# Arbeitskreis Beschleunigerphysik (AKBP)

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## Übersicht der Fachsitzungen

(Hörsäle BZ.08.06 (HS 1), BZ.08.04 (HS 2), F.10.01 (HS 4) und G.10.03 (HS 8), Poster Foyer Ebene G.10)

### Plenarvorträge mit direktem Bezug zur Beschleunigerphysik

| | | | | |
|---|---|---|---|---|
| PV II | Mo | 11:45–12:30 | K.11.24 (HS 33) | **FAIR - a heavy ion accelerator facilty for high intensity and high brightness ion beams** — •Oliver Kester |
| PV III | Di | 11:00–11:45 | K.11.24 (HS 33) | **Development of Laser-Driven High-Energy Particle and Radiation Sources** — •Jörg Schreiber |

### Plenarvorträge des fachübergreifenden Symposiums SYAB

Das vollständige Programm dieses Symposiums ist unter SYAB aufgeführt.

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| SYAB 1.1 | Mi | 14:00–14:45 | K.11.24 (HS 33) | **The Sun - observing cosmic particle accelerators in our neighbourhood** — •Rami Vainio |
| SYAB 1.2 | Mi | 14:45–15:30 | K.11.24 (HS 33) | **Teilchenbeschleunigung zu hohen Energien** — •Martin Pohl |
| SYAB 1.3 | Mi | 15:30–16:15 | K.11.24 (HS 33) | **Die Zukunft der Hadron-Collider - Möglichkeiten und Grenzen** — •Rüdiger Schmidt |

### Fachsitzungen

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|---|---|---|---|---|
| AKBP 1.1–1.5 | Mo | 14:00–15:15 | BZ.08.06 (HS 1) | **Synchrotron Radiation** |
| AKBP 2.1–2.8 | Mo | 14:00–16:00 | BZ.08.04 (HS 2) | **PWA / TNSA I** |
| AKBP 3.1–3.9 | Mo | 16:45–19:00 | BZ.08.06 (HS 1) | **RF, Resonators and Applications** |
| AKBP 4.1–4.9 | Mo | 16:45–19:00 | F.10.01 (HS 4) | **FEL, Seeding and Thomson Scattering** |
| AKBP 5.1–5.19 | Di | 11:00–19:00 | Foyer Ebene G.10 | **Poster** |
| AKBP 6.1–6.10 | Di | 13:45–16:15 | BZ.08.06 (HS 1) | **SC Resonators** |
| AKBP 7.1–7.8 | Di | 13:45–15:45 | G.10.03 (HS 8) | **PWA / TNSA II** |
| AKBP 8.1–8.8 | Di | 16:45–18:45 | BZ.08.06 (HS 1) | **Polarisation / EDM** |
| AKBP 9.1–9.8 | Di | 16:45–18:45 | BZ.08.04 (HS 2) | **Beam Dynamics / Simulation I** |
| AKBP 10.1–10.9 | Mi | 16:45–19:00 | BZ.08.06 (HS 1) | **Beam and Accelerator Control** |
| AKBP 11.1–11.5 | Mi | 16:45–18:00 | F.10.01 (HS 4) | **PWA / TNSA III** |
| AKBP 12.1–12.10 | Do | 13:45–16:15 | BZ.08.06 (HS 1) | **Beam Diagnosis** |
| AKBP 13.1–13.9 | Do | 13:45–16:00 | F.10.01 (HS 4) | **Beam Dynamics / Simulation II** |
| AKBP 14.1–14.9 | Do | 16:45–19:00 | BZ.08.06 (HS 1) | **Injectors, Lasers** |
| AKBP 15.1–15.9 | Do | 16:45–19:00 | F.10.01 (HS 4) | **Beam Dynamics / Simulation III** |

### Mitgliederversammlung Arbeitskreis Beschleunigerphysik

Dienstag 19:30–20:30 K.11.23 (HS 32)

- Bericht
- Wahl der/des Vorsitzenden
- Verschiedenes

# AKBP 1: Synchrotron Radiation

Zeit: Montag 14:00–15:15 Raum: BZ.08.06 (HS 1)

AKBP 1.1 Mo 14:00 BZ.08.06 (HS 1)

**Optics compensation for variable-gap undulator systems at FLASH** — •Philipp Amstutz[1], Sven Ackermann[2], Jörn Bödewadt[2], Christoph Lechner[1], Tim Plath[1], and Mathias Vogt[2] — [1]Universität Hamburg, Hamburg — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg

Variable-gap undulator systems are widely used in storage rings and linear accelerators to generate soft- and hard X-ray radiation for the photon science community. By closing the undulator its focussing effect gains in strength, which needs to be corrected, in order for the optical functions in downstream parts of the accelerator to be constant.

At the free-electron laser (FEL) facility FLASH at DESY two undulator systems share one common electron beamline. The first undulator is a variable-gap system used for seeding experiments, the second undulator is a fixed-gap system, which serves the user facility with FEL radiation. Variaton of the gap in the first undulator results in altered beam optics, which deteriorates the FEL process in the second undulator. This gives rise to the need for a method to calculate a steady correction function for quadrupole currents depending on the current gap size, effectively making the disturbance transparent for subsequent sections. The approach presented here applies the implicit function theorem to an analytical model of the beamline section and can be used for any pertubation of the beam optics. In this contribution we present the method and its implementation as well as measurements performed at FLASH.

AKBP 1.2 Mo 14:15 BZ.08.06 (HS 1)

**Calculation of Coherent Radiation** — •Markus Schwarz — ANKA, KIT

Electromagnetic radiation emitted by electron bunches in accelerators is usually incoherent. However, when the bunch length becomes shorter than the wavelength of the emitted radiation, the waves of the individual electrons interfere constructively. As a result, the intensity of this coherent radiation is enhanced by several orders of magnitude at this wavelength. On one hand, this allows for intense radiation. On the other hand, coherent radiation can act as a "magnifying glass", which allows one to study the electron bunch structure.

I give a brief derivation of the basic equation for coherent radiation and discuss its properties for a simple Gaussian bunch as well as more complex bunches.

AKBP 1.3 Mo 14:30 BZ.08.06 (HS 1)

**Studies of THz-radiation in the Bursting Regime at ANKA in Multi-Bunch Operation** — •Miriam Brosi[1], Michelle Caselle[4], Johannes Steinmann[1], Patrik Schönfeldt[3], Edmund Hertle[3], Nicole Hiller[3], Anke-Susanne Müller[1,2,3], Marc Weber[4], and Andreas Kopmann[4] — [1]LAS, KIT, Karlsruhe — [2]ANKA, KIT, Karlsruhe — [3]IPS, KIT, Karlsruhe — [4]IPE, KIT, Karlsruhe

The ANKA storage ring of the Karlsruhe Institute of Technology (KIT) operates in the energy range from 0.5 to 2.5 GeV and can generate brilliant coherent synchrotron radiation in the THz range with a dedicated bunch length-reducing optic. The high degree of longitudinal compression in this so-called low-alpha optics leads to complex longitudinal dynamics of the electron bunches. The resulting micro-bunching instability leads to time dependent fluctuations and strong bursts in the radiated THz power. The study of these fluctuations in the emitted THz radiation provides insight into the longitudinal beam dynamics. Fast THz detectors combined with KAPTURE, the dedicated KArlsruhe Pulstaking and Ultrafast Readout Electronics system developed at KIT, allow the simultaneous measurement of the radiated THz intensity for each bunch individually in a multi-bunch environment.

AKBP 1.4 Mo 14:45 BZ.08.06 (HS 1)

**Narrow-Band THz Radiation at the Synchrotron Light Source DELTA** — •Peter Ungelenk[1], Fin Hendrik Bahnsen[1], Max Bolsinger[1], Svenja Hilbrich[1], Markus Höner[1], Holger Huck[1], Maryam Huck[1], Shaukat Khan[1], Carsten Mai[1], Arne Meyer auf der Heide[1], Robert Molo[1], Helge Rast[1], Gholamreza Shayeganrad[1], Serge Bielawski[2], Clement Evain[2], Marc Le Parquier[2], Eléonore Roussel[2], Christophe Szwaj[2], Matthias Arndt[3], Konstantin Ilin[3], Artem Kuzmin[3], Juliane Raasch[3], and Michael Siegel[3] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund University, Germany — [2]PhLAM/CERLA, Université Lille 1, France — [3]Institute of Micro- and Nanoelectronic Systems, Karlsruhe Institute of Technology, Germany

Based on the interaction of 40-fs laser pulses with electron bunches at the 1.5-GeV synchrotron light source DELTA operated by the TU Dortmund University, coherent broad-band THz pulses are routinely generated since 2011. Recently, 11-ps laser pulses with a periodic intensity modulation have been employed in cooperation with PhLAM/CERLA, Lille, in order to generate THz pulses with a narrow bandwidth of down to 300 GHz and a tunable central frequency between 0.7 and 5.5 THz. As a first application, the frequency dependence of $YBa_2Cu_3O_{7-x}$-based (YBCO) THz detectors developed at the Institute of Micro- and Nanoelectronic Systems (IMS) at KIT, Karlsruhe, has been studied. In order to investigate a tuning range of the narrow-band pulses at lower central frequencies, a new spectrometer is under development.

AKBP 1.5 Mo 15:00 BZ.08.06 (HS 1)

**Non-interferometric spectral analysis of synchrotron radiation in the THz regime at ANKA** — •Johannes Steinmann[1], Erik Bründerman[2], Michele Caselle[3], Benjamin Kehrer[1], Paul Schütze[1], Patrik Schönfeldt[1], Marcel Schuh[1], Edmund Hertle[2], Nicole Hiller[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IPS, KIT, Karlsruhe — [3]IPE, KIT, Karlsruhe

The ANKA storage ring of the Karlsruhe Institute of Technology (KIT) can be operated in a low-alpha mode in order to compress bunches down to the picosecond range. Pico-second electron bunches radiate coherently in the observed THz range. The spectral information in this range can give valuable information about the bunch length and on bunch form and substructures created by micro-bunching instabilities We present the current activities at ANKA to explore this spectral range to address the instabilities arising from collective effects resulting in micro-bunching.

# AKBP 2: PWA / TNSA I

Zeit: Montag 14:00–16:00 Raum: BZ.08.04 (HS 2)

AKBP 2.1 Mo 14:00 BZ.08.04 (HS 2)

**Beam Optics for Laser Wake Field Accelerators** — •Paul Winkler[1,2], Winfried Decking[3], Bernward Krause[3], Klaus Floettmann[3], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]DESY, 22607 Hamburg

Laser wake field accelerators (LWFAs) offer a new technology to produce highly relativistic electron beams on a very compact scale. Nevertheless, beam qualities of today's LWFAs are not sufficient for applications. In particular, due to high energy spread and beam divergence, the emittance is not a conserved quantity.

The University of Hamburg, in close collaboration with DESY, is currently commissioning a dedicated beamline for laser wake field acceleration. The so called LUX experiment aims to achieve particle energies of about 400 MeV with 1 % energy spread and 1 mrad beam divergence. A compact quadrupole doublet is required in order to focus the beam, thereby reduce emittance growth, and then transport the beam through a miniature undulator.

In the talk, the design and construction of an electromagnetic quadrupole doublet is presented. With simple modifications the gradients of existing quadrupoles were increased by 50 % up to 150 T/m.

AKBP 2.2 Mo 14:15 BZ.08.04 (HS 2)

**Highly sensitive pulsed spectrometer for laser excited and field extracted electrons** — •Stephan Mingels, Vitali Porshyn, Dirk Lützenkirchen-Hecht, and Günter Müller — Physics Department, University of Wuppertal

We have completed an ultra-high vacuum system for investigations of cathodes in a triode configuration under high electric fields $E$ (up to ∼100 MV/m) and pulsed tunable laser illumination (3.5 ns, 10 Hz, $h\nu$=0.5-5.9 eV, >0.3 mJ) [1]. Measurements of the cathode current by a picoammeter and of the electron energy by a spectrometer for DC as well as laser-pulsed beams are enabled. The cathodes can be 3D-positioned with $\mu$m precision and cooled or heated in the range of 77-400 K. System commissioning with DC field emission from a W tip yielded a work function $\phi$ of 4.7 eV and a spectrometer resolution of <10 meV. Precise determination of the emitter temperature from the spectra at low currents (down to 60 nA) demonstrated the high sensitivity of the system. The suitability for laser-pulsed beams was shown with photoemission from a n-GaP(100) wafer. Quantum efficiency $QE(h\nu)$ measurements at low $E$ revealed expected band structure effects and $\phi$ values of 3.5-4.6 eV depending on the actual oxide layer. In order to develop novel highly brilliant electron sources, the suitability of various materials for photo-induced field emission by indirect ($QE(h\nu, E)$) and direct electron spectroscopy will be performed next.

[1] S. Mingels et al., submitted to Rev. Sci. Instrum.

Funded by the BMBF joint research project 05K13PX2.

AKBP 2.3 Mo 14:30 BZ.08.04 (HS 2)

**Generation of intense sub-nanosecond proton bunches with a novel laser-driven beamline concept** — •Diana Jahn[1], Simon Busold[2,3], Dennis Schumacher[2], Christian Brabetz[2], Florian Kroll[4], Abel Blazevic[2,3], Vincent Bagnoud[2,3], and Markus Roth[1] — [1]Technische Universität Darmstadt, Darmstadt, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Darmstadt — [3]Helmholtz-Institut Jena, Jena, Deutschland — [4]Helmholtzzentrum Dresden Rossendorf

In the context of the Laser Ion Generation, Handling and Transport (LIGHT) research project at GSI, laser-driven ion acceleration and beam shaping are explored, combining a target normal sheath acceleration (TNSA) proton source with conventional accelerator technology. Therefore, an ion test beamline was built at the Z6 experimental area. In the LIGHT experimental campaign in 2014, protons were accelerated via the TNSA mechanism, an energy of 7.8 MeV was selected and collimated with a pulsed solenoid and injected into a rf cavity. Through phase focusing, temporally compressed proton bunches were generated to a pulse length of <500 ps (FWHM) with up to $5 \cdot 10^8$ particles in a single bunch at a distance of 6 m from the source.

AKBP 2.4 Mo 14:45 BZ.08.04 (HS 2)

**Plasma wakefield generated by a modulated electron beam** — •Roberto Martorelli — Institut für Theoretische Physik I, Heinrich-Heine-Universität, Düsseldorf

Particle beams have a number of important applications, from medicine to high energy physics. The capabilities of the actual technology is limited and this results in the huge dimensions of the accelerators. One promising alternative to RF accelerators is the plasma wakefield acceleration, due to the high acceleration gradients the plasma can sustain. In a plasma wakefield, a driver - laser or particle beam - is injected in a plasma channel, exciting the Langmuir waves. The electric field associated with the wakefield can be used for the acceleration of a witness bunch.

Our work is focused on the wakefield driven by a modulated electron beam. The main research consists in finding the proper conditions for the train of bunches in order to obtain a higher transformer ratio (TR), defined as the ratio between the maximum accelerating electric field behind the driver and the maximum decelerating electric field inside the driver. Through a semi-analytical approach, combined with particle-in-cell simulations, we look for the proper initial configuration for the train of beams in order to maximize the TR, analysing subsequently the stability of the beams while propagating into the plasma.

AKBP 2.5 Mo 15:00 BZ.08.04 (HS 2)

**Ion Acceleration at the POLARIS-Laser with ultra high Contrast and ultra thin Foils** — •Jan Reislöhner[1], Georg Becker[1], Jens Polz[1], Lennart Bock[1], Andreas Seidel[1], Stephan Kuschel[1,2], Marco Hornung[1,2], Hartmut Liebetrau[1], Alexander Kessler[1,2], Frank Schorcht[2], Marco Hellwing[1], Wenjun Ma[3], Jianhui Bin[3], Jörg Schreiber[3,4], Matthew Zepf[1,2], and Malte Kaluza[1,2] — [1]Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität Jena — [2]Helmholtz-Institut Jena — [3]Fakultät für Physik, LMU München — [4]Max-Planck-Institut für Quantenoptik

The petawatt-class laser system POLARIS in Jena has been developed and continuously improved within the last two decades. For Laser induced ion acceleration the contrast of the laser is of crucial importance. The amplified spontaneous emission (ASE) and prepulses of high power lasers, such as POLARIS, create a preplasma on the target nanoseconds before the main pulse arrives. In the case of ultra thin foils with thicknesses of a few nanometers, it is essential that the main pulse ionizes the target. Therefore, the contrast was improved by adding an XPW stage in a double CPA setup. And it was further improved via second harmonic generation of the main laser pulses in a nonlinear crystal. The second harmonic pulses were then focused onto targets with thicknesses in the range of 5 nm to 1000 nm. The aim of this talk is to explain the experiment and to discuss the results.

AKBP 2.6 Mo 15:15 BZ.08.04 (HS 2)

**Scaling of ultra-intense laser generated hot electron current and heating** — •Thomas Kluge[1], Michael Bussmann[1], Lingen Huang[1], Thomas Cowan[2], and Ulrich Schramm[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Helmholtz-Zentrum Dresden-Rossendorf und TU-Dresden

We study the generation of hot electron currents in solid targets that are generated when an ultra-intense laser beam interacts with the solid. Simulations were performed with highly idealized parameters in order to allow direct comparison to existing and new models that often assume idealized conditions. We compare our results with popular existing scaling laws and show for example that the simple scaling j~gamma*n_c does not apply, especially when the electron energy is derived from the ponderomotive or similar scalings or when the laser intensity is large. We demonstrate the impact of correctly modeling the hot eletron current including its temporal structure on bulk electron heating and finally build a model that is in almost perfect agreement with simulations.

AKBP 2.7 Mo 15:30 BZ.08.04 (HS 2)

**Reflective probing of laser-driven plasma for ion acceleration** — •Martin Rehwald[1,2], Josefine Metzkes[1,2], Karl Zeil[1], Stephan Kraft[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]Technische Universität Dresden

Plasmas driven by intense, ultra-short laser pulses can support electrical field strengths of up to TV/m, making this concept promising for compact particle accelerators in which ions can gain MeV energies on a micrometer scale. For the acceleration, the laser pulse is focused onto a thin target which quickly ionized and transformed into a plasma in which electrons gain MeV energies in the laser field. These electrons leave the target volume and thereby create quasi-static charge-separation fields along the target surfaces in which the ion acceleration takes place. The acceleration is strongly influenced by the plasma conditions at the target during the main pulse interaction, which are determined by light preceding the intense main pulse or by the rising edge of the main pulse itself.

In this talk, we present a reflective pump probe method which allows to temporally resolve the lateral and longitudinal expansion of the critical plasma density. First experimental results with a pure imaging technique will be shown, in which the front and rear surface plasma were characterized. This technique is currently developed to include interferometry, in that way increasing the sensitivity in longitudinal direction. We will discuss the simulation results and a corresponding experimental setup.

AKBP 2.8 Mo 15:45 BZ.08.04 (HS 2)

**Observation of collective deceleration of electrons from laser wakefield acceleration** — •Shao-wei Chou[1,2], Jaincai Xu[1], Konstantin Khrennikov[2], Laszlo Veisz[1], and Stefan Karsch[1,2] — [1]Max-Planck-Institut für Quantenoptik, Hans-Kopfermannstr. 1, D-85748 Garching, Germany — [2]Ludwig-Maximilians-Universität, Am Coulombwall 1, D-85748 Garching, Germany

Electrons from Laser Wakefield Acceleration (LWFA) have been shown having an ultra-short, sub-5 fs temporal structure accompanying with a small transverse initial size. These electron bunches can drive a wakefield efficiently in an underdense plasma and lose their energy. We used ATLAS, a Ti:Sapphire based 100 TW laser as a driver for LWFA. A target for electron generation included a 0.3 mm diameter supersonic

helium gas jet with shock front injection, and another 1.5 mm gas jet was used as a target for electron deceleration. The measurement has shown that the electron energy as well as the total bunch charge were dumped under certain conditions almost completely (>90%) right after insertion of second jet. This effect was observed even with several mm separations between two jets. The divergence (~8 mrad) and total charge (~30 pC) from the first jet made an ideal bunch for driving plasma wave in second jet. The observed peak deceleration gradient was up to 23.7 GeV/m and 5.1 GeV/m in average. We interpret the observation by collective deceleration. Our measurement has demonstrated the feasibility of an efficient potential driver for particle-driven plasma wakefield acceleration as well as a compact beam dump for the future development the LWFA application.

