HK 4: Instrumentation II

Time: Monday 16:45–18:15 Location: HBR 19: C 2

Group Report HK 4.1 Mon 16:45 HBR 19: C 2

Current status in the concept design, assembly, and performance evaluation of the Silicon Tracking System for the CBM experiment — •Dario Alberto Ramirez Zaldivar for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) is one of the experimental pillars at the FAIR facility. The Silicon Tracking System (STS) is the central detector for tracking and momentum measurement. It consists of 876 double-sided silicon sensors arranged in 8 stations.

Significant strides have been made over the past year in developing the STS. The finalized concept design and geometry implementations mark a crucial milestone in the detector's evolution. The consolidation of the procedures for module assembly and testing materializes at the onset of the series production.

Prototype components of the STS have been operated in mini-CBM (mCBM), a small-scale setup at SIS18 consisting of sub-units of all major CBM systems, which aims to verify the concepts of free-streaming readout electronics, data transport, and online reconstruction as well as in the E16 experiments at J-PARC.

This report provides an overview of the recent progress and highlights the comprehensive performance studies conducted on the STS modules. In-beam operation at the mCBM and E16 facilities has provided invaluable insights into the detector's capabilities and response under realistic experimental conditions. These findings support extrapolating the detector's final performance.

HK 4.2 Mon 17:15 HBR 19: C 2

Studies of detector data rates and hit multiplicity for the Silicon Tracking Systems of the CBM experiment — •Mehulkumar Shiroya for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Silicon Tracking System (STS) is the main tracking device of the Compressed Baryonic Matter (CBM) Experiment, a fixed target experiment at the SIS100 accelerator, under construction at the FAIR Facility Darmstadt. The STS is designed to measure up to 700 charged particles produced in nucleus-nucleus collisions up to an interaction rate of 10 MHz.It consists of 876 double-sided micro-strips silicon sensors, read out by two Front-End Boards (FEBs) with 8 ASICs each, arranged in 8 tracking stations. To meet the high interaction rate demand, the CBM experiments operate with free streaming electronics. A realistic estimate of the data rate expected in the detector is therefore of crucial importance to drive the decisions on the read-out system design and network data transfer components procurement. Simulation studies have been performed including different experimental scenarios, a realistic detector geometrical setup, which includes all the known passive materials, as well as realistic modelling of the detector response and front-end electronics. The impact of the detector noise and additional signals of delta electrons originating from the target has been evaluated. Detector data rate and hit multiplicity are studied in real data and compared to simulations, to benchmark and validate the estimates for the highest rates expected at SIS100.

HK 4.3 Mon 17:30 HBR 19: C 2

HI-TREX: Compact, high resolution particle detection system for ISOLDE — Roman Gernhäuser, •Sergei Golenev, Robert Neagu, and Lutz Ziegele for the MINIBALL-Collaboration — Technische Universität München, Germany

HI-TREX is a particle detection setup, developed for the HIE-ISOLDE facility at CERN, designed for transfer reactions using radioactive ion beams.
HI-TREX is based on a thin double-sided silicon strip detector (DSSSD), high-resolution front-end electronics with SKIROC ASICs, and a custom FPGA-based readout board for the fiber-based TRB data acquisition system.
In order to characterize the performance of the detectors, a full system test was conducted in Delft, Netherlands. Even for very low-energy particles from the ^{6}Li(n,α)^{3}H reaction, we achieved an energy resolution FWHM $\approx$ 13 keV. We will present the experimental setup, simulations and a 3-dimensional vertex reconstruction, demonstrating the capability of this new instrument.
(supported by BMBF 05P21WOCI1)

HK 4.4 Mon 17:45 HBR 19: C 2

Module and ladder characterization and burn-in tests of the Silicon Tracking System for the CBM experiment — •Lady Maryann Collazo Sánchez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Silicon Tracking System (STS) in the upcoming heavy-ion CBM experiment is tailored for an unprecedented 10 MHz beam-target interaction rate. A unique integration strategy was employed to maintain a material budget within 2 - 8% X_0 while ensuring ample granularity, spatial precision, and timing accuracy. The read-out electronics sit external to the sensitive volume, connected to double-sided double-metal silicon sensors through ultra-thin micro cables. Each double-sided silicon strip sensor is connected to two Front-End Boards (FEBs), featuring eight custom-designed STS-XYTER ASICs (SMX) per FEB. Post-assembly, rigorous quality control tests, including time and amplitude calibration of all module ASICs, ensure reliable performance, operational refinement, and accurate data interpretation. Operating at room temperature to -20 °C (coolant) and -10 °C (effective), FEBs undergo mechanical stress due to temperature fluctuations. The burn-in test exposes modules to varying temperatures and power cycles, identifying weaknesses and evaluating electronics robustness and module functionality. Post-testing, modules are affixed to a carbon fiber ladder, undergoing further assessments to verify sustained functionality and performance. This study outlines the status and outcomes of tests on the first modules of the STS detector's series production, providing valuable insights into its development and performance capabilities.

HK 4.5 Mon 18:00 HBR 19: C 2

Functional and in-beam performance tests of a PANDA MVD detector prototype — •Nils Tröll[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Marvin Peter[1], Fabio Cossio[3], Michele Caselle[4], Tobias Stockmanns[2], Lukas Tomasek[5], Pavel Stanek[5], and Francesca Lenta[3] for the PANDA-Collaboration — [1]JLU Gießen, IIPI, Heinrich-Buff-Ring 16, 35392 Gießen, Germany — [2]FZ Jülich, Wilhelm-Johnen-Straße, 52428 Jülich, Germany — [3]INFN Physics Turin, Via Pietro Giuria, 1 10125 Torino-TO, Italy — [4]KIT, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany — [5]CVUT Prague, 22 Břehová 7, Praha 1, Czech Republic

The Micro-Vertex-Detector (MVD) of a PANDA experiment is the closest part with respect to the primary interaction point. Double-sided silicon strip sensors of the MVD enable tracking of charged particles, which is essential for a very precise determination of secondary decay vertices of short-lived particles.

For the first time, two double-sided MVD silicon strip detectors were successfully tested in conjunction with the Torino Amplifier for Strip detectors (ToASt) ASIC and the Data Acquisition System for the PANDA MVD during a beamtime. The detector system underwent testing in the high-energy proton beam at the COSY acceleration facility. In the analysis, various properties, such as clustering and strip multiplicity, were examined to validate the functionality of the system. The work is supported by BMBF.