Radiation and Medical Physics Division
Fachverband Strahlen- und Medizinphysik (ST)

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Overview of Invited Talks and Sessions

Plenary Talk

See plenary section for details.

PV VI	Wed	9:45–10:30	ZHG011	**Image-guided radiotherapy for cancer treatment: recent developments and future innovations** — •Daniela Thorwarth

Invited Talks

ST 2.1	Tue	16:15–16:45	ZHG003	**Photonenzählende Detektoren: Der nächste Schritt in der klinischen CT-Bildgebung** — •Thomas Stein
ST 2.2	Tue	16:45–17:15	ZHG003	**Life-view 3D endoscopy for colorectal cancer screening based on MHz optical coherence tomography** — •Maik Rahlves, Awanish Singh, Madita Göb, Sazgar Burhan, Simon Lotz, Wolfgang Draxinger, Berenice Schulte, Marvin Heimke, Tillmann Heinze, Mario Pieper, Thilo Wedel, Mark Ellrichmann, Robert Huber
ST 2.3	Tue	17:15–17:45	ZHG003	**Engineering Precision Medicine with Magnetic Imaging Techniques** — •Ioana Slabu
ST 4.1	Wed	13:45–14:15	ZHG009	**Mixed ion beams for treatment monitoring: recent developments and future prospects** — •Elisabeth Renner, Hermann Fuchs, Matthias Kausel, Claus Schmitzer
ST 9.1	Thu	17:15–17:45	ZHG003	**Making Surgery Intelligent: From Autonomous Systems to the Intelligent OR** — •Jannis Hagenah

Invited Talks of the joint Symposium SMuK Dissertation Prize 2025 (SYMD)

See SYMD for the full program of the symposium.

SYMD 1.1	Mon	14:15–14:45	ZHG011	**Fluid-dynamic description of heavy-quark diffusion in the quark-gluon plasma** — •Federica Capellino
SYMD 1.2	Mon	14:45–15:15	ZHG011	**Fast and faithful effective-one-body models for gravitational waves from generic compact binaries** — •Rossella Gamba
SYMD 1.3	Mon	15:15–15:45	ZHG011	**Nuclear Structure Near Doubly Magic Nuclei** — •Lukas Nies
SYMD 1.4	Mon	15:45–16:15	ZHG011	**Optimisation strategies for proton acceleration from thin foils with petawatt ultrashort pulse lasers** — •Tim Ziegler

Sessions

ST 1.1–1.6	Tue	13:45–15:15	ZHG003	**Computational Methods and Simulation**
ST 2.1–2.3	Tue	16:15–17:45	ZHG003	**DPG meets DGMP: Future Perspectives on Tomographic Imaging Techniques**
ST 3.1–3.6	Wed	11:00–12:30	ZHG003	**Radiation Monitoring and Dosimetry**
ST 4.1–4.7	Wed	13:45–15:45	ZHG009	**Accelerators for Medical Applications (joint session ST/AKBP)**

ST 5.1–5.4	Wed	16:15–17:15	ZHG003	**Detector Physics**
ST 6.1–6.4	Thu	11:00–12:00	ZHG003	**Medical Imaging and Treatment Monitoring**
ST 7.1–7.6	Thu	13:45–15:45	ZHG Foyer 1. OG	**Poster Session**
ST 8.1–8.4	Thu	16:15–17:15	ZHG003	**Particle Radiography**
ST 9.1–9.1	Thu	17:15–17:45	ZHG003	**Keynote Session**
ST 10	Thu	17:45–18:00	ZHG003	**Prize Ceremony and Closing Session**
ST 11	Thu	18:15–19:15	ZHG003	**Members' Assembly**

Members' Assembly of the Radiation and Medical Physics Division

Thursday 18:15–19:15 ZGH003

ST 1: Computational Methods and Simulation

Time: Tuesday 13:45–15:15 Location: ZHG003

ST 1.1 Tue 13:45 ZHG003

Geant4 Tool for Characterizing and Optimizing Albedo Dosimeters: Impact of Filter Configuration and Material Composition — •Suliman Harbaji[1], Kevin Kröninger[1], Andria Michael[1], Jörg Walbersloh[2], and Jens Weingarten[1] — [1]Technical University Dortmund, Dortmund, Germany — [2]Materials Testing Office, Dortmund, Germany

Thermoluminescence albedo dosimeters are employed to measure neutron and photon whole-body doses resulting from occupational radiation exposure. These dosimeters operate based on the albedo effect, in which neutron radiation is backscattered by the body and subsequently detected by the dosimeter components.

The albedo dosimeters consist of an arrangement of four detectors embedded in neutron absorbers, commonly referred to as filters. A critical factor in dosimeters functionality is the configuration of these filters. Additionally, the composition and thickness of the filters have a significant influence on the detection efficiency.

For a detailed characterization of albedo dosimeters and their functionality, a simulation tool was developed using Geant4. The study focuses on neutron interactions with the dosimeter under various filter configurations, material compositions, filter thicknesses, and detector material thicknesses. The results of the simutation provide valuable insights into optimising the detection properties and therefore improving the measurement accuracy of albedo dosimeters.

In this talk, the developed Geant4 tool and the results of the simulations will be presented and discussed.

ST 1.2 Tue 14:00 ZHG003

Experimental tuning of Geant for Cherenkov radiation of electrons — Yazeed Balasmeh, •Daniel Berker, Ivor Fleck, and Lars Maczey — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

Geant4 is a powerful tool and indispensable for the investigation of particle interactions as well as detector developments. But since there exists a variety of parameters, it is possible to make too idealistic simulations. Verifying a simulation by an experimental setup is a proper way to achieve simulations as realistic as possible. The aim of this talk is to experimentally verify the production of Cherenkov radiation as simulated in Geant4.

The main setup consists of a Strontium-90 source, placed in a vacuum chamber, whose emitted electrons with energies up to 2.2 MeV are bent in a homogeneous magnetic field with an adjustable field strength between 20 mT and 80 mT. After passing through the magnetic field, the electrons will hit a PMMA layer producing Cherenkov photons, that are detected by a SiPM array. A collimator in front of the PMMA reduces the energy spread to values below 5%. The setup is calibrated with Bismuth-207 to confirm the energy of the electrons after passing through the magnetic field.

This talk presents the current status of the experiment and underlines the importance of the interplay between simulation and experimental verification. In conclusion, I want to discuss my results regarding the development of a Cherenkov Compton camera.

ST 1.3 Tue 14:15 ZHG003

Fast dose predicition for treatment planning in matRad — •Ruben Trimpop[1], Carsten Burgard[1], Tobias Cremer[2], Cornelius Grunwald[1], Kevin Kröninger[1], Florian Mentzel[2], Marco Schlimbach[1], and Jens Weingarten[1] — [1]TU Dortmund — [2]Formerly TU Dortmund

Microbeam radiation therapy (MRT) is a preclinical method for tumor treatment, demonstrating potential for improved post-treatment outcomes. The method employs a multi-slit collimator to produce dose peaks with high dose rates, separated by valleys of lower dose rates. This method of spatially segmenting the beam, combined with applying high dose rates over a short amount of time, called FLASH-Therapy, enhances the survivability rate of healthy tissue.

