Working Group on Accelerator Physics
Arbeitskreis Beschleunigerphysik (AKBP)

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Overview of Invited Talks and Sessions

(Lecture halls ZHG004; Poster ZHG Foyer 1. OG)

Invited Talks

AKBP 3.1	Tue	16:00–16:30	ZHG004	**SRF accelerating cavity design for the future circular collider** — •SHAHNAM GORGI ZADEH

Sessions

AKBP 1.1–1.3	Mon	16:45–18:15	ZHG004	**Electron Accelerators I**
AKBP 2.1–2.7	Tue	13:45–15:45	ZHG004	**Novel Accelerator Concepts I**
AKBP 3.1–3.1	Tue	16:00–16:30	ZHG004	**AKBP Accelerator Prize Talks**
AKBP 4.1–4.19	Tue	16:30–18:00	ZHG Foyer 1. OG	**AKBP Posters**
AKBP 5.1–5.6	Wed	11:00–12:30	ZHG004	**Particle Sources**
AKBP 6.1–6.7	Wed	13:45–15:45	ZHG009	**Accelerators for Medical Applications (joint session ST/AKBP)**
AKBP 7.1–7.8	Wed	16:15–18:15	ZHG004	**Novel Accelerator Concepts II and FELs**
AKBP 8.1–8.6	Thu	11:00–12:30	ZHG004	**Diagnostics**
AKBP 9.1–9.7	Thu	13:45–15:45	ZHG004	**Novel Accelerator Concepts III and Hadron Accelerators**
AKBP 10.1–10.8	Thu	16:15–18:15	ZHG004	**Novel Accelerator Concepts IV and Applications**
AKBP 11	Thu	18:20–19:00	ZHG004	**Members' Assembly**
AKBP 12.1–12.6	Fri	9:00–10:30	ZHG004	**Radiofrequency and Instrumentation I**
AKBP 13.1–13.4	Fri	11:00–12:00	ZHG004	**Radiofrequency and Instrumentation II**

Members' Assembly of the Working Group on Accelerator Physics

Thursday 18:20–19:00 ZHG004

AKBP 1: Electron Accelerators I

Time: Monday 16:45–18:15 Location: ZHG004

Group Report AKBP 1.1 Mon 16:45 ZHG004
Exploring cutting-edge research and technology at KIT's advanced accelerator facilities — •Erik Bründermann for the IBPT accelerator team-Collaboration — KIT, Karlsruhe, Deutschland

The Institut für Beschleunigerphysik und Technologie at the Karlsruhe Institute of Technology operates the Karlsruhe Research Accelerator, KARA, with the 2.5 GeV electron storage ring, the 40 MeV to 90 MeV short-pulse linear accelerator FLUTE, and KITTEN, a test center for energy-responsible research infrastructures. Combined with additional ATP facilities of the accelerator technology platform like the Magnet and Cryogenics Facilities, this is a perfect environment for accelerator research at KIT and technology transfer. In the future, cSTART - a compact storage ring ideally suited to study novel operation scenarios - and compact laser-plasma accelerators including a 75 TW laser system will expand the short-pulse facilities. We will explore the existing and upcoming accelerator test facilities at KIT and highlight results for accelerator physics and technologies.

Group Report AKBP 1.2 Mon 17:15 ZHG004
Recent Developments at S-DALINAC* — •Michaela Arnold, Adrian Brauch, Lisa Dingeldein, Manuel Dutine, Joachim Enders, Ruben Grewe, Katharina E. Ide, Lars Jürgensen, Maximilian Meier, Fatemeh Sadat Moujani Ghomi, Clemens M. Nickel, Norbert Pietralla, Vincent Pruy, Lukas Reichel, Valentin Reichenbach, Felix Schliessmann, Dominic Schneider, Benjamin Thormann, and Tim Zimmermann — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

The superconducting Darmstadt linear accelerator S-DALINAC is a thrice-recirculating accelerator for electrons [1]. Besides the conventional acceleration scheme with corresponding nuclear physics experiments, the accelerator can also be operated as an energy recovery linac (ERL) [2]. Since its establishment in 1991, the S-DALINAC was mainly developed and operated by students. Multiple projects to improve the overall beam quality or the operational capabilities of the accelerator are currently in progress: A streak camera for investigating the bunch length, upgrades to the beamline and diagnostics system, support of beam tuning by machine learning techniques and more. A laser Compton backscattering setup is close to its commissioning. Lessons learned from the ERL operation are included in a design study for a future ERL. This contribution gives an overview.
[1] N. Pietralla, Nucl. Phys. News, Vol. 28, No. 2, 4 (2018).
[2] F. Schliessmann et al., Nat. Phys. 19, 597-602 (2023).
*Work supported by DFG (GRK 2128, IRTG 2891) and State of Hesse (Research Cluster ELEMENTS (Project ID 500/10.006)).

Group Report AKBP 1.3 Mon 17:45 ZHG004
Current Developments at ELSA — •Michael Switka, Max Ammann, Klaus Desch, Frank Frommberger, Daniel Fry, Samuel Kronenberg, Thomas Perlitius, Dennis Proft, Paul Rolf, Yannick Schober, Susanne Speath, Axel Spreitzer, and Leonardo Thome — Physikalisches Institut, Universität Bonn

The electron stretcher accelerator facility (ELSA) at the University of Bonn utilizes a storage ring design to deliver a continuous 3.2 GeV beam of polarized and unpolarized electrons to external experimental stations. Alongside its main purpose to service the hadron physics community, additional modes of operation are developed to allow versatile usage for accelerator-, detector- and medical research. Current developments in beam polarization enhancement, beam diagnostics, electron source and permanent magnet design as well as modification of beam extraction schemes for medical research and a more economic usage for the detector testing community are presented.

AKBP 2: Novel Accelerator Concepts I

Time: Tuesday 13:45–15:45 Location: ZHG004

Group Report AKBP 2.1 Tue 13:45 ZHG004
Energy Compression of a Laser-Plasma Accelerator — •Paul Winkler[1], Max Trunk[1], Lars Hübner[1], Alberto Martinez de la Ossa[1], Sören Jalas[1], Manuel Kirchen[1], Ilya Agapov[1], Sergey A. Antipov[1], Reinhard Brinkmann[1], Timo Eichner[1], Angel Ferran Pousa[1], Thomas Hülsenbusch[1], Guido Palmer[1], Matthias Schnepp[2], Kaja Schubert[1], Maxence Thévenet[1], Paul A. Walker[1], Christian Werle[1], Wim P. Leemans[1,2], and Andreas R. Maier[1] — [1]Deutsches Elektronen Synchrotron, DESY — [2]Universität Hamburg

Laser-Plasma accelerators (LPAs) promise a compact alternative to modern RF-technology, and support orders of magnitude higher electric fields. GeV-energy LPA electron beams from cm-scale sources have been demonstrated. However, the central energy jitter and energy spread, both on the percent-level, have yet prevented LPAs to drive real-world applications.

Here, we present active energy compression of laser-plasma accelerated electron beams. At the LUX experiment at DESY, a dipole chicane stretches the beams in time and thereby imprints an energy-time correlation (a chirp), which is subsequently removed inside an RF cavity. Our setup reduces the fluctuation in central energy as well as the energy spread of the beams by more than an order of magnitude down to the permille-level. We demonstrate performance so far only attributed to modern RF based accelerators which opens the door for a variety of applications, such as compact plasma-based injectors for synchrotron storage rings.

AKBP 2.2 Tue 14:15 ZHG004
Ultrafast plasma wave shadowgraphy for laser wakefield acceleration — •Paula Sedlatschek, Marc Osenberg, Thomas Heinemann, Mirela Cerchez, Onur Bilen, Edgar Hartmann, and Bernhard Hidding — Institute for Laser- and Plasmaphysics, Heinrich Heine University Düsseldorf

Plasma Shadowgraphy via an ultrashort laser pulse can be utilized to probe the small and fast processes in laser wakefield accelerators (LWFAs). This high-resolution technique reveals the plasma dynamics in the sub-micrometer, femtosecond-regime and visualizes the accelerating plasma wave. We present our approach to implement such a probe laser, using a low-power split-off from the main laser driver which is subsequently and further spectrally broadened. The modulated spectrum of the probe laser enables the use of cut-off filters which block the fundamental spectrum from the accelerating main laser. This is leading to precise visualization of density gradients within the plasma. By integrating this method, we aim for a comprehensive characterization of critical LWFA parameters, such as plasma density evolution, wakefield stability, and laser-plasma coupling. This non-intrusive diagnostic intends to improve our laser wakefield accelerator.

AKBP 2.3 Tue 14:30 ZHG004
Optical Imaging as Synthetic Diagnostic in PIConGPU — •Finn-Ole Carstens[1,2], Richard Pausch[1], Klaus Steiniger[1], Fabia Dietrich[1,2], Jessica Tiebel[1,2], Nico Wrobel[1,2], Susanne Schöbel[1], Patrick Ufer[1,2], Arie Irman[1], Michael Bussmann[1], Ulrich Schramm[1,2], and Alexander Debus[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Deutschland — [2]Technische Universität Dresden, Dresden, Deutschland

We present a synthetic shadowgraphy plugin for the particle-in-cell code PIConGPU. By time-integrating electric and magnetic fields and propagating them onto a screen in the far field with Fourier methods, shadowgram images equivalent to experimental measurements can be produced.

Our in-situ plugin enables recording few-cycle probe pulses after they propagate through plasma structures of e.g. laser-plasma accelerators. Propagation of the probe pulse takes place during the normal PIC cycle, meaning that all laser-plasma interactions are self-consistently taken into account. By analyzing these shadowgrams alongside the 3D, time-resolved density distribution from the simulation, one can trace the origin of specific features, such as cavity elongation and de-

formation and a variety of scattering signals that allow improving our understanding of the cavity formation and dynamics in experiments.

AKBP 2.4 Tue 14:45 ZHG004

Multidimensional sensitivity analysis of laser wakefield accelerated electrons in dependence on laser and plasma parameters — •Jessica Tiebel[1,2], Richard Pausch[1], Finn-Ole Carstens[1,2], Fabia Dietrich[1,2], Franziska Herrmann[1,2], Arie Irman[1], Susanne Schöbel[1,2], Klaus Steiniger[1,3], René Widera[1], and Ulrich Schramm[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden — [3]CASUS, Görlitz

Laser-plasma accelerators (LPAs) are a promising tool for generating high-charge, low-emittance electron beams, with broad applications in science and research. LPAs are highly sensitive to variations in laser and plasma parameters, some of which are detectable and others of which are difficult or impossible to measure. In addition, many of these parameters are subject to significant fluctuations. The limited knowledge of the parameters and the non-linear nature of laser wakefield acceleration (LWFA) make experimental investigations of the dependencies between laser and plasma parameters and electron beam properties challenging. In this work, we present a simulation-based study to develop a multi-dimensional mapping of laser and plasma parameters to electron beam parameters for self-truncated ionization injection in LWFA. Using the multi-GPU particle-in-cell code PIConGPU and an automated Snakemake workflow, we performed a comprehensive exploration of the parameter space. This study reveals complex multidimensional dependencies and provides actionable insights for experimentalists to optimize input parameters and achieve high quality electron beams with greater efficiency.

AKBP 2.5 Tue 15:00 ZHG004

Metrology of gas targets designed for laser plasma wakefield accelerators — •Natascha Thomas, Thomas Heinemann, Constantin Aniculaesei, and Bernhard Hidding — Institute of Laser- and Plasmaphysics, Heinrich Heine University Düsseldorf

Laser Wakefield Acceleration (LWFA) relies on the precise formation of plasma waves (wakes) driven by intense laser pulses to accelerate charged particles. The dynamics of this process thereby depend on the generated plasma density profile, which is, in turn, determined by the underlying gas density of the utilized targets. For this reason, an accurate and reliable measurement of their characteristics is an essential prerequisite for optimizing LWFA experiments. We present the development and application of an optical diagnostic setup built for the characterization of such gas jets over a wide range of densities and profiles. The system's design offers high flexibility and rapid adaptation to a range of various targets. Additionally, first results and further ideas for improved data collection and analysis are discussed.

