T 44: Gasgefüllte Detektoren

Zeit: Dienstag 16:00–18:35 Raum: ST 3

Gruppenbericht T 44.1 Di 16:00 ST 3

A Prototype High Pressure Gas Time Projection Chamber for Future Long Baseline Neutrino Experiments — •Philip Hamacher-Baumann for the HPTPC-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

Currently, a High Pressure gas Time Projection Chamber (HPTPC) is included in the baseline design for the near detector in the Deep Underground Neutrino Experiment DUNE and is a candidate for Hyper-Kamiokande long baseline neutrino experiments. Increased pressure results in a likewise increased probability for (neutrino) gas interactions, but retains a low momentum detection threshold for final state particles, compared to liquid or solid detectors. A Prototype HPTPC rated to 5 bar of pressure was built, using a novel readout based on the detection of scintillation light from gas amplification. A beam test was performed at the CERN East Area T10 beamline from August to September 2018 making measurements of proton and pion interactions in the HPTPC together with an upstream and downstream time of flight system. First results of the analysis of the test beam data are presented.

T 44.2 Di 16:20 ST 3

Progress of the Picosec Micromegas concept towards a particle detector with a restive and segmented readout — •Lukas Sohl — IRFU, CEA, Université Paris-Saclay, F-91191 Gif-sur-Yvette, France

Detectors with a time resolution of several 10 ps and robustness under higher particles flux are necessary for an accurate vertex separation in future HEP experiments.

The Picosec detector concept is a Micro-Pattern Gaseous Detector (MPGD) based solution facing this particular problem. The Picosec concept is based on a Micromegas MPGD coupled with a Cherenkov radiator and a photocathode. The feasibility of this concept to reach a time resolution in the order of several 10 ps has been demonstrated with a measured time resolution of up to 24 ps. The next step is to further develop this concept towards a usable device for precise time and position measurements in high flux environments. To archive this goal several prototypes have been build and tested.

Micromegas with restive layers have been tested to operate the detector stable under a high intensity pion beam. With the additional protective layer a time resolution of up to 28 ps has been obtained.

Different types of photocathode materials have been tested in order to find a robust solution against ion back flow bombardment under higher particle flux. Moreover a first prototype has been tested with a hexagonal segmented anode pads. With this detector a combined time resolution of 36 ps for shared signals over multiple pads has been measured.

T 44.3 Di 16:35 ST 3

Fake track studies for the ATLAS TRT in high pileup scenarios — •Patrick Bauer, Klaus Desch, and Christian Grefe — Physikalisches Institut, Nussallee 12, D-53115 Bonn

The Transition Radiation Tracker (TRT) is an integral component of the inner tracking setup of the ATLAS detector at CERN. During Run 3 the increased luminosity provided by the LHC will lead to an $\langle\mu\rangle \geq 75$ compared to $\langle\mu\rangle \approx 25$ in 2016. Therefore it is essential to investigate the detector response and the track reconstruction performance in an high occupancy (up to 80 %) environment with large numbers of pileup tracks.

In order to ensure a optimal tracking it is important to keep the number of fake tracks caused by combining hits from different tracks (including pileup tracks) to a minimum. In this talk studies of the the fake track rates in ATLAS TRT are presented for high pileup scenarios.

T 44.4 Di 16:50 ST 3

Commissioning of a new gas system for the Würzburg cosmic ray facility — •Thorben Swirski, Deb Sankar Bhattacharya, and Raimund Ströhmer — Universität Würzburg

The Würzburg cosmic ray facility is used to conduct research on the behavior of Micromegas detectors. A homogenious mixture of Argon and CO_2 can be prepared in desired ratios.

The behavior of the detector changes with any impurities in the gas. Of these impurities, water has been shown to be often present. In addition, oxygen can have a large effect due to its high electronegativity, while making up about 20.95% of the air, making entry in case of a leak likely. A systematic study on such changes of the detector behavior with a controlled infusion of impurities can give us an idea about the detector responses in large experiments like ATLAS, ALICE or ILC.

To be able to produce a gas containing only trace amounts of up to 1% each of oxygen and water, the cosmic ray facility had to be augmented with a new gas system. The system was built at the end of 2018.

This talk will give an overview over the new system and will show first measurements.

T 44.5 Di 17:05 ST 3

Developement of a low background low energy X-ray detector for IAXO — •Tobias Schiffer, Klaus Desch, and Jochen Kaminski — Uni Bonn

Gaseous detectors and especially micropattern gaseous detectors like MicroMegas are commonly used in particle physics. Due to their high granularity they achieve a very high spatial resolution. An appropriate way to maximise this is a pixelised readout chip, like the Timepix3 ASIC, with a perfectly aligned gas amplification stage (InGrid) on top. This GridPix3 (the successor of GridPix) is also able to detect single primary electrons giving a good energy reconstruction for X-rays.

The search for solar axions and chameleons with helioscopes like the International Axion Obeservatory (IAXO) experiment requires detectors with very low background rates and high detector efficiency, since the expected rates are in the order of one per day and cm^2 or less in the region of 2 to 7 keV.

