Working Group on Accelerator Physics
Arbeitskreis Beschleunigerphysik (AKBP)

Kurt Aulenbacher
Institut für Kernphysik
Universität Mainz
Becherweg 45
55099 Mainz
aulenbac@kph.uni-mainz.de

Overview of Sessions

(Lecture halls AKBP-H13 and AKBP-H14; Poster P)

Invited talks of the joint symposium Plasma Induced Accelerators (SYPA)

See SYPA for the full program of the symposium.

SYPA 1.1	Wed	11:00–11:30	Audimax	**Laser-driven ion acceleration -20 years of research: applications and prospect-** — •Markus Roth
SYPA 1.2	Wed	11:30–12:00	Audimax	**Laser-plasma ion accelerators for radio-biological research** — •Karl Zeil
SYPA 1.3	Wed	12:00–12:30	Audimax	**Hybrid plasma accelerators towards higher-quality electron beams** — •S. Karsch, M. Foerster, A. Döpp, M. Gilljohann, J. Götzfried, K. v. Grafenstein, F. Haberstroh, J. Wenz, S. Corde, O. Kononenko, B. Hidding, T. Heinemann, T. Kurz, J. Couperus-Cabadag, U. Schramm, A. Debus, A. Martinez de la Ossa

Sessions

AKBP 1.1–1.6	Mon	14:00–15:30	AKBP-H13	**New Accelerator Concepts 1**
AKBP 2.1–2.5	Mon	14:00–15:15	AKBP-H14	**Radiofrequency Systems 1**
AKBP 3.1–3.7	Mon	16:00–17:45	AKBP-H13	**Diagnostics, Control and Instrumentation 1**
AKBP 4.1–4.6	Mon	16:00–17:30	AKBP-H14	**Radiation Generation and Applications**
AKBP 5.1–5.6	Tue	14:00–15:30	AKBP-H13	**Hadron Accelerators – New Devices and Techniques**
AKBP 6.1–6.6	Tue	14:00–15:30	AKBP-H14	**Beam Dynamics 1**
AKBP 7.1–7.6	Tue	16:00–17:30	AKBP-H13	**Particle Sources**
AKBP 8.1–8.6	Tue	16:00–17:30	AKBP-H14	**Radiofrequency Systems 2 – Superconductivity**
AKBP 9.1–9.6	Wed	14:00–15:30	AKBP-H13	**Diagnostics, Control, Modeling, Modern IT Applications**
AKBP 10.1–10.5	Wed	14:00–15:15	AKBP-H14	**Electron Accelerators and FEL's**
AKBP 11.1–11.7	Wed	16:00–17:45	AKBP-H13	**Beam Dynamics 2**
AKBP 12.1–12.6	Wed	16:00–17:30	AKBP-H14	**New Accelerator Concepts 2**
AKBP 13.1–13.7	Thu	14:00–15:45	AKBP-H13	**Diagnostics, Control and Instrumentation 2**
AKBP 14.1–14.7	Thu	16:00–17:30	P	**Posters**
AKBP 15	Thu	18:00–19:00	AKBP-MV	**Members' Assembly**

Members' Assembly of the Working Group on Accelerator Physics

Thursday 18:00–19:00 AKBP-MV

AKBP 1: New Accelerator Concepts 1

Time: Monday 14:00–15:30 Location: AKBP-H13

AKBP 1.1 Mon 14:00 AKBP-H13

A new transport line for transverse gradient undulator experiments at the JETI laser plasma accelerator in Jena — •Maisui Ning, Samira Fatehi, Axel Bernhard, Robert Rossmanith, and Anke-susanne Müller — KIT,Karlsruhe,Germany

In this contribution, we describe the current status of the ongoing upgrade of an electron beam transport line employed in the successful experimental demonstration of capture and matching of a laser plasma-accelerated beam at the JETI laser facility, University of Jena. This upgrade aims at adapting the beam line to the higher electron energies achievable with the new JETI laser and enabling an experimental proof of the transverse gradient undulator concept to be performed in a collaboration between KIT and the University of Jena. The upgrade comprises the redesign of both the beam transport line magnets and of the beam optics, which will be described and discussed in detail. This work is supported by the BMBF project 05K19VKA PlasmaFEL (Federal Ministry of Education and Research).

AKBP 1.2 Mon 14:15 AKBP-H13

Synthetic shadowgrams of laser-plasma accelerators computed by a PIConGPU in-situ plugin — •Finn-Ole Carstens[1,2], Klaus Steiniger[1], Richard Pausch[1], Yen-Yu Chang[1], Susanne Schöbel[1], Jurjen Couperus[1], Arie Irman[1], Max Lehmann[1,2], Rene Widera[1], Michael Bussmann[1,3], Ulrich Schramm[1,2], Thomas Cowan[1,2], and Alexander Debus[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden — [3]Center for Advanced Systems Understanding Görlitz

Few-cycle shadowgraphy is a valuable diagnostic for laser-plasma accelerators to obtain 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 an initial version of the synthetic shadowgraphy diagnostic, the probe laser is propagated through the plasma using PIConGPU, and then extracted and propagated onto a virtual CCD using a post-processing code based on Fourier optics. However, the latter step requires 3D-FFTs, which results in performance and scaling limitations in large-scale simulations. To circumvent this, we develop an in-situ plugin for PIConGPU, in which we extract the probe laser slice-wise to obtain the synthetic shadowgrams during the simulation without post-processing.

In this talk, we present the development of the PIConGPU plugin and show preliminary results of synthetic shadowgrams for laser and plasma wakefield accelerators.

AKBP 1.3 Mon 14:30 AKBP-H13

Simulating hybrid laser-plasma wakefield accelerators using PIConGPU — •R. Pausch[1], J. P. Couperus[1], S. Schöbel[1,2], S. Bastrakov[1], Y.-Y. Chang[1], S. Corde[4], H. Ding[5,6], A. Döpp[5,6], F. M. Foester[5], M. Gilljohann[4,5,6], F. Haberstroh[5], T. Heinemann[7,8], B. Hidding[8], S. Karsch[5,6], A. Koehler[1], O. Kononenko[4], A. Knetsch[4], T. Kurz[1,2], A. Martines de las Ossa[7], A. Nutter[8], G. Raj[4], K. Steiniger[1], U. Schramm[1,2], P. Ufer[1,2], R. Widera[1], A. Irman[1], M. Bussmann[3,1], and A. Debus[1] — [1]HZDR — [2]TU Dresden — [3]CASUS — [4]LOA — [5]LMU — [6]MPQ — [7]DESY — [8]University of Strathclyde

An LPWFA accelerator uses electrons from a laser wakefield accelerator stage to drive a second plasma wakefield accelerator stage. This approach makes it possible to downscale PWFAs from kilometer-sized facilities to tabletop experiments and makes the improved beam quality of PWFAs available to LWFA laboratories. The experimental realization of the hybrid accelerator at HZDR was accompanied by a simulation campaign with the fully GPU accelerated, 3D3V particle-in-cell PIConGPU. Running simulations on modern GPUs allowed reducing simulation time while modeling different experimental settings in a fully three-dimensional setup. The latter enabled studying the influence of tilted shock fronts and few-cycle probes, among others. In this talk, we will not only introduce the general concept but also discuss some of the recent results obtained using particle-in-cell simulations. Moreover, the technical innovations in PIConGPU that have enabled these new types of simulations will also be briefly addressed.

AKBP 1.4 Mon 14:45 AKBP-H13

Investigation of beam quality enhancement with tailored down-ramp profiles in laser wakefield accelerators using particle-in-cell simulations — •Jonas Günzl[1,2], Richard Pausch[1], Sergei Bastrakov[1], Michael Bussmann[3,1], Yen-Yu Chang[1], Jurjen Couperus[1], Arie Irman[1], Susanne Schöbel[1,2], Klaus Steiniger[1], René Widera[1], Ulrich Schramm[1,2], and Alexander Debus[1] — [1]HZDR — [2]TU Dresden — [3]CASUS

Electrons from laser wakefield accelerators (LWFA) can be ultrashort and quasi-monoenergetic. They have the potential to be an ideal source for advanced light sources or beam drivers for hybrid laser-plasma wakefield accelerators (LPWFA). A wide variety of injection methods have already been developed to produce high-quality LWFA electrons. However, such high-quality electron bunches may degrade upon exiting the LWFA stage.

This poster addresses quality-preserving methods for extracting electron beams from laser wakefield accelerators by adjusting the plasma density of the down ramp. By modeling different gas profiles with the fully relativistic particle-in-cell code PIConGPU, not only the final beam quality but also all relevant physical effects can be studied in detail. This allows not only to find an optimal quality-preserving down ramp but also to study the influence of changes in laser focus position on beam properties during extraction.

AKBP 1.5 Mon 15:00 AKBP-H13

Progress toward high overall energy efficiency in a beam-driven plasma-wakefield accelerator stage — •Felipe Peña[1,2], Judita Beinortaite[1,3], Jonas Björklund Svensson[1], Lewis Boulton[1,4,5], Gregory Boyle[1], Jonathan Christopher Wood[1], Brian Foster[6], James Matthew Garland[1], Pau Gonzalez[1,2], Carl A. Lindstrøm[1], Gregor Loisch[1], Sarah Schröder[1], Stephan Wesch[1], Jens Osterhoff[1], and Richard D'Arcy[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg, Germany — [2]Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [3]University College London, London, United Kingdom — [4]SUPA, Department of Physics, University of Strathclyde, Glasgow, United Kingdom — [5]The Cockcroft Institute, Daresbury, United Kingdom — [6]John Adams Institute, University of Oxford, UK

Beam-driven plasma-wakefield acceleration has the potential to reduce the building cost of accelerator facilities, with large accelerating fields that are orders of magnitude greater than radio-frequency cavities. Sustaining strong decelerating fields for the driver and strong accelerating fields for the trailing bunch across long plasma stages will be key to demonstrating high energy efficiency in this scheme. We present preliminary experimental results towards high overall energy efficiency performed at the FLASHForward plasma-accelerator facility at DESY.

AKBP 1.6 Mon 15:15 AKBP-H13

Experimental results of Trojan horse injection in a hybrid LPWFA — •Patrick Ufer[1,2], Alastair Nutter[3], Yen-Yu Chang[1], Sébastien Corde[4], Jurjen Couperus Cabadağ[1], Alexander Debus[1], Andreas Döpp[5], Thomas Heinemann[3,6], Bernhard Hidding[3], Max Gilljohann[4,5], Stefan Karsch[5], Alexander Köhler[1], Olena Kononenko[4], Richard Pausch[1], Susanne Schöbel[1,2], Alberto Martinez de la Ossa[6], Ulrich Schramm[1,2], and Arie Irman[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Technische Universität Dresden, Germany — [3]University of Strathclyde, Glasgow, UK — [4]LOA, ENSTA ParisTech, CNRS, Ecole Polytechnique, Université Paris-Saclay, France — [5]Ludwig-Maximilians-Universität München, Germany — [6]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

A hybrid (LPWFA) plasma accelerator combines the two schemes of plasma acceleration, using a laser (LWFA) and an electron beam (PWFA) to drive the plasma wave, with the goal to combine the advantages of both methods. This concept allows studies of PWFA-physics in compact setups as well as generating high-quality electron beams to fulfill the demands of secondary light sources like FELs. We present experimental results from hybrid plasma accelerators using plasma cathode injection also known as Trojan horse injection. A short-pulsed laser is used as the injector in the second stage of the accelerator propagating perpendicular to the electron beam. When timed such, that injector laser and the first cavity of the wakefield overlap, the creation of low-energy-spread witness beams have been observed.

AKBP 2: Radiofrequency Systems 1

Time: Monday 14:00–15:15 Location: AKBP-H14

AKBP 2.1 Mon 14:00 AKBP-H14

Goubau-Line Set Up for Bench Testing Impedance of IVU32 Components — •Paul Volz — Helmholtz-Zentrum Berlin — Johannes Gutenberg Universität Mainz

The worldwide first 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. It will deliver radiation in the soft X-ray range to several beamlines. 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, as unforeseen heating of components could have catastrophic consequences. 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 transverse electric field resembling that of a charged particle beam out to a certain radial distance. A concept optimized for bench testing IVUE32-components will be discussed, microwave simulations will be presented, and progress towards a test bench prototype will be shown.

