T 93: Detectors 9 (gas detectors)

Time: Thursday 16:00–17:45 Location: Geb. 30.23: 2/17

T 93.1 Thu 16:00 Geb. 30.23: 2/17

Photon Position Reconstruction using Structured Converter Layers in Micro-Pattern Gaseous Detectors — •Katrin Penski, Otmar Biebel, Valerio D'Amico, Stefanie Götz, Roman Lorenz, Ralf Hertenberger, Eshita Kumar, Nick Schneider, Chrysostomos Valderanis, and Fabian Vogel — LMU München

Micro-Pattern Gaseous Detectors are high-rate capable with excellent spatial and temporal resolution. Developed for the detection of charged particles, the low density in the active gas volume of these detectors exhibit only a poor detection efficiency for electrically neutral particles. For photons the detection via the photoelectric effect can be increased using a solid converter cathode, which is made of high-Z materials. With our novel approach, the detection efficiency can be optimized by incorporating multiple converter plates quasi perpendicularly on top of the first GEM foil. Moreover, this technique aims to provide a full two-dimensional position reconstruction of the particle with a resolution of less than 100 μm within a converter plate. Using the two coordinates of the readout anode of the GEM detector enables this by mounting the converter layers at a specific angle that allows geometric position reconstruction. An optimized electric field, where the electric field lines are parallel to the amplification field, guides the electrons from the converter layers to the GEM foils. Simulations were performed to optimize the design and understand the underlying physical processes. These and measurement results are presented, which aim to image an object in order to verify the functionality of this method.

T 93.2 Thu 16:15 Geb. 30.23: 2/17

Development of a GridPix-based X-ray Polarimeter — Klaus Desch, •Markus Gruber, Jochen Kaminski, and Vladislavs Plesanovs — Physikalisches Institut Uni Bonn, Nussallee 12, 53115 Bonn

In astrophysics with X-ray telescopes and material science at synchrotron light sources the measurement of X-ray polarisation can be a valuable tool. It can be directly measured by tracking photoelectrons created in photoelectric interactions. This is possible because their emission angle depends on the direction of the electric field vector of the photons. Within a gaseous detector these electrons have a sufficiently long mean free path such that tracking is possible - if the granularity of the readout is high enough to resolve the tracks and scattering. Also resolving the charge and time distribution of secondary ionisations is needed to differentiate the start and the end of the track. For this a GridPix - a combination of a Timepix(3) ASIC with 55 μm pixel pitch and a photolithographically postprocessed gas amplification stage (integrated grid) can be used. Perfect alignment of the holes in the grid to the pixels enables the possibility to detect avalanches of individual primary electrons.

In this talk, I will present new results on the performance of a GridPix-based X-ray polarimeter. Based on data taken at PETRA III and at a polarised X-ray source at INAF-IAPS the dependence on different detector parameters like gas choice and geometry will be discussed and compared to simulations. Additionally challenges and possible improvements of such a detector will be presented.

T 93.3 Thu 16:30 Geb. 30.23: 2/17

Status of new GridPix production in Bonn — •Sabine Hartung, Yevgen Bilevych, Jochen Kaminski, and Klaus Desch — Physikalisches Institut Universität Bonn

GridPixes are Micropattern Gaseous Detectors optimized for highest resolution and single primary electron detection. It uses a highly pixelized readout ASIC, such as the Timepix and Timepix3, which have a pixel pitch of 55×55μm. To protect the ASIC an additional protection layer is built on the surface of the chip. On top a Micromegas gas amplification stage is built by photolithographic postprocessing. So far, this process has been done at the Fraunhofer Institute IZM in Berlin but is now being transfered to the Forschungs- und Technologiezentrum Detektorphysik (FTD) in Bonn. Here, besides the standard process developed before, more flexible production techniques without masks are available, allowing for a wider range of optimization.

This talk will explain both the general production steps as well as the status of the production in Bonn.

T 93.4 Thu 16:45 Geb. 30.23: 2/17

Studies on GEM amplification and time resolution — •Tim Fabisch, Thomas Hebbeker, Kerstin Hoepfner, Shawn Zaleski, and Francesco Ivone — III. Physikalisches Institut A, RWTH Aachen University

The GEM (Gas Electron Multiplier) technology is being adopted for muon detection in high energy physics experiments, for both tracking and triggering, as well as in other application areas. Two key detector performance figures are the amplification factor and the time resolution.

