HK 21: Instrumentation VI

Time: Tuesday 15:45–17:15 Location: SR Exp1B Chemie

Group Report HK 21.1 Tue 15:45 SR Exp1B Chemie

Recent results from the mCBM experiment at SIS18 of GSI/FAIR — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The mCBM experiment, a CBM demonstrator and full-system test-setup, was constructed 2017/18 at the SIS18 facility of GSI / FAIR, taking data within the FAIR Phase-0 program since 2019. The main focus lays on testing and optimizing the complete CBM data chain incl. the online track and event reconstruction as well as event selection algorithms in nucleus-nucleus reactions with collision rates up to 10 MHz (averaged). mCBM comprises pre-series and series productions of all CBM detector systems and their read-out chains. To further validate CBM's read-out and data processing concept, the production yield of rare Λ baryons is studied in nucleus-nucleus collisions serving as a benchmark observable, which will allow comparison with published data. Hence, latest results on performance studies of the CBM detector systems, the CBM online system prototype and on rare Λ reconstruction with the mCBM experiment will be presented.

HK 21.2 Tue 16:15 SR Exp1B Chemie

A High-Rate, Highly-Segmented Charged Particle Tracker — Devin Hymers[1], •Sebastian Schroeder[1], Olga Bertini[2], Johann Heuser[2], Joerg Lehnert[2], Christian Joachim Schmidt[2], and Dennis Muecher[1] — [1]Institute for Nuclear Physics, University of Cologne, Cologne, Germany — [2]GSI, Darmstadt, Germany

Tracking of charged particles with high spatial resolution, and at high event rates, is of significant interest in many sub-disciplines. Here, we present an adaptation of the high-performance detectors from the Silicon Tracking System of the Compressed Baryonic Matter experiment at GSI, to a general-purpose two-layer tracker. To maximize acceptance, the first layer consists of a 6x6 cm^2 sensor, while the second layer is a larger 6x12 cm^2. Each of these double-sided silicon strip detectors is segmented with a 58 μm pitch, for 1024 segments per side, offering a balance between spatial resolution, data rate, and a manageable number of electronic channels.

These sensors are coupled to a fully-digital readout system, currently capable of handling count rates up to 50 kHz per channel, or 100 kHz after a possible hardware upgrade. Tests have been performed tracking particles at rates above 1 MHz, with pileup-related data loss of 0.004%. At these interaction rates, tracking may be performed on the same timescale as data acquisition; on modern workstation hardware, 60 s of such high-rate data was typically reconstructed in 50 s or less using a highly-parallel algorithm. The performance of this system represents a significant opportunity for improvement in measurement and online analysis of particle tracking setups.

HK 21.3 Tue 16:30 SR Exp1B Chemie

Use of microchannel plate detectors for beam tracking at FAIR: test experiment at the Cologne FN Tandem accelerator — •Dennis Bittner[1], Gregor Košir[2], Christoph Fransen[1], Jan Jolie[1], Klemen Žagar[2], Matjaž Skobe[2], Matjaž Vencelj[2], Calum Jones[3], Kathrin Wimmer[3], Jelena Vesić[2], and Magdalena Górska[3] — [1]IKP, Cologne, Germany — [2]Jožef Stefan Institute, Ljubljana, Slovenia — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

At FAIR/GSI, radioactive ion beams of energies of hundreds of MeV/nucleon are available. To perform the low-energy Coulomb excitation experiments, the beams need to be slowed down with a thick degrader. Secondary reactions and scattering within the degrader result in a beam containing many secondary reaction products and a wide angular spread. For the experiments, it is crucial to know the position and momentum vector of the single ions. The approach is to place two foil-MCP (Micro Channel Plate) detectors with delay lines will be placed to obtain position sensitivity. The ions passing the foils generate secondary electrons, which are accelerated towards the MCP. Due to the large distance between the foil and the MCP, permanent magnets are used to force the electrons on circular trajectories. A test experiment of the full particle tracking detector setup was conducted at the 10 MV FN-Tandem accelerator in Cologne. The first results of this experiment will be presented and the further outlook will be discussed. Support by BMBF is acknowledged under ErUM Verbundprojekt 05P2024 (ErUM-FSP T07). Grant 05P21PKFN1.

HK 21.4 Tue 16:45 SR Exp1B Chemie

Microcontroller-based readout for ITS2 Outer Barrel modules — •Bent Buttwill for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg, Germany

The Outer Barrel Module (OBM) used in the four outermost layers of the Inner Tracking System (ITS2) of ALICE utilizes 2x7 interconnected ALPIDE monolithic active pixel sensors (MAPS). A number of such modules were integrated on dedicated PCBs to facilitate their use in outreach activities and to serve as large-acceptance detectors in particle telescopes.

A simplified readout using a RP2040 microcontroller was developed for tabletop experiments and successfully utilized in a beam test at the DESY II Test Beam Facility in Hamburg. The setup consisted of three OBM planes placed downstream of a particle telescope made up from single ALPIDE sensors, which operated independently from the OBM modules.

This contribution will discuss the synchronization of hits between the single-ALPIDE telescope and the OBM planes by simply using computer-clock-defined timestamps, enabling combination of data from the two separate data acquisition systems. This approach allows the measurement of the spacing between the ALPIDE chips of an OBM using tracks defined by the upstream telescope.

HK 21.5 Tue 17:00 SR Exp1B Chemie

Simulation studies of the Forward Conversion Tracker for ALICE 3 — •Cas van Veen for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Germany

During the Long Shutdown 4 of the Large Hadron Collider, ALICE will upgrade its complete detector to address new physics cases with unprecedented resolution and higher interaction rates, called ALICE 3. The Forward Conversion Tracker (FCT), located in the forward direction, will measure the photon spectrum predicted by Low's theorem in proton-proton collisions at $\sqrt{s} = 14$ TeV to address the long standing "soft-photon puzzle". The focus of this talk will be on the status of the simulation studies of the FCT. The O2 framework of ALICE allows for detailed, full simulations of proton-proton collisions including transportation through the detector setup of ALICE 3. The background bremsstrahlung generated by charged particles passing through material in front of the FCT is a major challenge for this study and strategies to reduce this background will be presented. This can be accomplished by an electron particle identification detector (ePID) behind the FCT in the form of a ring imaging Cherenkov detector (RICH) that provides a veto on the events containing an electron that is not part of the signal electron-positron pair.