HK 22: Instrumentation 8

Time: Tuesday 14:30–16:30 Location: M/HS2

HK 22.1 Tue 14:30 M/HS2

Development of GEM-based readout chambers for the upgrade of the ALICE TPC — •Alexander Deisting for the ALICE-Collaboration — Universität Heidelberg/Gesellschaft für Schwerionenforschung GmbH

The ALICE experiment at the LHC is designed to examine lead-lead (Pb-Pb) collisions in order to probe genuine multi-particle aspects of QCD. Its main tracking detector is a time projection chamber (TPC), being equipped with a multi wire proportional chamber (MWPC) based readout. Since the rate in Pb-Pb collisions will increase to up to 50kHz in LHC Run3 it is necessary to adapt the TPC to this new environment. A change from the current measurement mode with a gating grid and MWPCs to a continuous readout with new readout chambers is hence forseen.

To match the requirements for Run3 the new chambers should be able to cope with the higher rates and thereby preserve the momentum and $\mathrm{d}E/\mathrm{d}x$ resolution of the current chambers. In addition the ion back flow (IBF) from the amplification stage into the drift volume should be less then 1%. A solution has been found based on 4 gas electron multiplier foils (GEMs) stacked onto each other.

Extensive R&D studies of 4 GEM stacks were performed. In this talk different experimental setups to examine the performance of quadruple GEM stacks in terms of IBF, energy resolution and $\mathrm{d}E/\mathrm{d}x$ will be presented. Emphasis will be put on the simultaneous optimisation of the energy resolution and the IBF while studying different kinds of GEM foils in a stack.

HK 22.2 Tue 14:45 M/HS2

Spatial Resolution Studies of a GEM-TPC.* — •Martin Berger for the GEM-TPC-Collaboration — TU München, 85748 Garching, Germany

A GEM-TPC can exploit the intrinsic suppression of back drifting ions from the amplification stage of the GEM (Gas Electron Multiplier) foils to overcome the problem of drift-field distortions in an ungated operation. To explore the possibility of such a continuously running TPC (Time Projection Chamber) a large-size detector was built. This detector, with a drift length of 728 mm and a radius of 308 mm and a total of 10254 electronic channels, was designed as an upgrade for the FOPI experiment at GSI (Darmstadt, Germany) to improve the secondary vertex resolution especially for K^0_S- and Λ-reconstruction and the PID capabilities. After commissioning a large statistics of cosmic data and beam-target reactions has been collected [1] and the obtained tracks in the TPC have been used to improve the tracking algorithms.

During the track finding and fitting procedure a clustering algorithm which takes into account the track topology as well as the full 3D spatial information is employed. The the clustering algorithm, the cluster error calculation and the tracking resolution will be discussed in this contribution.

[1]L. Fabbietti et al., Nucl. Instr. and Meth. A, 628 204-208 (2011)

*Supported by BMBF, TUM Graduate School and Excellence Cluster "Universe".

HK 22.3 Tue 15:00 M/HS2

Energy resolution studies of an IROC GEM prototype for the ALICE TPC — •Andreas Mathis for the ALICE-Collaboration — TU München, Physik Department E12, Excellence Cluster "Universe", D-85748, Garching, Germany

The ALICE collaboration (A Large Ion Collider Experiment) is planning an upgrade of its central barrel detectors, to be able to cope with the increased LHC luminosity beyond 2018. In order to fully exploit the increase in collision rate to about 50 kHz in Pb−Pb, the TPC is foreseen to be operated in an ungated mode with continuous readout. This demands for a replacement of the currently used, gated MWPC by GEM-based readout chambers, while retaining the present tracking and particle identification capabilities of the TPC via measurement of the specific energy loss ($\mathrm{d}E/\mathrm{d}x$).

The present baseline solution for the TPC upgrade consists of a stack of four large-sized GEM foils as amplification stage, containing both Standard (S, 140 μm) and Large Pitch (LP, 280 μm) GEM foils arranged in the order S-LP-LP-S. This arrangement has been proven as advantageous in terms of ion backflow and energy resolution.

A prototype of an ALICE IROC (Inner Readout Chamber) was equipped with such a quadruple GEM stack, installed inside a field cage and exposed to a beam of electrons and pions from the CERN PS. The performance of the prototype in terms of energy resolution has been evaluated and will be presented.

This work has been supported by BMBF 05P12WOGHH and DFG Cluster of Excellence Origin and Structure of the Universe.

HK 22.4 Tue 15:15 M/HS2

Online tracking with GPUs at the PANDA Experiment — •Ludovico Bianchi, Andreas Herten, James Ritman, and Tobias Stockmanns for the PANDA-Collaboration — Forschungszentrum Jülich

The PANDA experiment is a next generation particle detector planned for operation at the FAIR facility, that will study collisions of antiprotons with beam momenta of 1.5–15 GeV/c on a fixed proton target. Signal and background events at PANDA will look very similar, making a conventional hardware-trigger based approach unfeasible. Instead, data coming from the detector are acquired continuously, and event selection is performed in real time. A rejection factor of up to 1000 is needed to reduce the data rate for offline storage, making the data acquisition system computationally very challenging. Our activity within the PANDA collaboration is centered on the development and implementation of particle tracking algorithms on Graphical Processing Units (GPUs), and on studying the possibility of performing tracking for online event filtering using a multi-GPU architecture. Three algorithms are currently being developed, using information from the PANDA tracking system: a Hough Transform, a Riemann Track Finder, and a Triplet Finder algorithm. This talk will present the algorithms, their performance, and studies for GPU data transfer methods based on so-called message queues for a deeper integration of the algorithms with the FairRoot and PandaRoot frameworks.

