T 129: Beschleunigerphysik XVI (Poster)

Zeit: Mittwoch 16:45–16:45 Raum: HSZ 1.OG

T 129.1 Mi 16:45 HSZ 1.OG

Teststand zur Optimierung und Reinigung von Photokathoden auf GaAs-Basis — •Martin Espig, Joachim Enders, Yuliya Fritzsche, Neeraj Kurichiyanil und Markus Wagner — Institut für Kernphysik, Technische Universität Darmstadt

Eine Quelle spinpolarisierter Elektronen wurde vor Kurzem am supraleitenden Darmstädter Elektronen-Linearbeschleuniger S-DALINAC in Betrieb genommen. Die Kathoden für die polarisierte Quelle sollen an einem separaten Teststand mit atomarem Wasserstoff gereinigt und die Präparationsprozeduren optimiert werden, um über lange Betriebszeiten hohe Quantenausbeuten gewährleisten zu können.

Gefördert durch die DFG im Rahmen des SFB 634 und durch das Land Hessen im LOEWE-Zentrum HIC for FAIR.

T 129.2 Mi 16:45 HSZ 1.OG

Gepulste magnetische Quadrupollinsen — •Carmen Tenholt[1], Peter Spiller[2], Isfried Petzenhauser[2], Udo Blell[2] und Oliver Kester[1,2] — [1]IAP, Frankfurt University, Germany — [2]GSI, Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Zur finalen Fokussierung eines Ionenstrahls oder zum Transfer von Ionen zwischen Synchrotronen werden eisenfreie, hochstromgepulste Quadrupollinsen entwickelt. Es wird mindestens eine Dublette zur Fokussierung benötigt, die über ihr erzeugtes Magnetfeld den Ionenstrahl in beide Achsenrichtungen staucht. Um den gewünschten Magnetfeldgradienten zu erreichen, wird ein Strom von ca. 400 kA benötigt. Um diesen hohen Strom erzielen zu können, wird gepulst gearbeitet. Der Puls, welcher einige 10 microsec andauern soll, entsteht durch das Entladen einer Kondensatorbank über eine Funkenstrecke. Diese führt den Strom dann zu vier in Reihe geschaltete Leiter weiter. Die Leiter der Linse sollen aus vielen einzelnen Litzen aufgebaut sein, die verdrillt und gegeneinander isoliert verlaufen. So wird dem Skin-Effekt Rechnung getragen. Die Leiter haben eine spezielle Form, die unter Berücksichtigung der Dicke und deren Abstand zum Strahl einer cos (2teta)Verteilung entspricht. Angedacht wird noch eine Abschirmung um die Linse herum, die laminiert konstruiert werden soll, um die Entstehung von Wirbelströmen zu vermeiden.

T 129.3 Mi 16:45 HSZ 1.OG

TELBE - the super-radiant THz facility at ELBE — •Bertram Green[1], Sergei Kovalev[1], Jens Hauser[1], Michael Kuntzsch[1], Alaa Al-Shemmary[2], Harald Schneider[1], Stephan Winnerl[1], Wolfgang Seidel[1], Sergei Zvyagin[1], Simon Wall[5], Ilie Radu[2], Lukas M Eng[3], Ulf Lehnert[1], Manfred Helm[1], Nikola Stojanovic[2], Joachim Heberle[4], Andrea Cavalleri[2], Peter Michel[1], and Michael Gensch[1] — [1]Helmholtz-Zentrum Dresden Rossendorf — [2]Deutsches Elektronen-Synchrotron — [3]Technische Universitaet Dresden — [4]FU Berlin — [5]FHI Berlin

It has been shown recently that relativistic electron bunches can be utilized for the generation of super-radiant coherent THz radiation by one single pass through an undulator, bending magnet, or CDR/CTR screens. However, the high THz fields have all been achieved at large accelerators that allow for high electron beam energies. A crucially important research topic for the next years at the HZDR is therefore to investigate whether an equally fine control over highly charged electron bunch form can be routinely achieved in a low electron beam energy accelerator like ELBE. If successful this development would allow the generation of high field THz fields by linear accelerators at considerably reduced cost. Given stable operation can be provided, TELBE, could also become a world-wide unique research facility for high field THz science. The current status and an outlook on future developments are presented.

T 129.4 Mi 16:45 HSZ 1.OG

Few Femtosecond level electron bunch diagnostic at quasi-cw electron accelerators — •Bertram Green[1], Michael Kuntzsch[1], Sergei Kovalev[1], Al-Shemmary Alaa[2], Jens Hauser[1], Stefan Findeisen[1], Christian Schneider[1], Caglar Kaya[1], Nikola Stojanovic[2], Peter Michel[1], and Michael Gensch[1] — [1]Helmholtz-Zentrum Dresden Rossendorf — [2]Deutsches Elektronen-Synchrotron

At the SRF based prototype cw accelerator ELBE a new electron beamline, providing for femtosecond electron bunches with nC bunch charges and repetition rates in the 1-200 KHz regime and with pC bunch charge and repetition rates of 13 MHz, is currently being constructed. The 40 MeV electrons will be used in photon-electron interaction experiments with TW and PW class lasers and the generation of broad and narrow bandwidth coherent THz pulses. Discussed here are ideas for novel online diagnostics of the electron bunch properties (e.g. arrival time and bunch form) based on the time and frequency domain analysis of the emitted coherent THz radiation, but also based on direct measurements by e.g. electro-optic sampling. The suitability of ELBE as a testbed for diagnostic of future cw X-ray photon sources (e.g. energy recovery linacs) will be discussed.

