into the micrometer and femtosecond plasma dynamics of existing experimental campaigns.

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Track Classification: Matter and Technologies

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **DEBUS, Alexander** on **Monday, September 19, 2022**

Abstract ID : **127**

Track reconstruction using a Quantum Computer for LUXE

Content

LUXE (Laser Und XFEL Experiment) is a proposed experiment at DESY using the electron beam of the European XFEL and a high-intensity laser.
The experiment's primary aim is to investigate the transition from the well-probed perturbative into the non-perturbative regime of Quantum Electrodynamics that occurs at very high energies. In LUXE, the number of produced positrons is one of the most crucial quantities for investigating the transition between regimes. Since the reconstruction of trajectories from a set of hits is a combinatorial problem challenging for a classical computer to solve, our group explores the novel approach of expressing the track pattern recognition problem as a quadratic unconstrained binary optimization (QUBO), allowing the algorithm to be mapped onto a quantum computer. The poster will cover the methods and the latest progress of quantum algorithm-based tracking, which relies on Variational Quantum Algorithms to minimize the QUBO. The results are then benchmarked against classical methods using Graph Neural Network or a Combinatorial Kalman Filter.

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Track Classification: Data Management and Analysis

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **KROPF, Annabel** on **Monday, September 19, 2022**

Abstract ID : **128**

Time of flight measurements using a compact solid methane moderator

Content

Long-wavelength neutrons for the investigation of nano-scale materials are an indispensable tool in neutron research. To slow down the free neutrons produced in a large-scale source to energies of a few meV and below, hydrogen-rich materials at cryogenic temperatures are applied.
At the High Brilliance Neutron Source (HBS) project, multiple cold moderators will be positioned inside the same Target-Moderator-Reflector unit (TMR), each providing its own instrument with cold or even very cold neutrons. All of these moderators can therefore be optimized in terms of material, operating temperature and geometry, depending on the requirements of the instrument.
To experimentally investigate the effect of lowering the operating temperature of a compact solid methane moderator to approximately 10 K, a cryogenic system was designed and manufactured at Forschungszentrum Jülich. Time of flight measurements were conducted for various temperatures of the solid methane, using a 45 MeV proton beam provided by the cyclotron JULIC at Forschungszentrum Jülich to produce free neutrons mainly by (p,n) reactions inside a tantalum target. The neutrons were subsequently moderated and guided to a detector cradle equipped with He-3 detectors.
The results will allow a more precise validation of scattering kernels used in Monte Carlo simulations and lead to a more efficient optimization of existing and future cold neutron sources.

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Track Classification: Matter and Technologies

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **SCHWAB, Alexander** on **Monday, September 19, 2022**

Abstract ID : **129**

X-ray radiation transport in GPU accelerated Particle In Cell simulations

Content

Ultra-high-intensity laser pulse interactions with solid density targets are of central importance for modern accelerator physics, Inertial Confinement Fusion(ICF) and astrophysics. In order to meet the requirements of real-world applications, a deeper understanding of the underlying plasma dynamics, including plasma instabilities and acceleration mechanisms, is needed. X-ray radiation plays a substantial role in plasma physics, either as an integral part of a physical system itself or as a useful diagnostic, hence it should be included in computational models.
Therefore, we bring a Monte Carlo based X-ray radiation transport module into our Particle In Cell simulation framework PIConGPU. It allows, among others, for Thompson scattering, e.g. for small-angle X-ray scattering (SAXS), and Faraday effect calculation for X-ray polarimetry - as online, in-situ diagnostics.

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Track Classification: Matter and Technologies

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **ORDYNA, Pawel** on **Monday, September 19, 2022**

Abstract ID : **141**

Optimizing a Tapered Plasma Lens Design for Matching Positrons at the ILC Positron Source

Content

In a positron source, the matching device is a focusing field, which is responsible for matching the produced positron beam into the downstream acceleration structures. This makes the matching device a crucial element regarding the positron luminosity. Conventionally sophisticated coils have been used for this task. Whereas more recently there have been considerations to utilize a plasma lens with its symmetric, high-gradient focusing. Here, the effectiveness of such a device for the ILC positron source is discussed by examining the beam dynamics simulation results aiming to optimize the tapered plasma lens design. The set of optimized parameters include the tapering shape, the opening and exit radius, the plasma lens length, and the total electric current.

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Track Classification: Accelerator Research and Development

Contribution Type: Poster with possible speed talk

Status: ACCEPTED

Submitted by **FORMELA, Manuel** on **Monday, September 19, 2022**

Abstract ID : **142**

The A4 Experiment – from Data to Data Publication

Content

The particle physics experiment A4 [1] at the Mainz Microtron (MAMI) produced a stream of valuable data for many years which already released scientific output of high quality and still provides a solid basis for future publications. Here, we report from our approach to make the data hoard of a dismounted project sustainable and publishable according to the FAIR principles which, finally, would make the data intelligible to, both, humans and machines. For this purpose, (meta)data is (i) enriched by metadata and qualified references, such as ORCIDs, Instrument PIDs and RDF annotations, (ii) stored in generally understandable xml and html file formats, and (iii) linked to a central file which defines relations of low-level files to create scientific context. The developed software is adjustable to the data set through configuration files and extendable by customized routines.

[1] https://www.blogs.uni-mainz.de/fb08-ag-maas/a4-collaboration-at-mami/

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Track Classification: Data Management and Analysis

Contribution Type: Poster without speed talk

Status: ACCEPTED

Submitted by **JANUSCHEK, Friederike** on **Wednesday, September 21, 2022**