ST 4: Poster session

Time: Tuesday 14:00–16:00 Location: Poster B1

ST 4.1 Tue 14:00 Poster B1

investigation of intrinsic property of 4 layer DOI PET detector — •MUNETAKA NITTA[1], GIULIO LOVATTI[1], GEROGE DEDES[1], MOHAMMAD SAFARI[1], TIM BINDER[1], JULIANA MARTIN[1], PETER THIROLF[1], TAIGA YAMAYA[2], and KATIA PARODI[1] — [1]Ludwig Maxmilians University, Munchen, Germany — [2]National institutes for quantum and radiological science and technology, Chiba, Japan

We have started to design an in-beam PET system for the project of ”small animal proton irradiator for research in molecular image-guided radiation-oncology (SIRMIO)”. The PET system should be designed to image positron emitters induced by proton beam. To achieve both uniform high image resolution in field of view and high sensitivity, we require a PET detector with high spatial resolution and depth of interaction (DOI) information. As the structure of DOI PET detector, the 4-layer DOI PET detector which is developed by national institute of radiological science in Japan is a leading candidate for the PET system. As a scintillator, both LYSO and GAGG are candidates for the PET detector. LYSO is commonly used for PET detector but contains natural radioactive isotope of Lu-176 which provides random coincidence for PET measurement as noise event. Such noise events might not be negligible because of the limited number of induced positron emitters. Although density of GAGG is lower than LYSO, GAGG does not contains such natural radioactive isotope. In this study, we carried out optical Monte Carlo simulation of both LYSO and GAGG based 4-layer DOI PET detector to investigate dependency of scintillation material on intrinsic property of the PET detector by Geant4.

ST 4.2 Tue 14:00 Poster B1

Contrast-Enhanced Spectral Mammography with a Compact Synchrotron Source — LISA HECK[1,2,3], •MIRKO RIEDEL[1,2], MARTIN DIEROLF[1,2], CHRISTOPH JUD[1,2], ELENA EGGL[1,2], THORSTEN SELLERER[1,2], KORBINIAN MECHLEM[1,2], BENEDIKT GÜNTHER[1,2], KLAUS ACHTERHOLD[1,2], BERNHARD GLEICH[2], STEPHAN METZ[4], DANIELA PFEIFFER[4], FRANZ PFEIFFER[1,2,4], and JULIA HERZEN[1,2] — [1]Chair of Biomedical Physics, Department of Physics, TU Munich, Germany — [2]Munich School of BioEngineering, TU Munich, Germany — [3]Chair of Experimental Physics IV, TU Dortmund, Germany — [4]Department of Diagnostic and Interventional Radiology, Klinikum rechts der Isar, TU Munich, Germany

Contrast-enhanced spectral mammography (CESM) based on K-edge subtraction (KES) helps to identify uncertain findings in mammography as second-level examination. Here, the commonly used dual-energy KES imaging technique and a two-material decomposition method were used to perform CESM with a mammographic accreditation phantom at a compact synchrotron source. For a better evaluation of the laboratory results, clinical CESM images were also performed. Improved image quality has been accomplished with both aforementioned methods while the spectral approach achieved even better results than the KES. Exemplarily, we demonstrate the reduction of the applied dose by up to 66% compared to the clinically applied dose. These promising results underline the potential of this novel type of X-ray source and of the spectral approach to improve the diagnostic quality of CESM and to reduce the applied dose in clinical examinations.

ST 4.3 Tue 14:00 Poster B1

Phase-sensitive water fat separation in frequency-modulated bSSFP cardiac CINE — •ANNE SLAWIG, TOBIAS WECH, THORSTEN BLEY, and HERBERT KÖSTLER — Institut für diagnostische und interventionelle Radiologie, Universitätsklinikum Würzburg, Deutschland

Balanced steady state free precession (bSSFP) is widely used for assessing cardiac function in MRI, as it provides fast imaging with high SNR and excellent contrast. The main drawbacks include banding artefacts caused by field inhomogeneity and the hyperintense fat signal. The former have been shown to be eliminated by using a frequency-modulated bSSFP acquisition (1). Further on, fat and water signal can be separated in standard bSSFP imaging by a phase sensitive approach (2). Here we present a combination of both methods, which allows the reconstruction of banding free, water-only and fat-only images of the whole cardiac cycle (CINE imaging). Cardiac images of a healthy volunteer were acquired for 20 cardiac phases using an ECG log and the phase-sensitive separation was applied. In standard bSSFP measurements severe off-resonance artefacts were observed, ultimately resulting in major swaps between water and fat. The combination of the frequency-modulated measurement with the phase-sensitive separation approach showed no off-resonance artefacts and a good separation of water and fat throughout all frames of the cardiac cycle.