AKBP 2.2 Mon 14:15 AKBP-H14

Commissioning of a new B-Mapping System for SRF Cavity Performance Tests — •Jonas C. Wolff[1,2], Wolfgang C. A. Hillert[1,2], Andre Gössel[1], Detlef Reschke[1], Lea Steder[1], and Lennart Trelle[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — [2]Universität Hamburg - Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Magnetic flux trapped in the Niobium bulk material of superconducting radio frequency (SRF) cavities degrades their quality factor and the accelerating gradient. The sensitivity for flux trapping is mainly determined by the treatment and the geometry of the cavity as well as the Niobium grain size and orientation. To potentially improve the flux expulsion characteristics of SRF cavities and hence the efficiency of future accelerator facilities, further studies of the trapping behavior are essential. For this purpose a so-called B-mapping system to monitor the magnetic flux along the outer cavity surface of 1.3 GHz TESLA-Type single-cell SRF cavities has been developed and is currently in the commissioning phase at DESY. Contrary to similar approaches, this system digitizes the sensor signals already inside of the cryostat to extensively reduce the number of required cable feedthroughs. Furthermore, the signal-to-noise ratio and consequently the measuring sensitivity can be enhanced by shorter analog signal lines, less thermal noise and the Mu-metal shielding of the cryostat. In this contribution the design, required signal processing circuitry for the calibration as well as first performance test results of the B-mapping system are presented in detail.

AKBP 2.3 Mon 14:30 AKBP-H14

Upgrading the Booster Synchrotron RF with a Solid State Amplifier — •Michael Switka, Frank Frommberger, Klaus Desch, Philipp Hänisch, and Daniel Elsner — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

The DESY-type RF resonator of the ELSA facility's 1.6 GeV synchrotron has been powered by a conventional klystron amplifier since its early days in 1967. The setup was modified to serve the ELSA stretcher ring as booster synchrotron in 1987, but the RF infrastructure was barely altered. As repairs of the reliable, but antiquated RF source become foreseeingly impossible due to the lack of spare part availability, the replacement of the klystron amplifier chain in favour of a state-of-the-art solid state amplifier is carried out. We present the current status of the replacement procedure and first results.

AKBP 2.4 Mon 14:45 AKBP-H14

Upgrade of the 25 MW RF Station for the Linear Accelerator LINAC2 at ELSA — •Dennis Proft, Klaus Desch, and Daniel Elsner — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

At the Electron Stretcher Facility ELSA the first acceleration stage consists of a 3 GHz traveling wave linear accelerator. It was powered by a 25 MW pulsed high power klystron amplifier. After a failure of the focusing solenoid the required output power could not be reached anymore resulting in an inadvertently complete overhaul of the RF station.

The new RF station has successfully been operating since the beginning of 2021. In this contribution I will present the new setup including the new parameter monitoring capabilities as well as the lessons learned in RF engineering as an accelerator physicist.

AKBP 2.5 Mon 15:00 AKBP-H14

Update of the Quadrupole Resonator for SRF R&D at DESY — •Ricardo Monroy-Villa[1,2], Detlef Reschke[1], Andrea Muhs[1], Jan-Hendrik Thie[1], Maike Röhling[1], Martin Lemke[1], Wolfgang Hillert[2], Marc Wenskat[2], Wolfgang Ackermann[3], Sebastian Keckert[4], and Oliver Kugeler[4] — [1]Deutsches Elektronen-Synchrotron, Hamburg, Germany — [2]Universität Hamburg, Institut für Experimentalphysik, Hamburg, Germany — [3]Institut für Teilchenbeschleunigung und Elektromagnetische Felder, Darmstadt, Germany — [4]Helmholtz-Zentrum Berlin, Berlin, Germany

Superconducting radiofrequency (RF) cavities made of Nb have been shown to achieve their theoretical limit, while only minor improvements using standard procedures are expected in operation. Hence, new treatments and materials that tailor the RF surface are mandatory. Since theoretical models of the RF behavior of such surfaces do not fully describe the observations, we lack guidance for future research and identifying important parameters. To provide experimental data to improve these theoretical models and study material properties, and their impact on the RF performance, a dedicated sample test system is needed. The quadrupole resonator (QPR) is such a test cavity and allows for investigating samples of 7.5 cm in diameter under superconducting-cavity-like conditions in a wide parameter space defined by temperature, magnetic field and frequency. In this work we report the status of the QPR being developed as a joint project of Universität Hamburg and DESY.

AKBP 3: Diagnostics, Control and Instrumentation 1

Time: Monday 16:00–17:45 Location: AKBP-H13

AKBP 3.1 Mon 16:00 AKBP-H13

Simulation of the effect of corrugated structures on the longitudinal beam dynamics at KARA — •Sebastian Maier[1], Miriam Brosi[2], Akira Mochihashi[2], Michael J. Nasse[2], Markus Schwarz[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

Two parallel corrugated plates will be installed at the KIT storage ring KARA (KArlsruhe Research Accelerator). This impedance manipulation structure will be used to study and eventually control the beam dynamics and the emitted coherent synchrotron radiation (CSR). In this contribution, we present the influence of the parameters of the structure on its impedance and simulation results obtained with the Vlasov-Fokker-Planck solver Inovesa showing the impedance impact of different corrugated structures on the CSR power. This work is supported by the DFG project 431704792 in the ANR-DFG collaboration project ULTRASYNC. Sebastian Maier acknowledges the support by the DFG-funded Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology"

AKBP 3.2 Mon 16:15 AKBP-H13

Implementing electro-optical detection methods for far-field THz detection at DELTA — •Vivek Vijayan, Arne Held, Shaukat Khan, Carsten Mai, and Boris Sawadski — Center for Synchrotron Radiation (DELTA), TU Dortmund, Dortmund, Ger-

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At the DELTA storage ring at TU Dortmund University, ultrashort THz pulses are coherently emitted by the interaction of a single electron bunch with an ultrashort laser pulse. This THz radiation can be used as a diagnostics tool for the laser-electron interaction as well as for studies of general storage ring parameters and electron beam dynamics. Currently, different thermal and photoconductive THz detectors are used at DELTA, which are sensitive to the intensity of the radiation. Detection schemes using the electro-optic effect enable a quantitative detection of the THz pulse shape with sub-picosecond resolution and are sensitive to both amplitude and phase information of the signal. An experimental setup based on electro-optical detection is currently being implemented at DELTA and its progress is discussed.

AKBP 3.3 Mon 16:30 AKBP-H13

Picosecond time-resolved solvated electron evolution triggered within laser-accelerated proton tracks in liquid water — •Alexander Prasselsperger[1], Mark Coughlan[2], Nicole Breslin[2], Mark Yeung[2], Christine Arthur[2], Hannah Donnelly[2], Steven White[2], Masoud Afshari[1], Martin Speicher[1], Rong Yang[1], Balder Villagomez-Bernabe[3], Frederick J. Currell[3], Jörg Schreiber[1], and Brendan Dromey[2] — [1]Fakultät für Physik, Ludwig-Maximilians-Universität München — [2]School of Mathematics and Physics, Queens University Belfast — [3]School of Chemistry, The University of Manchester

The processes initiating ion track formation in matter are fundamental to radiation science. Gauduel et al. (2010) proposed the dissipation time within these tracks to scale with the local energy density. This especially applies to state-of-the-art laser-based accelerators where peak currents of $> 10^6 A$ have been reached. Utilising a laser-ion-accelerator, we were able to demonstrate these delaying mechanisms for the first time (PRL 2021). By picking a synchronized chirped probe from the main driving laser pulse of a TNSA scheme, we implemented a single-shot $1.12ps$ time-resolved transmission imaging setup. Probing the interactions of accelerated proton bunches in H_2O with this setting revealed the temporal evolution of the solvated electron density over $1ns$ covering both, the x-ray and the ion bunch interactions emitted during the TNSA process. The absolute timing reference provided by the x-rays enabled the measurement of a $> 20ps$ delay in solvation time when compared to models presuming lower local energy density.

AKBP 3.4 Mon 16:45 AKBP-H13

Slow control loop to stabilize the RF power of the FLUTE electron gun — •Marvin Noll, Nigel Smale, Andreas Böhm, Igor Kriznar, Marcel Schuh, Robert Ruprecht, John Jelonnek, and Anke-Susanne Müller — Karlsruher Institut für Technologie (KIT), Karlsruhe, Germany

The linear accelerator FLUTE (Far Infrared Linac and Test Experiment) at KIT serves as a test facility for accelerator research and for the generation of ultra-intense coherent THz radiation.

To achieve stable THz photon energy and optimal beam trajectory, the energy of the electrons emitted from the RF photo-injector must be stable. The accelerating voltage of the RF cavity has been shown to be a significant influencing factor. Here, we report on the development of a slow closed-loop feedback system to stabilize the RF power and thus the accelerating voltage in the RF photo-injector cavity. With this closed-loop feedback system the relative standard deviation of the RF power in the cavity can be improved by 8.5 %.

AKBP 3.5 Mon 17:00 AKBP-H13

A streak camera for measuring the temporal correlation of two pulses in the few-fs range — •Marc Osenberg, Michael Stumpf, and Georg Pretzler — Institut für Laser- und Plasmaphysik, Heinrich-Heine-Universität Düsseldorf

For experiments with fs-scale XFEL or electron pulses together with laser pulses, the mutual timing is crucial. In this talk we present a novel all-optical method for obtaining such timing results with fs resolution. We developed a setup based on a Kerr gate which was elongated into a 1D structure along which single-shot temporal resolution is created within a tunable time window in the ps-range like in a streak camera. The setup requires an ultrashort laser pulse as the gate and an arbitrary light pulse as the signal. In the talk, we will present the setup and its characteristics and will discuss different ways to use it for various signal types, like OTR in the case of an electron pulse, for example.

AKBP 3.6 Mon 17:15 AKBP-H13

Laser alignment of internal components of the linear accelerator FLUTE — •Jens Schäfer, Bastian Härer, Matthias Nabinger, Michael J. Nasse, Robert Ruprecht, Nigel J. Smale, and Anke-Susanne Müller — KIT, Karlsruhe, Deutschland

The linac-based test facility FLUTE (Ferninfrarot Linac- Und Test Experiment) at KIT will be used to study novel accelerator technology and provide intense THz pulses. The latest experiments involving a Split Ring Resonator for longitudinal bunch profile measurements pushed the requirements on alignment precision of several hardware components down to the sub-milimeter level. In order to achieve the required precision, the low energy section of FLUTE was opened and an alignment laser was installed to mark mechanical axis of the machine. This presentation addresses details and challenges of this laser-based alignment process. Jens Schäfer acknowledges the support by the Doctoral School KSETA (Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology).

AKBP 3.7 Mon 17:30 AKBP-H13

Development of an electro-optical longitudinal bunch profile monitor at KARA towards a beam diagnostics tool for FCC-ee — •Micha Reissig[1], Erik Bründermann[1], Stefan Funkner[1], Bastian Härer[1], Gudrun Niehues[1], Meghana M. Patil[2], Christina Widmann[2], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

The Karlsruhe Research Accelerator (KARA) at KIT features an electro-optical (EO) near-field diagnostics setup to conduct turn-by-turn longitudinal bunch profile measurements in the storage ring using electro-optical spectral decoding (EOSD). Within the Future Circular Collider Innovation Study (FCCIS) an EO monitor using the same technique is being conceived to measure the longitudinal profile and center-of-charge of the bunches in the future electron-positron collider FCC-ee. This contribution provides an overview of the EO near-field diagnostics at KARA and discusses the development and its challenges towards an effective beam diagnostics concept for the FCC-ee.

M. R. and M. M. P. acknowledge the support by the DFG-funded Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology". C. W. achnowledges funding by BMBF contract number 05K19VKD.