A major impediment to the utilisation of this method is the large amount of time it takes for dose prediction using conventional methods. Previous research has successfully used Machine Learning (ML) networks to significantly reduce the required time for dose prediction.

In this work a ML network is integrated into matRad, an open source software for radiation treatment planning, developed for research purposes, substituting matRads internal dose prediction with a ML based dose prediction. This is one of the first steps to fully enable treatment planning for MRT.

This presentation will showcase the first results of ML integration into matRad, highlighting the advantages of ML-based dose prediction for MRT.

ST 1.4 Tue 14:30 ZHG003

Improving Brain Tumor Characterization Using Generative Neural Networks and Raw MRI Data — •Marco Schlimbach, Jens Kleesiek, Kevin Kröninger, Moritz Rempe, and Jens Weingarten — TU Dortmund University

Characterizing brain tumors from MRI scans remains a significant challenge in clinical practice. Determining the specific tumor type often requires invasive biopsies, which hold risks for patients. Research efforts aim to improve non-invasive tumor characterization by using machine learning techniques. However, despite significant advancements, the accuracy of these methods has not yet reached the level needed to reliably replace biopsies. Current state-of-the-art algorithms commonly rely on reconstructed MRI images optimized for human interpretation. These images are the result of complex reconstruction pipelines that discard the raw phase information.

This study investigates the diagnostic potential of raw MRI data, which retains phase information and provides a more comprehensive representation of scanned tissue. A novel workflow is introduced to generate synthetic raw MRI data, including both healthy scans and scans with lesions. By leveraging generative machine learning techniques alongside raw MRI data, this approach aims to reveal new features and insights that could enhance non-invasive tumor characterization.

ST 1.5 Tue 14:45 ZHG003

Autoencoder-based Anomaly Detection in MRI Raw Data — •Jessica Mnischek, Jens Weingarten, Kevin Kröninger, and Marco Schlimbach — TU Dortmund

Tumor distinction in medical imaging remains a challenging task due to the subtle differences between various tumor types and abnormal tissues. Magnetic Resonance Imaging (MRI) is a powerful diagnostic tool widely used in the detection and monitoring of tumors, providing detailed visualization of soft tissues.

To enhance diagnostic accuracy, machine learning methods have been increasingly applied to MRI data. Among these methods, autoencoders have demonstrated potential in detecting subtle differences between healthy and diseased scans. By training on healthy datasets, they learn compact, efficient representations of typical tissue patterns. When applied to diseased datasets, the reconstruction error can highlight anomalies, thereby facilitating the detection of irregularities that may indicate the presence of disease.

This study investigates the application of autoencoders to raw MRI data, which preserves the complete acquired information, including both magnitude and phase components. In contrast, standard MRI analyses mostly rely only on magnitude information. By working directly with raw MRI data, this approach explores the potential of utilizing phase information to more effectively differentiate between healthy and tumor-affected tissues.

ST 1.6 Tue 15:00 ZHG003

Cycle GAN-Based Style Transfer for Image Registration between Clinical and HiP-CT — Lukas Johanns[1], Michael Windau[1], Lucas Cremer[1], •Claire Walsh[2], Joe Jacob[2], Joseph Brunet[3], Paul Sweeney[4], and Stijn Verleden[5] — [1]TU Dortmund — [2]UCL London — [3]ESRF Grenoble — [4]Cancer Research UK — [5]UZA Antwerp

Registration is an image processing algorithm that enables the alignment of scans across domains. It finds applications in disease tracking and research, in the operating room, and as a preprocessing step for other machine learning algorithms.

However, registration across modalities requires careful tuning and preprocessing of the dataset, as different domains are often difficult to compare.

To improve the performance of registration algorithms, a Cycle-GAN model for style transfer is used as a preprocessing step. This model transfers the style of the target domain to the input image to enhance registration performance. This project investigates the performance and feasibility of such a deep learning model applied to Clinical-CT scans and high-resolution/high-contrast HiP-CT scans (Hierarchical Phase Contrast Tomography). In this talk, the concepts of registration and Cycle-GANs are briefly introduced. Afterwards, the results of our style-transfer network are presented, followed by a discussion of a future feasibility study for registration.

ST 2: DPG meets DGMP: Future Perspectives on Tomographic Imaging Techniques

Time: Tuesday 16:15–17:45 Location: ZHG003

Invited Talk ST 2.1 Tue 16:15 ZHG003
Photonenzählende Detektoren: Der nächste Schritt in der klinischen CT-Bildgebung — •Thomas Stein — Klinik für Diagnostische und Interventionelle Radiologie, Freiburg, Deutschland

Die Computertomographie hat sich als verlässliche Schlüsseltechnologie in Medizin und anderen Disziplinen etabliert. Nun halten Photonenzählende Detektoren (PCDs) verstärkt Einzug in die medizinische Bildgebung. PCDs erfassen einzelne Röntgenphotonen und ermitteln deren Energie, anstatt Signale, wie bisher, nur zu integrieren. Dadurch kann die räumliche Auflösung verbessert werden und unterschiedliche Gewebestrukturen sowie Materialien lassen sich präziser diskriminieren, was eine verfeinerte, spektrale CT-Bildgebung ermöglicht und damit die Patientenversorgung verbessert. Die Vorteile gehen über die bisherige Dual-Energy-CT hinaus: Spektrale Methoden erlauben, verschiedene Substanzen simultan zu analysieren und Artefakte zu reduzieren. Neue Kontrastmittel könnten damit besser identifiziert und die Diagnostik gesteigert werden. Darüber hinaus eröffnen Kooperationen mit der Grundlagenforschung ein erweitertes Spektrum an Untersuchungs- und Anwendungsmöglichkeiten, sodass neue Einsatzfelder erschlossen und wissenschaftliche Erkenntnisse gezielter vorangetrieben werden können. Fortschritte in der Signalverarbeitung, etwa durch iterative Rekonstruktionen und maschinelles Lernen, sorgen dafür, dass diese Weiterentwicklungen auch praktikabel werden. Die Photonenzähltechnologie stellt einen Quantensprung in der CT dar, erfordert jedoch weitere Forschung, um bestehende Herausforderungen zu meistern und ihr volles Potenzial auszuschöpfen.

Invited Talk ST 2.2 Tue 16:45 ZHG003
Life-view 3D endoscopy for colorectal cancer screening based on MHz optical coherence tomography — •Maik Rahlves[1], Awanish Singh[1], Madita Göb[1], Sazgar Burhan[1], Simon Lotz[1], Wolfgang Draxinger[1], Berenice Schulte[2], Marvin Heimke[3], Tillmann Heinze[3], Mario Pieper[4], Thilo Wedel[3], Mark Ellrichmann[2], and Robert Huber[1] — [1]Institute of Biomedical Optics, University of Lübeck, Lübeck, Germany — [2]Interdisciplinary Endoscopy, Medical Department 1, University Hospital Schleswig-Holstein, Campus Kiel, Kiel, Germany — [3]Center of Clinical Anatomy, Institute of Anatomy, Christian-Albrechts University Kiel, Kiel, Germany — [4]Institute of Anatomy, University of Luebeck, Luebeck, Germany

Colorectal cancer has one of the highest incidence rates among all types of cancer, which requires high resolution 3D imaging techniques for tissue layer differentiation for screening and tumor staging. We present our latest results on life-view 3D colorectal endoscopy based on Fourier-Domain Mode Locking Optical Coherence Tomography. The endoscope features a radially out-coupled rotating OCT-Laser beam. Our approach enables axial resolution of about 10 microns in tissue at A-scan rates of 3.4 MHz, which allows for screening large tissue areas as well as tissue layer differentiation. Solutions to common challenges such as Laser-triggering and non-uniform rotational scanning are presented. We present 3D images of human tissue obtained from ex-vivo body donor measurements. Furthermore, future prospects and preliminary results on novel OCT-imaging modalities are discussed.