## AKBP 3: RF, Resonators and Applications

Zeit: Montag 16:45–19:00 Raum: BZ.08.06 (HS 1)

AKBP 3.1 Mo 16:45 BZ.08.06 (HS 1)

**Implementation of a high level phase controller for the superconducting injector of the S-DALINAC** — •Thore Bahlo, Christoph Burandt, Florian Hug, and Norbert Pietralla — Institut für Kernphysik, Technische Universität Darmstadt

The Superconducting DArmstadt LINear Accelerator S-DALINAC is a recirculating electron accelerator with a design energy of 130 MeV. It operates in cw-mode at a radio frequency of 3 GHz and provides either unpolarized or polarized electron beams. Before entering the main accelerator the electron beam passes both, a normal-conducting injector beamline for beam preparation and a superconducting 10 MeV injector beamline for preacceleration. The phase of the beam which is injected into the 40 MeV main accelerator is crucial for the efficiency of the acceleration process and the minimization of the energy spread. Due to thermal drifts of the normal-conducting injector cavities this injection phase varies by about 0.2 degree over a timescale of an hour. In order to compensate these drifts, a high level phase controller has been implemented. It adjusts the phase measured at an rf-monitor at the exit of the superconducting injector by changing the phase of a prebuncher in the normal-conducting injector beamline. We will present the used hardware, the control algorithm as well as measurements showing the phase stabilization achieved by this controller.

This work has been supported by the DFG through CRC 634

AKBP 3.2 Mo 17:00 BZ.08.06 (HS 1)

**Systematic beam studies with the bunch-by-bunch feedback system at the ANKA storage ring** — •Edmund Hertle[1], Benjamin Kehrer[2], Nicole Hiller[1], Erhard Huttel[3], Nigel Smale[3], Alexander Papasch[3], Anke-Susanne Müller[1,2,3], and Dmitry Teytelman[4] — [1]IPS, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe — [3]ANKA, KIT, Karlsruhe — [4]Dimtel, Inc.

The bunch-by-bunch feedback system installed at the ANKA storage ring of the Karlsruhe Institute of Technology (KIT) has now been used to counteract transverse beam instabilities for more than one year. In addition, improvements of beam lifetime were observed. The system has been instrumental in systematic studies of the different operation modes of ANKA (e.g. at different beam energies and optics). Recently, the feedback system was complemented by the installation of a longitudinal kicker cavity. This presentation gives an overview of the systematic studies with the bunch-by-bunch feedback system at ANKA and reports possible first results of its operation in all three planes.

AKBP 3.3 Mo 17:15 BZ.08.06 (HS 1)

**Performance of the RF Phase Modulation System at DELTA** — •Marcel Bursy[1], Jonathan Fürsch[2], Peter Hartmann[1], Benjamin Isbarn[1], Malte Sommer[1], and Thomas Weis[1] — [1]Center for Synchrotron Radiation (DELTA) TU Dortmund University, 44227 Dortmund, Germany — [2]Affiliation changed meanwhile

At DELTA, a third generation 1.5 GeV synchrotron radiation facility, we use common schemes to damp longitudinal coupled bunch mode instabilities, including a bunch-by-bunch feedback system. We also utilize an RF-phase modulation of the master-RF at two times the synchrotron frequency, providing strong additional damping capabilities and a significant increase in beam lifetime of approximately 20%, due to bunch lengthening and reduced Touschek effect. Despite the apparent influence on beam lifetime and longitudinal beam stability the actual correlation between the phase modulation of the master-RF and its influence on the time dependent accelerating gradient has not been studied sufficiently yet. The presentation will give an overview on the existing modulation scheme together with first studies to provide a better understanding of the RF phase modulation impact on the small bandwidth accelerating cavity.

AKBP 3.4 Mo 17:30 BZ.08.06 (HS 1)

**Field emission investigations on flat Cu samples before and after surface cleaning** — •Stefan Lagotzky[1], Pavel Serbun[1], Günter Müller[1], Tomoko Muranaka[2], and Sergio Calatroni[2] — [1]University of Wuppertal, D-42097 Wuppertal, Germany — [2]CERN, Geneva, Switzerland

Enhanced field emission (EFE) resulting in electric breakdowns (BD) is one of the main field limitations of the accelerating structures for the Compact Linear Collider ($E_{acc}$ = 100 MV/m, $E_{pk}/E_{acc}$=2.43). Deep and quantitative understanding of the origin of EFE is therefore important to reduce the conditioning time as well as the final BD rate of these structures. Systematic EFE investigations on Cu samples manufactured in a similar way as the CLIC accelerating structures have revealed an emitter number density up to N= 372 $cm^{-2}$ at E = 243 MV/m. SEM investigations around the emission sites revealed mainly particulate contaminations as origin of EFE. Removal of such contaminations by cleaning with ionized $N_2$ led to N = 124 $cm^{-2}$, and a further reduction of N was achieved by applying dry ice cleaning (DIC) in a class 10 cleanroom resulting in N = 29 $cm^{-2}$. The emission sites that could not be removed by DIC showed onset fields down to $E_{on}$ = 30 MV/m and field enhancement factors up to $\beta$ = 360, and SEM investigations revealed mainly accidental scratches and etching pits. Moreover, a strong activation effect of emitters was observed on all samples. A possible breakdown mechanism based on this emitter activation will be discussed.

The work is funded by BMBF project 05H12PX6.

AKBP 3.5 Mo 17:45 BZ.08.06 (HS 1)

**Yacs - A New 2.5D FEM Eigenmode Solver for Axisymmetric RF-Structures*** — •Benjamin Isbarn, Bernard Riemann, Malte Sommer, and Thomas Weis — Center for Synchrotron Radiation (DELTA) TU Dortmund University, 44227 Dortmund, Germany

Most feasibility studies for modern accelerator concepts, including superconducting multicell RF-cavity-resonators in circular accelerators, depend on computing a large number of eigenmode frequencies and field patterns to obtain typical figures of merit. This task includes computational intensive numerical studies. To obtain the full eigenfrequency spectra most of these studies are performed in 3D, require a great amount of computation resources and thus are limited to a few hundred or thousand eigenmodes. To overcome this issue, some codes make use of the axisymmetric geometry of most of the RF-cavity-resonator structures and solve the problem in 2D. Solving in 2D however reduces the eigenmode spectra to eigenmodes with no azimuthal dependencies (so called monopole-modes). Due to the lack of freely available and easy to use 2.5D eigenmode solvers which are able to solve for the full 3D field in a reduced 2.5 dimensional problem, we developed yet another cavity solver (Yacs), a simple FEM based solver capable of solving for the full 3D eigenmodes of axisymmetric problems while only requiring a fraction of the computation resources required by most modern 3D codes.

* Work supported by the BMBF under contract no. 05K13PEB

AKBP 3.6 Mo 18:00 BZ.08.06 (HS 1)

**Status of the Robinson Wiggler Project at the Metrology Light Source** — •Tobias Goetsch, Jörg Feikes, Markus Ries, and Godehard Wüstefeld — Helmholtz-Zentrum Berlin, Berlin, Germany

The Metrology Light Source (MLS), situated in Berlin (Germany) is owned by Physikalisch-Technische Bundesanstalt and was built / is operated by Helmholtz-Zentrum Berlin. It is an electron storage ring operating from 105 MeV to 630 MeV and serves as the national primary source standard from the near infrared to the extreme ultraviolet

spectral region. The lifetime at the MLS is dominated by the Touschek effect. By installing a Robinson Wiggler, the bunches can be lengthend, as damping is transferred from the longitudinal to the horizontal plane. A considerable increase in lifetime seems achievable, while preserving the source size. The current status of this project will be presented.

AKBP 3.7 Mo 18:15 BZ.08.06 (HS 1)

**Status of Instability Damping-Rate Analysis Using Bunch-by-Bunch Feedback Systems at the DELTA Storage Ring*** — Markus Höner, Shaukat Khan, Malte Sommer, •Christian Waldera, and Thomas Weis — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

At the 1.5-GeV electron storage ring DELTA (TU Dortmund), bunch-by-bunch feedback systems are in use to analyze and counteract transverse and longitudinal multi-bunch instabilities. Synchronous phase measurements for different filling patterns will be presented. Furthermore, a feedback-based method to measure the damping times of stable and unstable multi-bunch modes will be compared with images from a streak camera. The dependence of growth rates and instability thresholds on the beam energy will be discussed. *Work supported by the BMBF.

AKBP 3.8 Mo 18:30 BZ.08.06 (HS 1)

**Chopper/Buncher System für MESA** — •Victor Bechthold — Inst.f. Kernphysik, JGU Mainz, 55128 Mainz, D

Im Rahmen des Exzellenzclusters "Precision Physics, Fundamental Interactions and Structure of Matter (PRISMA)"wird am Institut für Kernphysik an der Johannes Gutenberg-Universität Mainz der neue 1,3 GHz Teilchenbeschleuniger MESA (Mainz Energy Recovering Superconducting Accelerator) gebaut. Er wird im ERL Modus betrieben werden und Elektronen auf Energien von 150 MeV beschleunigen können um Experimente wie die Suche nach dem Dunklen Photon und der Vermessung des Weinbergwinkels zu ermöglichen. Um Elektronen mit falscher Phasenlage in den Beschleunigungssektionen abzutrennen wird direkt nach der Quelle und vor dem Injektor ein vom MAMI Chopper/Buncher abgeleitetes System verwendet. Der kontinuierliche Elektronenstrahl aus der Quelle wird hierbei vom Chopper in Bunche einer Länge von bis zu 20 Grad „*zerhackt*“ und im darauffolgenden Bunchersystem weiterhin im longitudinalen Phasenraum auf bis ±2 Grad fokussiert. Es wird eine bereits entwickelte und erfolgreich getestete Deflektor-Kavität des Choppers, sowie eine neue Buncher-Kavität präsentiert. Weiterhin ist es geplant dazu im Jahr 2015 einen Teststand aufzubauen.

AKBP 3.9 Mo 18:45 BZ.08.06 (HS 1)

**RF field asymmetry simulations for the PITZ RF Photo Gun.** — •Igor Isaev and Mikhail Krasilnikov — DESY, Platanenallee 6, 15738, Zeuthen

The photoinjector test facility at DESY, Zeuthen site (PITZ) has been built for the development, testing and optimization of high brightness electron sources for Free Electron Lasers (FELs). A radio frequency (RF) photo gun is one of the key components for the successful operation of modern FELs. The PITZ RF gun consists of a 1.6 cell copper cavity with a Cs2Te photocathode. It is surrounded by two solenoids for generation a constant external magnetic field for beam focusing. The gun is operated at an RF field resonance frequency of 1.3 GHz with an electric field strength of 60 MV/m at the cathode. The RF cavity is fed through a coaxial coupler.

An electron beam asymmetry has been observed at PITZ experimentally which could not be explained by imperfections of the photocathode laser transverse profile. An RF field asymmetry in the coupler section of the cavity generates a transverse RF field in the cavity which can deteriorate the transverse phase space of generated beams, therefore it is being considered as one of possible reasons of the observed electron beam distortions.

The influence of the transverse fields on the beam dynamics was studied using CST Particle Studio simulation code. Several coupler concepts were suggested and their field asymmetry was studied. The results of simulations are presented in this work.

## AKBP 4: FEL, Seeding and Thomson Scattering

Zeit: Montag 16:45–19:00 Raum: F.10.01 (HS 4)

AKBP 4.1 Mo 16:45 F.10.01 (HS 4)

**Seeding at FLASH – Challenges and perspectives** — Jorn Boedewadt[1], Ralph Assmann[1], Nagitha Ekanayake[1], Bart Faatz[1], Ingmar Hartl[1], Rosen Ivanov[1], Tim Laarmann[1], Jost Mueller[1], Kirsten Elaine Hacker[3], Shaukat Khan[3], Robert Molo[3], Sven Ackermann[1], Philipp Amstutz[2], Armin Azima[2], Markus Drescher[2], Leslie Lamberto Lazzarino[2], Christoph Lechner[2], Theophilos Maltezopoulos[2], •Tim Plath[2], and Jörg Rossbach[2] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg — [2]Universität Hamburg, Hamburg — [3]DELTA, Dortmund

Free-Electron Lasers (FELs) operated in the self-amplified spontaneous emission (SASE) mode start from shot-noise. The chaotic behaviour of this statistical process entails limited longitudinal coherence and spectral shot-to-shot stability of the emitted photon pulse. These drawbacks can be overcome by seeding the FEL process with an external light field.

The linear accelerator at the FLASH user facility drives two undulator beamlines, FLASH1 and FLASH2.

At FLASH1, the seeding experiment comprises two electro-magnetic undulators, three chicanes, and a variable-gap undulator system. Thanks to this variable infrastructure, the FLASH1 seeding beamline is an ideal test bed to study different seeding schemes and to learn from experiments for the design of FLASH2 seeding.

In this contribution we report on current activities at FLASH1 and possible seeding options for the second FEL beamline FLASH2.

AKBP 4.2 Mo 17:00 F.10.01 (HS 4)

**High energy narrow bandwidth light generation from inverse Thomson scattering with ultralow-emittance underdense photocathode plasma wakefield accelerated electron bunches** — •Paul Scherkl[1], Alexander Knetsch[1], Oliver Karger[1], Georg Wittig[1], Grace Manahan[2], and Bernhard Hidding[1,2] — [1]Department of Experimental Physics, University of Hamburg, Germany — [2]SUPA, Scottish Center for the Application of Plasma Accelerators (SCAPA) , University of Strathclyde, UK

Thomson scattering of light from fast moving electrons is a well-known and established technique as a high energy light source. Resulting X-Ray and $\gamma$-Ray radiation is used in many areas of science, industry and medicine, since it is intense and provides high photon energies with narrow bandwidth.

The achievable Thomson scattered light bandwidth strongly depends on electron beam emittance.

The underdense photocathode plasma wakefield acceleration scheme (Trojan horse, TH) is a promising method in order to generate ultralow emittance, ultrabright electron bunches. A low bandwidth inverse Thomson scattering light source scheme is presented based on 3D particle in cell simulations and 3D time and frequency resolved Thomson scattering simulations.

AKBP 4.3 Mo 17:15 F.10.01 (HS 4)

**Experimental Design of Optical Free-Electron Lasers in the Traveling-Wave Thomson-Scattering geometry** — •Klaus Steiniger[1,2], Michael Bussmann[1], Arie Irman[1], Axel Jochmann[1], Richard Pausch[1,2], Fabian Roeser[1], Roland Sauerbrey[1], Ulrich Schramm[1,2], and Alexander Debus[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden — [2]TU Dresden, 01062 Dresden

Traveling-Wave Thomson-Scattering (TWTS) realizes optical free-electron lasers (OFEL) from the extreme ultraviolet to the X-ray range with existing electron accelerators and high-power laser systems. In TWTS ultrashort laser pulses and relativistic electron bunches are utilized in a side-scattering geometry where laser pulse and electron bunch direction of motion enclose an interaction angle. The laser electric field thereby provides the optical undulator field for radiation generation. When the electrons traverse the laser beam cross-section, TWTS provides continuous overlap of electrons and laser pulse by employing a laser pulse-front tilt. Long optical undulators are thus realized in TWTS allowing for microbunching of the electron beam leading to the realization of TWTS OFELs. We present the scaling laws for the electron beam and laser pulse requirements to operate TWTS OFELs and

show with example scenarios that TWTS OFELs can be realized with existing radio-frequency electron accelerators such as ELBE at HZDR as well as laser-wakefield accelerated electrons. We detail the necessary equipment in a TWTS OFEL experiment and discuss how current experimental limitations affect the design of TWTS OFEL setups.

AKBP 4.4 Mo 17:30 F.10.01 (HS 4)

**Upgrade of the short-pulse facility at DELTA: employing the EEHG and femtoslicing techniques** — •Fin Hendrik Bahnsen, Max Bolsinger, Svenja Hilbrich, Markus Höner, Holger Huck, Maryam Huck, Shaukat Khan, Carsten Mai, Arne Meyer auf der Heide, Robert Molo, Helge Rast, Gholamreza Shayeganrad, and Peter Ungelenk — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

At the 1.5-GeV synchrotron light source DELTA, operated by the TU Dortmund University, a short-pulse facility employing a laser-induced modulation of the electron energy provides sub-picosecond synchrotron radiation pulses in the VUV regime using coherent harmonic generation (CHG). Significantly shorter wavelengths can be reached using the echo-enabled harmonic generation (EEHG) technique. Femtoslicing, another method employing laser-induced energy modulation, allows to reach even shorter wavelengths but with much lower photon flux. At DELTA, an upgrade of the short-pulse facility including EEHG and femtoslicing is planned for the next years. The design of new undulators and magnetic chicanes as well as simulations of the EEHG and femtoslicing process will be presented.

AKBP 4.5 Mo 17:45 F.10.01 (HS 4)

**Free-Electron-Lasers based on High-Brightness Electrons from Underdense Photocathode Plasma Wakefield Accelerator.** — •Gregor Hurtig[1], Georg Wittig[1], Alexander Knetsch[1], and Bernhard Hidding[1,2] — [1]Department of Experimental Physics, University of Hamburg, Germany — [2]2SUPA, Scottish Center for the Application of Plasma Accelerators (SCAPA) , University of Strathclyde, UK

Free Electron Lasers (FEL) are outstanding instruments for natural, material and life sciences and engineering. The FEL process and output depends strongly on the driving electron bunch parameters such as current and beam emittance, energy, and (slice) energy spread. Thanks to the GV/m-scale accelerating fields, plasma accelerators can reach high electron energies in compact setups, but beam quality until recently could not compete with large state-of-the-art facilities such as LCLS, FLASH, XFEL etc.

A potential, hybrid breakthrough method to produce electron bunches with emittance, current and brightness orders of magnitude better than at mentioned facilities is the underdense photocathode plasma wakefield acceleration scheme ('Trojan Horse'). In addition, the high degree of control and tunability of accelerated electron beam properties allows for flexibility in choosing the appropriate FEL process, undulator structure etc. Trojan Horse accelerated electron beams are analyzed based on 3D particle in cell simulations, and FEL simulations using state-of-the-art codes such as GENESIS and Puffin are presented and ongoing and future R&D is highlighted.

AKBP 4.6 Mo 18:00 F.10.01 (HS 4)

**Ultrashort VUV Synchrotron Radiation Pulses for Pump-Probe Experiments at DELTA** — •Arne Meyer auf der Heide, Fin Hendrik Bahnsen, Max Bolsinger, Svenja Hilbrich, Markus Höner, Holger Huck, Maryam Huck, Shaukat Khan, Carsten Mai, Robert Molo, Helge Rast, Gholamreza Shayeganrad, and Peter Ungelenk — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

Since 2011, the coherent harmonic generation (CHG) principle is employed to produce ultrashort VUV pulses at the short-pulse facility of the 1.5-GeV synchrotron light source DELTA operated by the TU Dortmund University. CHG is based on the interaction of ultrashort laser pulses with electrons in an undulator to generate coherent radiation at harmonics of the laser wavelength. Studies to characterize the CHG pulses were performed and the facility was prepared for pump-probe experiments. However, in standard user mode, an RF phase modulation is applied to increase the electron beam lifetime which leads to a significant loss of efficiency of the laser-electron interaction. Recently, methods to avoid this difficulty have been found, allowing CHG operation while the RF phase modulation is applied.

AKBP 4.7 Mo 18:15 F.10.01 (HS 4)

**Femtosecond level synchronization of titanium sapphire laser and microwave reference for external injection experiments at REGAE.** — •Mikheil Titberidze[1,2], Holger Schlarb[3], Benno Zeitler[1,2], Andreas Maier[1,2], Klaus Flöttmann[3], Thorsten Lamb[3], Cezary Sydlo[3], Matthias Felber[3], Ewa Janas[4], Irene Dornmair[1,2], and Florian Grüner[1,2] — [1]University of Hamburg, Institute for Experimental Physics, Hamburg 22607, Germany — [2]Center for Free-Electron Laser Science (CFEL), Hamburg 22607, Germany — [3]Deutsches Elektronen-Synchrotron (DESY), Hamburg 22607, Germany — [4]Warsaw University of Technology, Warsaw 00-665, Poland

Laser driven plasma accelerators are offering high gradient (10-100 GV/m), high quality (low emittance, short bunch length) electron beams, which can be suitable for future compact, bright and tunable light sources. In the framework of the Laboratory for Laser-and beam-driven plasma Acceleration (LAOLA) collaboration at Deutsches Elektronen-Synchrotron (DESY) the external injection experiment for injecting electron bunches from a conventional RF accelerator into a linear plasma wave is in progress. External injection experiments at REGAE (Relativistic Electron gun for Atomic Exploration) require sub-20 to 50 fsec precision synchronization of laser and electron beams in order to perform a beam scan into the plasma wave by varying the delay between electron beam and laser pulses. Here we present current and new optical to microwave femtosecond level synchronization schemes and preliminary results in comparison.

