Working Group on Accelerator Physics
Arbeitskreis Beschleunigerphysik (AKBP)

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Overview of Invited Talks and Sessions

(Lecture halls HSZ/0304, CHE/0183, and CHE/0184; Poster HSZ OG3)

Sessions

AKBP 1.1–1.7	Mon	16:00–17:45	CHE/0183	**Particle and Photon Sources**
AKBP 2.1–2.7	Mon	16:00–17:45	CHE/0184	**Advanced Light Sources and their Instrumentation**
AKBP 3.1–3.6	Tue	11:00–12:30	GER/038	**Accelerator and Medical Physics (joint session ST/AKBP)**
AKBP 4.1–4.5	Tue	16:30–19:00	CHE/0183	**Plasmas and Lasers**
AKBP 5.1–5.6	Tue	16:30–18:00	CHE/0184	**Hadron Accelerators**
AKBP 6.1–6.3	Wed	11:00–12:30	HSZ/0304	**New Results from Accelerators for Hadron Physics**
AKBP 7.1–7.3	Wed	14:00–15:30	HSZ/0304	**Experiments for Advanced Light Sources**
AKBP 8.1–8.6	Wed	15:45–17:15	CHE/0183	**Advanced IT Tools**
AKBP 9.1–9.6	Wed	15:45–17:15	CHE/0184	**Beam Dynamics I**
AKBP 10.1–10.6	Wed	17:30–19:00	CHE/0183	**Instrumentation I**
AKBP 11.1–11.6	Wed	17:30–19:00	CHE/0184	**RF and SRF Research**
AKBP 12.1–12.3	Thu	11:00–12:30	HSZ/AUDI	**AI Topical Day – Invited Talks (joint session AKPIK/HK/ST/T/AKBP)**
AKBP 13.1–13.2	Thu	14:00–15:30	HSZ/0304	**Preisverleihung des AKBP Nachwuchspreises und des Horst-Klein Preises**
AKBP 14.1–14.7	Thu	15:30–17:15	CHE/0183	**Instrumentation II**
AKBP 15.1–15.7	Thu	15:30–17:15	CHE/0184	**New Accelerator Concepts**
AKBP 16.1–16.17	Thu	15:45–18:30	HSZ OG3	**Poster**
AKBP 17.1–17.5	Thu	17:30–18:45	CHE/0183	**Instrumentation III**
AKBP 18.1–18.5	Thu	17:30–18:45	CHE/0184	**Beam Dynamics II**
AKBP 19	Thu	19:00–20:00	CHE/0091	**Members' Assembly**

Members' Assembly of the Working Group on Accelerator physics

Thursday 19:00–20:00 CHE/0091

- Bericht
- Terminfindung für Symposium „Verleihung der AKBP-Preise 2023“
- Verschiedenes

AKBP 1: Particle and Photon Sources

Time: Monday 16:00–17:45 Location: CHE/0183

AKBP 1.1 Mon 16:00 CHE/0183

Design of a New Photo and Thermionic Hybrid Mode 50 kV Pulsed Electron Gun for ELSA — •Samuel Kronenberg, Klaus Desch, Daniel Elsner, Dennis Proft, and Philipp Hänisch — Physikalisches Institut der Universität Bonn

For the Linac travelling wave S-band injector at ELSA a new electron gun is being designed, to enhance the beam parameters obtained from the old gun. Furthermore, a new single bunch injection mode is to be realized alongside the standard long pulse (multi bunch) mode, enabling single bunch operations for accelerator research and development in addition to the use for normal operation serving the experimental program. For that a dual-use design is pursued utilizing a caesium dispenser cathode both as photo- as well as thermionic cathode. First steps including the design of the gun assembly and studies about its usability as a photoemitter are conducted. A preliminary design of the gun is presented.

AKBP 1.2 Mon 16:15 CHE/0183

Automated Activation Procedure for GaAs Photocathodes at Photo-CATCH* — •Maximilian Herbert, Tobias Eggert, Joachim Enders, Markus Engart, Yuliya Fritzsche, and Vincent Wende — Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, Schlossgartenstr. 9, 64289 Darmstadt

Photo-electron sources using GaAs-based photocathodes are used to provide high-brightness and high-current beams of spin-polarized electrons for accelerator applications such as ERLs. Such cathodes require a thin surface layer consisting of Cs and an oxidant in order to achieve negative electron affinity (NEA) for efficient photoemission. The layer is deposited during a so-called activation procedure, whose performance greatly influences the resulting quantum efficiency η of the photocathode and robustness of the layer. An automatization of the activation procedure could simplify and accelerate this process, indipendent from expert input, for operational use in an accelerator. At TU Darmstadt, the dedicated test stand Photo-CATCH is available for GaAs photocathode research. The components of its activation chamber are remote-controlled using EPICS. This contribution will present recent proof-of-principle studies of a basic automated activation procedure at Photo-CATCH. Using a co-deposition scheme with Cs and O_2, several automated activations have been performed. A good reproducibility of η has been observed, with a slight reduction in mean η compared to manual activation.

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AKBP 1.3 Mon 16:30 CHE/0183

Multi-alkali antimonide photocathodes for highly brilliant electron beams — •Chen Wang[1,2], Sonal Mistry[1], Julius Kühn[1], and Chen Wang[1,3] — [1]HZB, Berlin, Germany — [2]University of Siegen, Institute for Materials Engineering, Siegen, Germany — [3]Humboldt University of Berlin, Berlin, Germany

One important goal at the SEALab facility is to bring an innovative superconducting radio-frequency photoelectron injector into operation. As the electron source in the injector, a photocathode with high quantum efficiency (QE) and long operation lifetime is required. The family of multi-alkali antimonide photocathodes deposited on Mo substrate is chosen for this application due to its high QE (>1%) at visible wavelengths and good thermal conductivity. Currently, Na-K-Sb photocathodes are produced in a UHV preparation chamber at the photocathode lab of HZB. The influence of deposition parameters is studied to optimize the growth procedure and to achieve high stability at high operational temperatures as expected in the photoinjector. X-ray photoemission spectroscopy (XPS) and QE measurements are performed, and the correlation between chemical composition and QE value are presented in this contribution.

AKBP 1.4 Mon 16:45 CHE/0183

Development of Multi-alkali antimonides photocathodes for high brightness photoinjectors — •Sandeep Mohanty[1], Mikhail Krasilnikov[1], Anne Oppelt[1], Frank Stephan[1], Daniele Sertore[2], Laura Monaco[2], Carlo Pagani[3], and Wolfgang Hillert[4] — [1]DESY Zeuthen, Germany — [2]Istituto Nazionale di Fisica Nucleare - LASA, Segrate, Italy — [3]Università degli Studi di Milano & INFN, Segrate, Italy — [4]University of Hamburg

Multi-alkali antimonide photocathodes can have high quantum efficiency similar to UV-sensitive (Cs2Te) photocathodes, but with the advantages of photoemission sensitivity in the green wavelength and a significant reduction in the mean transverse energy of photoelectrons. In order to optimize and better understand the photo emissive film properties of KCsSb photocathodes, a batch of two photocathodes with different thicknesses was grown on molybdenum substrates via a sequential deposition method in a new preparation system at INFN LASA. During the deposition, a "multi-wavelengths" diagnostic, i.e. the measurements of the real-time photocurrent and reflectivity at different wavelengths (in the range from 254 nm - 690 nm) has been applied.The optical spectra of these semiconductors provide a rich source of information on their electronic properties.In this report, we present and discuss the experimental results obtained from the two different thickness KCsSb photocathodes, along with the effect of Sb thickness on the cathode's properties.

AKBP 1.5 Mon 17:00 CHE/0183

Investigation of structural changes in Ti-6Al-4V via high energy X-ray diffraction caused by fast cyclical heating — •Tim Lengler[1,2], Dieter Lott[2], Gudrid Moortgat-Pick[1,3], and Sabine Riemann[4] — [1]Universität Hamburg, Hamburg, Deutschland — [2]Helmholtz-Zentrum Hereon, Geesthacht, Deutschland — [3]DESY, Hamburg, Deutschland — [4]DESY, Zeuthen, Deutschland

For the planned International Linear Collider (ILC) a material for the positron source target is required which can withstand the high energy deposition needed for a high luminosity positron source. To distribute the load and keep the target at a reasonable temperature, the target is rotated with high velocity. Therefore, the material needs not only withstand the cyclical thermal load but also the simultaneous mechanical load. In this work, the behaviour of the material Ti-6Al-4V, which is considered as an appropriate target material, was studied via high energy X-ray diffraction during a cyclical heating process to gain information about changes in the crystal structure and consequently phase fractions. The material was heated homogeneously via induction to temperatures between 300 °C and 800 °C with heating rates of 100 °C/s and cooling rates in the range of 25 °C/s and 100 °C/s. Here, the influence of the maximum and minimum temperature as well as the cooling rate was investigated. The lattice parameter of the β phase turns out to be the most sensitive parameter that correlates to the changes in phase fractions at higher temperatures and thus provides a valuable reference for experiments at the Microtron MAMI, where Ti-6Al-4V targets will be irradiated by high energy electron beams.

AKBP 1.6 Mon 17:15 CHE/0183

Computational homogenisation of laminated yokes in finite-element models of fast-ramped orbit corrector magnets — Jan-Magnus Christmann[1], Moritz von Tresckow[1], •Herbert De Gersem[1], Alexander Aloev[2], Sajjad H. Mirza[2], Sven Pfeiffer[2], and Holger Schlarb[2] — [1]TEMF, TU Darmstadt, Germany — [2]DESY, Hamburg, Germany

Fast corrector magnets need to be equipped with iron yokes to keep their inductance sufficiently low. Even iron stacks with thin laminates suffer from relevant eddy-current losses at elevated frequencies, causing Joule losses and invoking a time delay between excitation current and aperture field. Resolving the individual laminates within a finite-element model is not feasible. Instead, computational homogenisation is applied. The lamination stack is modelled as a bulk part and represented by an anisotropic and frequency-dependent surrogate material. This contribution illustrates the validity of this approach. The correction magnets planned for the fast orbit feedback system of PETRA IV at DESY serve as an example.

AKBP 1.7 Mon 17:30 CHE/0183

The Merit of a Thomson backscattering based Gamma Source at MESA. — •Christoph Lorey[1] and Atoosa Meseck[1,2] — [1]Johannes Gutenberg Universität, Mainz, Germany — [2]Helmholtz Zentrum Berlin, Berlin, Germany

The Mainz Energy-recovering Superconducting Accelerator (MESA), currently under construction at the Johannes Gutenberg University (JGU) in Mainz, will offer two modes of operation, one of which is

an energy-recovering (ER) mode in order to deliver electron beams of up to 155 MeV to two experiments. As an ERL, MESA, with it's high brightness electron beam, is a promising accelerator for supplying a Thomson back scattering based Gamma source. Furthermore, at MESA, the polarization of the electron beam can be set by the injector. We will present the first results of our performance studies for a Thomson backscattering based gamma source at MESA. Different polarization scenarios will be discussed considering a selection of laser and MESA configurations.

AKBP 2: Advanced Light Sources and their Instrumentation

Time: Monday 16:00–17:45 Location: CHE/0184

AKBP 2.1 Mon 16:00 CHE/0184

Powering test results of HTS undulator prototype coils for compact FELs at 4.2 K — •Sebastian C. Richter[1,2], Andreas W. Grau[3], David Saez de Jauregui[3], Amalia Ballarino[2], Axel Bernhard[1], and Anke-Susanne Müller[1,3] — [1]LAS, KIT, Karlsruhe — [2]CERN - 1211 Geneva 23 - Switzerland — [3]IBPT, KIT, Karlsruhe

Short-period and high-field undulators are crucial for the production of coherent light up to X-rays in compact free-electron lasers (FELs). Besides, future colliders like CLIC or FCC-ee demand high-field damping wigglers to reach a low beam emittance. Both applications may benefit from the use of high-temperature superconductors (HTS): magnetic field amplitudes in the range of 2 T become feasible for short periods of 15 mm and smaller with magnetic gaps of 6 mm at 4.2 K. Moreover, potential operation at higher temperatures may relax cryogenic requirements and reduce operational costs. This contribution presents and discusses the powering test results of several HTS undulator prototype coils, designed and manufactured at CERN, made from coated ReBCO tape superconductor. The coil set-up was already described in previous works and is based on non-insulated vertical racetracks with a period length of 13 mm, assembled with iron poles. Powering tests at 4.2 K were performed at KIT to explore the operation at high current densities (2 kA/mm^2) and the produced magnetic fields in the iron pole gap.

AKBP 2.2 Mon 16:15 CHE/0184

Spectro-temporal Properties of Coherently Emitted Radiation Pulses at DELTA — •Arjun Radha Krishnan[1], Benedikt Büsing[1], Shaukat Khan[1], Carsten Mai[1], Wa'el Salah[2], Zohair Usfoor[1], and Vivek Vijayan[1] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund, Dortmund, Germany — [2]The Hashemite University, Zarqa, Jordan

The short-pulse facility at the 1.5 GeV synchrotron light source DELTA, operated by the TU Dortmund University, employs the seeding scheme coherent harmonic generation (CHG) to produce ultrashort pulses in the vacuum ultraviolet and terahertz regime. Since the properties of the CHG radiation are based on the laser-induced energy modulation and the microbunching process, the spectral and temporal properties of the CHG pulses can be controlled by tuning the laser chirp and the strength of the dispersive chicane. The CHG spectra at several harmonics of the 800 nm seed laser were recorded using an image-intensified CCD camera and an XUV spectrometer for different seed laser chirps and chicane strengths. Convolutional neural networks were employed to fit the observed spectra with the simulations and extract the spectral phase information of the seed laser, taking the higher-order spectral phase of the seed pulse into consideration.

AKBP 2.3 Mon 16:30 CHE/0184

Highlights from seeded FEL@PITZ — •Georgi Georgiev — DESY Zeuthen

First results from a proof-of-principle experiment for a high-power accelerator-based THz source were obtained last year at the Photo Injector Test Facility at DESY in Zeuthen (PITZ). The THz source is an extension to the linac facility and it is based on a single LCLS-I undulator. A part of the research program includes studies on seeding methods for the FEL to improve the shot-to-shot stability of the THz pulses from what is expected from the self-amplified spontaneous emission (SASE) mode of operation. Several methods to achieve seeding are studied in simulation including pre-bunched electron beams, external radiation pulse and a super-radiant spike on top of the beam. Experimental measurements demonstrating the seeding effects from a pre-bunched electron beam are presented and discussed.

AKBP 2.4 Mon 16:45 CHE/0184

Wakefield Study for a PCB-Based Arrival-Time Pickup for Electron Accelerators — •Bernhard Erich Jürgen Scheible[1,2], Marie Kristin Czwalinna[3], Holger Schlarb[3], Wolfgang Ackermann[2], Herbert De Gersem[2], and Andreas Penirschke[1] — [1]Technische Hochschule Mittelhessen, Wilhelm-Leuschner-Str. 13, 61169 Friedberg, Germany — [2]Technische Universität Darmstadt, Karolinenplatz 5, 64289 Darmstadt, Germany — [3]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany

Many scientific applications utilize large-scale electron accelerators, e.g., for imaging in free-electron laser facilities such as the European XFEL or FLASH. Precise timing information is necessary for stable operation or to control and evaluate experiments. With growing demands on the accuracy of beam diagnostics especially with smaller bunch-charges, it is unavoidable that monitoring concepts significantly affect the beam. To prevent this interaction from becoming intolerable, it is necessary to quantify and compare it with existing state-of-the-art structures. In this contribution the wake loss factor of a pickup structure based on a printed circuit board is determined in electromagnetic simulations and compared to the pickups of the European XFEL.