Invited Talk ST 2.3 Tue 17:15 ZHG003
Engineering Precision Medicine with Magnetic Imaging Techniques — •Ioana Slabu — Institute of Medical Engineering, Helmut Schmidt University Hamburg — Institute of Applied Medical Engineering, Helmholtz Institute, Medical Faculty, RWTH Aachen University

Magnetic imaging techniques such as magnetic resonance imaging (MRI) and magnetic particle imaging (MPI) are of great interest in precision medicine. They have the potential to contribute to tremendous developments in two of the most challenging issues of today's healthcare: (i) early and precise detection of diseases with minimally invasive methods, and (ii) personalized therapy with high success rates and low side effects. This potential is largely driven by the development of image-guided therapies with magnetic nanomaterials, which are applied as contrast agents in MRI and as tracers MPI. Medical devices (e. g. stents, drug carriers) doped with magnetic nanomaterials are designed to respond to magnetic external stimuli, allowing them to sense, interact with, and adapt to their environment according to the therapeutical need. The talk focusses on the concept and realization of image-guided therapies based on such devices, highlighting the huge advantage of their *in vivo* monitoring in MRI and MPI.

ST 3: Radiation Monitoring and Dosimetry

Time: Wednesday 11:00–12:30 Location: ZHG003

ST 3.1 Wed 11:00 ZHG003
Dosimetry for sub-relativistic electrons and their potential use in radiotherapy — •Julian Freier[1], Leon Brückner[1], Stefanie Kraus[1], Julian Litzel[1], Bastian Löhrl[1], Christoph Bert[2], Luitpold Distel[2], and Peter Hommelhoff[1,3] — [1]Department Physik, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), 91058 Erlangen — [2]Department Strahlenbiologie, Universitätsklinikum Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), 91054 Erlangen — [3]Department Physik, Ludwig-Maximilians-Universität München (LMU), 80799 München

The acceleration of electrons based on nanophotonic structures may lead to dice-sized accelerators, emitting electrons with energies in the sub-MeV to MeV regime for potential use in radiotherapy [1,2,3]. Leveraging electron energies in the keV range and their proposed high biological efficiency [4], we present a method for calibrating EBT3 GafChromic films for low-energy electrons to be used in future experiments in biology. The used setup employs an ultrafast electron source, utilizing photoemission from a sharp nano-tip array that enables irradiation of cells with electrons up to 50keV for comparison with x-ray samples. This method allows to estimate the biological impact of such electron radiation on cells. References [1] England, et al., Rev.Mod.Phys.86.4 1337 (2014)[2] Chlouba, Shiloh, Kraus, Brückner, et al. Nature 622, 476 480 (2023) [3] Broaddus, et al. PRL 132, 085001 (2024) [4] Tye, et al, R.Soc. Open Sci.11240898 (2024)

ST 3.2 Wed 11:15 ZHG003
Investigating Regenerating Profiles for TL-Dos Detectors — •Paula Harnisch[1], Kevin Kröninger[1], Jörg Walbersloh[2], and Jens Weingarten[1] — [1]TU Dortmund — [2]MPA NRW

Reliable personal monitoring is essential for occupational radiation exposures. Lately, a thermoluminescence-based monitoring system was developed by MPA Dortmund and TU Dortmund, offering the advantage of reusable detectors. This study systematically examines the effects of different regeneration profiles on the lifetime dose signal and the fading characteristics of TL-DOS detectors.
Regeneration, the process of thermally exciting electrons trapped during radiation exposure, restores the detector to a baseline, signal-free state, making it ready for reuse. Traditionally, detectors are briefly heated to a high temperature post-readout, but recent findings suggest this method may not fully reset the signal. To address this, alternative regeneration profiles are being explored, with promising potential to reduce or even eliminate signal fading in TL-DOS detectors.

This presentation will provide an introduction to TL-DOS detector functionality and an overview of the various regeneration profiles tested, highlighting advancements toward improved detector reliability and longevity.

ST 3.3 Wed 11:30 ZHG003

Development of an H*(10) neutron dosimeter based on the TL-DOS for neutron and gamma dose measurements at TRIGA reactor Mainz — •Andria Michael[1], Kevin Kröninger[1], Marion Schulte[2], Jörg Walbersloh[2], and Jens Weingarten[1] — [1]University of Dortmund, Dortmund, Germany — [2]Materials Testing Office, Dortmund, Germany

The PhyBioN project, involving the TU Dortmund, Materialprüfungsamt Nordrhein-Westfalen, and University Medical Center Mainz, aims to address critical gaps in neutron radiation research by providing precise neutron dosimetry and improving our understanding of the radiobiological effects of neutron exposure.

The TRIGA Mark II research reactor at the University of Mainz, equipped with a graphite thermal column, provides a source of thermalized neutrons suitable for the study of radiobiological effects of neutron exposure. For this study, the neutron field in the thermal column must be characterized. An ambient neutron dosimeter, H*(10), is being developed, specifically tailored for the TRIGA Mainz reactor. The dosimeter is based on the TL-DOS, which uses the thermoluminescence (TL) effect for personnel monitoring in photon fields. The design and optimization of the neutron dosimeter are conducted using Monte Carlo simulations. The dosimeter response is characterized using neutron reference fields and correction factors for angular and energy dependencies are defined. This talk will present the status of the dosimeter development and the measurements obtained at the TRIGA reactor.

ST 3.4 Wed 11:45 ZHG003

Development of an electronic read out board for analog and digital data acquisition of a semiconductor neutron detector — •Janina Bolles, Kevin Kröninger, Jens Weingarten, and Alina Landmann — TU Dortmund University

Neutrons are biological highly effective particles which leads to an increased health risk in work and research spaces where neutron or neutron/photon mixed fields are present. This includes medical facilities like nuklear and radiation medicin, nuclear reactor facilities and also the field of aeronautics and astronautics. Therefore, a proper neutron dosimetry is highly relevant to ensure radiation protection in such working areas. Still, the biological consequences and dosimetry of neutrons are afflicted by rather large uncertainties due to the complexity of neutron interactions. This work contributes to the optimization of measurement methods to estimate the neutron flux by developing a semiconductor detector for real time measurements. For the neutron detection a silicon diode with a boron carbide converter was designed previously within this project. Now, for a more compact read out handling and a faster data acquisition a first prototype of an electronic read out board was developed including an integrating amplifier and a simple pulse shaper. For future board versions more noise filtering components and a digitial read out system are intended. We will present first results of the neutron detection with the improved read out design.

