HK 36: Instrumentation VII

Time: Thursday 13:45–15:45 Location: PHIL B 302

Group Report HK 36.1 Thu 13:45 PHIL B 302

The Silicon Tracking System for the CBM Experiment: Series Production and Detector Performance Evaluation — •Lady Maryann Collazo Sanchez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) investigates strongly interacting matter at high baryon densities. Its core tracking subsystem, the Silicon Tracking System (STS), provides charged–particle tracking and momentum reconstruction at interaction rates up to 10 MHz within a free–streaming data acquisition scheme, reconstructing around 10^3 charged tracks per nucleus–nucleus collision. The STS consists of eight tracking stations equipped with 876 double-sided silicon microstrip modules mounted on low-mass carbon–fiber ladders to minimize material budget. Prototype STS components were tested in beam experiments within the mini–CBM (mCBM) setup at SIS18 and in the E16 experiment, validating detector performance, free–streaming readout, and online reconstruction.

This report summarizes the current status of the STS project. Series production of modules and ladders is ongoing, and detector construction is in progress. It describes the full sequence of electrical, mechanical, and performance qualification procedures for modules, ladders, and half-unit assemblies. It presents results from comprehensive beam–based performance studies, detector controls, and the final readout chain.

HK 36.2 Thu 14:15 PHIL B 302

Aluminum strip-lines on pCVD diamond carriers* — •Evadhidho Taka[1], Franz A. Matejcek[1], Christian Müntz[1], and Joachim Stroth[1,2,3] — [1]Goethe-Universität Frankfurt — [2]GSI Darmstadt — [3]Helmholtz Forschungsakademie Hessen für FAIR

The present work focuses on the aluminum metallization of pCVD (polycrystalline Chemical Vapor Deposition) diamond substrates and patterning of strip-lines. This is a generic research project with the goal of producing lightweight, vacuum compatible modules to minimize multiple scattering, highly appealing for micro-vertexing applications. Conductive traces, to perform the readout and control of silicon sensors, are introduced directly on the carrier thus obtaining pCVD diamond carriers with expanded functionalities: adding electrical connectivity along with mechanical stability and efficient heat management.

This application requires trace thicknesses up to the order of micrometers. Since combining trace sharpness, thickness homogeneity, and a process with dependable reproducibility poses a challenge, a method consisting of consecutive deposition steps is proposed. A thin Aluminum seed layer is initially sputtered into a prepped pCVD diamond surface. The layer is then precisely patterned utilizing mask-less photolithography, and the so produced lines are subsequently thickened in an electrodeposition process. This contribution introduces the method and presents first results.

*This work is affiliated with the ERuM-Pro Si-D Consortium, supported by BMFTR (05H24RF1).

HK 36.3 Thu 14:30 PHIL B 302

Update on the Developments in Optimization and Characterization for the ToASt-based Silicon-Strip-Detectors of the $\overline{\text{P}}$ANDA MVD — •Raphael Ratz[1], Kai-Thomas Brinkmann[1], Marvin Peter[1], Hans-Georg Zaunick[1], Giovanni Mazza[2], Michele Caselle[3], and Daniela Calvo[2] for the PANDA-Collaboration — [1]2nd Physics Institute, Justus Liebig University, Giessen — [2]Istituto Nazionale di Fisica Nucleare - Sezione di Torino, Turin — [3]Karlsruhe Institute of Technology, Karlsruhe

The Micro Vertex Detector (MVD) of the $\overline{\text{P}}$ANDA experiment consists of silicon strip detectors, read out by the Torino Amplifier for silicon Strip detectors (ToASt) ASIC. Each ToASt employs a multitude of parameters, some of which affect the Signal-to-Noise Ratio (SNR) of the Time-over-Threshold (ToT) measurement. Thus, an optimization and an energy calibration for the measured ToTs is favorable.

After establishing the parameters that most affect SNR, they were optimized pairwise using a grid search method with the integrated test-pulser of the ToASt. As the analysis of the correlation matrix suggests multiparameter effects on the SNR, a Bayesian optimization algorithm was investigated. While covering more than two parameters simultaneously, this approach also decreases the time needed compared to a grid search, allowing each sensor channel to be optimized individually.