AKBP 4: Radiation Generation and Applications

Time: Monday 16:00–17:30 Location: AKBP-H14

AKBP 4.1 Mon 16:00 AKBP-H14

Status of Thomson Backscattering Investigation at MESA — •Christoph Lorey[1] and Atoosa Meseck[1,2] — [1]Johannes Gutenberg Universität, Mainz, Germany — [2]Helmholtz Zentrum Berlin, Berlin, Germany

At the Johannes Gutenberg University (JGU) in Mainz, a new accelerator is currently under construction in order to deliver electron beams of up to 155 MeV to two experiments. The Mainz Energy-recovering Superconducting Accelerator (MESA) will offer two modes of operation, one of which is an energy-recovering (ER) mode. 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. The aim of this work under the GraKo AccelencE is to provide a concept and comprehensive analysis of the merit and practical feasibility of a Thomson backscattering source at MESA under consideration of beam polarization and transversal effects. In this presentation, an overview and first results of our semi analytical approach to calculate various Thomson back scattering light source scenarios at MESA will be given.

AKBP 4.2 Mon 16:15 AKBP-H14

A novel compact x-ray source for microbeam radiation ther-

apy — •Christoph Matejcek[2,4], Johanna Winter[1,2,3], Jan J. Wilkens[2,3], Stefan Bartzsch[1,2], and Kurt Aulenbacher[4,5,6] — [1]Helmholtz Zentrum München GmbH, Neuherberg — [2]Technische Universität München, School of Medicine und Klinikum rechts der Isar, München — [3]Technische Universität München, Physik-Department, Garching — [4]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [5]elmholtz Institut Mainz — [6]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Microbeam radiation therapy is a new preclinical concept in radiation oncology. Due to the use of 25 to 100 um wide and a few 100 um separated planar x-ray beams, high peak dose values are crucial. Additionally, low photon energy of a few 100 keV and high dose rates are demanded to suppress blurring of the dose pattern. To produce such x-rays with a preclinical prototype of a compact microbeam x-ray tube, a new electron source with a fast rotating target for x-ray production is under development. The source will deliver electrons with a kinetic energy of 300 keV and a current of 300 mA on a strongly eccentric 0.05 mm x 30 mm focal spot. Transport of these high currents at low energy will be challenging concerning space charge forces. Furthermore, the realization of the focal spot, a good beam quality, and a low emittance are major topics. An additional application of the x-ray source can be phase contrast imaging. The final design of the x-ray source and the results of the electron tracking simulations will be presented.

AKBP 4.3 Mon 16:30 AKBP-H14

Spectro-temporal properties of CHG radiation — •Arjun Radha Krishnan, Benedikt Büsing, Arne Held, Hubertus Kaiser, Shaukat Khan, Carsten Mai, and Vivek Vijayan — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

The short-pulse facility at the 1.5-GeV synchrotron light source DELTA, operated by the TU Dortmund University, currently employs the Coherent Harmonic Generation (CHG) technique to generate ultrashort coherent radiation pulses in the vacuum ultraviolet spectrum. This is achieved via a laser-induced electron energy modulation and a subsequent dispersive section which converts it to a corresponding density modulation. The spectro-temporal properties of the CHG pulses can be manipulated by the chirp of the seed laser pulses and the strength of the dispersive chicane (R56).

CHG spectra for 400 nm, 266 nm and 200 nm were recorded under variation of R56 and laser chirp of the 800 nm seed laser pulses. The measured spectra and results of numerical simulations to reconstruct the spectra will be presented.

AKBP 4.4 Mon 16:45 AKBP-H14

Utilizing the ELSA accelerator for evaluation of the FLASH effect with ultra-high energy electrons — •Alexandra Wald[1], Manuela Denz[2], Klaus Desch[1], Daniel Elsner[1], Stephan Garbe[2], Frank Giordano[2], Carsten Herskind[3], and Dennis Proft[1] — [1]Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn — [2]Universitätsklinikum Bonn — [3]Medizinische Fakultät Mannheim, Universität Heidelberg

At the electron accelerator facility ELSA electrons with a final energy from 0.8GeV up to 3.2GeV can be accelerated and stored. These electrons can be extracted to one of the two detectors for hadron physics experiments as well as to a detector testing site, where the primary electron beam is directly provided for internal and external users.

In cooperation with the University Hospital Bonn (UKB), this test beam line will be used to carry out basic experiments on irradiation of biological cells to evaluate the FLASH-effect using ultra-high energy electron (UHEE) beams. This requires short and intense electron pulses in the order of microseconds to be extracted via a newly designed extraction mode from the storage ring. Furthermore, new diagnostics are planned to be set up to verify the reproducibility of overall charge and position of the electron pulses.

The first steps towards systematic irradiation of cells for measuring the relative biological effectiveness will be presented.

*Funded by the TRA Matter and TRA Life and Health (University of Bonn) as part of the Excellence Strategy of the federal and state governments.

AKBP 4.5 Mon 17:00 AKBP-H14

Status of the Laser-Compton backscattering Source at the S-DALINAC* — •Maximilian Meier, Michaela Arnold, Joachim Enders, and Norbert Pietralla — Institut für Kernphysik, TU Darmstadt, Germany

Compton scattering of a Laser beam off an ultra-relativistic electron beam ($E_e \gg m_e c^2$) through a restricted aperture can provide quasi-monochromatic highly polarized X-ray or gamma-ray beams for a variety of applications [1]. Highest energies of the scattered photons are obtained for photon-scattering angles of 180°, i. e., backscattering. 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. A project at TU Darmstadt foresees to synchronize a highly repetitive high-power laser with the Superconducting DArmstadt electron LINear ACcelerator (S-DALINAC [2]), capable of running in energy recovery mode [3], to realize a Laser-Compton backscattering (LCB) source with photon beam energies up to 180 keV. An overview over the design concept of the LCB Source at the S-DALINAC will be given, simulations on the layout and the estimated output will be presented.

[1] C. Bemporad et al., Phys. Rev. 138, B1546 (1965)
[2] N. Pietralla, Nucl. Phys. News 28(2), 4 (2018)
[3] M. Arnold et al., Phys. Rev. Accel. Beams 23, 020101(2020)

*Supported through the state of Hesse (LOEWE research cluster Nuclear Photonics) and DFG through GRK 2128 *AccelencE*.

AKBP 4.6 Mon 17:15 AKBP-H14

Investigation of irradiation damage in Ti6Al4V via high-energy x-ray diffraction — •Tim Lengler[1,4], Dieter Lott[1], Gudrid Moortgat-Pick[2,4], Sabine Riemann[3], Andrey Ushakov[2], Emad Maawad[1], Andreas Stark[1], and Peter Staron[1] — [1]Institute of Material Research, Helmholz-Zentrum Hereon, 21502 Geesthacht, Germany — [2]Deutsches Elektronen-Synchrotron (DESY), 22607 Hamburg, Germany — [3]Deutsches Elektronen-Synchrotron (DESY), 15738 Zeuthen, Germany — [4]Universität Hamburg, 20148 Hamburg, Germany

For the positron source of the International Linear Collider (ILC) the choice of a suitable target material is crucial. The material must resist the high cyclical load, which is induced in the target while creating about 10^{14} positrons per second. One of the most promising targets consists of the titanium alloy Ti6Al4V. For realistic feasibility tests, several thin plates of the alloy were subjected to an intense electron beam at the Mainzer Microtron.

In this work, we report about the investigation of the irradiated material via High Energy X-Ray Diffraction (HEXRD) at the Hereon endstation of the P07 beamline at DESY. Changes in the crystallographic properties and phases due to the treatment were examined since these may compromise the longevity of the material. Additional tests were performed, where the thermal component of the cyclical load was realized in a quenching dilatometer and again examined via HEXRD. The results will be discussed here.

AKBP 5: Hadron Accelerators – New Devices and Techniques

Time: Tuesday 14:00–15:30 Location: AKBP-H13

AKBP 5.1 Tue 14:00 AKBP-H13

Optimization of proton spin coherence time with three families of sextupoles at prototype EDM ring — •Aleksei Melnikov for the JEDI-Collaboration — Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russia

The JEDI collaboration aims to perform a direct measurement of the electric dipole moment (EDM) of protons. For this purpose the prototype storage ring (PTR) is designed. It will allow for feasibility studies of many experimental techniques that are needed to perform an ultimate precision storage ring EDM measurement.

A prototype EDM ring is an intermediate step before building the final storage ring to demonstrate sufficient beam lifetime and SCT (Spin Coherence Time) in a pure electrostatic ring as well as in storage ring with combined electric and magnetic bending elements.

The current lattice of such a ring has fourfold symmetry and operates in a frozen spin mode with weak vertical focusing. Two existing

sextupole families are used to increase the spin coherence time. In the current design the maximum value of proton SCT is about 100 s. The proposed way to increase SCT is to insert the third family of sextupoles to adjust chromaticities and second order momentum compaction factor to any desired value. All three families should be located at points with different ratios of optical functions and dispersion. A racetrack option of the prototype ring with strong focusing is proposed to fulfill this requirement. The adjustment of the third sextupole family helped to increase proton SCT up to 1000 s.

AKBP 5.2 Tue 14:15 AKBP-H13

Simulations of Beam Dynamics and Beam Lifetime for the Prototype EDM Storage Ring — •Saad Siddique[1,2,3], Jörg Pretz[1,2], and Andreas Lehrach[1,2] for the JEDI-Collaboration — [1]Institute of Nuclear Physics Forschungszentrum Jülich Germany — [2]Institute 3B Physikzentrum RWTH University Aachen Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH Darmstadt Germany

The matter-antimatter asymmetry 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 an accelerator. To increase the experimental precision step by step and to study systematic effects, the EDM experiment can be performed within three stages: the magnetic ring COSY, a prototype EDM ring and finally 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. The simulations of beam dynamics of prototype EDM ring with different lattices are performed to optimize the beam lifetime and to minimize the systematic effects. The preliminary design of prototype EDM ring helped to estimate the beam losses by using analytical formulas. Further investigations on enhancing EDM measurement precision and reducing systematic effects are in process.

AKBP 5.3 Tue 14:30 AKBP-H13

Spin tune response to vertical orbit correction at COSY — •Artem Saleev for the JEDI-Collaboration — University of Ferrara, Ferrara, Italy

Searches of electric dipole moments (EDM) of charged particles in pure magnetic rings, such as COSY, or electrostatic and hybrid magnetic-electric storage rings, planned in the future, require new methods to disentangle the EDM signal from the large background produced by magnetic dipole moments. In these experiments, the sources of systematic background are in-plane magnetic fields. It is important to distinguish the origins of the in-plane magnetic fields, which could be produced intentionally by vertical orbit correction to keep the beam on a closed path, or unintentionally due to the alignment errors of the magnets. We propose to use the method of spin tune mapping to determine the relative importance of the two origins. Such method was successfully tested at COSY when local vertical orbit correction was applied.

AKBP 5.4 Tue 14:45 AKBP-H13

Modeling of the optical setting for the measurement of the electric dipole moment of protons at cooler synchrotron COSY — •Mariia Manerova[1,2,3], Andreas Lehrach[1,2], and Maximilian Vitz[1,2] for the JEDI-Collaboration — [1]Institute for Nuclear Physics IV, FZ Jülich, Germany — [2]III. Physikalishes Institut B, RWTH Aachen University, Aachen, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Electric Dipole Moments (EDMs) of elementary particles are considered to be an excellent probe of physics beyond the Standard Model (SM). They violate parity and time reversal, while through the CPT-theorem also breaking the CP-symmetry. This mechanism may explain the matter-antimatter asymmetry in the universe.

The JEDI (Jülich Electric Dipole moment Investigations) collaboration uses storage rings to measure the EDMs of protons and deuterons with high precision. In a preliminary experiment, measurements of the EDM for deuterons were performed at COSY (COoler SYnchrotron) in Jülich. One important prerequisite for these experiments was the modelling of the optical settings and the beam orbit in COSY to analyze the EDM measurement results.

