HK 8: HK+T Joint Session I: Gas Detectors/TPC

Zeit: Montag 16:45–19:00 Raum: F 102

Gruppenbericht HK 8.1 Mo 16:45 F 102

Towards the mass production of readout chambers for the upgrade of the ALICE TPC — •Alexander Deisting for the ALICE-Collaboration — GSI, Darmstadt, Deutschland — Physikalisches Institut, Heidelberg, Deutschland

The LHC will provide, during run 3 (2021 onwards) lead-lead collisions at interaction rates as high as 50 kHz. In order to cope with this luminosity the ALICE Time Projection Chamber (TPC) will be upgraded with new readout chambers and new readout electronics.

The goal of this upgrade is to allow continuous readout of the TPC, while preserving its excellent momentum and dE/dx resolution. Therefore the ion back flow into the drift volume must be less than 1%, otherwise the field distortions due to space-charge build-up would decrease the performance significantly. Extensive R&D was performed to develop new readout chambers, meeting these goals. The resulting chambers employ a stack of four Gas Electron Multipliers (GEMs) with a special high voltage configuration.

With the long shutdown 2 approaching at the end of 2018, the design parameters have been finalized and the mass-production of the GEM-based readout chambers has started. In this talk the status of the ALICE TPC upgrade will be given. In particular the design of the chambers is presented. An overview of the recent R&D activities will be shown as well. These include stability studies of the four GEM setup, tests to ensure the quality of the GEM foils during mass-production and the commissioning of the first front-end cards. In addition we report on the challenges of the mass production.

HK 8.2 Mo 17:15 F 102

Studies of space-charge distortions in the ALICE TPC — •Ernst Hellbär[1], Jens Wiechula[1], Marian Ivanov[2], and Ruben Shahoyan[3] for the ALICE-Collaboration — [1]Institut für Kernphysik, Goethe-Universität Frankfurt — [2]GSI — [3]CERN

The Time Projection Chamber (TPC) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. With the advent of high luminosity data in LHC Run 2, unexpectedly large local distortions of the drift paths of ionization electrons are observed at the edges of specific readout chambers. These distortions are caused by ions which originate at the readout chambers, leading to local space-charge accumulation in the drift volume of the TPC. A dedicated correction procedure that was initially developed for the high-rate TPC operation in Run 3 and beyond has been implemented into the current detector calibration framework to correct the distortions with sufficient precision. The observed distortions will be shown as well as results of the investigation of their origin. Moreover, the correction procedure and its performance will be presented.

Supported by BMBF and the Helmholtz Association.

HK 8.3 Mo 17:30 F 102

Development and construction of InGrid based gaseous detectors — Klaus Desch, Jochen Kaminski, Christoph Krieger, and •Tobias Schiffer — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

Gaseous detectors are used in many particle physics experiments and applications. Especially multipattern gaseous detectors like Micromegas are able to achieve high spatial resolution through their granularity. To make full use of this granularity one has to combine the highly granular gas amplification stage with a readout structure of similar feature size, e.g. a pixelized readout chip like the Timepix and Timepix3 ASICs. The Micromegas stage can be produced directly on top of the chip by means of photolithographic postprocessing technology which allows for an almost perfect alignment between grid holes and pixels. This integrated gas amplification stage is called InGrid.

One application for detectors based on the InGrid technology is the detection of low energy X-ray photons exploiting the capability to detect individual primary electrons. To be able to detect low energy X-ray photons this kind of detector needs to fulfill special requirements which will be discussed.

Meanwhile the first InGrids on top of Timepix3 ASICs, the successor of the Timepix ASIC, are available. For testing purposes a versatile test detector is constructed and will be presented.

HK 8.4 Mo 17:45 F 102

Improving Hough transform algorithm for the track reconstruction of a Time Projection Chamber — •Amir Noori Shirazi and Ivor Fleck — Department Physik, Universität Siegen, Walter-Flex-Str. 3,57068 Siegen, Germany

A Time Projection Chamber (TPC) is foreseen as the main tracking detector for the International Large Detector (ILD) one of the two detectors for the next candidate collider named International Linear Collider (ILC).

GridPix, which is a combination of micro-pattern gaseous detector with a pixelised readout system, is one of the candidate readout systems for the TPC. One of the challenges in the track reconstruction is the large numbers of individual hits along the track (around 100 per cm). Due to the small pixel size of 55 x 55 μm^2, the hits are not consecutive. This leads to the challenge of assigning the individual hits to the correct track. Hits within a given distance from a reconstructed track are called inliers. Consequently, finding inliers within the many hits and noise is difficult for pattern recognition and this difficulty is increased by diffusion effects in the TPC.