AKBP 2.5 Mon 17:00 CHE/0184

Towards Fiber-Optics-Guided Synchrotron Radiation-Based Longitudinal Beam Diagnostics at the KARA Booster Synchrotron — •Marvin-Dennis Noll[1], Johannes L. Steinmann[1], Dima El Khechen[2], Christian Goffing[1], Christina Widmann[1], Erik Bründermann[1], and Anke-Susanne Müller[1] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

Before injection into the Karlsruhe Research Accelerator (KARA), the electron storage ring of the KIT Light Source, the beam energy is ramped up from 53 MeV to 500 MeV by a booster synchrotron. The whole booster is located in a concrete enclosure inside the storage ring and thus not accessible during operation. For the study of longitudinal beam dynamics, a cost-effective solution to leverage the synchrotron radiation emitted at the booster bending magnets is desired. To ensure durability of the setup and to not obstruct the removable concrete ceiling of the booster enclosure, it is required to place the radiation-sensitive readout electronics outside of the booster enclosure and outside of the storage ring. In this contribution, a fiber-optic setup consisting of commercially available optical components, such as collimators, optical fibers and high bandwidth photodetectors are used. As a proof-of-concept, we present experimental results of different components characterized at the visual light diagnostics port of the storage ring KARA. In addition, we report on further improvements of the setup along with planned future experiments.

AKBP 2.6 Mon 17:15 CHE/0184

Simulation Studies on a High-Gain XUV FEL Oscillator at FLASH — •Margarit Asatrian[1], Georgia Paraskaki[2], Velizar Miltchev[1], and Wolfgang Hillert[1] — [1]University of Hamburg, 22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, 22607 Hamburg, Germany

Externally seeded high-gain FELs can generate fully coherent radiation with high shot-to-shot stability. With the application of harmonic conversion schemes, these qualities can be achieved at wavelengths down to the soft X-Ray range. However, at the moment, such FEL schemes aimed at the generation of short-wavelength radiation are limited in their repetition rate by the suitable seed laser sources and thus are unable to operate at the full repetition rate of superconducting machines. Cavity-based FELs have been proposed as a possible solution that would allow the generation of short-wavelength, fully coherent FEL radiation at high repetition rates. We present simulation studies for such a high-gain FEL oscillator, which is planned to be implemented at FLASH. The setup is aimed to operate at the repetition

rate of 3 MHz, generating fully coherent radiation at the wavelength of 13.5 nm. The electron beam bunched at 13.5 nm can be further used in a harmonic conversion scheme to generate fully coherent radiation at much shorter wavelengths.

AKBP 2.7 Mon 17:30 CHE/0184

Advanced applications of laser heaters — •Linus Bölte[1], Philipp Amstutz[2], Christopher Gerth[2], Shaukat Khan[1], and Carsten Mai[1] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany — [2]Deutsches Elektronen Synchrotron DESY, Hamburg Germany

Many FEL facilities use laser heaters to increase the electron energy spread and hence suppress microbunching instabilities. As part of the FLASH2020+ upgrade at DESY, a laser heater has been installed upstream of the first bunch compressor chicane. The goal of the FLASH Laser-Assisted Reshaping of Electron bunches (FLARE) project is to implement energy modulation schemes expanding the laser heater's basic purpose. This includes intentionally overheating regions of the electron bunch, as well as an up to now untested bunch compression method that will allow the generation of tunable few-femtosecond and possibly sub-femtosecond electron distributions. First studies on advanced applications of the laser heater will be presented.

AKBP 3: Accelerator and Medical Physics (joint session ST/AKBP)

Time: Tuesday 11:00–12:30 Location: GER/038

AKBP 3.1 Tue 11:00 GER/038

Real-time analysis for a scintillating fiber-based ion beam profile monitor — •Liqing Qin, Qian Yang, and Blake Leverington — Physikalisches Institut, Heidelberg, Germany

For raster scanning of a pencil beam during ion beam therapy, it is necessary to monitor the beam in real-time for safety and quality reasons.

A scintillating fiber-based beam profile monitor developed from LHCb fiber winding techniques will offer real-time information of the pencil beam parameters, including position, width, and intensity, with a readout rate of up to 10 kHz.

The preliminary reconstruction algorithm for a Gaussian-like beam is being implemented on an FPGA. Preliminary results of the reconstruction algorithm performance on the FPGA will be presented.

AKBP 3.2 Tue 11:15 GER/038

Application of HV-CMOS sensor in a position monitoring system for therapeutic ion beams — •Bogdan Topko[1], Matthias Balzer[2], Alexander Dierlamm[1,2], Felix Ehrler[2], Ulrich Husemann[1], Roland Koppenhöfer[1], Ivan Perić[2], Martin Pittermann[1], and Alena Weber[2,3] — [1]Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT) — [2]Institute for Data Processing and Electronics (IPE), KIT — [3]now with Bosch AG

Cancer treatment with ion beams provides critical advantages compared to the photon irradiation approach. The Bragg peak of the ion energy deposition near the end of the particle range allows to deposit the maximum of energy to the tumor and minimize the damage of healthy tissue. The beam position and size can be precisely controlled by the beam delivery system. In order to provide effective and safe dose delivery to the tumor, a fast and reliable beam monitoring system is required. The studies presented in this talk are focused on the application of HV-CMOS sensors for such a beam monitoring system. This system should provide information about beam position, shape and fluence in real time. It should work under beam intensities up to 10^{10} s^{-1} and deliver fluence information every 1-2 μs. In order to fulfill the timing requirements, the HitPix chip family with counting electronics and frame based readout has been developed at the ASIC and Detector Lab (IPE, KIT). Recent measurements with ion beams and a multi-chip matrix as well as future developments are discussed.

AKBP 3.3 Tue 11:30 GER/038

Medical irradiation simulations for IBPT accelerators — •Katharina Mayer[1], Erik Bründermann[1], Alfredo Ferrari[3], Michael J. Nasse[1], Markus Schwarz[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe — [3]IAP, KIT, Karlsruhe

An important cancer treatment method used in oncology is radiation therapy, in which the tumor is irradiated with ionizing radiation. In recent years, the study of the beneficial effects of short intense radiation pulses (FLASH effect) or spatially fractionated radiation (Microbeam) have become an important research field. Systematic studies of this type often require non-medical accelerators capable of producing the requested short intense pulses. At KIT, the Ferninfrarot Linac- und Testexperiment (FLUTE) can produce ultra-short electron bunches and the KIT storage ring KARA (Karlsruher Research Accelerator) is a source of pulsed X-rays. Both can be used as pulsed high-energy radiation sources and compared to conventional X-ray tubes. In this contribution, first dose simulations for FLUTE using the Monte Carlo simulation program FLUKA are presented.

AKBP 3.4 Tue 11:45 GER/038

Dose Simulation of Ultra-High Energy Electron Beams for Novel FLASH Radiation Therapy Applications — •Kelly Grunwald, Klaus Desch, Daniel Elsner, Dennis Proft, and Leonardo Thome — Physikalisches Institut der Universität Bonn

The electron stretcher facility ELSA delivers up to 3.2 GeV electrons to external experimental stations. In a new setup the irradiation of tumor cells inside a water volume with doses of up to 50 Gy by ultra-high energy electrons (UHEE) in time windows of microseconds up to milliseconds (FLASH) is currently investigated. This technique may enable highly efficient treatment of deep-seated tumors alongside optimal sparing and protection of healthy tissue. Along the effort to measure the dose with a suitable detector, our approach is to determine the optimal dose distribution by simulations. Therefore, the electromagnetic shower process is simulated in Geant4, taking the extracted electron pulse properties into account. A virtual water volume is constructed of voxels of different sizes for precise investigation in the volume of interest. Various properties such as particle types, deposited energy and the energy spectra of the particle shower can be extracted and correlated to relative and absolute dose measurements at the real water phantom. The method and first results will be presented.

AKBP 3.5 Tue 12:00 GER/038

Evaluation of Measuring Techniques to Determine the Applied Dose of Ultra-High Energy Electorn Beams in Cell Samples for FLASH Therapy — •Leonardo Thome, Klaus Desch, Daniel Elsner, Dennis Proft, and Kelly Grunwald — Physikalisches Institut der Universität Bonn

The electron accelerator facility ELSA delivers up to 3.2 GeV electrons. Ultra-high energy electrons (UHEE) in short pulses of microseconds up to milliseconds (FLASH) are used to investigate the effect of UHEE on tumor cells. This may enable highly efficient treatment of deep-seated tumors due to the FLASH effect. Currently, in a preliminary setting the Booster-Synchrotron is used to deliver electrons of 1.2 GeV energy, to irradiate cell samples placed in a water phantom. A precise dose determination is necessary to monitor the efficacy of the biological effect. Therefore, the usability of different detector types for a precise dose determination is evaluated.

AKBP 3.6 Tue 12:15 GER/038

Dosimetry tests for FLASH RT at PITZ — •Felix Riemer, Zakaria Aboulbanine, Gowri Adhikari, Zohrab Amirkhanyan, Namra Aftab, Prach Boonpornprasert, Georg Georgiev, Anna Grebinyk, Andreas Hoffmann, Mikhail Krasilnikov, Xiangkun Li, Anusorn Lueangaramwong, Raffael Niemczyk, Houjun Qian, Chris Richard, Frank Stephan, Grygorii Vashchenko, Tobias Weilbach, and Steven Worm — Deutsches Elektronen-Synchrotron DESY, Platanenallee 6, 15738 Zeuthen, Germany

The Photo Injector Test facility at DESY in Zeuthen (PITZ) can provide unique beam parameters regarding delivered dose and dose rate. With an average dose rate of up to 10^7 Gy/s and peak dose rates of up to $4 \cdot 10^{13}$ Gy/s, PITZ is fully capable of FLASH radiation therapy. Nevertheless, dosimetry is a major challenge. Traditional detectors cannot provide reliable measurements and linearity up to such high

dose rates. A new setup is being built to create a test infrastructure for all kinds of detectors. This includes a completely new beamline exclusively for FLASH RT and biology experiments. The goal is to develop and test detectors (also from external users) which cover the whole range of dose rates available at PITZ. First dosimetry experiments using Gafchromic films were done in air and water. Dose rate linearity and a limit test of the films were done. Beam parameters like beam profile, dose depth profile in water, homogeneity and dark current were measured. First detector tests will be done using silicon sensors utilized in high energy physics experiments.

AKBP 4: Plasmas and Lasers

Time: Tuesday 16:30–19:00 Location: CHE/0183

Group Report AKBP 4.1 Tue 16:30 CHE/0183
Large Energy Depletion of a Beam Driver in a Plasma-Wakefield Accelerator — •Felipe Peña[1,2], Carl A. Lindstrøm[1,3], Judita Beinortaite[1,4], Jonas Björklund Svensson[1], Lewis Boulton[1,5,6], Severin Diederichs[1,2], James M. Garland[1], Pau González Caminal[1,2], Gregor Loisch[1,2], Sarah Schröder[1], Maxence Thévenet[1], Stephan Wesch[1], Jonathan Wood[1], Jens Osterhoff[1], and Richard D'Arcy[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Universität Hamburg, Germany — [3]University of Oslo, Norway — [4]University College London, UK — [5]SUPA, University of Strathclyde, Glasgow, UK — [6]The Cockcroft Institute, Daresbury, UK

Beam-driven plasma-wakefield acceleration has the potential to reduce the size and construction cost of large-scale accelerator facilities, by providing accelerating fields orders of magnitude greater than that of conventional accelerating structures. Affordable running costs require demonstration of high energy-transfer efficiency from the wall-plug to the accelerated bunch. For this, drive bunches must be efficiently produced, strong decelerating fields must be sustained for the drive bunches until their energy is depleted, and the resulting accelerating fields must be strongly beam loaded by the trailing bunches. Here we address the second of these points, showing measurements using a 500 MeV drive bunch where (50±7)% of its total energy is deposited into a 20 cm long plasma. This level of energy-transfer efficiency demonstrates that plasma accelerators hold the potential to become competitive with conventional accelerators.

Group Report AKBP 4.2 Tue 17:00 CHE/0183
SPEED: Worldwide first implementation of the EEHG scheme at a storage ring — •Zohair Usfoor[1], Benedikt Büsing[1], Arne Held[1], Shaukat Khan[1], Carsten Mai[1], Arjun Radha Krishnan[1], Wa'el Salah[1,2], and Vivek Vijayan[1] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany — [2]The Hashemite University, Zarqa, Jordan

At DELTA, a 1.5-GeV synchrotron radiation source at TU Dortmund University, the CHG (coherent harmonic generation) scheme is employed to generate ultrashort radiation pulses. In CHG, the interaction of electron bunches with laser pulses in a first undulator (modulator) causes a periodic electron energy modulation. A chicane then induces a density modulation, giving rise to coherent emission of ultrashort pulses at harmonics of the seed laser in a second undulator (radiator). A reconfiguration of the U250 device that incorporated the two undulators and the chicane went underway in summer 2022 to demonstrate EEHG (echo-enabled harmonic generation, originally proposed for linac-based free-electron lasers) at a storage ring and to enable the generation of higher harmonics. The coils of the U250 were rewired to create two modulators for a twofold laser-electron interaction, two chicanes for the manipulation of the electron density, and a radiator, with only a few undulator periods comprising each section. The produced EEHG pulses are detected by an in-vacuum grating spectrometer. Initial results are presented. To our knowledge, this is the first attempt worldwide to successfully apply EEHG at a storage ring.

Group Report AKBP 4.3 Tue 17:30 CHE/0183
High-temperature superconductor undulators and magnets for the future compact light sources — •Samira Fatehi, Axel Bernhard, and Anke-susanne Müller — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

In this contribution, an overview of the ongoing projects at KIT on the high-temperature superconductor (HTS) undulators and magnets is given, and the research on beam dynamics and magnet design of a laser-plasma accelerator-based, miniature beam transport line using HTS novel periodic magnets is presented in detail. In laser-plasma accelerators (LPA), due to extremely high accelerating gradients, electron bunches are accelerated to high energies in only a few millimeters to centimeters of acceleration length. To efficiently capture and transport the LPA-generated bunches in a compact transport line, beam line designs employing high-strength combined-function magnets based on high-temperature superconductor technology have been studied. Moreover, to overcome coil winding challenges in fabricating miniature HTS magnets, novel periodic magnets have been designed, which can collimate and guide the electron beams in a well-controlled short-length transport line. The designed transport line has a length of 1.4 m matching the beam optics parameters of the LPA-generated electron beams to the transverse-gradient undulator (TGU) requirements.

Group Report AKBP 4.4 Tue 18:00 CHE/0183
Status Of Plasma Diagnostics On The Prototype Plasma Lens For Optical Matching At The ILC e+ Source — •Niclas Hamann[1], Gregor Loisch[2], Manuel Formela[1], Kai Ludwig[2], Jens Osterhoff[2], and Gudrid Moortgat-Pick[1,2] — [1]Uni Hamburg — [2]DESY Hamburg

In recent years, high-gradient, symmetric focusing with active plasma lenses has regained significant interest due to its potential advantages in compactness and beam dynamics compared to conventional focusing elements. A promising application could be optical matching of highly divergent positrons from the undulator-based ILC positron source into the downstream accelerating structures to increase the positron yield. In a collaboration between University Hamburg and DESY Hamburg a downscaled prototype for this application has been developed. Here, we present first plasma diagnostics results, such as discharge current stability, electron density distribution and reproducibility. Additionally, future plans for measuring the magnetic field distribution and a possible fullscale prototype will be discussed.