AKBP 2.6 Tue 15:15 ZHG004

Recent developments of the cSTART project — •Markus Schwarz, Erik Bründermann, Robert Ruprecht, Axel Bernhard, Bastian Härer, Dima El Khechen, Anton Malygin, Michael Johannes Nasse, Gudrun Niehues, Alexander Papash, Jens Schäfer, Marcel Schuh, Nigel Smale, Pawel Wesolowski, Christina Widmann, Thiemo Schmelzer, Nathan Ray, David Squires, Alexander Saw, Joseph Natal, Anke-Susanne Müller, and Matthias Fuchs — KIT, Karlsruhe, Germany

The combination of a compact storage ring and a laser-plasma accelerator (LPA) can serve as the basis for future compact light sources. One challenge is the large momentum spread (about 2%) of the electron beams delivered by the LPA. To overcome this challenge, a very large acceptance compact storage ring (VLA-cSR) was designed as part of the compact STorage ring for Accelerator Research and Technology (cSTART) project, which will be realized at the Karlsruhe Institute of Technology (KIT, Germany). Initially, the Ferninfrarot Linac- Und Test-Experiment (FLUTE), a versatile source of ultra-short bunches, will serve as an injector for the VLA-cSR to benchmark and emulate LPA-like beams. In a second stage, a laser-plasma accelerator will be used as an injector. The small facility footprint, the large-momentum spread bunches with charges from 1 pC to 1 nC and lengths from few fs to few ps pose challenges for the lattice design, RF system and beam diagnostics. Recently, the Technical Design Report was developed in cooperation with Research Instruments and subcontractors. This contribution summarizes the latest state of the project.

AKBP 2.7 Tue 15:30 ZHG004

Laser-plasma accelerator as injector for the cSTART storage ring — •David Squires, Alexander Saw, Nathan Ray, Joseph Natal, and Matthias Fuchs — IBPT, KIT, Karlsruhe, Germany

Laser-plasma accelerators (LPAs) are promising options for next-generation accelerator facilities. Accelerating structures on the millimeter scale and accelerating gradients several orders of magnitude higher than RF cavities suggest that LPAs can be used as compact accelerators that produce ultrashort pulses of high intensity electrons. We plan to develop an LPA-based injector for cSTART, a compact, high-acceptance storage ring to be built at the Karlsruhe Institute of Technology (KIT).

The LPA injector for our compact storage ring must produce electron beams with a comparatively low beam energy (50-90 MeV) for an LPA, have a narrow relative energy spread (4%), and a high shot-to-shot stability. Reaching these parameters is challenging and requires extensive simulation work before physical devices are built. In our study, we have used fbpic to simulate an ionization injection scheme in combination with tailored plasma density profiles to generate stable LPA beams. The density profile enables us to reach the desired beam energy and energy spread.

AKBP 3: AKBP Accelerator Prize Talks

Time: Tuesday 16:00–16:30 Location: ZHG004

Invited Talk AKBP 3.1 Tue 16:00 ZHG004

SRF accelerating cavity design for the future circular collider — •shahnam gorgi zadeh — CERN, Geneva, Switzerland

The Future Circular Collider (FCC-ee) is an ambitious project aimed at conducting high-precision studies of the Z, W, Higgs, and top quark particles. A critical component of this electron-positron collider is the superconducting radiofrequency (SRF) system, which must adapt to the collider's diverse operational modes. The RF system is required to deliver 50 MW per beam to compensate for synchrotron radiation losses in the 91 km ring while accommodating beam currents and RF voltages that can vary by up to two orders of magnitude across different operational modes. This presentation delves into the design and optimization of SRF accelerating cavities, higher-order mode (HOM) couplers, and power couplers tailored for the FCC-ee's main collider and booster. The engineering of the RF system to handle varying beam currents and RF voltages will be presented. Additionally, it highlights novel concepts, including the SWELL cavity, which offers potential advantages beyond FCC-ee.

AKBP 4: AKBP Posters

Time: Tuesday 16:30–18:00 Location: ZHG Foyer 1. OG

AKBP 4.1 Tue 16:30 ZHG Foyer 1. OG

A novel test cavity setup for surface conductivity measurements of additive manufacturing samples — •Julian Sonpar[1], Hendrik Hähnel[1], Guenther Dollinger[2], Michael Mayerhofer[2], and Ricardo Helm[2] — [1]Goethe University Frankfurt, 60438 Frankfurt am Main, Germany — [2]Bundeswehr University Munich, 85579 Neubiberg, Germany

Additive Manufacturing (AM) has the potential to increase the per-

formance of radio frequency (rf) cavity resonators while cutting manufacturing costs. To investigate the surface conductivity of AM samples and postprocessing techniques, a compact rf cavity design has been introduced. The cylindrical cavity is made from Aluminum. The test body is held by a dielectric inside the cavity. A simulation assisted approach has been used to generate the dependence curve of surface conductivity to Quality factor. In order to calibrate this curve, to the rf cavity's experimentally measured Quality factor, an AOFC test body has been used which is assumed to have ideal conductivity. To further investigate the error that is made from said assumption and calibration, another method of generating the mentioned dependence curve is being investigated. This method uses simulations and Q-measurements to precisely evaluate the rf cavity's intrinsic (Aluminum) conductivity and loss tangent of the dielectric material. The aim is to generate the mentioned dependence curve without the need for AOFC test body calibration.

AKBP 4.2 Tue 16:30 ZHG Foyer 1. OG

Development of a 4:1 Guanella-type Impedance Transformer for the future SIS100 Broadband Cavity Systems — •Christoph Julien Wegmann[1] and Harald Klingbeil[1,2] — [1]Fachgebiet Beschleunigertechnik, Technische Universität Darmstadt, 64289 Darmstadt, Deutschland — [2]Abteilung Ring RF Systems, GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Deutschland

Most particle accelerator cavity systems like e.g. the acceleration cavities focus on generating a harmonic voltage of a given frequency. The SIS100 heavy ion synchrotron under construction at GSI/FAIR will also contain broadband cavity systems generating signals with significant spectral components in a range from 100 kHz to 20 MHz.

Previous analyses have shown that designing a suitable transmission path leads to multiple serious challenges. One of these is that the input capacitance of the tetrode amplifier limits the upper cutoff frequency. To counteract this effect, the load impedance at the input of the tetrode amplifier can be reduced from 50 Ω to 12.5 Ω at the expense of more driver amplifier power. However, to achieve an impedance matching to the driver amplifier necessitates the inclusion of a transformer generating a broadband 4:1 impedance transformation over the entire relevant frequency range.

A Guanella-type 4:1 ferrite transmission line transformer meeting these requirements was developed, built and verified. The core operating principles, approaches and measurement results are presented.

AKBP 4.3 Tue 16:30 ZHG Foyer 1. OG

Towards three-dimensional confinement of the electron beam inside dielectric laser accelerators — •Manuel Konrad[1], Julian Freier[1], Stefanie Kraus[1], Leon Brückner[1], Julian Litzel[1], Tomas Chlouba[1,2], Roy Shiloh[1,3], and Peter Hommelhoff[1,4] — [1]Department Physik, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), 91058 Erlangen — [2]Center for Nanophotonics, AMOLF, 1098 XG Amsterdam — [3]Institute of Applied Physics, Hebrew University of Jerusalem (HUJI), Jerusalem, Israel — [4]Department Physik, Ludwig-Maximilians-Universität München (LMU), 80799 München

Dielectric laser accelerators are the optical counterpart to classical RF-accelerators. Here, nanophotonic dielectric structures are illuminated by ultrashort laser pulses to create the accelerating modes. Alternating phase focusing (APF) is employed to confine the electron beam inside the acceleration channel [1]. After we successfully applied this concept to gain phase space control over the electrons in the longitudinal and one transverse direction [2], we have recently shown acceleration of electrons in combination with APF. By keeping the beam confined in a 500 μm long structure, we accelerated the electrons from 28.4 to 40.7 keV in a scanning electron microscope [3]. We will show how the APF scheme can be expanded to full 3D confinement and discuss how it is affected by illuminating the structure from the top.

[1] Niedermayer et al., PRL 121, 214801 (2018) [2] Shiloh et al., Nature 597, 498 (2021) [3] Chlouba et al., Nature, 622, 476 (2023)

AKBP 4.4 Tue 16:30 ZHG Foyer 1. OG

Optimisation of drift tube cooling and drift tube geometries of an additive manufacturing IH-type cavity — •Benjamin Dedic, Hendrik Hähnel, Adem Ateş, Jan Dominik Kaiser, and Ulrich Ratzinger — Institut für Angewandte Physik Goethe Universität Frankfurt am Main

Additive manufacturing is a now-powerful tool for the rapid prototyping and manufacturing of complex geometries. A proof-of-concept 433 MHz IH-DTL cavity was constructed for direct additive manufacturing of linear accelerator components. The CFD analysis of the initially designed cooling for the drift tube revealed a design with insufficient heat dissipation; this can lead to thermal deformations as well as problems in keeping the frequency stable during operation. In this respect, an optimization of the cooling system was done in detail with the help of advanced thermal simulation and iterative design improvements. Furthermore, the geometries of the drift tubes were refined to improve mechanical stability and thermal efficiency without compromising electromagnetic performance. The results illustrate that additive manufacturing can achieve significant design freedom, enabling new approaches toward the thermal management challenges faced by high-frequency linear accelerator components.

AKBP 4.5 Tue 16:30 ZHG Foyer 1. OG

Ultrafast electron diffraction at DELTA - commissioning and first results — •Linus Bölte[1], Xijie Wang[1,2], Arne Held[1], Peter Hartmann[1], Carsten Mai[1], Klaus Sokolowski-Tinten[2], and Marius Milnikel[2] — [1]Technische Universität Dortmund — [2]Universität Duisburg-Essen

Ultrafast electron diffraction (UED) enables the measurement of atomic-scale dynamics with femtosecond time resolution.

At DELTA, a new UED experiment has been commissioned, featuring a 100 kV direct current electron gun and a 3 GHz radiofrequency cavity. Here we present the commissioning process and initial results, demonstrating the potential for simultaneous bunch compression and acceleration.

AKBP 4.6 Tue 16:30 ZHG Foyer 1. OG

New aspects of laser polishing of niobium for the production of superconducting cavity resonators — •Florian Brockner and Dirk Lützenkirchen-Hecht — Bergische Universität Wuppertal, Germany

Superconducting cavity resonators require niobium surfaces with low roughness, high chemical purity and isotropic properties. Laser polishing is a more environmentally friendly alternative to established chemical and electrochemical polishing processes and avoids the formation of impurities through non-contact processing.

The melting of the surface during polishing not only smoothes the surface but also heats it. This allows niobium to be doped during the polishing process. Both polishing and doping are strongly influenced by process parameters such as laser power, nitrogen pressure and material parameters related to the crystal structure of the material.

The process parameters were varied to investigate the influence on nitrogen deposition and roughness. The surface properties were analysed using optical profilometry and electron microscopy. The changes in chemical composition and nitrogen incorporation were studied by electron microscopy combined with energy dispersive X-ray spectroscopy and extended X-ray absorption fine structure. X-ray diffraction was also carried out.

AKBP 4.7 Tue 16:30 ZHG Foyer 1. OG

Messung der dielektrischen Eigenschaften von 3D Druck Filamenten bei 500 MHz — •Philipp Müller und Hendrik Hähnel — Institut für Angewandte Physik, Goethe-Universität Frankfurt am Main, Frankfurt am Main, Deutschland

Zur Bestimmung der relativen Permittivität ϵ_r und des Verlustfaktors $\tan(\delta)$ von 3D-Druck Filamenten bei einer Frequenz von 500 MHz wurde ein Testresonator gebaut. Durch Einlegen von Testkörpern des jeweiligen Materials (Dielektrikums) ändern sich die Resonanzfrequenz, sowie die Güte der Kavität. Durch Vergleich mit Simulationen lassen sich dann ϵ_r und $\tan(\delta)$ bestimmen, was es ermöglicht 3D-Druck Filamente in HF Anwendungen, wie z.B. Kopplern einzusetzen. Die Ergebnisse der Untersuchung werden präsentiert.

AKBP 4.8 Tue 16:30 ZHG Foyer 1. OG

Utilizing Raspberry Pi Cameras for Multipacting Observations and Beam Characterization — •Leonie Bauer, Adem Ates, Hendrik Hähnel, and Ulrich Ratzinger — Institut für Angewandte Physik, Goethe Universität Frankfurt

Multipacting is a well-known phenomenon in accelerator cavities, typically appearing at lower RF power levels. To gain a better comprehension and characterization of these resonant discharges, the Institute for Applied Physics at Goethe University Frankfurt has implemented optical diagnostic techniques as part of the FRANZ project. By installing Raspberry Pi cameras both inside and outside the Radio Fre-

quency Quadrupole (RFQ) cavity, we can directly visualize low power multipacting events and even observe the beam passing through the RFQ. As the conditioning power increases, additional optical phenomena become evident, starting at approximately 15 kW. Moreover, these camera systems enable the detection of beam-induced residual gas fluorescence, providing a direct method to determine the x-y position of the 700 keV proton beam at the RFQ exit.