ST 3.5 Wed 12:00 ZHG003

Update on Radiation Measurements on the International Space Station with the RadMap Telescope — •Martin J. Losekamm[1,2], Thomas Berger[3], Liesa Eckert[4], Luise Meyer-Hetling[1,2], Peter Hinderberger[1,2], Stephan Paul[1,2], and Thomas Pöschl[5] — [1]Technical University of Munich, School of Natural Sciences — [2]Excellence Cluster ORIGINS — [3]German Aerospace Center, Institute of Aerospace Medicine — [4]Technical University of Munich, School of Engineering and Design — [5]European Organization for Nuclear Research (CERN)

The RadMap Telescope is a radiation monitor with two sensors — a tracking calorimeter made from scintillating-plastic fibers and a silicon-diode dosimeter — operating on the International Space Station. In this contribution, we give an update on the current status of the experiment and the ongoing analysis of data gathered in three modules of the station. We also present a selection of preliminary results. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy – EXC2094 – 390783311.

ST 3.6 Wed 12:15 ZHG003

Reconstructing Particle Tracks with the RadMap Telescope — •Luise Meyer-Hetling[1], Liesa Eckert[2], Peter Hinderberger[1], Martin J. Losekamm[1], Stephan Paul[1], and Thomas Pöschl[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany — [3]CERN, Geneva, Switzerland

The RadMap Telescope is a compact multi-purpose radiation detector developed to provide near-real-time monitoring of the radiation aboard crewed and uncrewed spacecraft. We operated a first prototype on the International Space Station (ISS) for an in-orbit demonstration of the instrument's capabilities. Its main sensor consists of a stack of scintillating-plastic fibers whose arrangement allows the three-dimensional tracking and identification of cosmic-ray nuclei by reconstruction of their energy-loss profiles. In this contribution, we give an overview of the current status of the track reconstruction. We describe our neural-network-based reconstruction methods and present the performance of the trained convolutional network on simulated detector data. We also discuss the progress of the analysis of real data gathered on the ISS and the applied preliminary tracking methods. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

ST 4: Accelerators for Medical Applications (joint session ST/AKBP)

Time: Wednesday 13:45–15:45 Location: ZHG009

Invited Talk ST 4.1 Wed 13:45 ZHG009

Mixed ion beams for treatment monitoring: recent developments and future prospects — •Elisabeth Renner[1], Hermann Fuchs[2], Matthias Kausel[3,1], and Claus Schmitzer[3] — [1]Atominstitut, TU Wien, Vienna, Austria — [2]MedUni Wien, Vienna, Austria — [3]MedAustron, Wiener Neustadt, Austria

In recent years, the use of mixed ion beams has been proposed as a method for treatment monitoring in ion beam therapy. A promising candidate in this context is a $^{12}C^{6+}$ beam with a small $^{4}He^{2+}$ contribution. The similar charge-to-mass ratios of these two ion species enable their simultaneous acceleration in medical synchrotrons. Being extracted at almost the same energy per mass, $^{4}He^{2+}$ features a range in matter approximately three times that of $^{12}C^{6+}$. This opens the possibility for tumor treatment with $^{12}C^{6+}$ while simultaneously performing $^{4}He^{2+}$ imaging downstream of the patient.

In 2024, the first successful delivery of a mixed $^{12}C^{6+}/^{4}He^{2+}$ beam in a clinical facility was achieved at MedAustron. Instead of being generated in a single ion source, as realized at GSI in late 2023, the two ion species were mixed during the injection into the synchrotron, before being simultaneously accelerated and extracted into the research irradiation room. There the ion mix was characterized using radiochromic films, low-gain avalanche diode detectors, and a configuration of two ionization chambers separated by multiple PTW RW3 slabs.

This talk provides a general overview of recent breakthroughs in mixed ion beam delivery, discusses technical challenges, and explores the future potential for treatment monitoring in ion beam therapy.

ST 4.2 Wed 14:15 ZHG009

Beam Dynamics and Energy Variation in H-Type Drift Tube Linac for Proton Eye Therapy — •Ali Almomani — Physics Department, Yarmouk University, 21163 Irbid, Jordan

In this study, we investigate the beam dynamics of a proposed H-type drift tube linac (DTL) designed for proton therapy in eye cancer treatment, utilizing the KONUS (Kombinierte Null Grad Struktur) beam dynamics approach and LORASR code. The linac design accelerates protons from 3 MeV to 70 MeV across six cavities with 140 accelerating gaps along a 20-meter structure, operating at a frequency of

325.244 MHz. To ensure transverse beam focusing and beam matching, 11 triplet quadrupole lenses are distributed along the linac. The beam dynamics analysis yielded optimized values for drift tube lengths and gap distances, and simulations showed 100% beam transmission efficiency. The design demonstrated low emittance growth, with less than 20% transversely and 90% longitudinally, ensuring a highly focused beam. The output beam emittances are smaller than what cyclotron can offer, facilitating the generation of a pencil beam capable of scanning the tumor volume from one point to another. Additionally, energy variation options allow flexible beam energy adjustment between 58 and 70 MeV, enabling customizable treatment depths. The energy variation may be realized by varying the gap of voltage levels. The simulation results indicate a stable structure even in the presence of machine errors, supporting further development for RF simulations and mechanical modeling. The overall outcomes are promising, confirming the feasibility of the design for proton therapy applications.

ST 4.3 Wed 14:30 ZHG009

Beam spot diagnostics of highly focused electron beams in therapeutic X-Ray generators via Optical Transition Radiation — •Thomas Beiser[1] and Kurt Aulenbacher[2] — [1]Helmholtz-Institute Mainz, (Germany), GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt (Germany) — [2]Helmholtz-Institute Mainz, (Germany), GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt (Germany), Johannes Gutenberg-University, Mainz (Germany)

Optical Transition Radiation (OTR), which is commonly used for beam diagnostics in accelerators at high energies (e.g. MeV to GeV electrons), allows for beam spot diagnostics of intense and highly focused electron beams in therapeutic X-Ray generators with energies as low as 100 keV, using off-the-shelf camera equipment.

ST 4.4 Wed 14:45 ZHG009

Development of a Fast Extraction Method to Extract High Intensity Short Pluses at ELSA — •Leonardo Thome, Klaus Desch, Dennis Proft, and Michael Switka — Physikalisches Institut der Universität Bonn

The electron accelerator facility ELSA delivers electron beams up to 3.2 GeV energy, extracted via slow resonance extraction from the stretcher ring in an extraction cycle of typically 10 s. Currently ongoing studies for radiation therapy, investigating the FLASH effect, require short beam pulses reaching from ns to ms. In a preliminary operation mode the booster synchrotron is already used to deliver electrons beam pulses of 1.2 GeV energy with fixed length of 250 ns to irradiate cell samples. To cover higher energies up to 3.2 GeV and different pulse lengths ranging from ns up to several ms, a fast extraction method from the stretcher ring is developed. The concept and realization by different techniques such as a repurposing of the existing injection kickers for extraction or utilizing a dispersive orbit to extract the beam is evaluated.