Group Report AKBP 4.5 Tue 18:30 CHE/0183
Multi-turn ERL mode of the S-DALINAC* — •Manuel Dutine, Michaela Arnold, Jonny Birkhan, Adrian Brauch, Jochim Enders, Marco Fischer, Ruben Grewe, Lars Juergensen, Maximilian Meier, Norbert Pietralla, Felix Schliessmann, Dominic Schneider, Merle Seeger, Alexander Smuskin, and Manuel Steinhorst — Institut für Kernphysik, Technische Universität Darmstadt

The superconducting Darmstadt linear accelerator S-DALINAC is a thrice-recirculating accelerator for electrons supporting a variety of experimental programs in nuclear physics and nuclear photonics. Besides the conventional acceleration scheme, it can also be operated as an energy-recovery linac (ERL) [1] and contributes to research on this exciting topic of technology development. The world-wide first successful operation as a superconducting multi-turn ERL has been demonstrated in August 2021 [2]. A variety of projects address further developments, for instance, dedicated diagnostics to measure the position of two beams in the same beamline, simultaneously, or to resolve its time structure, have been used for first measurements. This contribution gives an overview of their status. [1] M. Arnold et al., First operation of the superconducting Darmstadt linear electron accelerator as an energy recovery linac, Phys. Rev. Accel. Beams 23, 020101 (2020) [2] F. Schliessmann et al., Realization of a multi-turn energy-recovery accelerator, Nat. Phys. (in press). *Work supported by DFG (GRK 2128), BMBF (05H21RDRB1), the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006) and the LOEWE Research Group Nuclear Photonics.

AKBP 5: Hadron Accelerators

Time: Tuesday 16:30–18:00 Location: CHE/0184

AKBP 5.1 Tue 16:30 CHE/0184

Broadband laser cooling of stored relativistic bunched ion beams at the ESR — •Sebastian Klammes[1], Lars Bozyk[1], Michael Bussmann[2,3], Noah Eizenhöfer[4], Volker Hannen[5], Max Horst[4], Daniel Kiefer[4], Nils Kiefer[6], Thomas Kühl[1,7], Benedikt Langfeld[4,9], Xinwen Ma[8], Wilfried Nörtershäuser[4,9], Rodolfo Sánchez[1], Ulrich Schramm[3,10], Mathias Siebold[2], Peter Spiller[1], Markus Steck[1], Thomas Stöhlker[1,7,11], Ken Ueberholz[5], Thomas Walther[4,9], Hanbing Wang[8], Weiqiang Wen[8], Daniel Winzen[5], and Danyal Winters[1] — [1]GSI Darmstadt — [2]HZDR Dresden — [3]Casus Görlitz — [4]TU Darmstadt — [5]Uni Münster — [6]Uni Kassel — [7]HI Jena — [8]IMP Lanzhou — [9]HFHF Darmstadt — [10]TU Dresden — [11]Uni-Jena

High-precision experiments at heavy-ion storage rings strongly benefit from cold ion beams, i.e. beams with a small relative longitudinal momentum spread ($\Delta p/p$) and a small emittance (ϵ). Especially for the higher ion intensities and Lorentz factors (γ) at FAIR (SIS100), laser cooling has proven to be a powerful tool for cooling of relativistic bunched ion beams. The principle is based on resonant absorption (photon momentum & energy) in the longitudinal direction and subsequent spontaneous random emission (fluorescence & ion recoil) by the ions, combined with a moderate bunching of the ion beam. We will report on results from a 2021 laser cooling beamtime at the ESR, where we could demonstrate for the first time broadband laser cooling of relativistic bunched C^{3+} ions using a new pulsed UV laser system with a very high repetition rate, tunable pulse duration, and high power.

AKBP 5.2 Tue 16:45 CHE/0184

Tumor irradiation in mice with a laser-accelerated proton beam — •Florian Kroll[1], Florian-Emanuel Brack[1], Elke Beyreuther[1,2], Thomas Cowan[1,3], Leonhard Karsch[1,2], Josefine Metzkes-Ng[1], Jörg Pawelke[1,2], Marvin Reimold[1,3], Ulrich Schramm[1,3], Tim Ziegler[1,3], and Karl Zeil[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]OncoRay - National Center for Radiation Research in Oncology, Dresden, Germany — [3]Technische Universität Dresden, Dresden, Germany

Oncological studies identified beneficial properties of radiation applied at dose rates considerably exceeding the clinical standard of 1 Gy/min. At the Draco PW laser of Helmholtz-Zentrum Dresden-Rossendorf, a laser-driven proton research platform enables research on ultra-high dose rate effects for diverse user-specific small animal models.

Tunable single-shot doses are applied to mm-scale volumes on ns time scales, resulting in instantaneous dose rates around 10^9 Gy/s. Dose distributions that uniformly cover the sample volume were generated from individual broad-band proton bunches provided by our laser-driven source with unprecedented stability and long-term reliability. Maximum proton energies regularly exceeded 60 MeV.

We conducted the first radiobiological in vivo study with laser-driven protons using human tumors in a mouse model. We show the concerted preparation of mice and laser accelerator, the dose-controlled, tumor-conform irradiation using a laser-driven as well as a clinical reference proton source, and the radiobiological evaluation of irradiated and unirradiated mice for radiation-induced tumor growth delay.

AKBP 5.3 Tue 17:00 CHE/0184

Update on the Future Neutron Beam Line at the Bonn Isochronous Cyclotron — •Maximilian Loepke, Reinhard Beck, Dieter Eversheim, and Dennis Sauerland — Helmholtz-Institut für Strahlen- und Kernphysik Bonn

The Bonn Isochronous Cyclotron provides a beam of protons, deuterons, α-particles or other light ions with a mass-to-charge ratio $\geq 1/2$ with a kinetic energy ranging from 7 to 14 MeV per nucleon. Since 2019, a proton beam is utilized for irradiation of e.g. silicon pixel detectors for radiation hardness studies.

It is planned to extend the facility's irradiation and experimentation capabilities by providing a neutron beam in the near future. The neutrons are produced by splitting-up deuterons into protons and neutrons in a thick carbon or beryllium converter. Protons are stopped in the converter whereas the neutrons' flux and angular energy distribution is optimized by a subsequent copper/tungsten collimator. After collimation, the neutron beam can be utilized to irradiate a target.

The transversal dimension, yield and energy distribution of the neutron beam has been estimated for different collimator geometries using simulations with *Geant4* to optimize for radiation hardness tests.

This talk gives a conceptual overview of the future experimental area and results of the simulations are presented.

AKBP 5.4 Tue 17:15 CHE/0184

Standalone Readout for Mimosis-Sensors of the MVD. — •Benedikt Gutsche for the CBM-Collaboration — Goethe University Frankfurt

The Micro-Vertex-Detector (MVD) is a four-layer layer pixel detector and the first detector stage of the CBM experiment. Besides dedicated sensors (MIMOSIS), a fast and robust readout is necessary in order to handle the data in a proper way. In the prototyping phase of the detector and for sensor evaluation, a test system with smaller capabilities regarding the number of read-out sensors has been developed. This enables the use of a much simpler FPGA-based system. We chose the TRB platform and existing software framework, originally developed for HADES at GSI. We are going to show how automated tests of sensors can be implemented, in order to provide important information like the dead pixel count or the behaviour of DACs, using TRB-Software and root-based analysis applications (DABC, Go4) . This work has been supported by BMBF (05P21RFFC2) and GSI.

AKBP 5.5 Tue 17:30 CHE/0184

Upgrade of the Beam Preparation System of the Bonn Isochronous Cyclotron — •Béla Daniel Knopp[1], Reinhard Beck[1], Paul-Dieter Eversheim[1], Dennis Sauerland[1], and Pascal Wolf[2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik — [2]SiLab, Physikalisches Institut, Universität Bonn

With the Bonn Isochronous Cyclotron either protons, deuterons, alpha particles or other light ions with a charge-to-mass ratio $\geq 1/2$ are accelerated to a kinetic energy ranging from 7 to 14 MeV per nucleon. The extracted beam is guided to one of five experimental sites via a high-energy beamline.

To ensure a controlled beam transport via this beamline, the beam is stabilized in angle and position by the beam preparation system after extraction from the cyclotron. This is achieved by fixating the beam position in two consecutive locations. Using pairs of adjustable scrapers which are symmetrically aligned horizontally and vertically around the design orbit one can deduce the relative beam position in the transversal plane. This is done by comparing the beam scrape-off current at the scrapers when the beam is passing between them. Using the relative beam position as feedback for a control loop, the respective beam deviation from the design orbit can be minimized by using dedicated corrector magnets.

In this talk, the design and development of a new digital readout and control of the beam preparation system, which replaces the current analog one, will be presented.

AKBP 5.6 Tue 17:45 CHE/0184

Kaon beam studies employing coventional hadron beam concepts at the CERN M2 beam line for the future AMBER experiment — •Fabian Metzger[1,2], Dipanwita Banerjee[2], Johannes Bernhard[2], Lau Gatignon[3], Alexander Gerbershagen[4], Bernhard Ketzer[1], Laurence James Nevay[2], and Silvia Schuh[2] — [1]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]CERN, Geneva, Switzerland — [3]Lancaster University, Lancaster, United Kingdom — [4]University of Groningen, Particle Therapy Research Center, Netherlands

As a part of its rich proposed future physics programme, the AMBER (NA66) experiment aims to measure the inner structure and the excitation spectra of mesons with open strangeness with a high-intensity kaon beam at the CERN secondary beam line M2. One way to identify the small fraction of kaons in the available beam is tagging with the help of differential Cherenkov detectors (CEDARs), which are blind to other particles and whose detection efficiency depends critically on the beam parallelism.

In this contribution, we discuss possible improvements of the conventional beam optics to achieve a better performance of the CEDARs for the AMBER programme with hadron beams, in particular for the planned Drell-Yan and diffractive measurements. We focus on the in-

vestigation of multiple scattering in the present setup in the regions where the beam runs through vacuum windows and air at atmospheric pressure, and on the optimization of the beam optics.

AKBP 6: New Results from Accelerators for Hadron Physics

Time: Wednesday 11:00–12:30 Location: HSZ/0304

Group Report AKBP 6.1 Wed 11:00 HSZ/0304
Laser spectroscopy of Mg^+ at CRYRING@ESR — •Konstantin Mohr[1,2], Zoran Andelkovic[3], Volker Hannen[4], Frank Herfurth[3], Max Horst[1,2], Phillip Imgram[1], Kristian König[1,2], Claude Krantz[3], Michael Lestinsky[3], Yuri Litvinov[3], Bernhard Maass[1,5], Esther Menz[6], Patrick Müller[1], Wilfried Nörtershäuser[1,2], Simon Rausch[1,2], Rodolfo Sánchez[3], Ragandeep Singh Sidhu[7], and Ken Überholz[4] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Helmholtzforschungsakademie Hessen für FAIR HFHF, Darmstadt, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany — [4]Institut für Kernphysik, WWU Münster, Germany — [5]ANL, Illinois, USA — [6]Helmholtzinstitut Jena, Germany — [7]University of Edinburgh, Scotland

The storage ring CRYRING@ESR at GSI/FAIR is dedicated to precision experiments with stored and cooled ions of energies down to few MeV. One of the first experiments at CRYRING@ESR was laser spectroscopy on the stable Mg isotopes, carried out to test a possible in-flight polarization buildup by optical pumping. Especially parity-non-conservation experiments would benefit from this technique. During the first attempts, we found an unexpectedly fast population transfer between the hyperfine ground states F=2,3 of $^{25}Mg^+$, which could be associated with the mixing of velocity classes caused by synchrotron oscillations in bunched-beam operation. We present the current status of the experiment and discuss the influence of dynamic effects. This work is supported by BMBF contract 05P21RDFA1.

Group Report AKBP 6.2 Wed 11:30 HSZ/0304
Laser-Driven Acceleration of Gold Ions — •Laura Desiree Geulig, Erin Grace Fitzpatrick, Maximilian J. Weiser, Veronika Kratzer, Vitus Magin, Masoud Afshari, Jörg Schreiber, and Peter G. Thirolf — Ludwig-Maximilians-Universität München

The efficient acceleration of gold ions is a first step towards the 'fission-fusion' reaction mechanism, which aims at investigating the rapid neutron capture process in the vicinity of the N=126 waiting point[1]. In our recent measurement at the PHELIX laser with a pulse length of 500fs, for the first time, the laser-based acceleration of gold ions above 7 MeV/u was demonstrated. Additionally, individual gold charge states were resolved with unprecedent resolution[2]. This has allowed the investigation of the role of collisional ionization using a developmental branch of the particle-in-cell simulation code EPOCH[3], showing a much better agreement of the simulated charge state distributions with the experimentally measured ones than when only considering field ionization. This work is continued at the Centre for Advanced Laser Applications (CALA), using the ATLAS3000 laser (800nm central wavelength, 25 fs pulse length).

[1] D. Habs et al., Appl. Phys. B 103, 471-484 (2011)
[2] F.H. Lindner et al., Sci. Rep. 12, 4784 (2022)
[3] M. Afshari et al., Sci.Rep. 12, 18260 (2022)

Group Report AKBP 6.3 Wed 12:00 HSZ/0304
Pure Copper and Stainless Steel Additive Manufacturing of an IH-Type Linac Structure — •Hendrik Hähnel, Adem Ates, and Ulrich Ratzinger — Institut für Angewandte Physik, Goethe Universität, Frankfurt am Main

Additive manufacturing ("AM") has become a powerful tool for rapid prototyping and manufacturing of complex geometries. A 433 MHz IH-DTL cavity has been constructed to act as a proof of concept for direct additive manufacturing of linac components. In this case, the internal drift tube structure has been produced from 1.4404 stainless steel, as well as pure copper using AM. The Prototype cavity, as well as stainless steel AM parts have been copper plated. We present results from low level rf measurements of the cavity with and without copper plating, as well as the status of preparations for high power rf tests with a 30 kW pulsed power amplifier.

AKBP 7: Experiments for Advanced Light Sources

Time: Wednesday 14:00–15:30 Location: HSZ/0304

Group Report AKBP 7.1 Wed 14:00 HSZ/0304
Seeded free-electron laser driven by laser-plasma accelerators - a quest to compact high-brilliance x-ray lasers — •Arie Irman[1], Amin Ghaith[1], Marie Labat[2], Eléonore Roussel[3], Jurjen Couperus-Cabadag[1], Alexandre Loulergue[2], Susanne Schöbel[1], Maxwell LaBerge[1], Patrick Ufer[1], Yen-Yu Chang[1], Nicolas Hubert[2], Moussa El Ajjouri[2], Anthony Berlioux[2], Mathieu Valléau[2], Philippe Berteaud[2], Fréderic Blache[2], Sébastien Corde[4], Alexander Debus[1], Carlos De Oliviera[2], Jean-Pierre Duval[2], Yannick Dietrich[2], Christopher Eisenmann[1], Julien Gautier[2], René Gebhardt[1], Simon Grams[1], Uwe Helbig[1], Christian Herbeaux[2], Charles Kitégi[2], Olena Kononenko[4], Michael Kuntzsch[1], Stéphane Lê[2], Bruno Leluan[2], Fabrice Marteau[2], Manh Huy Nguyen[2], Richard Pausch[1], Pascal Rousseau[4], Mourad Sebdaoui[2], Klaus Steiniger[1], Keihan Tavakoli[2], Cédric Thaury[4], Marc Vandenberghe[2], José Vétéran[2], Victor Malka[4], Driss Oumbarek-Espinos[2], Damien Pereira[2], Thomas Püschel[1], Jean-Paul Ricaud[2], Patrick Rommeluère[2], and Ulrich Schramm[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf e. V. (Germany); — [2]Synchrotron SOLEIL (France) — [3]Lab. de Physique des Lasers, Atomes et Molécules (France) — [4]Lab. d'Optique Appliquée (France);

Free-electron lasers (FELs) produce high-brilliance coherent light pulses, serving as versatile research tools in fundamental science and applications. The recent development of short-wavelength seeded FEL now allows for unprecedented levels of control on longitudinal coherence, opening new scientific avenues such as ultra-fast dynamics on complex systems and X-ray nonlinear optics. Although those devices rely on state-of-the-art large-scale accelerators, advancements on laser-plasma accelerators, which harness gigavolt-per-centimetre accelerating fields, showcase a promising technology as compact drivers for FELs. This talk will review the current status of global effort toward realization of compact FELs. In particular, we present the development of high-quality laser-plasma accelerated electron beams and the commissioning of the COXINEL - FEL beamline, as well as experimental demonstration of FEL lasing at 270 nm in a seeded configuration. Control over the radiation wavelength is achieved with an improved bandwidth stability. Furthermore, the appearance of interference fringes, resulting from the interaction between the phase-locked emitted radiation and the seed, confirms longitudinal coherence, representing a key feature of such a seeded FEL. We anticipate a navigable pathway toward smaller-scale free-electron lasers at extreme ultraviolet wavelengths.

