HK 80: Instrumentation

Zeit: Donnerstag 16:45–19:00 Raum: HSZ-405

Gruppenbericht HK 80.1 Do 16:45 HSZ-405

Status and future of the ALICE TPC, a high-resolution detector for the highest particle multiplicities — •Christian Lippmann for the ALICE TPC-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Time Projection Chamber (TPC) of the ALICE experiment is a large 3-dimensional tracking and particle identification device for ultra-high multiplicity collision events. It has been operated successfully at the Large Hadron Collider (LHC) at CERN, recording collisions of protons (since November 2009) and lead nuclei (one month each in 2010 and 2011). In the beginning of 2013, just before the first long LHC shutdown (LS1) starts, ALICE will record p-Pb collisions that are expected to occur at interaction rates up to 200 kHz. During LS1 the necessary consolidation and upgrade activities in order to ensure reliable operation at nominal LHC energies ($\sqrt{s} = 14$ TeV pp and $\sqrt{s_{NN}} = 5.5$ TeV Pb-Pb collisions) will be carried out.

A new phase of the data taking will finally commence after the second long LHC shutdown (LS2) in 2018, where the ALICE upgrade plans foresee to operate the experiment in Pb-Pb at an interaction rate of 50 kHz. For this purpose, the MWPC-based TPC readout chambers will be replaced by Gas Electron Multipliers (GEMs), allowing a continuous readout of the TPC. These upgrade plans have recently been endorsed by the CERN LHC Committee.

In this presentation the performance and operational experience with the current TPC will be discussed and an overview of the upgrade plans and the ongoing R&D activities will be given.

HK 80.2 Do 17:15 HSZ-405

First results from the ALICE GEM TPC prototype test — •Piotr Gasik for the ALICE TPC-Collaboration — TU München, Boltzmannstr. 2, 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, 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. 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 with Gas Electron Multiplier (GEM) foils. A GEM TPC can exploit the intrinsic suppression of back-drifting ions from the amplification stage to reduce the problem of drift-field distortions in an ungated operation. The latter is essential for a continuous readout required for all central detectors of ALICE after the upgrade.

A prototype of an ALICE Inner Read-Out Chamber (IROC) was equipped with three large-size GEM foils as amplification stage to demonstrate the feasibility of this solution. The GEM IROC was installed within a test field cage with a drift length of 115 mm and commissioned with radioactive sources. The dE/dx resolution of the prototype was evaluated in a test beam campaign using protons, pions and electrons (1 to 6 GeV/c) at the CERN PS. Preliminary results from these measurements will be discussed in this contribution.

This work is supported by BMBF and DFG Cluster of Excellence "Universe" (Exc 153).

HK 80.3 Do 17:30 HSZ-405

Energy Calibration of a GEM-TPC with Kr83m — •Roman Schmitz for the GEM-TPC-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

A Time Projection Chamber (TPC) with Gas Electron Multiplier (GEM) readout has been developed with an inner/outer radius of 5/15 cm and a total drift length of 73 cm. It has been used as an inner tracking upgrade for the FOPI experiment at GSI and is planned as a future upgrade to the CBELSA/TAPS experiment. A radioactive ^{83m}Kr source has been produced and integrated into the setup in order to perform an accurate channel-wise relative gain calibration and monitor gain stability to achieve optimal dE/dx resolution. Its gaseous form makes it perfectly suitable for this purpose allowing a full coverage of the readout plane and providing a wide energy range of conversion peaks. Also its half-life of 1.83 h allows for normal detector operation after a short flushing period of several hours. Calibration method and measured energy resolution for different gas mixtures which have been compared to simulation results are presented in this talk. Also first results on gain stability and pressure/temperature-dependence will be showed.

This work is supported by DFG SFB/TR 16.

HK 80.4 Do 17:45 HSZ-405

Alterungseffekte in GEM-Detektoren — •Christian Dreisbach, Alexander Austregesilo, Jacopo Durandi, Florian Haas, Matthias Huber, Bernhard Ketzer, Igor Konorov, Stephan Paul, Katia Rodewald, Michael Tasior und Sebastian Uhl — TU München, Physik-Department E18, Garching bei München

Im COMPASS Experiment am CERN kommen „Gas Electron Multiplier (GEM)"-Spurdetektoren in einer höchst strahlungsreichen Umgebung zum Einsatz. Insbesondere die PixelGEM-Detektoren sind dem direkten Myonen- oder Hadronenstrahl ausgesetzt. Einige dieser Detektoren zeigten nach vierjahrigem Betrieb verminderte Signalstärken und damit verminderte Detektoreffizienzen. Dieses sogenannte „Aging" wird häufig durch Verunreinigungen im aktiven Gasvolumen eines Detektors hervorgerufen, welche im Betrieb zu Ablagerungen auf Auslese- oder Verstärkungselementen führen können.

