HK 10: Instrumentation III

Time: Monday 16:45–18:15 Location: SR Exp1A Chemie

Group Report HK 10.1 Mon 16:45 SR Exp1A Chemie

GEM detectors for AMBER - An Overview of ongoing research — •Jan Paschek[1], Paul Clemens[1], Karl Flöthner[1,2], Pascal Henkel[1], Igor Konorov[3], Michael Lupberger[1,4], Dimitri Schaab[1], and Bernhard Ketzer[1] — [1]Helmholtz-Instituts für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]Gaseous Detector Department, CERN, Switzerland — [3]Physik-Department, Technische Universität München, Germany — [4]Physikalisches Institut, Universität Bonn, Germany

The AMBER experiment at CERN's SPS explores fundamental questions in hadron physics using high-energy muon and hadron beams. By successfully completing its first physics runs in 2023 and 2024, AMBER provides valuable data for dark matter searches by measuring the antiproton production cross-section on hydrogen, deuterium and helium targets. Looking ahead, the experiment will carry out its first measurement of the proton electric form factor in 2025 through elastic muon-proton scattering. To fulfill the requirements of the physics program, next-generation planar GEM detectors are being developed that include a number of technological advances. For the antiproton production measurements, the detectors operated with APV25-based, triggered readout electronics. All future measurements will employ a self-triggering readout system using the VMM3a front-end chip. Extensive tests, both in the laboratory and in test-beam campaigns, have been conducted to asses and optimize the performance of both systems. This presentation will give you a brief overview of the latest results regarding the detector's development. Supported by BMBF.

HK 10.2 Mon 17:15 SR Exp1A Chemie

High-granularity investigations of gain inhomogeneities of new triple-GEM tracking detectors for AMBER — •Paul Clemens[1], Jan Paschek[1], Bernhard Ketzer[1], and Karl Flöthner[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]GDD, CERN, Geneva, Switzerland

The fixed-target experiment AMBER at CERN's SPS is dedicated to investigating the fundamental properties of hadrons. Following its first physics run in 2023, which focused on measuring antiproton-production cross sections, future studies will address the proton charge radius and Drell-Yan processes. Critical components for these measurements are 30×30 cm^2 triple-GEM detectors, enabling precise tracking close to the beam. The original detectors developed for the COMPASS experiment will be replaced by next-generation detectors that incorporate a number of advances in technology to fulfill the requirements of the experiment like a free-streaming readout and an active central region.

To ensure stable detector operation and efficiency, a highly homogeneous gain distribution is essential. During the commissioning of the first prototypes of this new detector generation, detector generation, strongly localized gain inhomogeneities were observed, referred to as „hot spots“ and „cold spots“. These findings were enabled by a newly developed setup employing x-ray fluorescence and the triggerless VMM3a front-end chip, allowing for high-resolution investigations of gain variations over the whole detector in a very short time.

In this talk, the results of multiple investigations towards the cause of these inhomogeneities will be presented. Supported by BMBF.

HK 10.3 Mon 17:30 SR Exp1A Chemie

Recent Detector Development and Tests — •Elena Rocco for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The FRagment Separator [H. Geissel et al., Nucl. Instr. Meth. B70 (1992) 286-297] (FRS) at the GSI is an in-flight separator and a high-resolution magnetic forward spectrometer at the Synchrotron SIS18, operating with relativistic heavy ion beams from proton to uranium, with an energy typically spanning from 500 up to 1500 MeV/u already in successful operation since more than 30 years. The identification in charge (Z) and mass (A) is executed using the Bρ * ToF * DeltaE method. This requires measurements of particle Time of Flight (ToF), magnetic rigidity (Bρ) and energy loss (DeltaE) on an event-by-event basis. Besides the regular maintenance, detector upgrades are performed and planned for the near and far future. This contribution provides a short overview of beam and particle detectors at the FRS, with special emphasis on the time project chamber (TPC), which gives tracking information operating in Ar/CH4 (90/10) at atmospheric pressure and on the planned installation of a second beam profile monitor (current grid) on the second FRS focal plane.

HK 10.4 Mon 17:45 SR Exp1A Chemie

HYDRA: A continuous-readout TPC for hypernuclei studies at R3B — •Andi Messingschlager[1,3], Meytal Duer[1], Alexandru Enciu[1], Piotr Gasik[1,3], Liancheng Ji[1], Leandro Milhomens Da Fonseca[1], Alexandre Obertelli[1], and Georgina Xifra Goya[2,3] — [1]TU Darmstadt — [2]Universidade de Santiago de Compostela — [3]GSI Helmholtzzentrum für Schwerionenforschung

The HYDRA experiment aims to measure the interaction cross-section of hypertriton with 12C nuclei to address the hypertriton puzzle. This puzzle explores the link between the lifetime and binding energy of the hypertriton and its possible Lambda-halo character. Approved at GSI/FAIR, the experiment will take place in the near future at the R3B facility, where hypertriton will be produced by colliding two 12C nuclei at 1.9 GeV per nucleon (18 T.m). The experiment identifies hypertriton by measuring its decay products, a 3He nucleus and a negatively charged pion (pi-), and reconstructing their invariant mass. Central to this is the HYDRA TPC, operating inside the GLAD dipole magnet at R3B. The readout of the TPC is based on the VMM3a front-end electronics and SRS readout system. In the presentation, the TPC and its readout system will be described, as well as first offline validation. Simulations for the front-end cooling will be detailed. Supported by Alexander von Humboldt Foundation, HFHF, BMBF under Verbundprojekt 05P24RD1, and Hessian Research Cluster ELEMENTS

HK 10.5 Mon 18:00 SR Exp1A Chemie

Production of detector modules for the CBM-TRD at FAIR — •Spicker Dennis[1] and Kähler Philipp[2] for the CBM-Collaboration — [1]Institut für Kernphysik, Goethe Uni Frankfurt — [2]Institut für Kernphysik, WWU Münster

At the forthcoming Facility for Antiproton and Ion Research (FAIR), the Compressed Baryonic Matter experiment (CBM) is designed to measure particles resulting from heavy-ion collisions at exceedingly high interaction rates. To this end, the data acquisition system will operate in a free-streaming mode, eliminating the need for a hierarchical trigger system. The Transition Radiation Detector (TRD), a subsystem of the CBM experiment, will comprise four layers of Multi-Wire-Proportional-Chambers (MWPC), each equipped with a foam radiator enabling the generation of transition radiation. The principal objective of the TRD is to distinguish between electrons and pions, to augment the light nuclei identification, and to provide tracking information. This contribution presents the latest advancements towards series production of MWPC modules for the outer region of the detector, as well as providing an update on the status of the final version of the readout electronics for these modules. Supported by the German BMBF-grant 05P24RF2