HK 69: Instrumentation XIX

Zeit: Freitag 14:00–16:00 Raum: S1/01 A2

Gruppenbericht HK 69.1 Fr 14:00 S1/01 A2

Development of a high rate TPC - The ALICE TPC upgrade after LS2 — •Markus Ball for the ALICE-Collaboration — Rheinische Friedrich-Wilhelms-Universität Bonn

The ALICE (A Large Ion Collider Experiment at CERN) collaboration plans an upgrade of the detector system during the second long shutdown of the LHC, during which the interaction rate will be increased to 50 kHz for Pb-Pb collisions. This demands operation of the Time Projection Chamber (TPC) in an ungated continuous mode. A conventional gating grid can not be used to prevent ions drifting back into the drift volume. Micro Pattern Gaseous Detectors (MPGD) such as GEMs and Micromegas offer suppression of the ion backflow. To keep distortions due to space-charge at a tolerable level an ion yield of 10 to 20 back drifting ions per incoming electron is required. However, the need for low ion backflow might be in conflict to other key parameters such as the detector performance and stability of the system. Therefore a careful optimisation of all three requirements was needed.

Furthermore the large scale capability of the system has to be guaranteed. Test beams have been carried out to study the large scale performance with an Inner Readout Chamber (IROC) equipped with a multiple GEM system. Also an quadruple GEM Outer Readout Chamber (OROC) was assembled and successfully operated being the largest detector of this type. The upgrade of all readout chambers with a quadruple GEM system has started in 2016. The strategy and the work flow of the TPC upgrade will be presented

HK 69.2 Fr 14:30 S1/01 A2

Space-charge distortion studies in the ALICE TPC — •Ernst Hellbär[1], Jens Wiechula[1], and Marian Ivanov[2] for the ALICE-Collaboration — [1]Institut für Kernphysik, Goethe-Universität Frankfurt — [2]GSI - Helmholtzzentrum fur Schwerionenforschung GmbH

The Time Projection Chamber (TPC) is the main particle identification detector of the ALICE experiment at the CERN LHC. For Run 3 starting in 2020, interaction rates of 50 kHz in Pb-Pb require a major upgrade of the TPC readout. The Multiwire Proportional Chambers (MWPCs) will be replaced by stacks of four Gas Electron Multiplier (GEM) foils, introducing an ion backflow of about 1%. In the high-luminosity environment, the back-drifting ions are the dominant source of space-charge, implying significant drift field distortions. In order to study the space-charge effect due to ion backflow, pp collision data was taken during Run 1 with the gating grid of the MWPCs operated in transparent mode. The measured space-charge distortions in the open gating grid data will be presented and compared to expectations for Run 3. The observed distortions in the latest Run 2 data as well as an efficient calibration scheme will be discussed.

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HK 69.3 Fr 14:45 S1/01 A2

Online Calibration of the ALICE-TPC in LHC-Run 2 — •Alex Chauvin for the ALICE-Collaboration — TUM, Munich, Germany

The Time Projection Chamber (TPC) is the main tracking detector of the ALICE Experiment at the LHC. As the calibration of other detectors in the ALICE central barrel are based on the TPC itself, its calibration and performance are primordial. During the Run I at LHC, a two-step offline calibration was employed, in which first the TPC and then the other detectors were calibrated. However, due to an higher interaction rate and to allow a continuous readout mode during Run III, data will have to be compressed online before storage. This can be done within the High Level Trigger, which also allow to run online calibrations. In this talk, I will present the TPC online calibration procedure during Run II and its improvements for Run III will be presented with a special focus on the dE/dx online calibration in the HLT.