T 129.5 Mi 16:45 HSZ 1.OG

Berechnung von Eigenmoden für die GSI SIS18 Ferritkavität — •Klaus Klopfer, Wolfgang Ackermann und Thomas Weiland — Theorie Elektromagnetischer Felder, TU Darmstadt, Darmstadt, Deutschland

Das GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt betreibt das Schwerionensynchrotron SIS18, um die Energie stabiler Kerne verschiedener Ordnungszahl nach einer Vorbeschleunigung weiter zu erhöhen. Hierzu sind im Ring zwei ferritgeladene Kavitäten installiert. Während der Phase der Beschleunigung ist es erforderlich, die Resonanzfrequenz dieser Resonatoren an die Umlauffrequenz der Teilchen anzupassen, da die Geschwindigkeit der schweren Ionen während der Energiezufuhr kontinuierlich ansteigt. Zu diesem Zweck sind innerhalb der Kavität spezielle vormagnetisierte Ferritringe angebracht, die eine breitbandige Frequenzabstimmung ermöglicht. Durch Wahl eines geeigneten Vormagnetisierungsstromes können die differentielle Permeabilität des Ferritmaterials und damit letztlich die Eigenfrequenz des Systems angepasst werden. Neben den geometrischen Abmessungen des Resonators bestimmen vor allem die magnetischen Eigenschaften der Ferrite die Resonanzfrequenz. Im vorliegenden Beitrag wird die numerische Bestimmung der niedrigsten Eigenmoden der GSI SIS18 Ferritkavität vorgestellt, wofür ein neuer Eigenwertlöser auf Basis der Methode der Finiten Integration entwickelt wurde.

T 129.6 Mi 16:45 HSZ 1.OG

Numerische Berechnung elektromagnetischer Felder in Beschleunigungsresonatoren unter präziser Berücksichtigung der Kopplerstrukturen — •Cong Liu, Wolfgang Ackermann, Wolfgang F.O. Müller und Thomas Weiland — Institut für Theorie Elektromagnetischer Felder , Technische Universität Darmstadt , Darmstadt, Deutschland

Die Beschleunigung mit supraleitenden Hochfrequenz (HF)-Kavitäten erfordert geeignete Koppler, um die Energie von der HF-Quelle zum Teilchenstrahl zu transportieren. Gleichzeitig müssen Koppler zur Extraktion der Moden höherer Ordnung (HOM) für die Dämpfung der parasitären Felder eingesetzt werden. Aufgrund des damit einhergehenden Energietransports ist die numerische Eigenmodenanalyse bezogen auf reellwertige Größen für die Beschreibung der verlustbehafteten Beschleunigungsstrukturen nicht mehr geeignet. Am Institut für Theorie Elektromagnetischer Felder (TEMF) steht mittlerweile ein paralleler, robuster Eigenwertlöser zur Berechnung der Eigenmoden in verlustbehafteten Beschleunigungsstrukturen zur Verfügung. Der Eigenwertlöser beruht auf komplexwertiger Finite-Elemente-Analyse und verwendet Basisfunktionen bis zur zweiten Ordnung auf quadratischen Tetraeder-Elementen, um eine präzise Simulation für die ellipsenförmigen Kavitäten zu ermöglichen. Der Eigenwertlöser wurde auf die TESLA 1,3 GHz-Beschleunigungskavität angewandt, um die Resonanzfrequenz, den Gütefaktor und die entsprechende Verteilung elektromagnetischer Felder für alle Eigenmoden bis zum fünften Dipol-Passband (3,12 GHz) zu bestimmen.

T 129.7 Mi 16:45 HSZ 1.OG

Chopping High Intensity Proton Beams — •Christoph Wiesner, Hannes Dinter, Martin Droba, Oliver Meusel, Ilja Müller, Daniel Noll, Onur Payir, Ulrich Ratzinger, and Philipp Schneider — IAP, Goethe-Universität Frankfurt, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

A novel E×B chopper system for high intensity proton beams is being developed to deliver 100 ns beam pulses in the low energy transport line of the accelerator driven neutron source FRANZ [1]. It combines a static magnetic deflection field with a pulsed electric compensation field in a Wien filter-type E×B configuration. Behind the deflection unit a massless septum system is used for beam separation. The setup minimizes the risk of voltage breakdowns and provides secure beam dumping outside the transport line.

The electric deflection field is driven by a HV pulse generator providing ±6 kV at a repetition rate of 250 kHz. Accurate layout of the deflection plates is required to tackle the issues of field quality, cooling and spark prevention.

