HK 6: Instrumentation III

Time: Monday 14:00–15:30 Location: HK-H5

HK 6.1 Mon 14:00 HK-H5

Gain Calibration of the Upgraded ALICE TPC — •Philip Hauer — Helmholtz-Institut für Strahlen- und Kernphysik – Universität Bonn

For the upcoming Run 3 of the Large Hadron Collider (LHC), the collision rate of lead-lead beams will be increased to 50 kHz. In order to cope with this rate, the TPC was upgraded with a new amplification stage which is now based on Gas Electron Multiplier (GEM) foils. After its re-installation in the experiment, an extensive commissioning and testing program was performed.

One of the main goals of the commissioning program was the calibration of the gain. This comprises a coarse equalisation of the gas gain by fine-tuning the high voltage settings of each GEM foil stack, but also a pad-by-pad gain calibration for each electronic readout channel. In order to achieve this goal, two different types of measurements were conducted. The first one makes use of an X-ray tube which irradiated the active volume of the TPC. The second method is based on the gaseous and meta-stable radioactive isotope Kr-83m which was injected into the TPC.

In this talk, both methods will be explained in more detail. In addition to being indispensible for reaching the desired $\mathrm{d}E/\mathrm{d}x$ performance of the TPC, the results of the measurements reveal interesting details on stretching issues and edge effects.

Supported by BMBF.

HK 6.2 Mon 14:15 HK-H5

Towards the PUMA pion tracker — •Sabrina Zacarias[1], Emanuel Pollacco[2], Christina Xanthopoulou[1], Alexandre Obertelli[1], and PUMA collaboration[1] — [1]TU-Darmstadt — [2]CEA-IRFU

The PUMA project (antiProton Unstable Matter Annihilation) aims at using low-energy antiprotons to probe the tail of the radial density of short-lived nuclei. With PUMA, the ratio of proton and neutron annihilations after capture will be determined, giving access to a new observable to quantify the ratio of proton to neutron densities at the nuclear periphery. To accomplish it, PUMA aims at transporting one billion low-energy antiprotons (produced at CERN/ELENA) to the CERN/ISOLDE facility where short-lived nuclei are produced. In the poster, the detection system (consisting of a time projection chamber and a trigger barrel) and the readout electronics development will be detailed.

HK 6.3 Mon 14:30 HK-H5

Development of the trigger barrel for PUMA — •Christina Xanthopoulou, Sabrina Zacarias, Dominic Rossi, and Alexandre Obertelli — Technische Universität Darmstadt

The antiProton Unstable Matter Annihilation project aims at the study of the periphery of short-lived nuclei by using low-energy antiprotons. The antiprotons annihilate with the nucleons on the surface of the nucleus which results in pions that pass through the detection system. By identifying the produced pions we are able to determine the ratio of protons to neutrons on the nuclear surface. The detection system consists of one time projection chamber and a trigger barrel. With the time projection chamber we are able to reconstruct the pions trajectories. The trigger barrel is composed of plastic scintillators to which Silicon PhotoMultipleres are attached. It will be used to trigger the trajectory measurements of the pions passing the time projection chamber. Simulations for the characterization of the trigger barrel are performed. Additionally, a trigger barrel test setup is build and used for benchmarking the simulation outcome. In the poster, the current status on the simulations and the test setup for the trigger barrel are presented.

HK 6.4 Mon 14:45 HK-H5

A calibration system for a modular small-format TPC with GEM amplification — •Dmitri Schaab, Reinhard Beck, and Bernhard Ketzer for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik

The performance of a Time Projection Chamber (TPC) relies on a good knowledge of the electric field inside the sensitive volume. This is crucial since deviations from a homogeneous drift field, either due to mechanical imperfections or due to space charge effects at high particle rates, deteriorate the spatial resolution of the detector if they remain uncorrected. One calibration method is to release electrons via the photoelectric effect at well-known positions on the cathode. By the electric field, these electrons are guided across the drift region towards the readout plane and show the integrated spatial distortions. In addition, a drift velocity measurement is provided. This photoelectric calibration concept, first employed at the T2K experiment, was implemented on a small scale involving a test tracking detector and a pulsed UV-laser. The laser light is conditioned using an optical setup and fed into the detector with the help of a multimode fiber bundle. Calculations were made in order to provide a uniform illumination of the detector cathode. The photoelectric calibration system was implemented in a newly built small TPC (sTPC) with GEM amplification. Its fully modular design allows for spatially resolved studies of field distortions using different GEM configurations or readout geometries.

The development of the measurement setup as well as characterizing photoelectric measurements will be presented.

HK 6.5 Mon 15:00 HK-H5

Distortions in the ALICE TPC caused by charge-up effects in the field cage — •Tim Geiger for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

ALICE is the dedicated heavy-ion experiment at the LHC at CERN. The main tracking and particle identification detector of ALICE is a large-volume Time Projection Chamber (TPC). To cope with the increased Pb-Pb interaction rate of 50kHz in Run 3, starting in 2022, the TPC was upgraded from multi-wire proportional chambers to a readout based on Gas Electron Multipliers (GEMs) which allows for a continuous readout of the detector.

In order to achieve its intrinsic track reconstruction resolution, a good understanding of possible space-point distortions is required. To study possible distortions, a dedicated commissioning campaign with x-ray illumination at different intensities was carried out. At the same time, a laser system was used to create ionization tracks in the TPC. The laser light also creates photo electrons at the aluminized high-voltage electrode of the drift field. Distortions in the drift time of the photo electrons are observed, varying with the x-ray intensity. This is caused by charge-up effects near the high-voltage electrode, locally modifying the electric field.

In this poster, we present an analysis of the measured distortions. They are compared to electrostatic calculations of different possible scenarios of modifications in the drift field.

HK 6.6 Mon 15:15 HK-H5

Photon Detection with THGEMs — •Thomas Klemenz[1], Laura Fabbietti[1], Piotr Gasik[2], Roman Gernhäuser[1], Berkin Ulukutlu[1], and Tobias Waldmann[1] — [1]Technische Universität München — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Traditional devices for photon detection like the Photomultiplier Tube or more recent technologies such as Silicon Photomultipliers are very cost-intensive. Therefore, especially with large area experiments in mind it is exciting to investigate new ways of detecting photons.

In this project we are taking the approach of combining a photosensitive material with a Thick GEM (THGEM) to produce a gaseous photon detector. THGEMs are robust, low-cost devices, which can be easily implemented in large area applications. One side of the THGEM is coated with a photosensitive material and placed within an electrical field. Photons captured by the active surface lead to a release of electrons which drift into the THGEM hole where they undergo avalanche multiplication due to strong electric fields applied. Below the THGEM an anode is reading out the amplified electron signal. Depending on the gain of the THGEM this could enable single photon detection.

We want to study the potential of this approach while trying different photosensitive materials. Ultimately, we aim to measure visible wavelength photons and to provide a low-cost, large area solution for neutrino observation in water and ice environments. In the talk the current status of the project is discussed.