Eine Untersuchung von GEM-Folien aus einem betroffenen Detektor mittels eines optischen Mikroskops, eines Rasterelektronenmikroskops (REM/SEM) und der Elementanalyse durch eine energiedispersive Röntgenspektroskopie (EDRS/EDX) ergab Silizium- und Schwefelablagerungen in den Bereichen hoher Strahlungsintensitäten. Die Ergebnisse dieser Untersuchung sowie mögliche Quellen der Ablagerungen werden präsentiert. Zudem wird ein Versuchsaufbau für Langzeitmessungen zur Reproduktion solcher Alterungseffekte in GEM-Detektoren gezeigt.

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HK 80.5 Do 18:00 HSZ-405

Construction and simulations of full-size CBM-TRD prototypes — •Ernst Hellbär for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The Compressed Baryonic Matter (CBM) experiment at the future FAIR facility in Darmstadt will explore the QCD phase diagram in the region of high baryon densities. One of the key observables will be charmed particles and vector mesons decaying into leptons or lepton pairs. To provide an efficient electron-pion separation and tracking capability multiple layers of Transition Radiation Detectors (TRD) will be used. The concept of a thin and fast Multiwire Proportional Chamber (MWPC) without drift region is considered with the aim of handling the high event rates in the experiment of up to 10 MHz. A thin foil-based entrance window leads to low transition radiation (TR) absorption probabilities. The development and construction of the first full-size TRD prototypes with this foil-based entrance window will be presented. Simulations of the mechanical stability of the entrance window and the influence on the gas gain of the detector will be shown and resulting design options will be discussed.

HK 80.6 Do 18:15 HSZ-405

In-beam performance studies of the first full-size CBM-TRD prototypes developed in Frankfurt. — •Pascal Dillenseger for the CBM-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt

The Compressed Baryonic Matter (CBM) experiment at FAIR will explore the QCD phase-diagram by studying fixed-target heavy-ion collisions from 10 to 45 AGeV. The CBM Transition-Radiation Detector (TRD) has to deliver a good tracking and particle identification performance in the high particle-density environment of the experiment. We plan to match the experimental requirements in terms of position resolution and electron identification, employing a thin MultiWire Proportional Chamber (MWPC). This type of readout-concept combined with different radiators was tested using full-size prototypes at the CERN-PS in October 2012. The results of the detector and radiator studies will be presented.

HK 80.7 Do 18:30 HSZ-405

Performance of CBM TRD Prototypes from Münster — •Cyrano Bergmann for the CBM-Collaboration — Institut für Kernphysik WWU, Münster, Deutschland

CBM is a fixed target heavy-ion experiment at the future FAIR accelerator facility. The CBM Transition Radiation Detector (TRD) is one of the key detectors to provide electron identification and charged particle tracking. Based on the ALICE TRD design, two CBM TRD prototype modules of $59\times59\,\mathrm{cm}^2$ were built in Münster and tested during October 2012 in beam at the CERN Proton Synchroton (PS) with electrons and pions of momenta up to $10\,\mathrm{GeV}/c$. Readout was performed with the time sampling Self-triggered Pulse Amplification and Digitization asIC (SPADIC), an especially designed front-end electronics component for the CBM TRD. The objectives of the beam test included measurements of: electron identification performance for different regular and irregular radiators, position resolution and dependence on particle momentum. First results of these measurements will be presented. The layout of the final TRD will be driven by these beam test results. Depending on the achieved electron identification performance, the TRD could be constructed in 6-10 layers, consisting in total of several 100 individual detector modules covering an area of up to $600\,\mathrm{m}^2$.

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HK 80.8 Do 18:45 HSZ-405

Simulationen zur Gasverstärkung im ALICE-TRD und einem Driftmonitor GOOFIE — •Stephan Dyba für die ALICE-Kollaboration — Wilhelm-Klemm-Str. 9, 48149 Münster, Institut für Kernphysik

Der ALICE Transition Radiation Detector (TRD) dient zur Identifikation von Elektronen und unterstützt die Rekonstruktion von Teilchenspuren. Zur Überwachung der Driftgeschwindigkeit und der Gasverstärkung des TRD ist ein Messystem, der Gas Proportional Counter For Drifting Electrons (GOOFIE), entwickelt worden. Dieser befindet sich zusammen mit dem TRD in der gleichen Gasversorgung. Dadurch ist sichergestellt, dass das Driftgas in beiden System vergleichbar ist. Driftgeschwindigkeit und Gasverstärkung hängen empfindlich von Umgebungsparametern ab, z.B. Temperatur, Druck und Gaszusammensetzung. Die Gaszusammensetzung variiert aufgrund von Kammerausgasungen und Austausch mit der Umgebungsluft. Temperatur und Druckänderungen sind mit den Wetterbedingungen vernüpft. Anhand von Simulationen der Gasverstärkung mit den Programmen MAGBOLTZ und GARFIELD werdem die Auswirkungen der oben genannten Parameter in Modellgeometrien einer TRD-Read-Out-Kammer und des GOOFIE studiert. Aus der Analyse der GOOFIE-Daten soll eine aktive online Kalibrierung der Drift- und Anodenspannung des TRD ermöglicht werden.