Careful matching of electric and magnetic deflection forces is required to prevent aberrations and emittance growth. [2] Numerical studies for the field design and their effects on beam transport are presented and an overview of the hardware development is given.

[1] U. Ratzinger et al., Proc. of IPAC2011, San Sebastián, Spain, WEPS040
[2] C. Wiesner et al., Proc. of IPAC2012, New Orleans, LA., USA, THPPP074

T 129.8 Mi 16:45 HSZ 1.OG

Transverse Phase Space Measurement of SRF-gun in HZDR using Single Slit Method — •Pengnan Lu[1,2], Jochen Teichert[1], Hannes Vennekate[1,2], Petr Murcek[1], Rong Xiang[1], and André Arnold[1] — [1]Helmholtz Zentrum Dresden Rossendorf, Dresden, Germany — [2]Dresden University of Technology, Dresden, Germany

A three-and-a-half-cell SRF-gun has been developed and commissioned in HZDR since 2004. The emittance of this gun was measured before by both solinoid/quadrupol scanning method and multiple slits method. Recently we did new measurements via single slit method to obtain the beam phase space with a higher space resolution and without the overlapping problem.

At first the hardware system composed of slit boards, a YAG screen and a camera will be described. Then the interface and structure of a labview program for data acquisition and processing will be shown. In data processing we will discuss the image correction, sensitivity of several parameters to the final result and how the background was eliminated. Finally we will give the estimation of the measurement error and the analysis of phase space measurement of both electron current and dark current. For electron current, the normalized rms emittance has a good agreement with that measured by solenoid scanning. For dark current, the phase space shows clearly two components, which echoes the assumption that both the cathode and the cavity contribute part of the dark current with different phases.

T 129.9 Mi 16:45 HSZ 1.OG

Eigenvalue study of a chaotic resonator — •Todorka Banova[1,2], Wolfgang Ackermann[1], and Thomas Weiland[1] — [1]Technische Universität Darmstadt, Institut für Theorie Elektromagnetischer Felder (TEMF), Schlossgartenstraße 8, D-64289 Darmstadt, Germany — [2]Technische Universität Darmstadt, Graduate School of Computational Engineering, Dolivostraße 15, D-64293 Darmstadt, Germany

The field of quantum chaos comprises the study of the manifestations of classical chaos in the properties of the corresponding quantum systems. Within this work, we compute the eigenfrequencies that are needed for the level spacing analysis of a microwave resonator with chaotic characteristics. The major challenges posed by our work are: first, the ability of the approaches to tackle the large scale eigenvalue problem and second, the capability to extract many, i.e. order of thousands, eigenfrequencies for the considered cavity. The first proposed approach for an accurate eigenfrequency extraction takes into consideration the evaluated electric field computations in time domain of a superconducting cavity and by means of signal-processing techniques extracts the eigenfrequencies. The second approach is based on the finite element method with curvilinear elements, which transforms the continuous eigenvalue problem to a discrete generalized eigenvalue problem. Afterwards, the Lanczos algorithm is used for the solution of the generalized eigenvalue problem. In the poster, a summary of the applied algorithms, as well as, critical implementation details together with the simulation results will be provided.

T 129.10 Mi 16:45 HSZ 1.OG

Simulations of beam transport at FRANZ — •Ole Hinrichs, Oliver Meusel, Kerstin Sonnabend, Rene Reifarth, Daniel Noll, Malte Schwarz, Manuel Heilmann, and Stefan Schmidt — Goethe-Universität Frankfurt

The Frankfurt Neutron Source at the Stern-Gerlach-Zentrum (FRANZ) currently under construction is operated by a proton beam of up to 20 mA current with energies between 1.8 and 2.2 MeV. This facility aims to explore proton- and neutron-induced reactions of astrophysical interest. The high proton flux is well suited for studying p-nuclei. Their nucleosynthesis might yield hints on the physics of type Ia supernovae. Furthermore, FRANZ will offer the opportunity to measure radiative neutron capture reactions for the unstable branch point nuclei of the s-process.

This poster will present the current status of the beam line towards the neutron production target and the setup to measure proton-induced reactions. It will focus on simulations to optimise beam transport and phase space distribution with respect to a variable beam spot size to provide optimal experimental conditions.

This project is supported by the DFG (SO907/1-2), the Helmholtz International Center for FAIR, the Helmholtznachwuchsgruppe VH-NG-327.

