ST 3: Detectors for Medical Applications

Time: Wednesday 13:45–15:30 Location: KH 01.013

ST 3.1 Wed 13:45 KH 01.013

electronCT - A Candidate for Image Guidance in VHEE Radiotherapy — •Aenne Abel[1,2], Leticia Braga da Rosa[1,2], Paul Schütze[1], Malinda de Silva[1], and Simon Spannagel[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, D-22607 Hamburg — [2]University of Hamburg, Hamburg, Germany

electronCT (eCT) is an imaging method, which uses multiple scattering of electrons to acquire images of unknown objects. This imaging method is a candidate for image guided radiotherapy with very high energy electrons (100-250 MeV). For eCT, a low emittance pencil beam is propagated through an object and the scattering of the beam is quantified. The widening of the beam is dependent on the radiation length of the materials traversed by the beam. A measurement of the opening angle then allows for a reconstruction of the material properties of the sample. In this contribution eCT is introduced as a method, proof of concept studies are shown and the performance is discussed with respect to the obtained tomographic reconstructions.

ST 3.2 Wed 14:00 KH 01.013

Evaluation of the KLauS Chip for Measurement of Scintillation and Cherenkov Light — Atharva Bahekar, Yazeed Balasmeh, Ivor Fleck, •Mara Fries, Lars Maczey, and Devanshi Mehta — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

Detecting and imaging ionising radiation is essential in fields ranging from fundamental physics to medical diagnostics, where precise reconstruction of high-energy γ-ray interactions remains a key challenge. Conventional Compton Cameras show promising results but are typically optimised for γ-rays below 1 MeV, limiting their applicability in high-energy imaging scenarios. The Cherenkov Compton Camera concept uses a novel approach by introducing a thicker scattering layer in order to use Cherenkov light to track the Compton electron. This enables a determination of the direction of the recoil electron, thereby extending the energy range of Compton Cameras beyond 1 MeV.

In this talk, I will present results from the ongoing development of the Cherenkov Compton Camera, focusing on the KLauS ASIC designed by the University of Heidelberg and its possible use in both the scattering and absorption layers. The KLauS ASIC has been tested with large scintillation signals from GAGG and LGSO crystals, as well as fast Cherenkov signals in UV-transparent PMMA. Characterization using UV-sensitive Broadcom SiPMs allows us to assess the suitability and operating performance of the KLauS readout for a high-energy Cherenkov Compton Camera.

ST 3.3 Wed 14:15 KH 01.013

SiPM Characterisation for the Construction of a Compton Camera Prototype — Atharva Bahekar, Yazeed Balasmeh, Ivor Fleck, Mara Fries, Lars Maczey, and •Devanshi Mehta — Experimentelle Teilchenphysik, Center for Particle Physics Siegen, Universität Siegen

The development of a next-generation Compton camera capable of operating beyond the current energy limitations of conventional nuclear medical imaging requires highly efficient and low-noise gamma detectors. As part of the ongoing Compton camera project at the University of Siegen, this work focuses on the characterization of UV-sensitive Silicon Photomultipliers (SiPMs), which will form a key component of the detector system. In this work, I will present the characterization of Hamamatsu SiPMs compared to Broadcom, focusing on noise behaviour, breakdown characteristics and photon detection efficiency. Staircase measurements were performed to study breakdown behaviour and noise characteristics. Furthermore, I will present the dependence of noise on bias voltage and temperature, including the integration of a cooling system to improve stability. Alongside UV tests, we are checking how the SiPMs perform with scintillators such as GAGG and LGSO, focusing on PDE in the visible range.

ST 3.4 Wed 14:30 KH 01.013

Diamond detector for proton therapy based on the readout system of the LHCb Beam Conditions Monitor — Johannes Albrecht, •Nicholas Oldman, Dirk Wiedner, and Lukas Witola — TU Dortmund University, Dortmund, Germany

Due to their exceptional radiation hardness and approximate tissue equivalence, synthetic diamonds make a promising candidate as detector material for the beam analysis in quality assurance at clinical proton therapy centers. At CERN, such diamonds are already in use as detectors at the so-called Beam Conditions Monitor (BCM) at the LHCb experiment.

