AKBP 16: Poster

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

AKBP 16.1 Thu 15:45 HSZ OG3

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

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

AKBP 16.2 Thu 15:45 HSZ OG3

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

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

AKBP 16.3 Thu 15:45 HSZ OG3

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

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

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

AKBP 16.4 Thu 15:45 HSZ OG3

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

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

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

AKBP 16.5 Thu 15:45 HSZ OG3

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

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

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

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

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

AKBP 16.6 Thu 15:45 HSZ OG3

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

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

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

AKBP 16.7 Thu 15:45 HSZ OG3

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

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

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

AKBP 16.8 Thu 15:45 HSZ OG3

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

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

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

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

AKBP 16.9 Thu 15:45 HSZ OG3

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

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

AKBP 16.10 Thu 15:45 HSZ OG3

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

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

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

AKBP 16.11 Thu 15:45 HSZ OG3

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

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

AKBP 16.12 Thu 15:45 HSZ OG3

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

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

AKBP 16.13 Thu 15:45 HSZ OG3

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

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

AKBP 16.14 Thu 15:45 HSZ OG3

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

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

AKBP 16.15 Thu 15:45 HSZ OG3

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

Scraper systems in particle accelerators are utilized for safely and efficiently removing undesired particles from the beam, e.g., those with too large momentum deviation or those belonging to the beam halo. They are of great importance for accelerators, in particular those with high energies and beam currents, where the risk of damage is high. In addition to the machine protection, the use of scraper systems can significantly improve the beam quality and reduce the experimental background. Also, such systems can be used for online beam diagnostics. Especially when operating an Energy Recovery Linac (ERL), it is important to prepare the beam for the return to the accelerator after the interaction with an experiment. In this contribution, we will present results of recent measurements with the High-Energy Scraper System of the S-DALINAC [1] and give an overview on the ongoing work. This work was supported by the state of Hesse within the cluster project ELEMENTS and within the LOEWE research project Nuclear Photonics

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

AKBP 16.16 Thu 15:45 HSZ OG3

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

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

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

AKBP 16.17 Thu 15:45 HSZ OG3

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

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