T 129.11 Mi 16:45 HSZ 1.OG

Quantifizierung von durch Messfehler bedingten Unsicherheiten in Magnetfeldern — Andreas Bartel[1], Herbert De Gersem[2], Timo Hülsmann[1], •Ulrich Römer[3], Sebastian Schöps[3,4] und Thomas Weiland[3] — [1]Bergische Universität Wuppertal, Chair of Applied Mathematics, Wuppertal, Germany — [2]KU Leuven, Wave Propagation and Signal Processing Group, Kortrijk, Belgium — [3]Technische Universität Darmstadt, Institut für Theorie Elektromagnetischer Felder, Darmstadt, Germany — [4]Technische Universität Darmstadt, Graduate School of Computational Engineering, Darmstadt, Germany

Eine Herausforderung im Designprozess für Beschleunigermagnete ist das stark nichtlineare Verhalten ferromagnetischer Materialien. Da die nichtlineare BH-Kennlinie durch Messungen bestimmt wird enthalten Simulationsergebnisse, wie die Berechnung von Multipolkoeffizienten, zwangsläufig Unsicherheiten. Zu deren Quantifizierung wurden in letzter Zeit verschiedene neue Verfahren vorgeschlagen, darunter das stochastische Kollokationsverfahren mit polynomialen Chaos. Ein zentraler Vorteil dieses Verfahrens ist der nicht-intrusive Charakter, das heißt bestehende Simulationsverfahren können direkt weiterverwendet werden. Diese Arbeit beschreibt die Anwendung einer stochastischen Kollokationsmethode zur Quantifizierung von Unsicherheiten in den Multipolkoeffizienten eines Beschleunigermagneten. Die Materialkennlinie wird durch das Brauermodell mit entsprechenden Messunsicherheiten modelliert. Als Anwendung werden Ergebnisse für einen Dipolmagneten gezeigt.

T 129.12 Mi 16:45 HSZ 1.OG

Die gekoppelte RFQ-IH Kombination der Neutronenquelle FRANZ — •Manuel Heilmann, Dominik Mäder, Oliver Meusel, Ulrich Ratzinger, Alwin Schempp und Malte Schwarz — Goethe Universität, Frankfurt

Die Frankfurter Neutronenquelle am Stern-Gerlach Zentrum (FRANZ-Projekt) liefert Neutronen hoher Intensität mit einer Energie zwischen 1 und 300 keV. Die Neutronen werden mit 2 MeV Protonen über eine 7Li(p,n)7Be Reaktion erzeugt. Die Linearbeschleuniger-Sektion enthält einen 4-Rod-RFQ gekoppelt an eine 8 Spalt IH-Kavität mit einer Gesamtlänge von 2,3 m. Die RFQ-IH-Kombination ermöglicht dabei einen Energiehub von 120 keV auf 2,03 MeV bei 175 MHz und einer Verlustleistung um 200 kW. Die gekoppelte Struktur wird von einem HF-Sender betrieben, um Anschaffungs- bzw. Betriebskosten zu sparen. Die Leistung wird induktiv in den RFQ eingekoppelt und die IH-Struktur wird über eine induktive interne Kopplung mit angeregt. Die RFQ-IH Kombination ist mit numerischen Simulationen und an einem HF-Model untersucht worden. Die longitudinale Spannungsverteilung entlang der Elektroden, die Frequenz und das Spannungsverhältnis zwischen beiden Kavitäten müssen für den Betrieb zueinander passen. Die RFQ Elektroden sind für einen Strahlstrom von 50 mA ausgelegt. Die Kavitäten werden wegen der kritischen Zeitstruktur im Dauerstrich (cw) betrieben, denn der Strahl ist mit 100 ns (250 kHz) gepulst.

T 129.13 Mi 16:45 HSZ 1.OG

Beam Dynamics in a Rebunching CH Cavity with High Space Charge — •Malte Schwarz, Manuel Heilmann, Oliver Meusel, Daniel Noll, Holger Podlech, Ulrich Ratzinger, and Anja Seibel — Institute for Applied Physics, Goethe-University, Frankfurt/Main, Germany

The Frankfurt Neutron Source at the Stern-Gerlach-Zentrum (FRANZ) will provide ultra short neutron pulses at high intensities and repetition rates. The facility is under construction with expected first beam in 2013. It will allow research on nucleosynthesis of elements in stars by the s-process as well as on neutron capture cross sections for activation experiments providing knowledge gain on transmutation of radioactive waste and fusion reactor materials. The 5-gap CH re-buncher is installed behind a coupled RFQ/IH-DTL combination and completes the LINAC section. It will be used for varying the output energy between 1.8 and 2.2 MeV as well as for focusing the proton beam bunch longitudinally to compensate the huge space charge forces at high currents up to 200 mA.

Therefore beam dynamics and beam transport performance research on this CH cavity is under progress. It includes benchmarking of different beam dynamic codes like LORASR, TraceWin and a new particle-in-cell tracking code for non-relativistic beams currently under development at IAP as well as validation of the results by measurements. Furthermore, this CH rebuncher serves as prototype for CH cavity operation at MYRRHA (Mol, Belgium), an Accelerator Driven System (ADS) for transmutation of high level nuclear waste.

