Working Group on Accelerator physics
Arbeitskreis Beschleunigerphysik (AKBP)

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Overview of Invited Talks and Sessions

(Lecture halls HSZ 301, HSZ 304, GÖR 226, and MOL 213; Poster P1C)

Invited Talks

AKBP 14.1	Thu	9:30–10:00	MOL 213	**Application of Machine Learning to Beam Diagnostics** — •Elena Fol
AKBP 14.2	Thu	10:00–10:30	MOL 213	**Towards Micro-Bunching Control at Storage Rings with Reinforcement Learning** — •Tobias Boltz
AKBP 14.3	Thu	10:30–11:00	MOL 213	**Towards Reinforcement Learning Based Optimization at the Light Source BESSY II** — •Luis Vera Ramirez
AKBP 14.4	Thu	11:00–11:30	MOL 213	**Advances in reinforcement learn for accelerator tuning at CERN** — •Simon Hirlaender

Sessions

AKBP 1.1–1.4	Mon	15:00–16:00	MOL 213	**Particle Sources**
AKBP 2.1–2.4	Mon	15:00–16:00	GÖR 226	**Radiofrequency**
AKBP 3.1–3.6	Mon	16:30–18:00	MOL 213	**Beam Dynamics**
AKBP 4.1–4.6	Mon	16:30–18:00	GÖR 226	**New Accelerator Concepts**
AKBP 5.1–5.6	Tue	9:30–11:00	MOL 213	**Beam Dynamics**
AKBP 6.1–6.5	Tue	9:30–11:00	HSZ 301	**New Accelerator Concepts**
AKBP 7.1–7.6	Tue	14:30–16:00	MOL 213	**Diagnostics, Control and Instrumentation**
AKBP 8.1–8.6	Tue	14:30–16:00	HSZ 301	**New Accelerator Concepts**
AKBP 9.1–9.6	Tue	16:30–18:00	MOL 213	**Diagnostics, Control and Instrumentation**
AKBP 10.1–10.6	Tue	16:30–18:00	HSZ 301	**New Accelerator Concepts and Miscellaneous (superconducting materials)**
AKBP 11.1–11.6	Wed	9:30–11:00	MOL 213	**Diagnostics, Syn. radiation and FELs**
AKBP 12.1–12.4	Wed	15:00–16:00	MOL 213	**Electron Accelerator**
AKBP 13.1–13.6	Wed	16:30–18:00	MOL 213	**Free Electron Lasers**
AKBP 14.1–14.4	Thu	9:30–11:30	MOL 213	**Focus session: Machine Learning**
AKBP 15	Thu	15:00–16:15	MOL 213	**Bestowal of Prizes**
AKBP 16.1–16.13	Thu	16:30–18:00	P1C	**Posters**
AKBP 17	Thu	19:30–21:00	HSZ 304	**General Assembly of the Working Group on Accelerator Physics**

Mitgliederversammlung Arbeitskreis Beschleunigerphysik

(General Assembly of the Working Group on Accelerator Physics)

Donnerstag 19:30–21:00 HSZ 304

- Bericht der Vorsitzenden
- Beschleunigerpreise
- Verschiedenes

AKBP 1: Particle Sources

Time: Monday 15:00–16:00 Location: MOL 213

AKBP 1.1 Mon 15:00 MOL 213

Development of polarized sources with new laser techniques — •Chrysovalantis S. Kannis[1,2], Ralf Engels[1], Anna Hützen[1,3], Lukas Huxold[3], Ilhan Engin[1], Dimitris Sofikitis[4], T. Peter Rakitzis[5,6], Andreas Lehrach[1,2], and Markus Büscher[1,3] — [1]Forschungszentrum, Jülich, Germany — [2]RWTH University, Aachen, Germany — [3]HHU, Düsseldorf, Germany — [4]UOI, Ioannina, Greece — [5]FORTH, Heraklion, Greece — [6]UOC, Heraklion, Greece

Molecular photodissociation and optical pumping are two innovative laser-based techniques for the production of macroscopic spin-polarized samples. The first is used for the production of high density spin-polarized hydrogen and deuterium atoms from UV photodissociation of hydrogen and deuterium halides (e.g. HBr, HCl, DI, etc.). The second is used for the production of nuclear-polarized ^{3}He. After the ionization of the atomic gases, the spin-polarized ion targets are useful for the study of laser-driven plasma acceleration induced by a high-power laser system. Theoretical calculations indicate that laser-induced acceleration of polarized protons/deuterons of kinetic energies up to several GeV is feasible. Another important application is the polarized laser-fusion. Nuclear-spin polarization plays a fundamental role in the dynamics of fusion reactions and it has been shown that the D-T and D-^{3}He reaction cross sections can be increased by ~50%. This reactivity enhancement has not been observed in plasma, nor has polarized D-D fusion been measured. However, the aforementioned methods can offer the required densities for such experiments.

AKBP 1.2 Mon 15:15 MOL 213

Development of a GaAs-based photo-electron source with cryogenic components — •Tobias Eggert, Joachim Enders, and Yuliya Fritsche — Institut für Kernphysik, TU Darmstadt, Germany

Polarized electron beams can be generated using the internal photoeffect with GaAs as a photocathode. However, a negative-electron-affinity (NEA) coating consisting of a CsO layer, is necessary when using GaAs. This layer limits the operational lifetime as it gets corroded by oxygen and destroyed by ionized residual gas molecules hitting the surface. The latter is called ion back-bombardment (IBB) and one of the main lifetime limiting factors. Improving the vacuum conditions near the cathode surface is expected to reduce IBB and increase the lifetime. At the Photo-CATCH test facility in Darmstadt, an electron source is developed which uses cryocooling of a sub-volume around the cathode. In addition to the sub-volume, the cathode itself gets cooled.

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

AKBP 1.3 Mon 15:30 MOL 213

Improved Performance of GaAs photo-cathodes activated by Cs, Li and NF_3* — •Maximilian Herbert[1], Joachim Enders[1], Matthew Poelker[2], and Carlos Hernandez-Garcia[2] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]Thomas Jefferson National Accelerator Facility, Newport News, VA, United States of America

Photo-cathodes based on GaAs can be characterized mainly by two parameters: quantum efficiency η and lifetime τ. The former describes the photo-emission efficiency, while the latter is an indicator for the decay of the surface layer required to achieve negative electron affinity (NEA) for GaAs. This layer typically consists of Cs in combination with an oxidant. Previous studies have suggested that the addition of Li to this layer can significantly increase cathode performance by boosting both η and τ. Recently, first lifetime studies of bulk GaAs photo-cathodes activated with Cs, NF_3, and Li have been conducted using the photo-electron gun of the Upgraded Injector Test Facility (UITF) at the Thomas Jefferson National Accelerator Facility (JLab), extracting beam currents of up to 100 μA. We will present the results of these measurements as well as planned measurements at the Institut für Kernphysik at Technische Universität Darmstadt.

*Work supported by DFG (GRK 2128 "AccelencE"), BMBF (05H18RDRB1), and through the Helmholtz Graduate School for Hadron and Ion Research for FAIR.

AKBP 1.4 Mon 15:45 MOL 213

A novel X-ray source for microbeam radiation therapy — •Christoph Matejcek[2,4], Johanna Winter[1,2,3], Jan Wilkens[2,3], Stefan Bartzsch[1,2], and Kurt Aulenbacher[4,5,6] — [1]Helmholtz Zentrum München GmbH, Neuherberg, Germany — [2]Technische Universität München, School of Medicine und Klinikum rechts der Isar, München, Germany — [3]Technische Universität München, Physik-Department, Garching, Germany — [4]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Mainz, Germany — [5]Helmholtz Institut Mainz, Mainz, Germany — [6]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Microbeam radiation therapy is a new preclinical concept in radiation oncology. Due to the use of 25 to 100 μm wide and a few 100 μm separated planar x-ray beams, high peak dose values are crucial. Additionally low photon energy of a few 100 keV and high dose rates are demanded to suppress blurring of the dose pattern. To produce such x-rays with a preclinical prototype of a compact microbeam x-ray tube, a new electron source with a fast rotating target for x-ray production is under development. The source will deliver electrons with a kinetic energy of 300 keV and a current of 300 mA on an eccentric 0.05×20 mm^2 focal spot. Transport of these high currents at relative low energy will be challenging concerning space charge forces. Furthermore the realisation of the focal spot, good beam quality, low emittance are major topics. An additional application of the source can be phase contrast imaging. The general design and recent calculations and simulations will be presented.

AKBP 2: Radiofrequency

Time: Monday 15:00–16:00 Location: GÖR 226

AKBP 2.1 Mon 15:00 GÖR 226

RF Measurements of the 750 MHz PIXE-RFQ — •Hermann W. Pommerenke[1,2], Yves Cuvet[1], Alexej Grudiev[1], and Ursula van Rienen[2] — [1]CERN, Geneva, Switzerland — [2]University of Rostock, Germany

As an Ion Beam Analysis technique (IBA), the Proton Induced X-ray Emission (PIXE) uses protons of a few MeV. Because of non-damaging character, it is used for the analysis of cultural heritage artwork. A transportable proton accelerator provides mobile access to ion beam analysis, avoiding the need of moving the artwork. CERN has recently designed and constructed the compact 1 meter long PIXE-RFQ operating at 750 MHz, which will provide 2 MeV protons for PIXE analysis. RF measurements and tuning of the PIXE-RFQ are presented. The results of RF measurements performed on the recently manufactured RFQ cavity are compared to the simulation results, demonstrating good agreement. Furthermore, the tuning procedure to obtain desired frequency and field distribution is described.

AKBP 2.2 Mon 15:15 GÖR 226

SRF R&D activities at the Universität Hamburg and DESY — •Marc Wenskat[1], Christopher Bate[1,2], Arti Dangwal Pandey[2], Isabel Gonzalez Diaz-Palacio[1,2], Ricardo Monroy-Villa[1,2], Timothy Nagel[1], Heshmat Noei[2], Detlef Reschke[2], Jörn Schaffran[2], Guilherme Dalla Lana Semione[1,2], Sven Sievers[2], Lea Steder[2], Vedran Vonk[2], Jonas Wolff[1,2], Robert Zierold[1], Wolfgang Hillert[1,2], Andreas Stierle[1,2], Robert Blick[1], and Hans Weise[2] — [1]Universität Hamburg, Hamburg, Deutschland — [2]Deutsches Elektronen-Synchrotron, Hamburg, Deutschland

The experience gained during the construction and commissioning of the world's largest superconducting linear accelerator, the European XFEL, forms the basis for current R&D activities on superconducting cavities by an international team of researchers including experts from RF and accelerator physics as well as surface and materials science. We explore empirically gained understandings and observed correlations within the SRF research field using modern material- and surface-physics methods. At the same time, we are constructing new diagnostic tools, developing surface and material treatments, and exploring alternative materials to improve this technology. This cutting-edge research creates new, exciting linkages between various disciplines combining diverse knowledge. Herein, we will give an overview of the current projects and topics of our research group

AKBP 2.3 Mon 15:30 GÖR 226

A quadrupole resonator for SRF R&D — •Ricardo Monroy-Villa[1,2], Wolfgang Hillert[1,2], Detlef Reschke[2], Jan-Hendrik Thie[2], and Marc Wenskat[1] — [1]University of Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Hamburg, Germany

Radio frequency cavities used in particle accelerators and made from superconducting materials, *i.e.* niobium, have many advantages. In order to further improve their performance, a variety of different approaches can be applied and have to be investigated in detail. Instead of a rather complicated treatment of complex cavities samples of superconducting materials are studied to understand the material properties and their evolution under surface treatments, since they allow for an easier preparation and turn-around time at a lower cost. However, RF properties of superconducting samples, under the same conditions as SRF cavities, need to be studied as well to understand the influence of the material properties. A test cavity called quadrupole resonator (QPR) has been developed and operated at CERN and at Helmholtz Zentrum Berlin, which allows for testing samples under cavity conditions. In this work we report the status of such a test resonator developed and fabricated at Universität Hamburg and DESY. We present the results of a forensic study of the existing QPRs and how problems will be addressed in the new design. Fabrication tolerance studies on the electromagnetic field distributions, together with a status report on the current fabrication state, will be presented. In addition, the outline of two research projects using the QPR will be briefly addressed.

AKBP 2.4 Mon 15:45 GÖR 226

Microphonics Measurement and Compensation at MESA* — •Anna Kujawa, Florian Hug, and Timo Stengler — JGU Mainz, Institut für Kernphysik

A new electron accelerator called MESA is currently under construction at the Institute for Nuclear Physics at the Johannes Gutenberg-University Mainz. MESA stands for Mainz Energy Recovering Superconducting Accelerator and is going to be used to perform precision tests on the Standard Model at low energies. The centrepieces of the accelerator are two superconducting modified ELBE-type modules, the so-called cryomodules. In order to accelerate electron bunches, resonant fields of 1.3GHz are induced into the cavities resulting in standing waves. Since its bandwidth of 100 Hz is rather narrow, the resonance reacts promptly to any external vibrations giving rise to troubles guaranteeing a stable beam. These external vibrations are called microphonics. This talk presents measurements of microphonic effects on one of the cryomodules and future improvements to minimize external disturbance. Furthermore, a measurement of the full set of the cavities' resonance frequencies in a normal conducting environment is presented.