Further steps include measurements of the proton EDM at COSY. The planned experiments on the proton spin coherence time at COSY will therefore be accompanied by simulation calculations with Bmad. The talk focuses on the model calculation of the beam orbit and optical functions of COSY and compares those to the measurement to achieve a significantly better model description of COSY.

AKBP 5.5 Tue 15:00 AKBP-H13

Laser cooling of bunched relativistic ion beams at the FAIR SIS100 — •Danyal Winters[1], Michael Bussmann[2,3], Daniel Kiefer[4], Volker Hannen[5], Thomas Kühl[1,6], Sebastian Klammes[1,4], Benedikt Langfeld[4], Ulrich Schramm[2,7], Mathias Siebold[2], Peter Spiller[1], Thomas Stöhlker[1,6,8], Ken Ueberholz[5], and Thomas Walther[4,9] — [1]GSI Darmstadt — [2]HZDR Dresden — [3]CASUS Görlitz — [4]TU-Darmstadt — [5]Uni Münster — [6]HI-Jena — [7]TU-Dresden — [8]Uni-Jena — [9]HFHF Frankfurt am Main

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

AKBP 5.6 Tue 15:15 AKBP-H13

Dispersive coupling in low-energy electron cooling at CRYRING@ESR — •Claude Krantz[1], Zoran Andelkovic[1], Christina Dimopoulou[1], Frank Herfurth[1], Regina Hess[1], Michael Lestinsky[1], Esther B. Menz[1], Konstantin Mohr[1,2], Wilfried Nörtershäuser[2], Andreas Reiter[1], Jon Rossbach[1], Rodolfo Sánchez[1], and Gleb Vorobjev[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt — [2]Institut für Kernphysik, TU Darmstadt, 64298 Darmstadt

The heavy-ion storage ring CRYRING has been recommissioned at GSI/FAIR. Downstream of the ESR, the ring can serve as a platform for precision experiments on highly-charged ions produced by the full GSI accelerator chain. In a complementary standalone mode, CRYRING can operate with weakly or singly charged ions provided by a local low-energy injector. Especially singly-charged ions are often limited to storage velocities of the order of $10^{-2}\,c$, not to exceed the maximum rigidity allowed by the bending magnets. Electron cooling of so slow beams is challenged by dispersive coupling effects which lead to entanglement of the horizontal and longitudinal cooling rates. If dispersion in the cooler section is significant, over-optimisation of cooling for one degree of freedom can lead to cancellation or even reversal of the cooling force in the other dimension. At CRYRING@ESR, the effect was found during preparation of a singly-charged beam of Mg^+ for an atomic-physics experiment, where unwanted heating of longitudinal ion motion by the electron cooler was observed. Dedicated machine studies on dispersive electron cooling at CRYRING are planned.

AKBP 6: Beam Dynamics 1

Time: Tuesday 14:00–15:30 Location: AKBP-H14

AKBP 6.1 Tue 14:00 AKBP-H14

Realization of the Multi-Turn Energy Recovery Mode at S-DALINAC* — •Felix Schliessmann, Michaela Arnold, Manuel Dutine, Marco Fischer, Ruben Grewe, Lars Jürgensen, Norbert Pietralla, Manuel Steinhorst, Lennart Stobbe, and Simon Weih — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

The electron accelerator S-DALINAC at TU Darmstadt was successfully operated in the multi-turn energy recovery mode. Here, electrons were accelerated twice in the same LINAC and were decelerated after-

wards in the very same LINAC just as often. During the deceleration in the LINAC, the electrons restore energy to the cavities, which can then be used to accelerate subsequent electrons. This principle enables a saving in acceleration power and an increase in the beam current, respectively. Therefore, this mode is a very promising basis for future accelerator facilities.
The multi-turn energy recovery mode is particularly challenging since several beams are superimposed in the same beamlines and the so-called phase slippage has to be taken into account in advance via beam dynamic simulations.
The content of this contribution covers the essential beam dynamics simulations, the setup of the multi-turn energy recovery mode and measured results.
*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 6.2 Tue 14:15 AKBP-H14

Beam dynamics aspects of RF separated beams at the CERN M2 secondary beam line — •Fabian Metzger[1,2], Johannes Bernhard[1], Markus Brugger[1], Lau Gatignon[3], Alexander Gerbershagen[1], Bernhard Ketzer[2], and Silvia Schuh-Erhard[1] — [1]CERN, Meyrin, Switzerland — [2]Helmholtz-Institut für Strahlen- und Kernphysik, University of Bonn, Bonn, Germany — [3]University of Lancaster, Lancaster, United Kingdom

Radio-frequency (RF) separation is a technique to enrich the content of a certain particle type within a beam consisting of different species at the same momentum. This technique exploits the different velocities of the different particle types due to their mass difference. The successor of the COMPASS experiment, AMBER, is aiming in its phase 2 for high-intensity, high-purity kaon and antiproton beams which cannot be delivered with the currently existing M2 beam line.

This contribution introduces the principle of RF separation and explains its dependence on different parameters of beam optics and hardware. We discuss particle production rates, beamline transmission principles for specific lines studied, as well as limitations for beam intensity and purity imposed by beam line acceptance and radiation protection. Different beam optics settings have been examined, providing either focused or parallel beams inside the RF cavities. We will discuss the separation and transmission capabilities of the different optics settings for given characteristics of the RF cavities and show preliminary results of the potential purity and intensity of the RF separated beam.

AKBP 6.3 Tue 14:30 AKBP-H14

Layout of the interaction region for electron proton collisions in the LHeC collider — •Tiziana von Witzleben[1] and Bernhard Holzer[2] — [1]CERN, RWTH Aachen — [2]CERN

The LHeC (Large Hadron electron Collider) project studies the design of a future electron-proton collider at CERN. Deep inelastic scattering collisions between electrons and protons will run in parallel to the standard HL-LHC (High Luminosity-LHC) operation. The electrons would be accelerated to a kinetic energy of 50 GeV in a tangential energy recovery linear collider and brought into collision with one of the 7 TeV proton beams of the HL-LHC. The design luminosity of the order of $10^{34} cm^{-2} s^{-1}$ requires strong focusing of both beams in a compact interaction region. The e-p collisions would take place simultaneously with the HL-LHC experiments ATLAS, CMS and LHCb, and possibly alternating with the ALICE experiment in a novel design under study. This, therefore, requires a highly precise beam optics for three beams: the two proton beams of the HL-LHC, as well as the additional electron beam. Initial design studies of the optics and orbits of the three beams have been performed to provide estimates for the aperture and gradients of the required magnets. Different strengths of the mini-beta quadrupoles, as well as different magnetic separations schemes have been modelled and the results will be presented.

AKBP 6.4 Tue 14:45 AKBP-H14

Dynamic aperture studies for the Transfer Line from FLUTE to cSTART — •Jens Schäfer, Bastian Härer, Alexander Papash, Robert Ruprecht, Marcel Schuh, and Anke-Susanne Müller — KIT, Karlsruhe, Deutschland

The compact Storage ring for Accelerator Research and Technology cSTART is a test facility for the application of novel acceleration techniques and diagnostics. The goal is to demonstrate storing the beam of a Laser Plasma Accelerator (LPA) for the first time in a compact circular accelerator. Before installing a LPA, the linear accelerator FLUTE will serve as a full energy injector for the compact storage ring, providing stable bunches with a length of a few femtoseconds. The transport of the bunches from FLUTE to the storage ring requires a transfer line which includes horizontal, vertical and coupled deflections which leads to coupling of the dynamics in the two transverse planes. In order to conserve the ultra-short bunch length during the transport, the transfer line relies on special optics which invokes high and negative dispersion. This contribution presents dynamic aperture studies based on six-dimensional tracking through the lattice of the transfer line.

AKBP 6.5 Tue 15:00 AKBP-H14

Optimization Studies of Simulated THz Radiation at FLUTE — •Chenran Xu[1], Erik Bründermann[1], Andrea Santamaria Garcia[2], Jens Schäfer[1], Markus Schwarz[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

The linac-based test facility FLUTE (Ferninfrarot Linac Und Test Experiment) at KIT will be used to study novel accelerator technology and provide intense THz pulses. In this paper, we present start-to-end simulation studies of FLUTE with different bunch charge and photoinjector laser properties. We employ a parallel optimization algorithm for different operation points of FLUTE to find optimized accelerator settings for the electron bunch length and generation of intense THz radiation.

C. Xu and J. Schäfer acknowledge the support by the Doctoral School KSETA "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 6.6 Tue 15:15 AKBP-H14

Status of the MESA injector — •Simon Friederich — Institut für Kernphysik, JGU Mainz, Deutschland

The MESA injection system will produce the spin-polarized beam for the upcoming accelerator MESA at the JGU Mainz. The photoemission electron source (STEAM) will deliver 150uA of spin-polarized electrons from GaAs-based photocathodes for the P2 experiment. Afterwards the low-energy beam transportation system (MELBA) can rotate the spin using two Wien filters and a solenoid for polarisation measurements and to compensate for the spin precision in MESA. A chopper and buncher system prepares the phase space for the first acceleration in the normal-conducting pre-booster MAMBO. An additional separation line is designed for polarisation measurements and high bunch charge injection. The overview talk will cover the basic principles and the design of the MESA injector. Particle-in-Cell simulation results with the simulation code OPAL and the status of the build-up in the LINAC tunnel at the "Institut für Kernphysik" will be presented.

AKBP 7: Particle Sources

Time: Tuesday 16:00–17:30 Location: AKBP-H13

AKBP 7.1 Tue 16:00 AKBP-H13

photocathodes for SRF photoinjectors: exploring GaN and multi-alkali options — •Chen Wang[1,2], Sonal Mistry[1], Julius Kühn[1], Thorsten Kamps[1,4], Qun Jin[2], Michael Vogel[2], Xin Jiang[2], Jana Schaber[3], Rong Xiang[3], and Andre Arnold[3] — [1]HZB, Berlin, Germany — [2]University of Siegen, Institute for Materials Engineering, Siegen, Germany — [3]HZDR, Dresden, Germany — [4]Humboldt University of Berlin, Berlin, Germany

Gallium nitride and multi-alkali antimonide photocathodes are two candidates for semiconducting photocathode materials for SRF photoinjectors. GaN photocathode has high thermal stability and can provides high QE under UV light, while multi-alkali antimonide provides high QE at visible wavelengths. The crystal quality and doping level of magnetron sputtered Mg doped GaN films are studied at University of Siegen, since they could affect the diffusion length of excited electrons and the electron affinity of the photocathode, which are re-

lated to QE of the sample. SEM and XRD methods are used to study the influence of substrates and sputtering conditions on crystal quality and structure. Doping levels are analyzed by hall effect measurement. QE measurements are conducted at HZDR and also in in-situ measurement chamber. Na-K-Sb photocathodes films are deposited on molybdenum substrates in UHV preparation chamber at HZB. The influence of deposition parameters is studied in order to optimize the growth procedure and to achieve better stability at higher temperature, which could benefit operational lifetime. The chemical compositions of films are analyzed by XPS, and then QE measurements are performed.

AKBP 7.2 Tue 16:15 AKBP-H13

Improved Performance of GaAs photo-cathodes activated by Cs, O_2 and Li — •Maximilian Herbert, Joachim Enders, Markus Engart, Yuliya Fritzsche, Julian Schulze, and Vincent Wende — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstraße 9, 64289 Darmstadt

Photo-cathodes based on GaAs can be characterized mainly by two parameters: quantum efficiency η and lifetime τ. The former describes the photo-emission efficiency, while the latter is an indicator for the decay of the surface layer required to achieve negative electron affinity (NEA) for GaAs. This layer typically consists of Cs in combination with an oxidant. Previous studies have suggested that the addition of Li to this layer can significantly increase cathode performance by boosting both η and τ. At the Institut für Kernphysik of the Technische Universität Darmstadt, a dedicated test stand for Photo-Cathode Activation, Test and Cleaning using atomic-Hydrogen (Photo-CATCH) is available for GaAs photocathode research. This contribution will present recent performance studies at Photo-CATCH of bulk GaAs photo-cathodes activated with Cs, O_2, and Li in comparison to activations using Cs and O_2 only. An increase in τ by a factor of 7 has been observed without significant reduction of η for Li-enhanced activation.

