ST 7: Poster Session

Zeit: Donnerstag 14:00–16:15 Raum: JUR Foyer

ST 7.1 Do 14:00 JUR Foyer

Analysis of Nuclear Cross Section Measurements for Particle Therapy — •Ronja Hetzel, Dominik Dorsel, Max Emde, Sebastian Lauber, and Achim Stahl — III. Physikalisches Institut B, RWTH Aachen University, Aachen, Deutschland

During ion therapy, nuclear reactions occur inside a patient. Substantial uncertainties are associated with the cross sections of these reactions.

Our working group develops an experiment to measure the cross sections of nuclear reactions in the collisions of protons and carbon ions. To identify the fragments, their kinetic energy, their time of flight, and their specific energy loss is measured with scintillation detectors. Measurements are performed at the medical accelerator at HIT in a fixed target experiment. The set-up is modelled in Geant4.

This contribution focuses on the analysis of measured data and simulation results to reconstruct the different particle types produced in the nuclear reactions.

ST 7.2 Do 14:00 JUR Foyer

Metrology for mobile detection of ionising radiation following a nuclear or radiological incident — •Patrick Kessler, Harald Dombrowski, and Stefan Neumaier — Physikalisch-Technische Bundesanstalt, Braunschweig, Deutschland

The European project "prepardness" focuses on the protection of the public against ionising radiation and radioactive contaminations caused by nuclear or other radiological incidents. During and following such an accident radiation protection authorities and other decision makers need quick and credible information on contaminated areas. To provide such data, accurate and traceable methods for measuring activity concentrations of radioactive contaminations and dose rates need to be developed, as well as transportable air-sampling systems and aerial detection systems for remote measurements.

These requirements are met by four different work-packages. Firstly, the development of unmanned aerial detection systems for the early monitoring of areas affected. Secondly, transportable air-sampling systems, because the average distance between field stations in Europe is up to hundreds of km and therefore the data is not representative for localised nuclear or radiological incidents. Thirdly, the data from civilian radiation measurement networks which are now more and more commonly available. The density and mobility of these networks might support decision makers, however the quality of the data has to be investigated. Fourthly, for the long term monitoring of affected areas, the passive dosimetry for environmental radiation monitoring requires the harmonisation of measurement and data acquisition procedures.

ST 7.3 Do 14:00 JUR Foyer

Simulationen zur Röntgen-Phasenkontrastbildgebung — •Andreas Artinger[1], Johannes Bopp[2], Florian Horn[1], Veronika Ludwig[1], Georg Pelzer[1], Jens Rieger[1], André Ritter[1], Maria Seifert[1], Max Schuster[1], Andreas Wolf[1], Thilo Michel[1] und Gisela Anton[1] — [1]ECAP – Erlangen Centre for Astroparticle Physics, Universität Erlangen-Nürnberg, Erwin-Rommel-Straße 1, 91058 Erlangen — [2]Lehrstuhl für Informatik 5 (Mustererkennung), Universität Erlangen-Nürnberg, Martensstr. 3, 91058 Erlangen

Das Phasenkontrast-Röntgen bietet viele Anwendungen in der medizinischen Bildgebung. Um eine Einordnung erzielter Ergebnisse zu erhalten und diese weiter zu optimieren, ist es notwendig, die genutzten Experimente und Aufbauten zusätzlich in Simulationsstudien zu untersuchen. Hierzu wurde das in Erlangen entwickelte cxi-Framework genutzt. Verschiedene Modelle anatomischer Proben wurden in Talbot-Lau-Gitterinterferometern simuliert und mit tatsächlichen Messungen verglichen. Des weiteren wurden weitere Methoden der Röntgen-Phasenkontrast-Bildgebung mit dem Framework implementiert, simuliert und gezeigt, dass die Simulation auch für andere Aufbauten als Talbot-Lau-Gitterinterferometer funktioniert. Die Vor- und Nachteile verschiedener Aufbauten wurden untersucht.