To achieve very low background rates the selection of special radiopure materials is required as well as a veto system for offline suppression of background events is necessary. In addition to gain a high detector efficiency an, in the low energy X-ray regime, highly transparent entrance window is important. This can be achieved by using utra thin (300 nm) vacuum-tight silicon nitride windows.

The challenges of building such a detector and the current developements will be presented.

T 44.6 Di 17:20 ST 3

Setup of a prototype for the SHiP Straw Tracker Spectrometer — •Benedict Kaiser, Caren Hagner, Daniel Bick, Stefan Bieschke, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

SHiP is a proposed general-purpose fixed-target experiment utilising 400 GeV protons from CERN's SPS accelerator. Its main focus is the search for hidden particles ("SHiP") such as Heavy Neutral Leptons (HNLs) in the intensity frontier. Besides, SHiP will also offer unparalleled measurements with τ-neutrinos and neutrino-induced charm production.

To fulfil this goal SHiP is designed as a bipartite detector consisting of an Emulsion Spectrometer and a Hidden Sector Decay Spectrometer. A crucial component of the latter is the Spectrometer Straw Tracker (SST) consisting of roughly 16000 straw tubes operated horizontally with an unprecedented length of five metres. Its purpose is the reconstruction of the vertices and masses of the hidden particles' trajectories.

Currently, a prototype of the SST consisting of four straw tubes is being built at Hamburg University. The layout of this prototype and first results will be presented in this talk.

T 44.7 Di 17:35 ST 3

Measuring the transverse diffusion with a Gas Monitoring Chamber — Philip Hamacher-Baumann, •Thomas Radermacher, Stefan Roth, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University

The Gas Monitoring Chambers of the T2K near detector ND280 are originally built to monitor and measure the drift velocity and relative gain, which are used for calibrating the Time Projection Chambers. These GMCs can also be used to measure the transverse diffusion coefficient. The width of an electron cloud can be reconstructed by the distribution of measured charge on two adjacent pad rows. From the charge distributions at two known drift lengths the transverse diffusion coefficient is determined.

T 44.8 Di 17:50 ST 3

Studies on Temperature Effects in GridPix-based Detectors
— •Lucian Scharenberg, Klaus Desch, Jochen Kaminski, and Tobias Schiffer — Physikalisches Institut, Universität Bonn

The GridPix technology is a read-out structure of gaseous detectors. It combines a MicroMegas-like gas amplification stage with a pixelised read-out, the Timepix ASIC. Capable of detecting single ionisation electrons, the advantages of the GridPix are a high spatial resolution and a good energy resolution. Thus the GridPix is the ideal detector technology for low background experiments, like the search for solar axions at the CERN Axion Solar Telescope (CAST) or its successor, the International Axion Observatory (IAXO).

During the development of a new detector for CAST a strong thermal influence on the detector operation was observed, which was related to the power consumption of the increased number of Timepix ASICs. It could be solved by installing an active water cooling. Nevertheless, a better understanding of the observed behaviour was pursued, since the development of a new detector for IAXO is considered. There the successor ASIC, the Timepix3, shall be used as read-out ASIC, which consumes about twice as much power as the Timepix.

Within this talk, the efforts to understand and quantify the temperature effects in GridPix-based detectors are presented. The dedicated test set-up, simulations, and results of the measurements are shown.

T 44.9 Di 18:05 ST 3

Study of ionizazion, apmplification and energy resolution in GridPix detectors
— Klaus Desch, •Markus Gruber, and Jochen Kaminski — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

In our group there are several gaseous detectors in development based on a highly granular pixel ASIC (Timepix) and a MicroMegas gas amplification stage (InGrid). The MicroMegas is produced by photolithographic postprocessing techniques and can be aligned with the pixel structure so that one grid hole is directly above one pixel. The combination of the Timepix ASIC and the InGrid amplification stage is then called "GridPix". Such GridPix detectors can be used for several different applications like tracking in a TPC (for instance ILD TPC) or for detection of X-ray photons (for instance at CAST or IAXO). The advantage of such a setup is its low capacitance and thus low noise which leads to the possibility of single primary electron detection. For improving future GridPix detectors like the IAXO detector it is important to understand and quantify all detection processes.

The detection of single primary electrons was used for studies of the processes in the conversion and in the amplification region of a GridPix X-ray detector with the detection of low energetic X-ray photons. In the talk I will present measurements and results regarding the ionization, the amplification and the energy resolution. Furthermore I will present estimations of the Fano factor and the Penning transfer efficiencies in argon isobutane mixtures based on these measurements and corresponding Garfield++ simulations.

T 44.10 Di 18:20 ST 3

ROPPERI - A TPC readout with GEMs, pads and Timepix
— •Ulrich Einhaus — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg

A novel anode readout structure for time projection chambers is presented. It combines GEM amplification with small pads on a separate PCB (for flexibility) and a pixel chip, the Timepix, as on-board digitization electronics (for high integration). Pad sizes in the order of a few 100 μm allow for the identification of the initial electron clusters which leads to an improvement of particle identification capabilities via dE/dx. This talk summarizes the hardware development, highlighting the challenges of the production, as well as the analysis of noise data of the second-generation boards, showing the principal feasibility of the technology. The adapted MarlinTPC simulation chain, including usage of the astrophysics software 'Source Extractor' for cluster identification, gives performance prospects of a future intermediate or large scale system.