AKBP 7.3 Tue 16:30 AKBP-H13

High bunch charges in the second injection beamline of MESA — •Anatolii Kalamaiko, Kurt Aulenbacher, Monika Dehn, and Simon Friederich — Institut für Kernphysik, Universität Mainz, Germany

MESA (Mainz Energy-recovering Superconducting Accelerator) is an accelerator with two laser-driven electron sources operating at 100 kV which is under construction at the Johannes Gutenberg University in Mainz. One of the sources is the unpolarized electron source MIST (MESA Injector Source Two) producing a bunch charge of up to 7.7 pC. This source and a Mott polarimeter will be arranged on the same height above the MESA injector main beamline. Thus, it is necessary to develop a parallel shifting beamline to transport electron beam from the source MIST to the main MESA beamline. Besides, the designed beamline should allow to transport beam from the electron source STEAM to the Mott polarimeter. This report is dedicated to the design of the separation beamline which transports and compresses highly charged electron bunches from the electron source MIST to the first acceleration section of MESA.

AKBP 7.4 Tue 16:45 AKBP-H13

RF Synchronised Semiconductor Laser System for MESA — •Rakshya Thapa — Institut für Kernphysik, Mainz, Germany

The Institute of Nuclear Physics at Johannes Gutenberg University Mainz is building the Mainz Energy-Recovering Superconducting Accelerator (MESA) facility. It is planned to operate with both polarised and unpolarised high average current electron beams. For both, a semiconductor photocathode is planned to be employed. To generate a polarised and unpolarised electron beam, laser beams with an emission wavelength in different regimes are used. However, to perform diagnostics that meet realistic beam dynamics, high bunch charge ($\approx$1 pC) and low average beam power (1-10 W) is deemed vital. This can be achieved by the reduction of duty cycle. Therefore, a commercial TAIKO laser, which can be RF synchronised, with emission wavelength 400.8 nm was chosen and its temporal structure was investigated at the chopper system of the Mainz Microtron (MAMI) facility. Results concerning the electron bunch shape and its dependence on operating parameters like laser-pulse energy, electron bunch charge and down conversion factor will be reported.

AKBP 7.5 Tue 17:00 AKBP-H13

Preparation for plasma lens prototype as an optical matching device for the ILC — •Niclas Hamann[1], Manuel Formela[1], Gudrid Moortgat-Pick[2], Klaus Flöttman[3], and Gregor Loisch[3] — [1]Uni Hamburg — [2]Uni Hamburg/DESY — [3]DESY

The ILC is an ambitious project. Therefore many challenges have to be overcome. One of these is to optimize the positron yield after the source. In this talk a new concept for capturing is proposed, the plasma lens. The latest simulations will be shown and preparation tests for an upcoming prototype will also be discussed. The preparation tests are done with a plasma cell designed for PITZ.

AKBP 7.6 Tue 17:15 AKBP-H13

Latest developments and performance of the FLUTE laser system — •Matthias Nabinger, Thiemo Schmelzer, Michael Johannes Nasse, Nigel Smale, Jens Schäfer, Carl Sax, and Anke-Susanne Müller — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

At the FLUTE linac-based accelerator short electron bunches are generated via a photo-injector system. The electrons are produced by laser pulses transported over several meters from the laser laboratory towards the photocathode. To ensure a controlled operation, the laser parameters are monitored and adjusted at several positions. In addition to electron generation, the pulses are used to generate THz pulses for a specific diagnostic experiment. Multiple systems are used to stabilize the laser pulses for optimal use. In this contribution, the latest developments of the FLUTE laser's improved performance will be presented.

Matthias Nabinger and Thiemo Schmelzer acknowledge the support by the Doctoral School KSETA 'Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology'.

AKBP 8: Radiofrequency Systems 2 – Superconductivity

Time: Tuesday 16:00–17:30 Location: AKBP-H14

AKBP 8.1 Tue 16:00 AKBP-H14

Implementation of Nb3Sn co-sputtering for copper cavity coating — •Sara Amidi, Nils Schäfer, Márton Major, and Lambert Alff — TU Darmstadt, Darmstadt, Germany

Thin-film coatings play a crucial role in the superconducting industry. One method of depositing them on a substrate is by using the magnetron sputtering method. The aim of this project is to design a system that can deposit a superconductive coating of Nb3Sn with uniform thickness on the interior side of a copper RF cavity system with TESLA geometry. As the first step in the project, Particle in Cell Monte Carlo (PIC-MC) and Direct Simulation Monte Carlo (DSMC) methods along with the simulation of the thin film deposition using NASCAM software will be investigated. Then based on the result, the practicality of the application of the numerical methods to the RF cavity is inspected and process parameters of the experimental method are improved. However, to have a uniform film thickness across the cavity, the deposition rate needs to be adjusted and we are planning to do that with a unique design of the magnetron system. An idea would be to change the design of the magnets i.e., using a hollow cathode magnetron (HCM) or post cathode magnetron instead of a magnetic rod. In addition, the number of the cathodes and their location in the system have significant importance. Our team would like to appreciate BMBF for funding this research project.

AKBP 8.2 Tue 16:15 AKBP-H14

Determination of High-Pressure Rinsing on the Oxide-Layer Thickness and Oxygen-Concentration of Niobium Samples — •Rezvan Ghanbari[1,2], Marc Wenskat[1,2], Wolfgang Hillert[1,2], and Detlef Reschke[2] — [1]Institute of Experimental Physics, University of Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Hamburg, Germany

This study is devoted to investigate the effect of High-Pressure Rinsing (HPR) on 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 and 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 may affect 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, on the surface of Nb samples before and after applying mid-T bake treatment via Vertical Scanning Interferometer (VSI) and used Secondary Ion Mass Spectrometry (SIMS) to obtain the interstitial oxygen concentration after the annealing. In this way, we have investigated the importance of repeating and jetting high pressure water on the surface of niobium cavities to control oxide growth and we will show the results of this study.

AKBP 8.3 Tue 16:30 AKBP-H14

Surface preparation on niobium TESLA cavities for MESA at the HIM* — •Paul Plattner, Florian Hug, and Timo Stengler — Institut für Kernphysik , Johannes Gutenberg-Universität Mainz

The Mainz Energy-Recovering Superconducting Accelerator (MESA) will be a new recirculating accelerator, which can operate in an external beam mode and an energy recovering mode. In the ERL-mode the electrons cross an internal gas-target at MAGIX and give their kinetic energy into the Superconducting Radio Frequency (SRF) system back after experimental use. The MESA cryomodules are based on ELBE-type cryomodules, which contain two 9-cell TESLA/XFEL-type cavities. In the cryomodule the superconducting cavities are cooled down to 1.8 Kelvin with liquid helium. For maintenance of the cryomodules can be used the clean room infrastructure at the Helmholtz Institute Mainz (HIM). Currently a cryomodule from the ALICE ERL at Daresbury, UK is in the process of refurbishment. So, the current progress can be shown. A superconducting 3 GHz six-cell injector cavity for the S-DALINAC was used to demonstrate that the treatment of a high pressure rinse in the clean room infrastructure at HIM was successful. * This work has been supported by DFG through the PRISMA+ cluster of excellence EXC 2118/2019. The authors acknowledge the transfer of one cryomodule to Mainz by STFC Daresbury.

AKBP 8.4 Tue 16:45 AKBP-H14

Nb_3Sn thin film synthesis for SRF application by co-sputtering — •Nils Schäfer[1], Damian Günzing[2], Nail Karabas[1], Alexey Arzumanov[1], Deborah Motta-Meira[3], Katharina Ollefs[2], Márton Major[1], Heiko Wende[2], and Lambert Alff[1] — [1]Institute of Materials Science, Advanced Thin Film Technology, Technische Universität Darmstadt, Alarich-Weiss-Str. 2, 64287 Darmstadt, Germany. — [2]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), Universityof Duisburg-Essen, 47048 Duisburg, Germany. — [3]Argonne National Laboratory, 9700 South Cass Avenue, Lemont, IL, 60439 USA.

Thin film Nb_3Sn is a promising candidate to outperform bulk Nb in next generation particle accelerators. Bulk Nb is a well elaborated material for the superconducting radio frequency (SRF) application. However, this technology has reached its physical limits. Thin film Nb_3Sn is able to push the limits or save tremendous amounts of energy during operation. Unfortunately, the possible acceleration gradients of about 90 MV/m are not reached. Local deviations of the local stoichiometry and grain boundary segregations can be a possible explanation for this. To improve the local homogeneity and grain boundary conditions, a co-sputtering process is used. Extended X-ray absorption fine structure (EXAFS), X-ray absorption spectroscopy(XAS) mappings and X-ray diffraction (XRD) are used to show different grain boundary and phase conditions. Resistance versus field and resistance versus temperature measurements demonstrate the role of grain boundary and phase of the present Nb_3Sn thin films.

AKBP 8.5 Tue 17:00 AKBP-H14

Studies on the stability of different joining methods for permanent magnets — •Simon Gaebel, Carsten Kuhn, Stefan Gottschlich, Sebastian Knaack, Laura Brandenberg, Mario Strehlke, Johannes Bahrdt, Atoosa Meseck, Jürgen Bakos, and Stefan Grimmer — Helmholtz-Zentrum-Berlin

At HZB, research is being conducted into how the supply of synchrotron light from BESSY II can be improved to enable new experimental techniques and detectors at the beamlines. There, permanent magnets are playing an increasingly important role in the construction of new multibend achromat-based particle accelerators to deflect charged particles. Another central part of this research is the development of modern permanent magnet undulators. One of the challenging areas with these is the precise assembly and placement of permanent magnets. Due to increased requirements, such as reducing the period length of an undulator, new concepts for mounting the magnets have become necessary. Properties such as fatigue strength, shear strength and in certain contexts, e.g. with in-vacuum undulators, the vacuum resistance of the connection must be investigated. For this purpose, methods have been developed to investigate the load capacity of adhesive and solder joints. The presentation shows how these are applied and what the consequences are for the application.

AKBP 8.6 Tue 17:15 AKBP-H14

HTS undulators: status and test results of prototype coils for compact FELs — •Sebastian C. Richter[1,2], Amalia Ballarino[1], Daniel Schoerling[1], Axel Bernhard[2], and Anke-Susanne Müller[2,3] — [1]CERN - 1211 Geneva 23 - Switzerland — [2]LAS, KIT, Karlsruhe, Germany — [3]IBPT, KIT, Karlsruhe, Germany

Compact free electron lasers (FELs) require short period, high-field undulators in combination with shorter accelerator structures to produce coherent light up-to X-rays. Likewise, for the production of low emittance positron beams for future linear and circular lepton colliders, like CLIC or FCC-ee, high-field damping wigglers are required. Using high-temperature superconductors (HTS) in form of coated REBCO tape conductor allows reaching higher magnetic fields and larger operating margins as compared to low-temperature superconductors, like Nb-Ti or Nb3Sn. This contribution discusses the development work done on two superconducting undulator geometries (vertical racetrack and helical) with a period length of 13 mm, as well as the status of the prototype coils. Measurement results from powering tests in LN2 of multiple vertical racetrack coils are presented, compared and discussed.

This work has been supported by the Wolfgang Gentner Program of the German Federal Ministry of Education and Research (grant no. 05E18CHA) and by the DFG-funded Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 9: Diagnostics, Control, Modeling, Modern IT Applications

Time: Wednesday 14:00–15:30 Location: AKBP-H13

AKBP 9.1 Wed 14:00 AKBP-H13

Sensitivity Analysis of Beam-influencing Parameters at the S-DALINAC Using Surrogate Models* — •Dominic Schneider, Michaela Arnold, Jonny Birkhan, Norbert Pietralla, and Felix Schliessmann — Institut für Kernphysik, TU Darmstadt, Germany

Particle accelerates are complex systems that coincide with their ideal design within the tolerances of its large number of technical components, only. Quantitative understanding of the beam dynamics and the analysis of their sensitivity to various components are challenging tasks. Machine learning methods provide a significant potential for the optimized operation of particle accelerators. In this contribution, the first 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 focus on a series of measurements performed in the injector section of the accelerator 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.