T 129.14 Mi 16:45 HSZ 1.OG

Neue Methode zur Reduzierung des Anteils der Strahlposition im quadrupolaren Signal — •Joel Alain Tsemo Kamga, Wolfgang F. O. Müller und Thomas Weiland — Theorie Elektromagnetischer Felder, Schloßgartenstrasse 8, 64289 Darmstadt

Quadrupolare Pickups sind in der Beschleunigerphysik von besonderer Bedeutung, weil sie die Messung bestimmter Parameter, wie der transversalen Ausdehnung des Strahls, ermöglichen. Dennoch ist das quadrupolare Signal aus einem üblichen elektrostatischen Pickup mit vier Elektroden nicht nur proportional zur r.ms. der Strahldimension ($\sigma_x^2-\sigma_y^2$), sondern hängt auch von der Strahlposition (x^2-y^2) ab. Insofern kann aus einem solchen Pickup die zu messende Strahldimension nicht direkt bestimmt werden, sondern erst nachdem der Anteil der Strahlposition von dem quadrupolaren Signal abgezogen wurde. Eine angemessene Genauigkeit erreicht man jedoch nur, wenn die Strahlposition klein gegenüber der transversalen Abmessung des Strahls ist. Das Ziel dieser Arbeit besteht darin, eine neue Methode zur Bestimmung des quadrupolaren Signals mit möglichst geringer Abhängigkeit von der Strahlposition.

T 129.15 Mi 16:45 HSZ 1.OG

Beam Dynamics in Magnetic Quadrupol Triplets — •Christine Claessens, Manuel Heilmann, Oliver Meusel, Holger Podlech, Ulrich Ratzinger, and Christoph Wiesner — IAP, University of Frankfurt, Germany

The Frankfurt Neutron source at the Stern-Gerlach-Zentrum (FRANZ) will produce high intensity neutron pulses in the energy range of 1 to 500 keV at a very short repetition rate. The neutrons are gained from 7Li(p,n)7Be reactions induced by 2 MeV protons and will be used to examine the nucleosynthesis during the s-process as it occurs in stars, cross sections of neutron capture reactions as well as the behaviour of non-neutral plasmas. In the linear accelerator section, consisting of a 4-rod-radio-frequency-quadrupol and a H-type drift tube linac, the proton pulses are accelerated to 2.03 MeV. Inside the drift tube cavity a magnetic quadrupole triplet will be integrated, in order to compensate transversally defocussing effects and therefore avoid losses. Behind the linear accelerator section the proton beam ist rebunched in a 5-cell CH-rebuncher which is framed by two more quadrupole triplets. To investigate the beam dynamics inside the magnetic quadrupole triplets, various magnetostatic and particle tracking codes like CST Studio and LORASR were used to simulate the beam transport properties of the magnets and compare the individual magnetic field distributions with the ones measured at the magnet laboratory at GSI. In doing so, important aspects to be considered are the longitudinal and transversal fringe fields and the saturation effects which all possibly cause emittance growth and geometrical aberrations.

T 129.16 Mi 16:45 HSZ 1.OG

Development of a reusable beam profile analyzer for laser accelerated proton beams — •Simon Frydrych, Simon Busold, Oliver Deppert, and Markus Roth — Institut für Kernphysik, TU Darmstadt, Schlossgartenstraße 9, 64289 Darmstadt

At the GSI Helmholtzzentrum für Schwerionenforschung GmbH, proton beams are generated with the PHELIX laser system through target normal sheath acceleration (TNSA). Within 1 ps, 10^{13} protons are produced with an exponential energy spectrum up to 50 MeV. For characterisation, the spatial beam profile is currently detected by a stack of radiochromatic films (RCF). These are blued depending on the beam intensity. One disadvantage of RCFs is its one-time usability. Therefore, they shall be replaced by a scintillator array. To ensure the longest possible shelf life of this new detector, the scintillator material used must be very robust against radiation damage. Also a point of current research is the maximal amount of particles, which can be detected separately.

T 129.17 Mi 16:45 HSZ 1.OG

Design and calibration of ultra-short, broadband (200nm - 12 μm), single-shot spectrometer for ultrashort electron bunch durations diagnostics — •Omid Zarini, Alexander Debus, Michael Bussmann, Jurjen Couperous, Arie Irman, Wolfgang Seidel, and Ulrich Schramm — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The properties of electron bunch based on the Laser-Wakefield accelerators (LWFA) vary from shot to shot due to changes in the environment, such as gas jet profile or laser pointing. In order to understand the properties of these ultra-short electron bunches like bunch duration and bunch substructure in the range of 0.7 to 40 fs we are building a broadband-spectrometer for measuring coherent and incoherent transition radiation (TR).

Our TR-spectrometer is able to measure the TR-spectrum from a thin Al-foil in a single shot experiment from UV (200 nm) to mid-IR (12 μm) by means of a CCD detector for the UV to VIS range and two array detectors for the NIR and MIR range. In this poster we present our design and calibration results of the detectors.

T 129.18 Mi 16:45 HSZ 1.OG

Niederenergetischer Strahltransport intensiver Ionenstrahlen für FRANZ — •Philipp Schneider, Hannes Dinter, Martin Droba, Oliver Meusel, Daniel Noll, Onur Payir, Ulrich Ratzinger und Christoph Wiesner — IAP, Goethe-Universität Frankfurt, Max-von-Laue-Str. 1, D-60438 Frankfurt am Main

Der Transport niederenergetischer Ionenstrahlen stellt insbesondere bei hohen Strahlintensitäten eine Herausforderung dar. In der Low Energy Beam Transport Section (LEBT) der Frankfurter Neutronenquelle FRANZ werden zur Fokussierung entlang der Transportstrecke vier Solenoide eingesetzt.