AKBP 4.9 Tue 16:30 ZHG Foyer 1. OG

Generation of few-cycle laser pulses via HCF-based compression for pump probe experiments in plasma-based accelerators — •Onur Bilen, Marc Osenberg, Mirela Cerchez, Edgar Hartmann, Paula Sedlatschek, and Bernhard Hidding — Institute of laser- und plasmaphysics, Heinrich Heine University Düsseldorf

Generating ultrashort laser pulses is essential for resolving femtosecond-timescale dynamics in plasma-based particle accelerators. Here we present a hollow-core fiber setup designed to achieve sub-10 femtosecond pulses with a record-breaking pulse energy output of at least 2 millijoule. These ultrashort laser pulses will be utilized to visualize the acceleration process of electrons within a plasma wake via shadowgraphy. To create an ultrashort pulse, multiple light frequencies must overlap constructively, the more frequencies the shorter the pulse. To introduce more frequencies into a pulse, a nonlinearity known as self-phase modulation is employed. Self-phase modulation requires an intense, short laser pulse and a material with strong third-order nonlinearity. Noble gases such as neon and argon have shown sufficiently strong third-order nonlinear behaviour and are widely used for spectral broadening. The necessary intensity is achieved by focusing the light down to a smaller beam diameter. A hollow-core fiber is used to maintain a small beam diameter over a longer distance and to clean the spatial profile of the pulse. The spectrally broadened pulse can then be compressed to sub-10 femtoseconds using chirped mirrors and used for shadowgraphy.

AKBP 4.10 Tue 16:30 ZHG Foyer 1. OG

Extended phase space tomography for EOSD simulation considering crystal geometry effects — •Felipe Donoso, Stefan Funker, Erik Bründermann, Anke-Sussane Müller, and Martin Frank — KIT, Karlsruhe, Germany

This theoretical study presents an advanced method for longitudinal phase space tomography in electron storage rings, focusing on reconstructing phase space densities from electro-optical spectral decoding (EOSD) measurements that incorporate crystal geometry effects. The EOSD crystal geometry significantly impacts the measurement signal due to signal integration along its length and interference from wake fields and Cherenkov diffraction radiation (ChDR). These effects add challenges to reconstructing the original phase space density from experimental data.

To address these challenges, we integrate two theoretical frameworks. First, we employ the Vlasov-Fokker-Planck equation to model the turn-by-turn evolution of the charge density distribution. Second, CST simulations of the bunch profile characterize the electric field inside the crystal, enabling a tailored simulation for the EOSD system at the Karlsruhe Research Accelerator (KARA). By combining these approaches, we propose a refined tomography method that more accurately reconstructs the longitudinal phase space from sensor data, effectively capturing the interplay between bunch dynamics and the EOSD system configuration.

AKBP 4.11 Tue 16:30 ZHG Foyer 1. OG

Possibilities for performance enhancement of a compact TDS at FLUTE — •Sergei Glukhov[1], Matthias Nabinger[2], Michael Nasse[2], Anton Malygin[2], Erik Bründermann[2], Anke-Susanne Müller[2], and Oliver Boine-Frankenheim[1] — [1]Institute for Accelerator Science and Electromagnetic Fields (TEMF), Darmstadt, Germany — [2]Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

A compact transverse-deflecting system (TDS) is being commissioned at the test facility FLUTE (Ferninfrarot Linac- und Test-Experiment) located at the Karlsruhe Institute of Technology (KIT). It has been proposed for diagnostics of short electron bunches. The idea of the technique is to use terahertz (THz) radiation, produced by the tilted-pulse front method using a part of the photoinjector laser, amplified by a sub-mm scale resonator for streaking of the electron bunch. Two types of resonators and their arrays have been studied: inverse split-ring and tilted slit resonator.

Since the temporal resolution of this technique depends strongly on the electric field strength in the resonator gap, it would be desirable to increase this field strength. A horn-antenna-like device placed near the resonator has been proposed and simulated for this purpose. Simulations and geometrical parameter optimization have been performed using CST MICROWAVE STUDIO and will be presented in this contribution.

AKBP 4.12 Tue 16:30 ZHG Foyer 1. OG

Experimental strategy for diagnostic and parameters control of ARCTURUS high power laser system — •Kamill Naczynski, Mirela Cerchez, Koen Macken, Thomas Heinemann, Marius te Poel, and Bernhard Hidding — Institute of Laser- and Plasmaphysics, Heinrich-Heine-University Düsseldorf, Germany

Plasma-based Laser-Wakefield Accelerators (LWFAs) are a compact source of highly relativistic electron beams. However, fluctuations in the laser-plasma interaction affect the stability and reproducibility compared to other acceleration methods. For this reason, the characterization and active control of laser parameters is vital to improve the LWFA performance.

Here, we present an integrated strategy to monitor, characterize and active control the ARCTURUS high power laser beam at the Heinrich Heine University Düsseldorf aiming towards the characterization of pulse duration, spatial and temporal intensity profile and spectrum. The beam pointing and wavefront are measured and actively corrected in a closed loop by an adaptive mirror, specifically including the possibility to employ this system at full-power operation. This setup aims for substantial improvements in reproducibility and shot-to-shot stability, in turn enhancing the performance of future LFWA experiments.

AKBP 4.13 Tue 16:30 ZHG Foyer 1. OG

Advanced Diagnostic Setup Combining Few-Cycle Shadowgraphy, Schlieren Imaging, and Interferometry for Laser Wakefield Acceleration Experiments — •Marc Osenberg, Paula Sedlatschek, Onur Bilen, Edgar Hartmann, Georg Pretzler, and Bernhard Hidding — Institute of Laser- and Plasmaphysics, Heinrich Heine University Düsseldorf

We present a comprehensive diagnostic setup for laser wakefield acceleration (LWFA) experiments, combining few-cycle pulse shadowgraphy with quantitative Schlieren imaging and interferometric phase shift measurements. This integrated approach enables precise visualization and quantification of refractive index gradients induced by the electron distribution in plasma wakefields generated by high-power laser pulses. The quantitative Schlieren method provides detailed mapping of refractive index variations, while the interferometric capability allows for accurate phase shift measurements to reconstruct plasma density profiles and electric field distributions. By leveraging advanced optical setups and image processing algorithms, the system achieves high spatial and temporal resolution, facilitating in-depth analysis of wakefield dynamics, including amplitude, phase velocity, and electron distribution. The combined techniques provide significant insights into laser-plasma interactions, paving the way for enhanced performance in next-generation accelerator technologies.

AKBP 4.14 Tue 16:30 ZHG Foyer 1. OG

Self- and pre-ionized electron-driven wakefields in mixed gases at SLAC FACET-II — •Edgar Hartmann[1], Ahmad Fahim Habib[2,3], Mirela Cerchez[1], Marc Osenberg[1], Thomas Heinemann[1], Andrew Sutherland[1], Alexander Knetsch[4], and Bernhard Hidding[1,2,3] — [1]Institute for Laser- and Plasmaphysics, Heinrich Heine University, Düsseldorf — [2]University of Strathclyde, Glasgow, UK — [3]The Cockcroft Institute, Warrington, UK — [4]SLAC National Accelerator Laboratory, Menlo Park, California, USA

We present experimental results from the Facility for Advanced Accelerator Experimental Tests II (FACET-II) at SLAC National Accelerator Laboratory, marking the first exploratory experiments of the E310: Trojan Horse-II program. This work focuses on advancing a novel mechanism for generating high-brightness witness beams in electron beam-driven plasma wakefield accelerators. The mechanism, known as Trojan Horse injection, relies on selective ionization of a low-ionization-threshold (LIT) and high-ionization threshold (HIT) species, such as hydrogen and the first ionization level of helium. In this process, the LIT species provides the plasma sustaining the wakefield accelerator and is ionized either by the electron beam itself or by a pre-ionizing laser pulse. A secondary injector laser pulse ionizes the HIT species only within a small, defined region directly within the wakefield. The preliminary experiments investigated the ionization capabilities of the 10 GeV electron driver in a gas mixture. Selective ionization of only

the LIT species is critical for enabling Trojan Horse injection.

AKBP 4.15 Tue 16:30 ZHG Foyer 1. OG

Extending aperture3d for Beam Dynamics Simulations of the High-Level Injector (HLI) at GSI — •Pascal Häckel[1,2], Winfried Barth[1,2], and Uwe Scheeler[1] — [1]GSI, Darmstadt — [2]Hi, Mainz

Beam dynamics simulations play a critical role in understanding and optimizing accelerator systems. In this work, we utilize and extend the capabilities of aperture3d, a versatile beam dynamics simulation framework, to model the High-Level Injector (HLI) at the GSI Helmholtzzentrum für Schwerionenforschung.

The study involves adapting aperture3d to accurately represent the unique components and operational parameters of the HLI, including the ion source, RFQ, and drift tube linac. Enhancements to the software were implemented to accommodate specific requirements, such as detailed beamline geometries, and custom diagnostics for analyzing transverse and longitudinal beam dynamics.

The extended functionality of aperture3d enabled precise simulations of the HLI's performance, highlighting emittance growth mechanisms, beam losses, and potential bottlenecks. These insights not only validate aperture3d as a robust tool for high-intensity accelerator studies but also pave the way for further software improvements tailored to complex accelerator systems.

This work underscores the value of extending modular simulation frameworks like aperture3d for advanced research in beam physics and accelerator optimization.

AKBP 4.16 Tue 16:30 ZHG Foyer 1. OG

Variation of the laser focus field geometry for direct electron acceleration — •Lars Torben Schwabe, Jan Riedlinger, Marc Osenberg, and Georg Pretzler — Institute of Laser- and Plasmaphysics, Heinrich Heine University Düsseldorf

The field geometry of a laser focus can be engineered by spatially resolved phase and polarization manipulations in the near field. In this work, focal structures with isolated longitudinal fields on axis, surrounded by a ring of transversal fields, are generated. Experimental results of these focal geometries, which match numerical simulations of the 3D field structures, are presented. Furthermore, PIC-simulations were performed to model the interaction of these fields with free electrons, for example in plasma. We discuss the possibilities and conditions for obtaining directed electron acceleration in the longitudinal fields of an ultrashort laser pulse and its properties.

AKBP 4.17 Tue 16:30 ZHG Foyer 1. OG

Thermal emittance measurements of photocathodes using single-shot techniques at the European XFEL — •Meng Cai — University of Hamburg, Mittelweg 177, 20148 Hamburg — DESY, Notkestraße 85, 22607 Hamburg

The operation of the European XFEL relies on the generation of high-quality electron beams at the photoinjector exit, with peak brightness limited by the photocathode's thermal emittance. Cathode characteristics evolve over time due to multiple cathode laser properties and actual gun conditions, making regular measurements essential for injector optimization. This work explores a single-shot measurement technique at the European XFEL to image and measure the transverse momentum distribution of photoemitted electrons. This method maps the momentum onto an observation screen, greatly enhancing time efficiency for thermal emittance measurements while preserving high spatial and momentum resolution.

AKBP 4.18 Tue 16:30 ZHG Foyer 1. OG

Adaptive automated activation of GaAs photocathodes at Photo-CATCH* — •Markus Engart, Joachim Enders, Maximilian Herbert, Maximilian Meier, Robin Petry, Julian Schulze, and Vincent Wende — Institut für Kernphysik - TU Darmstadt

Photocathodes based on the III-V seminconductor GaAs are used as photo-electron sources to supply spin-polarized electron beams for accelerator applications. In order to achieve a sufficient electron yield, a thin surface layer of cesium combined with an oxidant is applied onto the cathode surface. This process is called the cathode activation and is typically done manually by an experienced operator. This contribution presents the ongoing development and testing of an adaptive algorithm for automated activation at the Photo-CATCH test stand.