*Work supported by DFG (GRK 2128) and the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006).

AKBP 9.2 Wed 14:15 AKBP-H13

Optimization of spin-coherence time in a prototype storage ring for electric dipole moment measurements — •Rahul Shankar[1], Maximillian Vitz[2], and Paolo Lenisa[1] for the JEDI-Collaboration — [1]Università degli studi di Ferrara and INFN, Italy — [2]Institute of Nuclear Physics, Forshungszentrum Jülich, Germany

The JEDI experiment is dedicated to the search for the electric dipole moment (EDM) of charged particles using storage rings, which can be a very sensitive probe of physics beyond the Standard Model. In order to reach the highest possible sensitivity, a fundamental parameter to be optimized is the particles' Spin Coherence Time (SCT), i.e., the time interval within which the particles of the stored beam maintain a net polarization greater than 1/e. To identify the working conditions that maximize SCT, accurate spin-dynamics simulations with the code BMAD have been performed on the lattice of a "prototype" storage ring which uses a combination of electric and magnetic fields for bending. This talk will present the results of these simulations addressing the impact on the SCT of different factors like horizontal tune, and the electric bending field, as well as suggestions on lattice modifications to further improve its value.

AKBP 9.3 Wed 14:30 AKBP-H13

Parasitic Optimization of the Transfer Beamline Efficiency at ELSA — •Sebastian Witt, Klaus Desch, Daniel Elsner, and Dennis Proft — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

The 3.2 GeV electron accelerator ELSA consists of three acceleration stages each interconnected by tunable transfer beamlines. The steering of the electron beam through the transfer line from linear accelerator to the booster synchrotron is currently adjusted by hand, which limits a systematic optimization of the transfer efficiency.

To improve the situation, an automated optimization using the "simulated annealing" technique has been developed and integrated into the accelerator's control system. It allows for a continuous optimization without interfering with usual beamtime for experiments by utilizing the 6s off-time in between injections into the storage ring. In a simulation using the actual accelerator's settings as starting parameters, transmission rates have been increased significantly, while testing with the accelerator is still ongoing.

AKBP 9.4 Wed 14:45 AKBP-H13

Magnetic Field Characterization with Circular Scan and Multipole Moment Analysis — •Yimin Tong[1], Yuancun Nie[2], Axel Bernhard[1], and Anke-Suanne Müller[1] — [1]KIT, Karlsruhe, Germany — [2]Wuhan China

For the optimisation of an accelerator like FLUTE which aims at producing femtosecond bunches by means of a specially designed compressor chicane, it is important to take into account the detailed properties of the real and magnets in the beam dynamics simulations. A typical approach to do so is to use particle tracking through flux density maps, measured e.g. by a 3D Hall probe on a sufficiently dense 3D grid and interpolated by an appropriate integration procedure. This approach yields accurate results but can be very time consuming both, regarding the measurement and the simulation. For the FLUTE quadrupole and chicane dipole magnets, we have in addition to this method investigated the alternative approach of measuring the radial flux density component on a cylinder surface concentric with the beam axis and representing the field in the beam dynamics simulations by a set of magnet slices with the multipole components deduced from the measurement. In this contribution the calibration and measurement procedure is described and the two measurement and representation approaches are compared to each other.

This work is supported by the BMBF under grant No. 05H18VKRB1

AKBP 9.5 Wed 15:00 AKBP-H13

Injection optimization using machine learning at the Cooler Synchrotron COSY — •Awal Awal for the JEDI-Collaboration — RWTH Aachen University — GSI Helmholtzzentrum für Schwerionenforschung

In accelerators it is usually desired to have a particle beam with high intensity and small emittance. A key factor that limits the beam intensity in storage rings are 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. Machine learning methods exhibit promising algorithms to effectively tackle the challenge of optimize the IBL setup. In this research, Reinforcement Learning (RL) techniques are planned to be utilized to optimize the IBL for the Cooler Synchrotron (COSY) at Forschungszentrum Jülich (FZJ). Both simulation environment and actual data from COSY are to be used in the process of training the RL agent. 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 9.6 Wed 15:15 AKBP-H13

Microbunching Studies for FLASH2020+ Using Efficient Semi-Lagrangian Vlasov-Simulation — •Philipp Amstutz and Mathias Vogt — DESY, Hamburg, Germany

In semi-Lagrangian approaches a solution to the Vlasov-Equation is obtained by back-tracking its characteristics and subsequently evaluating the initial condition. These methods yield a smooth numerical approximation to the phase-space density (PSD), which can put them at an advantage over particle-based methods. For instance, when studying small-scale effects where the inherent stochastic noise of particle-tracking methods becomes burdensome, semi-Lagrangian schemes are a promising alternative.

In free-electron lasers the electron bunches typically exhibit an "exotic" structure in the longitudinal phase-space resembling a fine, wiggling hair-like band. Such PSDs are not efficiently captured by a regular grid, as large parts of the minimum bounding rectangle of the PSD are void and do not contribute to the dynamics of the system. We present studies of the microbunching instability for FLASH2020+ using SelaV – a semi-Lagrangian Vlasov code we developed, which employs tree-based domain decomposition to efficiently handle exotic PSDs.

AKBP 10: Electron Accelerators and FEL's

Time: Wednesday 14:00–15:15 Location: AKBP-H14

AKBP 10.1 Wed 14:00 AKBP-H14

Particle tracking study for the new laser heater at FLASH — •Dmitrii Samoilenko[1], Pardis Niknejadi[2], Christopher Gerth[2], Lucas Schaper[2], and Wolfgang Hillert[1] — [1]Institute for Experimental Physics, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, 22607 Hamburg (Germany)

The FLASH (Free electron LASer in Hamburg) facility is currently in a scheduled 9-month shutdown during which some of the upgrades planned in the FLASH2020+ project are being implemented. Among these upgrades is a laser heater which will be installed just upstream of the first bunch compressor, allowing an uncorrelated energy spread in the electron beam to be induced. Increasing energy spread makes it possible to reduce the microbunching gain through the machine and thus counteract one of the most detrimental effects for FEL operation. The amount of induced energy spread has to be carefully balanced to suppress microbunching. At the same time the total energy spread at the end of the linac, which is enhanced especially during the bunch compression, should be kept at a reasonable value not to deteriorate FEL operation. In this work, we use particle tracking simulations to (i) evaluate the performance of the laser heater in terms of induced energy spread; (ii) investigate how the energy spread evolves throughout the rest of the linac. The results are expected to be valuable also for the commissioning of the laser heater.

AKBP 10.2 Wed 14:15 AKBP-H14

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

Externally seeded Free Electron Lasers (FEL) deliver fully coherent

radiation at harmonics of the input seed laser wavelength. However, due to the lack of seed laser sources in the EUV/XUV range and at high repetition rates with sufficient peak power, the shortest wavelength and maximum repetition rate of the seeded FEL radiation are limited.

In order to utilize the full potential of superconducting RF technology being exploited in the world leading FEL facilities like FLASH at DESY and enabling bunch repetition rates in the MHz regime for seeding, an oscillator-amplifier approach is considered, where the role of the seed laser is taken by an optical cavity. A cavity tuned to 13.5 nm is used to store the seed pulse and reuse it for the seeding of bunches at MHz rate. The possibility to build up the power in the cavity starting from shot noise allows the seeding at an already short wavelength.

We present design considerations and our first simulation results for the future setup.

AKBP 10.3 Wed 14:30 AKBP-H14

Simulation for THz FEL seeding at PITZ using pre-bunched electron beams — •Georgi Georgiev[1], Prach Boonpornprasert[1], Wolfgang Hillert[2], Mikhail Krasilnikov[1], and Xiangkun Li[1] — [1]Deutsches Elektronen-Synchrotron DESY, 15738 Zeuthen, Germany — [2]University of Hamburg, 22761 Hamburg, Germany

A THz source with high power and tunability is required for pump and probe experiments at the European XFEL. One option is to use a short accelerator to drive a THz FEL, which could produce THz pulses with the same pulse train structure as the XFEL pulses. The Photo Injector Test facility at DESY in Zeuthen (PITZ) serves as the site for these developments and proof-of-principle experiments on short THz FEL are currently under preparation at this facility. To improve the stability of the THz source, FEL seeding is considered. Arrival time jitter and spectrum from pulse to pulse can be improved by FEL seeding with respect to SASE. This is demonstrated in Genesis simulation results performed with pre-bunched electron beams.

AKBP 10.4 Wed 14:45 AKBP-H14

Status of the EEHG Upgrade Project of the Short-Pulse Source at DELTA — •Benedikt Büsing, Arne Held, Hubertus Kaiser, Shaukat Khan, Carsten Mai, Arjun Radha Krishnan, and Vivek Vijayan — Center for Synchrotron Radiation (DELTA),TU Dortmund University, Dortmund, Germany

At the 1.5-GeV electron storage ring DELTA, operated by the TU Dortmund University, a short-pulse source based on the coherent harmonic generation (CHG) scheme provides ultrashort pulses in the vaccum ultraviolet regime. In this scheme a laser-electron interaction leads to microbunching within a short slice of an electron bunch which results in coherent emission of radiation. The emitted wavelength is limited to low harmonics of the laser wavelength, higher harmonics are accessible by the echo-enabled harmonic generation (EEHG) scheme, where another laser-electron interaction is added. To implement this scheme, it is necessary to modify the short-pulse source and thus about a quarter of the storage ring. The status of the upgrade project is presented.

AKBP 10.5 Wed 15:00 AKBP-H14

Recent Developments at S-DALINAC* — •M. Arnold, J. Birkhan, A. Brauch, M. Dutine, J. Enders, M. Fischer, R. Grewe, L. Jürgensen, M. Meier, N. Pietralla, F. Schliessmann, D. Schneider, M. Steinhorst, L. Stobbe, and S. Weih — Institut für Kernphysik, Technische Universität Darmstadt

The superconducting Darmstadt linear accelerator S-DALINAC is a thrice-recirculating accelerator for electrons. Besides the conventional acceleration scheme with corresponding nuclear physics experiments, the accelerator of TU Darmstadt can also be operated as an energy recovery linac (ERL) [1]. Since its establishment in 1991, the S-DALINAC was mainly developed and operated by students. The latest achievement was the successful operation as a superconducting multi-turn ERL in August 2021 [2]. Dedicated diagnostics to measure both beams in the same beamline simultaneously are in preparation or have been used for first measurements. The beam quality was improved significantly by a new capture cavity. Other projects are working on further improvements of the machine. This contribution will give an overview of the status of those projects.

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

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

*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 11: Beam Dynamics 2

Time: Wednesday 16:00–17:45 Location: AKBP-H13

AKBP 11.1 Wed 16:00 AKBP-H13

Investigation of the spin coherence time for measuring the electric dipole moment of protons in the COSY cooler synchrotron — •Daoning Gu[1,2,3], Maximilian Vitz[1,2], and Andreas Lehrach[1,2] for the JEDI-Collaboration — [1]Institute for Nuclear Physics IV , FZ Jülich, Germany — [2]III. Physikalisches Institut B, RWTH Aachen University, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Electric Dipole Moment (EDM) of a subatomic particle is predicted by the Standard Model (SM) and provides simultaneous violation of parity (P) and time reversal (T). Assuming CPT-theorem holds, an EDM is also a source of CP violation, which is needed to explain the matter-antimatter asymmetry. Measuring an EDM at a higher value than the SM prediction would therefore provide additional CP violation and would be a strong indication for physics beyond the SM.

Optimization of the Spin Coherence Time (SCT) plays a central role in storage ring EDM experiments, since a large SCT is required to achieve the statistical sensitivity for an EDM measurement. After a sufficient long SCT was achieved for deuteron beams, the JEDI-Collaboration in Jülich is preparing a similar measurement for the SCT for protons at the storage ring COSY. Many parameters indicate that for proton beams, the optimization procedure to realize long SCT is more difficult than for deuteron beams. Therefore, spin tracking simulations were performed with the software library BMAD to investigate the sextupole contributions. This talk will concentrate on the recent tracking results to optimize the SCT for a proton beam at COSY.

