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.