ST 7.4 Do 14:00 JUR Foyer

Richtungsabhängige Dunkelfeldbildgebung von Faserstrukturen in der gitterbasierten Röntgen-Phasenkontrastbildgebung — •Weiwen Weng[1], Michael Gallersdörfer[1], Florian Horn[1], Shiyang Hu[2], Veronika Ludwig[1], Georg Pelzer[1], Jens Rieger[1], Andreas Maier[2], Thilo Michel[1] und Gisela Anton[1] — [1]ECAP/Physikalisches Institut Universität Erlangen-Nürnberg, Erwin-Rommel-Str.1, 91058 Erlangen — [2]Lehrstuhl für Mustererkennung, Universität Erlangen-Nürnberg, Martensstraße 3, 91058 Erlangen

In der interferometrischen Röntgen-Phasenkontrastbildgebung kann durch drehen des Objekts in Bezug zur Ausrichtung der Gitterstege zusätzliche Information über die Orientierung von Faserstrukturen gewonnen werden. Dies bietet sowohl in der medizinischen Bildgebung als auch in der zerstörungsfreien Materialprüfung zahlreiche Anwendungsmöglichkeiten. In diesem Beitrag wird die Richtungsabhängigkeit des Dunkelfeldsignals in einem einzelnen Pixel mit Faserstrukturen in der Größenordnung von Mikrometern simuliert. Mithilfe vergleichbarer Fasern kann im Experiment diese Variation des Dunkelfeldsignals aufgrund der Richtungsabhängigkeit bei konstantem Absorptionssignal untersucht werden. Der Zusammenhang zwischen Dunkelfeldsignal und Ausrichtung der Fasern zu den Gitterstegen wird so in Messung und Simulation dargestellt und verglichen.

ST 7.5 Do 14:00 JUR Foyer

Measurement of Fissures in Femurs by High-Energy X-Ray Grating-Based Phase-Contrast Imaging — •Jonas Pfeiffer[1], Florian Horn[1], Georg Pelzer[1], Jens Rieger[1], Daniel Rusche[1], Thilo Michel[1], Kolja Gelse[2], Friedrich Paulsen[3], and Gisela Anton[1] — [1]ECAP Medical Physics Group - FAU Erlangen-Nuremberg, Germany — [2]Trauma surgery - FAU Erlangen-Nuremberg, Germany — [3]Anatomical Institute - FAU Erlangen-Nuremberg, Germany

Grating-based phase-contrast Talbot-Lau interferometry is a method to obtain information about the attenuation, the phase-shift and small angle scattering strength (darkfield) of x-rays propagating through an sample simultaneously.

At a surgical implantation of an artificial hip joint, a medical nail is driven into the femur on which the new joint is fixed. Thereby the bone can brake and small fissures may occur creating instabilities between hip and thigh. Due to their small size such fine cracks are problematic to identify by conventional X-ray imaging. Grating-based phase-contrast Talbot-Lau interferometry may present a promising approach to improve diagnosis in this field, because of its sensitivity of material interfaces.

The aim of this study is to investigate the potential of the differential phase-contrast and the dark-field image to detect the filamentous structures of fissures.

First measurements showed very promising results.

ST 7.6 Do 14:00 JUR Foyer

High resolution phase contrast radiography: A comparison between propagation-based and grating-based imaging — •Max Schuster, Michael Gallersdörfer, Veronika Ludwig, Jens Rieger, Maria Seifert, Andreas Wolf, Georg Pelzer, Thilo Michel, Gisela Anton, and Stefan Funk — ECAP - Erlangen Centre for Astroparticle Physics, Universität Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen

In addition to the attenuation of an X-ray wave both propagation- and grating-based X-ray phase contrast imaging (PCI) enable the reconstruction of its phase shift imprinted by the interaction with matter. This offers sensitivity to local variations in the electron density distribution and thus provides improved contrast for soft tissue imaging.

High spatial resolution measurements were performed using propagation-based PCI [1,2]. Compared to this, grating-based PCI promises better sensitivity to small variations in the densities [3].

In this contribution we will present a comparison between propagation- and grating-based PCI with regard to their requirements on the experimental setup and to their potential for future applications in the field of bio-medical imaging.

[1] Krenkel, Martin, et al. AIP Advances 6.3 (2016): 035007.

[2] Kitchen, Marcus J., et al. Physics in medicine and Biology 60.18 (2015): 7259.

[3] Macindoe, David, et al. Physics in Medicine and Biology 61.24 (2016): 8720.