ST 4.5 Wed 15:00 ZHG009

First Results from Cell Irradiation Experiments with Ultrahigh-Energy Electrons (UHEE) at ELSA — •Susanne Spaeth[1], Manuela Denz[2], Klaus Desch[1], Stephan Garbe[2], Frank Giordano[3], Barbara Link[3], Carsten Herskind[3], Barbara Link[3], Dennis Proft[1], and Leonardo Thome[1] — [1]Physikalisches Insitut der Universität Bonn — [2]Klinik für Strahlentherapie und Radioonkologie, Universitätsklinikum Bonn — [3]Klinik für Strahlentherapie und Radioonkologie, Universitätsklinikum Mannheim

A new approach to improve radiotherapy is the use of the so-called FLASH effect, a phenomenon characterised by significantly reduced toxicity in healthy tissue at high dose rates (>40 Gy/s). This effect potentially broadens the therapeutic window, improving tumour control while minimising side effects. At the electron accelerator facility ELSA, the FLASH@ELSA project utilises ultra-high energy electrons (UHEE) to study their effect on tumour cells. Electrons with energies of 1.2 GeV are delivered in sub-microsecond pulses via the booster synchrotron, enabling dose rates up to 10 MGy/s due to the short pulse lengths of 250 ns. Cell samples are irradiated within a water phantom, with dosimetry performed using radiochromic films and luminous screens. Further the FLASH irradiation at ELSA is compared to conventional radiotherapy using a medical linear accelerator (Varian TrueBeam STx) at the University Hospital Bonn. This comparison provides the first survival curves contrasting FLASH and conventional irradiation.

ST 4.6 Wed 15:15 ZHG009

Dosimetry of broadband electrons from laser-plasma accelerators — •Antonio Tarzikhan[1], Arpad Lenart[2], Chuan Zheng[1], Thomas Heinemann[1], Constantin Aniculaesei[1], Mirela Cerchez[1], and Bernhard Hidding[1] — [1]Institute of Laser- and Plasmaphysics, Heinrich Heine University, Düsseldorf, Germany — [2]University of Strathclyde, Glasgow, Scottland

Laser-plasma accelerators (LPA) offers compact sources of highly relativistic electron beams for various applications. This study focuses on the dosimetry of broadband electron beams, which are accelerated using the Arcturus laser system at the University of Düsseldorf with laser pulse energies of several millijoules sufficient to accelerate electrons to kinetic energies in the mega-electronvolt range, resulting in an energy distribution characterized by a shallow penetration and high dose deposition at the surface. These electron beams are therefore ideally suited for the treatment of skin cancer. We present the design and calibration of various diagnostics components and report on first experimental results obtained in a recent measurement campaign, incorporated with simulations to optimize the parameters used for the characterization of the electron beam energy- and angular-distribution and the charge calibration to determine the dose. Additionally, accelerated electron beams from intrinsic ultra-short bunch durations, are excellent candidates for FLASH radiotherapy and thus, minimizing damage to surrounding healthy tissues. This highlights the potential of LPA as a new technology in medical physics.

ST 4.7 Wed 15:30 ZHG009

Acoustic tracing of dose deposition of laser accelerated ion-bunches by modulation of the depth-dose curve — •Jeannette Cadeggianini, Alexander Prasselsperger, Anna-Katharina Schmidt, and Jörg Schreiber — Ludwig-Maximilian-Universität, München, Germany

A high-repetition-rate online dose reconstruction method is crucial for accelerated particle applications. Ionoacoustic measurements determine monoenergetic ion energies by recording acoustic signals generated by localized thermal expansion in the Bragg region. These waveforms encode the ion beam's energy and spatial distribution.

However, this method depends on pronounced spatial energy density gradients, which are absent in laser-accelerated ion beams, which exhibit broad, exponential energy spectra. To address this, we introduce TIMBRE (Tracing Ionoacoustic Modulations of Broad Energy Distributions), which uses modulator foils to create steeper energy deposition gradients. These foils serve two functions: due to the materials the stopping power in the foils is higher than in the interspaces, generating an acoustic wave at each interface because of the steep pressure gradient. Simultaneously, each foil reduces the amplitude of the signals from shallower foils, compressing the dynamic range.

By unfolding the measured acoustic traces with the corresponding analytic model, TIMBRE reconstructs depth dose distributions of laser-accelerated ion bunches. It offers a real-time diagnostic, supporting modern accelerators operating at Hz-level repetition rates and beyond.

ST 5: Detector Physics

Time: Wednesday 16:15–17:15 Location: ZHG003

ST 5.1 Wed 16:15 ZHG003

Neutron Dosimetry with Diamond Sensors — •Jennifer Schlüss[1], Christian Bäumer[2], Kevin Kröninger[1], and Jens Weingarten[1] — [1]TU Dortmund University — [2]West German Proton Therapy Center Essen

Neutron dosimetry is increasingly important in proton therapy, as neutron emissions provide valuable information on energy deposition within the body. However, neutron dosimetry presents challenges due to the complex interaction characteristics of neutrons. Diamond detectors offer a promising approach, as natural carbon-12 captures fast neutrons ($E_{kin} > 6.2$ MeV) and emits detectable alpha particles directly within the diamond sensor. This makes diamond detectors exclusively sensitive to fast neutrons. Enhancing the detector's sensitivity to both fast and thermal neutrons is a key objective. To achieve thermal neutron detection, we propose coating the diamond sensor with a converter layer, such as ^{6}LiF, with a high thermal neutron absorption cross-section. Using the Geant4 simulation platform, we examined neutron interactions and energy deposition in the detector, with simulations covering both thermal and fast neutron interactions to assess the response under different neutron energy ranges. Simulation results indicate that a ^{6}LiF-coated diamond sensor effectively measures both thermal and fast neutrons. A prototype is ready for initial neutron flux measurements in proton therapy, with further testing planned to fully characterize its detection capabilities across the neutron spectrum.

ST 5.2 Wed 16:30 ZHG003

Hardware Testing for the Construction of a Compton Camera Prototype — Yazeed Balasmeh, Daniel Berker, Ivor Fleck, and •Lars Maczey — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

Well-established detector systems for medical imaging such as PET or SPECT can only efficiently resolve source positions for gamma energies up to 600 keV. Compton cameras have been able to exceed the range to higher energies, but to date are limited to energies below 1 MeV. The Compton camera under construction at the University of Siegen pursues the novel approach of tracking the electron of a Compton scattering process based on its production of Cherenkov radiation, in the hope of overcoming the current limitations and creating new fields of study.

In this talk, I present first results obtained towards the construction of a Compton camera prototype, focusing mainly on the characterisation of hardware components, including UV-sensitive SiPMs from Broadcom Inc. and Hamamatsu Photonics, scintillation crystals such as GAGG and LGSO as well as readout ASICs such as the TOFPET2 ASIC from PETsys Electrionics or the KLauS chip developed by the University of Heidelberg. Regarding SiPMs, bias optimisation is discussed to ensure both a good noise behaviour and good detection efficiency. Results from depth of interaction measurements and energy calibrations performed by scintillator-based setups and the development of a multi-channel SiPM detection system are also presented.