HK 69.4 Fr 15:00 S1/01 A2

Describing charge transfer processes in GEM foils with a model based on electric flux calculations — •Viktor Ratza, Markus Ball, Bernhard Ketzer, and Jonathan Ottnad for the ALICE-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

With the planned upgrade of the ALICE Time Projection Chamber the current readout technology will be replaced by a Gas Electron Multiplier (GEM) - based readout technology in order to allow for a continuous operation at high interaction rates up to 50 kHz. A stack of four GEM stages has been chosen to achieve a suppression of the ion backflow below 1%, while maintaining a good energy resolution and guaranteeing a stable operation of the chamber. As the charge transfer between the GEM stages highly influences the energy resolution and the ion backflow, a detailed understanding of the transfer processes inside the GEM stack is mandatory in order to predict the performance of the detector.

Based on an analytic solution of the Poisson equation for a single GEM, expressions for the transfer efficiencies as a function of the GEM geometry can be deduced from calculations of the corresponding electric fields and electric fluxes. The model as well as the results will be presented and compared to simulations which include charge transfer processes in gases.

Supported by BMBF.

HK 69.5 Fr 15:15 S1/01 A2

A Prototype GEM Detector with 3D-Printing Technology — •Till Mayer, Alexander Austregesilo, Florian Kaspar, and Stephan Paul — Technische Universität München

GEM (Gas Electron Multiplier) detectors are widely used in modern high-energy physics experiments. They provide precise tracking information, have a high-rate capability and a low material budget. However, their production is delicate and time-consuming. Especially the support structures made of fiber-glass frames are expensive and difficult to machine.

The high-end engineering plastic PEEK is extensively used in aerospace, automotive, and chemical process industries. Its low outgassing, electrical insulation and high stiffness make it ideal for the design of GEM detectors. We explored the novel approach to process PEEK with a 3D-printer. A first GEM detector with printed support structures was already built and tested. We will report on the performance of this prototype regarding stability and aging. The next steps towards the realization of a fully 3D-printed GEM detector will also be presented.

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HK 69.6 Fr 15:30 S1/01 A2

Measurement of the spatial and energy-loss resolution with a prototype Straw Tube Tracker (STT) for the $\bar{P}ANDA$ experiment — •Alexandros Apostolou[1,2], Johan Messchendorp[1], James Ritman[2], and Peter Wintz[2] for the PANDA-Collaboration — [1]KVI-CART, University of Groningen — [2]Forschungszentrum Juelich, Juelich

The $\bar{P}ANDA$ experiment is one of the pillars of the future Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. The $\bar{P}ANDA$ physics program is focused on answering fundamental questions related to Quantum Chromodynamics (QCD), mostly in the non-perturbative energy regime, using antiproton collisions on proton and nuclear targets. The central Straw Tube Tracker (STT) will be the main tracking detector of the $\bar{P}ANDA$ target spectrometer. The STT will reconstruct tracks induced by charged particles (with a spatial resolution of $\simeq$ 150 μm transversal) and measure the corresponding particle momenta and specific energy-losses for particle identification (PID) with an energy resolution better than 10%. The PID information from the STT is especially needed to separate protons, kaons and pions in the momentum region below 1 GeV/c. In this work, the results obtained so far with a prototype STT using the proton beam at COSY in the momentum range from 0.5 to 3.0 GeV/c are summarised and discussed.

HK 69.7 Fr 15:45 S1/01 A2

Cascaded High-Voltage Power Supplies for the ALICE TPC Upgrade with GEMs — •Fabian Liebske for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt

For the upgrade of the Time Projection Chamber (TPC) of the ALICE experiment at the CERN LHC it is planned to replace the present MWPC-based readout chambers with detectors that employ stacks of four GEMs. At the same time, new HV power supplies are needed to provide the voltages to the eight GEM electrodes. To this end, a new generation of power supplies is being developed where the voltages are cascaded in such a way, that no over-voltages can occur in case of a GEM discharge. At the IKF in Frankfurt, a test board was developed that simulates the electric network of a 4-GEM system. This board allows to study the characteristics of a cascaded power supply prototype in terms of noise and study its behavior in case of a discharge. In this presentation, results of such tests will be presented.