*Work supported by DFG (GRK 2128 AccelencE, project number 264883531)

AKBP 4.19 Tue 16:30 ZHG Foyer 1. OG

Optical Emission Spectroscopy for the Characterization of a 2.45 GHz ECRIS Plasma — •Maria Molodtsova, Alexandra Philipp, and Erik Ritter — DREEBIT GmbH, Southwallstr. 5, 01900

ECR ion sources are widely used at many research institutions to provide ions for various experimental setups. DREEBIT GmbH aims to industrialize this type of ion source technology for efficient and reliable use in, e. g., hadron cancer therapy as well as ion implantation of semiconductors. Our goal is to build table-top sized ion sources which can easily be handled as part of a larger machine such as a particle accelerator or target irradiation facility, thereby fulfilling high requirements on beam current, quality, stability as well as reproducibility in serial production. To achieve this, we have already optimized the microwave injection system and magnetic plasma confinement by introducing a simple method to allow for injection of circularly polarized waves and adjusted the magnetic field distribution which led to an 80 % increase of beam current. In the present work, we show how optical emission spectroscopy was used to gain deeper information about the plasma of this specific type of ion source, independent from its ion extraction system. The plasma characterization includes studies of the electron energy distribution and the density of atomic and molecular hydrogen showing that the previous design changes of introducing circularly polarized microwaves and optimizing the magnetic field distribution have led to a well-optimized ECR ion source concerning plasma heating and proton production inside the plasma.

AKBP 5: Particle Sources

Time: Wednesday 11:00–12:30 Location: ZHG004

AKBP 5.1 Wed 11:00 ZHG004

Current Developments in a Hybrid Thermionic and Photoemission Electron Gun for ELSA — •Samuel Kronenberg, Klaus Desch, Philipp Hänisch, Dennis Proft, Yannick Schober, and Michael Switka — Physikalisches Institut der Universität Bonn

A novel electron gun is currently under development for the S-band Linac injector for ELSA. The goal of this enhancement is to realise a new single bunch injection mode in addition to the standard long pulse (multi bunch) mode along with a potential increase in emission current. A dual-mode design is being developed that utilises a caesium dispenser cathode both as a thermionic and a photo-cathode using thermally assisted photoemission. Initial measurements on dispenser cathodes were performed to verify the properties in this mode of operation. The current progress regarding gun design, as well as the development of a dedicated gun test stand will be presented.

AKBP 5.2 Wed 11:15 ZHG004

Spin-Polarized Electron Beams at the ELSA Accelerator Facility — •Axel Spreitzer, Klaus Desch, Dennis Proft, and Michael Switka — Physikalisches Institut der Universität Bonn

At the Electron Stretcher Facility (ELSA) in Bonn a spin-polarized electron beam is generated by irradiating a Strained-Layer Superlattice GaAs photocathode. The electron beam converted into a circularly polarized photon beam allows for double polarization hadron physics experiments. After being hibernated for several years, the polarized source is to be characterized and optimized to re-establish regular operation. Current efforts focus on the optimization of the source's laser and its beamline, as well as the investigation of the quantum efficiency of different photocathode crystals. Furthermore, in prospect of improving the overall system performance, plans include the optimization of the electron beamline and enhancing the electron polarization transfer efficiency. The current state of the polarized electron source setup is presented and discussed.

AKBP 5.3 Wed 11:30 ZHG004

Photocathode Research at Photo-CATCH* — •Maximilian Herbert, Joachim Enders, Markus Engart, Jonas Imhof, Maximilian Meier, Robin Petry, Julian Schulze, Vincent Wende, and Victor Winter — Institut für Kernphysik, Fachbereich Physik, Technische Universität Darmstadt, Darmstadt, Germany

TU Darmstadt's test stand for Photo-Cathode Activation, Testing and Cleaning using atomic-Hydrogen Photo-CATCH faciliates dedicated research on GaAs photocathodes for electron-beam production at accelerators. This contribution will give an overview of recent, ongoing and planned projects at Photo-CATCH, e.g., on automatized activations [1] and Li-enhanced surface layers for increased photocathode lifetime [2,3].

[1] M. Herbert et al., PoS(PSTP2022), Vol. 433, p. 003 (2023).
[2] N. Kurichiyanil et al., J. Instrum. 14 (8), P08025 (2019).
[3] M. Herbert et al., Phys. Rev. Accel. Beams, in press.

*Work supported by DFG (GRK 2128 "AccelencE", project number 264883531)

AKBP 5.4 Wed 11:45 ZHG004

Studie zur Nutzung einer Lanthanhexaborid-Kathode als thermionische Elektronenquelle des S-DALINAC* — •Benjamin Thormann, Michaela Arnold, Lars Jürgensen und Norbert Pietralla — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Deutschland

Der Elektronenbeschleuniger S-DALINAC verwendet aktuell ein Wolfram-Filament als thermionische Elektronenquelle. Hinsichtlich der ausgezeichneten Strahlqualität, die mittels LaB_6-Kathoden in Elektronenmikroskopen erreicht wird, wurde untersucht, ob die Elektronenquelle des S-DALINAC durch den Einsatz dieser Kathoden verbessert werden kann. Dazu wurde die Elektronenquelle mit LaB_6-Kathode in CST Studio simuliert und mit einer Simulation des aktuellen Aufbaus verglichen. Dieser Vortrag gibt einen Überblick über die Studie. Ihre Ergebnisse werden diskutiert.

*Unterstützt durch DFG (GRK 2128, IRTG 2891) und das Land Hessen (Research Cluster ELEMENTS (Project ID 500/10.006)).

AKBP 5.5 Wed 12:00 ZHG004

Positron Source at Future Linear Collider Designs (ILC, HALHF, CLIC) — •Gudrid Moortgat-Pick[1,2], Sabine Riemann[3], Peter Sievers[4], Gregor Loisch[2], Carmen Tenholt[2], Tim Lengler[5], Dieter Lott[5], Niclas Hamann[1,2], and Manuel Formela[1,2] — [1]University of Hamburg, Hamburg, Germany — [2]DESY, Hamburg, Germany — [3]DESY, Zeuthen, Germany — [4]CERN, Geneva, Switzerland — [5]Helmholtz Zentrum Hereon, Geesthacht

Positron Sources for high luminosity high-energy colliders with at least a cms of 500 GeV are a challenge for all future lepton colliders as, for instance, the International Linear Collider (ILC), Compact Linear Collider (CLIC) as well as new concepts as the HALHF collider design. In the talk new R&D developments for the undulator-based positron source are discussed. The talk includes physics requirements, target material tests, current prototypes for optic matching devices as pulsed solenoid as well as plasma lenses. The applicability of the undulator-based positron source in order to provide polarized positrons for all three collider designs is discussed.

AKBP 5.6 Wed 12:15 ZHG004

Results Of Longevity Measurements Of A Prototype Plasma Lens For Positron Matching — •Niclas Hamann[1], Manuel Formela[1], Gregor Loisch[2], Gudrid Moortgat-Pick[1,2], Kai Ludwig[2], Stephan Wesch[2], and Jonathan Wood[2] — [1]Uni Hamburg — [2]DESY Hamburg

The pursuit of novel technologies in the dynamic landscape of scientific exploration has driven the investigation of plasma lensing as a promising solution for optical matching at future positron sources. This research gains importance as emerging scientific objectives call for innovative approaches to advance experimental capabilities. Our initial experiments uncovered instabilities within the plasma and a significant level of copper sputtering at the electrodes. This presentation will explore these findings in detail and will also present the results of longevity tests conducted across various pressure regions and for two different materials.

AKBP 6: Accelerators for Medical Applications (joint session ST/AKBP)

Time: Wednesday 13:45–15:45 Location: ZHG009

Invited Talk AKBP 6.1 Wed 13:45 ZHG009

Mixed ion beams for treatment monitoring: recent developments and future prospects — •Elisabeth Renner[1], Hermann Fuchs[2], Matthias Kausel[3,1], and Claus Schmitzer[3] — [1]Atominstitut, TU Wien, Vienna, Austria — [2]MedUni Wien, Vienna, Austria — [3]MedAustron, Wiener Neustadt, Austria

In recent years, the use of mixed ion beams has been proposed as a method for treatment monitoring in ion beam therapy. A promising candidate in this context is a $^{12}C^{6+}$ beam with a small $^{4}He^{2+}$ contribution. The similar charge-to-mass ratios of these two ion species enable their simultaneous acceleration in medical synchrotrons. Being extracted at almost the same energy per mass, $^{4}He^{2+}$ features a range in matter approximately three times that of $^{12}C^{6+}$. This opens the possibility for tumor treatment with $^{12}C^{6+}$ while simultaneously performing $^{4}He^{2+}$ imaging downstream of the patient.

In 2024, the first successful delivery of a mixed $^{12}C^{6+}/^{4}He^{2+}$ beam in a clinical facility was achieved at MedAustron. Instead of being generated in a single ion source, as realized at GSI in late 2023, the two ion species were mixed during the injection into the synchrotron, before being simultaneously accelerated and extracted into the research irradiation room. There the ion mix was characterized using radiochromic films, low-gain avalanche diode detectors, and a configuration of two ionization chambers separated by multiple PTW RW3 slabs.

This talk provides a general overview of recent breakthroughs in mixed ion beam delivery, discusses technical challenges, and explores the future potential for treatment monitoring in ion beam therapy.

AKBP 6.2 Wed 14:15 ZHG009

Beam Dynamics and Energy Variation in H-Type Drift Tube Linac for Proton Eye Therapy — •Ali Almomani — Physics Department, Yarmouk University, 21163 Irbid, Jordan

In this study, we investigate the beam dynamics of a proposed H-type drift tube linac (DTL) designed for proton therapy in eye cancer treatment, utilizing the KONUS (Kombinierte Null Grad Struktur) beam dynamics approach and LORASR code. The linac design accelerates protons from 3 MeV to 70 MeV across six cavities with 140 accelerating gaps along a 20-meter structure, operating at a frequency of 325.244 MHz. To ensure transverse beam focusing and beam matching, 11 triplet quadrupole lenses are distributed along the linac. The beam dynamics analysis yielded optimized values for drift tube lengths and gap distances, and simulations showed 100% beam transmission efficiency. The design demonstrated low emittance growth, with less than 20% transversely and 90% longitudinally, ensuring a highly focused beam. The output beam emittances are smaller than what cyclotron can offer, facilitating the generation of a pencil beam capable of scanning the tumor volume from one point to another. Additionally, energy variation options allow flexible beam energy adjustment between 58 and 70 MeV, enabling customizable treatment depths. The energy variation may be realized by varying the gap of voltage levels. The simulation results indicate a stable structure even in the presence of machine errors, supporting further development for RF simulations and mechanical modeling. The overall outcomes are promising, confirming the feasibility of the design for proton therapy applications.

AKBP 6.3 Wed 14:30 ZHG009

Beam spot diagnostics of highly focused electron beams in therapeutic X-Ray generators via Optical Transition Radiation — •Thomas Beiser[1] and Kurt Aulenbacher[2] — [1]Helmholtz-Institute Mainz, (Germany), GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt (Germany) — [2]Helmholtz-Institute Mainz, (Germany), GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt (Germany), Johannes Gutenberg-University, Mainz (Germany)

Optical Transition Radiation (OTR), which is commonly used for beam diagnostics in accelerators at high energies (e.g. MeV to GeV electrons), allows for beam spot diagnostics of intense and highly focused electron beams in therapeutic X-Ray generators with energies as low

as 100 keV, using off-the-shelf camera equipment.

AKBP 6.4 Wed 14:45 ZHG009

Development of a Fast Extraction Method to Extract High Intensity Short Pluses at ELSA — •Leonardo Thome, Klaus Desch, Dennis Proft, and Michael Switka — Physikalisches Institut der Universität Bonn

The electron accelerator facility ELSA delivers electron beams up to 3.2 GeV energy, extracted via slow resonance extraction from the stretcher ring in an extraction cycle of typically 10 s. Currently ongoing studies for radiation therapy, investigating the FLASH effect, require short beam pulses reaching from ns to ms. In a preliminary operation mode the booster synchrotron is already used to deliver electrons beam pulses of 1.2 GeV energy with fixed length of 250 ns to irradiate cell samples. To cover higher energies up to 3.2 GeV and different pulse lengths ranging from ns up to several ms, a fast extraction method from the stretcher ring is developed. The concept and realization by different techniques such as a repurposing of the existing injection kickers for extraction or utilizing a dispersive orbit to extract the beam is evaluated.