Group Report AKBP 7.2 Wed 14:30 HSZ/0304
KIT accelerators and research highlights - an overview — •Härer Bastian — Karlsruhe Institute of Technology, KIT

The Institute for Beam Physics and Technology (IBPT) at the Karlsruhe Institute of Technology (KIT) operates the Karlsruhe Research Accelerator (KARA) and the short-bunch linear accelerator, Ferninfrarot Linac- und Test-Experiment (FLUTE). In addition, a new compact storage ring will be realised in the context of the cSTART project and a new laser plasma accelerator will be the stepping stone for R&D based on novel acceleration techniques. This contribution gives an overview of current and future facilities and highlight respective accel-

erator physics research activities.

Group Report AKBP 7.3 Wed 15:00 HSZ/0304
Recent Highlights at the Photo Injector Test Facility at DESY in Zeuthen (PITZ) — •Li Xiangkun — on behalf of the PITZ team, DESY, 15738 Zeuthen, Germany

The Photo Injector Test facility at DESY in Zeuthen (PITZ) develops high brightness photocathode RF guns, advanced diagnostics and applications of the high brightness electron beams, which currently can be accelerated up to 22 MeV. In this talk, we will focus on the two main experiments in 2022: the worldwide first high-power THz SASE free-electron laser (FEL) and a new R&D platform for FLASH radiation therapy and radiation biology. The THz SASE FEL aims at producing high power tunable narrow band THz pulses with an energy of hundreds of *J per pulse. This can be realized by transporting and matching an electron beam with a bunch charge of 2 to 4 nC and a peak current up to 200 A into an undulator. Methods have been developed at PITZ for the beam envelop and trajectory optimization of the strongly space charge dominated electron beam. Results from first lasing, seeding studies and even saturation at 3 THz will be presented. The R&D platform FLASHlab@PITZ for radiation biology and electron FLASH radiation therapy is being prepared at PITZ. PITZ can provide a uniquely wide parameter range for studying this newest modality of radiation treatment against cancer. A startup beamline has been installed, first successful experiments have been done and an upgrade plan for exploiting the full capability of PITZ was developed. All this will be summarized in the talk.

AKBP 8: Advanced IT Tools

Time: Wednesday 15:45–17:15 Location: CHE/0183

AKBP 8.1 Wed 15:45 CHE/0183
Image space reconstruction algorithm for LPS tomography at PITZ — •Namra Aftab[1], Prach Boonpornprasert[1], Georgi Georgiev[1], Matthias Gross[1], Andreas Hoffmann[1], Mikhail Krasilnikov[1], Xiangkun Li[1], Anne Oppelt[1], Christopher Richard[1], Frank Stephan[1], Grygorii Vashchenko[1], Wolfgang Hillert[2], and Andrew Reader[3] — [1]Deutsches Elektronen-Synchrotron, Zeuthen, Germany — [2]University of Hamburg, Institute for Experimental Physics, Hamburg, Germany — [3]School of Biomedical Engineering and Imaging Sciences, Kings College London, UK

At the Photo Injector Test facility at DESY in Zeuthen, longitudinal phase space (LPS) before the booster is determined by an iterative reconstruction method called Algebraic Reconstruction Technique (ART). Although ART is simple to implement with good convergence speed, the results show many artefacts and overestimate energy spread and bunch length. Recently LPS tomography was done via Image Space Reconstruction Algorithm (ISRA) which showed promising results owing to its assurance of non-negative solution. The weight matrix crucial for successive updates was improved by bilinear interpolation. The initial guess for iterations was established from low energy section momentum measurements. The aforementioned reforms resulted in reduced noise-like artefacts, better convergence speed and accurate longitudinal emittance. ISRA was tested on simulations as well as on experimental data. It can diagnose not only linear chirp in LPS but also higher order effects. Experiments with modulated laser beams were also designed to demonstrate the diagnostic capability.

AKBP 8.2 Wed 16:00 CHE/0183
Injection Optimization via Reinforcement Learning at the Cooler Synchrotron COSY — •Awal Awal[1,2], Jan Hetzel[2], and Jörg Pretz[1] — [1]RWTH Aachen University — [2]GSI Helmholtzzentrum für Schwerionenforschung

In accelerator facilities, it is important to have a particle beam with high intensity and small emittance in a timely manner for the successful operation of the experiments. The main challenges limiting the availability of the beam to the users and limiting the beam intensity in storage rings are the lengthy optimization process and the injection losses. The setup of the Injection Beam Line (IBL) depends on a large number of configurations in a complex, non-linear, and time-dependent way. Reinforcement Learning (RL) methods have shown great potential in optimizing various complex systems. However, unlike other optimization methods, RL agents are sample inefficient and have to be trained in simulation before running them on the real IBL. In this research, RL agents are trained to learn the optimal injection strategy of the IBL for the Cooler Synchrotron (COSY) at Forschungszentrum Jülich. The challenge of sim-to-real transfer, where the RL agent trained in simulation does not perform well in the real world, is addressed by incorporating domain randomization. The goal is to increase the beam intensity inside COSY while decreasing the setup time required. This method has the potential to be applied in future accelerators like the FAIR facility.

AKBP 8.3 Wed 16:15 CHE/0183
Beam Trajectory Control with Lattice-Agnostic Reinforcement Learning — •Chenran Xu[1], Erik Bründermann[1], Jan Kaiser[3], Anke-Susanne Müller[1,2], and Andrea Santamaria Garcia[2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe — [3]DESY, Hamburg

In recent work, it has been shown that reinforcement learning (RL) is capable of outperforming existing methods on accelerator tuning tasks. However, RL algorithms are difficult and time-consuming to train and currently need to be retrained for every single task. This makes fast deployment in operation difficult and hinders collaborative efforts in this research area. At the same time, modern accelerators often reuse certain structures within or across facilities such as transport lines consisting of several magnets, leading to similar tuning tasks. In this contribution, we use different methods, such as domain randomization, to allow an agent trained in simulation to easily be deployed for a group of similar tasks. Preliminary results show that this training method is transferable and allows the RL agent to control the beam trajectory at similar lattice sections of two different real linear accelerators. We expect that future work in this direction will enable faster deployment of learning-based tuning routines, and lead towards the ultimate goal of autonomous operation of accelerator systems and transfer of RL methods to most accelerators.

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

AKBP 8.4 Wed 16:30 CHE/0183
Sensitivity Analysis and Online Surrogate Construction at the S-DALINAC Using Polynomial Chaos and Neural Networks — •Dominic Schneider, Michaela Arnold, Jonny Birkhan, Ruben Grewe, Norbert Pietralla, and Felix Schliessmann — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Particle accelerators are complex systems that coincide with their ideal design within the tolerances of its large number of technical components. Quantitative understanding of the beam dynamics and the analysis of their sensitivity to various components are challenging tasks. Machine learning methods provide the potential for the optimized operation of particle accelerators. In this contribution, the application of so-called surrogate models to the electron accelerator S-DALINAC will be discussed. This machine learning technique gives access to predict future behavior and an extensive set of characteristics that can be extracted by analyzing the trained model. The talk will include the presentation of a series of measurements performed in the injector section of the S-DALINAC to study the behavior of beam-influencing elements. Surrogate models, constructed and based on the acquired data, are being evaluated to reveal the behavior of these elements. Based on the information obtained, optimizations of the alignment of magnets as well as the beam dynamics simulations at the S-DALINAC will be discussed.

Supported by the State of Hesse and the Research Cluster ELEMENTS (Project-ID 500/10.006).

AKBP 8.5 Wed 16:45 CHE/0183
Generating synthetic shadowgrams with an in-situ plugin in PIConGPU — •Finn-Ole Carstens[1,2], Klaus Steiniger[1], Richard Pausch[1], Susanne Schöbel[1,2], Yen-Yu Chang[1], Arie Irman[1], Ulrich Schramm[1,2], and Alexander Debus[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität

Dresden

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.

In this talk we present the in-situ plugin and preliminary synthetic shadowgrams from laser wakefield accelerator simulations.

AKBP 8.6 Wed 17:00 CHE/0183

X-ray radiation transport in GPU accelerated Particle In Cell simulations — •Paweł Ordyna, Thomas Kluge, Thomas Cowan, and Ulrich Schramm — HZDR, Dresden, Germany

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.

AKBP 9: Beam Dynamics I

Time: Wednesday 15:45–17:15 Location: CHE/0184

AKBP 9.1 Wed 15:45 CHE/0184

A Simulation for Ultrafast Electron Scattering Applications — •Simon Barg — Helmholtz-Zentrum Berlin

The superconducting radio-frequency (SRF) photoinjector is a photoelectron driven linear accelerator located at the SEALab facility at Helmholtz-Zentrum Berlin. With the injector, very flexible beam parameters can be achieved enabling many scientific applications like performing ultrafast electron scattering, with diffraction and imaging modalities, which is this work's focus. Complex structures such as biological molecules, which are not suitable for conventional crystallographic methods, could be imaged and studied with this technique.

To assess the feasibility of ultrafast imaging, a numerical simulation is developed to model an electron pulse from the gun that is deflected by a stream of molecules running perpendicular to the pulse's path to then create a (motion-) blurred image of an individual particle after passing through a magnetic lens system. Considering the injector's spatial coherence, this work's first goal is to find optimal imaging conditions to differentiate between two molecule orientations.

After showing that a contrast between different images can be successfully obtained, the simulation is currently being refined to work as a tool for parameter optimization. Given the pulse features, the model is able to output suitable lens settings. It is also used to compare different techniques, such as dark and bright field imaging, with the overall goal to find the most promising setups for future experiments.

AKBP 9.2 Wed 16:00 CHE/0184

Determination of the Invariant Spin Axis in a COSY model using Bmad — •Maximilian Vitz — Institute for Nuclear Physics IV, FZ Jülich, Germany — III. Physikalisches Institut B, RWTH Aachen University, Germany

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. A finite EDM would be, if discovered 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 Forschungszentrum Jülich by measuring the invariant spin axis.

In order to interpret the measured data and to disentangle a potential EDM signal from systematic effects in the radial part of the invariant spin axis, spin tracking simulations in an accurate simulation model of COSY are needed. Therefore a model of COSY has been implemented using the software library Bmad. Systematic effects were considered by including element misalignments, etc. These effects rotate the invariant spin axis in addition 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.

AKBP 9.3 Wed 16:15 CHE/0184

Simulations of Beam Dynamics and Beam Lifetime for the Prototype EDM Ring — •Saad Siddique for the CPEDM-Collaboration — JEDI Collaboration — GSI Helmholtzzentrum für Schwerionenforschung Darmstadt Germany

The matter-antimatter asymmetry seen in the universe may be explained through CP-violation by observing a permanent electric dipole moment (EDM) of subatomic particles. An advanced approach to measure the EDM of charged particles is to apply a unique method of Frozen spin on a polarized beam in a storage ring. To increase the experimental precision step by step and to study systematic effects, the EDM experiment will be performed within three stages: the magnetic ring COSY (Cool Synchrotron Forschungzentrum Jülich Germany), a prototype EDM ring, and finally an all-electric EDM ring. The intermediate ring will be a mock-up of the final ring, which will be used to study a variety of systematic effects and to implement the basic principle of the final ring. Simulations of beam dynamics of the prototype EDM ring with different lattices are carried out to optimize the beam lifetime and minimize the systematic effects. The preliminary design of the prototype EDM ring helped to estimate the beam losses by using analytical formulas. Beam-target effects with more detailed simulations are being studied for beam losses and the application of stochastic cooling to control beam emittance growth is also being studied by using a simulation program. Further investigations to reduce systematic effects are also in progress.

AKBP 9.4 Wed 16:30 CHE/0184

Compton transmission polarimetry of LPA-accelerated electron beams — •Jennifer Popp[1,2], Simon Bohlen[1], Louis Helary[1], Felix Stehr[1,2], Gudrid Moortgat-Pick[2,1], Jenny List[1], Jens Osterhoff[1], and Kristjan Põder[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]Universität Hamburg

For the study of spin-dependent processes polarised particle beams are indispensable. The LEAP (Laser Electron Acceleration with Polarisation) project at DESY aims to demonstrate the production of polarised electron beams exploiting the extremely high acceleration gradients of laser plasma accelerators. In this proof of principle experiment, spin-polarised electron beams with energies of tens of MeV will be generated in a sub-millimetre long plasma source. For electron beams of such energies, Compton transmission polarimetry is the ideal method to measure the polarisation. Gamma rays produced by bremsstrahlung are transmitted through a magnetised iron absorber core depending on their polarisation direction and that of the electrons in the iron. The resulting transmission asymmetry is proportional to the initial electron polarisation. In this talk, an overview of the LEAP project will be given and a polarimeter design, as well as its implementation and commissioning status will be presented.

AKBP 9.5 Wed 16:45 CHE/0184

Simulation studies on longitudinal beam dynamics manipulated by corrugated structures under different bunch length conditions at KARA — •Sebastian Maier[1], Miriam Brosi[3], Hyuk Jin Cha[1], Akira Mochihashi[2], Michael J. Nasse[2], Patrick Schreiber[2], Markus Schwarz[2], and Anke-Susanne Müller[1,2] —

[1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe — [3]MAX IV Laboratory, Lund, Sweden

In the KIT storage ring KARA (KArlsruhe Research Accelerator), two parallel plates with periodic rectangular corrugations are planned to be installed. These plates will be used for impedance manipulation to study and eventually control the beam dynamics and the emitted coherent synchrotron radiation (CSR). In this contribution, we present simulation results showing the influence of different corrugated structures on the longitudinal beam dynamics and how this influence depends on the machine settings in the low momentum compaction regime, which are related to the bunch length changes.

This work is supported by the DFG project 431704792 in the ANR-DFG collaboration project ULTRASYNC. S. Maier acknowledges the support by the Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 9.6 Wed 17:00 CHE/0184

Design of a Solenoid Magnet for the S-DALINAC* — •Merle Seeger, Michaela Arnold, Lars Jürgensen, Norbert Pietralla, and Felix Schliessmann — Institut für Kernphysik, Technische Universität Darmstadt, Germany

For the electron accelerator S-DALINAC, new focusing components in the low-energy injector section are needed. Small solenoid magnets can be used to focus low-energy beams in both transverse planes simultaneously. For this purpose, a precise magnetic field is beneficial. The effect of a specific magnet geometry on the magnetic field, as well as on the particle beam, can be investigated using computer simulations. Main influences to the magnetic field that are largely independent from installation constraints include the magnet radius and the yoke shape and material. To find an optimum design for a solenoid magnet for the S-DALINAC, variations of these magnet parameters were considered. Further calculations were made regarding the wiring and cooling of the magnet. In this contribution we will present the results of the computer simulations leading to the final design of the solenoid magnet, as well as detailing the challenges of the magnet construction.

*Work supported by DFG (GRK 2128 AccelencE).