Die ersten beiden Solenoide fokussieren den Strahl in ein Choppersystem, das notwendig ist, um die für die Messung von Neutroneneinfangquerschnitten notwendigen Zeitstrukturen dem Ionenstrahl aufzuprägen. Zwei weitere Solenoide passen den Strahl der Akzeptanz der anschließenden Beschleunigerstruktur an.

Wegen des von der Akzeptanz geforderten kleinen Radius werden die dort wirkenden Raumladungskräfte sehr hoch. Die daraus resultierende Aufweitung des Strahls muss mit hoher Genauigkeit berechnet werden, da die zu erwartenden Verlustleistungen eines falsch fokussierten Strahls in der anschließenden Beschleunigungsstruktur zu einer Leistungsdeposition von bis zu $200kW/cm^2$ führen können.

Es werden Simulationen für den Strahltransport und zur Betrachtung der Strahldynamik vorgestellt.

T 129.19 Mi 16:45 HSZ 1.OG

Relativistic LTE fluid plasma simulation — •Leon Buikstra[1,2], Michael Bussmann[1], Fred van Goor[2], Arie Irman[1], Ulrich Schramm[1], and Thomas Cowan[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Universiteit Twente, Enschede, The Netherlands

To allow simulation of nanosecond scale plasma processes, we are developing a 3D fully relativistic fluid code with LTE (local thermal equilibrium) closure. This code is intended to be able to take output from PIC simulations as its initial state, to allow self-consistent simulation of processes acting over multiple time and density scales. In this code, both electrons and ions are treated as inertial fluids. Local fluid pressure is tied to the energy density using the Maxwell-Jüttner distribution, allowing investigation of the effect of local temperatures on, for example, the expanding sheath in TNSA (target normal sheath acceleration) experiments.

T 129.20 Mi 16:45 HSZ 1.OG

Entwicklung des Krylov-Schur Eigenwertlösers für supraleitende Beschleunigungsstrukturen — •Vladimir Kudrin, Wolfgang Ackermann, Wolfgang F.O. Müller und Thomas Weiland — Theorie Elektromagnetischer Felder, TU Darmstadt, Darmstadt, Deutschland

In vielen Linearbeschleunigern werden zum effizienten Beschleunigen der geladenen Teilchenstrahlen erfolgreich geeignete Hochfrequenzresonatoren eingesetzt. Der Übertrag der Energie von den Quellen zu den einzelnen Teilchen erfolgt mit Hilfe der Kavitäten über ein gezielt von außen angeregtes elektromagnetisches Feld. Als unerwünschter Nebeneffekt tritt dabei der Teilchenstrahl selbst als die Quelle für breitbandige elektromagnetische Felder auf. Die angeregten parasitäre Moden erschweren ihrerseits den Betrieb des Beschleunigers oder können ihn gar gefährden. Die Anregung der Moden höherer Ordnung (engl. higher order modes, HOM), hängt dabei sowohl von der Geometrie der verwendeten Resonatoren als auch von der Verteilung des Teilchenstrahls ab und kann praktisch nicht vermieden werden. Für die in der Praxis relevanten Fälle kann die Berechnung dieser Moden nur numerisch durchgeführt werden. Zur Lösung kann man beispielsweise auf komplexwertige Eigenwertformulierungen zurückgreifen, wofür im Rahmen der vorgestellten Arbeit ein geeignetes Simulationswerkzeug basierend auf Krylov-Schur Verfahren entwickelt wurde.

T 129.21 Mi 16:45 HSZ 1.OG

TADPOLE for longitudinal electron-bunch diagnostics based on electro-optic upconversion — •Jan-Patrick Schwinkendorf, Steffen Wunderlich, Bernhard Schmidt, and Jens Osterhoff — Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, 22607 Hamburg, Germany

Electron-bunch diagnostics are desired to utilize unambiguous, non-destructive, single-shot techniques. Various methods fulfill the latter two demands, but feature significant ambiguities and constraints in the reconstruction of a time-domain electron-bunch profile, as for example uncertainties due to the phase retrieval of coherent radiation using the Kramers-Kronig relation. We present a novel method of upconverting the THz-field spectrum of fs electron bunches at the free-electron laser FLASH into the near-infrared in an electro-optic crystal. This technique allows the single-shot detection of its longitudinal form factor in both, amplitude and phase. The spectral phase and amplitude information is measured and thus the temporal profile reconstructed using temporal analysis by dispersing a pair of light E-fields, also known as TADPOLE. This is a combination of frequency resolved optical gating (FROG) and spectral interferometry, which enables the temporal measurement of low-power laser pulses. In this experiment, a narrow-bandwidth laser pulse detecting the longitudinal electric field of an electron bunch is interfered with a broadband and FROG-characterized reference pulse. The longitudinal beam profile may therefore be unambiguously inferred from the generated interferogram and the detected spectral-phase-information of the reference pulse.