AKBP 4.8 Mo 18:30 F.10.01 (HS 4)

**Demonstration of SASE suppression through a seeded microbunching instability** — •Christoph Lechner[1], Sven Ackermann[2], Armin Azima[1], Jörn Bödewadt[2], Günter Brenner[2], Martin Dohlus[2], Markus Drescher[1], Nagitha Ekanayake[2], Torsten Golz[2], Kirsten Hacker[3], Katja Honkavaara[2], Shaukat Khan[3], Tim Laarmann[2], Leslie Lamberto Lazzarino[2], Torsten Limberg[2], Theophilos Maltezopoulos[1], Velizar Miltchev[1], Robert Molo[3], Tim Plath[1], Juliane Rönsch-Schulenburg[1], Jörg Rossbach[1], Evgeny Schneidmiller[2], Nikola Stojanovic[2], and Mikhail Yurkov[2] — [1]University of Hamburg, Hamburg — [2]DESY, Hamburg — [3]TU Dortmund University, Dortmund

Collective effects and instabilities due to longitudinal space charge and coherent synchrotron radiation can degrade the quality of the ultra-relativistic, high-brightness electron bunches needed for the operation of free-electron lasers (FELs). In this contribution, we demonstrate the application of a laser-induced microbunching instability to manipulate the electron bunch properties and selectively suppress FEL lasing. A significant decrease of photon pulse energies was observed at the FEL user facility FLASH in coincidence with overlap of 800 nm laser pulses and electron bunches within a modulator located approximately 40 meters upstream of the undulators. We discuss these effects in the framework of longitudinal space charge amplification [E.A. Schneidmiller and M.V. Yurkov, Phys. Rev. ST Accel. Beams 13, 110701 (2010)] and present experimental results.

AKBP 4.9 Mo 18:45 F.10.01 (HS 4)

**Optical free-electron lasers on table-top with Traveling-wave Thomson scattering** — •Alexander Debus[1], Klaus Steiniger[1,2], Michael Bussmann[1], Richard Pausch[1,2], Tom Cowan[1], Arie Irman[1], Axel Jochmann[1], Roland Sauerbrey[1], and Ulrich Schramm[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

Optical FELs (OFELs) based on Traveling-wave Thomson scattering (TWTS) optimally exploit the high spectral photon density in high-power laser pulses by spatially stretching the laser pulse and overlapping it with the electrons in a side scattering setup. The introduction of a laser pulse-front tilt provides for interaction lengths appropriate for FEL operation. With careful dispersion control, electrons witness an undulator field of almost constant strength and wavelength over hundreds to thousands of undulator periods, thus giving enough time for self-amplified spontaneous emission (SASE) to seed the FEL instability and the realization of large laser gains.

We provide an overview on the differences between TWTS OFELs, head-on OFEL designs and magnetic undulator FELs. In this dicussion we emphasize the respective impact on transverse coherence, quantum recoil and space-charge.

# AKBP 5: Poster

Zeit: Dienstag 11:00–19:00 Raum: Foyer Ebene G.10

AKBP 5.1 Di 11:00 Foyer Ebene G.10

**Unterstützung der manuellen Strahleinstellung am S-DALINAC durch Anbindung von Strahldynamiksimulationen an das EPICS-basierte Kontrollsystem*** — Jonny Birkhan, •Christoph Burandt, Joachim Enders, Florian Hug, Norbert Pietralla und Thomas Schösser — Institut für Kernphysik, TU Darmstadt

Der supraleitende Elektronenbeschleuniger des Instituts für Kernphysik der TU Darmstadt (S-DALINAC) wird derzeit vollständig manuell eingestellt. Grundlage für eine individuelle Strahleinstellung sind neben Erfahrungswerten Berechnungen und Simulationen der Strahldynamik, die in der Vergangenheit vorgenommen wurden. Diese liegen meist abschnittsweise vor und wurden mit unterschiedlichen Simulationsprogrammen erzeugt, unter anderem mit Matrix-basierten Programmen sowie mit dem V-Code, einem am Institut für Theorie Elektromagnetischer Felder der TU Darmstadt entwickelten Programm, dem die Vlasov-Gleichung zugrunde liegt. Derzeitige Anstrengungen zielen darauf ab, Operateuren effizienten Zugang zu Simulationsergebnissen zu ermöglichen, während die Strahleinstellung vorgenommen wird. Darüber hinaus wird die Möglichkeit der Manipulation der Simulationen in Echtzeit angestrebt. Die Konzeption der Schnittstellen zwischen Kontrollsystem und den Simulationsprogrammen, sowie der Mechanismen zur automatischen Konfiguration aller Softwarekomponenten werden vorgestellt und diskutiert.

*Gefördert durch die DFG im Rahmen des SFB634.

AKBP 5.2 Di 11:00 Foyer Ebene G.10

**Functionality Demonstration of the non-invasive Bunch Shape Monitor at GSI high current LINAC** — •Benjamin Zwicker[1,2], Kester Oliver[1,2], Peter Forck[1,2], Piotr Kowina[1], Christoph Dorn[1], and Thomas Sieber[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]IAP Goethe Universität, Frankfurt, Germany

At the heavy ion LINAC at GSI, a novel scheme of a non-invasive Bunch Shape Monitor has been tested with several different ion beams at 11.4 MeV/u and beam currents in the range from 0.08 to 1 mA. Caused by the beam impact on the residual gas, secondary electrons are liberated. These electrons are accelerated by an electrostatic field, transported via a sophisticated electrostatic energy analyzer and an rf-deflector, acting as a time-to-space converter. Finally a MCP phosphor assembly amplifies the electrons and the electron distribution is detected by a CCD camera. For the applied beam settings this Bunch Shape Monitor is able to obtain longitudinal profiles down to 250 ps rms width with a resolution of 34 ps. Systematic parameter studies for the device were performed to demonstrate the feasibility and to detect, as expected, non-Gaussian profiles. Finally these obtained non-Gaussian profiles are analyzed.

AKBP 5.3 Di 11:00 Foyer Ebene G.10

**In Situ Measurement of Mechanical Vibrations of a 4-Rod RFQ at GSI** — •Peter Gerhard and Lars Groening — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

In 2009, a new 4-rod RFQ was commissioned at the UNILAC at GSI, Darmstadt, and went into operation in 2010 [1]. At high rf amplitudes strong modulations of the rf reflection emerge with $\nu_{mod} \approx 500$ Hz. They are attributed to mechanical oscillations of the rods, excited by the rf pulse. As these modulations could so far only be seen *during* the rf pulse by means of rf measurements, a direct observation of the mechanical vibrations was desirable. Such measurements have been conducted using a commercial laser vibrometer, allowing the investigation of the mechanical behavior of the RFQ *in situ* and independent of the presence of rf power. Results from investigations under standard operation conditions confirm the vibrations as the source of the modulations observed by rf as well as their excitation by the rf pulse. Further measurements revealed more details about the excitation process, leading to a better understanding and possibly new ways of mitigation.

[1] P. Gerhard *et al.*, "Experience with a 4-Rod CW RFQ", LINAC'12, Tel Aviv, Israel, Sept. (2012), THPB035

AKBP 5.4 Di 11:00 Foyer Ebene G.10

**Lorentz Boosted Frame Simulations of Laser Wakefield Acceleration with the PIC-Code WARP** — •Manuel Kirchen[1,2], Irene Dornmair[1,2], and Andreas Richard Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg, Germany — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg, Germany

Research on laser-driven plasma wakefield acceleration has evolved rapidly in the past few decades, demonstrating the generation of quasi-monoenergetic electron beams up to the GeV level in cm-scale targets, using high power laser systems. Particle-In-Cell simulations have become a favourable tool for gaining insights on the complex dynamics of laser-plasma interaction. Yet, they are computation-intensive, hence, a lot of effort is made in reducing the resource consumption of PIC-Codes. A promising approach is to model the interaction in a lorentz-boosted frame. Compensating for the disparity of smallest space (namely the laser wavelength) and time scales (i.e. the interaction length with the plasma), reduces the computational time of the simulation by $\approx 2\gamma^2_{wake}$. However, a back-transformation of the simulation data needs to be performed, in order to get physically interpretable results in the lab frame. Here, we present an efficient output method for boosted frame simulations and the implementation of the process with the PIC-Code WARP.

AKBP 5.5 Di 11:00 Foyer Ebene G.10

**Proposal of an IH-DTL design as replacement for the GSI UNILAC Alvarez for FAIR** — •Hendrik Hähnel, Ulrich Ratzinger, and Rudolf Tiede — Institut für Angewandte Physik, Goethe Universität Frankfurt, Deutschland

To meet the requirements of 15 mA $U^{28+}$ at 11.4 AMeV for injection into the SIS18, the GSI UNILAC has to be upgraded. By upgrading the MEBT section between the RFQ and IH-DTL as proposed by the authors, the prestripper section can reach the required 18 mA $U^{4+}$ with high efficiency. The Alvarez linac in the poststripper $U^{28+}$ section of the UNILAC is nearing 40 years of operation and therefore has to be replaced to ensure reliable and efficient operation for FAIR. We propose an IH-DTL linac as replacement for the current GSI UNILAC Alvarez. The new design is based on the KONUS beam dynamics concept and delivers high beam quality well within FAIR requirements. It will drastically reduce the fabrication costs and will leave about 30 m within the UNILAC for later linac energy upgrades to improve the high current performance of FAIR.

AKBP 5.6 Di 11:00 Foyer Ebene G.10

**Controlling the transverse electron beam quality in plasma wakefield accelerators** — •Jan-Hendrik Erbe, Charlotte Palmer, Matthew Streeter, Olena Kononenko, Timon Mehrling, Tobias Kleinwächter, and Jens Osterhoff — Deutsches Elektronen-Synchrotron DESY, 22607 Hamburg, Deutschland

Plasma-based accelerators (PBA) are rapidly gaining interest in the accelerator community for their ability to produce high energy electron beams in a compact design. One unresolved challenge is the capture of accelerated beams for transport via conventional beam optics. PBA beams intrinsically have a high divergence ∼1mrad and a large energy spread ∼1-10%. This leads to temporal elongation of the electron bunch and a growth of the initially low emittance ∼ $\mu$m inside the plasma during the vacuum drift following the plasma target. Tailoring the particle density profile at the transition from plasma into vacuum is a promising method by which the divergence can be decreased, thus improving the beam quality after a drift. To show the feasibility of analytically calculated density ramps in a plasma target computational fluid dynamics (CFD) simulations are performed. Numerical studies and particle-in-cell simulations employing the results from the CFD simulations show a promising mitigation of the divergence. The designed plasma targets will be produced and tested in a laser driven wakefield acceleration experiment.

AKBP 5.7 Di 11:00 Foyer Ebene G.10

**System Design for a Bunch to Bucket Synchronization** — •Thibault Ferrand — TEMF - Institut für Theorie Elektromagnetischer Felder, TU Darmstadt, Darmstadt, Deutschland

A deterministic bunch to bucket transfer system is currently under development in the frame of the FAIR project at GSI. To achieve our

accuracy requirements, a set of hardware modules will be implemented. These hardware modules are expected to provide values such as the relative phase advance between the RF systems of both, the source and the target synchrotron according to an external timing system. These values are exchanged via optical fibers between different supply rooms, and the considered RF signals are re-synthesized locally. These re-synthesized signals are synchronized to enable a precise phase advance control between the synchrotrons' RF systems. The first step of the development consists in modeling the actual DDS and DSP-based LLRF environment of the SIS18 under Ptolemy-II. We expect to use this simulation to refine our timing expectations regarding the synchronization process and the inter-module communication protocols and design the synchronization function, which will be implemented on the hardware modules.

AKBP 5.8 Di 11:00 Foyer Ebene G.10

**Investigation of Geometric Variations for the bERLinPro Main Linac Cavity Using Perturbative Methods** — •Korinna Brackebusch and Ursula van Rienen — Institute of General Electrical Engineering, University of Rostock

The design of multicell accelerator cavities is a challenging task since it implies the manipulation of various shape parameters regarding different (partially opposing) optimization goals. Simulating the electromagnetic characteristics of the full structure involves an enormous computational effort. In most cases, this constrains the observed frequency range and the number of optimization passes. An investigation of the effects of unintended shape deviations is usually entirely abstained from although it may be of particular importance for the final design.

Perturbative methods offer an efficient approach to tackle this issue. They allow the computation of the eigenmodes and the derived cavity performance parameters of a multitude of varied cavity designs based on one initial design. In this contribution, we investigate the applicability of perturbative methods for performance optimization and simultaneous consideration of shape variations exemplarily studying the 1.3 GHz bERLinPro Main Linac 7-cell Cavity.

Work supported by Federal Ministry for Research and Education BMBF under contract 05K13HR1.

AKBP 5.9 Di 11:00 Foyer Ebene G.10

**Design studies for the Proton-Linac RFQ for FAIR** — •Markus Vossberg, Robert Brodhage, Michael Kaiser, Fabio Maimone, and Wolfgang Vinzenz — GSI, Darmstadt

The planned 26 m long Proton-Linac (P-LINAC) for FAIR (Facility for Antiproton and Ion Research) comprises a RFQ (Radio-Frequency Quadrupole) and 6 CH-cavities to accelerate a 70 mA proton beam up to 70 MeV. The FAIR Proton-Linac starts with a 325.2 MHz, from 95keV to 3 MeV RFQ accelerator. The main RFQ for this Proton-Linac will be a 4-Vane RFQ. Beam dynamics designs with varying and constant transverse focusing strengt for the electrode parameters will be used. CST simulations will help to find cavity parameters for the working frequency. This paper presents the main cavity designs concepts and CST simulation results.

AKBP 5.10 Di 11:00 Foyer Ebene G.10

**Modeling of the Space Charge Compensation for ECRIS and LEBT** — Wolfgang Ackermann, Oliver Boine-Frankenheim, Herbert De Gersem, •Nikolai Schmitt, and Thomas Weiland — Theorie Elektromagnetischer Felder

In an ion linac the low energy beam transport (LEBT) is located between the ion source and the radio frequency quadruple (RFQ). Once the ions are extracted from the source plasma, they travel along a transfer line until the particles reach the RFQ. As the beam is at low energy, space charge compensation is indispensable. The required electrons yield from residual gas ionisation which strongly dependents on the gas pressure. Most simulation tools model the extraction process as a particle tracking algorithm (ray tracing) where the space charge compensation is either assumed by a given value or the electrons are modelled by means of a Boltzmann distribution. Where the first approach is usually based on experimental experience, the second approach demands the plasma to be collisionless, currentless, isothermal, and unmagnetised. This is however not necessarily valid in the LEBT. For the mentioned reasons, we plan to investigate the role of electrons within a more sophisticated model. As Particle-In-Cell solutions are numerically very demanding due to the large difference in the electron and ion timescale, a multi-fluid model is used.

AKBP 5.11 Di 11:00 Foyer Ebene G.10

**A Superconducting Transverse Gradient Undulator for a Laser Wakefield Accelerator: First Tests and Magnetic Field Measurements** — Veronica Afonso Rodriguez[1], •Axel Bernhard[1], Andreas Grau[1], Peter Peiffer[1], Steffen Schott[1], Walter Werner[1], Christina Widmann[1], Andreas Will[1], Anke-Susanne Müller[1], Marc Weber[1], Maria Nicolai[2], Alexander Sävert[2], and Malte Kaluza[2,3] — [1]Karlsruhe Institute of Technology (KIT), Germany — [2]Friedrich-Schiller University Jena, Germany — [3]Helmholtz-Institute Jena, Germany

A superconducting transverse gradient undulator (TGU) for the laser wakefield accelerator (LWFA) in Jena, Germany, has been designed and constructed. The transverse magnetic flux density gradient is achieved through a cylindric shape of the undulator halves. The 40-period undulator is designed for a relative energy acceptance of ±10% around a given central energy, covering both the width and the shot to shot fluctuations of the electron energy spectrum generated by the LWFA at a moderate dispersion of $\sim 20\,\mathrm{mm}$.

In this contribution we present details of the technical design and construction of the device and show results of the performed quench tests and field mappings.

AKBP 5.12 Di 11:00 Foyer Ebene G.10

**First Tests of a Beam Transport System from a Laser Wakefield Accelerator to a Transverse Gradient Undulator** — •Christina Widmann[1], Axel Bernhard[1], Veronica Afonso Rodriguez[1], Walter Werner[1], Maria Nicolai[2], Stephan Kuschel[2,3], Alexander Sävert[2], Matthew Schwab[2], Malte Kaluza[2,3], and Anke-Susanne Müller[1] — [1]Karlsruhe Institute of Technology (KIT) — [2]Friedrich Schiller University Jena — [3]Helmholtz Institute Jena

An experimental setup for the generation of monochromatic undulator radiation at the laser wakefield accelerator (LWFA) in Jena using a transverse gradient undulator (TGU) is planned. Proper matching of the betatron funcions and the dispersion of the electron beam to the undulator is essential. Therefor a beam transport system with strong focusing magnets and chromatic correction of these magnets is required.

As a first step, a linear beam transport system without chromatic correction was set up at the LWFA. With this setup the electron beam's dispersion and the beta function of one selected energy are matched to the parameters required in the experiment. This contribution presents the results of these measurements.

AKBP 5.13 Di 11:00 Foyer Ebene G.10

**Simulation study of beam halo collimation in the heavy ion synchrotron SIS 100** — •Ivan Prokhorov[1], Ivan Strasik[2], and Oliver Boine-Frankenheim[1,2] — [1]TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum, Darmstadt. Germany

The FAIR synchrotron SIS 100 will be operated with high-intensity heavy-ion beams. Hollow electron beam collimation is studied as an option to augment the SIS 100 collimation system for partially-stripped heavy-ion beam s, e.g., $U^{28+}$.

Hollow electron beam collimator is a pulsed magnetically confined electron beam with the hollow density profile overlapping with the primary ion beam. It enhances diffusion in the halo by giving a nonlinear kick to halo particle in the electric field of electrons space charge, whereas the beam core stays unaffected. Hollow electron beam acts as a soft scatterer and in contrary to conventional solid material collimators does not procure the shower of secondaries, charge exchange and heat loads in the collimator body.

In this work numerical simulation studies of the beam halo dynamics in the presence of the hollow electron beam collimator is shown. Together with estimations of halo cleaning efficiencies for different synchrotron regimes.

AKBP 5.14 Di 11:00 Foyer Ebene G.10

**Quality and stability monitoring software for the 200 TW laser ANGUS** — •Dominik Claus Trosien[1,2], Matthias Schnepp[1,2], Vincent Alain Gilles Leroux[1,2,3], Spencer Windhorst Jolly[1,2,3], Byunghoon Kim[1,2,3], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]ELI Beamlines, 18221 Praha 8, Czech Republic

Laser-plasma accelerators are promising candidates to provide a compact source of relativistic electron beams. However, their performance is currently severely limited by the achievable stability in driver laser

operation. In this poster we will present our approaches to integrate the recently commissioned 200 TW laser system ANGUS, operated within the LAOLA collaboration of University of Hamburg and DESY, into the accelerator controlls system available at DESY. With its many different amplification stages such a complex system is very easily detuned. To minimize down time and increase the efficiency of maintenance work, a reliable monitoring and logging system is required. We implemented a series of beam pointing, spectrum, energy and other diagnostics into the system and log it with the central DESY archive. Correlations of the different parameters provide valuable insight into the system. We will present first measurements and discuss first analysis.

AKBP 5.15 Di 11:00 Foyer Ebene G.10

**First Tests of a Beam Transport System from a Laser Wakefield Accelerator to a Transverse Gradient Undulator** — •Christina Widmann[1], Axel Bernhard[1], Veronica Afonso Rodriguez[1], Walter Werner[1], Maria Nicolai[2], Stephan Kuschel[2,3], Alexander Sävert[2], Matthew B. Schwab[2], Malte C. Kaluza[2,3], and Anke-Susanne Müller[1] — [1]Karlsruhe Institute of Technology (KIT) — [2]Friedrich Schiller University Jena — [3]Helmholtz Institute Jena

An experimental setup for the generation of monochromatic undulator radiation at the laser wakefield accelerator (LWFA) in Jena using a transverse gradient undulator (TGU) is planned. Proper matching of the betatron funcions and the dispersion of the electron beam to the undulator is essential. Therefor a beam transport system with strong focusing magnets and chromatic correction of these magnets is required.

As a first step, a linear beam transport system without chromatic correction was set up at the LWFA. With this setup the electron beam's dispersion and the beta function of one selected energy are matched to the parameters required in the experiment. This contribution presents the results of these measurements.

