HK 3: Instrumentation I

Time: Monday 16:30–18:30 Location: H2

Group Report HK 3.1 Mon 16:30 H2
Status of the Upgraded ALICE TPC — •Philip Hauer for the ALICE-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn

During the long shutdown 2 of the LHC, the ALICE Time Projection Chamber (TPC) was upgraded in order to cope with the increased Pb-Pb interaction rate of 50 kHz planned for Run 3. The MWPC-based amplification system was replaced by Gas Electron Multipliers (GEM). These avoid the long dead time caused by the ion gating grid of the MWPC, and allow for a continuous readout. To this end, also the front-end and readout electronics had to be replaced.

In August 2020, the TPC was moved back to its designated position at LHC interaction point 2 and an extensive commissioning program was started. It includes measurements of laser tracks, cosmic particles and the irradiation of the TPC with an X-ray source to carry out a pad-by-pad gain calibration. During this measurement campaign, the TPC operated at nominal conditions and the continuous readout capability was tested successfully.

The talk will summarise the performance and challenges during the commissioning phase. Furthermore, the present status and plans for the future will be discussed.

Supported by BMBF.

HK 3.2 Mon 17:00 H2
Simulations of the X-ray spectrum measured with the ALICE TPC — •Ankur Yadav, Philip Hauer, Philipp Bielefeldt, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The ALICE Time Projection Chamber (TPC) was upgraded with a Gas Electron Multiplier (GEM) readout. In the scope of a commissioning program, several measurements were already conducted. This includes the irradiation of the TPC with an X-ray source. The pulse height spectrum recorded with the new front end electronic showed three distinct peaks on a Bremsstrahlung background. In addition to the characteristic peak of the Ag anode, the second peak could be attributed to fluorescence from the Cu layer of the GEM.

In order to clarify the origin of the third peak, the GEANT4 toolkit was used to simulate the interaction of X-rays and associated secondary particles with the detector gas and the surrounding passive material. A complete detector simulation chain was developed, including drift, diffusion and gas amplification.

In the talk, we will present the comparison of the simulation with the measured data.

Supported by BMBF.

HK 3.3 Mon 17:15 H2
Photon detection with THGEMs — •Thomas Klemenz[1], Laura Fabbietti[1], Piotr Gasik[2], and Roman Gernhäuser[1] — [1]Technische Universität München — [2]GSI Helmholtzzentrum für Schwerionenforschung

Traditional devices for photon detection like Photomultiplier tubes 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 that drift into the THGEM holes 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.

HK 3.4 Mon 17:30 H2
Characterizing new (TH)GEM coating materials using spectroscopy methods — •Berkin Ulukutlu[1], Piotr Gasik[2], Tobias Waldmann[1], Lukas Lautner[1], and Laura Fabbietti[1] — [1]Technische Universität München — [2]GSI Helmholtzzentrum für Schwerionenforschung

Gas Electron Multiplier (GEM) has become a commonly employed technology for modern high-rate particle and nuclear physics experiments. Nonetheless, one of the key limitations to the long-term sustainability of these devices are electrical discharges which might occur during high gain operation. Discharge events lead to dead-times and can even result in irreparable damage on the detector components, therefore, there has been extensive research aiming to develop methods to mitigate or subdue such events. This effort has yielded great success and enabled the development of very reliable and stable instruments. However, there are still major unanswered questions remaining concerning the fundamental mechanisms leading to the formation of electrical discharges in GEMs. In our studies, we investigated discharge formation in GEMs and Thick-GEMs (THGEM) produced with various conductive layer materials replacing the standard copper with aluminium, molybdenum, tantalum, and tungsten. Moreover, we employed optical spectroscopy to study the light emitted from such discharges as a probe to analyze the material content of the formed plasma. The measurements provide new insight into the mechanism of the secondary discharge creation.

HK 3.5 Mon 17:45 H2
Validation studies of Lightyield non-linearity implementation within the PandaRoot simulation framework — Kai-Thomas Brinkmann, •Simon Glennemeier-Marke, and Markus Moritz for the PANDA-Collaboration — Justus-Liebig-University Giessen

The PANDA detector at FAIR/GSI Darmstadt will utilize an electromagnetic calorimeter to measure the energies of photons being generated in proton-antiproton collisions. The calorimeter will use tapered PWO-II crystals and will cover a significant fraction of the 4π solid angle. These crystals show a strong tapering along their length. Due to this asymmetric geometry and absorption phenomena, the light yield varies non-uniformly along the long axis of the crystals. This project utilizes simulations within the PandaRoot simulation framework to validate the computational implementation of the non-uniformity and compare it to experimental results of previous studies. This project was supported by BMBF, GSI and HFHF.

HK 3.6 Mon 18:00 H2
Machine Learning based calibration of Low Gain Avalanche Detector — •Vadym Kedych[1], Wilhelm Krueger[1], Adrian Rost[1,4], Jerzy Pietraszko[2], Tetyana Galatyuk[1,2], Sergey Linev[2], Jan Michel[3], Michael Traxler[2], Michael Traeger[2], and Joachim Schmidt Christian[2] — [1]Technische Universität Darmstadt, Germany — [2]GSI GmbH, Darmstadt, Germany — [3]Goethe-Universität Frankfurt, Germany — [4]FAIR GmbH, Darmstadt, Germany

Linacs suffer from high power consumption for particle acceleration when high energies are desired. Because of this there is a huge interest to accelerators with idea of energy recovery. ERL allow to recirculate beam to the main linac second time with a phase shift of 180° which cause to deceleration of the beam and returning energy to RF cavities. The S-DALINAC at TU Darmstadt allows the possibility to operate it in an ERL mode. Optimization of the acceleration and deceleration processes are extremely important for efficiency operation S-DALINAC in ERL mode. For these purposes setup based on LGAD are being developed. LGAD is a silicon detector optimized for 4D-tracking with timing precision below 50ps thanks to internal low gain which makes it an ideal candidate for precise timing monitoring at S-DALINAC.

In this contribution we present status of a machine learning based calibration for LGAD using deep learning and neural network (NN). Experimental data from proton beam run at the COoler SYnchrotron (COSY) facility in Jülich is used to train the calibration model.

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HK 3.7 Mon 18:15 H2
Experiments and reconstruction methods for NeuLAND, the New Large Area Neutron Detector — •Jan Mayer and Andreas Zilges for the R3B-Collaboration — Institute for Nuclear

Physics, University of Cologne

NeuLAND, the New Large Area Neutron Detector, is a core component of the Reactions with Relativistic Radioactive Beams (R^3B) setup at the Facility for Antiproton and Ion Research (FAIR), Germany.

In this talk, we give an overview of the detector performance achieved in experiments performed at the upgraded GSI facility. Reconstruction of the multiplicity and the first interaction points from the complex hit patterns is challenging. We present challenges, possible solutions, and results obtained with a diverse set of approaches including classical statistical methods and Machine Learning.

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