AKBP 6.5 Wed 15:00 ZHG009

First Results from Cell Irradiation Experiments with Ultrahigh-Energy Electrons (UHEE) at ELSA — •Susanne Spaeth[1], Manuela Denz[2], Klaus Desch[1], Stephan Garbe[2], Frank Giordano[3], Barbara Link[3], Carsten Herskind[3], Barbara Link[3], Dennis Proft[1], and Leonardo Thome[1] — [1]Physikalisches Insitut der Universität Bonn — [2]Klinik für Strahlentherapie und Radioonkologie, Universitätsklinikum Bonn — [3]Klinik für Strahlentherapie und Radioonkologie, Universitätsklinikum Mannheim

A new approach to improve radiotherapy is the use of the so-called FLASH effect, a phenomenon characterised by significantly reduced toxicity in healthy tissue at high dose rates (>40 Gy/s). This effect potentially broadens the therapeutic window, improving tumour control while minimising side effects. At the electron accelerator facility ELSA, the FLASH@ELSA project utilises ultra-high energy electrons (UHEE) to study their effect on tumour cells. Electrons with energies of 1.2 GeV are delivered in sub-microsecond pulses via the booster synchrotron, enabling dose rates up to 10 MGy/s due to the short pulse lengths of 250 ns. Cell samples are irradiated within a water phantom, with dosimetry performed using radiochromic films and luminous screens. Further the FLASH irradiation at ELSA is compared to conventional radiotherapy using a medical linear accelerator (Varian TrueBeam STx) at the University Hospital Bonn. This comparison provides the first survival curves contrasting FLASH and conventional irradiation.

AKBP 6.6 Wed 15:15 ZHG009

Dosimetry of broadband electrons from laser-plasma accelerators — •Antonio Tarzikhan[1], Arpad Lenart[2], Chuan Zheng[1], Thomas Heinemann[1], Constantin Aniculaesei[1], Mirela Cerchez[1], and Bernhard Hidding[1] — [1]Institute of Laser- and Plasmaphysics, Heinrich Heine University, Düsseldorf, Germany — [2]University of Strathclyde, Glasgow, Scottland

Laser-plasma accelerators (LPA) offers compact sources of highly relativistic electron beams for various applications. This study focuses on the dosimetry of broadband electron beams, which are accelerated using the Arcturus laser system at the University of Düsseldorf with laser pulse energies of several millijoules sufficient to accelerate electrons to kinetic energies in the mega-electronvolt range, resulting in an energy distribution characterized by a shallow penetration and high dose deposition at the surface. These electron beams are therefore ideally suited for the treatment of skin cancer. We present the design and calibration of various diagnostics components and report on first experimental results obtained in a recent measurement campaign, incorporated with simulations to optimize the parameters used for the characterization of the electron beam energy- and angular-distribution and the charge calibration to determine the dose. Additionally, accelerated electron beams from intrinsic ultra-short bunch durations, are excellent candidates for FLASH radiotherapy and thus, minimizing damage to surrounding healthy tissues. This highlights the potential of LPA as a new technology in medical physics.

AKBP 6.7 Wed 15:30 ZHG009

Acoustic tracing of dose deposition of laser accelerated ion-bunches by modulation of the depth-dose curve — •Jeannette Cadeggianini, Alexander Prasselsperger, Anna-Katharina Schmidt, and Jörg Schreiber — Ludwig-Maximilian-Universität, München, Germany

A high-repetition-rate online dose reconstruction method is crucial for accelerated particle applications. Ionoacoustic measurements determine monoenergetic ion energies by recording acoustic signals generated by localized thermal expansion in the Bragg region. These waveforms encode the ion beam's energy and spatial distribution.

However, this method depends on pronounced spatial energy density gradients, which are absent in laser-accelerated ion beams, which exhibit broad, exponential energy spectra. To address this, we introduce TIMBRE (Tracing Ionoacoustic Modulations of Broad Energy Distributions), which uses modulator foils to create steeper energy deposition gradients. These foils serve two functions: due to the materials the stopping power in the foils is higher than in the interspaces, generating an acoustic wave at each interface because of the steep pressure gradient. Simultaneously, each foil reduces the amplitude of the signals from shallower foils, compressing the dynamic range.

By unfolding the measured acoustic traces with the corresponding analytic model, TIMBRE reconstructs depth dose distributions of laser-accelerated ion bunches. It offers a real-time diagnostic, supporting modern accelerators operating at Hz-level repetition rates and beyond.

AKBP 7: Novel Accelerator Concepts II and FELs

Time: Wednesday 16:15–18:15 Location: ZHG004

AKBP 7.1 Wed 16:15 ZHG004

Considerations for high repetition rate plasma accelerator sources — •Juan Pablo Diaz, Stephan Wesch, and Jonathan Wood for the FLASHForward-Collaboration — Deutsches Elektronen-Synchrotron DESY

Electron-bunch-driven plasma-wakefield accelerators promise to revolutionize particle acceleration by providing compact and cost-effective energy boosters for electron linacs which could, for example, significantly enhance the photon energies produced by free-electron lasers. The FLASHForward facility at DESY has made substantial progress, demonstrating that accelerated electron bunches can maintain their charge, energy spread, and emittance during plasma acceleration. A major challenge remains in achieving high-repetition-rate operation, as is common in conventional radiofrequency accelerators.

To match the bunch patterns of superconducting RF linacs, identical plasma acceleration events must take place at MHz frequencies. This presents two challenges: how to maintain the same plasma density over these timescales, and how to deal with the high heat load in the plasma and its containment device. In this contribution we will first outline plans and recent results to measure the density evolution of discharge-initiated plasmas with high temporal and spatial resolution. Secondly, we will report on the long-term heating of the plasma cell from repeated plasma creation events with a view towards implementing mitigation strategies

AKBP 7.2 Wed 16:30 ZHG004

New radiation-based method for diagnosing driver dynamics in plasma wakefield accelerators — •Nico Wrobel[1], Alexander Debus[1], Arie Irman[1], Maxwell La Berge[1], Susanne Schöbel[1], Ulrich Schramm[1], Klaus Steiniger[2], Jessica Tiebel[1], Patrick Ufer[1], and Richard Pausch[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf: Dresden, Sachsen, DE — [2]Center for Advanced Systems Understanding: Görlitz, DE

Plasma Wakefield accelerators (PWFA) are a novel concept to build compact particle accelerators while improving beam quality compared to Laser Wakefield accelerators (LWFA). The precise dynamics of the driver in a PWFA are subject of interest, as they determine the created fields and therefore the capabilities to accelerate particles in the

wake. One issue in improving PWFA is understanding these driver beam dynamics in the plasma, since it cannot be observed directly in experiments.

Here, we present a novel diagnostic method to overcome this problem by using the measurement of radiation emitted by the driver electrons. This method can reconstruct transversal and longitudinal dynamics of the driver. To develop this method, the many-GPU particle-in-cell code PIConGPU was used to model the ab-initio plasma dynamics. In addition, we computed the spectrally and directionally resolved far field radiation in-situ. We also developed an analytical description to explain the complex driver dynamics, such as the oscillation and degradation patterns observed in the plasma simulations, and directly related them to the infrared radiation signatures.

AKBP 7.3 Wed 16:45 ZHG004

Hydrodynamic simulations of plasma sources for wakefield acceleration — •Mathis Mewes[1], Gregory Boyle[2], Harry Jones[1], Rob Shalloo[1], and Maxence Thévenet[1] — [1]DESY, Hamburg, Germany — [2]James Cook University, Townsville, Australia

With the recent advancements in plasma wakefield acceleration (PWA), it becomes more important to fully understand the dynamics of plasma sources. Some of the critical questions surround discharge control, laser guiding and cooling. Numerical simulations can provide detailed insight into the relevant dynamics.

Particle in Cell simulations work well in the kinetic regime of a wakefield, which occurs on femtosecond time scale, but they are impractical for long term plasma evolution. Instead, (Magneto-)Hydrodynamic simulations can describe thermalized plasma at viable computational costs.

In this work, we propose a quasi-neutral single-fluid plasma model for plasma sources. It uses two temperatures and evolves the composition via collisional reactions and diffusion. The model is implemented in the COMSOL multiphysics software.

We will present and examine simulation results and benchmarks for laser ionized and discharge plasma sources utilized in plasma wakefield accelerators.

AKBP 7.4 Wed 17:00 ZHG004

A virtual spectral diagnostic for plasma accelerated bunches at FLASHForward — •Philipp Burghart[1,2], Lewis Boulton[1], and Jonathan Wood[1] for the FLASHForward-Collaboration — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]University of Hamburg, Germany

Plasma-wakefield acceleration (PWFA) promises to reduce the size of future machines significantly by providing multi-GeV/m acceleration gradients, orders of magnitude higher than conventional RF accelerators. However, PWFA is a process with many non-linear dependencies, making it difficult to understand the influence of input parameters. Moreover, measurements of e.g. energy spectra are destructive, preventing the output beam from being used for applications whilst only allowing for the diagnosis of one bunch in a bunch train simultaneously. Neural networks trained on non-destructive measurements can be used to predict the properties of accelerated bunches, which would provide more insight into sources of variability and potential shot-to-shot, non-destructive measurements for whole bunch trains. Using experimental data collected at FLASHForward - a beam-driven plasma acceleration experiment at DESY, Hamburg - a neural network-based virtual diagnostic predicting the spectral properties of plasma accelerated bunches is being investigated. In this contribution, we present first results from this project.

AKBP 7.5 Wed 17:15 ZHG004

Plasma Afterglow Metrology for Laser-Wakefield Accelerators — •Nils Hanold, Marc Osenberg, Paula Sedlatschek, Kamil Naczynski, Edgar Hartmann, Onur Bilen, Natascha Thomas, Jesko Wrobel, Andrew Sutherland, Mirela Cerchez, Constantin Aniculaesei, Thomas Heinemann, and Bernhard Hidding — Institute of Laser- and Plasmaphysics, Heinrich Heine University Düsseldorf

Characterizing the plasma light emitted upon the interaction of a high-power laser with a gas target aims for the development of a non-invasive metrology technique for the complex processes in laser-wakefield accelerators (LWFAs). While integrating the emitted afterglow temporally and spectrally allows obtaining top level information about the interaction, resolving it spectrally and temporally allows extracting further information such as involved ionization levels, laser-plasma interaction strength, dynamics and evolution, to identify and quantify ionization processes along the laser propagation axis, and markers of injection events.

AKBP 7.6 Wed 17:30 ZHG004

Status of THz FEL activities at PITZ — •Namra Aftab, Xiangkun Li, and Mikhail Krasilnikov — Deutsches Elektronen-Synchrotron DESY, Platanenallee 6, 15738 Zeuthen, Germany

A single-pass THz free-electron laser (FEL) at the Photo Injector Test facility at DESY in Zeuthen (PITZ) was designed and implemented for a proof-of-principle experiment on a tunable high-power THz source for pump-probe experiments at the European XFEL. THz pulses are generated at a radiation wavelength of 100 μm within a 3.5 m long, strongly focusing planar LCLS-I undulator. High gain is achieved by driving the FEL with high brightness beams from the PITZ photoinjector at 17 MeV and a bunch charge of up to several nC. Simulations have been carried out to understand the experimental results. THz diagnostics are focused in particular in order to accurately characterize the radiation pulse energy, spectrum and temporal profile.

AKBP 7.7 Wed 17:45 ZHG004

High-gain high-efficiency tapered FEL oscillator — •Margarit Asatrian[1], Eugenio Ferrari[2], Andrew Fisher[3], Georgia Paraskaki[2], Pietro Musumeci[3], and Wolfgang Hillert[1] — [1]University of Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [3]University of California at Los Angeles, Los Angeles, California, USA

Free Electron Lasers (FELs) are unique light sources capable of producing intense, high-brightness radiation in the XUV and X-ray regimes. The growing demands of experimental science are pushing FELs to their performance limits in terms of radiation quality and output power. To meet these challenges, it is crucial to explore ways of improving the energy conversion efficiency between the electron beam and the FEL output. Enhanced efficiency could either expand the achievable power range of FELs or enable more compact infrastructures.

The TESSA (Tapering-Enhanced Stimulated Superradiant Amplification) scheme offers a promising solution, with efficiencies more than an order of magnitude higher than those of conventional FELs. This approach employs a strongly tapered undulator and a high-power seed to extract energy from a pre-bunched electron beam. At short wavelengths, however, the absence of suitable high-power seed laser sources calls for the use of cavity-based FELs to generate the required seed. Here, we present FEL simulations that illustrate the power buildup and steady-state regime of such a TESSA-based high-gain FEL oscillator in the XUV wavelength range.