AKBP 10: Instrumentation I

Time: Wednesday 17:30–19:00 Location: CHE/0183

AKBP 10.1 Wed 17:30 CHE/0183

Development of a Thermal Conduction Instrument for Niobium at Cryogenic Temperatures — •Cem Saribal, Mark Wenskat, Cornelius Martens, Isabel Gonzáles Díaz-Palacio, and Wolfgang Hillert — Department of Physics, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

Particle accelerators form an important tool in a variety of research fields including particle physics, material science, chemistry and medicine. In an effort to reduce operation costs while maintaining high energies, their accelerating structures, so-called superconducting radio-frequency (SRF) cavities, are steadily improved towards higher accelerating fields and lower RF losses. Stable operation of such a cavity generally requires Joule heating, generated in its walls, to be conducted to an outer helium bath. Therefore, it is of interest to experimentally evaluate how present and future cavity treatments affect thermal characteristics. We present an instrument for measuring the thermal performance of SRF cavity materials at cryogenic temperatures. Pairs of niobium disks are placed inside of a liquid helium bath and a temperature gradient is generated across them to obtain thermal transmission conductivity for temperatures ranging from 2 Kelvin to 4 Kelvin. To get an idea of the instrument's sensitivity and how standard cavity treatments influence thermal conductivity, samples are tested post fabrication, polishing and 800 degrees baking. These first tests serve as a baseline to study and evaluate new and promising cavity treatments such as ALD-coatings.

AKBP 10.2 Wed 17:45 CHE/0183

Status of the 5 MeV Mott polarimeter design for the MESA — •Rakshya Thapa — Institut für Kernphysik, Mainz, Germany

A high intensity polarised beam has to be delivered to the P2 experiment at Mainz Energy Recovering Superconducting Accelerator Facility (MESA). The absolute error of the beam polarisation should be $\leq$1%. To track the polarisation, a Mott polarimeter will be installed after the pre-acceleration of the polarised beam to 5 MeV energy and measurements will be done in quasi-online mode with beam current $\approx$150 μA at $\leq$1% precision. For that, the polarimeter scattering chamber and its assembly in the beam line is being designed which will be reported.

AKBP 10.3 Wed 18:00 CHE/0183

Teaching an old magnet new tricks — •Tasha Spohr — Helmholtz-Zentrum Berlin — Humboldt-Universität zu Berlin

For beam dynamics studies in the SeaLab SRF photoinjector, a dipole spectrometer built in 1993 and recycled from a decommissioned ion beamline was installed.

With this spectrometer, the beam energy and energy spread can be measured. The photoelectron beam will be bend by 60deg to a viewscreen in the dispersive section. For a precision energy analysis based on the beam size measurement at the viewscreen, it is necessary to know the beam transfer matrix of the dipole, as well as the relationship between magnetic field and coil current in the plane of all possible trajectories.

With this information about the dipole magnet, the transformation matrix of the beamline was determined and now can be applied for a large range of energy measurements.

AKBP 10.4 Wed 18:15 CHE/0183

Design and set-up of a spectrometer for the electro-optical far-field setup to monitor the CSR at KARA — •Ling Leander Grimm[1], Gudrun Niehues[2], Christina Widmann[2], Johannes Leonhard Steinmann[2], Micha Reissig[2], Erik Bründermann[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

At the KIT storage ring KARA (Karlsruhe Research Accelerator), a new system to monitor the emitted coherent synchrotron radiation (CSR) is under commissioning aiming for single-shot measurements. The electro-optical (EO) far-field setup measures the time profile of the CSR employing electro-optical spectral decoding (EOSD). To achieve a sub-picosecond resolution for single-shot measurements, a high signal-to-noise ratio is crucial. Therefore, a spectrometer setup for balanced detection is developed. The ultra-fast line camera KALYPSO (KArlsruhe Linear arraY detector for MHz-rePetition rate SpectrOscopy) will be installed as a detector. This contribution discusses the development and setup of the spectrometer, including optics simulations and first experiments.

AKBP 10.5 Wed 18:30 CHE/0183

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

The S-DALINAC at TU Darmstadt is a 3 GHz electron accelerator that allows the possibility to operate it in an energy recovery LINAC (ERL) mode. The multi-turn ERL operation mode was demonstrated in 2021. During the operation in this mode once accelerated and once decelerated beams share the same beamline which leads to the repetitive bunch rate of 6 GHz. A non-destructive beam monitoring tool is important for the simultaneous position measurement of both beams. For these purposes a setup based on Low Gain Avalanche Detectors (LGADs) is being developed for the beam time structure monitoring. LGADs are silicon detectors optimized for 4D-tracking with timing precision below 50 ps thanks to an internal charge amplification mechanism which makes it an ideal candidate for precise timing monitoring at S-DALINAC.

This work has been supported by DFG under GRK 2128.

AKBP 10.6 Wed 18:45 CHE/0183

Split-ring resonator experiments and data analysis at FLUTE

— •Jens Schäfer, Matthias Nabinger, Michael J. Nasse, Robert Ruprecht, Thiemo Schmelzer, Nigel Smale, Bastian Härer, and Anke-Susanne Müller — IBPT, KIT, Karlsruhe

FLUTE (Ferninfrarot Linac- Und Test-Experiment) is a compact linac-based test facility for accelerator and diagnostics R&D located at the Karlsruher Institute of Technology (KIT). A new accelerator diagnostics tool, called the split-ring resonator (SRR), was tested at FLUTE, which aims at measuring the longitudinal bunch profile of fs-scale electron bunches. Laser-generated THz radiation is used to excite a high frequency oscillating electromagnetic field in the SRR. Electrons passing through the 20 *m x 20 *m SRR gap are time-dependently deflected in the vertical plane, leading to a vertical streaking of the electron bunch. During the commissioning of the SRR at FLUTE, large series of streaking attempts with varying machine parameters and set-ups were investigated in an automatized way. The recorded beam screen images during this experiment have been analyzed and evaluated. This contribution motivates and presents the automatized experiment and discusses the data analysis.

AKBP 11: RF and SRF Research

Time: Wednesday 17:30–19:00 Location: CHE/0184

AKBP 11.1 Wed 17:30 CHE/0184

Thin Films On HOM Antennas To Push The Limits For Higher Beam Currents at MESA(*)(**) — •Paul Plattner, Florian Hug, and Timo Stengler — Institut für Kernphysik (KPH), Mainz, Deutschland

The Mainz Energy-Recovering Superconducting Accelerator (MESA), an energy-recovering (ER) LINAC, is currently under construction at the Institute for Nuclear physics at the Johannes Gutenberg-Universität Mainz, Germany. In the ER mode continues wave (CW) beam is accelerated from 5 MeV up to 105 MeV. The energy gain of the beam is provided through 2 enhanced ELBE-type cryomodules containing two 1.3 GHz 9-cell TESLA cavities each. By pushing the limits of the beam current up to 10 mA, a quench can occur at the HOM Antennas. This is caused by an extensive power deposition within the antenna. Calculations have shown that a power transfer of 1 W must be assumed. To prevent a quench of the HOM antennas by high beam currents without mayor modification of the design, it is necessary to find suitable materials. Nb3Sn and NbTiN can be applied as a coating to the antennas and have higher critical parameters than Nb which provides than a higher power limit. As a further approach to improve the power transfer by changing to material from the antenna to OFHC Copper. The limit of the coated antennas will be tested with the cavities of a cryomodule from the decommissioned ALICE from STFC Daresbury. (*)The authors acknowledge the transfer of one cryomodule to Mainz by the STFC Daresbury. (**)The work received funding by BMBF through 05H21UMRB1.

AKBP 11.2 Wed 17:45 CHE/0184

Nb3Sn Co-Sputtering for Interlayer-Free High Performance Copper SRF Cavities — •Nils Schäfer, Carl Jung, Matthias Mahr, Carl Jung, Christian Dietz, Sebastian Bruns, Márton Major, and Lambert Alf — Technische Universitaet Darmstadt (TU Darmstadt) Institute of Materials Science FB 11

Nb3Sn thin film coatings are a promising candidate to replace bulk Nb to increase performance and energy efficiency of SRF cavities. Replacing niobium by Nb3Sn coated copper would not only reduce material*s cost, but would also allow optimal heat removal for higher cryogenic efficiency. The challenge is the detrimental interdiffusion of Cu into Nb3Sn at the typically high deposition temperatures conventionally used for Nb3Sn synthesis. We have recently introduced a novel kinetically driven low-temperature co- sputtering process that overcomes the copper diffusion challenge. In this break-through process, even a diffusion barrier layer is not needed, because the Cu diffusion is minimized to an extent where the superconducting properties of Nb3Sn are not negatively affected. Magnetization versus temperature measurements demonstrate the good shielding performance in parallel orientation of the Nb3Sn thin films on the copper substrate. Mechanical nanondentation and scratch tests demonstrate that even after thermal cycling of the sample, the adhesion properties the Nb3Sn thin film coatings are excellent. Work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H21RDRB1 and the German Research Foundation (DFG) via the AccelencE Research Training Group (GRK 2128).

AKBP 11.3 Wed 18:00 CHE/0184

low-temperature magnetron co-sputtering of Nb3Sn for SRF application — •Hamidreza Ghasemi[1], Nils Schäfer[2], Márton Major[3], Alexey Arzumanov[4], and Lambert Alff[5] — [1]Technical University of Darmstadt, Darmstadt, Germany — [2]Technical University of Darmstadt, Darmstadt, Germany — [3]Technical University of Darmstadt, Darmstadt, Germany — [4]Technical University of Darmstadt, Darmstadt, Germany — [5]Technical University of Darmstadt, Darmstadt, Germany

For the last decades, bulk niobium has been the material of choice for superconducting RF cavity applications. Nb3Sn thin films are another candidate for SRF cavities. The benefits of using Nb3Sn instead of Nb would be higher critical temperature and higher critical magnetic field, leading to significant cryogenics cost reduction. The Tc is maximal for about 25% tin content and decreases significantly for less than 23at%. Therefore, the big problem of Nb3Sn is the synthesis of the material. The most promising fabrication method of Nb3Sn is the tin vapor diffusion method. Control of the small stoichiometry range and Sn gradients are the challenges of this method. In single-target sputtering and multi-layer sputtering we have to deal with tin loss and surface segregation(due to high annealing temperature). Co-sputtering allows the tuning of the kinetic energy of both elements independently and offers high-performance thin films at low temperatures. This work presents recent results of Nb3Sn synthesis on Copper substrate by magnetron co-sputtering. This work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H21RDRB1.

AKBP 11.4 Wed 18:15 CHE/0184

Development of a system for the rapid RF characterization of superconducting samples — •Sebastian Keckert[1], Felix Kramer[1], Oliver Kugeler[1], and Jens Knobloch[1,2] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin — [2]Universität Siegen, Fachbereich Physik, Siegen

Niobium is currently the material of choice to produce superconducting radio frequency (SRF) cavities for applications in particle accelerators. These cavities are operated at temperatures of 2 K or lower to ensure manageable dynamic losses at high accelerating gradients. Presently, alternative materials to niobium and composite structures relying on thin film coatings are investigated in various R&D projects. Applied to SRF cavities such an advanced material or coating will allow performances beyond the fundamental limits of niobium and eventually operation temperatures of 4.2 K or higher. The development of such coatings requires RF characterization of superconducting samples and especially measurements of the RF surface resistance.

This contribution discusses the development and first commissioning results of a Rapid Superconductor Test Apparatus (RaSTA), a compact sample test cavity. In contrast to other test setups, RaSTA allows to distinguish BCS and residual resistance with high resolution but with far shorter turnaround times, enabling systematic studies of multiple samples and thus iterative optimization of materials production techniques.

AKBP 11.5 Wed 18:30 CHE/0184

Gobau-Line Measurements for In-Vacuum Undulators — •Paul Volz — Helmholtz-Zentrum Berlin für Materialien und Energie — Johannes Gutenberg-Universität Mainz

The in-vacuum elliptical undulator, IVUE32, is being developed at Helmholtz-Zentrum Berlin. The 2.5 m long device with a period length of 3.2 cm and a minimum gap of about 7 mm is to be installed in the BESSY II storage ring. The proximity of the undulator structure to the electron beam makes the device susceptible to wakefield effects which can influence beam stability. A complete understanding of its impedance characteristics is required prior to installation and operation. To understand and measure the IVU's impedance characteristics a Goubau-Line test stand is being designed. A Goubau-line is a single wire transmission line for high frequency surface waves with a trans-

verse electric field resembling that of a charged particle beam out to a certain radial distance. First measurements from a prototype test stand, designed to measure IVUE32-components will be presented.

AKBP 11.6 Wed 18:45 CHE/0184

Influence of High-Pressure Rinsing on the Oxide-Layer Thickness and Oxygen-Concentration of Niobium Samples — •Rezvan Ghanbari[1], Marc Wenskat[1], Mona Kohantorabi[2], Heshmat Noei[2], Arti Dangwal Pandey[2], Detlef Reschke[2], and Wolfgang Hillert[1] for the University of Hamburg-Collaboration — [1]Institute of experimental physics, University of Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Germany

This study is devoted to investigate the effect of High Pressure Rinsing (HPR) on the outcome of annealing procedures of Niobium (Nb) superconducting radio-frequency cavities. Recently, a so-called "mid-T bake" treatment has exhibited very high-quality factors for Nb cavities. The complementary developed models assume that the quality factor severely depends on the oxygen concentration in the near-surface of niobium. On the other hand, based on our observation, we realize that HPR affects the thickness of oxide layers on the surface of niobium cavities, which is the dominant source of the oxygen diffusion during annealing. Thus, we have measured the oxide thicknesses after various HPR durations of Nb samples before and after applying mid-T bake treatment via X-ray Photoelectron Spectroscopy (XPS) and used Secondary Ion Mass Spectrometry (SIMS) to obtain the interstitial oxygen concentration after the annealing. The results of this investigation will be presented and discussed in the context of theoretical models.

AKBP 12: AI Topical Day – Invited Talks (joint session AKPIK/HK/ST/T/AKBP)

Time: Thursday 11:00–12:30 Location: HSZ/AUDI

Invited Talk AKBP 12.1 Thu 11:00 HSZ/AUDI

AI Techniques for Event Reconstruction — •Ivan Kisel — Goethe University, Frankfurt, Germany

Why can we relatively easily recognize the trajectory of a particle in a detector visually, and why does it become so difficult when it comes to developing a computer algorithm for the same task? Physicists and computer scientists have been puzzling over the answer to this question for more than 30 years, since the days of bubble chambers. And it seems that we are steadily approaching the answer in our attempts to develop and apply artificial neural networks both for finding particle trajectories and for physics analysis of events in general.

This talk will present the basics of artificial neural networks in a simple form, and provide illustrations of their successful application in event reconstruction in high energy physics and heavy ion physics experiments. You will get an insight into the application of traditional neural network models, such as deep neural network, convolutional neural network, graph neural network, as well as those standing a little aside from traditional approaches, but close in idea of elastic network and even cellular automata.

Invited Talk AKBP 12.2 Thu 11:30 HSZ/AUDI

Accelerator operation optimisation using machine learning — •Pierre Schnizer — Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany

Accelerators are complex machines whose many components need to be accurately tuned to achive design performance. Reliable operation requires frequent recalibration and tuning. Especially for large machines tools have been developed that facilitating this task.

Machine learning allows building such tools using simulations, archiver data or interaction with the real machine, thus making many tools now also available for smaller machines.

This talk will give an overview of different machine learning projects targeted to accelerators, which simplifies accelerator operation or even enable applications not been possible before.

Invited Talk AKBP 12.3 Thu 12:00 HSZ/AUDI

Is this even physics? – Progress on AI in particle physics — •Gregor Kasieczka — Universität Hamburg

Motivated by the large volume and high complexity of experimental data and mathematical structures, particle physics has a long tradition of employing state of the art computing and analysis techniques. Recent progress in machine learning and artificial intelligence have further pushed this trend, and these approaches are now ubiquitous in our field. This overview attempts to capture key developments such as the rise of unsupervised approaches and the quest for suitable neural network architectures for physics tasks; challenges like ultra-low latency inference and robust predictions; as well as promising new ideas looking forward.

AKBP 13: Preisverleihung des AKBP Nachwuchspreises und des Horst-Klein Preises

Time: Thursday 14:00–15:30 Location: HSZ/0304

Prize Talk AKBP 13.1 Thu 14:00 HSZ/0304

TBA — •Carl A. Lindström — Universität Oslo/DESY — Laureate of the DPG-Nachwuchspreis für Beschleunigerphysik 2023

Details will be published online in a programme update.