AKBP 5.16 Di 11:00 Foyer Ebene G.10

**Laser Focusing and Electron Spectrometer Design of the LUX Beamline** — •Christian Markus Werle[1,2], Dariusz Kocon[1,2,3], Enrique Rodríguez García[3], Carlos-José Astúa[3], Niels Matthias Delbos[1,2], Paul Andreas Walker[1,2], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]ELI Beamlines, 18221 Praha 8, Czech Republic

Within the LAOLA Collaboration, the University of Hamburg and DESY work closely together to combine university research in the field of laser-plasma acceleration with the expertise of a large and well-established accelerator facility. In this poster we will present the design of two elements of the future LUX beamline, a dedicated beamline for generation of laser-plasma-driven undulator radiation within the LAOLA framework. The laser focusing system allows for positioning of the focusing mirror in 5 degrees of freedom in order to align the laser beam onto the acceleration target. A 4D-beam diagnostic ensures that the laser positioning and angle is kept at its design values. The electron spectrometer, based on a C-shaped permanent dipole magnet, is specifically designed to offer a very large dynamic range (50 to 1200 MeV). This allows the spectrometer to cope with the varying central beam energy and potentially broadband spectra resulting from these experimental sources. Both designs are developed with the accelerator technology standards in mind.

AKBP 5.17 Di 11:00 Foyer Ebene G.10

**Controlled Plasma Generation for Beam Driven Plasma Wakefield Accelerators** — •Gabriele Tauscher[1], Jan-Hendrik Erbe[2], Matthew Streeter[3], John Dale[3], Lucas Schaper[3], Lars Goldberg[2], Timon Mehrling[2], and Jens Osterhoff[3] — [1]Universität Hamburg — [2]Deutsches Elektronen-Synchrotron/Universität Hamburg — [3]Deutsches Elektronen-Synchrotron

Plasma-based wakefield acceleration is a promising approach in shrinking the size and cost of future particle accelerators and free-electron lasers. In the FLASHForward project, the ionisation of hydrogen with a laser creates a plasma inside which a wakefield is generated by an electron bunch of the FLASH accelerator. Disentangling these two processes enables improved control over plasma density profiles and therefore the structure of the wakefields. This has a crucial effect on the accelerated beams. In particular, the transverse focusing fields experienced by the beams are responsible for emittance evolution during acceleration. Simulations have shown that this focusing can be controlled by decoupling transverse and longitudinal fields using a hollow-core plasma channel. To precisely control the plasma generation we compute over-barrier strong-field ionization depending on the temporal evolution of the laser-intensity profile from a measured beam intensity and phase distribution. Various optics can be introduced into the beam path to affect laser-beam propagation. We plan to implement these concepts and realise different plasma shapes in proof of concept experiments.

AKBP 5.18 Di 11:00 Foyer Ebene G.10

**RF Measurements of a CH Power Prototype for the FAIR Proton Linac** — •Robert Brodhage[1], Gianluigi Clemente[1], Wolfgang Vinzenz[1], Markus Vossberg[1], and Ulrich Ratzinger[2] — [1]GSI, Darmstadt — [2]IAP, Uni Frankfurt

For the research program with cooled antiprotons at FAIR a dedicated 70 MeV, 70 mA proton injector is required. The main acceleration of this room temperature linac will be provided by six CH cavities operated at 325 MHz. Within the last years, the assembly and tuning of the first power prototype was finished. The cavity was tested with a preliminary aluminum drift tube structure, which was used for precise frequency and field tuning. Afterwards, the final drift tube structure has been welded inside the main tanks and the galvanic copper plating has taken place at GSI workshops. This paper will report on the main tuning and commissioning steps towards that novel type of DTL and it will show the latest results gained during copper plating and assembly. Final low level RF tests have been performed on the prototype which will show the performance and capability of the CH cavities.

AKBP 5.19 Di 11:00 Foyer Ebene G.10

**Femtosecond laser micromachining of sapphire capillaries for laser-wakefield acceleration** — •Philipp Messner[1,2], Niels Matthias Delbos[1,2], Thomas Calmano[2], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg

Laser-plasma accelerator are promising candidates to provide ultra-relativistic electron beams for compact light sources. One factor that limits the achievable electron beam energy in a laser plasma accelerator is the Rayleigh length of the driver laser, which dictates the length over which the electron beams can effectively be accelerated. To overcome this limitation lasers can be guided in a capillary waveguide to extend the acceleration length beyond the Rayleigh length. The production of waveguide structures on scales, that are suitable for plasma acceleration is very challenging. Here, we present experimental results from waveguide machining in sapphire crystals using a Clark MXR CPA 2010 laser with a wavelength of 775nm, 1KHZ repetition rate and a pulse duration of 160 fs. We discuss the effects of different parameters like energy, lens types, writing speed and polarisation on the size and shape of the capillaries, and compare the performance of different parameter sets.

## AKBP 6: SC Resonators

Zeit: Dienstag 13:45–16:15 Raum: BZ.08.06 (HS 1)

AKBP 6.1 Di 13:45 BZ.08.06 (HS 1)

**Status and running experience of the SRF gun at HZDR** — •rong xiang, andre arnold, pengnan lu, petr murcek, jochen teichert, and hannes vennekate — Helmholtz Zentrum Dresden Rossendorf, 01328 Dresden

In order to achieve a high average current up to 1 mA with a low emittance of 1 mm mrad at 77 pC, an improved SRF gun has been installed and commissioned at HZDR since 2014. This new gun replaces the first 3.5-cell SRF gun at the superconducting linear accelerator ELBE which had been in operation since 2007. The new gun has been

tested first with a Cu photocathode. The RF performance of the niobium cavity has been evaluated, the transverse and longitudinal beam parameters for low charge bunches have been measured, and the first beam has been guided into the ELBE beamline. The photocathode transfer system is also installed for the first high current beam test in 2015. In this contribution the status of the gun and the results of this first measurement period will be presented in detail.

AKBP 6.2 Di 14:00 BZ.08.06 (HS 1)

**Transverse Emittance Compensation** — •H. Vennekate[1,2], A. Arnold[1], T. Kamps[3], P. Kneisel[4], P. Lu[1,2], P. Murcek[2], T. Jochen[2], and R. Xian[2] — [1]TU Dresden — [2]HZDR — [3]HZB — [4]JLab

Superconducting RF injectors are promising candidates for the particle sources of future accelerators. While machines like high power free electron lasers or energy recovery linacs are planned to be operated with large duty factors, or even continuous wave mode, to increase the beam intensity, they also demand high beam quality. As this is already determined at the very start of the generation of each particle bunch, the concept of an SRF gun becomes appealing. Transverse Emittance marks the beam quality which is of tremendous relevance for all beam optics and further more sets the level of angular resolution of any scattering experiment performed with the beam. Several concepts to enhance this quality with the lately comissioned Rossendorf SRF Gun II have been presented in recent year's conferences. The talk will summarize the expended efforts, discuss some of the reflections on installation and operation of the used tools and present preliminary results of the recent achievements.

AKBP 6.3 Di 14:15 BZ.08.06 (HS 1)

**A Method for Quality Factor Measurements of the S-DALINAC Superconducting Cavities*** — •Ruben Grewe, Christoph Burandt, Florian Hug, Thorsten Kürzeder, and Norbert Pietralla — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

The S-DALINAC is a recirculating superconducting linear electron accelerator designed for beam energies of up to 130 MeV. For acceleration it uses 20-cell niobium cavities that are operated at 2 K. While operational experience showed that the design electric field gradient of 5 MV/m can be reached and exceeded, it was found that the quality factor is more than two times worse than the design value of $3 \cdot 10^9$. This results in more power being dissipated into the liquid helium bath which limits the electric field gradient for cw operation. For the assessment of q-factor improvements and for monitoring of q-factor variance over time, an *in-situ* method is needed. A phase-locked loop is used to make *in-situ* decay time measurements of the cavities. The presented method makes use of the extended adjusting capabilities of the S-DALINAC rf-input couplers to reach sufficiently low uncertainties of $\Delta Q_0/Q_0 < 10$ %.

AKBP 6.4 Di 14:30 BZ.08.06 (HS 1)

**Optimization of SRF Cavities using State-Space Modeling** — •Tomasz Galek, Johann Heller, Thomas Flisgen, and Ursula van Rienen — Universität Rostock, Institut für Allgemeine Elektrotechnik, Albert-Einstein-Str. 2, 18051 Rostock

The design of modern superconducting radio frequency cavities for acceleration of charged particle bunches requires intensive numerical simulations. A wide variety of parameters vital to the proper operation of accelerating cavities must be optimized. To compute properties of large and complicated RF structures a concatenation scheme is used. The aspects of concatenation using state-space Modeling and its application to the BESSY$^{\mathrm{VSR}}$ cavity chains is discussed.

AKBP 6.5 Di 14:45 BZ.08.06 (HS 1)

**Surface study of centrifugal barrel polished 1.3 GHz Nb cavities** — •Yegor Tamashevich[1,2], Eckhard Elsen[2], Brian Foster[1,2], Aliaksandr Navitski[2], and Alena Prudnikava[1,2] — [1]DESY, 22607 Hamburg, Germany — [2]University of Hamburg, 20146 Hamburg, Germany

Superconducting radio-frequency (SRF) cavities are the key components of accelerators such as the European X-ray Free Electron Laser and the planned International Linear Collider (ILC). Centrifugal barrel polishing (CBP) is a promising technique both for repairing and improving the performance of such cavities due to ability to remove large defects effectively and obtaining mirror-like surface without chemistry. In spite of numerous attempts, the CBP-treated cavities show yet worse SRF performance than expected. The present study explores the multistep recipe last developed at FNAL/JLab by using a coupon cavity with removable samples. It allows investigation of the interior surface after each polishing step by microscopic techniques such as laser profilometry, SEM/EDX, AFM etc. and measurement of the roughness and material removal rates at the most relevant areas. The study reveals some polishing media (e.g. Al2O3) to be embedded into the surface which causes new surface scratches in the final polishing step and * being normal conducting * most probably the worsening of the SRF performance. Additionally, a possibly detrimental shearing and deformation of the upper surface layer is observed. An improvement of the recipe is under study.

AKBP 6.6 Di 15:00 BZ.08.06 (HS 1)

**ILC-HiGrade cavities as a tool of quality control for the EXFEL and further SRF R&D** — •Aliaksandr Navitski[1], Yegor Tamashevich[1,2], Ricarda Laasch[1,2], Eckhard Elsen[1], Waldemar Singer[1], Jens Iversen[1], Axel Matheisen[1], and Detlef Reschke[1] — [1]DESY, 22607 Hamburg, Germany — [2]University of Hamburg, 20146 Hamburg, Germany

The order for superconducting radio-frequency (SRF) cavities for the European XFEL includes an additional set of 24 cavities which are part of the ILC-HiGrade program. Initially, these cavities serve as quality control (QC) sample extracted in parallel to the EXFEL cavities series production on a regular basis. These QC cavities include all processing steps of the EXFEL cavities and experienced identical treatment with the exception of mounting of the Helium vessel. After the normal acceptance tests at the cavity RF measurement facility, the cavities are removed from the production flow and subjected to further R&D studies and quality assurance (QA) tests. To maximize the information from these cavities, a temperature surface mapping technique is applied in the second cold RF test followed by a high-resolution optical inspection (OBACHT) of the inner cavity surface. These QA steps are carried out to improve the understanding of defects in close collaboration with the standing experts engaged in the EXFEL production. Correlations between cold RF tests, temperature mapping and optical surface quality help identifying limitations and provide valuable feedback for the production sequence. Results of the QC tests and R&D work will be presented and discussed.

AKBP 6.7 Di 15:15 BZ.08.06 (HS 1)

**Second sound quench localization system for 1.3 GHz Nb cavities** — •Ricarda Laasch[1,2], Yegor Tamashevich[1,2], Aliaksandr Navitski[2], Eckhard Elsen[2], and Brian Foster[1,2] — [1]University of Hamburg, 20146 Hamburg, Germany — [2]DESY, 22607 Hamburg, Germany

Precise localization and understanding of local thermal breakdowns or 'quenches' in 9-cell 1.3 GHz superconducting RF cavities are important steps in improving the performance of cavities, such as for the production of cavities for the European XFEL or the planned International Linear Collider. The 2nd sound method is a threshold technique that utilizes the phase transition of superfluid Helium induced during a quench and detected in Oscillating Superleak Transducers (OST). With several OSTs employed typical resolutions of ~1cm and better have been obtained. The number and position of sensors has to be optimized. The results are compared with a resistor-based temperature mapping system. Identified quench locations can be inspected for defects using the optical inspection system (OBACHT). Test results of several cavities will be shown.

AKBP 6.8 Di 15:30 BZ.08.06 (HS 1)

**Studying Superconducting Samples with a Quadrupole Resonator** — •Raphael Kleindienst, Jens Knobloch, Oliver Kugeler, Andrew Burrill, and Sebastian Keckert — Helmholtz-Zentrum-Berlin

Modern CW accelerators increasingly rely on superconducting cavities, which currently obtain quality factors well above $10^{10}$, corresponding to surface resistances below 10 nΩ. To reach such high quality factors, all processes that can affect the material properties of either bulk niobium or thin superconducting films need to be thoroughly understood. Measuring the superconducting properties of flat samples in comparison to entire cavities is useful, as they are fabricated more easily, and the influence of geometric and mechanical effects is reduced.

Presently, only few facilities exist capable of measuring the surface resistance of superconducting samples with a resolution in the nano-ohm range over a wide temperature span. A dedicated test stand consisting of a Quadrupole Resonator (QPR) has therefore been con-

structed at the Helmholtz Zentrum Berlin (HZB).

Taking as a baseline the 400MHz QPR at CERN, the design was adapted and optimized to 433 MHz, making available the higher harmonic mode at 1,3GHz. After production by Niowave, the resonator was brought to Jefferson Lab for surface processing and a first RF test. The first cooldown with the complete assembly was performed in the new vertical test stand at HZB. The results for a large grain niobium sample are presented.

AKBP 6.9 Di 15:45 BZ.08.06 (HS 1)

**High-Q cavity operation: Study on the thermoelectrically induced contribution to RF surface resistance** — •Julia-Marie Vogt, Oliver Kugeler, and Jens Knobloch — Helmholtz-Zentrum Berlin

We present a study concerning the operation of a superconducting RF cavity in horizontal testing with the focus on understanding the thermoelectrically induced contribution to the surface resistance. Starting a few years ago, we suggested a means of reducing the residual resistance by warming up a cavity after initial cooldown to about 20K and cooling it down again, a thermal cycle. In subsequent studies we demonstrated a manipulation of the residual resistance by more than a factor of 2. We postulated that thermocurrents during cooldown generate additinal trapped magnetic flux that impacts the cavity quality factor. Since serveral questions remained open, we present here a more extensive study including measurement of two additional passband modes of the 9-cell cavity (8/9 $\pi$ and 1/9 $\pi$) that confirms the effect. We also discuss simulations that substantiate the claim. While the layout of the cavity LHe tank system is cylindrically symmetric, we show that the temperature dependence of the material parameters result in a nonsymmetric current distribution. Hence a significant amount of magnetic flux can be generated at the RF surface resulting in an increased surface resistance.

AKBP 6.10 Di 16:00 BZ.08.06 (HS 1)

**Superconducting RF Cavity and Cryomodule Concept for Bessy-VSR** — •Andrew Burrill, Wolfgang Anders, Jens Knobloch, Axel Neumann, and Adolfo Velez — Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, DE

The next step in the evolution of the Bessy-II Storage ring at Helmholtz-Zentrum Berlin is perhaps the most ambitious to date. This entails the installation of higher harmonic Superconducting RF (SRF) cavities that will allow for variable pulse length operation, delivering short and long photon pulses to all users simultaneously, without a decrease in beam current when compared to standard Bessy-II operation. The name of this project is Bessy-VSR (Variable pulse length Storage Ring) and the approach to delivering these long and short pulses simultaneously is unique, requiring two new SRF cavity designs as well as a new cryomodule in which the cavities will be installed. The entire cavity and cryomodule design begins from a blank piece of paper and presents many significant technical challenges that must be addressed, all stemming from how to operate these new SRF cavities in the 300 mA recirculating electron beam of the Bessy-II storage ring. In this talk I will address the technical challenges that are encountered in the cavity and cryomodule design and the plans to overcome them.

## AKBP 7: PWA / TNSA II

Zeit: Dienstag 13:45–15:45 Raum: G.10.03 (HS 8)

AKBP 7.1 Di 13:45 G.10.03 (HS 8)

**Field-reversed bubble in deep plasma channels for high quality electron acceleration** — •Alexander Pukhov — Uni Düsseldorf

We study hollow plasma channels with smooth boundaries for laser-driven electron acceleration in the bubble regime. Contrary to the uniform plasma case, the laser forms no optical shock and no etching at the front. This increases the effective bubble phase velocity and energy gain. The longitudinal field has a plateau that allows for monoenergetic acceleration. We observe as low as $10^{-3}$ r.m.s. relative witness beam energy uncertainty in each cross-section and 0.3% total energy spread. By varying plasma density profile inside a deep channel, the bubble fields can be adjusted to balance the laser depletion and dephasing lengths. Bubble scaling laws for the deep channel are derived. Ultra-short pancake-like laser pulses lead to the highest energies of accelerated electrons per Joule of laser pulse energy.

AKBP 7.2 Di 14:00 G.10.03 (HS 8)

**Few-cycle optical probe-pulses: Diagnosing Laser Wakefield Accelerators** — •Daniel Ullmann[1], Matthew Schwab[2], Stephan Kuschel[1], Mark Yeung[1,3], Alexander Sävert[2], Matt Zepf[1,3], and Malte C. Kaluza[1,2] — [1]Helmholtz-Institut Jena, Friedrich-Schiller-Universität, 07743 Jena, Germany — [2]Institut für Optik und Quantenelektronik, Friedrich-Schiller-Universität, 07743 Jena, Germany — [3]Department of Physics and Astronomy, Queens University Belfast, BT7 1NN Belfast, United Kingdom

Several applications of a few-cycle optical probe-pulse (fc-probe pulses) in Laser Wakefield Acceleration (LWFA) experiments on the JETI 40 TW laser system in Jena will be described. These investigations are motivated by the need for high-resolution diagnostics of the wakefield to gain a deeper insight into the physics underlying the acceleration process and to benchmark numerical simulations which have so far been the only source for detailed information.

Various measurements using the fc-probe pulses were performed during a LWFA experimental campaign. Here, a gas-cell filled with a 95:5 Helium:Nitrogen mixture was used as the target material. Interferometric measurements of the electron plasma density were done and compared using both a Mach-Zehnder interferometer and a polychromatic wavefront sensor. Further measurements implementing the relationship between spectral bandwidth and temporal resolution of the fc-probe pulses were performed as an investigation into multi-frame, single-shot shadowgraphic techniques.

AKBP 7.3 Di 14:15 G.10.03 (HS 8)

**Synchronous Acceleration in the Optical Regime: Recent Results and Future Directions of Dielectric Laser Acceleration** — •Joshua McNeur[1], Jonas Hammer[1], Ang Li[1], Norbert Schönberger[1], Alexander Tafel[1], and Peter Hommelhoff[1,2] — [1]Department of Physics, Friedrich-Alexander-Universität Erlangen Nürnberg, Staudtstr. 1, D-91058 Erlangen, Germany — [2]Max Planck Institute of Quantum Optics, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany

Dielectric laser acceleration scales phase synchronous acceleration – proposed by Widerøe approximately 90 years ago [1] and successfully employed within multitudes of accelerator facilities – to the optical regime. Within the last year, acceleration has been demonstrated in this new regime on multiple fronts (at different electron energies, laser wavelengths and laser pulse energies) [2,3]. The theory [4] and recent demonstration of Dielectric Laser Acceleration of subrelativistic electrons is reviewed. Future directions of the FAU DLA project including proton acceleration, use of a 2 micron Th fiber laser, deflecting and focusing geometries and a laser-triggered electron source, are discussed.

1. Widerøe, R., Arch Electronik Übertragungstechnik 21 4 387
2. Peralta et al., 2013 Nature 503 91
3. Breuer and Hommelhoff, 2013 Phys. Rev. Lett. 111 134803
4. Breuer, McNeur and Hommelhoff, 2014 J. Phys. B: At. Mol. Opt.Phys. 47 234004

AKBP 7.4 Di 14:30 G.10.03 (HS 8)

**Pulsed high field magnets – An efficient way of shaping laser accelerated proton beams for application** — •Florian Kroll[1,2], Vincent Bagnoud[4,5], Abel Blazevic[4,5], Christian Brabetz[4], Simon Busold[4,5], Oliver Deppert[6], Diana Jahn[6], Leonhard Karsch[3], Stephan Kraft[1], Umar Masood[3], Markus Roth[6], Dennis Schumacher[4], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden - Rossendorf, 01328 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden, Germany — [3]OncoRay-National Center for Radiation Research in Oncology, TU Dresden, 01307 Dresden, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany — [5]Helmholtz Institut Jena, 07734 Jena, Germany — [6]Technische Universität Darmstadt, 64289 Darmstadt, Germany

Compact laser-driven proton accelerators are a potential alternative to complex, expensive conventional accelerators, enabeling unique beam

properties, like ultra-high pulse dose. Nevertheless, they still require substantial development in reliable beam generation and transport.