ST 5.3 Wed 16:45 ZHG003

Studies for the development of a pixel detector for proton therapy — •Alina Hild, Kevin Kröninger, Hendrik Speiser, and Jens Weingarten — TU Dortmund University

For various applications in proton therapy, it is important to know the deposited energy and the linear energy transfer (LET), as the latter directly relates to the relative biological effectiveness (RBE) of the protons. Due to their good spatial resolution and radiation hardness, pixelated silicon detectors are a suitable choice for the measurement of these quantities.

This talk presents some ideas for determining specifications for a new monolithic active pixel sensor (MAPS) that is being developed specifically to meet the requirements of proton imaging. The detector should be capable of simultaneously measuring the LET and the deposited dose, while handling the high fluxes and relatively high deposited energies that occur.

In an initial study, measurements of the signal current in a silicon detector were taken at the Westdeutsche Protonen Zentrum (WPE) to evaluate the mean energy dose. The talk summarizes these measurements and provides an outlook on other required quantities.

ST 5.4 Wed 17:00 ZHG003

MaPSA quality control for the CMS phase-II detector upgrade — •Leticia Rosa[1,2], Andreas Nuernberg[1], Doris Eckstein[1], and Andreas Mussgiller[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]University of Hamburg, Hamburg, Germany

The Phase-II upgrade of the CMS detector aims to equip the outer tracker with new silicon sensor modules to handle the increased luminosity of the LHC. These modules integrate strip and pixel layers to enable precise position measurements, which will be placed in the inner layers of the outer tracker. The pixelated silicon sensor layer, paired with its readout chips, forms the macro-pixel sub-assembly (MaPSA). This presentation discusses the quality control procedures performed at DESY by the CMS Phase-II Tracker Upgrade group in Hamburg.

ST 6: Medical Imaging and Treatment Monitoring

Time: Thursday 11:00–12:00 Location: ZHG003

ST 6.1 Thu 11:00 ZHG003

Spatially resolved mid-IR spectroscopy on healthy and cancerous lung tissue — •Maximilian Schmock[1], Tobias Steinle[1], Cleo-Aron Weis[2], and Harald Giessen[1] — [1]4th Physics Institute and Research Center SCoPE, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germany — [2]Institute of Pathology, Heidelberg University Hospital, Heidelberg, Germany

Cancer diagnosis is complex and can take a long time. To support and accelerate this process, the possibilities of mid-IR spectroscopy are investigated. Therefore, a widely tunable IR-laser (from 1.3 to 20 μm) is used to perform sweep-measurements on histological samples of human lung tissue. In combination with a x-y-stage, spatially resolved measurements are performed as well. We demonstrate that with this setup, different spectral features can be highlighted depending on the wavelength, with a spatial resolution of around 20 μm. For this task, the entire spectrum between 2.7 μm and 12 μm can be used. A standardized control system that controls the entire experiment allows for fast switching between different measurement types and direct feedback on the recorded data.

ST 6.2 Thu 11:15 ZHG003

Towards Clinical Use of Range Monitoring in Heavy-Ion Therapy — •Sebastian Schroeder[1], Devin Hymers[1], Olga Bertini[2], Johann Heuser[2], Joerg Lehnert[2], Christian Joachim Schmidt[2], and Dennis Muecher[1] — [1]Institute for Nuclear Physics, University of Cologne, Cologne, Germany — [2]GSI, Darmstadt, Germany

Interaction Vertex Imaging (IVI) is a proposed method for online range monitoring in heavy-ion therapy which will help ensure correct Bragg peak (BP) positioning, and could act as a safety interlock, pausing irradiation if incorrect BP depth is detected. IVI tracks secondary ions produced by beam-patient interactions, and calculates the origin of each secondary ion as the closest approach of its track to the treatment beam. This data is used to determine BP range shifts with sub-mm precision. The tracking hardware is a purpose-built system, using sensors developed by GSI for the Compressed Baryonic Matter experiment. These highly segmented, double sided silicon strip detectors have a 58 μm pitch, and cover a large sensitive area of up to 72 cm^2. These detectors are coupled to readout electronics capable of count rates up to 250 kHz per segment. To test IVI with this system under clinical conditions, measurements were performed at the Heidelberg Ionenstrahl-Therapiezentrum. PMMA phantoms of 16 cm and 32 cm diameter were irradiated at BP depths of 27-80 mm and 27-160 mm respectively. A 9 mm air gap was also introduced in the phantom, as a first step towards measuring inhomogeneities. These results, as well as next steps towards anthropomorphic phantoms, will be discussed.

ST 6.3 Thu 11:30 ZHG003

Monitoring of beam shape and position with an HV-CMOS detector matrix in ion beam therapy — •Baudry Bartels[1], Alexander Dierlamm[1,2], Ulrich Husemann[1], Markus Klute[1], Ivan Perić[2], Bogdan Topko[1], and Hui Zhang[2] — [1]Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT) — [2]Institute for Data Processing and Electronics (IPE), Karlsruhe Institute of Technology (KIT)

Ion beam therapy has been proven to be an efficient treatment for cancer with less damage to healthy tissue compared to photon beam therapy.

A beam monitoring system is essential for ensuring a precise execution of the treatment plan. To increase the treatment precision, an online imaging of the target tissue during irradiation is beneficial.

Magnetic resonance imaging (MRI) gives high tissue contrast without additional irradiation dose, and MRI-guided ion beam therapy is being established. This requires a magnetic field tolerant sensor system offering precise beam measurements and fast readout.

We are developing a beam monitor based on HV-CMOS detectors to meet the challenging requirements. A small prototype matrix has been built and commissioned. For user friendliness, a graphical user interface with implemented quick data analysis has been designed to provide the beam characteristics.

ST 6.4 Thu 11:45 ZHG003

Development of a Compton Camera for Biological and Medical Imaging — •Yazeed Balasmeh, Daniel Berker, Ivor Fleck, and Lars Maczey — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

The Compton Camera offers a novel, collimator-free imaging technology based on Compton scattering, addressing the need for advanced imaging systems capable of detecting high-energy gamma rays above 1 MeV. Its versatility makes it suitable for medical imaging applications, real-time dosimetry, and dynamic adjustments in particle beam therapies, particularly in cancer treatment.

In this talk, I will present the development of a novel Compton Camera at the University of Siegen, designed for high-energy gamma ray imaging. The system features an enhanced scattering layer to increase interaction probability and generate Cherenkov photons, allowing precise determination of interaction depth and electron trajectories. Measuring the scattered gamma ray and recoil electron energies enables accurate source localization. Incorporating electron tracking further improves spatial resolution by narrowing the possible gamma ray path. Additionally, GEANT4 simulations were employed to optimize device geometry and compare different scintillation materials, with depth of interaction (DOI) measurements validated against experimental results to refine performance.