ST 7.7 Do 14:00 JUR Foyer

Status of the scatterer component of a Compton camera for ion beam range verification in proton therapy — •Silvia Liprandi[1], Saad Aldawood[1,2], Vincent Beck[1], Michael Mayerhofer[1,3], Tim Binder[1], Ingrid Valencia Lozano[1], Juna Bortfeldt[1], Ludwig Maier[4], Rudi Lutter[1], Roman Gernhäuser[4], Guntram Pausch[5], Fine Fiedler[6], Wolfgang Enghardt[5,6], George Dedes[1], Katia Parodi[1], and Peter G. Thirolf[1] — [1]LMU München, Germany — [2]King Saud Univ., Riyadh, Saudi Arabia — [3]Univ. Hamburg, Germany — [4]TU München, Germany — [5]OncoRay and TU Dresden, Germany — [6]Helmholtz-Zentrum Dresden-Rossendorf, Germany

At LMU we are developing a Compton camera, designed to detect prompt γ-rays induced by nuclear reactions, during the irradiation of tissue in particle therapy. Our prototype consists of a stack of double-sided silicon strip detectors acting as scatterers and an absorber formed by a $LaBr_3$(Ce) scintillator. Both detectors have been characterized off- and online at different accelerator facilities, showing good agreement with MC simulations. Here, the present readout for the DSSSDs (based on the GASSIPLEX ASIC chip) revealed several limitations that urge for an improved upgrade. This poster will focus on the status of the scatterer component and its readout: a characterization of the detectors and specifications for their readout will be shown. Different readout options will be presented, together with first tests performed using a system based on the AGET ASIC chip.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MAP) and KSU, Riyadh, Saudi Arabia.

ST 7.8 Do 14:00 JUR Foyer

Evaluation of a scintillator readout system based on a Silicon Photomultiplier (SiPM) Array and an ASIC-based readout system for a Compton camera — •Tim Binder[1,2], Saad Aldawood[1,4], George Dedes[1], T. Ganka[2], Roman Gernhäuser[5], Silvia Liprandi[1], Rudi Lutter[1], Ludwig Maier[5], Michael Mayerhofer[1,3], Agnese Miani[1,6], Katia Parodi[1], F. Schneider[2], and Peter G. Thirolf[1] — [1]LMU München, Germany — [2]KETEK GmbH, Munich, Germany — [3]Univ. Hamburg, Germany — [4]King Saud Univ., Riyadh, Saudi Arabia — [5]TU München, Germany — [6]Univ. degli Studi di Milano, Italy

The LMU Compton camera prototype consists of a scatterer (6 layers of double-sided Si-strip detectors) and an absorber ($LaBr_3$) with a photomultiplier tube (PMT) and NIM/VME based readout. In order to optimize the system for different applications, a set of alternative components was evaluated. Firstly, a $CeBr_3$ crystal, providing an increased S/N ratio, due to the absence of internal radioactivity compared to $LaBr_3$, is read out with the present electronics and the spatial resolution is determined. Secondly, a SiPM array and an ASIC-based readout system, allowing the Compton camera to be used in multimodal imaging devices (e.g. combined with MRI), is evaluated. Therefore results of nonuniformity and temperature dependence measurements of the single component's channels, as well as for the combined system are presented. Finally, energy spectra are reconstructed and the energy resolution is compared to results from a standard readout system.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MAP) and KETEK GmbH.

ST 7.9 Do 14:00 JUR Foyer

Study of the spatial resolution of a monolithic $LaBr_3$:Ce scintillator — •Michael Mayerhofer[1,2], Saad Aldawood[1,3], Tim Binder[1], George Dedes[1], Roman Gernhäuser[5], Silvia Liprandi[1], Rudi Lutter[1], Ludwig Maier[5], Agnese Miani[1,4], Katia Parodi[1], Dennis R. Schaart[6], Ingrid Valencia Lozano[1], and Peter G. Thirolf[1] — [1]LMU München, Germany — [2]Univ. Hamburg, Germany — [3]King Saud Univ., Riyadh, Saudi Arabia — [4]Univ. degli Studi di Milano, Italy — [5]TU München, Germany — [6]TU Delft, Netherlands

We develop a Compton camera for ion-beam range verification during hadron therapy by detecting prompt γ rays from nuclear reactions between the beam and organic tissue. The camera consists of a scatterer (6 layers of double-sided Si-strip detectors) and a $LaBr_3$(Ce) scintillator as absorber, read out by a multianode photomultiplier. Key ingredient of the γ-source reconstruction is the determination of the γ-ray interaction position in the scintillator. This contribution will focus on the "k-Nearest Neighbor" (k-NN) and the "Categorical Average Pattern" (CAP) algorithm [1]. Both require a large reference library of 2D light amplitude distributions, derived by scanning the scintillator front surface with tightly collimated ^{60}Co and ^{137}Cs sources and a fine step size (0.5 mm). The determination of the spatial resolution as a function of the photon energy, the PMT granularity and the systematic performance of the two algorithms will be present.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MPA).

[1]van Dam et al., IEEE TNS 58 (2011).