T 129.22 Mi 16:45 HSZ 1.OG

Beam Dynamics Simulation of the S-DALINAC Injector Section — •Sylvain Franke, Wolfgang Ackermann, and Thomas Weiland — Institut für Theorie Elektromagnetischer Felder , Technische Universität Darmstadt, Darmstadt, Germany

In order to extend the experimental possibilities at the superconducting electron linear accelerator S-DALINAC a new polarized gun has recently been installed in addition to the well-established thermionic electron source. Beside the two electron sources the injector section consists of several short quadrupole triplets, an alpha magnet, a Wien filter and a chopper/prebuncher system. The setup of these components differs depending on whether bunched polarized electrons with kinetic energy in the 100 keV range are supplied by the polarized source or whether a continuous unpolarized 250 keV electron beam is extracted from the thermionic gun. The electrons pass through the injector at a relatively low energy and therefore are very sensitive to the beam forming elements in this section. Thus, a proper knowledge of the particle distribution at the exit of the injector section is essential for the quality of any simulation of the subsequent accelerator parts. In this contribution first numerical beam dynamics simulation results of the S-DALINAC injector setup will be discussed.

T 129.23 Mi 16:45 HSZ 1.OG

PIConGPU - How to built one of the fastest GPU particle-in-cell codes in the world — •Heiko Burau[1], Alexander Debus[1], Anton Helm[1], Axel Hübl[1], Thomas Kluge[1], Rene Widera[1], Michael Bussmann[1], Ulrich Schramm[1], Thomas Cowan[1], Guido Juckeland[2,3], Felix Schmitt[4], and Wolfgang Nagel[2,3] — [1]HZDR, Dresden — [2]TU Dresden — [3]ZIH Dresden — [4]NVIDIA

We present the algorithmic building blocks of PIConGPU, one of the fastest implementations of the particle-in-cell algortihm on GPU clusters. PIConGPU is a highly-scalable, 3D3V electromagnetic PIC code that is used in laser plasma and astrophysical plasma simulations.

T 129.24 Mi 16:45 HSZ 1.OG

PIConGPU - Physics Validation for Laser Plasma and Astrophysics Plasma Simulations — Axel Hübl[1], Heiko Burau[1], Anton Helm[1], Rene Widera[1], Alexander Debus[1], Thomas Kluge[1], Jurjen Couperous[1], Arie Irman[1], Michael Bussmann[1], Ulrich Schramm[1], Thomas Cowan[1], Felix Schmitt[2], Guido Juckeland[3,4], and •Wolfgang Nagel[3,4] — [1]HZDR, Dresden — [2]NVIDIA — [3]TU Dresden — [4]ZIH, Dresden

PIConGPU is a highly-scalable implementation of a 3D3V electromagnetic particle-in-cell code. It allows for fast simulations of laser plasma interaction and astrophysical plasmas. We present several physics validation results and show applications in laser wakefield acceleration of electrons instabilities in plasmas.

T 129.25 Mi 16:45 HSZ 1.OG

Pulsed power magnet technology for laser particle acceleration and laser plasma physics - a survey of developments at Helmholtz-Zentrum Dresden-Rossendorf — •Florian Kroll[1,2], Trevor Burris-Mog[1], Thomas Herrmannsdörfer[1], Martin Joost[1,2], Stephan Kraft[1], Umar Masood[1], Hans-Peter Schlenvoigt[1], Manfred Sobiella[1], Bernd Wustmann[1], Sergei Zherlitsyn[1], Thomas Cowan[1], and Ulrich Schramm[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]TU Dresden

Since the mid-1950s, pulsed high-field magnets have become a common, versatile research tool with application mostly in solid state physics and material research. Recently developed pulsed power magnet technology, specifically designed to meet the demands of laser acceleration and laser plasma experiments, open up new research opportunities:

We present a pulsed air core solenoid (up to 20 T) for effective collection and focusing of laser accelerated particles. It could function as a crucial part of a compact, laser-based ion source (pursued by the LIGHT collaboration) or of beam guidance systems. Furthermore, the poster shows a split pair coil, utterly compact and with optical access in between the coil pairs and on axis, to study laser-driven plasma expansion under high magnetic fields (~ 30 T). To power such devices, portable capacitor-based pulse generators have been developed at Helmholtz-Zentrum Dresden-Rossendorf. We present first results of the functional testing of our third-generation pulse generator. Looking forward, we outline a concept for a medical gantry based on pulsed high field beam optics.