Prize Talk AKBP 13.2 Thu 14:45 HSZ/0304

TBA — •Ferdinand Willeke — Brookhaven National Laboratory — Laureate of the Horst Klein-Forschungspreis 2023

Details will be published online in a programme update.

AKBP 14: Instrumentation II

Time: Thursday 15:30–17:15 Location: CHE/0183

AKBP 14.1 Thu 15:30 CHE/0183

System for Bunch Length Measurements behind the Injector of S-DALINAC* — •A. Brauch, M. Arnold, J. Enders, L. Jürgensen, and N. Pietralla — Technische Universität Darmstadt, Department of Physics, Institut für Kernphysik, Darmstadt, Deutschland

The estimation of the bunch length in accelerators is vital for monitoring and preserving the quality of the beam. At the S-DALINAC accelerating cavities are used for measuring this parameter at higher energies. However, values obtained by this method only serve as an upper estimate for the bunch length. A new setup involving a streak camera will be used to provide accurate evaluations of the small bunch lengths of < 2 ps at the S-DALINAC. An integrative measurement with a comparable resolution to the bunch length at different positions behind the injector is planned. This contribution will present the layout of this system, its current status and design considerations.

*Work supported by the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006).

AKBP 14.2 Thu 15:45 CHE/0183

Simulationen zur Optimierung von Vakuumsystemen für Beschleunigerstrahlführungen* — •Alexander Smushkin, Ruben Grewe, Michaela Arnold, Manuel Dutine, Marco Fischer, Lars Jürgensen, Felix Schliessmann und Norbert Pietralla — Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany

Der S-DALINAC ist ein supraleitender, rezirkulierender Linearbe-

schleuniger. Im Rahmen der fortschreitenden Optimierungen der Systeme am S-DALINAC wurden Segmente der Strahlführung bezüglich ihrer Vakuumeigenschaften untersucht. Hierbei wurde der Einfluss verschiedener Geometrien und Pumpenkonfigurationen auf das Vakuum mit der Simulationssoftware Molflow untersucht, um eine Grundlage für weitere Entwicklungen zu schaffen. Insbesondere werden Verbindungen zwischen Bereichen mit unterschiedlichen Vakuumanforderungen untersucht, wie z.B. beim Übergang zu den Kryostatmodulen oder Experimentierplätzen mit hohen Vakuumanforderungen. In diesem Vortrag werden diese Simulationsergebnisse vorgestellt.
*Gefördert durch die DFG (GRK 2128 AccelencE)

AKBP 14.3 Thu 16:00 CHE/0183

An all-optical streak camera to measure the jitter between two beams in the single-digit femtosecond regime — •Marc Osenberg[1], Ahmad Fahim Habib[2], Lina Wübbena[1], Michael Stumpf[1], and Georg Pretzler[1] — [1]Institute of Laser- and Plasmaphysics, University Düsseldorf — [2]University of Strathclyde, Glasgow

We present a novel All-Optical Streak Camera (AOSC) based on the Kerr-effect which measures the relative temporal position of a laser pulse and a second short pulse of arbitrary constituents (e.g., electrons, protons, light, or x-rays) in a single shot. Many modern accelerator concepts rely on the coupling of an electron beam with a laser beam, which must overlap with ultra-high temporal precision down to the low fs-regime which will be shown quantitatively by simulation results. Our new device comes in at this point, measuring the temporal position of the electron pulse relative to the laser pulse for single shots, which will also show jitter or temporal drifts. We show proof-of principle experiments of this new device with an ultrashort laser pulse (6 fs FWHM) demonstrating resolution in the 10-fs regime.

AKBP 14.4 Thu 16:15 CHE/0183

controlling the transverse beam shape of the photoinjector laser via a spatial light modulator — •Stephan-Robert Kötter, Erik Bründermann, Matthias Nabinger, Michael Nasse, Andrea Santamaria Garcia, Chenran Xu, and Anke-Susanne Müller — KIT, Karlsruhe, Germany

In order to achieve unprecedented control over the phase space of electron beams in linear accelerators, the laser pulse of the photoinjector can be shaped by spatial light modulators (SLMs). Here, we use a convolutional neural network (CNN) from a proof-of-principle test with a visible diode laser on the TiSa-800-nm photoinjector laser system of the Ferinfrarot Linac- und Test-Experiment (FLUTE) at KIT to compensate the effects of compression and the non-linear process of third harmonic generation on the transverse laser profile.

AKBP 14.5 Thu 16:30 CHE/0183

First two-bunch measurements using the electro-optical near-field monitor at KARA — •Micha Reissig[1], Erik Bründermann[1], Bastian Härer[1], Akira Mochihashi[1], Gudrun Niehues[1], Meghana M. Patil[2], Robert Ruprecht[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

The Karlsruhe research accelerator KARA is an electron storage ring, which features an electro-optical near-field monitor as a tool for longitudinal bunch profile measurements. The device performs well in single-shot turn-by-turn measurements during single-bunch operation and over the years, the design has been optimized to be prepared for measurements in multi-bunch operation. The ability to work with multiple bunches and short bunch spacing is an important step to make the device suitable for more application purposes, such as a diagnostics tool for the future electron-positron collider FCC-ee. This contribution provides first tests of the monitor during two-bunch operation with minimum 2 ns bunch spacing. Challenges like crystal heating due to an increased beam current are discussed and strategies for mitigation are presented.

AKBP 14.6 Thu 16:45 CHE/0183

Analytic formulation of the zero-crossing slope for a circular button-like pickup — •Stefano Mattiello, Bernhard Erich Jürgen Scheible, and Andreas Penirschke — Technische Hochschule Mittelhessen, Friedberg, Hessen

With the emerging demand of the experimenters for future experiments with ultra-short X-ray free-electron lasers (XFEL) shots, fs precision is required for the synchronization systems even with 1pC bunches using one or more button-like pickups in the Bunch Arrival Time Monitors (BAM). Because the sensitivity of the BAM depends in particular on the slope of the bipolar signal at the zero crossing and thus, also on the bunch charge, a precise theoretical prediction of the slope is a challenging and fundamental task. In this contribution the theoretical foundations of the pickup signal are presented in a systematic way, and we focus on a button-like pickup with circular active surface, that is the standard choice in the past. We present an exact general estimation of the zero-crossing slope and then discuss the results for ultra-short bunches. The comparison to the long-bunch case allows to achieve a deeper understanding of the features of these limiting cases as well as of the intermediate region.

AKBP 14.7 Thu 17:00 CHE/0183

Evaluation of a terahertz camera system for imaging, tomographic and diagnostic measurements at KARA — •André Schmidt[1], Stefan Funkner[1], Gudrun Niehues[1], Erik Bründermann[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

With a short bunch operation mode, the KIT electron storage ring KARA (Karlsruhe Research Accelerator) features the creation of the so-called microbunching instability, which emits bright bursts of THz radiation.

The creation of an instability provides the opportunity to study complex beams dynamics by the investigation of properties from the emitted radiation. Furthermore, the emission of bright THz radiation bears the potential for many research applications in photon science.

In this contribution, we present an evaluation of a microbolometer-based THz-camera system, which is able to operate at 50 frames/s. In this regard, first results from tomographic measurements with a standalone THz illumination source and results from diagnostic beam measurements during the short bunch operation mode at KARA are shown.

AKBP 15: New Accelerator Concepts

Time: Thursday 15:30–17:15 Location: CHE/0184

AKBP 15.1 Thu 15:30 CHE/0184

Laser Transmission in the Relativistically Induced Transparency Regime for High Performance Proton Acceleration at PW Laser Systems — •Marvin E. P. Umlandt[1,2], Tim Ziegler[1,2], Nicholas P. Dover[3,4], Ilja Göthel[1,2], Thomas Kluge[1], Chang Liu[3], Thomas Püschel[1], Milenko Vescovi[1,2], Mamiko Nishiuchi[3], Josefine Metzkes-Ng[1], Karl Zeil[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Technische Universität Dresden, Germany — [3]Kansai Photon Science Institute, QST, Japan — [4]John Adams Institute for Accelerator Science, Imperial College London, UK

Ion acceleration by laser-plasma sources promises many applications, but reaching the required beam quality parameters demands a high level of understanding and control over the interaction process. Several advanced schemes, including the Relativistically Induced Transparency (RIT) regime, have been proposed and investigated in search of a stable acceleration for proton energies beyond 100 MeV. In the RIT scheme, the absorption of the electromagnetic laser field by the target and the generated plasma is critical. In joint experiments at the DRACO PW (HZDR) and J-KAREN (KPSI) lasers, we use transmission diagnostics to study the onset of transparency and learn about the sensitivity of the laser input to improve the process's robustness. Using ultra-short pulses on thin solid density foil targets, we observe high performance proton beams in an expanded foil case. Our analysis of the effects on the transmission and its correlation with the acceleration performance indicates changes in the plasma interaction process.

AKBP 15.2 Thu 15:45 CHE/0184

Towards spin-polarised electron beams from a Laser Plasma Accelerator — •Felix Stehr[1,2], Simon Bohlen[1], Louis Helary[1], Jennifer Popp[1,2], Jenny List[1], Gudrid Moortgat-Pick[2,1], Jens

Osterhoff[1], and Kristjan Põder[1] — [1]Deutsches Electronen-Synchrotron DESY, Hamburg — [2]University of Hamburg

Polarised beams are indispensable for many experiments in particle, atomic and nuclear physics where spin-dependent processes are to be studied. Unlike RF accelerators, the accelerating fields in Laser-Plasma-Accelerators (LPA) are not limited by material breakdown. LPAs can create beams of tens to hundreds of MeV in only a millimeter, making them a promising alternative to conventional accelerators.

The LEAP (Laser Electron Acceleration with Polarisation) project at DESY aims to generate and measure spin-polarised electron beams from a compact LPA for the first time. The generation of spin-polarised beams from an LPA relies on a pre-polarised plasma source, where hydrogen halide molecules are dissociated by a circularly polarised UV laser pulse. The dissociation of an HCl gas target requires a laser pulse with a wavelength of about 200 nm, which has to be synchronised with the LPA driver laser, as the depolarisation of the electrons in the gas occurs in the sub-nanosecond range. Therefore, the UV pulse will be generated by cascaded second harmonic generation of the fundamental 800 nm LPA driver pulse. This contribution will discuss the physics of spin-polarised LPA, the experimental progress of preparing a pre-polarised plasma source for LPA and will provide an overview of the polarisation measurement within the LEAP project.

AKBP 15.3 Thu 16:00 CHE/0184

Feasibility Study of a Low Energy Laser Driven Plasma Injector for ELSA — •Michael Switka and Klaus Desch — Physikalisches Institut der Universität Bonn

The injector of the 3.2 GeV ELSA storage ring consists of a 26 MeV linear accelerator and a 1.2 GeV booster synchrotron. The advent of functional plasma-based MeV electron accelerators may raise a prospective opportunity to replace the conventional Linac, which currently delivers electron pulses of up to 16 nC at a repetition rate of 50 Hz. We conduct a feasibility study of using a plasma based injector for the booster synchrotron. For this, we improve the diagnostic capabilities of the Linac transfer beamline and the injector synchrotron to obtain and verify acceptance parameters which are to be matched to beam properties from contemporary operated laser plasma accelerator setups. Possible facility operating modes using a plasma based injector are evaluated.

AKBP 15.4 Thu 16:15 CHE/0184

Better Atomic Physics for Laser Accelerator Plasmas — •Brian Edward Marre[1], Axel Huebl[2], Rene Widera[1], Sergei Bastrakov[1], Michael Bussmann[3], Thomas Cowan[1], Ulrich Schramm[1], and Thomas Kluge[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Berkley National Lab, Berkley, USA — [3]CASUS, Görlitz, Germany

Standard atomic physics models in PIC simulation either neglect excited states, predict atomic state population in post processing only, or assume quasi-thermal plasma conditions.

This is no longer sufficient for high-intensity short-pulse laser generated plasmas, due to their non-equilibrium, transient and non-thermal plasma conditions, which are now becoming accessible in XFEL experiments at HIBEF (EuropeanXFEL), SACLA (Japan) or at MEC (LCLS/SLAC). To remedy this, we have developed a new extension for our PIC simulation framework PIConGPU to allow us to model atomic population kinetics in-situ in PIC-Simulations, in transient plasmas and without assuming any temperatures. This extension is based on a reduced atomic state model, coupled to the existing PIC-simulation and solved explicitly in time, depending on local interaction spectra and with feedback to the host simulation. This allows us to model de-/excitation and ionization of ions in transient plasma conditions, as typically encountered in laser accelerator plasmas. This new approach to atomic physics modelling will be very useful in plasma emission prediction, plasma condition probing with XFELs and laser plasma accelerator performance prediction.

AKBP 15.5 Thu 16:30 CHE/0184

Plasma Density Evolution Background to the Ion-motion Recovery in a Beam-driven Plasma-wakefield Accelerator — •Judita Beinortaite[1,2], Jonas Björklund Svensson[1], James Chappell[3], Matthew James Garland[1], Harry Jones[1], Carl A. Lindstrøm[1], Gregor Loisch[1], Felipe Peña[1,4], Sarah Schröder[1], Stephan Wesch[1], Matthew Wing[2], Jens Osterhoff[1], and Richard D'Arcy[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]University College London, London, UK — [3]University of Oxford, Oxford, UK — [4]Universität Hamburg, Hamburg, Germany

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)). The duration of this ion motion could vary with the mass of the plasma ions, thus significantly decreasing in lighter gas species. To observe this, the understanding of the background processes, such as microsecond-level plasma density evolution of different gases in a capillary, is needed. Here we present the first steps of exploring this plasma evolution.

AKBP 15.6 Thu 16:45 CHE/0184

Laser-induced breakdown of targets for Laser-ion acceleration — •Stefan Assenbaum[1,2], Constantin Bernert[1,2], Martin Rehwald[1], Karl Zeil[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden, Germany

After the interaction of ultra-short high intensity laser pulses with thin solid targets, strong electric fields within the resulting plasma can accelerate ions to energies of tens of MeV. The performance of such laser driven ion sources critically depends on the initial conditions of the target plasma at the arrival time of the driving laser pulse. Pre-pulses and pedestals in the intrinsic temporal laser contrast can cause dielectric breakdown of the target long before the arrival of the main laser pulse, causing the target to ionize and pre-expand uncontrolledly.

Here, we present a study of the laser-induced breakdown (LIB) threshold intensity of 300nm thin formvar foils as well as cryogenic solid hydrogen jets, which are both used as targets for ion accleration at the Draco laser facility at Helmholtz-Zentrum Dresden-Rossendorf. By stretching the pump laser pulse, the dependence of LIB threshold intensity on laser pulse duration is investigated. This helps to understand and model the pre-plasma formation during the rising flank of a high power laser pulse impinging on a thin dielectric target.

AKBP 15.7 Thu 17:00 CHE/0184

Laser Performance Monitoring at Centre for Advanced Laser Applications (CALA) — •Michael Bachhammer, Sonja Gerlach, Leonard Doyle, Felix Balling, Florian Schweiger, and Jörg Schreiber — Faculty of Physics, Ludwig-Maximilians-Universität München, Garching, Germany

One major interest of our research in the field of laser-driven ion acceleration is establishing a stable source of energetic ions. However, shot-to-shot fluctuations as well as long-term drifts of the PW-class Advanced Titanium Sapphire Laser ATLAS can cause instabilities and a significant degradation of the ion-beam performance. This prompted us to investigate and monitor the stability of our 1-Hz laser system. To this end, a 'Performance Report' has been implemented, which is automatically generated daily and summarizes the performance of the laser system throughout the day. This allows the detection of correlated fluctuations. The report is enabled by a Tango-Controls [1] based control system and comprises not only important laser parameters such as laser energy, spectrum and beam profile but also environmental factors like temperatures at different positions in the laser chain. In a next step we will implement diagnostics that enable more direct correlation of laser parameters with ion bunch parameters with the ultimate goal of enabling active control. This work was supported by the BMBF within project 01IS17048 and the Centre for Advanced Laser Applications.