* This work has been supported by DFG through the PRISMA+ cluster of excellence EXC 2118/2019 and by the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 730871.

AKBP 3: Beam Dynamics

Time: Monday 16:30–18:00 Location: MOL 213

AKBP 3.1 Mon 16:30 MOL 213

Simulation of a Prototype Proton EDM Storage Ring — •Maximilian Vitz[1,2] and Andreas Lehrach[1,2] for the JEDI-Collaboration — [1]Institut for Nucler Physics IV, FZ Jülich, Germany — [2]III. Phyysikalisches Institut B, RWTH Aachen University, Germany

The matter-antimatter asymmetry might be understood by investigating the EDM (Electric Dipole Moment) of elementary charged particles. A permanent EDM of a subatomic particle violates time reversal and parity symmetry at the same time and would be a strong indication for physics beyond the Standard Model. The JEDI-Collaboration (Jülich Electric Dipole moment Investigations) in Jülich is preparing a direct EDM measurement for protons and deuterons: first at the storage ring COSY (COoler SYnchrotron) and later at a dedicated storage ring. The prototype proton EDM storage ring is an intermediate step before building the final storage ring to demonstrate suffcient beam lifetime and spin coherence time in a pure electrostatic ring as well as in storage ring with combined electric and magnetic bending elements. In order to study the effect of E-B-detectors on the orbit and the spin motion the software library Bmad is used. First results of optics and spin simulations towards the prototype ring will be discussed.

AKBP 3.2 Mon 16:45 MOL 213

Dynamic aperture studies for the Transfer Line from FLUTE to cSTART — •Jens Schäfer[1], Bastian Härer[1], Alexander Papash[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe, Deutschland — [2]LAS, KIT, Karlsruhe, Deutschland

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

AKBP 3.3 Mon 17:00 MOL 213

Investigation of RF-dependent charge production and electron energy at the FLUTE injector — •Tonia Windbichler[1], Michael J. Nasse[2], Thiemo Schmelzer[1], Marcel Schuh[2], Nigel Smale[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe, Deutschland — [2]IBPT, KIT, Karlsruhe, Deutschland

FLUTE (Ferninfrarot Linac und Test Experiment) is a linear electron accelerator which is currently being commissioned at the Karlsruhe Institute of Technology. The electron bunch is produced by a photoinjector in the injector section. The beam parameters, like energy and charge, are highly dependent on the RF settings of the 3 GHz electron gun. One adjustable RF parameter is the accelerating phase at the time of electron production with our laser system. By scanning this parameter the points of highest energy transfer and highest charge production can be distinguished. In this contribution measurements of the influence of the RF phase on the transported charge will be discussed.

AKBP 3.4 Mon 17:15 MOL 213

Progress towards short bunches and short pulses at the DELTA storage ring — •Benedikt Büsing, Shaukat Khan, Daniel Krieg, Carsten Mai, and Arne Meyer auf der Heide — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

DELTA is a 1.5-GeV synchrotron light source operated by the TU Dortmund University providing synchrotron radiation in a spectrum from hard X-rays to the VUV regime. The bunch length in a storage ring can be compressed by either increasing the cavity voltage or decreasing the momentum compaction factor. On the other hand, short pulses can be generated by using seeding schemes to modulate a short slice of the bunch by a laser-electron interaction. Latest results on bunch shortening due to a newly installed cavity as well as low-alpha optics and the status of the upgrade plan for the short-pulse source from coherent harmonic generation (CHG) to echo-enabled harmonic generation (EEHG) will be presented.

AKBP 3.5 Mon 17:30 MOL 213

Efficient Semi-Lagrangian Vlasov-Simulation of FEL-type Phase-Space Densities — •Philipp Amstutz and Mathias Vogt — DESY, Hamburg, Germany

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

In free-electron lasers (FELs) the electron bunches typically exhibit an “exotic” structure in the longitudinal phase-space resembling a fine, wiggling hair-like band. Such PSDs are not efficiently captured by a regular grid, as large parts of the minimum bounding rectangle of the PSD are void and do not contribute to the dynamics of the system. We present a code which employs tree-based domain decomposition to overcome this problem and its application to the study of space-charge driven micro-bunching in bunch-compressor stages of FEL-injectors.

AKBP 3.6 Mon 17:45 MOL 213

Beam matching to superconducting short crossbar H-Mode cavities — •Simon Lauber[1,2,3], Kurt Aulenbacher[1,2,3], Winfried Barth[1,2], Christoph Burandt[1,2], Florian Dziuba[1,2,3], Peter Forck[2], Viktor Gettmann[1,2], Manuel Heilmann[2], Thorsten Kürzeder[1,2], Julian List[1,2,3], Maksym Miski-Oglu[1,2], Holger Podlech[4], Anna Rubin[2], Malte Schwarz[4], Thomas Sieber[2], and Stepan Yaramyshev[2] — [1]Helmholtz Institute, Mainz, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Johannes Gutenberg University, Mainz, Germany — [4]Goethe University, Frankfurt, Germany

The superconducting (SC) heavy ion linear accelerator HELIAC is going to be operated with SC short crossbar H-Mode (CH) cavities. One of the special features of the linear accelerator, besides its continuous wave capability, is the smoothly variable output energy from 3.5 to 7.3 MeV/u, which requires a special beam dynamics concept. This can be realized with the Equidistant Multigap Structure (EQUUS). The deployment of this novel concept requires a detailed study of the beam matching to these structures.

AKBP 4: New Accelerator Concepts

Time: Monday 16:30–18:00 Location: GÖR 226

AKBP 4.1 Mon 16:30 GÖR 226

Polarized Particle Beams from Laser-Plasma Accelerators — •Anna Hützen[1,2], Johannes Thomas[2], Andreas Lehrach[3,4], T. Peter Rakitzis[5,6], Alexander Pukhov[2], Liangliang Li[7,8], Yitong Wu[7,8], Ralf Engels[4], and Markus Büscher[1,2] — [1]PGI-6, FZJ — [2]HHU Düsseldorf — [3]JARA-FAME — [4]IKP, FZJ — [5]University of Crete, Greece — [6]FORTH, Greece — [7]SIOM, China — [8]CAS, China

The generation of polarized particle beams still relies on conventional particle accelerators which are typically very large in scale and budget. Thus, concepts based on laser-driven wakefield acceleration have strongly been promoted during the last decades. Despite many advances in the understanding of fundamental physical phenomena, one largely unexplored issue is how highly polarized beams can be produced. The realization of laser-plasma based accelerators for polarized beams is now being pursued as a joint effort of groups from Germany (FZJ, RWTH, HHU), Greece, and China within the ATHENA consortium. As a first step, we have theoretically investigated and identified the mechanisms that influence the beam polarization in laser-plasma accelerators. We then carried out a set of Particle-in-cell simulations on the acceleration of electrons and proton beams from gaseous and foil targets showing the generation of intense polarized beams if prepolarized gas targets of high density are employed. Such polarized sources for electrons, protons, deuterons and 3He ions are now being built at FZJ. Proof-of-principle measurements at the (multi-)PW laser facilities PHELIX (GSI) and SULF (Shanghai) are in preparation.

AKBP 4.2 Mon 16:45 GÖR 226

High intensity laser interaction with cryogenic hydrogen jet target — •Constantin Bernert[1,2], Stefan Assenbaum[1,2], Florian-E. Brack[1,2], Lennart Gaus[1,2], Stefan Kraft[1], Florian Kroll[1], Josefine Metzkes-Ng[1], Martin Rehwald[1,2], Marvin Reimold[1,2], Hans-P. Schlenvoigt[1], Karl Zeil[1], Tim Ziegler[1,2], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany

High-intensity short-pulse lasers in the Petawatt regime offer the possibility to study new compact accelerator schemes by utilizing high-density targets for the generation of energetic ion beams. The optimization of the acceleration process demands comprehensive exploration of the plasma dynamics involved, for example via optical probing. In particular, experiments using near critcal density cryogenic hydrogen jet targets with um-scale transverse size are well suited to deliver new results which can then be compared to predictive particle-in-cell simulations. We show the results of an experimental campaign at the DRACO PW laser at Helmholtz-Zentrum Dresden Rossendorf where we were able to tune the proton acceleration performance by dedicated shaping of the target density profile.

AKBP 4.3 Mon 17:00 GÖR 226

Resonant small angle x-ray scattering probing ultrashort pulse high-intensity laser-solid interactions — •Lennart Gaus[1], Michael Bussmann[1], Alejandro Laso García[1], Siegfried Glenzer[2], Christian Gutt[3], Bob Nagler[2], Alexander Pelka[1], Melanie Rödel[1], Hans-Peter Schlenvoigt[1], Tom Cowan[1], Ulrich Schramm[1], and Thomas Kluge[1] — [1]HZDR — [2]SLAC — [3]Universität Siegen

The development of second-generation short-pulse laser-driven radiation sources requires a mature understanding of the relativistic laser-plasma processes as e.g. plasma oscillations, heating and transport of relativistic electrons as well as the development of plasma instabilities. These dynamic effects occurring on femtosecond and nanometer scales are very difficult to access experimentally. In a first experiment in 2014 at the Matter of Extreme Conditions facility at LCLS we demonstrated that small angle x-ray scattering (SAXS) of femtosecond x-ray free electron laser (XFEL) pulses is able to make these fundamental processes accessible on the relevant time and length scales in direct in-situ pump-probe experiments [Kluge et al., Phys. Rev. X 8, 031068 (2018)]. Here we report on a recent follow-up experiment with significantly higher pump intensity reaching the relativistic intensity domain. We give an overview of the new capabilities in combining a full suite of particle and radiation diagnostics and SAXS scattering. Especially probing at resonant x-ray energies can give new insight into the ultra-fast ionization processes, plasma opacity and equation-of-state in non-equilibrium plasmas.

AKBP 4.4 Mon 17:15 GÖR 226

Temperature effects on the electron injection in laser-plasma accelerators — •Soeren Jalas, Manuel Kirchen, and Andreas R. Maier — Luruper Chaussee 149 22761 Hamburg GERMANY

In laser plasma accelerators a high power laser generates plasma waves that can sustain accelerating fields on the order of GV/m. When the laser intensity is sufficiently high these waves can break which enables electrons from the plasma background to be trapped and accelerated. Here we show that the temperature of the plasma background can influence the plasma wave and thereby changes the threshold for wave-breaking to occur. Further, using the Particle-in-Cell code FBPIC we show that a finite plasma temperature can benefit the accuracy and performance of simulations.

AKBP 4.5 Mon 17:30 GÖR 226

Beamline Design Studies for a Laser-Wakefield Driven FEL — •Lars Hübner[1], Cora Braun[2], Timo Eichner[2], Thomas Hülsenbusch[2], Sören Jalas[2], Laurids Jeppe[2], Manuel Kirchen[2], Philipp Messner[1,3], Matthias Schnepp[2], Maximilian Trunk[2], Christian Werle[1], Paul Winkler[1], and Andreas R. Maier[2] — [1]DESY — [2]Center for Free- Electron Laser Science & Department of Physics, University of Hamburg — [3]Max Planck Institute for the Structure and Dynamics of Matter

Laser-plasma accelerators are promising candidates to drive compact, laboratory-scale free-electron lasers. However, the unique properties of plasma accelerated electron beams present a challenge to the conventional beam transport and lasing concepts. Here, we present the upgrade of the LUX beamline, that is built and operated by the University of Hamburg and DESY, with the goal of demonstrating FEL gain from a laser-plasma accelerator. The beamline design features a chicane to decompress the electron beam and relax the conditions on the initial beam parameters from the plasma target. The presented concept shows a balancing between the decrease in beam current due to the decompression, the effects of coherent synchrotron radiation in the chicane, and the manipulation of the phase-space to optimize the slice properties of the beam.

AKBP 4.6 Mon 17:45 GÖR 226

Characterisation of cryogenic hydrogen jet target for Laser Proton acceleration — •Stefan Assenbaum[1,2], Constantin Bernert[1,2], Florian Brack[1,2], Lennart Gaus[1,2], Stephan Kraft[1], Martin Rehwald[1,2], Hans-Peter Schlenvoigt[1], Karl Zeil[1], Tim Ziegler[1,2], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany

With the rise of a new generation of high intensity, high repitition rate laser systems, new interesting fields of application emerge, like e.g. hadron therapy using laser accelerated protons. This trend imposes new demands on targetry systems for laser ion acceleration to offer both high repitition rate capability as well as tight control of all target parameters.

In recent experiments, a renewable, cryogenically cooled, solid hydrogen jet target has been implemented into the Draco PW Laser System at HZDR. This debris-free target system allows for acceleration of single-species ion beams while offering superb acceleration performance through controlled pre-expansion of the jet prior to the high intensity interaction.

In this talk, we present detailed studies on the preplasma expansion process being conducted at the Draco 150 TW system at HZDR via high resolution optical probing. Furthermore, we investigate the geometric properties of the jet and report on further efforts to enhance jet stability.