AKBP 11.2 Wed 16:15 AKBP-H13

Beam dynamics studies by long-term observation of coherently emitted THz pulses at DELTA — •Carsten Mai, Benedikt Büsing, Arne Held, and Shaukat Khan — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

At DELTA, a 1.5-GeV electron storage ring operated as a synchrotron light source by the TU Dortmund University, experiments with THz radiation are carried out at a dedicated beamline. An interaction of short laser pulses with electron bunches is used to generate broadband as well as tunable narrowband radiation up to 6 THz. Coherent emission of (sub-)THz pulses is typically observed during several storage ring revolutions after the initial laser-electron interaction. However, a coherent emission is observed at half-integer multiples of the synchrotron oscillation period after the interaction because the density in the longitudinal phase space is similar to the initial situation. Experimental results and simulations of the longitudinal phase space are presented.

AKBP 11.3 Wed 16:30 AKBP-H13

Detailed analysis of transverse emittance of the FLUTE electron bunch — •Thiemo Schmelzer, Erik Bründermann, Igor Kriznar, Matthias Nabinger, Michael Nasse, Robert Ruprecht, Jens Schäfer, Marcel Schuh, Nigel Smale, Pawel Wesolowski, and Anke-Susanne Müller — KIT, Karlsruhe

The new compact and versatile linear accelerator-based test facility FLUTE (Ferninfrarot Linac- Und Test-Experiment) is operated at KIT. Its primary goal is to serve as a platform for a variety of accelerator R&D studies like the generation of strong ultra-short terahertz pulses. The amplitude of the generated coherent THz pulses is proportional to the square number of particles in the bunch. With the

transverse emittance, a measure for the transverse particle density can be determined. It is therefore a vital parameter in the optimization of the operation. In a systematic study, the transverse emittance of the electron beam was measured in the FLUTE injector. A detailed analysis considers different influences such as the bunch charge and compares this with particle tracking simulations carried out with ASTRA. In this contribution, the key findings of this analysis are discussed. Thiemo Schmelzer acknowledges the support by the Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 11.4 Wed 16:45 AKBP-H13

Development of a transfer line for LPA-generated electron bunches to a compact storage ring — •Bastian Härer[1], Erik Bründermann[1], Alexander Papash[1], Robert Ruprecht[1], Jens Schäfer[1], Christina Widmann[1], Anke-Susanne Müller[1], Laurids Jeppe[2], Philipp Messner[2], Andreas R. Maier[2], Jens Osterhoff[2], and Eva Panofski[2] — [1]Karlsruhe Institute of Technology (KIT) — [2]Deutsches Elektronen-Synchrotron (DESY)

The injection of LPA-generated beams into a storage ring is considered to be one of the most prominent applications of laser plasma accelerators (LPAs). In a combined endeavour between Karlsruhe Institute of Technology (KIT) and Deutsches Elektronen-Synchrotron (DESY) the key challenges will be addressed with the aim to successfully demonstrate injection of LPA-generated beams into a compact storage ring with large energy acceptance and dynamic aperture. Such a storage ring and the corresponding transfer line are currently being designed within the cSTART project at KIT and will be ideally suited to accept bunches from a 50 MeV LPA prototype developed at DESY.

This contribution presents the foreseen layout of the transfer line from the LPA to the injection point of the storage ring and discusses the status of beams optics calculations.

AKBP 11.5 Wed 17:00 AKBP-H13

Beam Pulsing at the S-DALINAC: Superposition of the 3 GHz Beam Structure with a 1 MHz Macrostructure* — •Lennart Stobbe, Michaela Arnold, Jonny Birkhan, Uwe Bonnes, Lars Jürgensen, and Norbert Pietralla — Institut für Kernphysik, TU Darmstadt, Germany

The superconducting electron-linear-accelerator S-DALINAC provides a cw-beam with a 3 GHz time structure for different experiments. This mode is fixed and does not allow to deliver a (macro-) pulsed beam to the experimental setups. As time of flight measurements should become feasible at the so-called QCLAM magnetic spectrometer an additional pulsing device has been built and studied. The 3 GHz beam structure was superimposed with a 1 MHz macrostructure. The superposition was archived with a plate capacitor setup in the S-DALINAC's injector-beamline. The plate capacitor deflected the beam across an aperture with a repetition rate of 1 MHz. The current state of the capacitor setup as well as the first test measurement of the macrostructure with a plastic scintillator will be presented.

*Work supported by DFG (GRK 2128) and the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006).

AKBP 11.6 Wed 17:15 AKBP-H13

Proton Irradiation Site for Si-Detectors at the Bonn Isochronous Cyclotron — •Dennis Sauerland[1], Paul-Dieter Eversheim[1], Reinhard Beck[1], Pascal Wolf[2], and Jochen Dingfelder[2] — [1]Helmholtz-Institut für Strahlen und Kernphysik, Universität Bonn — [2]SiLab, Physikalisches Institut, Universität Bonn

With the Bonn Isochronous Cyclotron either protons, deuterons or ions up to $^{12}C^{4+}$ 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.

At a new proton irradiation site, a 1 μA proton beam with a diameter of $\leq$ 6 mm is utilized to irradiate a target in air, e.g. cooled Si semiconductor detectors for radiation hardness tests. For homogeneous irradiation, the targets are scanned through the beam in a row-wise pattern with constant velocity and a row spacing much smaller than the beam diameter. During the irradiation procedure, the beam current and position is continuously measured non-destructively using a calibrated, secondary electron emission-based beam monitor, positioned at the exit window of the beamline. An on-the-fly beam monitor calibration can be obtained using a movable Faraday Cup. The diagnostics and the irradiation procedure ensure a homogeneous irradiation of the target with a fluence error of $\leq$ 2 %.

In this talk, an overview of the accelerator facility will be given, the irradiation site with its beam diagnostics will be presented in detail, along with an outlook on planned future developments at the facility.

AKBP 11.7 Wed 17:30 AKBP-H13

Progress of the SSMB Proof-of-Principle experiment at the Metrology Light Source — •Arnold Kruschinski[1], Arne Hoehl[2], Roman Klein[2], Ji Li[1], Jana Puls[2], Markus Ries[1], and Jörg Feikes[1] — [1]Helmholtz-Zentrum Berlin, Berlin, Germany — [2]Physikalisch-Technische Bundesanstalt, Berlin, Germany

The method of Steady-State Microbunching (SSMB) as proposed by Alex Chao and Daniel Ratner in 2010 is envisioned to generate intense coherent synchrotron radiation at a storage ring. The scheme would allow synchrotron light with brilliance similar to an FEL while enabling high repetition rates typical for a storage ring.

A proof-of-principle (PoP) experiment is conducted at the MLS storage ring in Berlin and has successfully demonstrated the viability of the general mechanism behind SSMB by showing stability of a microbunch structure over one turn in the storage ring. This talk will briefly introduce the idea behind SSMB and give an overview of the PoP experiment, its current status and outlook.

AKBP 12: New Accelerator Concepts 2

Time: Wednesday 16:00–17:30 Location: AKBP-H14

AKBP 12.1 Wed 16:00 AKBP-H14

Excitation of beam driven plasma waves in a hybrid LPWFA — •Susanne Schöbel[1,2], Richard Pausch[1], Finn-Ole Carstens[1,2], Yen-Yu Chang[1], Sébastien Corde[3], Jurjen Couperus Cabadağ[1], Alexander Debus[1], Hao Ding[4], Andreas Döpp[4], Thomas Heinemann[5,6], Bernhard Hidding[6], Max Gilljohann[3,4], Stefan Karsch[4], Alexander Köhler[1], Olena Kononenko[3], Alastair Nutter[6], Patrick Ufer[1,2], Alberto Martinez de la Ossa[5], Ulrich Schramm[1,2], and Arie Irman[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Technische Universität Dresden, Germany — [3]LOA, ENSTA ParisTech, CNRS, Ecole Polytechnique, Université Paris-Saclay, France — [4]Ludwig-Maximilians-Universität München, Germany — [5]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [6]University of Strathclyde, Glasgow, UK

Here we present imaging of plasma wakefields driven by both, high intensity laser pulses or high peak current electron beams. In particular, a scheme of high-current electron beams from a LWFA as drivers of a beam-driven plasma wakefield accelerator (PWFA) is being extensively studied, aiming to fulfill the demanding quality requirements for applications such as FELs. Observing plasma wakefields in this regime demonstrates the capability of the LWFA beam to create the plasma as well as drive plasma wakefields. Additionally we observed a correlation between the drive beam charge and the shape of the plasma wave. This enables us to find an optimum parameter set towards the experimental demonstration of the hybrid LPWFA.

AKBP 12.2 Wed 16:15 AKBP-H14

Traveling-wave electron accelerators – Getting PIConGPU simulations ready for exascale — •Alexander Debus[1], Sunita Chandrasekaran[2,3], Klaus Steiniger[1], René Widera[1], Sergei Bastrakov[1], Felix Meyer[1], Richard Pausch[1], Marco Garten[1], Thomas Kluge[1], Jeffrey Kelling[1], Benjamin Hernandez[6], Matthew Leinhauser[2,3], Jeff Young[2,5], Franz Pöschel[1], Axel Hübl[4], David Rogers[6], Guido Juckeland[1], and Michael Bussmann[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]CASUS, Center for Advanced Systems Understanding, Görlitz, Germany — [3]University of Delaware, Newark, Delaware, USA — [4]Lawrence Berkeley National Laboratories, Berkeley, CA, USA — [5]Georgia Institute of Technology, Atlanta, GA, USA — [6]Oak Ridge National Laboratory, Knoxville, TN, USA

Traveling-wave electron acceleration (TWEAC) is an advanced laser-plasma accelerators scheme, which is neither limited by dephasing, nor by pump depletion or diffraction. Such accelerators are scalable to energies beyond 10 GeV without the need for staging and are candidates for future compact electron-positron colliders.

TWEAC simulations to high energies require exascale compute resources. Within the early-access program (CAAR) for the upcoming exascale Frontier cluster at ORNL, we prepare PIConGPU, a 3D3V particle-in-cell code, for large-scale TWEAC simulations, including tuning and refining PIConGPU to run on the latest AMD GPUs. In this talk we present progress in TWEAC simulations and the technical advances in PIConGPU that enable running on Frontier.

AKBP 12.3 Wed 16:30 AKBP-H14

Operational Experience and Characterization of a Superconducting Transverse Gradient Undulator for Compact Laser Wakefield Accelerator-Driven FEL — •Kantaphon Damminsek, Axel Bernhard, Sebastian Richter, Robert Rossmanith, Anke-Susanne Müller, Yimin Tong, and Andreas Grau — Karlsruhe Institute of Technology, Karlsruhe, Germany

A 40-period superconducting transverse gradient undulator (TGU) has been designed and fabricated at Karlsruhe Institute of Technology (KIT). Combining a TGU with a Laser Wakefield Accelerator (LWFA) is a potential key for realizing an extremely compact Free Electron Lasers (FEL) radiation source, as the TGU scheme is a viable option to compensate the challenging properties of the LWFA electron beam in terms of beam divergence and energy spread. The superconducting TGU has been commissioned off-line, step by step reaching its final operational parameters. A specially designed set-up for mapping of the magnetic field in the TGU's extremely narrow gap has been installed, commissioned and employed for the magnetic characterization. In this contribution, we report on the operational experience of the TGU and on the magnetic characterization measurement.

This work is supported by the BMBF project 05K19VKA PlasmaFEL (Federal Ministry of Education and Research).