[1] https://www.tango-controls.org/

AKBP 16: Poster

Time: Thursday 15:45–18:30 Location: HSZ OG3

AKBP 16.1 Thu 15:45 HSZ OG3

Beam-Based Characterization of a Non-Linear Injection Kicker at BESSY II — •Anny Gora, Markus Ries, Michael Abo-Bakr, Marc Dirsat, and Günther Rehm — Helmholtz-Zentrum Berlin, Germany

Top-up operation at BESSY II is performed with average injection efficiencies of 98 %. Howe- ver, the four kicker bump and the half-sine-wave septum pulser, that form the present injection system, both contribute to an injection distortion of the stored beam with an amplitude of a few millimeters for several thousand turns. A non-linear pulsed injection kicker (NLK) could be used to reduce the kicker induced distortion by a factor of approximately 30 and thus create a necessary condition for transparent injection. Studies with a NLK and optimized sextupole settings have shown that it is also possible to achieve injection efficiencies of up to 97 %. With regard to the application of the NLK for BES- SY II user operation and a possible injection method for BESSY III, the NLK was characterized beam-based and measurements and theory were reconciled.

AKBP 16.2 Thu 15:45 HSZ OG3

Spin-polarized electron beam generation in the colliding pulse injection scheme — •Zheng Gong[1], Michael Quin[1], Simon Bohlen[2], Christoph Keitel[1], Kristjan Põder[2], and Matteo Tamburini[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany

We studied the laser-wakefield acceleration of pre-polarized plasma electrons in the colliding pulse injection scheme. We found that the whole process is composed of two stages. In the first stage, the interaction between the plasma electrons and the transverse fields of the counterpropagating pulses leads to stochastic heating, which can substantially affect the longitudinal spin polarization of plasma electrons. As a result of the laser pulse collision, some plasma electrons gain a residue momentum in the longitudinal direction. The latter can result in the electrons being trapped and further accelerated by the forward-moving wakefield driven by the most intense laser pulse. The subsequent acceleration in the wakefield does not appreciably affect the longitudinal spin of the generated electron beam. Our theoretical model is supported by multi-dimensional particle-in-cell (PIC) simulations.

AKBP 16.3 Thu 15:45 HSZ OG3

Electro-stress-thermal analysis of quadrupole resonator designs — •Piotr Putek[1], Shahnam Gorgi Zadeh[2], Marc Wenskat[3], Simon Adrian[1], and Ursula van Rienen[1] — [1]Universität Rostock, Rostock, Germany — [2]CERN, Meyrin, Switzerland — [3]Hamburg, Hamburg, Germany

Exploring the fundamental properties of materials such as niobium or Nb3Sn, in terms of high-precision surface resistance measurements, is crucial for the further development of SRF technology. Quadrupole resonators (QPRs) are dedicated devices for determining superconducting materials' radio frequency properties using the so-called calorimetric measurement. Due to the electromagnetic radiation pressure (Lorentz detuning), microphoning, and geometrical deviations of cavity design uncertainties, measurements can substantially be distorted. Therefore, we address a stochastic multi-physical problem to study a significant measurement bias of the surface resistance, observed mainly for the third operating mode of the given HZB-QPR and all modes of CERN2-QPR. We explore the uncertainty quantification technique and sensitivity analysis to efficiently measure the impact of shape deformation on the QPRs' performance. The simulation results and their implication for the operational conditions of the QPR are discussed.

Founded by the German Federal Ministry for Research and Education BMBF under Contract No. 05H21HRRB1

AKBP 16.4 Thu 15:45 HSZ OG3

Design and Status of the Laser-Compton Backscattering Source at the S-DALINAC* — •Maximilian Meier, Michaela Arnold, Joachim Enders, and Norbert Pietralla — Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, Darmstadt, Germany

Laser-Compton Backscattering (LCB) provides quasi-monochromatic highly polarized beams in the X-ray and gamma-ray regimes for a variety of applications. A powerful, stable, and well synchronized laser with a high repetition rate is essential for a high-flux Laser-Compton light source with narrow energy-bandwidth. This contribution presents the design of an LCB-based X-ray source at the Superconducting DArmstadt electron LINear ACcelerator (S-DALINAC), aimed at identifying optimum conditions for LCB photon sources for nuclear-photonics applications and accelerator science. At the LCB source a highly repetitive high-power laser beam will be scattered off the electron beam of the S-DALINAC. As a first step, the X-rays from LCB will be used as a diagnostic tool for determining the electron beam energy and the energy spread of the S-DALINAC. Later, combining LCB with the S-DALINAC's operation as an Energy Recovery Linac (ERL), is expected to yield X-rays at several 10s of keV with high brilliance.

*Supported by DFG (GRK 2128 'AccelencE' and Inst163/308-1 FUGG) and HMWK (cluster project ELEMENTS, ID 500/10.006, and research cluster LOEWE 'Nuclear Photonics')

AKBP 16.5 Thu 15:45 HSZ OG3

Development of a 6 GHz Cavity BPM for the Multi-Turn ERL Operation at the S-DALINAC* — •Manuel Dutine, Michaela Arnold, Aleksandar Dimitrov, Ruben Grewe, Lars Juergensen, Norbert Pietralla, Felix Schliessmann, and Manuel Steinhorst — Institut für Kernphysik, TU Darmstadt

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

[1] M. Arnold et al., First operation of the superconducting Darmstadt linear electron accelerator as an energy recovery linac, Phys. Rev. Accel. Beams 23, 020101 (2020)

[2] F. Schliessmann et al., Realization of a multi-turn energy-recovery accelerator, Nat. Phys. (in press)

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

AKBP 16.6 Thu 15:45 HSZ OG3

Design and first tests of a fast precision high voltage divider for the CRYRING electron cooler — •Ken Ueberholz, Timo Dirkes, Volker Hannen, and Christian Weinheimer — Westfälische Wilhelms-Universität Münster, Institut für Kernphysik

High-precision experiments performed on relativistic ions in storage rings and accelerators require a small momentum distribution of the ions. At the Cryring at ESR, electron cooling is the chosen technique, which overlaps the ion beam with a nearly mono-energetic electron beam. The electrons transfer their momentum via Coulomb interactions to the ions until the ion velocity has adjusted to the electron velocity. The energy of the ions is therefore set by the accelerating voltage of the electron cooler. Consequently, a precise knowledge of the voltage is needed for high-resolution spectroscopy and further experiments. These experiments include electron-ion collision experiments where the electrons of the cooler fulfill an additional function as a target for the ions. To conduct such experiments, the cooler voltage has to be stepped from the baseline cooling voltage to values differing by up to 1 kV during intervals of about 10 ms and still needs to be measured precisely. For this purpose, a fast precision divider has been developed, capable of measuring voltages up to 20 kV within a 10 ms interval with uncertainties in the 10 ppm range. The poster will present the design and construction of the new high-voltage divider and provide first results from test and calibration measurements.

This work is supported by BMBF under contract number 05P21PMFA1.

AKBP 16.7 Thu 15:45 HSZ OG3

Measurement of ω mesons in $\sqrt{s} = 13\,\text{TeV}$ pp collisions at the LHC with ALICE — •Jens Lühder for the ALICE Germany-Collaboration — Institut für Kernphysik, Wilhelm-Klemm-Str. 9, 48149 Münster

Measurements of neutral mesons in small collision systems can serve as a baseline to understand modifications in heavy-ion collisions, where a QGP is formed. These measurements can also be used to test pQCD predictions and to constrain fragmentation functions as well as parton distribution functions. Furthermore, a precise knowledge of the ω-meson production improves the measurement of direct photons, as photons produced in ω meson decays represent the third largest contribution of decay photon background.

This poster presents the invariant cross section of the ω-meson in pp collisions at a center-of-mass energy of $\sqrt{s} = 13\,\text{TeV}$ measured by ALICE via its dominant decay channel $\omega \to \pi^+\pi^-\pi^0$. While charged pions can directly be measured by the ALICE central barrel tracking detectors, neutral pions are reconstructed using their decay channel into two photons. This reconstruction is realized with several complementary methods using the ALICE calorimeters as well as the central barrel tracking detectors. The combined result covers an unprecedented p_T range with competitive statistical and systematic uncertainties.

AKBP 16.8 Thu 15:45 HSZ OG3

Aufbau und Inbetriebnahme eines optische Quellpunkt-Abbildungssystem für den BESSY II Booster — •Pauline Ahmels — Helmholtz-Zentrum Berlin

Das Ziel des Aufbaus ist die Messung der Elektronstrahlgröße im Booster. Dafür wird die Annahme getroffen, dass bei dem vorherrschenden Injecktor-Energielevel von 50 MeV bis 2GeV, die gestrahlten Photonen die Elektronenpakete darstellen.

Die Beamline besteht aus mehreren verstellbaren Linsen und Spiegeln und einer CCD-Kamera zur Messung der Normalverteilung der Photonen. Problemstellung ist, einen idealen Arbeitspunkt zu finden, wobei nach hoher Intensität und geringer Strahlgröße optimiert wird. Weiterhin soll dieser Zustand reproduzierbar sein.

Auf dem optischen Tisch steht noch eine Diode zur Messung der Bündellänge. Diese muss sehr genau und stabil getroffen, was mit Hilfe einem automatisierten Feedback-System realisiert wird.

AKBP 16.9 Thu 15:45 HSZ OG3

Characterization of an All-Optical Streak Camera (AOSC) by ultrashort laser pulses — •Lina Wübbena, Marc Osenberg, Michael Stumpf, and Georg Pretzler — Institute of Laser- and Plasmaphysics, University Düsseldorf

For experiments with two or more ultra-short particle or photon beams the mutual timing is crucial. In this poster we present an all-optical streak camera which is based on optical Kerr gating. The speciality of the setup is that it operates with single-shot measurements thus allowing shot-to shot jitter monitoring, for example. On our poster we will present a series of characterization experiments with sub-10-fs laser pulses. These experiments prove that the device's best temporal resolution is in the 10-fs regime, with a total time frame in the picosecond range which can be tuned by the angle of the gating beam in respect to the signal beam. We will also discuss various applications of this new technique.

AKBP 16.10 Thu 15:45 HSZ OG3

Characterization and optimization of laser-generated THz beam for THz based streaking — •Matthias Nabinger[1], Michael Johannes Nasse[1], Christina Widmann[1], Zoltan Ollmann[2], Erik Bründermann[1], and Anke-Susanne Müller[1] — [1]Karlsruher Institut für Technologie, Karlsruhe, Deutschland — [2]Universität Bern, Bern, Schweiz

At the Ferninfrarot Linac- Und Test-Experiment (FLUTE) at the Karlsruhe Institute of Technology (KIT) a new and compact method for longitudinal diagnostics of ultrashort electron bunches is being developed. For this technique, which is based on THz streaking, strong electromagnetic pulses with frequencies around 240 GHz are required. Therefore, a setup for laser-generated THz radiation using tilted-pulse-front pumping in lithium niobate was designed, delivering up to 1 microjoule of THz pulse energy with a conversion efficiency of 0.03 %.

In this contribution we study the optimization of the THz beam transport and environment.

AKBP 16.11 Thu 15:45 HSZ OG3

Investigations of two-dimensional laser polishing of niobium surfaces as a manufacturing process during the production of superconducting cavity resonators — •Florian Brockner and Dirk Lützenkirchen-Hecht — University of Wuppertal, Gauss-Str. 20, 42119 Wuppertal, Germany

Laser polishing (LP) has the potential to increase the electrical field gradients accessible in superconducting RF-cavities made of niobium, by substantially suppressing electron field emission. Thus extensive measurements were performed investigating which effects a planar LP has on the morphology and the microstructure of a niobium surface. Here we will report on a new experimental setup that allows LP under high vacuum conditions, with the capability to in-situ detect effects of the LP by measuring pressure changes, emitted electrical charges and the incident and reflected laser intensities, respectively. The change in surface properties as a result of the LP was subsequently investigated using SEM/EDX, optical profilometry and electron field emission measurements. The results show that moderate laser energies allow a cleaning of the Nb surfaces. Furthermore, local defects can be efficiently removed by LP. In addition, there is no direct relation between surface roughness and the onset fields for parasitic field emission after LP. Moreover, the orientation of individual grains within a large grain Nb sample seem to have a strong influence on the efficiency of the LP processes. This work was supported by the BMBF under grants no. 05H18PXRB1 and 05H21PXRB1.

AKBP 16.12 Thu 15:45 HSZ OG3

Recent Results from the Steady-State Microbunching Proof-of-Principle Experiment at the Metrology Light Source — •Arnold Kruschinski[1], Xiujie Deng[2], Jörg Feikes[1], Ji Li[1], Arne Hoehl[3], Roman Klein[3], and Markus Ries[1] — [1]Helmholtz-Zentrum Berlin, Berlin, Germany — [2]Tsinghua University, Beijing, China — [3]Physikalisch-Technische Bundesanstalt, Berlin, Germany

Steady-state microbunching (SSMB) has been proposed by Alex Chao and Daniel Ratner in 2010 to enable the generation of high-power coherent synchrotron radiation at an electron storage ring for wavelengths up to the extreme ultraviolet. The viability of the concept has been shown in a proof-of-principle (PoP) experiment at the Metrology Light Source (MLS) in Berlin. An enhanced detection scheme allows systematic studies of the conditions needed for the creation of microbunches within the continuing PoP experiment. It was found that the generation of coherent radiation from microbunches is favored in specific nonlinear longitudinal phase space structures, known as alpha buckets, which arise when the momentum compaction function becomes dominated by higher order terms. We present recent improvements to the experimental setup as well as newest results and their interpretation.

AKBP 16.13 Thu 15:45 HSZ OG3

Commissioning Status of the Frankfurt Neutron Source FRANZ LEBT and RFQ — •Hendrik Hähnel, Adem Ates, Christopher Wagner, Klaus Kümpel, Ulrich Ratzinger, and Holger Podlech — Institut für Angewandte Physik, Goethe Universität, Frankfurt am Main

The Frankfurt Neutron Source FRANZ will be a compact accelerator driven neutron source utilizing the $^7\text{Li}(p,n)^7\text{Be}$ reaction with a 2 MeV proton beam. Recent comissioning efforts showed succesful proton beam operation at the targeted RFQ injection energy of 60 keV up until the point of RFQ injection. The RFQ was retrofitted with new electrodes for the injection energy of 60 keV. We report on the status of comissioning of the beamline and RFQ

AKBP 16.14 Thu 15:45 HSZ OG3

Beamline Optimization for ELSA in Preparation for UHEE Flash Irradiation — •Miriam Lösgen, Daniel Elsner, Klaus Desch, Dennis Proft, and Michael Switka — Physikalisches Institut der Universität Bonn

The ELSA facility is optimized to deliver 3.2 GeV electrons to external experimental stations via slow resonance extraction. Research towards the usability of an intense ultra-high-energy electron beam (UHEE, Flash effect) for tumor cell irradiation requires an optimization of the ELSA storage ring operation mode. This includes adjustments of the extraction procedure, beam optics and extraction elements. The current status of investigation is presented.

AKBP 16.15 Thu 15:45 HSZ OG3

The Scraper System at S-DALINAC and ERL application — •M. Fischer, M. Arnold, M. Dutine, L. Jürgensen, N. Pietralla, F. Schliessmann, and D. Schneider — Institute for Nuclear Physics, Technische Universität Darmstadt, Germany

Scraper systems in particle accelerators are utilized for safely and efficiently removing undesired particles from the beam, e.g., those with too large momentum deviation or those belonging to the beam halo. They are of great importance for accelerators, in particular those with high energies and beam currents, where the risk of damage is high. In addition to the machine protection, the use of scraper systems can significantly improve the beam quality and reduce the experimental background. Also, such systems can be used for online beam diagnostics. Especially when operating an Energy Recovery Linac (ERL), it is important to prepare the beam for the return to the accelerator after the interaction with an experiment. In this contribution, we will present results of recent measurements with the High-Energy Scraper System of the S-DALINAC and give an overview on the ongoing work. This work was supported by the state of Hesse within the cluster project ELEMENTS and within the LOEWE research project Nuclear Photonics

[1] N. Pietralla, Nuclear Physics News, Vol. 28, No. 2, 4 (2018).