We present experimental studies on capture, shape and transport of laser and conventionally accelerated protons via pulsed high-field magnets. These magnets, common research tools in the fields of solid state physics, have been adapted to meet the demands of laser acceleration experiments.Our work distinctively shows that pulsed magnet technology makes laser acceleration more suitable for application and can facilitate compact and efficient accelerators, e.g. for material research as well as medical and biological purposes.

AKBP 7.5 Di 14:45 G.10.03 (HS 8)

**Gas density measurement for self-modulation experiments at PITZ** — •Gaurav Pathak[1] and Matthias Gross[2] — [1]Institut für Experimentalphysik, Universität Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Germany

Self-modulation (SM) of proton beams in a plasma has recently gained interest in the context of the PWFA experiment of the AWAKE collaboration which is in preparation at CERN. Instrumental for experiment is the SM of the proton beam via transverse wakefields in the plasma to generate bunchlets for resonant wave excitation and efficient acceleration. In turn, these generated wakefields dependent on the plasma density. A fundamental understanding of the underlying physics is vital, and hence an independent experiment has been set up at the beam line of the Photo Injector Test Facility at DESY, Zeuthen Site (PITZ), to study the SM of long electron beams in a plasma. This contribution presents experimental progress made for the gas density measurement, which later on, when subjected to an ArF laser radiation will create the required plasma. The Gas density measurement is crucial to optimize the beam and plasma parameters for the experiment. Knowledge of the gas density and hence the plasma density helps to deduce the key properties of the generated wakefields such as their magnitude and phase velocity, which both are of significant importance for the design of self-modulated plasma-based acceleration experiments.

AKBP 7.6 Di 15:00 G.10.03 (HS 8)

**Charakterisierung von Ionen aus laserinduziertem Plasma** — •Florian-Emanuel Brack[1,2], Josefine Metzkes[1,2], Stefan Kraft[1], Florian Kroll[1,2], Lieselotte Obst[1], Martin Rehwald[1,2], Hans-Peter Schlenvoigt[1], Philipp Sommer[1,2], Karl Zeil[1] und Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Bautzner Landstr. 400, 01328 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden, Germany

Durch die Fokussierung eines ultrakurzen und hochintensiven Laserpulses auf ein Festkörpertarget können Pulse von Protonen und anderen positiv geladenen Ionen erzeugt werden. Auf Basis des etablierten TNSA (target-normal sheath acceleration) Prozesses konnten am Helmholtz-Zentrum Dresden-Rossendorf mit dem 150 TW Ultrakurzpulslaser DRACO Protonenpulse mit Energien bis zu 20 MeV erzeugt und charakterisiert werden. Die Charakterisierung dieser Teilchenstrahlung erfordert die Identifizierung der Ionenspezies und die Bestimmung ihrer spektralen Verteilung möglichst nach jedem Puls, wofür standardmäßig Thomsonspektrometer verwendet werden.

In den letzten Jahren wurde das DRACO-Lasersystem bis zu einer Pulsleistung über 500 TW erweitert. Aufbauend auf dem bisherigen Spektrometerdesign wurde in dieser Arbeit ein kompaktes Spektrometer für einen höheren Energiebereich bis über 80 MeV entworfen. Besonders wichtig dabei ist die Identifizierung möglicher das Messergebnis verfälschender Sekundärstrahlungsquellen, die mit Hilfe von Monte-Carlo Simulation analysiert werden müssen.

AKBP 7.7 Di 15:15 G.10.03 (HS 8)

**Guiding of pulsed lasers in plasma waveguides created by a slow capillary discharge** — Maximilian Messmer[1,2], •Alexander Köhler[1,2], Jurjen Couperus[1], Axel Jochmann[1], Arie Irman[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

Laser Wakefield Acceleration (LWFA) has emerged as a promising concept for the next generation of high energy electron accelerators. To attain highest possible particle energies in this acceleration scheme, high intensity lasers must be focused over distances much greater than the Rayleigh length. Hence, laser guiding is necessary to counteract the diffraction induced divergence of the beam.

The guiding of pulsed lasers with intensities up to $2\times10^{16}$ W/cm$^2$ in a plasma waveguides of several centimeter length is shown. A plasma is created within a capillary via the concept of slow capillary discharge. Interferometry shows that the plasma channel has a refractive index profile suitable for laser guiding. Laser guiding capabilities of a pulsed Ti:Sa laser are evaluated. The results show a broad, easy to realize parameter window for pressure and time in which high transmission above 75% are achieved.

AKBP 7.8 Di 15:30 G.10.03 (HS 8)

**Concept for Continuous Gas Flow Operation of a LWFA-Target** — •Niels Matthias Delbos[1,2], Dariusz Kocon[1,2,3], Philipp Messner[1,2], Paul Pourmoussavi[1,2], Christian Markus Werle[1,2], Benno Zeitler[1,2], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]ELI Beamlines, 18221 Praha 8, Czech Republic

Stable operation of the plasma-target for Laser Wakefield Acceleration (LWFA) is a key element for reliable, accessible and reproducible experiments. Most LWFA experiments rely on targets, which are operated with short bursts of gas, as the vacuum system is not capable of handling higher gas loads. After each pulse of gas, the vacuum system needs a considerable amount of time to reduce the pressure to a low enough level for the next laser-shot, which is still the highest limiting constraint in electron shot-to-shot repetition rate of the whole accelerating system. In contrast to a pulsed gas operation, this talk will show a concept to be implemented at the LUX-Beam Line, operated by a collaboration of University of Hamburg and DESY, that allows for continuous flow operation of the target and thus highest electron repetition rates, only limited by the repetition rate of the laser. Furthermore, continuous gas flow operation mitigates possible error sources from pressure fluctuations inside the target and timing jitter between laser pulse and gas pulse. The concept features a differential pumping setup, specially designed for laser applications, as well as a gas supply system and an online pressure measurement inside the target.

## AKBP 8: Polarisation / EDM

Zeit: Dienstag 16:45–18:45 Raum: BZ.08.06 (HS 1)

AKBP 8.1 Di 16:45 BZ.08.06 (HS 1)

**Towards an RF-Wien-Filter for EDM Experiments in Storage Rings** — •Sebastian Mey and Ralf Gebel for the JEDI-Collaboration — Forschungszentrum Jülich GmbH, Jülich, Deutschland

The JEDI Collaboration (Jülich Electric Dipole Moment (EDM) Investigations) is developing tools for the measurement of permanent EDMs of charged, light hadrons in storage rings. While the standard model prediction for the EDM gives unobservably small magnitudes, a non-vanishing EDM can lead to a tiny build-up of vertical polarization in a beforehand horizontally polarized beam. This requires a spin tune modulation by an RF Wien-Filter *.

In the course of 2014, a prototype RF ExB-Dipole has been successfully commissioned and tested. To determine the characteristics of the device, the force of a radial magnetic field is canceled out by a vertical electric one to achieve a net Lorentz-Force compensation. In this configuration, it directly rotates the particles' polarization vector. We were able to verify that the device can be used to continuously flip the vertical polarization of a 970 MeV/c deuteron beam without exciting any coherent beam oscillations.

For a first EDM Experiment, the RF ExB-Dipole in Wien-Filter mode is going to be rotated by 90° around the beam axis and will be used for systematic investigations of sources for false EDM signals.

* William M. Morse, Yuri F. Orlov, and Yannis K. Semertzidis: Phys. Rev. ST Accel. Beams 16, 114001 (2013)

AKBP 8.2 Di 17:00 BZ.08.06 (HS 1)

**Status of the Darmstadt Photo-Cathode Activation, Test, and Cleaning with atomic Hydrogen (Photo-CATCH) test facil-**

**ity** — •Neeraj Kurichiyanil, Joachim Enders, Markus Wagner, Martin Espig, and Yuliya Fritzsche — Institut für Kernphysik

We report on the development status of a photocathode activation, test and cleaning using atomic hydrogen (Photo-CATCH) facility for semiconductor photocathodes used at the polarized electron source at the Darmstadt superconducting accelerator S-DALINAC. This standalone system consists of three ultra-high vacuum (UHV) chambers for atomic hydrogen cleaning, single- or multi-alkali negative electron affinity (NEA) activation and quantum efficiency (QE) as well as lifetime measurements and test of the activated cathodes at high-voltage, respectively. A beam-line featuring necessary characterization elements for a polarized electron beam of up to 60 keV will be available for operational QE and charge lifetime measurements and other possible experiments with spin-polarized electrons. The research is mainly aimed at improving vacuum conditions, cathode dark and charge lifetimes, exploring superior activation procedures and perfecting characterization techniques. Supported by DFG through SFB 634 and by the state of Hesse within the LOEWE centre HIC for FAIR.

AKBP 8.3 Di 17:15 BZ.08.06 (HS 1)

**Tracking Studies towards EDM Measurements at COSY** — •Marcel Rosenthal — Institut für Kernphysik, Forschungszentrum Jülich, Jülich, Deutschland — Physikalisches Institut III B, RWTH Aachen, Aachen, Deutschland

Electric Dipole Moments (EDMs) violate parity and time reversal symmetries. Therefore, direct measurements of charged particles' EDMs would be a strong hint for physics beyond the Standard Model. The JEDI collaboration investigates the feasibility of such measurements for protons, deuterons, and Helium3 in storage rings. Precursor studies are performed at the existing conventional Cooler Synchtrotron COSY in Jülich. A measurement time of about 1000 seconds is proposed. This requires a setup providing a long spin coherence time in the plane perpendicular to the invariant spin axis. During the measurement run, it is planned to use radiofrequency devices to create an EDM related signal. The contribution of imperfections, which could mimic such a signal, is explored in beam and spin dynamics simulations. The software framework COSY INFINITY is used to calculate transfer maps of the magnets and performs long term tracking studies. Recent efforts extend the code by the EDM contribution to spin motion and by the calculation of timedependent maps required for tracking in nonstatic fields. These enhancements are benchmarked with analytical predictions and with test measurements at COSY.

AKBP 8.4 Di 17:30 BZ.08.06 (HS 1)

**Simulationsstudien zur Compton-Polarimetrie an ELSA** — •Rebecca Koop und Wolfgang Hillert — ELSA, Physikalisches Institut der Universität Bonn

Für Doppelpolarisationsexperimente an der Elektronen-Stretcher-Anlage ELSA können polarisierte Elektronen auf eine Energie von bis zu 3.2GeV beschleunigt werden. Die Untersuchung auftretender depolarisierender Effekte soll durch ein Compton-Polarimeter erfolgen, welches sich momentan im Aufbau befindet. Der Konzeption des Polarimeters sind umfangreiche Simulationsstudien mit der Fortran-Software COMPTONSIM vorangegangen. Um Daten aus einer weiteren, unabhängigen numerische Methoden zu gewinnen, wurde der Compton-Streuprozess zudem unter Zuhilfenahme der Monte-Carlo Plattform Geant4 simuliert. Beide Methoden sollen vorgestellt und erhaltene Simulationsergebnisse verglichen werden.

AKBP 8.5 Di 17:45 BZ.08.06 (HS 1)

**Präzise Bestimmung von Beschleunigerparametern über Polarisationsmessungen** — •Jan Schmidt, Manuel Schedler, Jens-Peter Thiry und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Ein polarisierter Teilchenstrahl ist ein wertvolles Werkzeug zur Bestimmung verschiedener Parameter eines Kreisbeschleunigers. So können Polarisationsmessungen bei Energien nahe einer ganzzahligen depolarisierenden Resonanz genutzt werden um die Strahlenergie experimentell zu bestimmen. Dabei werden hohe Genauigkeiten erreicht, da die Resonanzen sehr schmal sind. Darauf aufbauend können auch andere Parameter mit Bezug zur Strahlenergie präzise gemessen werden. Beispielsweise wurde mit dieser Methode an der Beschleunigeranlage ELSA eine Messung des Momentum Compaction Faktors mit einer Genauigkeit von $10^{-4}$ durchgeführt.

AKBP 8.6 Di 18:00 BZ.08.06 (HS 1)

**Towards JEDI@COSY: systematic studies of spin dynamics in preparation for the EDM searches** — •Artem Saleev[1,3], Nikolay Nikolaev[2], and Frank Rathmann[1] for the JEDI-Collaboration — [1]Institut für Kernphysik, Forschungszentrum Jülich, Deutschland — [2]Landau Institute for Theoretical Physics, Chernogolovka, Russia — [3]Samara State University, Samara, Russia

According to BMT equation, the EDM spin rotation in a storage ring is proportional to the bending Lorentz force. The troubling issue is that the so-called imperfection, radial and longitudinal, B-fields abound in the ring. The MDM rotation in the imperfection fields emerges as a background to the expected much weaker EDM rotation. One of the most precise quantities measured presently at COSY at $10^{-10}$ level is a spin tune. To study the systematic effects from the imperfection fields at COSY we proposed the original method which makes use of the two static solenoids acting as artificial imperfections. The emerging spin tune mapping, the measurements of the spin tune with respect to the strength of the solenoid's field, gives an access to the ring imperfections, and has been successfully tested in the JEDI September 2014 run at COSY.

AKBP 8.7 Di 18:15 BZ.08.06 (HS 1)

**Lebenszeitmessung von Halbleiterkathoden** — •Valentin Schmitt — Institut für Kernphysik, Mainz, Deutschland

Um an rezirkulierenden Elektronenbeschleunigern wie MESA an internen Targets eine genügende Luminosität zu erzielen, sind Ströme von mehr als 1 mA erforderlich. Die hierfür eingesetzten Halbleiterkathoden erwärmen sich jedoch mit steigender Laserleistung bis zu dem Punkt, an dem sie zerstört werden. Um die Erwärmung der Kathode zu reduzieren, wird versucht eine deutlich verbesserte thermische Ableitung zu realiseren, ohne die Funktionalität der Photoelektronenquelle zu gefährden. Die Untersuchung der Auswirkungen auf die Lebenszeit der Photokathode sind Gegenstand dieser Arbeit.

AKBP 8.8 Di 18:30 BZ.08.06 (HS 1)

**Spin tune investigations for the storage ring EDM experiment at COSY** — •Stanislav Chekmenev for the JEDI-Collaboration — III. Physikalisches Institut, RWTH Aachen, 52056 Aachen, Germany

An experimental method which is aimed to find a permanent electric dipole moment (EDM) of a charged particle was proposed by JEDI (Juelich Electric Dipole moment Investigations) collaboration [1]. EDMs can be observed by their small influence on spin motion. The only possible way to perform a direct measurement is to use a storage ring.

For this purpose, it was decided to carry out the first precursor experiment at the Cooler Synchrotron (COSY). Since the EDM of a particle violates CP invariance it is expected to be tiny, treatment of all various sources of systematic errors should be done with a great level of precision. A recent achievement of the JEDI collaboration is the determination of the spin tune with a precision of $10^{-10}$ in a single accelerator cycle. In parallel with that achievement a new spin tracking code was developed. It is planned to use the spin tune measurement to benchmark the simulation code.

In the last data taking period, spin motion changes were generated by steerers and solenoids. Comparison of simulation results with data collected will be discussed.

[1] A. Lehrach, F. Rathmann, J. Pretz et al., "Search for Permanent Electric Dipole Moments at COSY, proposal #216.0, 2012, available: https://collaborations.fz-juelich.de

# AKBP 9: Beam Dynamics / Simulation I

Zeit: Dienstag 16:45–18:45 Raum: BZ.08.04 (HS 2)

AKBP 9.1 Di 16:45 BZ.08.04 (HS 2)

**Differences in tracking simulations of Insertion Devices** — •Julian Gethmann[1], Axel Bernhard[1], Edmund Hertle[1], Steffen Hillenbrand[1], Anke-Susanne Müller[1], Nigel Smale[1], and Konstantin Zolotarev[2] — [1]Karlsruhe Institute of Technology (KIT) — [2]Budker Institute of Nuclear Physics

Simulations of the effects of insertion devices on beam dynamics are necessary to design and run a synchrotron. To that end, different approaches and codes are used. In some cases the results of the different codes and the measurements don't agree very well. Limitations of different simulation software—namely elegant, AT, Opera3D—are discussed and edge cases are presented in this talk. The edge cases were investigated by comparing multiple simulation approaches and codes among themselves. In addition experimental data is acquired and taken as a reference to compare against the models. These experiments were performed with a superconducting wiggler with known magnetic field component at the ANKA synchrotron light source.

AKBP 9.2 Di 17:00 BZ.08.04 (HS 2)

**Computation of complex structures using the State Space Concatenation Scheme** — •Johann Heller, Thomas Flisgen, and Ursula van Rienen — Institut für Allgemeine Elektrotechnik, Rostock, Germany

For the design and operation of radio frequency (RF) structures for high energy physics, the knowledge of the electromagnetic fields inside such structures is of crucial importance. These fields are computed numerically by solving the curl-curl equation, derived from Maxwells equations. For large and complex structures, due to the huge size of the problem the field patterns can not be computed on standard workstation computers in reasonable time. Actually, for such type of problems, sophisticated parallel codes are employed on high performance computers (HPC). Being very expensive, HPC platforms are rather rare and have a very limited access. Therefore, we recently proposed a concatenation scheme, denoted as State Space Concatenations (SSC), which is able to compute complex RF structures on standard workstations. In this contribution, we will present very promising results of performance studies related to FLASH and the European XFEL.

AKBP 9.3 Di 17:15 BZ.08.04 (HS 2)

**Start-to-End Simulations for a 100 $\mu$m SASE FEL at PITZ** — •Prach Boonpornprasert[1], Mahmoud Bakr[1,3], Mikhail Krasilnikov[1], Barbara Marchetti[2], and Frank Stephan[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Zeuthen, Germany — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [3]Physics Department, Assiut University, Assiut, Egypt

High brightness electron sources for modern linac-based Free-Electron Lasers (FELs) have been characterized and optimized at the Photo Injector Test facility at DESY, Zeuthen site (PITZ). Since the time structure of the electron bunches at PITZ is identical to that at the European XFEL, the PITZ accelerator is being considered as a proper machine for the development of an IR/THz source prototype for pump and probe experiments planned at the European XFEL. Furthermore the development of such a THz radiation source at PITZ will allow also to test at this location new IR/THz radiation diagnostics devices and to develop an experimental setup for the characterization of the THz radiation, which can be used in parallel for the longitudinal diagnostic of the electron beam properties. For this reason simulation studies concerning the radiation generation using high gain FELs and Coherent Transition Radiation (CTR) have been started. In this work, start-to-end simulations for a Self Amplified Spontaneous Emission (SASE) FEL at a wavelength of 100 $\mu$m have been performed. The code ASTRA has been used to track the electron beams. The SASE FEL radiation is calculated by using the GENESIS1.3 code. The results of these studies will be presented and discussed in this contribution.

AKBP 9.4 Di 17:30 BZ.08.04 (HS 2)

**Beam dynamics simulations for the S-DALINAC*** — •Jonas Pforr, Michaela Arnold, Florian Hug, Lars Jürgensen, Thorsten Kürzeder, and Norbert Pietralla — Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany

The superconducting electron accelerator S-DALINAC is a twofold recirculating linear accelerator located at TU Darmstadt. However, the design energy of 130 MeV could not be reached, yet, due to limitations in the cooling power.

It is planned to build a third recirculation in order to increase the possible beam energy and stability. In this process, simulations of the beam dynamics had to be done.

In general, in recirculating LINACs the beam current is limited by beam-breakup (BBU). BBU occurs when higher order modes (HOMs) in the cavities cause a transverse displacement of the beam, which can after the recirculation amplify the higher order modes. This can lead to a growth of the HOMs and the beam displacement until the beam is lost. In order to test different strategies to overcome BBU limits, we will integrate skew quadrupoles and sextupoles in the lattice.

In this talk we will present the beam dynamics simulations with these new magnets.

*Work supported by BMBF through 05K13RDA

AKBP 9.5 Di 17:45 BZ.08.04 (HS 2)

**Space-charge matching of the transverse phase space at PITZ** — •Georgios Kourkafas[1], Alexey V. Bondarenko[2], Mikhail Krasilnikov[1], Barbara Marchetti[1], and Aleksandr N. Matveenko[2] — [1]DESY, Zeuthen, Germany — [2]HZB, Berlin, Germany

Various diagnostics, applications and experiments at PITZ require specific transverse beam parameters at certain parts of the beamline. The standard matching techniques which do not include the effect of space charge are proven to be unsuccessful due to the moderate energy and high charge density of the generated bunches. On the other hand, codes which accurately simulate the self fields are too slow to provide results quick enough for on-line application.