AKBP 12.4 Wed 16:45 AKBP-H14

Studies for a Laser Wakefield Driven Injector at ELSA — •Kilian Kranz, Klaus Desch, Daniel Elsner, and Michael Switka — Elektronen-Stretcher-Anlage, Physikalisches Institut, Universität Bonn

At the University of Bonn the storage ring ELSA extracts electrons with energies up to 3.2 GeV to hadron physics and novel detector testing experiments. We study the feasibility of replacing the current 26 MeV LINAC injector with a laser wakefield accelerator (LWA). For this, contemporary parameters from current LWA setups at other laboratories are assumed and matched to the acceptance of the booster synchrotron. Moreover, a conceptional draft of a potential LWA setup is created. This takes into consideration the influence of building conditions such as available floor space and building vibrations to estimate a setup and laser beam stability of a plasma generating high power laser system and beamline to the plasma cell. The methods and intermediate results of this study will be presented.

AKBP 12.5 Wed 17:00 AKBP-H14

Signal subtraction of consecutive electron bunches from a high-repetition-rate plasma-wakefield accelerator — •Judita Beinortaite[1,2], James Chappell[2], Gregor Loisch[1], Carl A. Lindstrøm[1], Sarah Schröder[1], Stephan Wesch[1], Matthew Wing[1,2], Jens Osterhoff[1], and Richard D'Arcy[1] — [1]DESY, Hamburg, Germany — [2]University College London, London, UK

Plasma-wakefield acceleration (PWFA) is one of the main candidates for future compact-accelerator technologies with applications in high energy physics and photon science. For PWFA, which currently operates at Hz level, to meet the luminosity and brilliance demands of current users, at least thousands of bunches must be delivered per second. As recently explored at FLASHForward, DESY, the fundamental limitation for the highest repetition rate is the long-term motion of ions that follows the dissipation of the driven wakefield (D'Arcy, R. et al. Recovery time of a plasma-wakefield accelerator. Nature (accepted) (2021)). The recovery of the plasma to an undisturbed state after the driving of a wakefield was observed in the images of consecutive electron bunches, separated by tens of nanoseconds, while the imaging screens have scintillation lifetimes of the order milliseconds. As such, an image processing technique capable of resolving individual bunches within that lifetime is needed. This technique - termed the 'subtraction method' - uses many shots of a preceding bunch to accurately identify and remove its signal from the overlapping signal of a subsequent bunch. As a result, high-repetition-rate processes can be studied to advance PWFA for meaningful application to facilities of the future.

AKBP 12.6 Wed 17:15 AKBP-H14

Radiative particle-in-cell simulations of the beam hosing instability – an analysis by components — •Anton Lebedev[1], Richard Pausch[1], Rene Widera[1], Sergei Bastrakov[1], Michael Bussmann[1,2], Ulrich Schramm[1,3], and Alexander Debus[1] — [1]Abteilung Laser-Teilchenbeschleunigung, Helmholtz Zentrum Dresden-Rossendorf, Dresden — [2]Center for Advanced Systems Understanding, Görlitz — [3]Institut für Strahlenphysik, Technische Universität Dresden, Dresden

We present first results and analyses of radiation spectra expected to be produced by ultrarelativistic particle beams propagating through a plasma medium experiencing the hosing instability. We determine these spectra in particle-in-cell simulations by in-situ computation of radiation based on Liénard-Wiechert potentials, emitted by all simulated particles (>10^9) of the beam and plasma for over 160 distinct detectors distributed across half a solid angle.

In the simulation campaign, conducted at the JUWELS Booster cluster at JSC, we considered linear and non-linear regimes of the instability for ultrarelativistic electron beams of varying emittance impacting a homogeneous electron plasma. We further show a preliminary analysis of the data relating observed characteristics of the spectra to the characteristics of the instability.

Our goal is to open up new experimental avenues for better understanding the beam instability evolution by identifying its radiation signatures that can be measured in experiments.

AKBP 13: Diagnostics, Control and Instrumentation 2

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

AKBP 13.1 Thu 14:00 AKBP-H13

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

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

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

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

*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 13.2 Thu 14:15 AKBP-H13

Detection of single monoenergetic ion bunches using ionoacoustics — •Sonja Gerlach[1], Felix Balling[1], Anna-Katharina Schmidt[1], Florian-Emanuel Brack[2], Leon Kirsch[1,3], Florian Kroll[2], Marvin Reimold[2], Walter Assmann[1], Ulrich Schramm[2], Christina Trautmann[3], Karl Zeil[2], Katia Parodi[1],

and Jörg Schreiber[1] — [1]Ludwig-Maximilians-Universität München, München, Deutschland — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Deutschland — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

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

AKBP 13.3 Thu 14:30 AKBP-H13

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

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

AKBP 13.4 Thu 14:45 AKBP-H13

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

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

AKBP 13.5 Thu 15:00 AKBP-H13

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

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

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

This work has been supported by DFG under GRK 2128.

AKBP 13.6 Thu 15:15 AKBP-H13

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

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

AKBP 13.7 Thu 15:30 AKBP-H13

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

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

AKBP 14: Posters

Time: Thursday 16:00–17:30 Location: P

AKBP 14.1 Thu 16:00 P

A miniature transport-line design for laser plasma accelerator-driven FELs using HTS magnets — •Samira Fatehi, Axel Bernhard, and Anke-Susanne Müller — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Laser-plasma acceleration is an outstanding candidate to drive the next-generation compact light sources and FELs. Due to extremely high accelerating gradients in LPAs, electron bunches can gain sufficient energies to generate synchrotron radiation in the X-ray regime in only a few millimetres to centimeters of acceleration length. To efficiently capture and transport the LPA-generated bunches in a compact transport line, beam line designs employing combined-function high-strength magnets based on high temperature superconductor technology have been studied. In this contribution we present the beam dynamics calculations as well as the magnet designs for a compact transport line matching the LPA-generated beam to a transverse-gradient undulator.

This work is supported by the BMBF project 05K19VKA PlasmaFEL (Federal Ministry of Education and Research).

AKBP 14.2 Thu 16:00 P

Future Neutron Beam Line at the Bonn Isochronous Cyclotron — •Maximilian Loepke and Reinhard Beck — Helmholtz-Institut für Strahlen- und Kernphysik Bonn

The Bonn Isochronous Cyclotron provides a beam of protons, deuterons or ions up to $^{12}C^{4+}$ with a kinetic energy ranging from 7 to 14 MeV per nucleon. Since 2019 the proton beam is utilized for irradiation of e.g. silicon pixel detectors for radiation hardness tests.

Currently, it is planned to extend the facility's irradiation and experimentation capabilities by providing a neutron beam. The neutrons are produced by converting deuterons into protons and neutrons in a thick carbon or berylium target. Protons are stopped by the target whereas the neutrons, are subsequently collimated and can be used for irradiation of a secondary target.

The angular distribution of neutrons from this stripping reaction is peaked forward and the energy of neutrons emerging at 0 degree is around 0.4 times the deuteron energy for deuterons in this energy range. The neutron flux at the secondary target after collimation has been estimated using simulations with Geant4 and experimental data found in literature to be in the order of 10^7 n/cm^2/s.

AKBP 14.3 Thu 16:00 P

Nitrogen-doping of niobium for SRF cavities — •Márton Major, Lambert Alff, Michaela Arnold, Jens Conrad, Stefan Flege, Ruben Grewe, and Norbert Pietralla — Technische Universität Darmstadt, Darmstadt, Germany

Niobium is the standard material for superconducting radio-frequency (SRF) cavities for particle acceleration. Superconducting materials with higher critical temperature or higher critical magnetic field allow cavities to work at higher operating temperatures or higher accelerating fields, respectively. One direction of search for new materials with better properties is the modification of bulk niobium by nitrogen doping. In the Nb-N phase diagram, the cubic δ-phase of NbN has the highest critical temperature.

Niobium samples were annealed and doped with nitrogen in the high-temperature furnace at TU Darmstadt and investigated at its Materials Research Department with respect to structural modifications. X-ray diffraction (XRD) confirmed the appearance of Nb_4N_3 and Nb_2N phases on the surface of the samples. A single cell cavity was annealed under optimized doping conditions. The test samples treated together with the cavity showed almost single Nb_4N_3 phase. XRD pole figures also showed grain growth during sample annealing.

The work was supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H18RDRB2 and the German Research Foundation (DFG) via the AccelencE Research Training Group (GRK 2128).

AKBP 14.4 Thu 16:00 P

Improving the lifetime of GaAs-photo-cathodes with cryogenic components — •Tobias Eggert, Yuliya Fritzsche, and Joachim Enders — Institut für Kernphysik, TU Darmstadt, Germany

GaAs photocathodes provide a suitable source for polarized lectron beams. However, the operational lifetime is limited by a mandatory negative-electron-affinity (NEA) coating consisting of a cesium and oxygen. This layer gets corroded by oxygen over time and destroyed by ionized residual gas molecules hitting the surface. The latter is called ion back-bombardment (IBB) and is one of the main lifetime limiting factors. Improving the vacuum conditions around the cathodes surface is expected to reduce IBB and corrosion and therefore increase operational time. At the Institut für Kernphysik at TU Darmstadt a dedicated test stand is set up to develop a new kind of GaAs electron source, which uses cryocooling of a sub-volume to increase the vacuum condition around the cathode. In addition to the sub-volume, the cathode itself ets cooled to compensate for the temperature rise from high laser power.

This project is supported by DFG (GRK 2128) and BMBF (05H18RDRB1).

AKBP 14.5 Thu 16:00 P

Electro-thermal studies of quadrupole resonator designs — •Piotr Putek[1], Shahnam Gorgi Zadeh[2], Marc Wenskat[3,4], Simon Adrian[1], and Ursula van Rienen[1] — [1]Universität Rostock, Rostock, Germany — [2]CERN, Meyrin, Switzerland, — [3]Universität Hamburg, Hamburg, Germany — [4]Deutsches Elektronen-Synchrotron, 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. To precisely determine the radio frequency (RF) properties of superconducting materials, a calorimetric measurement is carried out with the aid of a so-called Quadrupole Resonator (QPR). However, the measurement procedure is affected by various uncertainties, such as geometrical deviations of the cavity design and the accuracy of numerical simulations. Additionally, the measurement bias for the third operational mode is observed in the pre-existing QPR designs, including the QPRs built at CERN and HZB. It motivated us to re-design the QPR to improve the measurement accuracy for the third operational mode (1.3 GHz). We compare the pre-existing QPR designs with optimized configurations from the perspective of electro-thermal simulations.

AKBP 14.6 Thu 16:00 P

Superconducting solenoid field analysis and optimization — •Shuai Ma[1,2], André Arnold[1], Anton Ryzhov[1], Jana Schaber[1,3], Petr Zwartek[1], Jochen Teichert[1], Rong Xiang[1], Paul Zwartek[1], Wolfgang Hillert[2], and Houjun Qian[4] — [1]HZDR — [2]Hamburg University — [3]Technische Universität Dresden — [4]Photo Injector Test Facility at DESY, Zeuthen site

The superconducting solenoid for SRF Gun III at ELBE will be installed and measured. Both the longitudinal and transverse fields will be measured and analyzed. The field axis can be derived from the field and it is helpful for the alignment of the solenoid. Formalism form to the transverse field will be used to analyze the multipole field.

AKBP 14.7 Thu 16:00 P

SRF Cavity and HOM Coupler Design for the W Working Point of the FCC-ee — •Sosoho-Abasi Udongwo[1], Shahnam Gorgi Zadeh[1], Rama Calaga[2], and Ursula van Rienen[1] — [1]University of Rostock, Rostock, Germany — [2]CERN, Geneva, Switzerland

The Future Circular electron-positron Collider (FCC-ee) is planned to operate with beam energies from 45.6 to 182.5 GeV and beam currents from 5.4 to 1390 mA to study the four operation points, the **Z**, **W**, **H** and $\mathbf{t\bar{t}}$. The energy and current specifications for the **W** working point are 80 GeV and 147 mA, respectively. Due to strong higher-order mode (HOM) effects, 2-cell 400 MHz elliptical SRF cavities are proposed for operation at this working point. This contribution summarises the RF design and optimization of the 2-cell cavity and its HOM couplers compatible with the **W** working point.

AKBP 15: Members' Assembly

Time: Thursday 18:00–19:00 Location: AKBP-MV

Members' Assembly