[1] Benkert T et al., Magn. Reson. Med. 2015;73:182-194
[2] Hargreaves BA et al., Magn. Reson. Med. 2003;50:210-213

ST 4.4 Tue 14:00 Poster B1

Using ultraviolet light for velocity determination of magnetic nanoparticles in external magnetic fields. — •JÖRG FUSENIG[1], ROBERT ENGLERT[1], SVEN MANTOWSKY[1], TOBIAS ROTH[1], HELLMUT HUPE[1], and MARC SCHNEIDER[2] — [1]Trier University of Applied Sciences, Engineering and Technology, D-54293 Trier — [2]Saarland University, Biopharmaceutics and Pharmaceutical Technology, D-66123 Saarbrücken

This contribution deals with the linear transportation of magnetic nanoparticles by the use of a linear moving field device. To understand the acting forces and how they are affected by the viscosity, the transport process through transparent cylindrical tubes filled with different media can be monitored. In order to access the velocity of the magnetite particles, a stand-alone device equipped by an ultraviolet light transmission tool is developed. Locally differing volume concentrations within the moving particle cloud lead to a time-dependent change in the attenuation of the transmitted light which is a measure for the clouds velocity. Simultaneously, the magnetic flux density is recorded with a set of hall sensors. The device is immersible in water, as the field exciting coils are fully submerged in a flow-through vessel to transfer power losses. We test the performance of the setup by a comparison with a commercial UV/Vis spectrometer and a magnetometer, respectively.

ST 4.5 Tue 14:00 Poster B1

Performance of a monolithic scintillator studied under realistic conditions in a Compton Camera system — •GIOVANNI PAOLO VINCI, TIM BINDER, SILVIA LIPRANDI, MARIA KAWULA, KATIA PARODI, and PETER G. THIROLF — Ludwig-Maximilans-Universität München

The Compton Camera (CC) prototype under commissioning in Garching aims at providing an online beam range verification tool using the prompt γ rays emitted by excited nuclei during the irradiation of tissue with a particle beam. Currently, we are working with 50x50x30 mm^3 monolithic $LaBr_3$:Ce or $CeBr_3$ scintillators as CC absorber component, read out by multianode photomultipliers. These configurations show excellent energy, spatial and timing resolutions.

In realistic conditions, however, the Compton electrons, generated in the scatterer, consisting of 6 layers of 0.5 mm thick double-sided Silicon strip detectors (DSSSD), may reach the scintillator, since the thickness of the DSSSD array is not enough to stop them. So far, the determination of the photon interaction position in the absorber crystal was studied only with individual collimated γ sources. Yet, it remains to be explored how the resolution is affected by either an electron and the Compton scattered photon or two photons impinging simultaneously onto the crystal. This work will present a study of these two scenarios using simultaneous irradiation by a collimated ^{204}Tl electron source and collimated ^{137}Cs or ^{60}Co photon sources.

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

ST 4.6 Tue 14:00 Poster B1

Investigation of the dependency of properties of a 4-layer DOI PET detector on the scintillator material — •MUNETAKA NITTA[1], GIULIO LOVATTI[1], GEORGIOS DEDES[1], SODAI TAKYU[2], MOHAMMAD SAFARI[1], TIM BINDER[1], GIOVANNI VINCI[1], TAIGA YAMAYA[2], KATIA PARODI[1], and PETER G. THIROLF[1] — [1]LMU, Munich, Germany — [2]NIRS-QST, Chiba, Japan

