T 10: Gaseous detectors

Time: Monday 16:00–18:15 Location: Tj

T 10.1 Mon 16:00 Tj

A Cherenkov Position Micromegas — •Maximilian Rinnagel, Otmar Biebel, Maximilian Herrmann, Christoph Jagfeld, Felix Klitzner, Katrin Penski, Chrysostomos Valderanis, Fabian Vogel, and Ralf Hertenberger — LMU München

Detectors utilizing the Cherenkov effect have been well established for particle identification of charged particles in detector systems such as LHCb or HADES. In reverse it is possible to determine the momentum of a known particle by measuring the opening angle of the Cherenkov cone in thick Cherenkov media. Our goal with this 10x10 cm^2 prototype is a proof of principle using cosmic muons. A traversing muon creates around 700 Cherenkov photons in a 1-2 cm thick ulta-violet (UV) transparent LiF, CaF_2 or MgF_2 window with an optical refractive index around 1.5 in the UV range. The conversion to electrons happens in transmission in a photosensitive CsI layer at the bottom of the radiator. High voltage around -300 V, applied to a thin layer of Chromium in between the crystal and the CsI, forces the electrons into the drift region of a Micromegas, i.e. gaseous micro pattern detector, where the electrons are detected with excellent spatial resolution after gas-amplification in the anode-stage of the detector. Overall efficiencies of 7% seem possible at transparencies of 60% through the Chromium layer and conversion efficiencies around 12% in the CsI layer. Thus, good momentum resolution and spatial resolution of an incident muon particle will be achieved. We will present the detector design as well as studies concerning the transmission of the radiator material and the predicted photon yield.

T 10.2 Mon 16:15 Tj

Photon Detection by a Structured Cathode of a Micro-Pattern Gaseous Detector — •Katrin Penski, Otmar Biebel, Maximilian Herrmann, Ralf Hertenberger, Christoph Jagfeld, Felix Klitzner, Maximilian Rinnagel, Chrysostomos Valderanis, and Fabian Vogel — LMU München

Micro-Pattern Gaseous Detectors (MPGDs) are high-rate capable and show an extremely good spatial and temporal resolution. Nevertheless, due to the low density of the gas these detectors exhibit only a poor detection efficiency for electrically neutral particles. For photons the detection efficiency can be increased by using a solid converter cathode which is made of high-Z materials. Even higher efficiencies are obtained by stacking several tilted converter layers with large overlap inside a MPGD. In an interaction process electrons are created which have to be guided to the amplification and readout area for detection which is achieved by a specific designed electric field configuration. The tilted layers in combination with the electric guidance field act as structured cathode. In order to investigate the photon detection efficiency measurements are performed using a prototype structured cathode, a GEM detector and an ^{241}Am-source emitting 59.5 keV photons. These results are presented and compared to corresponding simulations regarding the electron guiding efficiency, the electron distribution as well as the photon detection efficiency.

T 10.3 Mon 16:30 Tj

Developement of a low background GridPix detector for IAXO — •Tobias Schiffer, Klaus Desch, Markus Gruber, Jochen Kaminski, and Sebastian Schmidt — Physikalisches Institut, Universität Bonn

In the scope of the search for axions and axion like particles (Alps) with helioscopes, like the International Axion Obeservatory (IAXO) and its precurser BabyIAXO, detectors capable of measuring low energy X-rays down to the 200 eV range are necessary. For this purpose the GridPix detector is an appropriate solution, which has already been used successfully at CAST.

The GridPix is a MicroMegas like readout consisting of a pixelized readout ASIC (Timepix/Timepix3) with a perfectly aligned gas amplification stage on top of the ASIC. Due to the very high granularity this detector is capable of detecting single electrons allowing the measurement of low energy X-rays. To convert these X-rays into electrons a gas volume is built above the readout sealed with an X-ray entrance window.

For the goals of IAXO and BabyIAXO a very low background needs to be achived with the detector, therefore only a few radiopure materials are contemplable. Also, to get a good signal to noise ratio the X-ray entrance window needs to be as transparent as possible for the low energy X-rays, while still maintaining a barrier between the detector gas and the vacuum system in front. This is achived with an ultra thin (<200 nm) silicon nitride membrane.

The challenges and the status of the detector will be presented.

T 10.4 Mon 16:45 Tj

X ray reconstruction for IAXO using a Timepix 3 based InGrid — Ivor Fleck, •Jan Hahn, and Ulrich Werthenbach — Center for Particle Physics Siegen, Experimentelle Teilchenphysik, Universität Siegen

We present a reconstruction algorithm for X ray photons in a gaseous volume instrumented with a Gridpix. The algorithm is based on the Cambridge Aachen algorithm for jet reconstruction. By recursive recombination, active pixels on the readout chip are combined to clusters based on their distance to each other, combining the closest pair until the minimal distance exceeds a threshold. Each pixel corresponds to one electron from the primary ionisation.These clusters are subjected to cuts to to reject background and noise. Several X ray energies are investigated using iron-55 and X ray fluorescence of aluminum, copper and rubidium to obtain an energy calibration for energies in the region of interest for solar axion searches between 1 and 14 keV. In addition, different cuts are investigated to separate signal and background. Unknown energies can be reconstructed by the number of hits assigned to the cluster and the calibration. The experimental setup operates in an 80:20 mixture of argon and carbon dioxide at room temperature and ambient pressure.