AKBP 5: Beam Dynamics

Time: Tuesday 9:30–11:00 Location: MOL 213

AKBP 5.1 Tue 9:30 MOL 213

Systematic studies of RF phase modulation at KARA — •Sebastian Maier[1], Edmund Blomley[1], Tobias Boltz[1], Akira Mochihashi[2], Marcel Schuh[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

At the KIT storage ring KARA (KArlsruhe Research Accelerator), the beam lifetime is limited by scattering with rest gas atoms, but also affected by Touschek scattering. It has been reported in previous work, that a bunch lengthening can be achieved by a modulation of the RF acceleration voltages' phase, which causes an excitation of longitudinal oscillation modes within the stored bunches. In this contribution, we present first results of a systematic study of phase modulation (PM) close to the second harmonic of the synchrotron oscillation frequency with peak-to-peak amplitudes between 10% and 20% of the synchronous phase, focusing explicitly on its impact on the beam lifetime.

AKBP 5.2 Tue 9:45 MOL 213

Alignment Studies for the Low Energy Stage of FLUTE — •Micha Reissig[1], Axel Bernhard[2], Bastian Härer[2], Anton Malygin[1], Michael Nasse[2], Robert Ruprecht[2], Nigel Smale[2], Jens Schäfer[2], Thiemo Schmelzer[1], Pawel Wesolowski[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

The versatile linear accelerator FLUTE (Ferninfrarot Linac- Und Test-Experiment) at Karlsruhe Institute for Technology (KIT) is designed to generate strong ultra-short THz pulses, which can be used for photon science. It provides a platform for a variety of accelerator studies and different diagnostics for the characterization of electron bunches. The low energy stage of FLUTE includes an electron gun, a solenoid, a quadrupole and a spectrometer, which are currently being commissioned. This contribution presents simulations showing the impact of alignment errors and compares them to measurements taken at FLUTE.

AKBP 5.3 Tue 10:00 MOL 213

Developing Beam Optics for BESSY-VSR Project — •Felix Andreas and Paul Goslawski — Helmholtz-Zentrum Berlin, Hahn-Meitner-Platz 1, 14109 Berlin

At the HZB superconducting cavities are developed for the generation of long and short electron bunches. A cavity module, consisting of two 1.5 GHz and 1.75 GHz cavities each, can be assembled into a straight of the BESSY II storage ring, if the space for the module can be enlarged by modifying the beam optics. One possible solution is to remove two quadrupoles to gain the required installation length. With a self-developed code the two quadruples were turned off in simulations and the obtained optics was transferred to the storage ring. To avoid coupled bunch instabilities low beta functions within the VSR-module are required. Therefore a tool was developed which can change the minimum beta function within the given straight by interpolating between two different optics. The sextupoles were used to optimize the phase acceptance to such an extent that they were better than in the current standard optics. In another session the optics was successful audited for user operation by testing for high current, life time, kicker lifetime, bunch length and chromaticity.

AKBP 5.4 Tue 10:15 MOL 213

Studies on Instabilities and Negative Momentum Compaction Operation at KARA — •Patrick Schreiber[1], Tobias Boltz[1], Miriam Brosi[2], Alexander Papash[2], Marcel Schuh[2], Bastian Haerer[2], Akira Mochihashi[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

New operation modes are often considered during the development of new synchrotron light sources. An nderstanding of the instabilities involved is inevitable for a successful operation of these schemes. At the Karlsruhe Research Accelerator, KARA, new modes can be implemented and tested employing a variety of performant beam diagnostics devices and therefore instabilities in those regimes can be investigated. Currently, a negative momentum compaction optics is being established. In order to reinject quickly, the operation with a negative momentum compaction factor is being implemented at injection energy (500 MeV). This contribution presents the status of the implementation of this new regime as well as first results of instability studies at this energy.

AKBP 5.5 Tue 10:30 MOL 213

Model based algorithm to specify the alignment of the bERLinPro photoinjector components — •Jens Völker and Bettina Kuske — Helmholtz Zentrum Berlin, Berlin, Deutschland

The photoinjector module for bERLinPro will be assembled in the beginning of 2020 and will be installed in the bERLinPro injector beamline afterwards. Due to tight installation shedule, it is not possible to operate the assembled module prior to installation. Thus, module components like the SRF gun cavity, SC Solenoid or photocathode, can only be pre-adjusted in the warm state. However, they can be remotely adjusted in the module during operation. Therefore, a method is needed to quantify the alignment and other parameters of module components based on electron beam measurements with the aid of only limited diagnostic tools. With scans of known module parameters and the measurement of the changing beam response, this method should quickly clarify the alignment status and helps to adjust important components. In this talk, we will present the algorithm and simulation results.

AKBP 5.6 Tue 10:45 MOL 213

Design studies for final focus system for laser wake field acceleration experiment at SINBAD facility at DESY — •Sumera

Yamin, Ralph W Assmann, Florian Burkart, Francois Lemery, Barbara Marchetti, Eva Panofski, and Paul A Walker — Deutsches Elektronen Synchtron, DESY, Notkestrasse 85, 22607, Hamburg, Germany

The ARES (Accelerator Research experiment at SINBAD) Linac at SINBAD (Short and INnovative Bunches and Accelerators at DESY) facility at DESY aims to produce high brightness ultrashort electron bunches (sub fs to few fs) at around 100 MeV, suitable for injection into novel accelerators such as dielectric Laser acceleration (DLA) and Laser Wake Field Acceleration (LWFA). The LWFA Experiment with external injection planned at ARES aims towards studies for stable LWFA by combining the reproducible and stable RF based- accelerator technology with high gradient plasma wake field dynamics. One of the possible configurations, which is currently under consideration, for the injection in the plasma experiment requires the Twiss parameter β to be of the order of few mm at the injection point. The effect of space charge for high density electron bunches, such the ones produces at ARES with bunch charge of up to 10 pC and bunch length from sub fs to few fs, is dominant in the matching region. With the co-propagating Laser and electron beam in the external injection experiment, there are a lot of technical constraints that has to be considered for the final design. We aim to present design studies for the final focus system for LWFA experiment planned at ARES.

AKBP 6: New Accelerator Concepts

Time: Tuesday 9:30–11:00 Location: HSZ 301

AKBP 6.1 Tue 9:30 HSZ 301

Photonic particle acceleration: from advanced electron phase space control to attosecond electron pulse train generation — •Alexander Tafel[1], Norbert Schönenberger[1], Johannes Illmer[1], Anna Mittelbach[1], Ang Li[1], Roy Shiloh[1], Yuya Morimoto[1], Peyman Yousefi[1], Stefanie Kraus[1], Leon Brückner[1], Uwe Niedermayer[2], Peter Hommelhoff[1], and ACHIP Collaboration[3] — [1]Department Physik, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), 91058 Erlangen — [2]Technische Universität Darmstadt, 64289 Darmstadt — [3]achip.fau.de, achip.stanford.edu

The combination of high damage threshold dielectrics, high repetition rate femtosecond lasers and the nanofabrication capabilities of today enable the realization of an all-optical miniaturized particle accelerator on a chip. While the miniaturization is one of the biggest benefits, it is also one of the key challenges, which comes along with the micrometer wavelength of the driving laser pulses: we need to control the 6D electron phase space on the nanometer, milliradian and attosecond level. Here we report on how we use optical near-fields of tailored photonic nanostructures to manipulate both the transverse and the longitudinal phase space of the electron beam, which has recently enabled us to generate attosecond bunch trains and to confine the electron beam over long distances by virtue of alternating phase focusing. All of this brings us close to building the accelerator on a photonic chip. We will give an overview over the current state of the art and the upcoming challenges.

AKBP 6.2 Tue 10:00 HSZ 301

Online Diagnostics and Stabilization of the ANGUS 200 TW Laser — •Cora Braun[1], Timo Eichner[1], Thomas Hülsenbusch[1,2], Matthias Schnepp[1], and Andreas R. Maier[1] — [1]Center for Free-Electron Laser Science, Hamburg, Germany — [2]DESY, Hamburg, Germany

Laser-Plasma-Accelerators are prominent candidates to drive a next generation of high-brightness x-ray sources. The LUX laser-plasma-accelerator, driven by the ANGUS 200 TW laser, has recently demonstrated the generation of few-nm-plasma-driven undulator radiation. Long-term operation of the plasma accelerator with reproducible and stable electron beams requires a highly stable drive laser. To reach this goal, we have integrated the ANGUS laser in an accelerator-grade control system. Enabled by the analysis tools at every stage of the laser system, we observe that changes in the front-end of the amplifier chain have a direct impact on both, laser parameters in all amplification stages and the properties of the accelerated electrons. We will report on the long-term-drifts we have observed during laser operation and their effects on the laser system, and present recent upgrades to the laser system to stabilize against these drifts.

AKBP 6.3 Tue 10:15 HSZ 301

Influence of flat-top lasers in Particle-In-Cell simulations of plasma accelerators — •Laurids Jeppe, Sören Jalas, Manuel Kirchen, and Andreas R. Maier — Center for Free-Electron Laser Science and Department of Physics, Universität Hamburg

In a laser-plasma accelerator, electron beams are accelerated in strong plasma wakefields excited by a high-power laser pulse. A common simplification when modelling these experiments is the use of simple Gaussian profiles for the transversal laser envelope. However, to increase the energy density, modern laser systems typically feature flat-top transverse intensity profiles out of focus. We use the spectral, quasi-cylindrical Particle-in-Cell code FBPIC to model such a laser profile and discuss its effects on the laser-plasma interaction.

AKBP 6.4 Tue 10:30 HSZ 301

External injection plasma wakefield acceleration at FLASHForward — •Sarah Schröder[1,2] and on behalf of FLASHForward[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, 22607 Hamburg — [2]Universität Hamburg, Mittelweg 177, 20148 Hamburg

Owing to high-gradient accelerating fields (>GV/m), plasma wakefield accelerators (PWFA) have the potential of significantly reducing size and costs of future high-average power accelerator facilities. Acceleration stability and beam quality are largely dependent on the interplay between the parameters of the injected bunch and the structure of the plasma wakefield. Precise control of the bunch profile is essential for maximising the energy transfer efficiency and preserving the energy spread. At FLASHForward, driver/witness bunch pairs of adjustable bunch length and separation are generated by collimators in a dispersive section. Here we present the capabilities of precision measurements at FLASHForward and the latest experimental results.

AKBP 6.5 Tue 10:45 HSZ 301

FLASHForward X-1: High brightness beams from a plasma cathode — •Bridget Sheeran[1,2], A. Aschikhin[1,2], S. Bohlen[1,2], G. Boyle[1], L. Boulton[1,4], R. D'Arcy[1], M. Dinter[1], T. Bruemmer[1], J. Chappel[3], S. Diederichs[1,2], B. Foster[1,2], M.J Garland[1], L. Goldberg[1,2], P. Gonzalez[1,2], S. Karstensen[1], A. Knetsch[1], O. Kononenko[1,2], A. Kontogoula[1,2], P. Kuang[1], V. Libov[1,2], C.A Lindstroem[1], K. Ludwig[1], A. Martinez de la Ossa[1], F. Marutzky[1], M. Meisel[1,2], T. Mehrling[1,2], P. Niknejadi[1], K. Poeder[1], P. Pourmoussavi[1], A. Rahali[1], J-H. Roeckemann[1,2], L Schaper[1], A. Schleiermacher[1], B. Schmidt[1], S Schroeder[1,2], J-P. Schwinkendorf[1,2], T. Staufer[1,2], G. Tauscher[1,2], S. Thiele[1], S. Wesch[1], P. Winkler[1,2], J.C Wood[1], M. Zeng[1], and J. Osterhoff[1] — [1]DESY — [2]University of Hamburg — [3]University College London — [4]University of Strathclyde

The FLASHForward facility at DESY provides a unique opportunity for the study of Plasma Wakefield Acceleration (PWFA). At FLASHForward, a several kA electron beam with energies up to 1.25 GeV interacts with a plasma in a dedicated windowless, differentially pumped beamline. The FLASHForward X-1 experiment focuses on the development and study of internal injection techniques to produce ultra-high quality, fs-length electron bunches. Pulses from a 25~TW, fs-class, synchronised laser system allow for selective dual-arm pre-formation of density down-ramp. In this work we present the first demonstration of highly stable internal injection at FLASHForward on density-downramps.

AKBP 7: Diagnostics, Control and Instrumentation

Time: Tuesday 14:30–16:00 Location: MOL 213

AKBP 7.1 Tue 14:30 MOL 213

Rogowski-based beam position monitors for storage rings — •Falastine Abusaif for the JEDI-Collaboration — Juelich Forschungszentrum (IKP-2)

The Electric Dipole Moment (EDM) of elementary particles has gained a big interest in particle physics for the fact that it violates Charge Parity (CP) symmetry. The standard model lacks additional CP violating phenomenons to explain the matter-antimatter asymmetry. The Jülich Electric Dipole moment Investigations (JEDI) collaboration is preparing for measuring the EDM of charged hadrons (protons and deuterons) using the Cooler Synchrotron (COSY) storage ring. The search for an EDM requires highly precise measurement conditions. This comes from theoretical predictions, the strength of the EDM signal is so tiny that it can be easily mimicked by other effects. For this, it is necessary to disentangle a real EDM signal from systematic ones. The beam orbit is one of the important things that needs to be well known and controlled. The beam position monitors (BPMs) are used to deliver the transverse beam positions. The Rogowski coil operation, which is based on magnetic induction is exploited in a compact and sensitive position monitor for storage rings. This poster will present the working principles and the latest achievements of the Rogowski-based beam position monitor used at COSY.

