HK 13: Instrumentation 5

Time: Monday 17:00–19:00 Location: M/HS2

Group Report HK 13.1 Mon 17:00 M/HS2

Status of the ALICE TPC upgrade for high-rate operation — •Piotr Gasik for the ALICE-Collaboration — TU München, Physik Department E12, Excellence Cluster "Universe", D-85748, Garching, Germany

A large Time Projection Chamber (TPC) is the main device for tracking and charged particle identification in the ALICE experiment at the CERN LHC. After the second long shutdown in 2018/2019, the LHC will deliver Pb beams colliding at an interaction rate of about 50 kHz, which is about a factor of 100 above the present readout rate of the TPC. This will result in a significant improvement on the sensitivity of rare probes that are considered key observables to characterise the hot and dense QCD matter created in such collisions. In order to make full use of this luminosity, a major upgrade of the TPC is required. It is foreseen to replace the existing MWPC-based readout chambers by Gas Electron Multiplier (GEM) detectors to overcome the rate limitations imposed by the present gated readout scheme.

An extensive R&D program has been launched to reach the challenging requirements of the upcoming upgrade of the detector. In this presentation the most recent results will be discussed concerning ion backflow suppression, gain stability, energy and $\mathrm{d}E/\mathrm{d}x$ resolution and stability against discharges. The status of the upgrade of the online calibration and data reduction system, which includes advanced techniques for online corrections of space-charge distortions, as well as the development of a new readout electronics will be reported.

HK 13.2 Mon 17:30 M/HS2

Space charge calibration of the ALICE TPC operated with an open gating grid — •Ernst Hellbär[1], Marian Ivanov[2], and Jens Wiechula[3] for the ALICE-Collaboration — [1]Institut für Kernphysik, Goethe-Universität Frankfurt — [2]GSI — [3]Universität Tübingen

The Time Projection Chamber (TPC) is the main particle identification detector of the ALICE experiment at the CERN LHC. High interaction rates of 50 kHz in Pb-Pb during the Run 3 period after 2020 require a major upgrade of the TPC readout. The currently used Multiwire Proportional Chambers (MWPCs) will be replaced by readout chambers (ROCs) based on Gas Electron Multiplier (GEM) technology which will be operated in a continuous mode. While the gating grid of the MWPCs prevents the positive ions of the amplification region from entering the drift volume, the GEM-based ROCs will introduce an ion backflow (IBF) of about 1%. In combination with the high-luminosity environment, this amount of back-drifting ions results in a considerable space charge density which distorts the drift path of the primary ionisation electrons significantly. In order to still provide a high tracking efficiency and cluster-to-track association, an efficient calibration scheme will be implemented. As a test ground for the new calibration scheme, pp collision data was taken during Run 1 with the gating grid operated in a transparent mode allowing the ions to enter the drift volume. The measured space point distortions due to the space charge will be presented together with the corrected data and compared to simulations for Run 3.

Supported by BMBF and the Helmholtz Association.

HK 13.3 Mon 17:45 M/HS2

GEM Setup — •Merter Dülgar für die ALICE-Kollaboration — Physikalisches Institut, Universität Tübingen

Die Time Projection Chamber (TPC) ist der Hauptdetektor zur Teilchenidentifikation im ALICE Experiment am CERN. Nach dem zweiten Long Shutdown 2018 soll eine Kollisionsrate von mehr als 50 kHz erreicht werden. Um die neue Luminosität vollständig nutzen zu können wird ein Upgrade der bisherigen Auslese benötigt. Bisher kommt in der TPC die Vieldrahtkammer zum Einsatz. Durch das Sperrgitter zur Ionenunterdrückung wird die Ausleserate auf wenige kHz eingeschränkt. Das Ziel ist eine kontinuierliche Auslese. Hierfür ist vorgesehen die Vieldrahtkammer durch die Gas Electron Multiplier (GEM) zu ersetzen. Dabei stellt der Ionenrückfluss eine kritische Größe dar und muss gering gehalten werden.

Dazu wurde am Physikalischen Institut in Tübingen ein vier Lagen GEM Detektor aufgebaut. Der Ionenrückfluss wurde anhand der Parameter GEM-Spannung, Transferfeld-Spannung, Folienabstand und Lochdurchmesser/-abstand untersucht. Dir vorläufigen Ergebnisse werden präsentiert.