T 129.26 Mi 16:45 HSZ 1.OG

Generation and Transport of laser accelerated ion beams — •Peter Schmidt[1,2], Oliver Boine-Frankenheim[1,2], Vladimir Kornilov[2], and Peter Spädtke[2] for the LIGHT-Collaboration — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Currently the LIGHT- Project (Laser Ion Generation, Handling and Transport) is performed at the GSI Helmholtzzentrum für Schwerionenforschung GmbH Darmstadt. Within this project, intense proton beams are generated by laser acceleration, using the TNSA mechanism. After the laser acceleration the protons are transported through the beam pipe by a pulsed power solenoid. To study the transport a VORPAL 3D simulation is compared with CST simulation. A criterion as a function of beam parameters was worked out, to rate the importance of space charge. Furthermore, an exemplary comparison of the solenoid with a magnetic quadrupole-triplet was carried out. In the further course of the LIGHT-Project, it is planned to generate ion beams with higher kinetic energies, using ultra-thin targets. The acceleration processes that can appear are: RPA (Radiation Pressure Acceleration) and BOA (Break-Out Afterburner). Therefore the transport of an ion distribution will be studied, as it emerges from a RPA acceleration.

T 129.27 Mi 16:45 HSZ 1.OG

Higher Order Modes in Superconducting Radio Frequency Resonators for Energy Recovery Linacs — •Tomasz Galek and Ursula van Rienen — Universität Rostock, Institut Allgemeine Elektrotechnik, Albert-Einstein-Str. 2, 18051 Rostock, Germany

The main scope of this work is the automation of the extraction procedure of the external quality factors of Higher Order Modes (HOMs) in Superconducting Radio Frequency (SRF) cavities. The HOMs are generated by charged particle beams traveling through a SRF cavity at the speed of light. The HOMs decay very slowly, depending on localization inside the structure and cell-to-cell coupling, and may influence succeeding charged particle bunches. Thus it is important, at the SRF cavity design optimization stage, to calculate the external quality factors (Qext) of HOMs. Traveling Poles Elimination (TPE) scheme was used to automatically extract Qext from the transmission spectra and careful eigenmode analysis of the SC cavity was performed to confirm TPE results. The eigenmode analysis also delivers important information about band structure, cell-to-cell coupling of HOMs and allows rapid identification of modes that could interact with the charged particle bunches.

T 129.28 Mi 16:45 HSZ 1.OG

First coupled CH Power Cavity for the FAIR Proton Injector — •Robert Brodhage[1], Ulrich Ratzinger[1], Wolfgang Vinzenz[2], and Gianluigi Clemente[2] — [1]IAP, Uni Frankfurt — [2]GSI, Darmstadt

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. Each cavity will be powered by a 2.5 MW Klystron. For the second acceleration unit from 11.5 MeV to 24.2 MeV a 1:2 scaled model has been built. Low level RF measurements have been performed to determine the main parameters and to prove the concept of coupled CH cavities. In Summer 2012, the assembly and tuning of the first power prototype was finished. Until then, the cavity was tested with a preliminary aluminum drift tube structure, which was used for precise frequency and field tuning. Before Spring 2013 the final drift tube structure will be welded inside the main tanks and the preparation for copper plating will take place. This paper will report on the main tuning and commissioning steps towards that novel type of DTL and it will show the latest results measured on a fully operational CH proton cavity.

T 129.29 Mi 16:45 HSZ 1.OG

Design Study of a High Frequency Proton Ladder RFQ — •Robert Brodhage and Ulrich Ratzinger — IAP, Uni Frankfurt

For the research program with cooled antiprotons at FAIR a dedicated 70 MeV, 70 mA proton injector is required. In the low energy section, between the Ion Source and the main linac an RFQ has to be designed. Accelerating protons from 95 keV to 3.0 MeV the RFQ will oscillate at 325 MHz. This particular high frequency for an RFQ creates difficulties which are challenging in developing this cavity. In order to define a satisfactory geometrical configuration for this resonator, both from the RF and the mechanical point of view, different designs have been examined and compared. Very promising results have been reached with an ladder type RFQ, especially concerning the dipole component of the accelerating fields, which is almost not noticeable. This paper will show 3D simulations of the general layout and a whole cavity demonstrating the power of a ladder type RFQ. It will outline a possible layout for the RFQ within the new FAIR proton injector.

T 129.30 Mi 16:45 HSZ 1.OG

Hollow Beam creation with diffractive phase masks at PHELIX — •Christian Brabetz[1], Simon Busold[2], Oliver Deppert[2], Oliver Kester[1,2], Dennis Schumacher[3], Florian Wagner[2], Bernhard Zielbauer[3], and Vincent Bagnoud[3] for the LIGHT-Collaboration — [1]Goethe-Universität Frankfurt, Senckenberganlage 31, 60325 Frankfurt am Main, Germany — [2]Technische Universität Darmstadt, Karolinenplatz 5, 64289 Darmstadt, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt , Germany

In the framework of the Laser Ion Generation Handling and Transport (LIGHT) research project at GSI, the reduction of the divergence of the laser accelerated ions is a central issue. One solution resides on engineering the electron sheath using in TNSA for reducing the initial divergence of the ion beam. In our first attempt, we were successful in creating and propagating a *donut* laser mode at the PHELIX laser. We have then conducted a experimental campaign at PHELIX

One sees a qualitative effect of the focal spot beam shape on the ion beam divergence as expected.

The energy cut-off in the proton spectrum was nearly higher when a donut focus was applied, although this resulted in contradiction with the intensity scaling law of TNSA.