The electron amplification in GEM detectors depends on the gas mixture, GEM foil's structure, environmental conditions and high voltage settings. The foil's structure is affected by the manufacturing technique which can be based on either single or double mask etching. The time resolution strongly depends on the gas mixture and applied voltage.

In this contribution, we describe the influence of the aforementioned parameters on the amplification factor and the time resolution of a GEM detector. The study complements experimental measurements with numerical simulations.

T 93.5 Thu 17:00 Geb. 30.23: 2/17

Efficiency Increase of Photon Detection of Micro-Pattern Gaseous GEM Detectors via Material Optimisation of Strucured Converter Layers — •Nick Schneider, Otmar Biebel, Valerio D'Amico, Stefanie Götz, Ralf Hertenberger, Eshita Kumar, Katrin Penski, Chrysostomos Valderanis, Fabian Vogel, and Roman Lorenz — LMU München

Micro-Pattern Gaseous Detectors (MPGDs) are heavily used for the detection of charged particles with excellent temporal and spatial resolution. Electrically neutral particles like photons are detected with poor efficiency due to the low density in the active gas volume. By inserting solid converter layers of high-Z material this disadvantage can be mitigated. In our desgin multiple converter layers are placed perpendicular to the amplification region. In order to further increase the photon detection efficiency the material and structure of the converter layers need to be optimised to find the balance between creation and extraction rate. For photon conversion copper plated layers are used with relatively thin FR4 or Kapton as carrier material. Different converter layer geometries are tested in order to achieve high photon detection efficiencies. These results are compared to simulations for better understanding of the physical processes. The best performing converter layer type increases the photon detection efficiency by a factor of ≈ 5 compared to the non-optimised layers.

T 93.6 Thu 17:15 Geb. 30.23: 2/17

Electron swarm parameter measurements at subatmospheric pressures — Stefan Roth, Keitlin Sejdarasi, David Smyczek, Jochen Steinmann, and •Nick Thamm — RWTH Aachen University - Physics Institute III B, Aachen, Germany

Tissue Equivalent Gas mixtures (TEGs) were created to mimic the interactions of ionizing particles in human tissue for precise dose measurements. Filling Time Projection Chambers (TPCs) with TEGs enables measurements which resolve the spacial development of particles passing through tissue. By lowering the operating pressure inside a TPC, it is possible to fine-tune these detectors towards improved track resolution for low energies. For the correct interpretation of the low-pressure TPC data, various electron swarm parameters need to be precisely determined at these low pressures. Existing drift parameter simulations can be verified by utilizing a specialized Gas Monitoring Chamber (GMC). In this talk the hardware modification of a GMC towards low pressure operation is addressed, the associated challenges are explained and first measurement results of TEGs are shown.

T 93.7 Thu 17:30 Geb. 30.23: 2/17

High-rate electron detectors to study Compton scattering in strong-field QED — •Antonios Athanassiadis[1,2], Louis Helary[1], Luke Hendriks[1,3], Ruth Magdalena Jacobs[1], Jenny List[1], Gudrid Moortgat-Pick[2], Evan Ranken[1], Stefan Schmitt[1], Ivo Schulthess[1], and Matthew Wing[1,3] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [2]Universität Hamburg, Hamburg, Germany — [3]University College London (UCL), London, UK

In the field of non-perturbative quantum electrodynamics (QED), ad-

vances in high-intensity lasers allow the generation of strong fields in collisions between laser pulses and relativistic electron beams. This enables phenomena such as non-linear Compton scattering and Breit-Wheeler pair production to be probed in the laboratory.

The study of Compton energy spectra in these collisions is challenging due to the large number and wide range of outgoing particles per collision (10^3 to 10^9). Our study introduces a new detector concept combining a segmented gas-filled Cherenkov detector with scintillator screens and a camera system. Integrated into experiments such as E320 at SLAC and LUXE at DESY, these detectors allow to resolve the electron energy spectrum within the required wide dynamic range.

This talk presents the results of first beam tests with a prototype and discusses techniques to reconstruct the non-linear Compton electron energy spectrum.