HK 13.4 Mon 18:00 M/HS2

Ion backflow and energy resolution in micro-pattern gas detectors for the ALICE TPC — •Esther Bartsch, Alexander Grein, Michael Jung, Rainer Renfordt, and Harald Appelshäuser 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 multiwire proportional readout chambers by Gas Electron Multiplier (GEM) stacks. The high interaction rate of 50 kHz foreseen for the Run 3 period of the LHC requires a readout scheme that can accommodate the 100 times higher rates. GEM-based readout chambers that can be operated in continuous mode are the prime candidate. To reduce the backflow of positive ions (IBF) into the detector volume several measures can be taken, such as optimization of the GEM voltages and transfer fields between the foils, and a systematic variation of the hole pitch. As alternative technology Micromegas (MICRO MEsh GAseous Structure) in addition to two GEM foils is also considered for gas amplification. Two dedicated test detectors, one for the characterization of triple and quadruple GEM stacks and one for the characterization of Micromegas, were set up at the IKF in Frankfurt. The results of systematic studies of the IBF and the energy resolution in several arrangements of GEM foils with different pitch sizes and in arrangements of Micromegas and GEM foils will be presented.

Supported by BMBF and the Helmholtz Association.

HK 13.5 Mon 18:15 M/HS2

Entwicklung großflächiger mikrostrukturierter Gasdetektoren für MAGIX — •Pepe Gülker — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

Das geplante MAGIX-Experiment wird im energierückgewinnenden Bogen des zukünftigen MESA-Beschleunigers stehen und von diesem mit einem Elektronenstrahl (105 MeV | bis zu 10 mA) versorgt werden. In der Fokalebene der hochauflösenden Spektrometer (TARDIS) sollen MPGDs genutzt werden, die speziell für diese Anwendung zu entwickeln sind. Aufgrund der niedrigen Energien muß die effektive Strahlungslänge der Detektoren auf ein Minimum reduziert werden um unerwünschte Effekte, wie Vielfachstreuung zu reduzieren. Die hiermit zusammenhängenden Herausforderungen im Bezug auf die Optimierung der Effizienz und des räumlichen Auflösungsvermögens stehen im Mittelpunkt der anlaufenden Entwicklung.
In diesem Vortrag werden die gesteckten Ziele und der aktuelle Stand der Entwicklungen vorgestellt.

HK 13.6 Mon 18:30 M/HS2

Spatial and Energy-loss Measurements of a PANDA STT Prototype — •Haroutioun Ohannessian, Peter Wintz, and James Ritman for the PANDA-Collaboration — Forschungszentrum Juelich

The PANDA experiment will study charmonium and open charm physics, gluonic excitations and the nucleon structure by means of interaction of antiprotons with protons and nuclei. The PANDA central tracker consists of 4636 straw tube drift detectors, which are arranged in a hexagonal layout. The straws have a diameter of 10 mm and a wall thickness of 27μm and are filled with a mixture of Ar/CO_2 (9:1) gas operating at a high voltage of about 1800 V at a pressure of 2 bar absolute.

The readout system provides drift time information for trajectory reconstruction and momentum determination. Moreover, specific energy-loss information is provided for particle identification (p, K, π separation $<$ 0.8 GeV/c).

The STT prototype consists of 96 straws, which are being tested by cosmic and beam measurements in the Forschungszentrum Jülich. Measurements are being performed using the COSY accelerator to provide beams of protons and deuterons at momenta in the range of 0.6 - 3 GeV/c. This information will be used for particle identification (p/d separation).

This presentation will show the results of the different measurements that have been taken recently at COSY. In addition, further improvements on the next STT prototype will be discussed.

HK 13.7 Mon 18:45 M/HS2

Charge transfer in Gas Electron Multipliers — •Jonathan Ottnad, Markus Ball, Bernhard Ketzer, Viktor Ratza, and Cina Razzaghi — HISKP, Bonn University, Nussallee 14-16, D-53115 Bonn

In order to efficiently employ a Time Projection Chamber (TPC) at interaction rates higher than $\sim 1\,\mathrm{kHz}$, as foreseen e.g. in the ALICE experiment (CERN) and at CB-ELSA (Bonn), a continuous operation and readout mode is required. A necessary prerequisite is to minimize the space charge coming from the amplification system and to maintain an excellent spatial and energy resolution. Unfortunately these two goals can be in conflict to each other.

Gas Electron Multipliers (GEM) are one candidate to fulfill these requirements. It is necessary to understand the processes within the amplification structure to find optimal operation conditions. To do so, we measure the charge transfer processes in and between GEM foils with different geometries and field configurations, and use an analytical model to describe the results. This model can then be used to predict and optimize the performance.

The talk will give the present status of the measurements and describe the model.

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