A compromise is found when considering only the linear space-charge forces in the beam dynamics. For stationary beams in dense and periodic lattices, the smooth-approximation theory can be used to include the space-charge effect in matching codes like MAD. For the general case, codes like SC (developed in HZB) can be used to solve and iteratively optimize the beam envelope equation for each longitudinal slice of the bunch, taking into account the correlated emittance growth. The performance of both approaches is demonstrated and evaluated using the ASTRA software for the matching requirements of the phase space tomography at PITZ.

AKBP 9.6 Di 18:00 BZ.08.04 (HS 2)

**Status of the FCC-ee lattice design and chromaticity correction scheme** — •Bastian Härer[1,2], Bernhard J. Holzer[1], and Anke-Susanne Müller[2,3,4] — [1]CERN, Geneva — [2]LAS, KIT, Karlsruhe — [3]ANKE, KIT, Karlsruhe — [4]IPS, KIT, Karlsruhe

FCC-ee is a new large-scale electron positron collider with 100 km circumference designed within the Future Circular Collider Study (FCC) at CERN. It is supposed to run at four different beam energies in the range of 45-175 GeV imposing different boundary conditions on the design. At high energies operation is limited by beamstrahlung and at low energies by the beam-beam threshold. To limit the impact of the respective effect different beam emittances need to be obtained by modifying the arc lattice. Furthermore the very ambitious interaction region requirements create very high chromaticity that has to be corrected with a sophisticated sextupole scheme. This talk will present the status of the lattice design and the chromaticity correction scheme.

AKBP 9.7 Di 18:15 BZ.08.04 (HS 2)

**Ion optical simulations of large-aperture separators including realistic magnet field models** — •Erika Kazantseva — TEMF, Schlossgartenstr.8, Technische Universität Darmstadt

The main goal of this work is to develop an effective approach to fast and accurate ion optical simulations of an ensemble of large-aperture magnets such as in-flight fragment separators like the FRS at GSI and the future Super-FRS at FAIR. For accurate simulations capable of predicting the behavior of real particles it is necessary to have an ion-optical model in which a detailed and realistic description of the magnetic fields is implemented.

There are different approaches to make the ion-optical model more realistic, for example, the use of analytical functions to describe the fringe fields, for example, Enge-functions. One should also consider representing the effect of the fringe fields via effective fringe field maps

or fringe field integrals. Large aperture magnetic elements and short distances between them could make simple models invalid. Thus the influence of the neighboring magnet yokes has to be taken into account.

We will also investigate the generation of transfer maps of arbitrary order from the magnetic fields of given elements. In this case, it is possible to relate computationally the final coordinates to the initial ones by the numerical integration of the equations of motion.

AKBP 9.8 Di 18:30 BZ.08.04 (HS 2)

**Beam Extraction Dynamics at the Space-Charge-Limit of the High Brightness E-XFEL Electron Source at DESY-PITZ** — •Ye Chen, Erion Gjonaj, and Thomas Weiland — TEMF, Technische Universitaet Darmstadt, Schlossgartenstrasse 8, 64289 Darmstadt, Germany

The physics of the photoemission, as one of the key issues for successful operation of linac based free-electron lasers like the European X-ray Free Electron Laser (E-XFEL) and the Free-electron Laser in Hamburg (FLASH), is playing an increasingly important role in the high brightness DESY-PITZ electron source.

We study photoemission physics and discuss full three-dimensional numerical modeling of the electron bunch emission. The beam extraction dynamics at the photocathode has been investigated through the 3D fully electromagnetic (EM) Particle-in-Cell (PIC) solver of CST Particle Studio under the assumption of the photoemission source operating at or close to its space charge limit. PIC simulation results have shown good agreements with measurements on total emitted bunch charge for distinct experimental parameters.

Further comparisons showed a general failure for the conventional Poisson solver based tracking algorithm to correctly predict the beam dynamics at the space charge limit. It is furthermore found, that fully EM PIC simulations are also consistent with a simple emission model based on the multidimensional Child-Langmuir law.

## AKBP 10: Beam and Accelerator Control

Zeit: Mittwoch 16:45–19:00 Raum: BZ.08.06 (HS 1)

AKBP 10.1 Mi 16:45 BZ.08.06 (HS 1)

**Inbetriebnahme eines SPS-basierten Personen- und Maschinensicherheitssystems am S-DALINAC*** — Michaela Arnold, Thore Bahlo, •Jonny Birkhan, Jens Conrad, Manfred Hess, Florian Hug, Peter von Neumann-Cosel und Norbert Pietralla — Institut für Kernphysik, TU Darmstadt

Das Personen- und Maschinensicherheitssystem am supraleitenden Darmstädter Elektronenlinearbeschleuniger S-DALINAC basierte bis vor Kurzem auf hart verdrahteter Relais-Schaltungstechnik. Die technische Weiterentwicklung des Beschleunigers und der Wunsch nach höheren Sicherheitsstandards machten es notwendig, auch die Sicherheitssysteme zu erneuern. Das alte System ist daher durch ein speicherprogrammierbares ersetzt worden. Dieses überwacht zum Beispiel das Absuchen der Anlage, wie es unmittelbar vor dem Strahlbetrieb nötig ist, um die Personensicherheit zu gewährleisten. Ebenso erlaubt es eine umfassende Überwachung und komfortable Steuerung aller sicherheitsrelevanten Ventile in der Strahlführung des Beschleunigers. Die Steuereinheit des Systems lässt sich kompakt aufbauen und ist leicht wartbar. Ihre benutzerfreundliche Oberfläche erleichtert die zentrale Bedienung erheblich. Die technische Realisierung des neuen Systems und erste Betriebserfahrungen sollen in diesem Vortrag vorgestellt werden.

*Gefördert durch die DFG im Rahmen des SFB 634.

AKBP 10.2 Mi 17:00 BZ.08.06 (HS 1)

**Entwicklung eines Timing-Systems zur Single-Bunch-Akkumulation an ELSA** — •Dennis Proft und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

An der Elektronen-Stretcher-Anlage ELSA wird derzeit ein Intensitätsupgrade von 20 mA auf 200 mA durchgeführt. Der maximal mögliche gespeicherte Strom ist allerdings durch Single- und Multibunch-Strahlinstabilitäten begrenzt. Um diese unabhängig voneinander analysieren zu können ist die Erzeugung einer frei konfigurierbaren Füllstruktur im Speicherring erforderlich.

Diese kann bei den gewünschten Intensitäten nur durch Akkumulation mehrerer Singlebunch-Injektionsschüsse aus dem Vorbeschleuniger erzeugt werden. Das bestehende Timing-System ist dazu nicht geeignet.

Das in diesem Rahmen neu entwickelte FPGA-basierte Timing-System wird in diesem Vortrag zusammen mit ersten Testergebnissen vorgestellt.

AKBP 10.3 Mi 17:15 BZ.08.06 (HS 1)

**Automated adjustment of the electron beam line of the 2 MeV Electron Cooler at COSY.** — •Arthur Halama and Vsevolod Kamerdzhiev — Forschungszentrum Jülich, Institut für Kernphysik

The 2 MeV electron cooler has an energy range of 25 keV to 2 MeV and is fully magnetized. These particularities and the transport line's geometry proved manual beam line adjustments to be impractical, which led to the request of an automated adjustment. The fundamentals of electron cooling will be presented. Main difficulties of beam adjustments will be touched upon. The latest developments of model-based adjustment methods for the 2 MeV Cooler will be presented supported by experimental results from cooler operations. Emphasis lies on compensation of heating effects, beam orbit adjustment, and achieving acceptable collector efficiencies.

AKBP 10.4 Mi 17:30 BZ.08.06 (HS 1)

**Entwicklung einer mikrocontrollerbasierten Ansteuerelektronik für die Netzgeräte der ELSA-Hauptmagnete** — •Thomas Perlitius und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

An der Elektron-Stretcher-Anlage ELSA werden Elektronen mit einer Energierampe von 6 GeV/s beschleunigt. Um hierbei die korrekten Energie- und Arbeitspunktwerte einzuhalten und somit Strahlverlust zu verhindern, ergeben sich hohe Anforderungen an die Netzgeräte der Hauptmagnete und deren Ansteuerung.

Die bestehende, 30 Jahre alte Ansteuerelektronik der Netzgeräte soll ersetzt und hierbei vor allem die Genauigkeit der Analogwertverarbeitung verbessert werden.

Hierzu wurde eine mikrocontrollerbasierte Schaltung entwickelt, welche sich in zwei Teile gliedert. Der Echtzeitteil gibt Arbiträr-Rampen-Verläufe über einen DAC auf bis zu vier Kanälen aus und digitalisiert die Istwerte. Der Kommunikationsteil verfügt über ein Ethernet-Interface und ist für zeitunkritische Steueraufgaben zuständig. Durch das flexible Design lässt sich die Ansteuerelektronik auch für andere Typen von Netzgeräte, wie z.B. den der Korrektormagnete nutzen.

Der Vortrag gibt einen Überblick über die wesentlichen Eigenschaften der neu entwickelten Schaltung und der zu deren Realisierung angewendeten Hardware- und Software-Konzepte.

AKBP 10.5 Mi 17:45 BZ.08.06 (HS 1)

**Strahlenschutz an der neuen externen Strahlführung an ELSA** — •Nikolas Heurich, Philipp Hänisch, Frank Frommberger und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Am Elektronenbeschleuniger ELSA ist momentan eine neue externe Strahlführung im Aufbau, deren Aufgabe die Lieferung eines primären Elektronenstrahls für Detektortests ist.

Das mit Hilfe des Monte-Carlo-Simulationsprogramms *Fluka* entworfene Strahlenschutzkonzept für den gesamten Bereich der neuen Strahlführung ist zum größten Teil auch baulich umgesetzt.

Zur Vernichtung und gleichzeitigen Strommessung des Elektronenstrahls hinter den Detektorkomponenten wird ein Faraday-Cup, bestehend aus abgereichertem Uran, eingesetzt. Dieser Aufbau kann durch den intensiven Elektronenstrahl und entstehende Neutronen aktiviert werden. Mit *Fluka* wurde simuliert, inwieweit eine Aktivierung erfolgt, und über Zerfallsrechnungen abgeschätzt, welche Restaktivität nach gewissen Zeiten noch zu erwarten ist.

Neben der Präsentation der Ergebnisse der Simulationen wird auch über Fortschritte am Bau der Strahlführung berichtet.

AKBP 10.6 Mi 18:00 BZ.08.06 (HS 1)

**Monte-Carlo simulations at the Mainzer Mikrotron with FLUKA** — •Steffen Heidrich — B2, Institut für Kernphysik,

Johann-Joachim-Becher-Weg 45, 55128 Mainz, Germany

FLUKA is a well benchmarked high energy particle simulation software based on the Monte-Carlo principle and developed by CERN. It is widely used to evaluate radiation protection problems and to simulate particle scattering experiments. Based on the results of a FLUKA simulation and an accordingly performed experiment, the radiation effects of a total beam loss in a deflecting magnet of the Mainzer Mikrotron are discussed. Furthermore, a comparison of the results is used to find the needed thickness of a planned radiation protection wall towards the construction site of the new MESA accelerator and to evaluate the errors within the simulation model.

AKBP 10.7 Mi 18:15 BZ.08.06 (HS 1)

**Vermessung eines supraleitenden Solenoids** — •Tom Beutler, Jens Völker, Thorsten Kamps und Andreas Jankowiak — Helmholtz-Zentrum, Berlin, Berlin

Für den zukünftigen Energy Recovery Linac bERLinPro wird ein supraleitender Hochfrequenz (SHF) Photoinjektor als Elektronenquelle verwendet. Ein ebenfalls supraleitender Solenoid fokussiert den extrahierten Elektronenstrahl und dient somit der Emittanzkompensation für die weitere Beschleunigung. Fehlstellungen des Magneten und Asymmetrien des Solenoidfeldes führen hingegen zu erheblichen Emittanzvergrößerungen. Durch eine kryotaugliche Verfahreinheit können zwar Fehlstellungen korrigiert werden, jedoch müssen Feldfehler aufwendig durch Korrekturmagneten kompensiert werden. Um mögliche Feldfehler zu untersuchen, wurde das Magnetfeld des Solenoids mit Hilfe eines Antikryostaten vermessen. In diesem kann der Solenoid auf 4°K gekühlt werden, während die Messsonden weiterhin bei Raumtemperatur arbeiten können. Neben der Aufnahme einer 3-D Feldmappe, wurden höhere Feldordnungen und Hystereeffekte untersucht. In dieser Arbeit werden Aufbau und Ergebnisse dieser Messung präsentiert.

AKBP 10.8 Mi 18:30 BZ.08.06 (HS 1)

**Compensation of Steerer Crosstalk between FLASH1 and FLASH2** — •Florian Müller[1], Mathias Vogt[2], and Johann Zemella[2] — [1]Universität Hamburg, Hamburg, Germany — [2]DESY, Hamburg, Germany

At the Free-Electron Laser in Hamburg (FLASH) a new beamline has been commissioned. The two beamlines are now driven by the same electron source and use the same accelerator modules. A septum has been installed downstream of the accelerator modules to kick the electron bunches used for FLASH2 into the new beam line, while the bunches for FLASH1 remain undisturbed.

In the extraction area of FLASH2, there are multiple steering coils used to deflect the beam. Unfortunately, the steering coils for each beam line are close to the other and leakage fields introduce an unwanted additional kick to the electrons, which can destroy the lasing of either FLASH1 or FLASH2.

This talk presents measurements and methods of compensating this steerer crosstalk.

AKBP 10.9 Mi 18:45 BZ.08.06 (HS 1)

**The Heidelberg Heavy Ion Beam Gantry Experience** — •Michael Galonska, Stefan Scheloske, Rainer Cee, Klaus Höppner, Jörg Mosthaf, Andreas Peters, and Thomas Haberer — Heidelberger Ionenstrahl-Therapiezentrum, Heidelberg, Germany

The Heidelberg Ion Beam Therapy Facility (HIT) is the first dedicated proton and carbon cancer therapy facility in Europe. It uses full 3D intensity controlled raster scanning dose delivery method of pencil beams with ion beams of 48 - 430 MeV/u provided by a linac-synchrotron-system. The patient treatment at the first 360° raster scanning heavy ion gantry beam line at HIT started in October 2012 using carbon ion and proton beams, but with a restriction on a few selected angles in the initial phase. Since then the variety of available gantry angles for patient treatment has been extended for the carbon and proton beams. The commissioning steps have been accomplished in parallel to clinical operation. This contribution outlines some activities including ion optical modifications which minimize the coupling of the transversal beam properties under gantry rotation, and some control system aspects such as the sophisticated device control data handling routines. As the key challenge these modifications have been implemented while preserving the validated accelerator settings and the clinically approved beam quality.

## AKBP 11: PWA / TNSA III

Zeit: Mittwoch 16:45–18:00 Raum: F.10.01 (HS 4)

AKBP 11.1 Mi 16:45 F.10.01 (HS 4)

**Adiabatic Matching at the External Injection Experiment at REGAE** — •Irene Dornmair[1,2], Klaus Floettmann[3], Florian Grüner[1,2], Andreas R. Maier[1,2], and Benno Zeitler[1,2] — [1]Universität Hamburg, Institut für Experimentalphysik, 22761 Hamburg — [2]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [3]DESY, 22607 Hamburg

Laser Plasma Accelerators provide very high accelerating gradients, but also strong focusing fields. Within the LAOLA Collaboration, the University of Hamburg and DESY work closely together to combine university research in the field of laser-plasma acceleration with the expertise of a large and well-established accelerator facility.

Externally injecting an electron bunch from a conventional gun into a laser driven plasma wakefield is a promising path towards increased control over the injected electron phase space. To prevent emittance growth, the beam size needs to be matched to the focusing forces present in the wakefield. This matched beam size is very small, which requires very strong focusing optics, both for injection and for beam capturing after the plasma. We show how the requirements on the beam optics can be relaxed by introducing tapered matching sections in the plasma target where the focusing is slowly, thus adiabatically, changed.

AKBP 11.2 Mi 17:00 F.10.01 (HS 4)

**Laser-Plasma Acceleration in Hamburg** — •Andreas R. Maier[1,2], Niels Delbos[1,2], Irene Dornmair[1,2], Klaus Flöttmann[3], Vaclav Hanus[1,2,4], Spencer Jolly[1,2,4], Byunghoon Kim[1,2,4], Manuel Kirchen[1,2], Vincent Leroux[1,2,4], Philipp Messner[1,2], Nils Plambeck[1,2], Matthias Schnepp[1,2], Dominik Trosien[1,2], Paul Andreas Walker[1,2], Christian Werle[1,2], Paul Winkler[1,2], Benno Zeitler[1,2], and Florian Grüner[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]DESY, 22607 Hamburg — [4]ELI Beamlines, 18221 Praha 8, Czech Republic

The stability and reproducibility of todays laser-plasma generated electron beams is not comparable to the performance of conventional machines. Within the LAOLA Collaboration, the University of Hamburg and DESY work closely together to combine university research with the expertise of a large and well-established accelerator facility. On behalf of the LAOLA collaboration, we will discuss the experimental programm driven by the recently commissioned 200 TW laser ANGUS. It drives two beamlines, REGAE and LUX, to study external injection of electrons from a conventional gun into a plasma stage, as well as plasma-driven undulator radiation. We provide an overview on the commissioning of the facility and its experiments. As an outlook, we will discuss the experimental strategies in Hamburg towards a first proof-of-principle FEL experiment using plasma-driven electron beams available today.

AKBP 11.3 Mi 17:15 F.10.01 (HS 4)

**GPGPU Powered 3D Simulations of Micro Droplets in Laser-Ion Acceleration** — •Axel Huebl[1,2], Thomas Kluge[1], Peter Hilz[3], and Michael Bussmann[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden — [3]Ludwigs-Maximilians-Universität München

We present current large scale, full 3D particle-in-cell simulations and studies of laser-ion acceleration utilizing highly over-dense, mass and volume limited micro targets with PIConGPU. Powered by thousands of GPGPUs on Oak Ridge's supercomputer Titan, we show early results such as the influence of the target to laser spot size and the arising acceleration regimes thereof.

The simulations show the capability of PIConGPU, a highly scalable particle-in-cell code for many-core compute architectures that allows

for in-situ, real time visualization and ultra-fast computation of large systems.

AKBP 11.4 Mi 17:30 F.10.01 (HS 4)

**Radiation as synthetic spectral diagnostics in the particle-in-cell code PIConGPU** — •Richard Pausch[1,2], Alexander Debus[1], Axel Huebl[1,2], Klaus Steiniger[1,2], René Widera[1], Michael Bussmann[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

We present in-situ computation of relativistic radiation in the particle-in-cell code PIConGPU that can give both qualitative and quantitative agreement with analytical models and thus has predictive capabilities. This new kind of synthetic spectral diagnostics can be used to infer plasma dynamics with high spatial and temporal resolution.

Our method is based on the far field approximation of Liénard-Wiechert potential. Its direct integration with the highly-scalable GPU framework of PIConGPU allows computing the spectrally and angularly resolved radiation for thousands of frequencies, ranging from infrared to x-rays, hundreds of detector positions and billions of particles efficiently. Recent updates allow studying polarization and improve time resolution thus extending the range of applications.

These capabilities are demonstrated using recent simulations of laser wakefield acceleration (LWFA), high harmonics generation during target normal sheath acceleration (TNSA) and the Kelvin-Helmholtz instability (KHI).

AKBP 11.5 Mi 17:45 F.10.01 (HS 4)

**Bright Subcycle Extreme Ultraviolet Bursts from a Single Dense Relativistic Electron Sheet** — •wenjun ma[1], jianhui bin[1,2], hongyong wang[2,3], mark yeung[4,5], christian kreuzer[1], peta foster[4,6], brendan dromey[4], xueqing yan[3], juergen meyer-ter-Vehn[2], matthew zepf[4,5], and joerg schreiber[1,2] — [1]Fakultät für Physik, Ludwig-Maximilians-University, Garching, Germany — [2]Max-Planck-Institute of Quantum Optics, Garching, Germany — [3]State Key Laboratory of Nuclear Physics and Technology & Center of Applied Physics and Technology, Peking University, Beijing, China — [4]Department of Physics and Astronomy, Queen's University Belfast, Belfast, United Kingdom — [5]Helmholtz Institute Jena, Jena, Germany — [6]Central Laser Facility, STFC Rutherford Appleton Laboratory, Chilton, United Kingdom

Relativistic electrons are prodigious sources of photons. Beyond classical accelerators, ultra-intense laser interactions are of particular interest as they allow the coherent motion of relativistic electrons to be controlled and exploited as sources of radiation. Here we report that bright extreme ultraviolet (XUV) radiation was observed when double foil targets separated by a low density plasma were irradiated by a PW-class laser. Simulations show that a dense sheet of relativistic electrons is formed during the interaction of the laser with the tenuous plasma between the two foils. The coherent motion of the electron sheet as it transits the second foil results in a subcycle XUV pulse, consistent with our experimental observations.