In this analysis, a Hough transform is used. Instead of collected the inliers in the image space they are collected directly in the Hough space using a bivariate normal distribution based on the covariance matrix calculated from the diffusion defects. Results for track reconstruction efficiency and double track resolution will be presented.

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A Time Projection Chamber for the CBELSA/TAPS experiment — •Jonathan Ottnad, Markus Ball, Reinhard Beck, Dimitri Schaab, and Bernhard Ketzer — Helmholtz-Institut für Strahlen und Kernphysik, Bonn, DE

The CBELSA/TAPS experiment in Bonn aims to investigate the excitation spectrum of baryons and the properties of baryon resonances. Up to now, only the neutral decay products of the baryonic resonances are observed by the Crystal Barrel (CB), a high resolution electromagnetic calorimeter. A Time Projection Chamber (TPC) is foreseen to grant access to charged reaction channels in addition. Besides tracking, a TPC provides particle identification via the specific energy loss.

A TPC consists of a gas-filled, cylindrical volume with very low material-budget. The combination of electric and magnetic fields allows a three-dimensional track reconstruction. Constraints from the experimental setup limit the size of the fieldcage (length: 727.8 mm, outer diameter: 308 mm). The experiment's fixed target geometry results in a strong forward boost of the reaction products. Therefore the readout-electronics can only be mounted on one side of the TPC, which means one HV-cathode and one segmented readout-anode. For the gaseous amplification stage Gas Electron Multipliers were chosen.

This talk will cover the implementation of a TPC at the CBELSA/TAPS experiment, the current status of the TPC-prototype and its connected soft- and hardware infrastructure, as well as the development of a field calibration system.

Supported by SFB/TR 16.

HK 8.6 Mo 18:15 F 102

Track Reconstruction for the CBELSA/TAPS TPC — •Philipp Bielefeldt, Markus Ball, Jonathan Ottnad, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, DE

The CBELSA/TAPS Experiment at the ELSA accelerator facility in Bonn is a photo-production experiment that studies the spectrum and properties of baryon resonances. The current set-up is well-suited for the identification of neutral particles. For a future upgrade, a gas-filled Time Projection Chamber (TPC) with Gas Electron Multiplier (GEM) based amplification is under construction. It will allow studies of charged final states and provide improved particle identification capabilities and suppression of low-energetic electron background.

Track reconstruction will be done using GENFIT II, a sophisticated, experiment-independent tracking framework. It offers an abstract way to describe detector measurements and material handling as well as fitting routines, i. a. a Kálmán fitter. By design, measurement dimensionality and detector plane orientation need not be constrained, making it especially useful for a TPC, where the passage of particles is not measured on predefined planes.

In this talk, the implementation of the GENFIT II framework for the CBELSA/TAPS experiment will be discussed. An overview of the pattern recognition and fitting algorithms for the experiment will be given, as well as information on the expected performance of the GEM-TPC upgrade for the CBELSA/TAPS set-up.

Supported by SFB/TR 16.

HK 8.7 Mo 18:30 F 102

Transverse Diffusion in the TPC of the T2K Near Detector — Philp Hamacher-Baumann, Lukas Koch, •Thomas Radermacher, Stefan Roth, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

Transverse diffusion affects the spatial resolution in a Time Projection Chamber (TPC). In the TPCs of the T2K near detector it can be derived from the charge distribution on the Micromegas plane. The electron cloud width is reconstructed from the charge fraction detected by the individual anode pads. This cloud width is investigated in dependence of the drift distance and the transverse diffusion coefficient is extracted.

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Multicomponent drift gas mixtures for the SHiP Muon Magnetic Spectrometer — •Stefan Bieschke, Caren Hagner, Daniel Bick, Joachim Ebert, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

SHiP is a proposed beam dump experiment to Search for Hidden Particles. It has a dedicated subdetector for neutrino physics that is equipped with a Muon Magnetic Spectrometer. For the spectrometer, upgraded drift tubes from the OPERA experiment are foreseen. The drift gas mixture used at OPERA had a high maximum drift time and a non-linear *rt*-relation. Due to the high rates at a beam dump experiment, a faster drift gas is needed. By adding small amounts of Nitrogen to the drift gas mixture, the maximum drift time was significantly reduced and the *rt*-relation became more linear. The drift gas mixture $Ar:CO_2:N_2$ 96:3:1 was found to be best suited candidate for a linear and fast drift gas mixture at atmospheric pressure.