HK 13: Instrumentation V

Time: Tuesday 16:30–18:15 Location: H2

Group Report HK 13.1 Tue 16:30 H2

CBM TRD performance at DESY and in mCBM at FAIR-Phase0 — •Adrian Meyer-Ahrens for the CBM-Collaboration — Institut für Kernphysik, Münster, Deutschland

The Transition Radiation Detector (TRD) of the Compressed Baryonic Matter (CBM) experiment is composed of irregular polyethylene (PE) foam radiators and Multi-Wire Proportional Chambers (MWPCs). It will serve as intermediate tracker and for heavy fragments and electron identification. A high yield of TR generated by electrons passing through the radiator is crucial for electron identification. In a dedicated electron testbeam campaign, two TRD chambers were set up at DESY in August of 2019 and tested with electron beams using various radiator thicknesses.

In the first part of this talk, results on the performance of the detector in this testbeam campaign as well as comparisons to radiator simulations will be presented. The second part focuses on the participation of the TRD in the mCBM campaigns at GSI at SIS18. High-rate collisions on a fixed-target are used here for CBM detector and readout performance measurements. This talk presents the TRD performance in continuous readout mode in the measurement campaigns of 2020 and 2021.

This work is supported by BMBF grant 05P19PMFC1.

HK 13.2 Tue 17:00 H2

ALICE TRD Trigger Performance Study and its Application on the Hypertriton Analysis in p–Pb collisions at the LHC — •Benjamin Brudnyj for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt am Main

At the Large Hadron Collider (LHC) at CERN significant production rates of light (anti-)(hyper-)nuclei have been measured in heavy-ion collisions. The production of such nuclei has recently become a topic of high interest. One interesting example is the lifetime of the lightest hypernucleus, the hypertriton (a bound state of a proton, a neutron and a Λ hyperon). Several measurements have shown a significant deviation from the theoretical expectation, in particular in heavy-ion collisions. Therefore, it is important to also measure these rare nuclei in p–p and p–Pb collisions.

Due to their short lifetime, only their decay products can be measured, e.g. the charged two body decay channel ${}^3_\Lambda\mathrm{H} \rightarrow {}^3\mathrm{He} + \pi^-$. In order to be able to measure these rare (anti-)fragments also in p–p and p–Pb collisions, a trigger on nuclei was implemented on p–Pb collisions at $\sqrt{s_{NN}} = 8.16$ TeV to increase the statistics by using the ability of the ALICE TRD to perform fast trigger decisions.

In this talk the performance of a nuclei trigger in terms of enhancement factors and transverse momentum sensitive effieciencies for the different light nuclei will be shown. In addition, the current status of a hypertriton analysis on p–Pb collisions at $\sqrt{s_{NN}} = 8.16$ TeV will be presented.

HK 13.3 Tue 17:15 H2

Design of a luminosity monitor for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Kathrin Imai[1], Rahima Krini[1], Frank Maas[1,2,3], •Tobias Rimke[1], David Rodriguez Pineiro[2], and Malte Wilfert[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The P2 experiment at the future MESA accelerator in Mainz plans to measure the weak mixing angle $\sin^2(\theta_W)$ in parity violating elastic electron-proton scattering. The aim of the experiment is a very precise measurement of the weak mixing angle with a precision of 0.15% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}$ GeV^2. In order to achieve this precision, it is necessary to monitor the stability of the electron beam and the liquid hydrogen target. Any helicity correlated fluctuations of the target density lead to false asymmetries.

Therefore, it is planned to install a luminosity monitor in forward direction close to the beam axis. The motivation and challenges for designing and testing an air Cherenkov luminosity monitor will be discussed in this talk.

HK 13.4 Tue 17:30 H2

The filling process in the neutron lifetime experiment τSPECT — •Kim Ulrike Ross for the tauSPECT-Collaboration — Department of Chemistry, Johannes Gutenberg University, Mainz

The τSPECT experiment aims to measure the neutron lifetime τ_n using a 3D magnetic storage technique with spin flip loading. Due to the neutron's magnetic moment, very low-energetic neutrons (ultracold neutrons, UCN) with a maximum energy of ≈ 50 neV can be stored in the magnetic trap with a volume of ≈ 10 L. Counting surviving UCN after varying storage times, the neutron lifetime can be extracted from an exponential fit. The target uncertainty in the neutron lifetime is $\Delta\tau_n = 1.0$ s in phase I of the experiment.

The overall measurement duration to achieve this goal is currently limited by UCN statistics, so an optimised filling process is crucial. Two filling techniques have been investigated so far, which are using either one or two adiabatic fast passage spin flippers.

This talk will give a short introduction into spin flipping UCN in τSPECT as well as the current status of the filling optimisation process.

HK 13.5 Tue 17:45 H2

Measuring the free neutron lifetime with τSPECT — •Noah Yazdandoost for the tauSPECT-Collaboration — Department of Chemistry, Johannes Gutenberg University, Mainz

The τSPECT experiment aims to measure the free neutron lifetime. Neutrons with energies in the range of nano electron-volts are loaded by spin flipping into τSPECT's storage volume, where they are confined by magnetic fields only. Magnetic storage of the neutrons will reduce the systematic errors with respect to previous experiments with material confined neutrons since there is no interaction between stored neutrons and wall atoms. With the τSPECT experiment, the free neutron lifetime can be extracted by counting the surviving neutrons in the storage volume after different storage times. This talk gives an overview of the magnetic field configuration, the measurement process, and the data analysis strategies of the τSPECT experiment.

HK 13.6 Tue 18:00 H2

Performance Studies of Micromegas based Detectors — •Tobias Waldmann[1], Rossana Facen[1], Berkin Ulukutlu[1], Piotr Gasik[2], and Laura Fabbietti[1] — [1]Technische Universität München — [2]GSI Helmholtzzentrum

Micro Mesh Gaseous Structures (Micromegas) and Gas Electron Multipliers (GEM) are detectors implemented in a wide range of modern particle physics experiments. Among their major advantages are high achievable gains, good energy resolution and intrinsic ion backflow suppression. One method to improve their performance even further is to stack a Micromegas and a GEM. Still, a huge limiting factor to the performance is the formation of electrical discharges between the electrodes, which can eventually blind or permanently damage the involved detector components. Therefore, the limits of safe operation of such detectors need to be studied in detail. In our studies we, hence, investigated the performance of a Micromegas and a GEM + Micromegas detector. Firstly, we performed scans of the various parameters contributing to the detector performance, including the applied electric fields and the geometry of its components. Here, a special focus was put on ion backflow reduction and energy resolution optimization. Optimal working regions with respect to a set of boundary parameters can thus be defined. Secondly, we investigated the discharge stability of the two detectors, which provides further limits for the safe working regions.