# AKBP 12: Beam Diagnosis

Zeit: Donnerstag 13:45–16:15 Raum: BZ.08.06 (HS 1)

AKBP 12.1 Do 13:45 BZ.08.06 (HS 1)

**First Tests of the New LHC K-Modulation Tool in the SPS** — •Maria Kuhn — CERN, Geneva, Switzerland — Hamburg University, Hamburg, Germany

Several measurement techniques for optics functions have been developed for the LHC. This presentation discusses the first results with a new k-modulation measurement tool. A fully automatic and online measurement system has been developed for the LHC. It takes constraints of various systems such as tune measurement precision and powering limits of the LHC superconducting circuits into account. K-modulation with sinusoidal excitation will also be possible. First tests of the new application in the SPS will be presented and an outlook on the achievable beta function accuracy will be given.

AKBP 12.2 Do 14:00 BZ.08.06 (HS 1)

**Visible Light Diagnostics at the ANKA Storage Ring** — •Benjamin Kehrer, Edmund Hertle, Nicole Hiller, Michael Holz, Anke-Susanne Müller, Patrik Schönfeldt, and Paul Schütze — Karlsruhe Institute of Technology, Karlsruhe, Germany

Synchrotron radiation in the visible light range is a versatile diagnostics tool for accelerator studies. At the ANKA storage ring of the Karlsruhe Institute of Technology (KIT), we have a dedicated visible light diagnostics beamline and two additional beam ports close to the radiation's source point.The visible light diagnostics beamline hosts a time-correlated single-photon-counting unit to measure the bunch filling pattern and a streak camera for longitudinal diagnostics. Recently, the beamline has been extended with a fast-gated intensified camera to study transverse instabilities. The synchrotron light monitor ports were previously used for direct source imaging. Due to the diffraction limit the vertical beam size could not be resolved. One of the two ports has recently been equipped with a double-slit to allow for interferometric measurements of the vertical beam size. An overview of the different setup modifications will be given and first results will be presented.

AKBP 12.3 Do 14:15 BZ.08.06 (HS 1)

**A Fast Gated Intensified Camera Setup for Transversal Beam Diagnostics at the ANKA Storage Ring** — •Paul Schütze[1], Edmund Hertle[2], Nicole Hiller[2], Benjamin Kehrer[1], Anke-Susanne Müller[1,2,3], and Patrik Schönfeldt[2] — [1]LAS, KIT, Karlsruhe, Germany — [2]IPS, KIT, Karlsruhe, Germany — [3]ANKA, KIT, Karlsruhe, Germany

ANKA, the synchrotron light source at KIT, can be operated in different modes, including the low-alpha operation with bunch lengths compressed to a few picoseconds. In this mode coherent synchrotron radiation (CSR) is emitted leading to beam instabilities. For gaining further insight into those processes, a setup based on a fast gated intensified camera was installed recently at the visible light diagnostics beamline of the ANKA storage ring. The experimental layout consists of an optical setup, which magnifies the image of the beam in the horizontal and demagnifies it in the vertical plane to obtain a projection of the horizontal beam shape, the camera itself and a fast scanning galvanometric mirror that sweeps the image across the sensor. This allows the tracking of the horizontal bunch size and position over many turns. Here we present the setup, simulations and first tests of the fast gated intensified camera.

AKBP 12.4 Do 14:30 BZ.08.06 (HS 1)

**Development of new Beam Position Monitors at COSY** — •Fabian Hinder for the JEDI-Collaboration — Institut für Kernphysik IKP-4, Forschungszentrum Jülich, Deutschland — III. Physikalisches Institut B, RWTH Aachen, Deutschland

Electric Dipole Moments (EDMs) violate parity and time reversal symmetries. Assuming the CPT-theorem is valid, this leads to CP violation, which is needed to explain the matter over antimatter dominance in the Universe. Thus, a non-zero EDM is a hint to physics beyond the Standard Model. The JEDI (Jülich Electric Dipole moment Investigations) collaboration has started investigations of a direct EDM measurement of charged hadrons at a storage ring. To measure a tiny EDM signal with high precision, systematic effects have to be controlled to the same level. One way of controlling systematic effects is the use of high precision Beam Position Monitors (BPMs). The idea is based on the usage of magnetic pick-ups in a Rogowski coil configuration. The main advantage of the coil design is the response to the particle bunch frequency and the compactness of the coil itself. In a first step the BPMs will be benchmarked in a laboratory test system. In the next step the calibrated BPMs will be installed and tested at the conventional storage ring COSY (Cooler Cyclotron). In a further step an extension of the BPMs to measure the relative posit ion of two counter rotating particle beams is proposed. At the conference first results and the planned developments will be presented.

AKBP 12.5 Do 14:45 BZ.08.06 (HS 1)

**Beam Induced Fluorescence (BIF) monitor development** — •Yulia Shutko[1], Dieter Hoffmann[1], Peter Forck[2,3], Beata Walasek-Höhne[2], Thomas Sieber[2], and Serban Udrea[3] — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Goethe-Universität Frankfurt am Main, Frankfurt am Main, Germany

The development of non-interceptive beam diagnostic methods is of high relevance for the future FAIR accelerator facilities to be built at the GSI. One of these methods is based on Beam Induced Fluorescence (BIF), which is under development at the GSI accelerators. BIF based monitors are already in operation at the GSI's LINAC since some years. Further BIF-monitor development is required for applying this method to high energy beams, as those to be delivered by FAIR's SIS-100 synchrotron. For this purpose beam profile and spectroscopic investigations with Nitrogen and Argon in a pressure range from 1e-3 to 1 mbar with heavy ion beams at energies between 100 and 900 MeV/u have been performed. The results concerning image reproduction and emission spectra will be presented in this contribution.

AKBP 12.6 Do 15:00 BZ.08.06 (HS 1)

**Microwave Radiation Studies with a LNB Detector System** — •Matthias Martin, Marcel Schuh, Johannes Steinmann, and Anke-Susanne Müller — LAS, KIT, Karlsruhe

At ANKA, the synchrotron radiation facility at KIT (Karlsruhe Institue of Technology), beam studies with an LNB (Low Noise Block) have been carried out. This detector system is normally used to receive satellite TV signals and allows polarization dependent measurements of microwave radiation. We report on beam experiments with this inexpensive detector. Special focus is laid on the signal's polarization and dependencies on bunch length.

AKBP 12.7 Do 15:15 BZ.08.06 (HS 1)

**Preserving 3D beam information in one streak camera measurement*** — •Michael Switka and Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

At the pulse stretcher ring ELSA, the imaging of fast beam dynamics is performed by a streak camera system. The design of its optical beamline has been optimized to match the machine characteristics and allows simultaneous observation of all three beam dimensions at various time scales down to the picosecond regime. The streak camera naturally displays longitudinal information at the expense of one transverse dimension. Hence, in order to preserve 3D beam dynamics in one single shot measurement, the beamline couples two images onto the streak camera slit of which one is perpendicularly orientated to its double. This technique is used in slow sweep and synchroscan camera operation. Characteristics and exemplary measurements, demonstrating the capabilities and limits of this technique, are presented. *Work funded by the DFG within SFB TRR16

AKBP 12.8 Do 15:30 BZ.08.06 (HS 1)

**Considerations for a Wakefield-Optimized Near-Field EO Setup at the ANKA Storage Ring** — •Patrik Schönfeldt[1], Nicole Hiller[1], Benjamin Kehrer[2], and Anke-Susanne Müller[1,2] — [1]IPS, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

ANKA, the synchrotron light source of the Karlsruhe Institute of Technology (KIT), is the first storage ring with a near-field single-shot electro-optical (EO) bunch profile monitor inside its vacuum chamber. Using the method of electro-optical spectral decoding (EOSD), the current setup made it possible to study longitudinal beam dynamics (e.g. microbunching) occurring during ANKA's low-alpha-operation with sub-ps resolution (granularity). However, the setup induces strong wake-fields spanning the distance between consecutive bunches which cause heat load to the in-vacuum setup for high beam currents. This heat load in turn leads to a laser misalignment thus preventing measurements during multi-bunch operation. Fortunately, the EOSD setup also allows us to directly study these wake-fields so simulation results can be compared to measurement data. This talk reviews possible changes of the setup's geometry with respect to a reduction of the wake-field effects.

AKBP 12.9 Do 15:45 BZ.08.06 (HS 1)

**Aufbau eines optischen Messsystems zur Untersuchung von Halo- und Dunkelstrom in GunLab** — •Jens Völker, Thorsten Kamps und Andreas Jankowiak — Helmholtz Zentrum Berlin

GunLab ist eine kompakte Test Beamline zur detaillierten Untersuchung des vollständigen Phasenraums von Raumladungsdominierten Elektronenstrahlen. Dadurch sollen vor allem supraleitende Hochfrequenz (SHF) Photoinjektoren charakterisiert werden. Das Design und die Messsysteme von GunLab wurden optimiert um für einen großen Parameterbereich auf unterschiedlichen Wegen die Phasenraumverteilungen der Elektronenpakete zu untersuchen. Somit können verschiedene Messmethoden gegeneinander getestet werden. Eines dieser Systeme dient der optischen Messung der transversalen Ladungsverteilung mit einem hohen Dynamikbereich um Halo- und Dunkelstrom zeitgleich zum Hauptstrahl untersuchen zu können. Dies wird durch eine optodigitale Maske und einer hochauflösenden CCD-Kamera mit hohem Dynamikbereich realisiert. In dieser Arbeit werden Aufbau und erste Tests des Halo-Systems präsentiert.

AKBP 12.10 Do 16:00 BZ.08.06 (HS 1)

**Upgrade of the profile monitors in the injection beam line of COSY** — •Karl Reimers and Vsevolod Kamerdzhiev — Forschungszentrum Jülich, IKP-4

The injection beam line (IBL) of COSY consists of 4 straight and 4 bent sections. At the beginning and at the end of each bent section a wire array is used to measure the profile of the ion beam delivered by the cyclotron 'JULIC' to COSY.

The 8 stations of wire array assemblies consist of a vacuum chamber holding arrays of each 39 wires for the two transversal planes.

The profile data is used primarily to optimize the beam line transmission.

Further maintenance of the old readout electronics is considered impractical. A decision was made to upgrade the readout system with a state of the art multichannel electronics, designed by iThembaLABS in South Africa.

Each multichannel pico ammeter electronics is connected to one wire array. They measure currents at the wires being hit by the beam.

A brief overview of existing methods of taking beam profile data is presented. Some technical aspects and the latest measurement results are discussed.

## AKBP 13: Beam Dynamics / Simulation II

Zeit: Donnerstag 13:45–16:00 Raum: F.10.01 (HS 4)

AKBP 13.1 Do 13:45 F.10.01 (HS 4)

**Transverse decoherence and emittance growth of ion bunches with space charge** — •Ivan Karpov[1], Vladimir Kornilov[2], and Oliver Boine-Frankenheim[1,2] — [1]TEMF, TU Darmstadt, Schloßgartenstraße 8, 64289 Darmstadt, Germany — [2]GSI, Planckstr. 1, 64291 Darmstadt, Germany

The transverse decoherence of the bunch signal after an initial bunch displacement is an important process in synchrotrons and storage rings. It can be useful, for the diagnostic purposes, or undesirable. Coherent bunch oscillations can appear after the bunch-to-bucket transfer between synchrotrons and can lead to an emittance blow-up. In heavy ion and proton beams, like in SIS100 synchrotron of the FAIR project, transverse space charge can strongly modify the decoherence signals.

The bunch oscillations produced by a transverse kick and the time evolution of the transverse emittance have been measured at the SIS18 synchrotron for different beam and machine parameters. For comparison, particle tracking simulations of transverse bunch decoherence and emittance increase due to chromaticity, nonlinearities and strong space-charge have been performed. The goal of these studies is a detailed understanding of the interplay of the different effects.

AKBP 13.2 Do 14:00 F.10.01 (HS 4)

**Simulation studies of plasma-based charge strippers for heavy ion beams** — •Oliver Sebastian Haas[1] and Oliver Boine-Frankenheim[1,2] — [1]TU-Darmstadt, Darmstadt, Deutschland — [2]GSI, Darmstadt, Deutschland

Charge stripping of intense heavy ion beams is a major challenge in current and future linear heavy ion accelerators. Conventional stripping techniques are limited in their applicability, e.g. solid carbon foils suffer from short lifetimes at high intensities. One possible alternative is the use of a plasma as a stripping medium, which the presented work focuses on. The main goal of the studies is the prediction of the final

charge state distribution of the ion beam. Rate equations were implemented numerically, taking into account different models for ionization, recombination and energy loss processes. The limits and applicability of simplified models, e.g. for ionization cross sections, are discussed. First quantitative results are presented in form of an overview of the charge state distributions of different - conventional and novel - charge stripping media. Furthermore comparisons are performed with charge state distributions obtained from different pinch experiments at GSI. Future studies intend to include detailed models for the plasma conditions and beam optics. This includes, e.g., the implosions process of pinch plasmas and the detailed plasma parameters along the beam axis.

AKBP 13.3 Do 14:15 F.10.01 (HS 4)

**Eine C++ Bibliothek für Beschleunigerlattices** — •Jan Schmidt und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Ausgehend von den Anforderungen bei der Entwicklung des Spintracking-Programms POLE wurde an der Beschleunigeranlage ELSA eine C++ Bibliothek für Beschleunigerlattices entwickelt. Sie stellt verschiedene Datenstrukturen bereit, die Strahlführungen, bestehend aus einzelnen Komponenten, sowie physikalische Größen im Beschleuniger, wie Twissparameter oder Teilchentrajektorien, darstellen.

Kernbestandteil der Bibliothek ist die Verknüpfung mit den etablierten Simulationsprogrammen Mad-X und Elegant. Lattices und Simulationsergebnisse können importiert werden und stehen dann für beliebige Anwendungen in C++ zur Verfügung. Beschleunigermodelle können auch zur Nutzung mit Mad-X oder Elegant exportiert werden, sodass die Bibliothek als Hilfsmittel beim Transfer zwischen verschiedenen Formaten genutzt werden kann. Zusätzlich steht ein LaTeX-Export zur Verfügung, der das Erstellen von Skizzen eines Lattices basierend auf tikz ermöglicht.

AKBP 13.4 Do 14:30 F.10.01 (HS 4)

**Inclusion of the multipole components in beam dynamic simulations for the HESR** — •Jan Henry Hetzel[1], Giordana Severino[2], Domenico Caiazza[2], Andreas Lehrach[1], Ulf Bechstedt[1], Raimund Tölle[1], Bernd Lorentz[1], and Marie-Julie Leray Pereira[3] — [1]FZ Jülich, Jülich, Deutschland — [2]CERN, Genf, Schweiz — [3]Sigma Phi, Vannes, Frankreich

The High-Energy Storage Ring HESR is a part of the emerging accelerator complex FAIR (Facility for Antiproton and Ion Research) at the GSI in Darmstadt. The HESR will accelerate and store antiprotons with a momentum range from 1.5 to 15 GeV/c.

This talk will be about the multipole errors in the dipole and quadrupole magnets and their impact on the beam dynamic calculations for the HESR. The protoypes of the quadrupole magnet and the dipole magnet have been produced recently. The multipole components of the quadrupole magnet have been measured using a rotating coil system. The dipole magnet has been characterized with a seach coil. Both measurements are now basis for beam dynamic simulations that are carried out to estimate the dynamic aperture of the HESR.

AKBP 13.5 Do 14:45 F.10.01 (HS 4)

**Ein realistisches Magnetoptik-Modell für ELSA** — •Jens-Peter Thiry und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

An der Elektronen-Stretcher-Anlage ELSA werden polarisierte Elektronen auf eine Energie von bis zu 3.2 GeV beschleunigt und anschließend mittels Resonanzextraktion verschiedenen Experimenten zugeführt.

Ein realistisches Modell der Magnetoptik ist dabei eine Grundvoraussetzung um den Beschleuniger stabil betreiben zu können. Insbesondere muss das Modell die Arbeitspunkte sowie Betafunktionen korrekt vorhersagen können. Bei ELSA wird das Programm elegant für die Simulation des Beschleuniger-Modells verwendet.

Um das Modell an die tatsächliche Magnetoptik anzupassen wird die von elegant berechnete Orbit-Response-Matrix an die gemessene Matrix angeglichen. Als Eingabeparameter für die Berechnung dienen beispielsweise Gradienten- und Aufstellungsfehler der Magnete. In Abhängigkeit dieser Parameter wird dann mittels des Levenberg-Marquardt-Algorithmus die berechnete Matrix optimiert.

In diesem Vortrag wird die konkrete Implementation der Anpassung vorgestellt und die Leistungsfähigkeit untersucht.

AKBP 13.6 Do 15:00 F.10.01 (HS 4)

**Collimation simulation of heavy-ion beams in the LHC** — •Pascal Dominik Hermes[1,2], Roderik Bruce[1], and Stefano Redaelli[1] — [1]CERN, Geneva, Switzerland — [2]Westfälische Wilhelms-Universität Münster, Germany

Simulations of the LHC collimation cleaning efficiency are crucial to understand the expected beam losses in superconducting magnets so that quenches can be avoided. Such simulations for heavy-ion beams require specialized software including ion-specific physics effects. A simulation approach combining ion fragmentation at a collimator with subsequent fragment tracking is presented. Simulated loss maps are compared to measured losses from LHC heavy-ion runs and possible improvements are discussed on the basis of the applied approximations. An outlook on the ion cleaning performance with future settings of the LHC collimation system is given.

AKBP 13.7 Do 15:15 F.10.01 (HS 4)

**Modification of the quadrupole strength and effective length** — •Nahid Scahill — Institut für Kernphysik Johannes Gutenberg-Universität Mainz

Quadrupoles needed for the operation in the injection systems of MAMI and MESA have a high ratio of aperture to length. This requires a modification of conventional beam transport matrices. Depending on the excitation of such quadrupoles, a correction of the usual definition of quadrupole strength and effective length must be made. We present calculations and observations of this correction for the quadrupoles used in the MAMI low energy beam transport sections.

AKBP 13.8 Do 15:30 F.10.01 (HS 4)

**Simulation der Laserkühlung von intensiven Schwerionenstrahlen** — •Lewin Eidam[1] und Oliver Boine-Frankenheim[1,2] — [1]TEMF, Schlossgartenstraße 8, 64289 Darmstadt, Germany — [2]GSI, Plankstraße 1, 64291 Darmstadt, Germany

Das Prinzip der Laserkühlung wurde erfolgreich in niederenergetischen Speicherringen untersucht und verifiziert. Im Rahmen des FAIR Projekts wird erstmalig die Laserkühlung an einem hochenergetischen Schwerionensynchrotron verwendet. Die Kühlung resultiert in einer Verdichtung des Phasenraums und in longitudinalen Strahlprofilen, die stark von der Gaußverteilung abweichen. Um einen stabilen Strahlbetrieb garantieren zu können und die Effektivität des Kühlprozesses zu optimieren werden detaillierte numerische Studien zur Wechselwirkung der Laserkraft und Intensitätseffekten durchgeführt.

Die entscheidenden Randbedingungen für eine effektive Laserkühlung unter verschiedenen Konfigurationen der Beschleunigeranlage werden in diesem Beitrag identifiziert. Für höhere Strahlenergien ist die Beschreibung der Photonenstreuung durch gemittelte Kräfte nicht mehr zu rechtfertigen. Die stochastische Modellierung der Laserkraft im numerischen Löser wird diskutiert.

AKBP 13.9 Do 15:45 F.10.01 (HS 4)

**Characterization of the SESAME-Injector** — •Rachid Ramadan[1], Shaukat Khan[1], Erhard Huttel[2], and Maher Attal[2] — [1]DELTA, TU Dortmund — [2]SESAME, Allan (Jordan)

SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East) is a third-generation Synchrotron-light-source under construction located in Jordan. In consists of a 20 MeV Microtron pre-injector, a 800 MeV Booster-synchrotron and a 2.5 GeV Storage-Ring. The Microtron and the Booster-synchrotron is the former BESSY I Injector. The Booster had been commissioned in 2014. This work describes the characterization of the Microtron and the Booster. Tune, Beta-function, Dispersion, Chromaticity and Emittance have been measured and found in sufficient agreement with the expectations.