AKBP 16.16 Thu 15:45 HSZ OG3

EXAFS study on role of grain boundaries and phase of Nb3Sn thin films — Nils Schäfer[1], Damian Günzing[2], Nail Karabas[1], Alexey Arzumanov[1], Debora Motta Meira[3], Katharina Ollefs[2], Philipp Komissinskiy[1], Stefan Petzold[1], •Márton Major[1], Dirk Lützenkirchen-Hecht[4], Heiko Wende[2], and Lambert Alff[1] — [1]Technical University of Darmstadt, Darmstadt, Germany — [2]University of Duisburg-Essen, Duisburg, Germany — [3]Argonne National Laboratory, Lemont, IL, USA — [4]University of Wuppertal, Wuppertal, Germany

In this contribution the low-temperature synthesis of Nb_3Sn, a promising material for superconducting radio frequency (SRF) application is presented. Theoretically Nb_3Sn is superior to Nb in surface resistivity, critical temperature and critical field, but in practice the performance is lacking behind due to early quenching at low fields. Co-sputtering at low sample temperature could overcome the microstructure-related limitations due to the high kinetic energy of the sputtered particles. Extended x-ray absorption fine structure analysis and x-ray absorption spectroscopy mapping were utilized to show the improved local order and elemental homogeneity of the Nb_3Sn films. Additionally, the presence of a grain-boundary network acting as Josephson-like junctions was found. Excellent elemental homogeneity and a good grain boundary state promoted by kinetic energy was demonstrated.

Work supported by BMBF through grant Nos. 05H21RDRB1, 05H21PXRB1 and DFG via the AccelencE Research Training Group (GRK 2128).

AKBP 16.17 Thu 15:45 HSZ OG3

Hydrodynamic plasma simulations of discharge capillary waveguides at FLASHForward for high-repetition-rate plasma-wakefield acceleration — •Advait Kanekar, G. Boyle, M. J. Garland, H. Jones, G. Loisch, S. M. Mewes, T. Parikh, S. Schröder, M. Thévenet, S. Wesch, J. Osterhoff, and R. D'Arcy — Deutsches Elektronen-Synchrotron (DESY)

Plasma-wakefield accelerators provide acceleration gradients several orders of magnitude larger than conventional accelerators, representing a promising technology for reducing the footprint of future particle accelerators. The luminosity in colliders and the brilliance in free-electron lasers scales with the repetition rate at which the accelerator operates. Therefore, high repetition rate is an important parameter to consider when developing plasma-based accelerators for these applications. FLASHForward is a beam-driven plasma-accelerator experiment at DESY that is unique in the field due to its ability to explore and develop concepts for MHz-repetition-rate operation. The capability to support such high repetition rates is strongly influenced by the functionality of the plasma source. Crucial physics effects including gas refill time and temporal evolution of 3D plasma profiles are in part determined by the cell geometry and gas/discharge properties. In this talk, 2D axisymmetric hydrodynamic plasma simulations of plasma cell designs are presented and compared. Through this a better understanding of current plasma-source designs and hints at how designs may be optimised in the future are revealed.

AKBP 17: Instrumentation III

Time: Thursday 17:30–18:45 Location: CHE/0183

AKBP 17.1 Thu 17:30 CHE/0183

Tracing Ionoacoustic Modulations of Broad Energy Distributions — •Alexander Prasselsperger, Felix Balling, Hans-Peter Wieser, Julia Liese, Anna K. Schmidt, Florian Schweiger, Ina Hofrichter, Katia Parodi, and Jörg Schreiber — LMU München, Fakultät für Physik - Medizinische Physik, Am Coulombwall 1, 85748, Garching

Modern laser-plasma based ion accelerators challenge particle detectors with very high beam intensities, strong EMP emission and tens of Hz repetition rates. This calls for new detector types for characterising ion-bunch characteristics. A first step towards this ambition is the ion-bunch energy acoustic tracing (I-BEAT) detector which measures the ionoacoustic signal generated by the energy deposition of energy-selected ion bunches in a water reservoir to reconstruct the incident energy spectrum [1]. Here we propose a new detector concept which expands the I-BEAT approach to arbitrary ion spectra by tracing ionoacoustic modulations of broad energy distributions (TIMBRE). By inserting modulator foils into the water reservoir the deposited energy distribution and the ionoacoustic wave are modulated which allows to reconstruct the ion spectrum on-line by measuring these modulations. The detector is placed within centimetre range behind the laser target to collect most of the accelerated particles. It inherently is EMP and saturation resistant and allows re-usability as the water reservoir does not suffer from major radiation damage. A minimum sensitivity to ion fluences of $\approx 10^4$ $protons/mm^2/bunch$ is predicted.

[1] D. Haffa et al. Sci. Rep. 9 (2019) 6714

AKBP 17.2 Thu 17:45 CHE/0183

Acoustic Measurement of the Energy Deposition of Heavy Ions in Water at 4°C — •Anna-Katharina Schmidt, Julia Liese, Alexander Prasselsperger, Felix Balling, Sonja Gerlach, Martin Speicher, Walter Assmann, and Jörg Schreiber — LMU München, Fakultät für Physik - Medizinische Physik, Am Coulombwall 1, 85748 Garching

Energy deposition of ions in water leads to the emission of a pressure, i.e. ionoacoustic wave. It is commonly described in the thermoacoustic approximation, that is, localized heating and volume change is considered as prime cause of the wave. If this was true, no pressure wave is expected at 4°C, which was indeed observed after localized absorption of light. Contrary, when initiated by protons, this minimum is shifted to significantly higher temperatures of around 4.5°C, hinting towards an additional, non-thermal excitation mechanism that has not yet been understood and is referred to as "charge effect" in the literature [1]. We want to investigate this effect, which as of today lacks an explanation, experimentally for femto-second laser induced water plasmas and heavy ions with higher charge than protons for the first time by measuring the polarity change of the pressure wave around the water anomaly at 4°C. Understanding the non-thermal effects has potential implications for completely new measurement principles, could open up new insights into the fast, pre-thermal processes and even help classifying the relevance of mechanically induced radiation damage.This work is supported by GSI-LMU F&E cooperation LMSCH2025.

[1] R. Lahmann et al. Astroparticle Physics 65 (2015): 69-79.

AKBP 17.3 Thu 18:00 CHE/0183

Characterization of low-density gas targets for wake driven plasma field using high harmonics — •Piet Leyendecker, Marc Osenberg, Dirk Hemmers, Bastian Hagmeister, and Georg Pretzler — Institute of Laser- and Plasmaphysics, University Düsseldorf

Low-density gas jets are a crucial part for wake driven plasma accelerators. Measuring the spatial and temporal density profile is challenging with common methods. Fortunately, the used gases have high and varying absorption rates in the XUV. Using high harmonics, we can

detect the absorption for different wavelengths simultaneously. This method allows to determine the gas density even for hydrogen and helium down to the $10^{17} cm^{-3}$ regime. In this talk we will discuss the setup and challenges for this rarely used method, and we show actual results.

AKBP 17.4 Thu 18:15 CHE/0183

Time-Resolved Interferometric Measurement of Ultrasound Pulses in Water — •Julia Liese, Anna-Katharina Schmidt, Alexander Prasselsperger, Jens Hartmann, and Jörg Schreiber — LMU München, Fakultät für Physik - Medizinische Physik, Am Coulombwall 1, 85748 Garching

Current development in laser-driven ion acceleration demands for reliable techniques for ion beam monitoring. The ultra-short and intense ion bunches with a broad spread in energy are a challenge for conventional beam detectors. Our group recently presented a new approach for online detection of laser-accelerated ions referred to as Ion-Bunch Energy Acoustic Tracing (I-BEAT) [1]. This method is based on measuring the pressure pulse induced by ions stopping in water with piezoelectric transducers. Here, we investigate an optical method based on measurements of the refractive index change associated with the pressure pulse by femtosecond laser pulse probing. In contrast to transducer measurements, we can thus study the volume of the pressure pulse origin directly. To this end, an interferometric setup was tested in first experiments with ultrasound pulses generated by a piezoelectric transducer. Experimental results show temporally resolved images of the ultrasound pulse and reveal characteristics of the ultrasound pulse in agreement with theory. Within an ongoing project funded by the DFG (491853809), the pressure waves originating from laser-accelerated ions will be investigated optically to facilitate new insights into the fast dynamics of ion energy deposition.
[1] D. Haffa et al., Sci. Rep. 9 (2019), 6714.

AKBP 17.5 Thu 18:30 CHE/0183

Analysis of Real Materials for the RF Window of a GHz Transition Radiation Monitor — •Stephan Klaproth[1,2], Herbert De Gersem[2], and Andreas Penirschke[1] — [1]Technische Hochschule Mittelhessen, Friedberg, Hessen — [2]TU Darmstadt, Darmstadt, Hessen

State of the art measurement devices for longitudinal beam profiles typically include Feschenko monitors, Fast Faraday Cups, and field monitors. A novel approach of a GHz diffraction radiation monitor is able to non-destructively measure the longitudinal charge distribution of each micro-bunch within a bunch-train of a heavy ion beam. In this contribution, we compare several vacuum-grade, dielectric materials for the monitor's rf window aiming at signals as strong and well distinguishable as possible with beam energies of $\beta = 0.05$ to 0.75. To achieve this, numerical field simulations were performed with CST Particle Studio® to investigate the influence of different window materials on the signal strength.

AKBP 18: Beam Dynamics II

Time: Thursday 17:30–18:45 Location: CHE/0184

AKBP 18.1 Thu 17:30 CHE/0184

beam dynamics simulation and optimization of an electron beam for magnetic bunch compressor commissioning at PITZ — •Ekkachai Kongmon, Prach Boonpornprasert, Xiangkun Li, Mikhail Krasilnikov, Frank Stephan, Namra Aftab, Dima Dmytriiev, Grygorii Vashchenko, Georgi Georgiev, Christopher Richard, Anne Oppelt, and Matthias Gross — Deutsches Elektronen-Synchrotron DESY, Platanenallee 6, 15738, Zeuthen, Germany

A THz free electron laser (FEL) prototype has been developed at the Photo Injector Test Facility at DESY in Zeuthen (PITZ) for obtaining high intensity radiation for THz-pump-X-ray-probe experiments at the European XFEL. In this development, a magnetic chicane was recently installed to enhance the THz FEL performance. The aim of this study was to investigate the beam dynamics in the chicane for finding the optimum machine parameters for an electron beam transportation in the experiment. The simulation was performed via ASTRA software using a 3-dimensional magnetic field of the chicane simulated with CST-EM Studio. Furthermore, the influences of the Coherent Synchrotron Radiation (CSR) on the electron beam were studied by using the OCELOT code. The simulated results indicate the possibility of obtaining on-axis trajectory and zero-momentum dispersion of the compressed beam. The commissioning results are also reported in this presentation.

AKBP 18.2 Thu 17:45 CHE/0184

Measurement of emittance and spatial coherence for low intensity electron beams — •Benat Alberdi-Esuain — Helmholtz-Zentrum Berlin, 12489 Berlin — Humboldt-Universität zu Berlin, 12489 Berlin

The SRF-Photoinjector is a superconducting linear electron accelerator currently being commissioned in Helmholtz-Zentrum Berlin. It is able to provide a very broad range of beam parameters, which enables applications of the injector that go beyond its original operation purpose as an ERL technology demonstrator. The ultra-short bunch length, high repetition rate and low achievable emittances make the SRF Photoinjector an ideal candidate for Ultrafast Electron Diffraction (UED) and direct imaging experiments with the aim of imaging biological molecules in gas or liquid solutions. The first stage of the development of UED capabilities in HZB consists of a static UED experiment to prove that the spatial resolution required for UED experiments can be achieved. To monitor the performance of the experiment the diagnostics of transverse beam parameters is necessary, which is challenging to do with traditional techniques given the small emittances and low bunch charges. In this work we present the results of the measurement of transverse normalized emittance and spatial coherence length with appropriate methods for UED experimental conditions. The experiments were carried out at the UED user facility in KAERI, in South Korea, with the goal of developing the capabilities for beam monitoring for when the SRF Photoinjector in HZB becomes operational.

AKBP 18.3 Thu 18:00 CHE/0184

Influence of the Complex Filling Patterns on the Results of the Transverse Beam Size Measurements with the Interferometric Technique — •Irma Shmidt, Ji-Gwang Hwang, Gregor Schiwietz, and Andreas Jankowiak — Helmholtz-Zentrum Berlin

The transverse size of the electron beam in a storage ring can be measured using the synchrotron radiation of a bending magnet. Due to the diffraction limit, many facilities exploit beam size monitors in the X-ray regime. On the other hand, the visible part of the emitted radiation delivers spatial information via an interference pattern after passing through a double slit. Assuming a Gaussian beam distribution the size of the beam can be easily obtained with an analytical formula. If this assumption is not fulfilled, the calculated beam shape will vary from the real distribution. This can appear for instance in case of exotic beam optics settings or complicated filling patterns, that are widely used in modern storage-ring-based light sources. Influence of the additional electron distribution with larger emittance on the measurement of the transverse size of the multi-bunch train with the usual interferometric method will be discussed in this presentation.

AKBP 18.4 Thu 18:15 CHE/0184

Investigations of TRIBs in BESSY III design lattices — •Michael Etienne Arlandoo — Helmholtz-Zentrum Berlin — Humboldt-Universität zu Berlin

At HZB's BESSY II and PTB's Metrology Light Source (MLS), resonances and islands in transverse phase space are exploited in a special operation mode usually referred to as Transverse Resonance Island Buckets (TRIBs). This mode provides a second stable orbit well separated from the main orbit and one of its applications in photon science is the ultra-fast switching of the helicity of circularly polarized light pulses. In the context of the conceptual design study of BESSY III, investigations have already started to study the feasibility of the implementation of this special optics mode in the MBA lattice candidates. Here, we present some studies, fundamental and applied, regarding the implementation of TRIBs in the context of BESSY III lattice design.

AKBP 18.5 Thu 18:30 CHE/0184

Turn-by-turn Measurements of the Energy Spread at

Negative Momentum Compaction Factor at KARA — •Christian Goffing[1], Erik Bründermann[1], Michele Caselle[1], Stefan Funkner[1], Gudrun Niehues[1], Marvin-Dennis Noll[1], Meghana Patil[1], Patrick Schreiber[1], Johannes Steinmann[1], Anke-Susanne Müller[1], Giovanni Paternoster[2], Maurizio Boscardin[2], and Matteo Centis Vignali[2] — [1]KIT, Karlsruhe, Germany — [2]FBK, Trento, Italy

The Karlsruhe Research Accelerator, the storage ring KARA at KIT, allows short electron bunch operation with positive as well as negative momentum compaction factor. For both cases, the beam dynamics are studied. Using the KALYPSO (KArlsruhe Linear arraY detector for MHz rePetition rate SpectrOscopy) linear array, based on TI-LGAD, the horizontal intensity distribution of the emitted visible part of the synchrotron radiation is measured at a 5-degree port of a bending magnet on a turn-by-turn time scale. Because the measurement is located at a dispersive section, the dynamics of the energy spread can be studied by measuring the horizontal bunch profile. The acquisition rate at MHz-frequencies and the low-charge sensitivity of the line camera allow the investigation of the microbunching instability. This contribution presents the results of the bunch profile measurements performed at positive and negative momentum compaction factor.

AKBP 19: Members' Assembly

Time: Thursday 19:00–20:00 Location: CHE/0091

All members of the Working Group on Accelerator Physics are invited to participate.