AKBP 7.8 Wed 18:00 ZHG004

Beam-by-design pulse shaping for seeded Free-Electron Laser — •Andreas Thiel[1], Skirmantas Alisauskas[2], Margarit Asatrian[1], Giovanni Cirmi[2], Eugenio Ferrari[2], Ingmar Hartl[2], Wolfgang Hillert[1], Nhat-Phi Hoang[2], Tino Lang[2], Pardis Niknejadi[2], Lucas Schaper[2], and Jiaan Zheng[2] — [1]Universität Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Hamburg, Germany

External seeding offers significant improvements in the pulse properties of Free-Electron Lasers (FELs) compared to Self-Amplified Spontaneous Emission (SASE) FELs. Seeding techniques such as High-Gain Harmonic Generation (HGHG) and Echo-Enabled Harmonic Generation (EEHG) utilize seed lasers and dispersive beamline elements to structure the longitudinal phase space of the electron beam. This process creates a density modulation that initiates the FEL process. The coherence properties of the seed are transferred to the FEL output, enabling the production of fully coherent, narrowband radiation with enhanced stability at shorter wavelengths. At the FEL facility FLASH (DESY), the ongoing FLASH2020+ upgrade project includes the integration of external seeding at high repetition rates. A key component of this upgrade is the development of an advanced laser system (SLASH) to act as the seed source. We explore the use of pulse shaping on the seed laser to control the characteristics of the seeded FEL output. Here, we present initial results from a test of the pulse shaper on our laser system, along with numerical simulations that investigate the potential and limitations of generating custom-tailored FEL pulses.

AKBP 8: Diagnostics

Time: Thursday 11:00–12:30 Location: ZHG004

AKBP 8.1 Thu 11:00 ZHG004

Terahertz Streaking Detection for Longitudinal Bunch Diagnostics at FLUTE — •Matthias Nabinger[1], Michael Nasse[1], Erik Bründermann[1], Matthias Fuchs[1], Anke-Susanne Müller[1], Marvin Noll[1], Johannes Steinmann[1], Jens Schäfer[1], Thiemo Schmelzer[1], Robert Ruprecht[1], Nigel Smale[1], Micha Dehler[3], Rasmus Ischebeck[3], Matthias Moser[3], Volker Schlott[3], Thomas Feurer[4], Zoltan Ollmann[4], Sergei Glukhov[2], Oliver Boine-Frankenheim[2], Mozghan Hayati[4], and Marcel Schuh[1] — [1]KIT, Karlsruhe, Deutschland — [2]TU Darmstadt, Darmstadt, Deutschland — [3]PSI, Villingen, Schweiz — [4]Universität Bern, Bern, Schweiz

The Karlsruhe Institute of Technology is currently exploring a compact method of longitudinal electron bunch diagnostics with femtosecond resolution that has recently been demonstrated for other parameter ranges. The experimental setup utilizes a THz-based streaking approach with resonator structures, achieving both high compactness and efficiency. In this contribution, we report on the experimental observation of streaking signals with our Compact Transverse Deflecting System, which has been successfully tested using two different resonators, an Inverse Split-Ring Resonator and a Tilted-Slit-Resonator.

AKBP 8.2 Thu 11:15 ZHG004

Time-resolved measurements of transverse beam excitation in an electron storage ring — •Marvin Noll, Johannes Steinmann, Erik Bründermann, Erhard Huttel, and Meghana Patil — KIT-IBPT

In the Karlsruhe Research Accelerator (KARA), electron beams of up to 200 mA are stored with an energy of 2.5 GeV, while injection is performed at 500 MeV. At the injection energy, the beam life time and the injection efficiency depend largely on Touschek and/or intrabeam scattering. As a counter measure, the beam size can be enlarged transversally by an exciting modulation, e.g., applied via a strip-line.

Here, we examine different excitation strategies and their effects on beam size and the beam orbit. The ultra-fast line camera KALYPSO is used to measure the transverse beam profile from the emitted synchrotron radiation on a turn-by-turn basis.

AKBP 8.3 Thu 11:30 ZHG004

Upgrade of the RF Readout Electronics of the Cavity Beam Position Monitors at the S-DALINAC* — •Valentin Reichenbach, Michaela Arnold, Uwe Bonnes, Manuel Dutine, Ruben Grewe, Lars Jürgensen, Norbert Pietralla, Dominic Schneider, and Felix Schliessmann — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

At the electron accelerator S-DALINAC, cavity BPMs are used for high-precision non-destructive beam parameter measurements. The preexisting RF readout boards have a limited dynamic range. Hence, the existing electronics cannot be used for both low beam current applications (e.g. tuning) and high current experiments without manual adjustments. A new generation of RF boards with a significantly improved dynamic range have been developed in-house, leading to an extensive upgrade of the RF electronics at the S-DALINAC. Within this contribution, the implementation of the new cavity BPM electronics including performance measurements will be presented.

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

AKBP 8.4 Thu 11:45 ZHG004

High-Resolution Longitudinal Beam Diagnostics with a Fast Faraday Cup at the UNILAC Accelerator — •Nimue Schmidt[1,2], Maksym Miski-Oglu[1], Rahul Singh[1], and Winfried Barth[1,3,4] — [1]GSI, Darmstadt, Deutschland — [2]TU, Darmstadt, Deutschland — [3]HIM, Mainz, Deutschland — [4]JGU, Mainz, Deutschland

At the heavy ion accelerator UNILAC at GSI Helmholtz Center for Heavy Ion Research in Darmstadt, measurements were carried out with a Fast Faraday Cup (FFC) in order to precisely measure the time structure of the particle beam. The FFC offers a highly accurate time-resolved recording of the charge distribution along the longitudinal beam profile. The data obtained in combination with a dipole magnet is used to determine the longitudinal phase space and emittance of the beam. After analyzing the measurement results, the method is integrated into the regular beam diagnostics to ensure continuous monitoring and control of the particle beam during operation. Measurement procedure and results are presented.

AKBP 8.5 Thu 12:00 ZHG004

Stabilization of Transverse Beam Parameters for Future Electron-Induced Fission Experiments at the S-DALINAC* — •Dominic Schneider, Michaela Arnold, Jonny Birkhan, Uwe Bonnes, Adrian Brauch, Manuel Dutine, Ruben Grewe, Bastian Hessbacher, Lars Jürgensen, Igor Jurosevic, Norbert Pietralla, Tim Ramaker, Maximilian Resch, Felix Schliessmann, and Gerhart Steinhilber — Institut für Kernphysik, TU Darmstadt

Research on electron-induced fission reactions of transuranium actinides is in preparation at the S-DALINAC. The intended small target sizes require a limitation of transverse displacement of the electron beam due to drifts and distortions to below 200 μm. Three systems have been developed, implemented and interconnected to monitor and improve the transverse beam stability: (i) A beam position monitoring system based on high-speed cameras provides transverse beam parameters with micrometer resolution at a kilohertz rate. (ii) A newly designed compensator device mitigates longitudinal and transversal perturbations from the mains frequency on the electron beam. (iii) Lastly, an active beam-stabilization system ensures high beam stability at the intended interaction point of the electron beam and the fission target. A brief overview of the design and implementation of these systems as well as performance measurements will be presented in this contribution. *Work supported by State of Hesse within the Research Cluster Project ELEMENTS (Project ID 500/10.006) and DFG (GRK 2128 AccelencE).

AKBP 8.6 Thu 12:15 ZHG004

Precise Beam Position Characterization for MESA using ALICE Stripline BPM. — •Robin Wolf — Johannes Gutenberg Universität Mainz

In order to ensure precise beam positioning and stability, the MESA accelerator relies on accurate and fast beam position measurements. This study focuses on adapting the ALICE stripline beam position monitor (BPM) for MESA's beam diagnostics. Originating from the ALICE accelerator, which operates at 1.3 GHz, this BPM aligns well with MESA*s frequency.

Initial laboratory testing demonstrated the functional reliability of the BPM, laying the foundation for practical applications. Subsequent deployment in the Mainz Microtron (MAMI) beamline allowed for further evaluation, despite MAMI*s higher operating frequency of 2.45 GHz. By employing a broadband stripline and fast oscilloscope, the ALICE BPM captured time-resolved images of MAMI bunches, providing the first successful diagnostics of this kind. However, observed non-linearities in position data highlighted the need for deeper analysis.

This talk will present the performance outcomes of the ALICE stripline BPM, addressing challenges such as non-linearities, while showcasing its potential for rapid and precise measurements under diverse operational conditions.

AKBP 9: Novel Accelerator Concepts III and Hadron Accelerators

Time: Thursday 13:45–15:45 Location: ZHG004

Group Report AKBP 9.1 Thu 13:45 ZHG004

Establishing a new class of High-Current Acceleratordriven Neutron Sources (HiCANS) with the HBS project — •Andreas Lehrach[1], Thomas Gutberlet[1], Paul Zakalek[1], and Holger Podlech[2] — [1]Forschungszentrum Jülich — [2]Johann Wolfgang Goethe-Universität Frankfurt

Accelerator-driven high brilliance neutron sources are an attractive alternative to the classical neutron sources of fission reactors and spallation sources to provide scientists with neutrons to study and analyze the structure and dynamics of matter. With the advent of high-current proton accelerator systems, a new class of such neutron facilities can be established referred to as High-Current Acceleratordriven Neutron Sources (HiCANS). The basic features of HiCANS are a medium-energy proton accelerator with of tens of MeV and up to 100 mA beam current, a compact neutron production and moderator unit and an optimized neutron transport system to provide a full suite of high performance, fast, epithermal, thermal and cold neutron instruments. The Jülich Centre for Neutron Science (JCNS) has established a project to develop, design and demonstrate such a novel acceleratordriven facility termed High Brilliance neutron Sources (HBS). The aim of the project is to build a versatile neutron source as a user facility with open access and service according to the diverse and changing demands of its communities.

Embedded in an international collaboration with partners from Germany, Europe and Japan, the Jülich HBS project offers the best flexible solutions for scientific and industrial users.

AKBP 9.2 Thu 14:15 ZHG004

Laser cooling of bunched relativistic ion beams at the FAIR SIS100 — •Danyal Winters[1], Michael Bussmann[2,3], Tamina Grunwitz[4], Jens Gumm[4], Volker Hannen[5], Thomas Kühl[1,6], Sebastian Klammes[1], Benedikt Langfeld[4], Ulrich Schramm[2,7], Denise Schwarz[4], 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 Campus Darmstadt

The heavy-ion synchrotron SIS100 is (at) the heart of the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. It is designed to accelerate intense beams of heavy highly charged ions up to relativistic velocities and to deliver them to unique physics experiments, such as those planned by the APPA/SPARC collaboration. In order to cool these extreme ion beams, bunched beam laser cooling will be applied using a dedicated facility at the SIS100. We will use a novel 3-beam concept, where laser beams from three complementary laser systems (cw and pulsed) will be overlapped in space, time and energy to interact simultaneously with a very broad ion velocity range in order to maximize the cooling efficiency. 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 9.3 Thu 14:30 ZHG004

BEETLE - High average power laser-plasma accelerator using a 1 kW Yb-based laser with nonlinear compression — •Tatiana Nechaeva, Timo Eichner, Sören Jalas, Christian Werle, Lutz Winkelmann, Guido Palmer, Manuel Kirchen, and Andreas Maier — DESY, Hamburg, Germany

Laser-plasma acceleration (LPA) is a promising technology for a future compact accelerator. However, current Ti:Sapphire laser technology typically supports few-hertz repetition rates, with scaling to higher rates being challenging. High energy, kHz-level Yb-based laser systems have longer, sub-picosecond pulses. After nonlinear spectral broadening in a multipass cell, these pulses can be compressed to tens of fs duration, becoming a promising LPA driver alternative. In this poster, we introduce the BEETLE project, recently initiated at DESY, that aims to demonstrate high-energy, high repetition rate electron acceleration. The driver laser pulses, provided by a 5 kHz Yb-based laser system (Trumpf Scientific Lasers), have an energy of 200 mJ and are compressible to 30 fs via spectral broadening. We present an overview, goals and the current status of the project.

AKBP 9.4 Thu 14:45 ZHG004

Modular, Automated Beam Stabilization of the ATLAS-3000 Laser at the Centre for Advanced Laser Applications (CALA) — •Florian Schweiger, Michael Bachhammer, Timo Pohle, Johannes Zirkelbach, Leonhard Doyle, Sonja Gerlach, and Jörg Schreiber — LMU Physik, Munich, Germany

Thermal effects in optical elements as well as subtle changes in the experimental environment (e.g. airflow, humidity, vibrations) are well-known challenges affecting laser alignment. For high-power lasers comprising a multitude of amplification stages, the resulting long-term drifts (occurring over minutes to hours) affect both beam and laser parameters. Monitoring these drifts at the Petawatt-class ATLAS laser at CALA prompted us to develop a modular solution for long-term beam stabilization. This stabilization system consists of separate diagnostic and control modules in between the individual amplification stages of the laser chain. Each module measures the laser near- and far-field and is capable of stabilizing both the position and angle of the beam using motorized mirror mounts. Currently, a total of three stabilization units are installed in the ATLAS frontend, and (supervised) stabilization on the minute timescale has been successfully implemented. Overall, the system improves the stability, precision, and reproducibility of the laser alignment and is therefore advantageous for high-class laser-plasma accelerators. This work was supported by the BMBF within project 01IS24028 and CALA.