AKBP 7.2 Tue 14:45 MOL 213

Beam-based alignment at the Cooler Synchrotron (COSY) in Jülich — •Tim Wagner for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich — III. Physikalisches Institut B, RWTH Aachen University

The JEDI collaboration intends to perform a direct measurement of the electric dipole moment (EDM) of protons and deuterons using a storage ring. In order to measure the EDM with a high precision a small orbit RMS is needed, since unknown magnetic fields, which are picked up when one is off of the optimal orbit, significantly add to the systematic error. In order to achieve a good orbit RMS in the accelerator one needs to know the size of the offsets between the beam position monitors (BPM) and the magnets, i.e. quadrupoles. A beam time to determine those offsets for the first time for all quadrupoles in the Cooler Synchrotron (COSY) has been performed in September/October 2019. During the beam time the so called beam-based alignment method was used to determine the location of the magnetic center for all the quadrupoles with respect to the electric center of the BPMs. With the known offsets between the BPMs and quadupoles one can recalibrate the BPMs to have the zero orbit go through the magnetic centers of the quadrupoles. In this talk the results of that beam time and other insight gained into the positions of the quadrupoles will be presented.

AKBP 7.3 Tue 15:00 MOL 213

Towards Automated Operation of the Super-FRS — •Jan-Paul Alexander Hucka[1,2], Stephane Pietri[2], and Joachim Enders[1] — [1]TU Darmstadt, Institut für Kernphysik — [2]GSI Helmholtzzentrum für Schwerionenforschung

For the upgrade of the GSI accelerators to the FAIR facility, a new control system is required to provide maximized parallelization and synchronicity of individual machines during operation.

Hence a framework from CERN, LSA [1], is being implemented and adapted to the needs of the GSI/FAIR facilities and its accelerators and beam transfers. The fragment separator FRS [2] and - at a later stage - also the superconducting fragment separator Super-FRS [3] at FAIR will be operated via LSA.

Current developments at the FRS towards an automated operation has shown to be successful as a proof of principle during the last engineering run. These developments encompass an automatic online setting generation by including energy-loss calculations for matter. It was shown that both primary beams of ^{40}Ar and ^{238}U as well as secondary fragment beams could be transported through the FRS without prior setting preparation.

Work supported by BMBF (05P19RDFN1) and through the TU Darmstadt-GSI cooperation contract.

[1] M. Lamont et al., LHC Project Note 368 (2005)
[2] H. Geissel et al., NIM B 70, 286 (1992)
[3] M. Winkler et al., NIM B 266, 4183 (2008)

AKBP 7.4 Tue 15:15 MOL 213

Energy Resolved Emittance Measurements of Laser-Wakefield Accelerated Beams — •Paul Winkler[1], Lars Hübner[1], Björn Hubert[2], Sören Jalas[2], Manuel Kirchen[2], Philipp Messner[2,3], Laurids Jeppe[2], Vincent Leroux[2], Timo Eichner[2], Thomas Hülsenbusch[2], Matthias Schnepp[2], Maximilian Trunk[2], Christian Werle[1], Bernhard Schmidt[1], and Andreas R. Maier[2] — [1]DESY — [2]Center for Free-Electron Laser Science and Department of Physics, Universität Hamburg — [3]Max Planck Institute for the Structure and Dynamics of Matter

Laser-wakefield accelerators enable the generation of electron beams with initially nm-small emittances and GeV-level beam energies within cm-scale. However, shot-to-shot fluctuations in beam quality can pose a limit to the transportability of plasma-generated beams, and, in particular, impede the measurement of the beam emittance using conventional methods.

Here, we present results from an emittance diagnostic implemented at the LUX laser-plasma accelerator. Results from a single-shot method are compared to results obtained from a quadrupole-scan for different energy-slices. After proving the applicability of the single-shot method at our setup for a narrow energy interval, we show an energy-resolved measurement of the electron phase-space. Slice-emittances as low as 0.8 mm mrad from ionization-injected beams as well as a complex modulation of the electron phase-space along the broad energy spectrum are observed.

AKBP 7.5 Tue 15:30 MOL 213

Optimization of RF Synchronization with the FLUTE Timing System — •Thiemo Schmelzer[1], Michael J. Nasse[2], Marcel Schuh[2], Nigel Smale[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

FLUTE (Ferninfrarot Linac- Und Test-Experiment) is a new compact versatile linear accelerator at KIT. Its primary goal is to serve as a platform for a variety of accelerator studies as well as to generate strong ultra-short THz pulses for photon science. Trigger signals with several frequencies are needed at FLUTE for devices as well as for sampling or as synchronization references. The trigger generation was revised to optimize the power stability for the RF system, which will be presented in this contribution.

AKBP 7.6 Tue 15:45 MOL 213

Bayesian Optimization of Injection Efficiency at KARA using Gaussian Processes — •Chenran Xu[1], Tobias Boltz[1], Akira Mochihashi[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

The injection at the KIT storage ring KARA is tuned by many parameters, such as the strength of various magnets and the RF frequency. The tuning process is currently performed manually by machine operators, which is time consuming and often gets stuck in local optima. This is exactly the domain for Bayesian optimization, a technique to optimize noisy black box functions. Using Gaussian processes (GPs) for regression, we obtain a probabilistic model which allows the integration of prior knowledge about the physical process. The model can be queried during the optimization procedure in order to efficiently explore the given parameter space, leading to comparably fast convergence. In this contribution, we demonstrate the implementation of Bayesian optimization to automate and optimize the injection process.

AKBP 8: New Accelerator Concepts

Time: Tuesday 14:30–16:00 Location: HSZ 301

AKBP 8.1 Tue 14:30 HSZ 301

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

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

AKBP 8.2 Tue 14:45 HSZ 301

Ion acceleration from ultra-thin foil targets using a PW-class laser with optimized temporal pulse profile — •Tim Ziegler[1,2], Constantin Bernert[1,2], Florian-Emanuel Brack[1,2], Stefan Bock[1], Lennart Gaus[1,2], Stephan Kraft[1], Florian Kroll[1], Josefine Metzkes-Ng[1], Thomas Pueschl[1], Martin Rehwald[1,2], Hans-Peter Schlenvoigt[1], Ulrich Schramm[1,2], and Karl Zeil[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]TU Dresden, Dresden, Germany

Laser-driven ion acceleration promises to provide a compact solution for demanding applications like radiobiological experiments. Controlling the particle beam parameters to achieve these goals is currently pushing the frontier of laser driven particle accelerators. The acceleration performance is strongly dependent on the complex plasma formation processes which in turn are determined by the temporal laser intensity profile and spatio-temporal couplings on a large dynamic range.

We present experimental results on the interaction of the DRACO Petawatt ultra-short pulse laser with ultra-thin foil targets. A combination of particle and plasma diagnostics for ions and electrons as well as reflected and transmitted light revealed clear indications of acceleration in the relativistic transparency regime. Furthermore, the implementation of a large suite of laser pulse diagnostic directly at the experimental area enabled an unprecedented level of laser pulse property characterization which allowed the laser plasma interaction to be optimized with extraordinary high precision and effectiveness.

AKBP 8.3 Tue 15:00 HSZ 301

Minimizing betatron coupling of energy spread and divergence in laser-wakefield accelerated electrons — •Alexander Köhler[1], Richard Pausch[1], Jurjen Pieter Couperus Cabadag[1], Omid Zarini[1], Yen-Yu Chang[1], Thomas Kurz[1,2], Susanne Schöbel[1,2], Michael Bussmann[1], Alexander Debus[1], Ulrich Schramm[1,2], and Arie Irman[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

Matched beam loading in laser wakefield acceleration (LWFA) flattens the accelerating electric field along the bunch and leads to the minimization of energy spread at high bunch charges. By using the self-truncated ionization injection scheme for controlling the injected charge, we demonstrate that minimal energy spread coincides with a reduction of the normalized beam divergence. Betatron radiation spectroscopy simultaneously confirms a constant beam radius at the plasma exit. Together, the decrease in divergence can be attributed to the reduction of chromatic betatron decoherence. Thus, beam loading enables the highest longitudinal and transverse phase space densities by optimizing energy spread and normalized divergence.

AKBP 8.4 Tue 15:15 HSZ 301

Simulations and applications for hollow-core photonic crystal fibers in the context of particle accelerators — •Luca Genovese[1], Francois Lemery[1], Frank Mayet[1,2], Max Kellermeier[1], Gordon Wong[3], Philip Russell[3,4], and Ralph Assmann[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]University of Hamburg, Institut für Experimentalphysik, Hamburg, Germany — [3]Max Planck Institute for the Science of Light, Erlangen, Germany — [4]Department of Physics, Friedrich-Alexander-Universität, Erlangen, Germany

Lasers have become an integral part of the development and performance optimization of modern high-brightness electron and light sources. Laser-based energy modulation of particle beams is routinely achieved using meter-scale magnetic undulators that provide the coupling between laser field and particles.

In this work we propose an alternative compact scheme based on hollow-core photonic crystal fibers, which support GV/m field gradients. We discuss several use cases for these fibers to charged particle beams

AKBP 8.5 Tue 15:30 HSZ 301

Online measurement of the fully angularly resolved energy spectrum of laser plasma-based accelerated protons. — •Marvin Reimold[1,2], Josefine Metzkes-Ng[1], Heide Meissner[1], Karl Zeil[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]TU Dresden, Dresden, Germany

Laser plasma-based accelerators promise to provide proton sources for radiobiological studies with extended possibilities compared to conventional accelerators due to short accerelation lengths, high pulse doses, high dose rates and the usage of compact pulsed operated magnets for beam guiding. For the generation of radiobiological relevant proton energies, Petawatt (PW) clase laser powers are required, which can be provided at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) by the DRACO laser system and the upcoming PENELOPE laser system. Both laser systems will be used to perform radiobiological studies. This requires the fully angularly resolved characterization of the produced proton energy spectrum at the source. At the moment no online detector is existing, which could fullfill this task. We present our detector system design based on scintillator emission tomography for the fully angularly resolved characterization of the proton energy spectrum at the source. We will focus on the reconstruction of the 3D dose distribution inside the scintillator volume and the reverse calculation of the angularly resolved proton energy spectrum from the reconstructed 3D proton dose distribution.

AKBP 8.6 Tue 15:45 HSZ 301

Controlled Plasma Generation for Beam-Driven Wakefield Acceleration — •Gabriele Tauscher[1,2], Lucas Schaper[1], Matthew James Garland[1], Bernhard Schmidt[1,2], Kristjan Poder[1], Lars Goldberg[2], Jan-Patrick Schwinkendorf[1], Gregory Boyle[1], Pardis Niknejadi[1], Theresa Brümmer[1], Simon Bohlen[1,2], Alexander Knetsch[1], Martin Meisel[1,2], Sarah Schroeder[1,2], Bridget Sheeran[1,2], Theresa Staufer[1], and Jens Osterhoff[1] — [1]Deutsches Elektronen-Synchrotron DESY — [2]Hamburg University

Plasma targets required for wakefield acceleration rely on establishing specific electron density distributions in longitudinal and transverse direction to allow for preservation of beam quality during the acceleration of electron bunches. In the FLASHForward project an electron bunch from the FLASH linac drives large amplitude wakefields in a pre-ionised plasma. The plasma can be generated by a multi-TW short-pulse laser or a high-current HV discharge. Especially in complex scenarios, where multiple gas species can be involved, the strength of the plasma generating source has to be adjusted to accommodate for the specific ionisation thresholds to e.g. generate strong gradient down ramps. To assess the plasma density distribution across the target experimentally, targets are investigated by different interferometry and spectroscopy. The comprehension of the underlying processes of laser and discharge induced plasma generation allows us to control and tailor plasma shapes.

AKBP 9: Diagnostics, Control and Instrumentation

Time: Tuesday 16:30–18:00 Location: MOL 213

AKBP 9.1 Tue 16:30 MOL 213

An Ultra-fast detector for wide-spectral range measurements — •Meghana Mahaveer Patil, Matthias Balzer, Erik Bründermann, Michele Caselle, Andreas Ebersoldt, Stefan Funkner, Benjamin Kehrer, Michael J. Nasse, Gudrun Niehues, Weijia Wang, Anke-Susanne Müller, and Marc Weber — Karlsruhe Institute of Technology

The KALYPSO (Karlsruhe Linear arraY detector for MHz rePetition rate SpectrOscopy) is a novel detector for beam diagnostics purposes capable of operating at frame rates up to 10 MHz. This detector consists of a silicon or InGaAs line array sensor with spectral sensitivity from 350 nm to 1600 nm. Such a wide range of spectral sensitivity is obtained by applying an ARC (anti-reflective coating) optimized for these wavelengths. The unprecedented frame rate of this detector is achieved by a custom-designed ASIC readout chip. The FPGA readout architecture enables continuous data acquisition and real-time data processing. In this contribution, various features of KALYPSO and initial measurements will be presented.