ST 7: Poster Session

Time: Thursday 13:45–15:45 Location: ZHG Foyer 1. OG

ST 7.1 Thu 13:45 ZHG Foyer 1. OG

Update on the Development of a ^{10}BNNT-based Neutron Detector — •Kim Tabea Giebenhain[1], Anna Becker[2], Lara Dippel[1,2], Markel Fix Martinez[2], Dzmitry Kazlou[1], Hans-Georg Zaunick[1], Klemens Zink[2], and Kai-Thomas Brinkmann[1,2] — [1]II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Germany — [2]LOEWE Research Cluster for Advanced Medical Physics in Imaging and Therapy (ADMIT), Technische Hochschule Mittelhessen, Gießen, Germany

BNNT (Boron Nitride Nanotubes) is a material with excellent mechanical and thermal properties. Enriched with ^{10}B, an isotope of Boron with a high thermal neutron capture cross-section, it can be used as a neutron-sensing element by measuring the decay products of the ^{10}B(n,α)-reaction.
Two prototypes based on a ^{10}B-enriched BNNT mat coupled to inorganic scintillators (BGO and GaGG, respectively) have been developed. The detector systems are read out by a Photomultiplier tube.
Both systems were tested initially for their capabilities as neutron detectors at the DT neutron source at HZDR, Dresden. Those tests and their results will be discussed in the contribution.
This work is part of the ADMIT consortium and financed with funds of LOEWE

ST 7.2 Thu 13:45 ZHG Foyer 1. OG

The influence of tumor tissue vascularization on temperature in Magnetic Hyperthermia — •Viorica-Monica Moisiuc and Iordana Astefanoaei — Faculty of Physics, Alexandru Ioan Cuza University of Iasi, Romania

Magnetic hyperthermia is an innovative and promising method in cancer treatment, based on the ability of magnetic nanoparticles to generate heat under the influence of a high-frequency electromagnetic field, aiming to destroy cancer cells by locally increasing the temperature [1, 2]. This work investigates the impact of tumor vascularity on the thermal heating process in therapy, considering that the structure and density of blood vessels in the tumor can significantly influence nanoparticle distribution and, therefore, the uniformity of temperature distribution in the tissue. A model has been developed to allow a detailed analysis of heat transfer in vascularized tumor tissue, taking into account the magnetic field parameters and the properties of the magnetic systems used. The study highlights the potential of magnetic hyperthermia to generate optimal therapeutic temperatures and contribute to the selective destruction of tumor tissues, emphasizing the advantages of this method in oncological therapy through its ability to provide more precise control over thermal effects on the target tissue.

ST 7.3 Thu 13:45 ZHG Foyer 1. OG

Development of a BaF-Plastic Phoswich Detector for Fast Neutron Detection — •Lara Dippel[1,2], Kai-Thomas Brinkmann[1,2], Hans-Georg Zaunick[1,2], and Dzmitry Kazlou[1] — [1]II. Physikalisches Institut, JLU Gießen — [2]LOEWE Research Cluster for Advanced Medical Physics in Imaging and Therapy (ADMIT), TH Mittelhessen University of Applied Sciences, Giessen, Germany.

This poster presents the initial development steps of a Phoswich detector designed for fast neutron detection. The detector comprises a Barium Fluoride (BaF) crystal optically coupled to a thin plastic scintillator, with the system read out via a photomultiplier tube (PMT) on the BaF side. Particle discrimination is evaluated using pulse shape discrimination (PSD) techniques and integral versus amplitude histograms, enabling the identification of different particle types. The system was tested using Na-22, Sr-90, and an AmBe neutron source, as well as cosmic particles. For comparison, reference measurements were conducted with a standalone BaF detector to assess the particle identification capabilities and potential advantages of the Phoswich configuration. This work is part of the ADMIT consortium under Project Part A, which focuses on estimating spectral neutron fluxes for therapy in tumor treatment applications.
This project is financed with funds of LOEWE - Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 2: LOEWE-Schwerpunkte.

ST 7.4 Thu 13:45 ZHG Foyer 1. OG

Reconstruction Techniques for electron CT Measurements using Multiple Scattering — •Aenne Abel[1,2], Leticia Braga da Rosa[1,2], Paul Schuetze[1], Malinda De Silva[1], and Simon Spannagel[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]University of Hamburg, Hamburg, Germany

Electron CT (eCT) is a new imaging method, which uses multiple scattering of electrons to determine the material budget of objects. This method could be used as the imaging method for flash radiotherapy with Very High Energy Electrons (VHEE, 50-250 MeV). A pencil beam of MeV range electrons passes through the sample under test. The beam widening caused by Coulomb scattering in the sample is dependent on the sample's material budget and is measured using a single planar silicon pixel sensor (Timepix3) placed downstream of the sample. First studies have been performed at DESY Hamburg to test this method. The results and the current status are presented in this poster with a focus on reconstruction algorithms.

ST 7.5 Thu 13:45 ZHG Foyer 1. OG

Development of a Real-Time PbWO4-based Detector System for Depth Dose Distribution Measurement in Clinical Proton Therapy — •Niclas Fiedler[1], Kai-Thomas Brinkmann[1], Dzmitry Kazlou[1], Hans-Georg Zaunick[1], and Kilian-Simon Baumann[2] — [1]Justus Liebig University, Giessen, Deutschland — [2]Technische Hochschule Mittelhessen, Giessen, Deutschland

Proton therapy has emerged as a highly precise form of radiotherapy, leveraging the unique dose deposition characteristics of ions to maximize tumor dose while sparing surrounding healthy tissues. However, the presence of heterogeneous media can significantly broaden the Bragg peak and obscure the distal fall-off, a phenomenon quantified by the modulation power.

This project introduces a novel PbWO4-based detector system designed for real-time measurement of the depth dose distribution in proton therapy. The clinical aim is to employ a high-energy, low intensity beam and position the detector posterior to the patient, where the system achieves accurate and most importantly fast quantification of the modulation power, whilst minimizing patient radiation exposure. The real-time measurement capabilities provide rapid feedback, allowing the substitution of slow, conventional peak finders, whilst enhancing treatment adaptability in clinical settings without compromising workflow efficiency. *Supported by THMconnectsFCMH.*

ST 7.6 Thu 13:45 ZHG Foyer 1. OG

Work towards a small scale detector array for cosmic showers based on scintillation detectors — •Erik Euler, Hans-Georg Zaunick, Kai-Thomas Brinkmann, Marvin Peter, Simon Glennemeier-Marke, and Mohammed Hassan — Justus Liebig University, Gießen, Germany

The detectors from the MuonPi Cosmic Detector Project are used to measure muons from cosmic air showers (secondary cosmic radiation). A MuonPi utilizes a plastic scintillation detector with a silicon photomultiplier (SiPM) for signal read out by RaspberryPi-based data acquisition. A larger, distributed detector array with 16 single detectors based on the MuonPi hardware, but with large plastic scintillator bars (100 x 100 x 10 cm), is currently under construction in Giessen. Its final goal, beside the mere detection of shower events, is to determine the direction of the shower through time-of-flight measurements and its special orientation in combination with the MuonPi Network. Over the course of the last year a working prototype of the detector array was built and tested in the lab. The current setup consists of three working detector bars, the main part of the array's central data acquisition with a prototype of the FPGA-based event analysis. The current status of the project as well as the next steps will be presented.