AKBP 9.5 Thu 15:00 ZHG004

More realistic laser-plasma simulations by laser profiles measured via Insight — •Fabia Dietrich[1,2], Jessica Tiebel[1,2], Richard Pausch[1], Thomas Püschel[1], Ulrich Schramm[1], and Klaus Steiniger[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]TU Dresden — [3]CASUS, Görlitz

Laser-plasma physics is an important field of research with wide-ranging applications such as particle acceleration for medical purposes or inertial confinement fusion. A fundamental challenge in this field is understanding and controlling the complex interaction between high-intensity laser pulses and the plasma, for which Particle-in-Cell (PIC) simulations have become indispensable tools.

A significant limitation in many simulation codes is the assumption of idealized laser conditions, such as perfectly Gaussian beams. This simplification arises from the difficulty in analytically modelling spatio-temporal couplings (STCs) that inevitably influence realistic laser pulses.

To address this discrepancy, we present a method for importing realistic laser field data from INSIGHT measurements into multiple-GPU PIC simulations with PIConGPU. INSIGHT measurements provide complete field information of the laser pulse at the focal position, and therefore allow to create a digital twin of experimental setups. This enables us to investigate in detail the impact of STCs on the performance of laser particle accelerators realized at HZDR. Moreover, this new capability permits the prediction of optimized operation points in upcoming experiments.

AKBP 9.6 Thu 15:15 ZHG004

Full Power Laser Diagnostic — •Luis Gwinner, Michael Bachhammer, Leonard Doyle, and Jörg Schreiber — Faculty of Physics, Ludwig-Maximilians-Universität München, Garching, Germany

In the field of particle acceleration, laser-driven ion acceleration has garnered significant research interest. Recent studies have identified several key parameters in the laser-target interaction that can be optimized to maximize particle acceleration efficiency. However, interpreting results when tuning these parameters is often challenging due to the high shot-to-shot variability inherent in laser systems, such as the PW-class Advanced Titanium Sapphire Laser (ATLAS) at the Centre for Advanced Laser Applications (CALA). If these variations stem from statistical fluctuations, one potential solution is to perform a large number of shots to average out the laser-induced variations. This approach necessitates a high-repetition-rate laser and target system, which is a major focus of current research. Another strategy is to directly monitor the key laser parameters just before the laser interacts with the target, without compromising the full laser power delivered to the target. This poses a significant challenge, as monitoring a laser capable of turning matter into plasma requires sophisticated optical

systems. Such minimally invasive systems must split the laser beam, directing a small, predictable portion to diagnostic tools while ensuring that the remaining high-energy beam remains unperturbed and reaches the target. The presentation will include preliminary designs, concepts, and first results for this innovative diagnostic setup.

AKBP 9.7 Thu 15:30 ZHG004

100Hz repetition rate, high energy Ti:Sapphire amplifier for laser plasma acceleration — •Thomas Hülsenbusch, Timo Eichner, Man Jiang, Juan B. Gonzalez-Diaz, Adbullah Yousefi, Jelto Thesinga, Mikhail Pergament, Wim P. Leemans, Guido Palmer, and Andreas R. Maier — Deutsches Elektronen-Synchrotron DESY, Notkestrasse 81, 22607 Hamburg, Germany

To move Laser Plasma Acceleration (LPA) from a few-shot, proof-of-principle experiments to applications, it is necessary to increase the repetition rate of the driving laser to the kHz range. While it has been shown that Ti:Sapphire (Ti:Sa) lasers can deliver the high quality, high intensity pulses required for LPA, the high quantum defect of Ti:Sa poses a major challenge for high repetition rate operation. As a first step towards kHz operation, we here present experimental results on a 100Hz Ti:Sa amplifier that delivers pulses of >700 mJ energy, supporting a transform limited pulse duration of <30 fs. The thermal lens can be managed with cryogenic cooling of the laser crystal, allowing a high beam quality of $M^2 < 1.7$ at 100Hz to be maintained. This laser will enable high repetition rate LPA experiments in the near future.

AKBP 10: Novel Accelerator Concepts IV and Applications

Time: Thursday 16:15–18:15 Location: ZHG004

AKBP 10.1 Thu 16:15 ZHG004

Studies on laser driven fission at CALA — •Maximilian J. Weiser, Erin G. Fitzpatrick, Laura D. Geulig, Jinbao Hong, and Peter G. Thirolf — Ludwig-Maximilians-Universität München, Garching, Germany

The field of laser ion acceleration has attracted great interest in the recent years as an alternative to classical accelerators due to its unique features like a small footprint, short bunch duration and solid state like bunch densities. Especially the latter is crucial for studying the so-called *fission-fusion* nuclear reaction mechanism which could help exploring the r-process nucleosynthesis of heavy elements in the Universe. A necessary preliminary study for realising this mechanism experimentally is to gain a better understanding how fission induced by light particles impinging onto high-Z elements performs [1]. For this reason, we developed a gas-based transportation system which enables us to transport the fission products away from our EMP-contaminated experimental chamber to a shielded HPGe γ-detector. In our first experimental campaign conducted at the Centre of Advanced Laser Applications (CALA) we found that the expected fission products could not be measured due to a to small yield arriving at the detector. Therefore, we are currently focusing onto improving the amount of produced fission fragments and the transport efficiency of the setup. This work has been funded by the BMBF under Grant No. 05P24WM2. We acknowledge the GSI target lab (Dr. Bettina Lommel) for providing the U targets. [1] D. Habs et al., Appl. Phys. B 103, 471-484 (2011)

AKBP 10.2 Thu 16:30 ZHG004

Improved strong-field QED rates for collisions of particle-beams with high-power laser pulses — •Nikita Larin[1,2,3] and Daniel Seipt[1,2,3] — [1]Helmholtz Institute Jena, Jena, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Institute of Optics and Quantum Electronics, Jena, Germany

In collisions of high-energy particle beams with intense laser pulses, dominate effects of strong field QED (SFQED), such as emission of high-energy gamma rays and pair production. Contemporary particle accelerators, combined with high-intensity lasers, make the observation of these effects feasible. And for successful experimental measurements, the reliable numerical simulations are of the great importance.

The key component of these simulations are the probability rates, which contain information about the quantum nonlinear processes that play a significant role in such extreme conditions. These rates can be readily implemented in Monte-Carlo modules amending laser-plasma and laser-beam simulation codes.

In this talk, I will present a new derivation of the so-called "locally monochromatic approximation" of SFQED processes. It is suited to simulate SFQED processes in beam-laser collisions in the transition regime from perturbative to nonperturbative QED, such as the LUXE project [1] aims to measure. Moreover, our new derivation allows us to remedy some technical issues of the previously known rates.

[1] H. Abramowicz et al., Eur. Phys. J. Spec. Top. **230** (2021) 2445-2560.

AKBP 10.3 Thu 16:45 ZHG004

Nonlinear Breit-Wheeler pair production using polarized photons from inverse Compton scattering — •Daniel Seipt[1], Mathias Samuelsson[2], and Tom Blackburn[2] — [1]Helmholtz Institute Jena, Fröbelstieg 3, 07743 Jena, Germany — [2]Department of Physics, University of Gothenburg, SE-41296 Gothenburg, Sweden

The production of electron-positron pairs from the collision of photons is one of the most elusive processes in QED. Observing multiphoton electron-positron pair production (the nonlinear Breit-Wheeler process) requires high-energy γ rays to interact with strong electromagnetic fields. In order for these observations to be as precise as possible, the γ rays would ideally be both mono-energetic and highly polarized. In this talk I will present Monte Carlo simulations of an experimental configuration that accomplishes this in two stages. First, a multi-GeV electron beam interacts with a moderately intense laser pulse to produce a bright, highly polarized beam of γ rays by inverse Compton scattering. Second, after removing the primary electrons, these γ rays collide with another, more intense, laser pulse in order to produce pairs. I will show that it is possible to measure the γ-ray polarization dependence of the nonlinear Breit-Wheeler process in near-term experiments, using a 100-TW class laser and currently available electron beams. Furthermore, it would also be possible to observe harmonic structure and the perturbative-to-nonperturbative transition if such a laser were colocated with a future linear collider.

AKBP 10.4 Thu 17:00 ZHG004

Real-time search for Dark Photons at the Upgraded LHCb experiment — •Carlos Eduardo Cocha Toapaxi — Heidelberg University, Heidelberg, Germany

Different theoretical model predicts the existence of dark matter mediators which interact minimally with standard model particles. Charm decays are an excellent place to search for dark photons, one kind of light dark matter mediators. The challenge to reconstruct dark photons consists in finding a peak on top of an irreducible non-resonant background of several kHz. Here the search profites enormously from the novel real-time analaysis strategy implement at the LHCb experiment in Run 3. LHCb can read out the entire detector in real time (at 30 MHz) and filter interesting events through a two-stage software trigger using farms of GPUs (first stage) and CPUs (second stage). Sophisticated online selections are employed at both trigger stages to select charm decays, identify the extremely soft electrons that dark photons decay into, and reduce the overwhelming combinatorial background, followed by a dedicated offline selection. In this talk we present the trigger selections and initial sensitivity estimates for dark photons in LHCb Run 3.

AKBP 10.5 Thu 17:15 ZHG004

Simulations of Beam Dynamics and Beam Lifetime for the Prototype EDM Ring — •Saad Siddique for the JEDI and CPEDM Collaborations-Collaboration — GSI 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 (Cooler Synchrotron Juelich), 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 were performed to optimize the beam lifetime and to minimize the systematic effects. After getting beam losses estimations by using analytical formulas for preliminary design of prototype EDM ring , beam-target interaction have been studied in detail which helped to find optimized position of target in storage ring for minimum beam losses. After finding dynamic aperture by using more sophisticated program Bmad, a long term tracking is being performed along with beam-target interactions. Further investigations to reduce systematic effects are also under process.

AKBP 10.6 Thu 17:30 ZHG004

Precision measurement of the beam polarisation for the P2 experiment — •Rakshya Thapa — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

A 5 MeV Mott polarimeter will be implemented at Mainz Energy-recovering Superconducting Accelerator (MESA) to precisely measure the polarisation of the polarised electron beam. The polarimeter is being fabricated and will soon undergo a pilot test at MAMI.

AKBP 10.7 Thu 17:45 ZHG004

Status of the Laser Compton Backscattering Source at the S-DALINAC* — •Lisa Dingeldein, Michaela Arnold, Adrian Brauch, Manuel Dutine, Ruben Grewe, Lars Jürgensen, Maximilian Meier, Norbert Pietralla, Felix Schliessmann, and Dominic Schneider — Institut für Kernpysik, Technische Universität Darmstadt, Darmstadt, Germany

The COmpton Backscattering at a Recirculating Accelerator (COBRA) project utilizes a high-power laser, which is well synchronized to the electron beam of the Superconducting DArmstadt LINear ACcelerator (S-DALINAC). The backscattering provides high-energy photons for diagnostic and nuclear-photonic applications. A stable and precise laser beam transport to the interaction point in an evacuated beamline is ensured before COBRA will be used during an upcoming operation of the Energy Recovery Linac (ERL). The installation of laser safety precautions, methods for centered alignment of both beams and the detector for the backscattered photons, along with recurring measurements of the laser parameters will be presented.

*Work supported by DFG (GRK 2128, IRTG 2891, Inst163/308-1 FUGG)

AKBP 10.8 Thu 18:00 ZHG004

Advanced bandwidth and energy control of an all-optical hard Compton X-ray source — •Martin Meisel[1], Simon Bohlen[1], Theresa Brümmer[1], Florian Grüner[2], Cristina Mariani[1,2], Theresa Staufer[2], Jonathan Wood[1], Jens Osterhoff[3], and Kristjan Poder[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany — [2]Universität Hamburg and Center for Free-Electron Laser Science, Luruper Chaussee 149, 22761 Hamburg, Germany — [3]Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA

Compact, tunable X-ray sources with narrow bandwidths are essential for many applications. Laser-plasma accelerator-driven inverse Compton scattering sources show promise but are limited by broad bandwidths and low photon flux. Using an active plasma lens for electron beam tailoring, we demonstrated X-ray tunability from 34 keV to 81 keV without moving parts and reduced electron bunch-induced broadening, achieving a threefold improvement in total bandwidth. Ongoing work to shape the scattering laser aims to further narrow the bandwidth and boost photon production, paving the way for highly precise and efficient compact X-ray sources for future applications.