AKBP 9.2 Tue 16:45 MOL 213

Advanced temporal and spatial electron bunch diagnostics for laser-wakefield accelerated electron bunches — •Omid Zarini[1], Maxwell LaBerge[3], Jurjen Couperus Cabadag[1], Alexander Köhler[1], Richard Pausch[1], Thomas Kurz[1,2], Susanne Schöbel[1,2], Yen-Yu Chang[1], Michael Bussmann[1], Michael Downer[3], Ulrich Schramm[1,2], Alexander Debus[1], and Arie Irman[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden — [3]University of Texas at Austin

Laser wakefield accelerators (LWFA) feature unique electron bunch characteristics, namely micrometer beam size with duration ranging from a few fs to tens of fs. Precise knowledge of the longitudinal profile of such ultra-short electron bunches is essential for the design of future table-top x-ray light-sources. Our broadband, single-shot spectrometer combines the coherent transition radiation (CTR) spectrum in UV/VIS, near-IR and mid-IR. Our fully calibrated spectrometer is capable to characterize electron bunches with charges as low as 1 pC and resolve time-scales from 0.4 to 40 fs. In addition, complementary data on the transverse bunch profile is provided by simultaneously imaging the CTR in the far- and near-field. We present recent experimental results on electron bunch profiles and peak currents of different LWFA injection mechanisms. Furthermore, we present single-shot CTR imaging and interferometry data from electron bunches. We combine near field (NF) and far field (FF) imaging of CTR from a foil just outside the accelerator to determine the transverse structure of micro-bunched portions of the beam.

AKBP 9.3 Tue 17:00 MOL 213

Impedance studies at the Karlsruhe Research Accelerator using the Bunch-by-Bunch feedback system — •Edmund Blomley, Akira Mochihashi, Marcel Schuh, and Anke-Susanne Müller — IBPT, KIT, Karlsruhe

At the KIT storage ring KARA (KArlsruhe Research Accelerator) the impedance is influenced by several factors like in vacuum moving gap insertion devices and scrapers. Additionally, over the last several years, the vacuum chamber has been modified multiple times due to installation of new insertion devices. This contribution presents systematic studies of the impedance using long-term archive data as well as measurements using the fully digital 3D bunch-by-bunch feedback system.

AKBP 9.4 Tue 17:15 MOL 213

Status of Slice Emittance Measurements at PITZ — •Raffael Niemczyk[1], Prach Boonpornprasert[1], Ye Chen[1], James Good[1], Matthias Gross[1], Holger Huck[1], Igor Isaev[1], Christian Koschitzki[1], Mikhail Krasilnikov[1], Shankar Lal[1], Xiangkun Li[1], Osip Lishilin[1], Gregor Loisch[1], David Melkumyan[1], Anne Oppelt[1], Houjun Qian[1], Hamed Shaker[1], Guan Shu[1], Frank Stephan[1], and Wolfgang Hillert[2] — [1]DESY, Zeuthen site — [2]University of Hamburg

The Photo Injector Test facility at DESY in Zeuthen (PITZ) conditions and optimises high-brightness electron sources for the use at X-ray free-electron lasers (FELs). Since the lasing process occurs only on a fraction of the bunch, much smaller than the total bunch length, the slice emittance is of interest. To characterise the slice emittance, a measurement procedure was developed at PITZ, combining a single-slit scan with a transverse deflecting structure. The transportation of the beam at low energies of 20 MeV is complicated due to the high bunch charge and wide separation of the needed diagnostics devices. The slice emittance measurement setup, improving the beam transport, will be discussed. Also, problems arising from low signal-to-noise ratio during emittance measurements and possible solutions will be presented.

AKBP 9.5 Tue 17:30 MOL 213

Adding an Online Orbit-Response-Matrix Model to the Slow Orbit Feedback at DELTA — •Stephan Kötter and Thomas Weis — TU Dortmund University, DELTA

At DELTA, a 1.5 GeV synchrotron radiation light source operated by the TU Dortmund University, a software upgrade for the slow orbit feedback was introduced. An online fit of the bilinear-exponential model with dispersion (BE+d model) which passively leverages beam position measurements from orbit corrections is currently being added to the system. The fit will boost diagnostic capabilities by supplying estimates of beta functions and phases in both planes. The fitted model can also be used instead of a measured orbit-response matrix for estimating steerer currents for orbit corrections to adapt to changing beam optics without a dedicated orbit-response measurement.

AKBP 9.6 Tue 17:45 MOL 213

Towards arbitrary shaping of THz pulses from a laser-electron interaction at DELTA — •Carsten Mai, Benedikt Büsing, Shaukat Khan, Daniel Krieg, and Arne Meyer auf der Heide — Center for Synchrotron Radiation (DELTA), TU Dortmund University

The TU Dortmund University operates the 1.5-GeV electron storage ring DELTA as a lightsource in user operation. In 2011, a short-pulse facility including a beamline for experiments with THz radiation was commissioned. Broadband as well as tunable narrowband radiation up to 6 THz is generated by an interaction of short laser pulses with a single electron bunch. The spectral profile of the THz pulses was controlled using a modulation of the spectral phase of the laser pulses. This was realized by employing a spatial light modulator as a phase shifter in the Fourier plane of the laser beam setup. Measurements of THz spectra shaped by laser modulation are presented.

AKBP 10: New Accelerator Concepts and Miscellaneous (superconducting materials)

Time: Tuesday 16:30–18:00 Location: HSZ 301

AKBP 10.1 Tue 16:30 HSZ 301

TWEAC – Scalable laser-plasma acceleration — •Alexander Debus[1], Richard Pausch[1,2], Axel Hübl[1,2,3], Klaus Steiniger[1,2], René Widera[1], Thomas Cowan[1], Ulrich Schramm[1], and Michael Bussmann[1,4] — [1]HZDR, Helmholtz-Zentrum Dresden - Rossendorf, Bautzner Landstr. 400, Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden — [3]Lawrence Berkeley National Laboratory, Berkeley, California, US — [4]CASUS, Center for Advanced Systems Understanding, Görlitz, Germany

While laser-plasma accelerators provide multi-GeV electron beams today, the acceleration to higher energies is limited. The sub-luminal group-velocity of plasma waves let electrons outrun the accelerating field. We present Traveling-Wave Electron Acceleration [1], a novel compact laser-plasma accelerator scheme which circumvents the LWFA constraints of electron beam dephasing, laser pulse diffraction and depletion.

In order to control the speed of the accelerating plasma cavity, TWEAC utilizes two pulse-front tilted laser pulses whose propagation directions enclose an acute angle. The accelerating cavity is created along their overlap region in the plasma and can move at the vacuum speed of light. Thus, TWEAC provides constant acceleration which opens the way for electron energies beyond 10 GeV, possibly towards TeV class electron beams, without the need for multiple laser-accelerator stages.

[1] Debus *et al.*, Phys. Rev. X **9**, 031044 (2019)

AKBP 10.2 Tue 16:45 HSZ 301

Simulating the hybrid LPWFA scheme - a millimeter-sized plasma wakefield accelerator — •Richard Pausch[1], Thomas Kurz[1,2], Thomas Heinemann[3,6], Jourjen Couperus Cabadag[1], Olena Kononenko[5], Susann Schöbel[1,2], Ralf Assmann[3], Michael Bussmann[1,7], Klaus Steiniger[1], Sebastian Corde[5], Andreas Döpp[4], Bernhard Hidding[6], Stefan Karsch[4], Ulrich Schramm[1,2], Alberto Martinez de la Ossa[3], Arie Irmann[1], and Alexander Debus[1] — [1]HZDR — [2]TU Dresden — [3]DESY — [4]LMU München — [5]LOA — [6]University of Strathclyde — [7]CASUS

The hybrid LPWFA acceleration scheme combines laser- (LWFA) with plasma-wakefield acceleration (PWFA) and has the potential to provide an ultra-compact, high-brightness electron source. Witness bunch acceleration within this scheme was recently demonstrated at HZDR. This talk presents the latest start-to-end simulations, that accompanied the experimental campaign, and provided fundamental insights into the injection and acceleration process of this novel, compact accelerator. With recent advances in simulation capabilities, significantly enhanced agreement between theoretical predictions and experimental measurements could be achieved by resembling the experiment to a very high degree using the 3D3V particle-in-cell code PIConGPU. These simulations provide insight into the plasma dynamics, otherwise inaccessible in experiments. Various intrinsic, as well as controllable injection mechanisms, will be presented in detail. Furthermore, we will discuss the challenges in maintaining numerical stability and experimental comparability with these long-duration simulations.

AKBP 10.3 Tue 17:00 HSZ 301

Optimal parameters for laser ion acceleration — •Ilja Goethel[1,2], Thomas Kluge[1], Michael Bussmann[1], Richard Pausch[1], Klaus Steiniger[1], Axel Huebl[1,3], and Ulrich Schramm[1,2] — [1]HZDR, Dresden — [2]Technische Universität Dresden — [3]Lawrence Berkeley National Laboratory

Accelerating ions by irradiating solid density foils with high intensity, femtosecond laser pulses of relativistic strength (i.e. causing relativistic electron energies within one half-cycle) is a highly complex, nonlinear and instability-prone process with dynamic timescales between femtoseconds to picoseconds, and very challenging to treat analytically.

By connecting experiments with simulation results we are able to develop insight into acceleration processes in different regimes. Simulations are performed with the highly scalable, open-source code PIConGPU developed at HZDR.

This talk presents our methods and the details of two physical systems: a jet of cryogenic hydrogen that is preexpanded to a varying degree; and a thin foil with varying preplasma scale lengths irradiated by a laser that is not purely gaussian but with an additional rising upramp.

In order to find global optima of the ion cutoff energies and other quality measures we want to apply methods of machine learning. We aim thereby to find sensitive regions in the parameter space and predict promising constellations.

AKBP 10.4 Tue 17:15 HSZ 301

Level populations in PIC-Simulations — •Brian Edward Marre[1], Michael Bussmann[1], Axel Huebl[2], Thomas Kluge[1], and Ulrich Schramm[1] — [1]Helmholtz Zentrum Dresden – Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Deutschland — [2]Lawrence Berkeley National Laboratory, CA United States

The irradiation of solids with high intensity laser light is one future ion acceleration concept. The short laser pulse accelerates electrons which isochoricly heat the plasma and may accelerate ions due to local charge gradients.

Modelling atomic physics in Particle-in-a-Cell(PIC) simulations allows us to model these processes much more accurately. Predicting the charge state distributions more reliably which are important for all fundamental processes of laser absorption, electron acceleration and transport.

In order to include those processes self-consistently into PIC-Simulations we need to model the time evolution of the level populations based on local cell conditions and directly couple them to the PIC simulation. We explicitly solve the rate equations, without relying on a quasi Maxwellian local plasma temperature or local equilibrium conditions. This is necessary due the very short timescale of laser interactions, making a temperature definition difficult and prohibiting the use of lookup tables based on equilibrium assumptions.

We will include this as a package into the existing highly parallelized PIConGPU code to make the demanding calculations computationally feasible.

AKBP 10.5 Tue 17:30 HSZ 301

Low temperature formation of high quality Nb_3Sn thin films by co-sputtering for SRF cavities — •Nils Schäfer[1], Nail Karabas[1,2], Márton Major[1], and Lambert Alff[1] — [1]Institute of Materials Science — [2]Institut für Kernphysik

Nb_3Sn is a promising thin film material for superconducting radiofrequency (SRF) cavities as it can empower the cavity to operate at higher acceleration fields and lower expenses for cooling in respect to current state of the art Nb-cavities. This is achievable by the superior material properties like critical temperature, superheating field and surface resistivity. Up to now, Nb_3Sn coated Nb-cavities could not replace bulk Nb, mainly due to the huge difference in vapor-pressure of Nb and Sn which makes the thermal approach challenging. Co-sputtering is used to overcome this limitation by utilizing the larger kinetic energy of the sputtering process. In case of co-sputtering the kinetic energy of both elements is controlled separately to form Nb_3Sn at substrate temperatures as low as 400°C with T_C up to 16.3 K, close to the bulk critical temperature. Work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H18RDRB2.

AKBP 10.6 Tue 17:45 HSZ 301

Nitrogen-doping of niobium for SRF cavities — •Márton Major[1], Stefan Flege[1], Lambert Alff[1], Jens Conrad[1], Ruben Grewe[1], Michaela Arnold[1], Norbert Pietralla[1], and Florian Hug[2] — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]Johannes Gutenberg Universität Mainz, Mainz, Germany

Niobium is the standard material for superconducting RF (SRF) cavities. Superconducting materials with higher critical temperature and higher critical magnetic field allow cavities to work at higher operating temperatures and higher accelerating fields. One direction of search for new materials with better properties is the modification of bulk niobium by nitrogen doping. In the Nb-N phase diagram the cubic δ-phase of NbN has the highest critical temperature (16 K).