HK 22.5 Tue 15:30 M/HS2

Optimization of Local On-line Tracking in the ALICE TRD — •Hannah Klingenmeyer for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

The Transition Radiation Detector (TRD) at the LHC (CERN) provides electron identification in the central barrel of ALICE as well as trigger contributions for electrons and jets. More than 65,000 multichip modules allow a fast on-detector reconstruction of chamber-wise track segments, which include position, angle and PID information. These track segments are then merged into tracks which provide information on transverse momenta and electron identification.

This talk will focus on the optimization of the reconstruction of the track segments to improve the PID and trigger performance. The settings in the multi-chip modules are varied to study their impact on the performance. In particular, the parameters for cluster finding and fitting will be discussed, as these determine the efficiency and resolutions of the local on-line tracking, which in turn strongly influence the trigger performance. The optimization of the performance for the triggers is foreseen for LHC Run 2.

HK 22.6 Tue 15:45 M/HS2

Kalman Filter based algorithms for PANDA@ FAIR — •Elisabetta Prencipe[1], James Ritman[1], and Johannes Rauch[2] for the PANDA-Collaboration — [1]IKP - Forschungszentrum Juelich — [2]E18 - Technische Universität München

$\overline{\mathrm{P}}$ANDA at the future FAIR facility in Darmstadt is an experiment with a cooled antiproton beam in a range between 1.5 and 15 GeV/c, allowing a wide physics program in nuclear and particle physics. High average reaction rates up to $2{\cdot}10^7$ interactions/s are expected. $\overline{\mathrm{P}}$ANDA is the only experiment worldwide, which combines a solenoid field and a dipole field in an experiment with a fixed target topology. The tracking system must be able to reconstruct high momenta in the laboratory frame. The tracking system of $\overline{\mathrm{P}}$ANDA involves the presence of a high performance silicon vertex detector, a GEM detector, a Straw-Tubes central tracker, a forward tracking system, and a luminosity monitor. The first three of those, are inserted in a solenoid homogeneous magnetic field (B=2T), the latter two are inside a dipole magnetic field (B=2Tm), The offline tracking algorithm is developed within the PandaRoot framework, which is a part of the FAIRRoot project. The algorithm is based on a tool containing the Kalman Filter equations and a deterministic annealing filter (GENFIT). The Kalman-Filter-based routines can perform extrapolations of track parameters and covariance matrices. In GENFIT2, the Runge-Kutta track representation is available. First results of an implementation of GENFIT2 in PandaRoot are presented. Resolutions and efficiencies for different beam momenta and different track hypotheses are shown.

HK 22.7 Tue 16:00 M/HS2

FPGA helix tracking algorithm for PANDA — •Yutie Liang[1], Martin Galuska[1], Thomas Gessler[1], Wolfgang Kühn[1], Jens Sören Lange[1], David Münchow[1], Björn Spruck[1], and Hua Ye[2] for the PANDA-Collaboration — [1]II.Physikalisches Institut, Giessen University, 35392, Germany — [2]Institute of High Energy Physics, Beijing, China

The PANDA detector is a general-purpose detector for physics with high luminosity cooled antiproton beams, planed to operate at the FAIR facility in Darmstadt, Germany. The central detector includes a silicon Micro Vertex Detector (MVD) and a Straw Tube Tracker (STT). Without any hardware trigger, large amounts of raw data are streaming into the data acquisition system. The data reduction task is performed in the online system by reconstruction algorithms programmed on FPGAs (Field Programmable Gate Arrays) as first level and on a farm of GPUs or PCs as a second level. One important part in the system is the online track reconstruction. In this presentation, an online tracking algorithm for helix tracking reconstruction in the solenoidal field is shown. The tracking algorithm is composed by two parts, a road finding module followed by an iterative helix parameter calculation module. A performance study using C++ and the status of the VHDL implementation will be presented.

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HK 22.8 Tue 16:15 M/HS2

Alpha Spectroscopy — Kai Zuber, •Heinrich Wilsenach, and Felix Krueger — IKTP TU-Dresden, Dresden, Germany

Alpha decays from long living isotopes are one of the limiting backgrounds for experiments searching for rare decays with stringent background constrains, such as neutrinoless double beta decay experiments. It is thus very important to accurately measure the half-lifes of these decays, in order to properly model their background contribution. Therefore, it is important to be able to measure half-lifes from alpha decays of the order of 1×10^{15} yr. A measurement of such a long lived decay imposes, however, a series of challenges, where the correct discrimination between background and true signal is critical. There is also a more general interest in such long living half-life measurements, as their value depends crucially on the underlying nuclear model.

This talk presents a new ionisation chamber for alpha-spectroscopy that has been built from radio pure materials for the purpose to investigate long lived alpha decays. The analysis makes use of pulse shape analysis to discriminate between signal and background. The design and performance of the chamber will be presented here. A background rate of 10 counts per day in the energy region of 1-8 MeV has been achieved. A detailed investigation of Sm-isotopes was performed using high precision alpha- and gamma spectroscopy. The results of which will also be presented here as well as some results obtained with calibration sources or varying thickness.