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 $\approx 2\gamma_{wake}^2$. 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 $\sim \mu$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 $\pm 10\%$ 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 ~ 20 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

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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.