For the investigation of the NbN phases niobium samples were doped at the refurbished UHV furnace at IKP Darmstadt. In this contribution we focus on the structural investigations (x-ray diffraction and pole figure, secondary ion mass spectroscopy, scanning electron microscopy) of the doped samples. We show results of the first samples with NbN surface phase.

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

AKBP 11: Diagnostics, Syn. radiation and FELs

Time: Wednesday 9:30–11:00 Location: MOL 213

AKBP 11.1 Wed 9:30 MOL 213

2D Analysis of Excited-Bunch Dynamics at BESSY II — •Marten Koopmans, Ji-Gwang Hwang, Andreas Jankowiak, Markus Ries, and Gregor Schiwietz — Helmholtz-Zentrum Berlin

With the VSR upgrade for the BESSY II electron-storage ring bunch resolved diagnostics are required for machine commissioning and to ensure the long-term quality and stability of operation. For bunch-length measurements a dedicated beamline equipped with a fast streak camera was set up and successfully commissioned. The beamline is also capable of direct beam-profile imaging and interferometry of the vertical beam size using the X-ray blocker bar. While optimizations are still ongoing, 2D bunch-resolved measurements with an additional transverse dimension are already possible with the streak camera.

Using this potential, we present a new method to study the properties of the "pulse picking by resonant excitation" (PPRE) bunch. Applying a statistical analysis to single shot (of a single turn) images, enables to distinguish between horizontal orbit motion and the broadening of the bunch due to the excitation. The results are compared with data from the beam position monitor system.

AKBP 11.2 Wed 9:45 MOL 213

Synchrotron radiation-based beam size measurements at KARA — •Carl Sax[1], Benjamin Kehrer[2], Marcel Schuh[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

At synchrotron light sources it is crucial to know the size of the electron beam both for accelerator physics and applications of the synchrotron radiation. One way is to use the radiated synchrotron light to infer to the electron beam size. This contribution presents such a beam diagnostic system implemented at the Karlsruhe Research Accelerator (KARA). A python interface for epics (pyDevSup) allows to analyze and calculate the image information inside an epics IOC and transfer it via epics PV to the KARA control system. Additionally it is possible to use a double slit to provide information about the vertical beam size. This setup has been included into the KARA control system and first measurements will be presented.

AKBP 11.3 Wed 10:00 MOL 213

Eddy Current Sensor to detect the superconducting transition of the SC magnetic shielding inside the bERLinPro Photoinjector — •Jens Völker — Helmholtz Zentrum Berlin, Berlin, Deutschland

Inside the Photoinjector module for bERLinPro a superconducting (SC) magnetic shield will be installed between SRF gun cavity and SC solenoid to reduce the magnetic flux next to the cavity shielding during solenoid operation. A test setup was build up to measure the magnetic shield and the cooling efficiency of our new shield design. One element of this setup is a system to detect the superconducting transition of the Niobium plate based on an Eddy-Current Sensor (ECS). The sensor and the read out were designed and tested to observe the thermal induced changes of the ohmic resistance of copper and aluminum plates and also superconducting transition of Niobium. In this talk the ECS system will be introduced and measurement results will be shown.

AKBP 11.4 Wed 10:15 MOL 213

Developing a coherent radiation direct detection scheme for the SSMB PoP experiment — •Arnold Kruschinski[1,2], Arne Hoehl[3], Roman Klein[3], Markus Ries[1], and Jörg Feikes[1] — [1]Helmholtz-Zentrum Berlin — [2]Humboldt-Universität zu Berlin — [3]Physikalisch-Technische Bundesanstalt

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

A proof-of-principle experiment is conducted at the MLS storage ring in Berlin, demonstrating stability of a microbunch structure over one turn in the storage ring. So far it has only been possible to detect the coherent synchrotron light at the second harmonic of the laser wavelength. This is because the laser pulse used to imprint a microbunch structure onto the electron beam saturates the detectors, blinding them for the detection of the coherent pulse. A Master's project now aims to also enable a first harmonic detection scheme where Pockels cells are to be used for temporal isolation of the coherent signal appearing 160 ns after the laser pulse.

AKBP 11.5 Wed 10:30 MOL 213

Numerical simulation of a superradiant THz source at the PITZ facility — •Natthawut Chaisueb[1,2], Sakhorn Rimjaem[1], and Mikhail Krasilnikov[3] — [1]Plasma and Beam Physics Research Facility (PBP), Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand — [2]Doctor of Philosophy Program in Physics (International Program), Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand — [3]DESY, Zeuthen, Germany

An accelerator-based THz source is under development at the Photo Injector Test Facility at DESY in Zeuthen (PITZ). The PITZ accelerator consists of a photocathode RF electron gun enclosed by solenoid magnets, a booster cavity (cut disk structure, CDS) for further acceleration, and several precise instruments for electron beam diagnostics. The facility can produce high brightness electron beams with small emittance and currently plans to develop a tunable high-power THz SASE FEL source for supporting THz-pump, X-ray probe experiments at the European XFEL. An LCLS-I undulator, a magnetic chicane bunch compressor, and THz pulse diagnostics will be installed downstream the current setup of the PITZ beamline. Additionally to the SASE FEL, a possibility to generate THz undulator radiation from short electron bunches is under investigations. Numerical simulations of the superradiant THz radiation by using sub-picosecond electron bunches from the PITZ accelerator are presented and discussed in this contribution.

AKBP 11.6 Wed 10:45 MOL 213

Studies on seeding of THz SASE FEL by photocathode laser pulse modulation for PITZ — •Georgi Georgiev[1], Mikhail Krasilnikov[1], and Wolfgang Hillert[2] — [1]Deutsches Elektronen-Synchrotron DESY, 15738 Zeuthen, Germany — [2]University of Hamburg, 22761 Hamburg, Germany

A THz SASE FEL is investigated at the Photo Injector Test Facility at DESY in Zeuthen (PITZ) as a THz radiation source, that is proposed for pump-probe experiments at the EXFEL. Proof-of-principle experiments are considered with LCLS-I undulators, to be installed in the tunnel annex. Start to end simulations point to FEL saturation from shot noise being reached at about the lenght of the undulator with approximately 0.5 mJ THz pulse energy at 100 μm center wavelenght. To further improve the pulse energy, saturation lenght and stability of SASE, several seeding methods are considered. A temporal intensity modulation of the photocathode laser pulse is planned as one of these methods. Beam dynamics simulations carried on ASTRA have been performed to study the longitudinal modulation of the electron beam from the PITZ photo injector and results will be presented.

AKBP 12: Electron Accelerator

Time: Wednesday 15:00–16:00 Location: MOL 213

AKBP 12.1 Wed 15:00 MOL 213

Recent Developments at the S-DALINAC* — •M. Arnold, J. Birkhan, A. Brauch, C. Caliari, M. Dutine, J. Enders, M. Fischer, R. Grewe, J. Hanten, L. Jürgensen, M. Meier, J. Pforr, N. Pietralla, F. Schliessmann, M. Steinhorst, L. Stobbe, and S. Weih — IKP, TU Darmstadt

The superconducting Darmstadt linear accelerator, S-DALINAC, was set into operation at TU Darmstadt in 1991 as a twice-recirculating linac for electrons. In 2015/2016 a third recirculation beam line was added to achieve the maximum design energy of 130 MeV, higher operational stability, and to enable operation in an energy-recovery linac (ERL) mode [1,2]. Since its establishment, the S-DALINAC was mainly developed and operated by students. Also during the past year, various projects have progressed and several measurements with beam have been done. For example, a new system for the measurement of beam emittance by optical transition radiation (OTR) was set into operation. Additional diagnostics have been commissioned or are under construction. Further upgrades of the injector section are in preparation. Several projects are addressing the ERL operation of the S DALINAC. Simulations and dedicated diagnostics for the twice-recirculating ERL mode are under investigation. This contribution will give an overview on the status of those projects.

[1] N. Pietralla, Nuclear Physics News, Vol. 28, No. 2, 4 (2018).
[2] M. Arnold et al., submitted to PRAB (2019).

*Work supported by DFG (GRK 2128), BMBF (05H18RDRB2),

State of Hesse (LOEWE Nuclear Photonics)

AKBP 12.2 Wed 15:15 MOL 213

Beam Pulsing at the S-DALINAC: Superposition of the 3 GHz Beam Structure with a 10 MHz Macrostructure — •Lennart Stobbe, Michaela Arnold, Jonny Birkhan, Uwe Bonnes, Lars Jürgensen, and Norbert Pietralla — Institut für Kernphysik, TU Darmstadt, Germany

The superconducting electron-linear-accelerator S-DALINAC provides a cw-beam with a 3 GHz time structure for electron scattering experiments [1]. This mode is fixed and does not allow to deliver a pulsed beam to the experimental setups. Time of flight measurements are currently not feasible at the so-called QCLAM magnetic spectrometer, which would be needed for particle separation within coincidence experiments as well as for a significant background suppression. Therefore, a new concept for pulsing the electron beam at the S-DALINAC has been developed. It is planned to superimpose the 3 GHz beam structure with a 10 MHz macrostructure. This concept is based on using a plate capacitor setup in order to achieve the superposition. The plate capacitor will deflect the beam across an aperture with a repetition rate of 10 MHz. The current state of the capacitor setup as well as several simulations will be presented.

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

AKBP 12.3 Wed 15:30 MOL 213

Status of the KIT accelerators at KARA and FLUTE — •Bastian Härer[1], Axel Bernhard[1], Edmund Blomley[2], Tobias Boltz[2], Miriam Brosi[2], Andi Chai[2], Erik Bründermann[1], Sara Casalbuoni[1], Kantaphon Damminsek[2], Dima El Khechen[2], Stefan Funkner[2], Julian Gethmann[2], Andreas Grau[1], Erhard Huttel[1], Benjamin Kehrer[2], Anton Malygin[2], Sebastian Maier[2], Matthias Martin[2], Sebastian Marsching[2], Yves-Laurent Mathis[1], Wolfgang Mexner[1], Akira Mochihashi[1], Matthias Nabinger[2], Michael J. Nasse[1], Gudrun Niehues[2], Meghana Patil[2], Alexander Papash[1], Micha Reissig[2], Robert Ruprecht[1], David Saez de Jauregui[1], Carl Sax[2], Jens Schäfer[2], Thiemo Schmelzer[2], Patrick Schreiber[2], Marcel Schuh[1], Nigel J. Smale[1], Johannes L. Steinmann[1], Yimin Tong[2], Pawel Wesolowski[1], Tonia Windbichler[2], Chenran Xu[2], Minjie Yan[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe, Germany — [2]LAS, KIT, Kalrsruhe, Germany

The Institute for Beam Physics and Technology (IBPT) at the Karlsruhe Institute of Technology (KIT) operates the Karlsruhe Reaseach Accelerator (KARA) and the Ferninfrarot Linac and Test Experiment (FLUTE). This contribution gives an overview of both facilities and the respective accelerator physics research activies.

AKBP 12.4 Wed 15:45 MOL 213

Status of the Conceptual Design of Ultrafast Electron Diffraction at DELTA — •Daniel Krieg[1], Shaukat Khan[1], Klaus Sokolowski-Tinten[2], and Thies Johannes Albert[2] — [1]Center for Synchrotron Radiation, TU Dortmund University, Dortmund, Germany — [2]University Duisburg-Essen, Duisburg, Germany

Ultrafast electron diffraction (UED) is a pump-probe technique that combines sub-angstrom De-Broglie wavelengths of MeV electrons with a femtosecond time resolution. Therefore, an ultrashort pump laser adjustable in photon energy, electron bunches with small emittances, ultrashort length and typically charges well below 1pC, as well as an excellent synchronization system are required. UED systems based on a radiofrequency photocathode gun offer advantages regarding emittance and bunch length compared to electrostatic keV systems. Hence, providing more electrons per bunch is possible. Furthermore, the longer mean free path of MeV electrons allows for thicker samples and thus a broader range of possible materials. In this talk, latest results on the conceptual design of a university-based UED facility with ultrashort and low-emittance MeV electron bunches are presented.

Funded by MERCUR Pr-2017-0002

AKBP 13: Free Electron Lasers

Time: Wednesday 16:30–18:00 Location: MOL 213

AKBP 13.1 Wed 16:30 MOL 213

Electron beam characterisation based on seeded FEL properties — •Mathis Mewes — Universität Hamburg, Hamburg, Germany

The performance of high gain FELs strongly depends on the electron bunch properties. In seeded FEL mode the electron bunches are usually much longer than the XUV-pulse and therefore only the properties of the seeded slices are relevant to the lasing process. If complete time resolved electron beam diagnostics is not available one can try to characterize the electron bunch slices indirectly by analyzing the FEL output radiation. This approach has been used to determine the electron beam slice emittance and energy spread at the HGHG seeding experiment (sFLASH) at the Free-electron Laser in Hamburg. Furthermore time resolved measurements of the contrast of the seeded FEL with respect to SASE mode give the possibility to estimate the initial bunching factor and henceforth the induced energy modulation by the seeding laser pulse.