T 10.5 Mon 17:00 Tj

Commissioning of a Gas Monitoring Chamber for the T2K Near Detector Upgrade — Philip Hamacher-Baumann, Paula Nehm, Paolina Noll, Thomas Radermacher, Stefan Roth, •David Smyczek, and Nick Thamm — RWTH Aachen University - Physics Institute III B, Aachen, Germany

A pair of High Angle Time Projection Chambers (HATs) will be installed during the upgrade of the T2K near detector ND280. These HATs have the task to reconstruct particle tracks and energy loss at high scattering angles of the final state charged leptons. The new Gas Monitoring Chambers will continuously measure important electron drift parameters, especially drift velocity and gain. This data will be used in the calibration procedure to improve the resolution of the measurement of the specific ionisation dE/dx and to guarantee the long term stability of track reconstruction. The design, construction and commissioning of a first prototype is presented.

T 10.6 Mon 17:15 Tj

Boron based neutron Time Projection Chamber — •Divya Pal[1], Klaus Desch[1], Jochen Kaminski[1], Micheal Luperger[1], and Markus Köhli[1,2] — [1]Physikalisches Institut, Universität Bonn — [2]Physikalisches Institut, Universität Heidelberg

Thermal neutrons have widespread applications ranging from fundamental physics tests to neutron tomography, solid-state physics and medical physics, making their detection important. Thermal neutrons are traditionally detected with Helium-3 filled proportional counters. However, due to the supply shortage of Helium-3, leading to a rapid increase in its price, alternative detectors are sought.

In Bonn, the BOron DEtector with Light and Ionization Reconstruction (BODELAIRE) is being developed with the aim of providing high spatial and time resolution in thermal neutron detection. The BODELAIRE is based on the principle of a Time Projection Chamber (TPC) with thin layers of Boron-10 neutron converters placed perpendicular to a GridPix readout which will have Timepix3 as ASIC. The trigger is placed along the field cage and consists of multiple layers: Boron, scintillator and light readout. Thus, the working principle is that the conversion of the neutron with Boron-10 gives two tracks, one giving a trigger signal in the scintillator while the other leaves a track in the gas volume.

The concept and current development status of the BODELAIRE will be presented.

T 10.7 Mon 17:30 Tj

Tracking-TPC for a Belle II Upgrade — Florian Bernlochner,

Jochen Dingfelder, Peter Lewis, •Andreas Löschcke Centeno, and Christian Wessel for the Belle II-Collaboration — Physikalisches Institut der Rheinischen Friedrich-Wilhelms-Universität Bonn

The central drift chamber (CDC) in the Belle II experiment will suffer from large cross-talk effects and high occupancy at full design luminosity of the SuperKEKB accelerator at KEK in Tsukuba, Japan.

In the context of a future upgrade of the Belle II tracking system, the viability of removing the CDC and replacing its outer region with a time projection chamber (TPC) is investigated. This upgrade scenario would see the silicon layers in the inner region being extended into the region not covered by the TPC.

The first-order and conceptual designs are simulated in the Belle II software. Of particular interest are the ion backflow characteristics and the event overlap in the TPC.

Due to the high design luminosity at Belle II there will be a large overlap in physics events due to the long drift time compared to the event rate.

Beam background contributions are dominant in the number of hits in the TPC volume. While a solid background rejection is part of tracking studies not conducted in this project, it is outlined here how the beam-induced background complicates tracking in the TPC.

T 10.8 Mon 17:45 Tj

A simple method to improve the position resolution — •Lucian Scharenberg[1,2], Jona Bortfeldt[3], Florian Brunbauer[1], Klaus Desch[2], Francisco Garcia[4], Marek Hracek[1,5], Djunes Janssens[1,6], Marta Lisowska[1,7], Michael Lupberger[2], Hans Muller[1], Hugo Natal da Luz[5], Eraldo Oliveri[1], Dorothea Pfeiffer[8,1], Heikki Pulkkinen[1,9], Leszek Ropelewski[1], Jerome Samarati[8,1], Miranda van Stenis[1], Antonija Utrobicic[1], and Rob Veenhof[1,10] — [1]CERN — [2]University of Bonn — [3]Ludwig Maximilian University of Munich — [4]Helsinki Institute of Physics — [5]Czech Technical University in Prague — [6]Free University of Brussels — [7]Wroclaw University of Science and Technology — [8]ESS — [9]VR Group — [10]Bursa Uludag University

During the development of position-sensitive particle detectors, significant efforts are spent on finding segmented readout electrodes that suit the experimental requirements. The centre-of-gravity method is a popular choice to then reconstruct the position of the incident radiation. However, the discretisation by the electrode causes an information loss, leading to inaccuracies in the position reconstruction.

We present the observed inaccuracies and a simple method that reduces them. Using imaging techniques, we show that the reduction is not the consequence of a smoothing effect. For these studies, we made use of a hardware feature from our readout electronics (VMM3a ASIC and RD51's Scalable Readout System) that allows us to gain more charge information. Afterwards, we present results with MIPs that confirm the improved position resolution.

T 10.9 Mon 18:00 Tj

Particle position reconstruction using a segmented GEM foil in a micro-structure gaseous detector — •Christoph Jagfeld, Otmar Biebel, Maximilian Herrmann, Ralf Hertenberger, Felix Klitzner, Katrin Penski, Maximilian Rinnagel, Chrysostomos Valderanis, and Fabian Vogel — LMU München

In Micromegas (Micro-MEsh GAseous Structures) detectors, a modern form of micro-pattern gaseous detectors, the signal is usually read out via readout strips on the anode. The signal created at the mesh is usually neglected for the particle position reconstruction. By replacing the mesh with a GEM (Gas Electron Multiplier) foil, which is segmented into 0.5 mm broad readout strips on its side facing the anode readout strips, the particle position can be determined on the "mesh" as well. If the strips on the GEM foil are orientated perpendicular to the anode readout strips, a particle position can be reconstructed in two spatial coordinates without adding a second layer of readout strips on the anode. First measurements with the new GEM foil will be presented.