We have started to design an in-beam PET system for the Small animal proton irradiator for research in molecular image-guided radiation-oncology (SIRMIO) project. The PET will image positron emitters generated by the proton beam or externally injected with radioactive tracers. To achieve both uniform high image resolution and high sen-

sitivity, we require a PET detector with high spatial resolution and depth-of-interaction (DOI) identification capability. Here, the 4-layer DOI PET detector developed by the NIRS is a leading candidate. As a scintillator material, both LYSO and GAGG are candidates. LYSO is commonly used for PET detectors, but contains the radioactive isotope of Lu-176 which provides random coincidences for PET measurement as background. Such noise events might not be negligible due to the limited yield of generated positron emitters for pre-clinical treatment. Although the density of GAGG is lower than for LYSO, GAGG does not contain such radioactivity. In this study, we carried out simulations using Geant4 of both LYSO and GAGG-based 4-layer DOI PET detectors to investigate the dependency of the PET detector properties on the scintillator material. This work is funded by the European Research Council (ERC) under grant agreement number 725539.

ST 4.7 Tue 14:00 Poster B1

Reichweitenbestimmung für therapeutisch eingesetzte Protonen: optische Messung im Vergleich zu herkömmlichen Messmethoden. — •Jan Michael Burg[1], Hilke Vorwerk[2] und Klemens Zink[1,2,3] — [1]THM Gießen — [2]UKGM, Gießen/Marburg — [3]FIAS, Frankfurt

Die Therapie mittels Protonen findet immer häufiger Einsatz in der modernen Strahlentherapie. Bei der Qualitätssicherung dieser Anlagen ist einen wiederkehrende dosimetrische Fragestellung, das Bestimmen der energieabhängigen Reichweiten der eingesetzten Protonen. Die herkömmliche Messung mittels beweglicher Ionisationskammern in Wasser ist, je nach geforderter Ortsauflösung und Anzahl der zu messenden Energien, sehr zeitintensiv. Es konnte in einem Experiment am Marburger Ionenstrahl-Therapiezentrum bereits gezeigt werden, dass es mittels einer hochempfindlichen Kamera möglich ist optische Photonen zu detektieren, die während der Bestrahlung eines Wasserphantoms entstehen. Da diese Methode das gesamte Strahlprofil in einer Messung aufnimmt ergibt sich ein deutlicher Zeitvorteil gegenüber der schrittweisen Messung mittels Ionisationskammern. In dieser Arbeit soll die optische Reichweitenbestimmung mit herkömmlichen Methoden im Detail verglichen werden. Das Auflösungsvermögen und die Zeitersparnis für die Reichweitenmessung, im Vergleich zu herkömmlichen Messmethoden, wurden bestimmt. Darüber hinaus wurde geprüft ob sich die optische Messmethode auch zum charakterisieren des Peak-to-Pateau Verhältnisses eines Bragg-Peak eignet.

ST 4.8 Tue 14:00 Poster B1

Determination of the photon interaction position in a monolithic scintillator applied in a Compton Camera system — •Maria Kawula[1], Silvia Liprandi[1], Tim Binder[1,2], Rita Viegas Rego[1,3], Ben Hoyle[1], Katia Parodi[1], and Peter G. Thirolf[1] — [1]LMU München, Munich, Germany — [2]KETEK GmbH, Munich, Germany — [3]University of Coimbra, Portugal

The LMU Compton Camera is being developed for ion beam range verification during particle therapy. The system detects prompt gamma rays produced after tissue irradiation. The camera consists of a scatterer (6 layers of double-sided Si-strip detectors) and a monolithic $LaBr_3(Ce)$ scintillator as an absorber, read out by a multianode photomultiplier. To determine the photon interaction position in the scintillator the "Categorical Average Pattern" (CAP) algorithm [1] is used. This algorithm is based on the comparison of every recorded photon event with a reference library of 2D light amplitude distributions obtained by scanning the scintillator front surface with tightly collimated ^{60}Co and ^{137}Cs sources respectively in 10404 positions (400 photopeak events per position are acquired). A second method based on Convolutional Neural Networks (CNN) is under development. The reference library acquired for the CAP algorithm is used as training data. The architecture of the network as well as a quantitative comparison of CAP and CNN in terms of computational time, memory consumption and obtained spatial resolution will be presented. This work is supported by the DFG Cluster of Excellence Munich Centre of Advanced Photonics (MAP).