AKBP 13.2 Wed 16:45 MOL 213

HTS undulators: status of prototype coils for compact FELs — •Sebastian C. Richter[1,2], Daniel Schoerling[1], Axel Bernhard[2], Kantaphon Damminsek[2], Julian Gethmann[2], and Anke-Susanne Müller[2,3] — [1]CERN, Geneva, Switzerland — [2]LAS, KIT, Karlsruhe, Germany — [3]IBPT, KIT, Karlsruhe, Germany

Compact free electron lasers (FELs) require short-period high-field undulators in combination with shorter accelerator structures to produce coherent light up-to X-rays. Applying high-temperature superconductor (HTS) in form of coated REBCO tape conductors allows reaching higher magnetic fields and larger operating margins. This contribution discusses and summarizes the potential of HTS for the major superconducting undulator geometries (horizontal, vertical racetrack and helical) as well as the status of prototype coils for each type, to be wound with REBCO tape.

AKBP 13.3 Wed 17:00 MOL 213

Simulation results of an HGHG Seeded Oscillator-Amplifier — •Georgia Paraskaki[1], Vanessa Grattoni[1], Bart Faatz[1], Christoph Lechner[1], Johann Zemella[1], Sven Ackermann[1], and Wolfgang Hillert[2] — [1]DESY — [2]University of Hamburg

External seeding techniques are drawing the attention of the FEL community due to the higher brightness and improved longitudinal coherence of the output FEL pulse, and at the same time, there is an interest in higher repetition rates. Since the seed lasers currently available cannot offer sufficient energy in repetition rates of superconducting machines, at the moment one has to decide between seeded FEL radiation and higher flux. In order to overcome this dilemma, we discuss the concept of an HGHG seeded Oscillator-Amplifier, with the aim of achieving high repetition rate seeding. With this scheme, we can use a seed laser of 10 Hz and a resonator to feedback the radiation at repetition rates of superconducting machines instead of using an external seed at these high-repetition rates. The first simulation results with final wavelengths between 4.17 nm and 60 nm will be presented.

AKBP 13.4 Wed 17:15 MOL 213

Status of the CompactLight Design Study — •Regina Rochow and Gerardo D'Auria — Elettra Sincrotrone Trieste, Trieste, Italy

CompactLight (XLS) is a H2020 Design Study funded by the European Union under grant agreement 777431 and carried out by an International Collaboration of 24 partners and 5 third parties. The project started in January 2018 with a duration of 36 months and aims at designing an innovative, cost-effective and compact hard X-ray FEL facility beyond today's state of the art. This will be achieved using an advanced C-band photo-injector, high gradient X-band accelerating structures, and novel short period undulators. The hard X-ray FEL will be complemented by a soft X-ray source that can be operated up to 1 KHz pulse repetition rate. The presentation, held on behalf of the CompactLight Consortium, will give an overview of the state of the project, focusing in particular on the facility design and its potential regarding future user needs.

AKBP 13.5 Wed 17:30 MOL 213

Potential of variable polarizing undulators as afterburners —

•Julian Gethmann[1], Sebastian C. Richter[1,2], Axel Bernhard[1], and Anke-Susanne Müller[1] — [1]LAS, KIT, Karlsruhe — [2]CERN, Geneva

As part of the EU funded Compact Light project, pros and cons of superconducting undulators with variable polarisation as afterburners for compact Free-Electron Lasers are discussed. For Free-Electron Lasers that use superconducting undulators for compactness, afterburners are the most promising way to provide variable polarized light. Until now, afterburners only exist as permanent magnet undulators which might limit the advantages of using superconducting undulators as main amplifiers in Free-Electron Lasers. However, variably polarizing superconducting undulators have been shown to be feasible. In this contribution we discuss the findings of our simulations and parameter studies exploring the potential of superconducting variably polarizing undulators as afterburners for compact Free-Electron Lasers.

AKBP 13.6 Wed 17:45 MOL 213

Seeding bei FLASH2020+ — •Sven Ackermann — Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg, Deutschland

Sven Ackermann für das FLASH2020+ Seeding Team

Seit mehr als einer Dekade stellt der Freie-Elektronen-Laser FLASH am Helmholtz-Zentrum DESY Wissenschaftlern aus aller Welt hochintensive, ultrakurz gepulste Strahlung im extremen Ultraviolett und im weichen Röntgenbereich zur Verfügung. FLASH war weltweit der erste Freie-Elektronen Laser (FEL), der in den Bereich dieser kurzen Wellenlängen vorstoßen konnte.

Unter dem Namen FLASH2020+ wird die zukünftige Ausrichtung der über 300 Meter langen FEL-Anlage erarbeitet. Um die gestiegenen Anforderungen der Experimente auch weiterhin befriedigen zu können soll in der ersten der zwei Strahlführungen mittels Einstrahlung externer Laserpulse (”Seeding”) die Ladungsdichteverteilung der Elektronenpakete so manipuliert werden, dass im Undulator insbesondere longitudinal kohärente Strahlung bis in den weichen Röntgenbereich emittiert wird. Dabei sollen auch in diesem Betriebsmodus die durch die supraleitende Beschleunigungstechnologie möglichen hohen Wiederholraten erreicht werden. Ferner soll der Einsatz entsprechender Undulatoren eine frei wählbare zirkulare Polarisation der FEL-Pulse ermöglichen.

In diesem Beitrag werden die vorgeschlagenen Seeding-Schemata und ihre technische Realisierung diskutiert, sowie Einblicke in Simulationen zur Leistungsfähigkeit der geplanten Anlage präsentiert.

AKBP 14: Focus session: Machine Learning

Time: Thursday 9:30–11:30 Location: MOL 213

Invited Talk AKBP 14.1 Thu 9:30 MOL 213

Application of Machine Learning to Beam Diagnostics — •Elena Fol — CERN, 1211 Geneva 23, Switzerland — Goethe University, 60438 Frankfurt am Main, Germany

Machine Learning (ML) techniques are widely used in science and industry to discover relevant information and make predictions from data. Recently, the application of ML has grown also in accelerator physics and in particular in the domain of control and diagnostics. The target is to provide an overview of ML techniques demonstrating their potential to be efficiently applied to accelerator problems. A short summary of recent achievements and current studies will be presented, followed by the application of ML to beam optics measurements and corrections in the Large Hadron Collider at CERN.

Invited Talk AKBP 14.2 Thu 10:00 MOL 213

Towards Micro-Bunching Control at Storage Rings with Reinforcement Learning — •Tobias Boltz — KIT

The operation of ring-based synchrotron light sources with short electron bunches can provide intense coherent synchrotron radiation (CSR) up to the THz frequency range. Yet, the continuous reduction in bunch length and stable emission of CSR are limited by the self-interaction of the bunch with its own radiation field. Above a machine-specific threshold current, the emitted CSR power starts fluctuating rapidly and continuously due to the formation of dynamically evolving microstructures in the longitudinal charge distribution. As these small spatial structures lead to an increased emission of CSR at higher frequencies, this effect might also be desirable dependent on the application at hand. In this contribution, we discuss complementary approaches to both excitation and mitigation of the micro-bunching dynamics in order to optimize the emitted CSR for each application individually. Therefore, we motivate the usage of an RF modulation scheme to exert control over the longitudinal beam dynamics and illustrate how reinforcement learning methods can be applied to optimize towards different objective functions.

Invited Talk AKBP 14.3 Thu 10:30 MOL 213

Towards Reinforcement Learning Based Optimization at the Light Source BESSY II — •Luis Vera Ramirez — luis.vera_ramirez@helmholtz-berlin.de

The incorporation of Machine Learning tools in order to improve the performance and the experimental setups at the large-scale user facility BESSY II is an important part of the next years' roadmap at the Helmholtz-Zentrum Berlin. In this talk, we will focus on several use cases based on Reinforcement Learning (RL) based on simulations as well as experiments with real machine data. These experiments are currently being developed by both the beamline and the accelerator groups and include, among others, the optimization of booster current and injection efficiency (already carried at out the machine) as well as first RL-approaches regarding automatic parameter tuning for beamline raytracing.

Invited Talk AKBP 14.4 Thu 11:00 MOL 213

Advances in reinforcement learn for accelerator tuning at CERN — •Simon Hirlaender — University of Malta / CERN

The preservation of reliable and stable performance of accelerator complexes demands arduous effort. Hence to fully exploit the potential of accelerator-based facilities around the world, tackling unavoidable problems as drifts, hysteresis or fast set-up after configuration changes in an automated, efficient manner has become increasingly important. Well-known numerical optimization algorithms, as well as modern techniques based on reinforcement learning (RL), found their way into the control rooms for that purpose. This talk will address the main challenges with RL for accelerator operation and discuss recent progress at the CERN accelerator complex, especially at the LINAC4 accelerator and the AWAKE electron line. Various successful tests employing model-free optimization as well as highly sample efficient deep RL algorithms with more than ten degrees of freedom for problems such as trajectory steering and optics matching are covered. The method of transfer learning, where the controller was trained purely on simulated data, could be demonstrated. Besides, the training of a controller in disentangled latent space representations of image-based measurements was shown. The next boost in sample efficiency is expected from model-based reinforcement learning algorithms that learn the dynamics of a particular process explicitly and in this way, can reduce the interaction with the real environment as the accelerator time by orders of magnitude. In many cases, RL training is unfeasible otherwise. These models are uncertainty aware and offer promising properties for a wide range of possible applications, where an apriori model is not available. These studies mark the first mile-stones towards a self-tuning accelerator at CERN.

AKBP 15: Bestowal of Prizes

Time: Thursday 15:00–16:15 Location: MOL 213

75 min.

AKBP 16: Posters

Time: Thursday 16:30–18:00 Location: P1C

AKBP 16.1 Thu 16:30 P1C

Activation Studies of GaAs Photo-Cathodes at TU Darmstadt* — •Vincent Wende, Joachim Enders, Markus Engart, Yuliya Fritzsche, and Maximilian Herbert — Institut für Kernphysik, Technische Universität Darmstadt, Germany

Spin-polarized electron sources based on GaAs photo-cathodes can be used to supply high-current electron beams for various applications. A thin layer covering the GaAs surface - typically consisting of Cs in combination with an oxidant - is required to achieve negative electron affinity (NEA). The aim of this process is to reach high quantum efficiency η and long surface layer lifetime τ to ensure smooth and sustained operation of a photo-gun in an accelerator. Both parameters strongly depend on the activation procedure. Hence, an optimization of this process is desired. For this purpose, a dedicated test stand for Photo-Cathode Activation, Test and Cleaning using atomic-Hydrogen Photo-CATCH has been set up at the Institut für Kernphysik at TU Darmstadt [1]. This setup consists of a vacuum system for photo-cathode activation and cleaning, as well as a DC photo-gun test chamber with adjacent 60 keV beamline. Results of ongoing experiments and options for automatizing the activation procedure will be discussed.

[1] N. Kurichiyanil et al., J. Instr. 14, P08025 (2019)

*Work supported by the Deutsche Forschungsgemeinschaft (GRK 2128 "AccelencE") and BMBF (05H18RDRB1)

AKBP 16.2 Thu 16:30 P1C

Mechanical and electromagnetic analysis of a quadrupole resonator under different loading conditions — •Shahnam Gorgi Zadeh, Pankajkumar Devganiya, Ursula van Rienen, and Piotr Putek — University of Rostock, Albert Einstein Str.2, 18059 Rostock, Germany

Most of the radio frequency (RF) cavities are nowadays made of superconducting materials, e.g. niobium. The surface resistance of superconductors at very low temperatures is typically in the range of tens of nano-ohms. Special dedicated devices are required to measure the extremely low surface resistance of superconductors. Quadrupole resonators (QPR) have been used since the 1990s for precise determination of the RF properties of superconducting materials. The QPR is typically composed of a pillbox-like niobium cavity containing four vertically placed niobium rods. By placing the superconducting samples under the rods and exciting a quadrupole-like magnetic field on the sample, the surface resistance could be investigated using calorimetric methods. The mechanical displacement of the rods can change the field distribution on the sample and thus affect the experiment setup. In this contribution the displacement of the rods under various mechanical loading conditions such as vacuum and helium pressure, as well as Lorentz force effects are studied. A sensitivity analysis is also carried out to find the sensitivity of the commonly used figures of merit of the QPR with respect to the shape of the rods.

This research is funded by the Bundesministerium für Bildung und Forschung (BMBF) under Grant No. 05H18HRRB1.

AKBP 16.3 Thu 16:30 P1C

Compact Neutron Sources Utilizing Laser Plasma Ion Acceleration — •Benedikt Schmitz[1], Oliver Boine-Frankenheim[1], and Markus Roth[2] — [1]TEMF, Technische Universität Darmstadt, Darmstadt — [2]IKP, Technische Universität Darmstadt, Darmstadt

The LOEWE NP goal is to develop compact accelerator based tabletop neutron sources, where the ion acceleration is induced by laser plasma interaction.

This setup can be split into two separate parts, first the laser plasma interaction causing the ion acceleration, second the ion to neutron conversion process.

Joining this different parts into one coherent model is difficult since the physics in both parts has different scales and therefore need different approaches. The goal is a unification of both parts to an effective model for the identification and optimization of all important parameters.