ST 8: Particle Radiography

Time: Thursday 16:15–17:15 Location: ZHG003

ST 8.1 Thu 16:15 ZHG003

Online Adaptive Radiotherapy with Silicon Detectors — Kevin Kröninger, Hendrik Speiser, •Annsofie Tappe, Helen Thews, and Jens Weingarten — TU Dortmund

Proton therapy is a relevant modality of radiation therapy used to treat cancer, offering the main advantage of a well-defined proton range. Knowing the exact range is crucial in proton therapy to minimize radiation exposure to healthy tissues and ensure the correct tumor dose. Anatomical changes in the patient between treatments significantly impact proton range. Therefore, an imaging technique is required to monitor these changes. One potential solution is a proton radiography system that can be used behind the patient in the beam axis.

We currently study the realization of a two-plane imaging system, consisting of two silicon pixel detectors and an intermediate absorber. This setup measures a two dimensional image of the water equivalent thickness (WET) of the patient along the beam axis during the treatment. A trigger for plan adaption could be given when the measured WET deviates from the expected value.

As part of a master thesis, this system is being implemented in the Monte Carlo simulation tool Allpix^2, to optimize the prototype and the post processing of the measured data. With simulations, we aim to improve data analysis and make first predictions of the feasibility in online adaptive proton therapy. To evaluate this, we want to determine the WET accuracy and precision with this system.

The talk will provide a short introduction of proton radiography, introduce the two-plane system and showcase simulated WET images.

ST 8.2 Thu 16:30 ZHG003

A Two Plane Proton Imaging System Using ATLAS FE-I4 Pixel Detectors — •Hendrik Speiser[1], Claus Maximilian Bäcker[2], Christian Bäumer[2], Johannes Esser[2], Kevin Kröninger[1], Annsofie Tappe[1], Helen Thews[1], and Jens Weingarten[1] — [1]TU Dortmund — [2]West German Proton Therapy Center Essen

For years, proton therapy is increasingly being used to treat cancer because of its well-known advantages, such as the high dose precision of protons. However, exploiting this precision requires improved imaging techniques to ensure accurate patient positioning and dose delivery. One such technique is proton radiography, where an image of the water equivalent thickness (WET) distribution of the patient is taken measuring the residual proton energy.

Former studies showed the feasibility of proton radiography using a single radiation hard ATLAS FE-I4 pixel detector. To improve the WET resolution of the resulting images, a second pixel detector of the same kind and a water equivalent absorber between both detectors are used. Proof-of-concept simulation studies of the so-called Two-Plane-System showed promising results. Thus, the aim of the project is to realize such a system and investigate the yielded WET resolution. To this purpose, prototype measurements were conducted at the West German Proton Therapy Centre in Essen.

This talk will briefly introduce the Two-Plane-System. Subsequently, the first results of the prototype measurement using ATLAS FE-I4 pixel detectors and future steps of the project are presented.

ST 8.3 Thu 16:45 ZHG003

Simulations of detector setups for Helium Radiography and CT — Alexander Dierlamm[1], Tim Gehrke[2], Ulrich Husemann[1], Oliver Jäkel[2], Maria Martisikova[2], and •Linus Schlee[1] — [1]Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT) — [2]Medical Physics in Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg

For the precise irradiation treatment of cancers that are located near critical tissues, ion beam therapy has been developed as an efficient and highly conformal treatment compared to x-ray therapy. Compared to the established methods with proton or carbon beams, helium provides a higher linear energy transfer than protons while causing less secondary radiation than heavier nuclei like carbon. To obtain higher precision with helium therapy, precise knowledge of the integrated stopping power of the affected region is needed. In future, the imaging for the treatment planning could be performed by the same He ions but at higher energies compared to the therapeutic range. In this talk, research on detector setups involving helium beams is presented. With the Allpix^2-Framework, the path of ions through a plexiglass-phantom (PMMA) and the resulting hits and signals of different detector setups are simulated. With subsequent analysis of simulated detector data on the positions and deposited energies of tracked particles, the goal is to optimise the setups to achieve higher measurement accuracy. The simulations are based on and compared to existing setups at the German Cancer Research Center (DKFZ).

ST 8.4 Thu 17:00 ZHG003

First experimental time-of-flight-based helium radiography of a mouse phantom — •Felix Ulrich-Pur[1], Ashish Bisht[2], Thomas Bergauer[3], Tetyana Galatyuk[1,4,5], Albert Hirtl[6], Matthias Kausel[6,7], Mladen Kis[1], Barbara Knäusl[8], Yevhen Kozymka[4], Wilhelm Krüger[4], Sergey Linev[1], Jan Michel[1], Jerzy Pietraszko[1], Christian Joachim Schmidt[1], Michael Träger[1], Michael Traxler[1], and Matteo Centis Vignali[8] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Fondazione Bruno Kessler — [3]Austrian Academy of Sciences, Institute of High Energy Physics — [4]Technische Universität Darmstadt — [5]Helmholtz Forschungsakademie Hessen für FAIR — [6]TU Wien, Atominstitut — [7]EBG MedAustron — [8]Medical University of Vienna, Department of Radiation Oncology

Ion computed tomography (iCT) is an imaging modality for the direct measurement of the relative stopping power (RSP) distribution inside the patient. To reconstruct the RSP map, the traversed path and corresponding energy loss of ions passing through the patient have to be estimated. While this is usually done via a tracking system and a separate calorimeter, we present a so-called time-of-flight (TOF) iCT system that uses only one detector technology, namely Low Gain Avalance Diodes (LGADs), for both tracking and the energy loss measurement. In this contribution, first ion images, recorded with the TOF-iCT system, will be shown, including a proton radiograph of an aluminium stair phantom and a helium radiograph of a mouse phantom.

ST 9: Keynote Session

Time: Thursday 17:15–17:45 Location: ZHG003

Invited Talk ST 9.1 Thu 17:15 ZHG003
Making Surgery Intelligent: From Autonomous Systems to the Intelligent OR — •Jannis Hagenah — Center for Digital Surgery, University Medical Center Göttingen, Göttingen, Germany

Automatization in surgery holds the potential to significantly increase patient outcomes, minimize risks, and provide a sufficient answer to demographic change and staff shortage. However, surgery remains one of the most challenging medical disciplines to automize. This is due to a combination of high risks, a vast inter-patient variability, the amount of different sensing modalities, the necessity to physically interact with tissue as well as the collaborative nature of the field. Recent advances in robotics and Artificial Intelligence hold the potential to overcome these challenges and step forward towards intelligent operating rooms that optimally support the human team. This talk will present modern approached to digital surgery, the possibilities of merging cognitive system and collaborative robots into surgical procedures and highlight the interdisciplinary nature of the path towards fully intelligent ORs.

ST 10: Prize Ceremony and Closing Session

Time: Thursday 17:45–18:00 Location: ZHG003

In this last session we would like to take the opportunity to thank all participants for their attendance and contributions. We will announce the winner of this years award for the *Best contribution in the radiation and medical physics division at the DPG Spring Meeting 2025*. We welcome everyone to celebrate all prize winners and a successful conference with us, to provide some final feedback and to take the chance to meet again the other participants of this meeting.

ST 11: Members' Assembly

Time: Thursday 18:15–19:15 Location: ZHG003

Members' Assembly of the Radiation and Medical Physics Division