ST 2: Postersession - Medical Physics

Time: Tuesday 17:00–18:00 Location: Grotte

ST 2.1 Tue 17:00 Grotte

Photon interaction position determination in monolithic scintillators via Neural Network algorithms — •Maria Kawula[1], Tim Binder[1,2], Silvia Liprandi[1], Katia Parodi[1], and Peter G. Thirolf[1] — [1]Ludwig-Maximilians-Universität München — [2]KETEK GmbH München

Monolithic scintillators are an attractive alternative to pixelated crystals as a part of multiple-component photon detectors like Compton cameras. We propose a novel algorithm for determining the position of γ-ray interactions in a monolithic scintillation crystal, based on Supervised Machine Learning involving Convolutional Neural Networks (CNN). The new method is an alternative to well-established algorithms such as "k-Nearest Neighbours" (kNN), which suffers from long computation time and high memory requirements. Two crystals, $LaBr_3$:Ce and $CeBr_3$, of size 50 mm×50 mm×30 mm were examined. The spatial resolution of the CNN algorithms was tested for three energies of the initial γ quanta: 662 keV (^{137}Cs), 1.17 MeV and 1.33 MeV (^{60}Co). A spatial resolution of the algorithm of 1.04 ($\pm$0.04 stat. $\pm$ 0.2 sys.) mm at 662 keV and 0.90 ($\pm$0.02 stat. $\pm$ 0.2 syst.) mm at 1.3 MeV for $LaBr_3$:Ce and $CeBr_3$, respectively, was achieved. The new reconstruction scheme is compatible with CPUs and GPUs and can reconstruct up to $2 \cdot 10^4$ events/s, which is four orders of magnitude faster than the kNN. Memory requirements are reduced by $\approx$1/1000. This work was supported by the DFG Cluster of Excellence MAP (Munich Centre for Advanced Photonics) and the Bayerische Forschungsstiftung.

ST 2.2 Tue 17:00 Grotte

Event Processing for the SiFi-CC based on Geant4 Simulations — •Jonas Kasper[1], Achim Stahl[1], Ronja Hetzel[1], Aleksandra Wronska[2], Majid Kazemi-Kozuni[2], Andrzej Magiera[2], and Katarzyna Rusiecka[2] — [1]III. Physikalische Institut B, RWTH Aachen University, Aachen — [2]Institute of Physics, Jagiellonian University, Kraków

In 2014 NuPECC listed online monitoring of the beam range in hadron therapy as one of the most important challenges in hadron therapy. Monitoring systems based on the detection of prompt gamma radiation are considered as one of the most promising options. A Compton Camera, yielding the full three-dimensional dose distribution, is one of the favoured detector setups. Scientist of the Jagiellonian University in Cracow and the RWTH Aachen University in Aachen develop the SiPM and scintillating Fiber-based Compton Camera (SiFi-CC) to detect prompt gamma radiation. The Compton Camera consists of two modules, the scatterer and the absorber. Both modules are built from stacked, heavy, scintillating fibers read out by SiPMs. Different setup approaches for the SiFi-CC are simulated with Geant4. Based on these simulations, an analysis and reconstruction chain is set up. The steps of the data processing are the reconstruction of the interactions in the detector on fiber level, building detector events from these fibers, sorting these events for the picture reconstruction and the reconstruction of the source distribution. The performance of the different steps based on the simulated response of the SiFi-CC to the radiation produced by the interactions of a proton beam in a PMMA phantom are presented.

ST 2.3 Tue 17:00 Grotte

Purification of the organo-metallic liquid TMBi for use in a novel PET detector — •Simon-Nis Peters[1], Konstantin Bolwin[2], Björn Gerke[2], Volker Hannen[1], Christian Huhmann[1], Klaus Schäfers[2], and Christian Weinheimer[1] — [1]Institut für Kern- physik, WWU Münster — [2]European Institute for Molecular Imaging, WWU Münster

Recently, a new type of PET detector has been proposed using a heavy organo-metallic liquid - TriMethyl Bismuth (TMBi) - as target material. TMBi is a transparent liquid 82% by weight of Bismuth as the heaviest non-radioactive element. 511 keV photons from annihilation processes are effectively converted to photo-electrons in the material due to the high Z bismuth component. These photo-electrons produce both Cherenkov light and charges in the liquid. While the optical component enables a fast timing, charge readout using a segmented anode can provide an accurate position reconstruction. To be able to drift the charges to the anode a high level of purification of the liquid is required, removing any electro-negative contaminations. Due to the reactive nature of the liquid, purification using getter materials is not an option. In addition only vacuum grade ceramics and stainless steel components can be used for a purification system. The Poster will present the design of a purification bench combining a TMBi distillation column with molecular sieves and a prototype detector cell which will allow to determine the characteristics of charge readout in the liquid. This work is supported by the DFG (Project number: WE 1843/8-1; SCHA 1447/3-1)

ST 2.4 Tue 17:00 Grotte

Design of a detector cell for charge-readout tests in TMBi — •N. Marquardt[1], K. Bolwin[2], B. Gerke[2], V. Hannen[1], C. Huhmann[1], S. Peters[1], K. Schäfers[2], and C. Weinheimer[1] — [1]Institut für Kernphysik, WWU Münster — [2]European Institute for Molecular Imaging, WWU Münster

The heavy organo-metallic liquid TriMethyl Bismuth (TMBi) has been proposed as a medium for a new type of PET detector. TMBi is a transparent liquid with a Bismuth mass fraction of 82%. Due to the high Z component of Bismuth, the 511 keV photons produced in annihilation processes are effectively converted to photo-electrons in the liquid. These photo-electrons produce both Cherenkov light and charge carriers in the TMBi. The detection of the Cherenkov light allows a fast timing, whereas charge-readout using a segmented anode provides an accurate position reconstruction.

Detection of the charge signals requires extremely low noise electronics and a highly purified liquid devoid of any electro-negative components to be able to drift electrons in the liquid. The electrical properties of TMBi relevant for this measurement have barely been studied up to now. Therefore, a small volume detector for charge-readout tests was build to study the TMBi characteristics under high voltage. The poster will present the design and setup of the detector cell and provide preliminary results of the measurements.

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