AKBP 11: Members' Assembly

Time: Thursday 18:20–19:00 Location: ZHG004

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

AKBP 12: Radiofrequency and Instrumentation I

Time: Friday 9:00–10:30 Location: ZHG004

AKBP 12.1 Fri 9:00 ZHG004

Refurbishment of TESLA Cavities for future ERL upgrades at MESA (*)(**) — •Paul Plattner, Florian Hug, and Timo Stengler — Institut für Kernphysik, Mainz, Deutschland

A future upgrade from 1 mA to 10 mA beam current is planned for the Mainz Energy-Recovering Superconducting Accelerator (MESA), an Energy-Recovering (ER) LINAC. Calculations show a potential limitation of the Higher Order Mode (HOM) antennas, which couple the stored power from HOM out. Through the upgrade of the beam current a quench at the HOM antenna would happen. This limit can be increased by using a superconducting material with a higher ctritical temperature than Niobium. For the studies are chosen NbTiN and Nb3Sn, which are applied as a thin film on substrates like Niobium and Copper. The modified antennes will be tested in an cryomodule from the decomissioned ALICE. This cryomodule need to be refurbished and modified for fulfill the requirements for MESA. (*)We would like to thank STFC Daresbury for their generous gift. (**)The work received funding by BMBF through 05H21UMRB1.

AKBP 12.2 Fri 9:15 ZHG004

Development of a new Chopper Cavity for the S-DALINAC* — •Vincent Pruy, Michaela Arnold, Adrian Brauch, Manuel Dutine, Ruben Grewe, Katharina E. Ide, Lars Jürgensen, Clemens M. Nickel, Norbert Pietralla, Felix Schliessmann, and Dominic Schneider — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

The operation of the superconducting radio-frequency cavities of the S-DALINAC relies on a bunched electron beam. Currently, the continuous beam generated by the thermionic gun is divided into bunches using a chopper system incorporating a single deflecting cavity. However, this system induces nonlinear curvatures to the beam trajectory. To mitigate this effect, a second, identically constructed deflecting cavity can be employed to re-bend the beam thus counteracting the nonlinear distortions. This work focuses on an excellent deflection behavior and quality factor of the cavity by performing electromagnetic and particle tracking simulations. In this contribution, we report on the progress in the simulation and design of such a double-cavity chopper system.
*Work supported by DFG (GRK 2128, IRTG 2891) and State of Hesse (Research Cluster ELEMENTS (Project ID 500/10.006)).

AKBP 12.3 Fri 9:30 ZHG004

Performanceverbesserung der 6-zelligen Einfangstruktur des S-DALINAC durch Anpassung der Kopplerlängen* — •Lukas Reichel, Michaela Arnold, Manuel Dutine, Ruben Grewe, Katharina E. Ide, Lars Jürgensen, Norbert Pietralla, Felix Schliessmann und Dominic Schneider — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Der supraleitende Injektorbeschleuniger des S-DALINAC besteht aus einer 6-zelligen Einfangstruktur und zwei 20-zelligen Beschleunigungsstrukturen. Der 6-Zeller ist auf ein relativistisches Geschwindigkeitsverhältnis von $\beta = 0{,}86$ ausgelegt und beschleunigt die eintreffenden Elektronen so weit vor, dass sie von den auf $\beta = 1$ ausgelegten 20-Zellern angemessen weiterbeschleunigt werden können, weshalb er großen Einfluss auf die Strahlqualität hat. Bei der Inbetriebnahme des 6-Zellers wurde festgestellt, dass die Güte und die maximale Feldstärke deutlich unter den erwarteten Werten lagen. Des Weiteren waren die ausgekoppelte Leistung und der Wärmeeintrag in das Heliumbad problematisch hoch, sodass ein Betrieb nur mit einem reduzierten Energiegewinn durch die Einfangstruktur möglich war. Durch ein gezieltes Kürzen der Ein- und Auskopplerlänge konnte die maximale Feldstärke ungefähr um den Faktor 2,9 erhöht und die ausgekoppelte Leistung

deutlich reduziert werden. In diesem Vortrag werden die Vergleichsmessungen, die vorgenommenen Änderungen und deren Ergebnisse vorgestellt und diskutiert.

*Work supported by DFG (GRK 2128, IRTG 2891) and State of Hesse (Research Cluster ELEMENTS (Project ID 500/10.006)).

AKBP 12.4 Fri 9:45 ZHG004

Helium Level Stabilization System of Cryomodule for HELIAC — •Szymon Kowina[1], Maksym Miski-Oglu[1], Thorsten Kuerzeder[1,2], and Viktor Gettmann[1] — [1]GSI, Darmstadt, Deutschland — [2]HIM, Mainz, Deutschland

The superconducting heavy-ion HELmholtz LInear ACcelerator (HELIAC) is designed to meet the needs of the Super Heavy Element (SHE) research and materials science user programs at GSI in Darmstadt. The beam energy can be varied smoothly between 3.5 and 7.3 MeV/u, with an average current of up to 1 emA and a duty cycle of 100 %. Recently, the first cryomodule, CM1, was fully commissioned and tested. CM1 comprises three Crossbar H-mode (CH)-type accelerator cavities, a CH-rebuncher, and two superconducting solenoid lenses. The focus of this contribution is on the details of the liquid helium stabilization system of CM1.

AKBP 12.5 Fri 10:00 ZHG004

Co-sputtering of Nb_3Sn thin films on copper for superconducting HOM antenna application — •Amir Farhood[1], Alexey Arzumanov[1], Márton Major[1], Paul Plattner[2], Florian Hug[2], Timo Stengler[2], and Lambert Alff[1] — [1]Institute of Materials Science, TU Darmstadt, 64287 Darmstadt, Germany — [2]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, D-55128 Mainz, Germany

For superconducting (SC) accelerators working in continuous wave (CW) mode the power coupled at the higher order mode (HOM) antennas is a power limiting factor. In particular, HOM antennas could quench in energy-recovery operation at high beam currents. Calculations showed that HOM antennas coated with a superconducting film can increase the possible maximal deposited power in HOMs. For this study a copper HOM antenna model was coated with SC Nb_3Sn thin film by co-sputtering. The sputtering system was modified to achieve homogeneous coating of the three-dimensional antenna. Since stoichiometry plays a significant role on the critical temperature of the coating, the Nb to Sn ratio was checked by energy dispersive spectroscopy (EDS) measurements on test samples attached to different areas of the model antenna. The temperature dependence of resistivity and magnetization was measured on the test samples. A minimum critical temperature (T_c) of 13 K at every part of model was shown and on the top part of the antenna, where the heat load is the largest (T_c) of 14.5 K and critical field (H_{c1}) of 150 mT (at 5K) were achieved.

AKBP 12.6 Fri 10:15 ZHG004

Nb_3Sn thin films grown by co-sputtering for SRF cavity application — •Márton Major[1], Alexey Arzumanov[1], Amir Farhood[1], Michaela Arnold[2], Norbert Pietralla[2], and Lambert Alff[1] — [1]Institute of Materials Science, Technical University of Darmstadt, Darmstadt, Germany — [2]Institute of Nuclear Physics, Technical University of Darmstadt, Darmstadt, Germany

Superconducting (SC) RF cavity technology is dominated by bulk Nb due to its proven physical performance and mature production technology. Needs for reducing the energy consumption of particle accelerators, however, call for alternative SC materials, such as Nb_3Sn, to allow their operation at higher temperatures at lower cryogenic costs. The Nb_3Sn coating of carrier structures has a huge potential to reach high acceleration gradients even at 4.2 K. Utilizing thin film technology enables to use copper, an excellent heat conductor, for the bulk of the cavity to which Nb_3Sn can be sputtered for high-quality SC coatings. However, several key technological and physical challenges must be mastered to coat the hollow body of a cavity from inside. At our group, based on a low-temperature magnetron co-sputtering process, the direct deposition of SC Nb_3Sn on Cu became possible. The grown films had high critical fields and critical temperatures. Presently we are scaling up the coating process from small substrates to larger structures, like HOM antennae and QPR cups.

This work was supported by the BMBF through grant 05H21RDRB1 and by the DFG via the Research Training Group GRK 2128 "AccelencE", project No. 264883531.

AKBP 13: Radiofrequency and Instrumentation II

Time: Friday 11:00–12:00 Location: ZHG004

AKBP 13.1 Fri 11:00 ZHG004

Design of a permanent magnet septum with variable field strength for ELSA — •Daniel Fry, Klaus Desch, Dennis Proft, and Michael Switka — Physikalisches Institut der Universität Bonn

As a way to greener accelerators and reduced power consumption permanent magnets have been a rising contender in the last years. For a first project in this field at the ELSA electron accelerator, a permanent magnet septum is designed and evaluated for its feasibility. Intended for a beam energy range of 0.5GeV−3.2GeV magnetic field stregths of 0.15T−0.97T need to be achieved. A mechanism with moveable Samarium-Cobalt (SmCo) magnets, which are chosen for their radiation hardness, is proposed. The magnets are moved from the iron yokes of the septum into a magnetic short circuit iron loop to cover the variable field strength. CST Studio simulations are used to evaluate possibilities to minimize the magnetic forces on this movement and the feasibility of the design. A simulation model is presented and further steps towards construction are discussed.

AKBP 13.2 Fri 11:15 ZHG004

Lattice Optimization for the MESA Injection and Recirculation Arcs Using ELEGANT. — •Esraa Khidr — Institut für Kernphysik, Mainz, Germany

The Mainz Energy-Recovering Superconducting Accelerator (MESA) is under construction at the Johannes Gutenberg University Mainz. MESA will enable a range of high-precision experiments in particle and nuclear physics through its dual-mode operation: External Beam Mode runs with 150 *A with polarized electrons at 155 MeV and Energy Recovery Linac (ERL) Mode with an unpolarized beam of 1 mA at 105 MeV. This work presents beam dynamics simulations for MESA's injection and recirculation arcs. We optimize the lattice design using the ELEGANT tracking code to achieve dispersion-free and small beta functions within the cryomodule. Additionally, the acceptance of the injection arc has been analyzed to ensure robust beam transport. These simulations are essential for ensuring MESA's successful operation in both modes.

AKBP 13.3 Fri 11:30 ZHG004

Beam-Dynamics Simulations for the ERL-Facility Concept DICE* — •Fatemeh Sadat Moujani Ghomi, Michaela Arnold, Norbert Pietralla, and Felix Schliessmann — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

The Darmstadt Individually recirculating Compact Energy recovery linac (DICE) is a multi-turn energy-recovery concept in a racetrack structure with two linacs and separate beam transport. This layout allows to tune each arc individually with respect to transverse beam focusing and longitudinal dispersion. The latter enables sophisticated manipulations of the longitudinal phase space. In this contribution, beam-dynamics simulations addressing the tracking through certain sections of DICE are presented. For the tracking, the software ELEGANT is used.

*Work supported by DFG (GRK 2128, IRTG 2891) and State of Hesse (Research Cluster ELEMENTS (Project ID 500/10.006))

AKBP 13.4 Fri 11:45 ZHG004

Developing an Ion Beam Analysis Setup in Bonn — •Henry Schumacher, Dennis Sauerland, and Sebastian Neubert — Helmholtz-Institut für Strahlen und Kernphysik, Universität Bonn

The Bonn Isochronous Cyclotron can accelerate protons, deuterons and ions up to $^{12}C^{4+}$ with nominal ion energies of 7 to 14 MeV/nucleon. At one of the five beam lines, a new measuring station for material analysis is in development.
Initially the site will be equipped with two detectors for Rutherford backscattering (RBS) and two additional ones for particle induced X-Ray emissions (PIXE). Employing these two methods together pro-

vides the possibility to detect, identify and distinguish most isotopes. Utilizing this ion beam setup, it will be possible to analyze a wide variety of samples, such as biological, geological, archaeological and even pieces of art and items of historical value in a non-destructive manner. In this talk, an overview over the planned ion beam analysis setup as well as estimations on the setup's count rates for RBS and PIXE at the Bonn Isochronous Cyclotron are presented.