The present work focuses on the optimization and understanding of the laser plasma accelerated ion spectra via particle-in-cell (PIC) simulations and the development and understanding of neutron converter via Monte Carlo simulations. First results are presented.

AKBP 16.4 Thu 16:30 P1C

Automated optimization of synchrotrons for high intensity beams — •Dmitrii Rabusov — TU Darmstadt TEMF, Schloßgartenstr. 8, 64289 Darmstadt

Achieving high intensities is one of the main challenges during the exploitation of a synchrotron. The challenge can be complicated by various effects such as the space charge, wakefields, etc. Errors in the lattice of the synchrotron lead to additional obstacles during the operation: the orbit distortion, the beating of lattice functions: alpha, beta, dispersion, etc.

It's known that the aperiodic perturbation of the magnet structure breaks the symmetry of the synchrotron and particles cross undesired resonances driven by a nonlinear force, which is the space charge in the case of this work. Space charge with the linear perturbation of the lattice can be the reason for the increasing rate of particle losses. The high level of losses yields to damaging of the equipment. Finally, beta-beating at high intensities can cause the blow-up of the emittance.

Described effects and the compensation of them are essential for SIS100 project. Correction schemes for lattice optimization are studied. The goal of the correction is to restore the periodicity of the beta-function using an optimal set of correctors. Different optimization techniques are validated with simple FODO lattice first. A python library *cpymad* provided all required single-particle MADX computations for this project. Moreover, particle tracking with the space charge in PyORBIT is performed in order to investigate the benefits of different optimization functions.

AKBP 16.5 Thu 16:30 P1C

Simulation of ion motion and dynamics in particle accelerator ELSA — •Anthony Francis John Benedict, Shahnam Gorgi Zadeh, Dirk Hecht, and Ursula van Rienen — University of Rostock, Albert Einstein Str.2, 18109 Rostock, Germany

In particle accelerators, ions are generated by the interaction of the particle beam with the residual gas by direct collision or by synchrotron radiation. The generated particles get trapped by the attractive potential of the particle beam and cause negative effects such as tune shift and beam instabilities. If left unchecked, the ions can cause the beam quality to deteriorate and even lead to neutralization of the particle beam. To mitigate the negative effects of the accumulated ions, ion clearing methods such as clearing electrodes are employed. To optimize the use of adequate clearing methods, the ion motion and dynamics in various beamline elements must be investigated. Numerical methods such as Particle in Cell (PIC) simulations are employed to study the motion of ions in the presence of electromagnetic fields. In this contribution, the generation, accumulation, and clearance of ions in the beamline elements of the high energy storage ring (HESR) of particle accelerator ELSA (Elektronen Stretcher Anlage) are studied. The space-charges are studied using the finite element method (FEM). The effects of electromagnetic fields in radiofrequency (RF) cavities on ion motion are studied. An estimation of clearing current at the clearing electrodes is also carried out.

This research is funded by the Bundesministerium für Bildung und Forschung (BMBF) under contract 015K16HRA.

AKBP 16.6 Thu 16:30 P1C

Exploratory Analysis of Simulated Radiation from a Plasma Wakefield Accelerator — •Anton Lebedev[1], Alexander Debus[1], Richard Pausch[1], Ulrich Schramm[1,2], and Michael Bussmann[1,3] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Bautzner Landstr. 400, Dresden — [2]Technische Universität Dresden, 01062 Dresden — [3]CASUS, Center for Advanced Systems Understanding, Görlitz, Germany

In this contribution, we present an exploratory study of the radiation expected to be produced during plasma wakefield acceleration (PWFA) of electrons.

Understanding radiation in the IR to UV range is key to diagnosing the responsible plasma processes in future PWFA accelerators. One goal of the study is to identify radiation signatures suitable for controlling beam quality, thereby enabling high-brightness electron beams for future applications.

The data for our analysis is obtained from PWFA simulations with the 3D3V particle-in-cell code PIConGPU. Emissions are computed using electromagnetic fields derived from Liénard-Wiechert potentials for the entirety of the simulated particles, thereby enabling analysis of the influence of collective plasma dynamics on the observed radiation and allowing quantitative predictions of signal-to-noise ratios. Furthermore, the capability of PIConGPU to select specific groups of radiating particles allows us to determine the origin of spectral signatures.

AKBP 16.7 Thu 16:30 P1C

RF Tuning of the 325 MHz Ladder-RFQ — •Maximilian Schuett, Marc Syha, and Ulrich Ratzinger — IAP, Goethe University Frankfurt, Germany

Based on the positive results of the unmodulated 325 MHz Ladder-RFQ prototype from 2013 to 2016, we developed and designed a modulated 3.4 m Ladder-RFQ*. The Ladder-RFQ features a very constant voltage along the axis, low dipole modes and easy field tuning opportunities. Furthermore, the Ladder-RFQ is completely maintainable and free of welding and soldering. The prototype accepted 3 times the operating power of which is needed in operation**. That level corresponds to a Kilpatrick factor of 3.1 with a pulse length of 200 μs.

The 325 MHz Ladder-RFQ is designed to accelerate protons from 95 keV to 3.0 MeV according to the design specifications of the proton linac within the FAIR project. This particular high frequency for a 4-ROD-RFQ creates difficulties, which triggered the development of a Ladder-RFQ with its high symmetry. The results of the unmodulated prototype have shown, that the Ladder-RFQ is very well suited for that frequency. The duty cycle is up to 5% for the applied cooling concept. Tuning and the final machining step have been completed in April 2019. We will show low level RF measurements as well as frequency and field tuning opportunities with solid movable plungers.

*Journal of Physics: Conf. Series 874 (2017) 012048 **Proceedings of LINAC2016, East Lansing, TUPLR053

AKBP 16.8 Thu 16:30 P1C

Advanced Landau Damping for high energy and high intensity machines — •Vadim Gubaidulin[1,2], Vladimir Kornilov[2], Elias Metral[3], and Oliver Boine-Frankenheim[1,2] — [1]TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]CERN, Geneva, Switzerland

Impedance driven transverse beam instabilities in hadron synchrotrons are damped by either an active feedback system or passive mitigation via Landau damping due to dedicated Landau octupole magnets.

For high energy machines, like the proposed Future Circular Collider (FCC-hh) or the Large Hadron Collider high luminosity upgrade (HL-LHC), this passive mitigation mechanism is weakened due to smaller transverse amplitudes. This study considers other sources of Landau damping (DC and pulsed electron lenses and RFQs) and their combination with octupole magnets for transverse beam instabilities mitigation in high energy and high-intensity machines.

DC and pulsed electron lens options are studied with stability diagram theory and particle tracking simulations with beam transfer function and simple impedance driven instability models. This study considers the effect of different electron beam profile shapes and sizes on Landau damping and an effect of combining octupoles with newer methods. An example of slow head-tail instability in HL-LHC is used to compare particle tracking results with stability diagram theory for advanced Landau damping sources and their combination with octupole magnets.

AKBP 16.9 Thu 16:30 P1C

Further Investigations on the Beam Dynamics Design of the FAIR p-Linac RFQ — •Marc Syha, Hendrik Hähnel, Ulrich Ratzinger, and Maximilian Schuett — Institute for Applied Physics, Frankfur, Gemrany

The construction of a 3.3 m Ladder-RFQ at IAP, Goethe University Frankfurt, has been finished successfully in 2018. This RFQ is designed to accelerate protons from 95 keV to 3.0 MeV according to the design parameters of the p-Linac [1, 2] at FAIR1 [3]. The development of an adequate beam dynamics design was done with the aid of the RFQGen-code and in close collaboration with the IAP resonator design team, whereby a design current of 100 mA was assumed. The RFQ beam dynamics design could be successfully reproduced with the TOUTATIS-routine of CEAs2 TraceWin-code in 2019. Furthermore, the effects of image-charge effects and bunch-bunch interactions on the RFQGen simulations were examined. The results of these studies were then compared to field map calculations in TraceWin [2]. [1] C. M. Kleffner et al., *Status of the FAIR Proton Linac*, in Proc. 10th Int. Particle Accelerator Conf. (IPAC*19), Melbourne, Australia, May 2019. [2] H. Hähnel et al., *End to End Simulations and Error Studies of the FAIR Proton Linac*, in Proc. 10th Int. Particle Accelerator Conf. (IPAC*19), Melbourne, Australia, May 2019. [3] FAIR, https://fair-center.eu/index.php?id=1 [4] M. Schuett, M. Syha and U. Ratzinger, *Compensation of longitudinal entrance and exit gap field effects in RFQ*s of the 4-ROD type*, Nuc. Inst. A, Volume 928, p. 58.

AKBP 16.10 Thu 16:30 P1C

Operation of copper cavities at cryogenic temperatures — •Huifang Wang and Ulrich Ratzinger — IAP, Frankfurt, Germany

The anomalous skin effect of copper will be studied in the experiment. The accurate quality factor Q and resonant frequency of three coaxial cavities will be measured over the temperature range from 300 to 22 K. The three coaxial cavities have the same structure, but different lengths, which correspond to resonant frequencies: around 100 MHz, 220 MHz and 340 MHz. The motivation is to check the feasibility of an effcient pulsed, liquid nitrogen cooled ion linac.

AKBP 16.11 Thu 16:30 P1C

Investigations On Algorithm Development For Non-Invasive Transverse Beam Emittance Measurements — •Ezgi Sunar[1], Adem Ates[2], Hendrik Hähnel[3], and Ulrich Ratzinger[4] — [1]IAP, Frankfurt, Germany — [2]IAP, Frankfurt, Germany — [3]IAP, Frankfurt, Germany — [4]IAP, Frankfurt, Germany

A non-invasive diagnostic concept has recently been developed for the Frankfurt Neutron Source Experiment (FRANZ) at the Institute for Applied Physics (IAP) at Goethe University Frankfurt. The aim of this improvement is to compute transverse emittances by monitoring the beam induced rest gas fluorescence along the diagnostic box at the LEBT section of the FRANZ experiment. Because the special cameras are inserted into the vacuum and observing the beam along a 480mm path it is expected to measure the angle of divergence in a more precise way. An algorithm has been developed for these imaging and computing processes. It is based on extracting the width of the transverse intensity distribution of the beam at three different positions or by setting the solenoid magnetic field strength at three different values. The reliability test of the algorithm has been done with various simulated data in TraceWin and further progress for improving the algorithm is assumed. The preliminary results measured by the simulation data are showing a decent outcome consistently.

AKBP 16.12 Thu 16:30 P1C

A Diagnostics Setup for Low-Energy Beam Characterization at the Injector of the S-DALINAC* — •Adrian Brauch, Michaela Arnold, Joachim Enders, Norbert Pietralla, and Simon Weih — Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany

A new superconducting reduced-beta capture cavity will be installed at the injector of the superconducting Darmstadt electron linear accelerator (S-DALINAC [1]). For a successful operation of the upgraded injector, detailed knowledge of beam-parameters upstream the capture section is crucial. Therefore, a vertical diagnostics beamline is currently being installed. Capable of transverse and longitudinal beam parameter measurements, the setup will be used to characterize the beams from the thermionic and polarized electron guns. With the anticipated diagnostics data we aim at an acceleration in the superconducting injector linac optimized with respect to energy spread and both longitudinal and transverse beam quality. This contribution introduces the general layout of the diagnostics beamline, the current status, and the design of a transverse deflecting cavity which is planned to be installed for bunch length measurements.

[1] N. Pietralla, Nuclear Physics News, Vol. 28, No. 2, 4 (2018). *Work supported by the DFG-funded GRK 2128 ”AccelencE” and by the Hessian HMWK through the LOEWE research cluster ”Nuclear Photonics”

AKBP 16.13 Thu 16:30 P1C

Modelling of thermal and elastic response of x-ray optics exposed to high peak power fel pulses — •Roman Shayduk, Alexey Zozulya, Ilia Petrov, and Markus Scholz — European XFEL GmbH Holzkoppel 4 22869 Schenefeld Germany

The European X-ray Free-Electron Laser delivers femtoseconds-long pulses in soft and hard X-ray wavelength range with up to 2 mJ pulse energy. The pulses are arranged into pulse trains containing from 1 to several hundreds of pulses spaced down to 220 ns apart. Trains arrive at 10 Hz rate. Stochastic nature of Self-Amplified Spontaneous Emission (SASE) defines rather short ~0.2 fs coherence time of pulses due to the broad spectral band width. Many experimental techniques require longer temporal coherence, so monochromators are currently used to reduce the spectral bandwidth. However, due to the combination of ultra high peak power and high repetition rate of X-ray pulses the impulsive heat load becomes a real challenge for preserving the performance parameters of monochromators as the number of pulses per train grows.

We propose a unified model for simulating thermoelastic response of solid targets to fs/ps/ns pulsed electromagnetic radiation in the visible and hard X-ray range and apply it for the case of impulsive X-ray excitation of monochromator crystals. Calculations show that the heat induced strain relaxation time exceeds by far the pulse repetition period of 220 ns and the amplitude of strain exceeds the Darwin width of a crystal reflection multiple times.

AKBP 17: General Assembly of the Working Group on Accelerator Physics

Time: Thursday 19:30–21:00 Location: HSZ 304

90 min.