# AKBP 14: Injectors, Lasers

Zeit: Donnerstag 16:45–19:00 Raum: BZ.08.06 (HS 1)

AKBP 14.1 Do 16:45 BZ.08.06 (HS 1)

**Preliminary Results from the Laser System generating Quasi 3-D Ellipsoidal Photocathode Laser Pulses at PITZ** — •James Good[1], Alex Andrianov[2], Ekaterina Gacheva[2], Efim Khazanov[2], Martin Khojoyan[1], Mikhail Krasilnikov[1], Sergey Mironov[2], Tino Rublack[1], Frank Stephan[1], Eugeniy Syresin[3], and Victor Zelenogorsky[2] — [1]DESY, Zeuthen, Germany — [2]IAP, Nizhny Novgorod, Russia — [3]JINR, Dubna, Russia

The optimization of photoinjectors is crucial for the successful operation of linac-based free electron lasers, and beam dynamics simulations have shown that 3D ellipsoidal photocathode laser pulses result in significantly lower electron beam emittance than that of conventional cylindrical pulses. Therefore, in collaboration with the Institute of Applied Physics (Nizhny Novgorod, Russia) and the Joint Institute of Nuclear Research (Dubna, Russia), a Laser system capable of generating quasi 3-D ellipsoidal laser pulses has been developed and installed at the Photo Injector Test facility at DESY, Zeuthen (PITZ).

The pulse shaping has been realized using the spatial light modulator technique, characterized by cross-correlation measurements, and is going to be demonstrated by electron beam measurements. In this contribution the overall setup, operating principles, and initial results of the new photocathode laser system at PITZ will be reported.

AKBP 14.2 Do 17:00 BZ.08.06 (HS 1)

**Diagnostics for stable operation of a 200 TW laser system for laser-plasma acceleration** — •Spencer Windhorst Jolly[1,2,3], Dominik Trosien[1,2], Byunghoon Kim[1,2,3], Matthias Schnepp[1,2], Vincent Leroux[1,2,3], and Andreas Richard Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg, Germany — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg, Germany — [3]ELI Beamlines, 18221 Prague 8, Czech Republic

Laser-plasma based acceleration has matured into a technique providing comparable electron energies and secondary source characteristics to conventional accelerators. The missing piece is stability and repetition rate, which are, among other aspects, severely limited by the driver laser performance. Within the LAOLA Collaboration, the University of Hamburg and DESY work closely together to combine university research in the field of laser-plasma acceleration with the expertise of a large and well-established accelerator facility. We present in this talk a summary of hardware, software, and operation based changes to the 200 TW laser system (ANGUS) to increase ease of operation and stability. We concentrate on camera-based alignment and diagnostics, implemented within the DESY accelerator controls system. These improvements to the laser system will greatly help the operation of LUX and REGAE, the two dedicated experiments in Hamburg which study laser-plasma acceleration.

AKBP 14.3 Do 17:15 BZ.08.06 (HS 1)

**Diagnostics of the FLUTE Gun Laser and Design of a Beam Transport System** — •Sophie Walther, Erik Bründermann, Nicole Hiller, Anke-Susanne Müller, and Michael Nasse — KIT, Karlsruhe, Germany

FLUTE (Ferninfrarot Linac Und Test Experiment) is a new linear accelerator currently under comissioning at the Karlsruhe Institute of Technology (KIT). It is aimed at accelerator physics and THz radiation research. The electrons are generated with a photo-injector gun using picosecond long UV laser pulses. A Ti:Sapphire laser system with a consecutive third harmonic generation unit is used to generate the electrons. We present the design of a stabilized laser beam transport system to guide the laser to the cathode, including crucial diagnostic devices such as a 'virtual cathode' to monitor the laser beam. Additionally, first test results with the laser system will be presented.

AKBP 14.4 Do 17:30 BZ.08.06 (HS 1)

**Photocathode development and spectral response measurements at HZB** — •Martin A. H. Schmeisser, Julius Kühn, Thorsten Kamps, and Andreas Jankowiak — Helmholtz-Zentrum Berlin

Photocathodes of the Alkali Antimonide group are promising candidates for the generation of electron beams with high brightness and high average current in photoinjectors. A preparation and analysis system for these cathodes was commissioned at HZB and first results are presented. The system supports the in-situ characterization of cathodes regarding their spectral response, and depth-profiled chemical composition using XPS and LEIS.

AKBP 14.5 Do 17:45 BZ.08.06 (HS 1)

**Laser wavefront optimisation for laser-plasma acceleration** — •Vincent Leroux[1,2,3], Matthias Schnepp[1,2], Spencer Jolly[1,2,3], Buynghoon Kim[1,2,3], Ji-Ping Zou[4], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]ELI Beamlines, 18221 Praha 8, Czech Republic — [4]Laboratoire pour l'Utilisation des Lasers Intenses, CNRS, Ecole Polytechnique, Palaiseau, France

Laser-Plasma Wakefield Accelerators showed promising results in the past few years, generating high-energy electron beam over cm-distances. Nevertheless, the quality and shot-to-shot stability of such beams have not yet reached the level of conventional accelerators. One of the crucial factors is the driver laser beam quality, which need to be focused close to the diffraction limit. To achieve the highest electron beam quality, the laser wavefront has to be controlled via a closed loop including a deformable mirror and a wavefront sensor. Within the LAOLA collaboration between the University of Hamburg and DESY, the LUX beamline is developed to generate and study plasma-driven undulator radiation. It is driven by the commercial 200 TW ANGUS laser system which includes such adaptive optics. In this talk, I will present considerations on closed-loop wavefront control for enhanced beam quality in laser-plasma acceleration.

AKBP 14.6 Do 18:00 BZ.08.06 (HS 1)

**Laser transport for the LUX laser plasma beamline** — •Paul Andreas Walker[1,2], Niels Matthias Delbos[1,2], Darek Kocon[3], Vincent Leroux[1,2,3], Nils Plambeck[1,2], Matthias Schnepp[1,2], Christian Markus Werle[1,2], Benno Zeitler[1,2], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]ELI Beamlines, 18221 Praha 8, Czech Republic

Within the LAOLA collaboration the university of Hamburg and DESY work closely together within the field of Laser Wakefield Acceleration. We report on the new laser transport beamlines which will feed two laser plasma experiments, LUX and REGAE. We outline the technical challenges and their solutions the first laser beamline within the accelerator UHV environment posed. The in-house design of the 7 inch diameter mirror mounts and the design process of their vacuum chambers are discussed alongside vibration studies, vacuum force analysis, and material selections.

AKBP 14.7 Do 18:15 BZ.08.06 (HS 1)

**ANGUS Laser System for Laser-Plasma Acceleration** — •Matthias Schnepp[1,2], Spencer Windhorst Jolly[1,2,3], Byounghoon Kim[1,2,3], Vincent Alain Gilles Leroux[1,2,3], Claus Domink Trosien[1,2], Julian Zeyn[1,2], and Andreas R. Maier[1,2] — [1]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [2]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [3]ELI Beamlines, 18221 Praha 8, Czech Republic

Within the LAOLA Collaboration, the University of Hamburg and DESY work closely together to combine university research with the expertise of a large and well-established accelerator facility. In this talk we will introduce the recently commissioned 200 TW laser system ANGUS. We will report on the integration of the laser system into the accelerator infrastructure, in particular about requirements for the air conditioning and demands for the vacuum system. Important characteristic laser parameters will be discussed as well as the progress towards stable operation. We will present results on measured energy stability, pulse duration and temporal intensity contrast as well as wave front distortion and pointing stability.

AKBP 14.8 Do 18:30 BZ.08.06 (HS 1)

**Compton Polarimetry at ELSA - Properties of the Laser System** — •Florian Hinterkeuser, Wolfgang C.A. Hillert, Rebecca Koop, and Michael T. Switka — Elektronen-Stretcher-

Anlage ELSA, Physikalisches Institut, Universität Bonn

For double polarization experiments, the Electron Stretcher Facility ELSA provides a spin polarized electron beam with energies ranging from 0.5 to 3.5 GeV. Since the initial polarization is not preserved during the acceleration and storage process, it is crucial to monitor the electron polarization in the stretcher ring. Hence the installation of a Compton polarimeter, consisting of a laser and a silicon microstrip detector system, is in progress. The laser system provides two polarized photon beams, which are scattered off the stored electrons. After recent inevitable repairs, the final laser properties have been measured in order to obtain a stable system with optimized performance. The laser properties and the expected performance are presented.

AKBP 14.9 Do 18:45 BZ.08.06 (HS 1)

**Time domain characterization of the cone-shaped pick-ups at FLASH, ELBE and SwissFEL Injector Test Facility** — •Aleksandar Angelovski[1], Andreas Penirschke[1], Michael Kuntzsch[4], Marie Kristin Czwalinna[2], Cezary Sydlo[2], Vladimir Arsov[3], Stefan Hunziker[3], Holger Schlarb[2], Michael Gensch[4], Volker Schlott[3], Thomas Weiland[1], and Rolf Jakoby[1] — [1]TU Darmstadt, Darmstadt, Germany — [2]DESY, Hamburg, Germany — [3]PSI, Villigen, Switzerland — [4]HZDR, Dresden-Rossendorf, Germany

As a part of the 40 GHz Bunch Arrival-time Monitors (BAMs) for low charge operation mode at the European XFEL, the cone-shaped pick-ups were introduced. The pickups are installed at FLASH (DESY), ELBE (HZDR) and SwissFEL Injector Test Facility (PSI). Time domain measurements with real time and sampling oscilloscopes are conducted at the three accelerators. The pickup signal is recorded for different machine and bunch settings. For validation the measurement results are compared to the simulations.

## AKBP 15: Beam Dynamics / Simulation III

Zeit: Donnerstag 16:45–19:00 Raum: F.10.01 (HS 4)

AKBP 15.1 Do 16:45 F.10.01 (HS 4)

**Beam Transfer Functions and Tune Spread in Bunched Beams** — •Paul Görgen[1], Oliver Boine-Frankenheim[1], and Wolfram Fischer[2] — [1]Institut für Theorie Elektromagnetischer Felder (TEMF), Technische Universität Darmstadt, Schloßgartenstr. 8 64289 Darmstadt, Germany — [2]Brookhaven National Laboratory, Upton, NY 11973, United States

We present our results on measurement of transverse tune spread due to transverse nonlinearities in high energy synchrotrons using Beam Transfer Functions (BTF). We work under the assumption of frozen or near-frozen synchrotron motion commonly found in high energy machines. We discuss the analytic equation for the BTF in absence of coherent modes. We show that the tune distribution can not be recovered from the transverse BTF alone. We then show that even in absence of additional knowledge, the BTF can be used to measure the tune spread. We discuss the application and applicability of this method and show agreement between analytic results, simulation and measurement.

AKBP 15.2 Do 17:00 F.10.01 (HS 4)

**Fast determination of optical functions using multiturn and closed-orbit data** — •Stephan Kötter, Bernard Riemann, Peter Hartmann, Benjamin Isbarn, and Thomas Weis — DELTA, TU-Dortmund, Dortmund, Germany

Today closed-orbit measurements via conventional beam position monitor (BPM) systems are established tools to derive twiss parameters in storage rings. While the application of turn-by-turn data acquisition techniques increases the availability of fast measurement data, the required expensive hardware and the related synchronization issues hamper its use. It was shown in a proof-of-principle experiment* that a minor addition of two turn-by-turn data acquisition sources to conventional beam position monitor systems holds the potential of combining the advantages of turn-by-turn and closed-orbit methods.

The introduced fast beam position monitors need to be set up in a drift space with two small orbit corrector magnets installed. By deriving the ß-function at the position of the corrector magnets, the ß-function at all conventional monitors in the storage ring can be calculated via the orbit response matrix.

Currently the described system is being implemented for robust daily use at the DELTA facility in Dortmund. This presentation will give an overview on the applied method and will illustrate the approach chosen for the implementation and the progress of developing dedicated software to steer the magnets, read out monitor data and compute beam optics parameters.

*B. Riemann et al., Phys. Rev. ST Accel. Beams 14, 062802 (2011)

AKBP 15.3 Do 17:15 F.10.01 (HS 4)

**Influence of Transient Beam Loading on the Longitudinal Beam Dynamics at BESSY VSR** — •Martin Ruprecht[1], Paul Goslawski[1], Andreas Jankowiak[1], Markus Ries[1], Godehard Wüstefeld[1], and Thomas Weis[2] — [1]Helmholtz-Zentrum Berlin, Germany — [2]Technische Universität Dortmund, Germany

BESSY VSR, a scheme where 1.5 ps and 15 ps long bunches (rms) can be stored simultaneously in the BESSY II storage ring has recently been proposed[1]. The strong longitudinal bunch focusing is achieved by superconducting high gradient RF cavities. If the fill pattern exhibits a significant inhomogeneity, e.g. due to gaps, transient beam loading causes a distortion of the longitudinal phase space which is different for each bunch. The result are variations along the fill pattern in synchronous phase, synchrotron frequency and bunch shape. This paper presents investigations of transient beam loading and depicts the consequences on bunch length, phase stability and longitudinal multi-bunch oscillations for the projected setup of BESSY VSR.

[1] G. Wüstefeld, A. Jankowiak, J. Knobloch, M. Ries, Simultaneous Long and Short Electron Bunches in the BESSY II Storage Ring, Proceedings of IPAC2011, San Sebastián, Spain

AKBP 15.4 Do 17:30 F.10.01 (HS 4)

**A Semi-Analytic Model for The Determination of Wakefields in Dielectrically Lined Rectangular Waveguides** — •Franziska Reimann[1], Ursula van Rienen[1], Peter Michel[2], and Ulf Lehnert[2] — [1]Universität Rostock, Institut für All- gemeine Elektrotechnik — [2]Helmholtz-Zentrum Dresden-Rossendorf

Dielectrically lined waveguides are planned to be used as a passive wakefield dechirper [1] for the electron beam at the ELBE facility of the Helmholtz-Zentrum Dresden Rossendorf. In this work we introduce a complete semi-analytical model based on eigenmode expansion [2] to determine the longitudinal wakefield in these structures. The result gained from this model is the point-charge wakefield, which serves as a Green's function for convolution with the ELBE beam shape. As an example, semi-analytical results for different beam shapes are compared to numerical results of commercial software, e.g. CST Studio [3].

[1] Antipov et al., *Passive Momentum Spread Compensation by a *Wakefield Silencer"", in: Proceedings of IPAC2012, New Orleans, USA, 2012

[2] Robert E. Collin, *Field Theory of Guided Waves, Second Edition*, IEEE Press, 1991, p. 419

[3] CST Studio Suite, CST AG, Darmstadt, Germany

AKBP 15.5 Do 17:45 F.10.01 (HS 4)

**Multi Beam Storage in Transverse Resonance Island Buckets at MLS and BESSY II** — •Paul Goslawski, Joerg Feikes, Tobias Goetsch, Ji Li, Markus Ries, Martin Ruprecht, Andreas Schälicke, and Godehard Wüstefeld — Helmholtz-Zentrum Berlin, HZB

Operating a storage ring at a working point close to horizontal resonances ($f_x/f_0 = 1/2, 1/3$ or $1/4$) generates two, three or four resonance island buckets in the $x, x'$ phase space. Several beams can be stored simultaneously in these buckets. First experiments with such an operation mode have been conducted at the Metrology Light Source (MLS) and then applied at BESSY II. This operation mode enables spatially or angularly separated beams with different properties such as filling pattern, bunch length, beam intensity or subharmonic revolution frequencies. We will present experimental results as well as operational experience at the MLS and BESSY II such as tuning the machine for high current, controlling intra-bucket diffusion rates or improving the overall lifetime.

This mode allows for a more flexible operation of the machine having the potential to simultaneously fulfil diverse user demands, e.g., real single bunch operation.

AKBP 15.6 Do 18:00 F.10.01 (HS 4)

**Advanced Bunching Scheme at REGAE** — •Benno Zeitler[1,2], Klaus Flöttmann[3], and Florian Grüner[1,2] — [1]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [2]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [3]DESY, 22761 Hamburg

The field of laser wakefield acceleration offers very high accelerating gradients. To combine the university research on this topic with the expertise of a large and well-established accelerator facility, the LAOLA Collaboration was formed between DESY and the University of Hamburg. One of the campaigns pursued within this framework is the external injection of an electron bunch from a conventional gun into a laser-driven plasma wakefield, which is a promising path towards increased control over the injected electron phase space. The Relativistic Electron Gun for Atomic Exploration (REGAE), a small accelerator located at DESY, is an interesting candidate for such an external injection experiment due to the short bunches on the order of 10 fs, required for the primary design goal of the machine: Time-resolved electron diffraction. In this case the particles are compressed using the ballistic bunching method. The shortness of the bunching is limited by non-linearities in the longitudinal phase space. We present a method that allows for a correction of these non-linearities, enabling even shorter bunches.

AKBP 15.7 Do 18:15 F.10.01 (HS 4)

**Untersuchung der Wirkung von Ionensäuberungsmaßnahmen an ELSA*** — •Dennis Sauerland und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Im ELSA Stretcherring der Universität Bonn werden Elektronen mit einer Energie von bis zu 3,2 GeV für hadronenphysikalische Experimente zur Verfügung gestellt. Hierbei akkumulieren Ionen, welche durch Kollision mit den Elektronen kontinuierlich produziert werden, im Strahlpotential und sind Ursache für inkohärente Arbeitspunktverschiebungen und Strahlinstabilitäten. Da die Effekte mit der Anzahl der Ionen skalieren ist es notwendig diese durch den Einsatz von Absaugelektroden und Füllstrukturlücken zu begrenzen. Die Ionenanzahl kann durch die Messung der Strahltransferfunktion bestimmt werden: Durch eine breitbandige Anregung des Strahls um seinen transversalen Arbeitspunkt mittels eines Stripline-Kickers ist es möglich die Transferfunktion des Strahls zu bestimmen. An Hand der Verschiebung und Verbreiterung des Arbeitspunktes kann die inkohärente Arbeitspunktverschiebung und somit die Anzahl der Ionen im Beschleuniger bestimmt werden. Im Vortrag wird diese Messmethode im Kontext der Effizienz der Ionensäuberung durch Absaugelektroden und Füllstrukturlücken an ELSA vorgestellt.

*Gefördert vom Bundesministerium für Bildung und Forschung unter Fördernummer 05K13PDA

AKBP 15.8 Do 18:30 F.10.01 (HS 4)

**Modelling of the short bunch optics for bERLinPro** — •Andreas Ginter and Aleksandr Matveenko — Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Elektronenspeicherring BESSY II, Albert-Einstein-Str. 15, 12489 Berlin, Germany

The Energy Recovery Linac principle allows compressing electron bunches to the length at least two orders of magnitude shorter compared to storage rings. At bERLinPro bunch compression and decompression can be done in two stages in the injector and main arcs. The distribution of compression between these two stages is subject to optimization.

Simulations show that the length and shape of the bunch in the injector and before the linac are the limiting factors for minimal bunch length. Injector simulations have to consider space charge effects, whereas CSR effects are limiting compression in the arcs. Current status of injector optimization and effect on the compressed bunch are presented.

AKBP 15.9 Do 18:45 F.10.01 (HS 4)

**Laser Cooling of High Energy Ion Beams - from ESR and CSRe to FAIR and HIAF** — •Michael Bussmann[1], Weiqiang Wen[1,2,3], Danyal Winters[4], Christina Dimopoulou[4], Fritz Nolden[4], Markus Steck[4], Shahab Sanjari[4], Tino Giacomini[4], Yuri Litvinov[4], Christophor Kozhuharov[4], Thomas Kühl[4], Matthias Lochmann[5], Johannes Ullmann[5], Rodolfo Sanchez[4,5], Wilfried Nörtershäuser[4,5], Thomas Stöhlker[4,6], Tobias Beck[5], Benjamin Rein[5], Thomas Walther[5], Sascha Tichelmann[5], Gerhard Birkl[5], Hanbing Wang[3], Dacheng Zhang[3], Zhongkui Huang[3], Bang Hai[3], Youjin Yuan[3], Xinwen Ma[3], Markus Löser[1,2], Matthias Siebold[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden — [3]Institute of Modern Physics, Lanzhou — [4]GSI Helmholtzzentrum für Schwerionenforschung — [5]Technische Universität Darmstadt — [6]Helmholtz-Institut Jena

We present results from laser cooling experiments at ESR, GSI Darmstadt and CSRe, IMP Lanzhou. We show that with a cw laser system it is possible to cool ion beams with large initial momentum spread and that laser cooling can overcome intra-beam scattering, regardless of the initial ion beam current.

We furthermore discuss first laser cooling tests with a pulsed laser system and present an outlook on how to optimize laser cooling for heavy ion beams at highly-relativistic energies, focusing not only on laser technologies but also on optical beam diagnostics.