HK 17: Instrumentation III

Time: Tuesday 16:15–18:15 Location: PHIL A 301

Group Report HK 17.1 Tue 16:15 PHIL A 301

The MAGIX Experiment at MESA — •David Markus — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

At the new high-intensity, low-energy electron accelerator MESA, construction of the multi-purpose MAGIX experiment is in the final phases and preparations for the first physics run are underway. This first run with beam is planned to both provide a new more precise measurement of the transition form factor between the Hoyle state and the ground state of carbon-12 and to provide data to calibrate the new detectors, using a thin diamond foil as target.

In the future, MAGIX will use a gas jet target, which will be capable of operating with a variety of gases and enable a new frontier in high precision electron scattering experiments. Combined with MESA's high intensity electron beam and two high precision magnetic spectrometers, these experiments aim to contribute to the study of hadron structure and few-body systems, as well as investigations of reactions relevant to nuclear astrophysics and into the dark sector.

In the focal plane of the spectrometers, which are connected windowlessly to the scattering chamber, the two detector systems of MAGIX are installed, a time projection chamber for particle tracking and a trigger veto system combining plastic scintillation detectors and passive lead absorbers for particle identification and triggering.

This contribution outlines the physics program at MAGIX and provides an overview of both the setup of MAGIX and and the planned first physics experiment.

HK 17.2 Tue 16:45 PHIL A 301

GEM detectors for AMBER - Production and streaming readout — •Shania Müller[1,2], Pascal Henkel[1], Max Knauseder[1,2], Jakob Krauss[1,2], Jonathan Kunecke[1,2], Jan Paschek[1,2], and Bernhard Ketzer[1,2] — [1]Helmholz-Institut für Strahlen- und Kernphysik, University of Bonn, Germany — [2]Forschungs- und Technologiezentrum Detektorphysik

The AMBER experiment at CERN's Super Proton Synchrotron is a facility that explores how the fundamental properties of mesons and baryons emerge from the underlying quark and gluon dynamics. In its first physics runs in 2023 and 2024, the experiment measured cross-sections for antiproton production in hadron-hadron collisions. The run in 2025 has been a preparation run for the upcoming proton electric form-factor measurement using a high-energy muon beam, showing the feasibility of the planned experimental program.

To measure the trajectories of scattered muons downstream of the traget close to the beam, a new generation of 30×30 cm^2 triple-GEM detector stations are being produced and integrated into the setup. These detectors are constructed and characterized in the laboratories at the University of Bonn. To fulfill the requirements for this physics program a new free-streaming data acquisition system was established. To match the free-streaming mode, the self-triggering VMM3a front-end chip was implemented to readout the GEM detectors.

This talk will present the construction procedure of the detectors, their quality assurance and the characterization using the new readout system. Supported by BMFTR.

HK 17.3 Tue 17:00 PHIL A 301

Drift-field distortion corrections of the ALICE TPC in LHC Run 3 — •Janis Jäger for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

At CERN's Large Hadron Collider (LHC), the Time Projection Chamber (TPC) of the ALICE experiment provides an excellent tracking and particle identification performance. For LHC Run 3, the Multi-wire Proportional Chambers (MWPCs) were replaced with stacks of four Gas Electron Multiplier (GEM) foils to cope with the high interaction rates of up to 50 kHz and enabling a continuous data acquisition. Despite the low intrinsic ion-backflow properties of the 4-GEM setup, a residual amount of ions, produced during the amplification process, drift back into the active volume of the TPC, leading to space-charge distortions of the drift field. Further effects such as geometric imperfections and interaction rate variations lead to additional static and time-dependent drift-field distortions. These drift-field distortions need to be corrected to preserve the intrinsic particle tracking precision of the ALICE TPC.

This talk will give an overview of the observed drift-field distortions in the ALICE TPC in Run 3, together with the correction procedure and its precision.

Supported by BMFTR and the Helmholtz Association.

HK 17.4 Tue 17:15 PHIL A 301

A New Automatised Wire Tension Measurement for the CBM-TRD Chambers — •Hannes Olbring for the CBM-Collaboration — Institut für Kernphysik, Universität Münster

At the Facility for Antiproton and Ion Research (FAIR) in Darmstadt the Compressed Baryonic Matter (CBM) experiment is currently being built. The goal of the experiment is to study the QCD phase diagram at high net baryon densities using heavy ion collisions at interaction rates of up to 10 MHz.