The BCM features fast readout electronics that process the signal current from the detector diamonds with a time resolution of $40\,\mu$s. Based on the operating principle of the BCM, a novel detector system is being developed that aims to implement the use of diamond detectors into the clinical setting. Synthetic polycrystalline diamonds grown by chemical vapor deposition are used for this detector system. They are coated with metallic electrodes to obtain position-sensitive detectors with sub-millimeter spatial resolution. The readout electronics of the BCM are utilized to achieve a fast signal sampling rate.

The progress made in the development of this novel detector system will be presented. Using a simple readout chain, a first test setup is constructed to prepare future measurements of the beam at a proton therapy center.

ST 3.5 Wed 14:45 KH 01.013

Fast beam monitoring for ion beam therapy with an HV-CMOS detector system — •Thomas Renkhoff[1], Alexander Dierlamm[1,2], Ulrich Husemann[1], Markus Klute[1], Ivan Perić[2], and Bogdan Topko[1] — [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 is a well-established cancer treatment available at more than one hundred centers worldwide. Compared to more common photon-based radiation therapy, ion beam therapy allows for more precise dose deposition into the tumor volume. A conformal dose deposition to the tumor volume requires a beam monitor that needs to be fast, radiation tolerant and should have a low material budget to reduce the beam particle scattering.
To meet these requirements we are developing a beam monitor based on HitPix sensors. The HitPix sensors are monolithic active pixel sensors produced in high-voltage CMOS technology. HV-CMOS technology comes with several advantages, including high radiation tolerance, thin sensors and better affordability compared to hybrid pixel detectors. HitPix sensors feature hit-counting pixels with on-sensor hit projection-calculation, radiation tolerance and frame-based readout.
The talk evaluates readout speed and performance after irradiation of the HitPix sensors. In order to test beam parameters, a quasi-online reconstruction, the estimator block, is integrated into the existing FPGA-firmware and tested.

ST 3.6 Wed 15:00 KH 01.013

Dosimetry of high intensity electron beams for FLASH radiotherapy using Dosepix detectors and nitrogen fluorescence — •Florian Beisser for the NitroFLASH-Collaboration — ECAP, FAU Erlangen-Nürnberg, Erlangen, Germany

FLASH radiation therapy with high-intensity electrons, where the full dose is delivered in a very short time frame, has been proven to be a very promising evolution of radiation therapy. Yet there currently exist no established methods for online dosimetry and position determination as the established detector concepts, such as monitor chambers, saturate in the high intensity beams. We here explore two possible technologies: the detection of stray electrons using Dosepix solid-state detectors and nitrogen fluorescence in air. The response of the Dosepix detectors showed clear monotonous trends with respect to distance and bunch charge, enabling the determination of the beam position and intensity from that data. Additionally, a UV camera was mounted perpendicular to the beam axis to detect the emitted nitrogen fluorescence photons as the beam traverses air, thus imaging the electron beam and reconstructing its full position and width. Although a fluorescence signal of the beam could be detected with the UV-camera, the observed intensity was too low to meaningfully reconstruct beam parameters for ARES. However, much higher intensities are expected for the FLASHlab at PITZ.

ST 3.7 Wed 15:15 KH 01.013

Active Eye Lens Dosimetry with Dosepix: Influence of Measurement Position and Lead Glass Shielding —

•Leonie Ullmann[1], Florian Beisser[1], Rolf Behrens[2], Stefan Funk[1], Gerhard Hilgers[2], Oliver Hupe[2], Jürgen Roth[2], Tom Tröltzsch[3], Hayo Zutz[2], and Thilo Michel[1] — [1]Erlangen Centre for Astroparticle Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany — [2]Physikalisch-Technische Bundesanstalt, Braunschweig, Germany — [3]Karlsruher Institut für Technologie, Karlsruhe, Germany

Due to its sensitivity to radiation, the eye lens is subject to strict dose limits. Since exceeding these limits can lead to cataracts, precise monitoring of the dose in the eye is necessary. For this purpose, an active personal dosemeter for the eye lens has been developed for use by medical personnel. Previous investigations have shown that the prototype of this dosemeter delivers reliable results. Since the eye lens dosemeter is intended to be worn on the side of the head, follow-up studies now examined the effects of the measurement position for frontal and lateral positioning.

Furthermore, it is common practice for medical personnel to wear radiation protection glasses. As an approach to reproduce the absorption of such glasses, the attachment of lead glass pieces to the dosemeter was investigated. The resulting dose values were compared to those of thermoluminescent dosemeters (TLDs) behind radiation protection glasses.