The Transition Radiation Detector (TRD) of CBM is based on Multi-wire Proportional Chambers (MWPCs). The wire electrodes of the MWPCs will be produced with a well-controlled mechanical wire tension, dictated by the requirements on the electrostatic deflection caused by high voltages applied to the wires. To check the proper tension prior and after the wire gluing, a wire tension measurement device needs to be built. The wires will be brought to (harmonic) oscillation by an air blast, such that the actual measurement of the tension can be achieved by measuring the oscillation frequency. This talk will focus on commissioning and first performance measurements of a newly constructed wire tension measurement device and its automatisation.

We thank our colleagues from IFIN-HH, Măgurele, Romania, in particular Marian Olteanu, for the collaboration on developing this new device. This work is supported by BMFTR grant 05P24PM1.

HK 17.5 Tue 17:30 PHIL A 301

Hit Position Reconstruction and Tracking with the CBM-TRD in mCBM Beam Data — •Henning Pauels for the CBM-Collaboration — Institut für Kernphysik, Universität Münster

The Compressed Baryonic Matter (CBM) experiment is a fixed-target experiment currently under construction at FAIR in Darmstadt. It is designed to investigate the QCD phase diagram at high net-baryon densities using heavy-ion beams from the SIS100 accelerator.

The Transition Radiation Detector (TRD) will play an important role in both the identification and the tracking of particles in CBM. To further confirm its performance as part of the future full CBM experiment, TRD modules were included in the in-beam measurements of the mCBM setup at the SIS18 facility at GSI. Consisting of modules of almost all of CBM's subdetectors, mCBM performed data taking and reconstruction under high-rate conditions. This talk will focus on the TRD hit and track reconstruction using two TRD modules operated in mCBM runs.

This work is supported by BMFTR grant 05P24PM1.

HK 17.6 Tue 17:45 PHIL A 301

Developing radiopurity screening with alpha spectrometry for the LEGEND experiment — •Christoph Seibt, Björn Lehnert, Steffen Turkat, and Kai Zuber for the LEGEND-Collaboration — TU Dresden

LEGEND is one of the leading experiments in the search for neutrinoless double-beta ($0\nu\beta\beta$) decay. With its second phase, LEGEND-1000, the experiment uses one ton of germanium crystals enriched in ^{76}Ge to reach a discovery potential of half-lives greater than 10^{28} years.

However, to reach this sensitivity, an extremely low background level of 10^{-5} cts/(keV kg yr) at $Q_{\beta\beta}$ is necessary. One step towards this goal is to minimize the radioactivity of all components and to classify them with material screening methods.

We report on our recent efforts in developing alpha spectrometry with improved sensitivity beyond commercial low background solutions. Using an Frisch-gridded ionization chamber offers a high resolution and allows an analysis on individual radionuclides of one decay chain. In addition, we are sensitive to surface contaminations of less than 0.5 mBq/m^2 for ^{238}U and ^{232}Th. This presentation will show the optimization of the energy resolution, efforts in background reduction and first screening measurements with test samples.

This work is supported by: U.S. DOE, NSF, LANL, ORNL and LBNL LDRD programs; European ERC and Horizon programs; German DFG, BMBF, and MPG; Italian INFN; Polish NCN and MNiSW;

Czech MEYS; Slovak RDA; Swiss SNF; UK STFC; Canadian NSERC and CFI; LNGS and SURF facilities.

HK 17.7 Tue 18:00 PHIL A 301

LHCb OT Straw-Tube Modules in mCBM: Integration and First Beam-Time Results — •Luca Schramm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt

Several of the former LHCb Outer Tracker (OT) straw tube modules were successfully installed and evaluated in the mini CBM (mCBM) test environment. The CERN-LHCb collaboration donated the OT straw tube detector to GSI. The aim is to install it as part of the Forward Tracking Systems in FAIR experiments such as PANDA and recently also as part of the Muon Detector of the CBM.

During the spring of 2025, the LHCb modules were operated under varied high-voltage and threshold settings during heavy-ion beam tests at GSI to assess performance stability. The contribution will present the beam-test setup and results obtained. A joint PANDA-CBM cooperation developed simulation and reconstruction software to enable the analysis of beam-test data. The results demonstrate consistent straw tube performance across the tested conditions, confirming the detector's readiness for integration into either experiment.