In addition, a calibration between the measured ToT and the deposited charge, and subsequently the deposited energy, was achieved. Lastly, a web-based user interface for configuring sensors and online analysis of measurements was developed. *Supported by BMFTR.*

HK 36.4 Thu 14:45 PHIL B 302

The Assembly and Integration of a Half-unit of the Silicon Tracking System (STS) Detector — •Gnana Sindhu Subramanya for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) investigates strongly interacting matter at high net-baryon densities. Its Silicon Tracking System (STS) provides precise tracking of charged particles in heavy-ion collisions, where tracking efficiency and vertex resolution are crucial for rare probes such as open charm and di-leptons, directly linking detector performance to CBM's physics goals.

This presentation describes the STS half-unit and the development and verification of a reliable assembly and integration protocol. Prototype components were used to simulate mechanical assembly and ensure safe handling before working with sensor modules and electronics. The protocol defines the placement of mechanical and electronic components, including ladders with Front-End Board (FEB) boxes housing front-end electronics (FEEs). Cable routing and power connections between FEBs and the readout chain were verified. Mechanical constraints were checked to prevent interference during module assembly and integration into the full STS.

HK 36.5 Thu 15:00 PHIL B 302

Amplification Based Radiation Damage Compensation in Diamond Detectors — •Yevhen Kozymka[1], Thomas Bergauer[2], Tetyana Galatyuk[1,3,4], Albert Hirtl[5], Matthias Kausel[5,6], Mladen Kis[3], Wilhelm Krüger[1], Sergey Linev[3], Jan Michel[3], Jerzy Pietraszko[3], Christian Joachim Schmidt[3], Michael Träger[3], Michael Traxler[3], Felix Ulrich-Pur[5], Matteo Centis Vignali[7], and Ashish Bisht[7] — [1]Technische Universität Darmstadt — [2]Marietta Blau Institute for Particle Physicsof the Austrian Academy of Sciences — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Helmholtz Forschungsakademie Hessen für FAIR — [5]TU Wien, Atominstitut — [6]EBG MedAustron — [7]Fondazione Bruno Kessler, Centre of Materials and Microsystems

Diamond detectors are widely used for beam monitoring and time zero applications due to their high timing precision, detection efficiency and radiation hardness. However, the accumulated radiation damage from heavy-ion beams eventually drops the charge collection efficiency below the detectable threshold, resulting in loss of efficiency.

Diagnostics are performed on a pcCVD diamond sensor that saw heavy use in the mCBM experiment and has an efficiency hole in the center, utilizing LGADs as reference detectors. We demonstrate the use of a two-stage amplification circuit and conversion from strip to pad readout for restoring the efficiency of a highly damaged diamond sensor with a 73 AMeV helium beam.

HK 36.6 Thu 15:15 PHIL B 302

The Super-FRS beam intensity monitor — •Chiara Nociforo[1], Matteo Alfonsi[1], Tobias Blatz[1], Joshua Alvaro Galvis Tarquino[1], Rainer Haseitl[1], Rainer Hettrich[1], Christos Karagiannis[1], Mladen Kiš[1], Martin Kumm[2], Rolf Lonsing[2], Rahul Singh[1], and Michael Träger[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Fulda University of Applied Sciences, Fulda, Germany

The beam diagnostics at the entrance of the Super-FRS, under installation at FAIR for the production of in-flight radioactive ion beams, is used to tune the separator and provide the necessary measures for machine protection and online monitoring. In addition, the high intensity of the primary SIS ion beams delivered up to the target must be stored to normalise the measured rates and extract the production cross sections of the new secondary ion beams. The main design challenge is to cope with the high intensities and the expected background radiation, since the detecting system should survive for extended periods of operation without hands-on maintenance. Two complementary CVD diamond detectors with excellent radiation resistance were built as reference counting detectors up to few MHz particle rate, overlapping with the standard intensity monitors at FAIR. Customised electronics with large dynamic range developed for the readout of the diamond analogue signals was coupled to the detector and tested at the pre-assembled target vacuum chamber. The design of the Super-FRS intensity monitor and its peculiarity will be presented and the latest achievements of the performed tests will be reported.

HK 36.7 Thu 15:30 PHIL B 302

Development and performance of the readout board of the STS detector for the CBM experiment — •Patryk Semeniuk for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany — Goethe University Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt am Main, Germany — AGH University of Krakow, Mickiewicza 30, 30-059 Kraków, Poland

The Silicon Tracking System (STS) of the CBM experiment requires a high-bandwidth readout chain operating under strict spatial and performance constraints. A new generation of STS Readout Boards (STS-ROB), developed as the successor to the CROB, forms the concentrator stage between the front-end electronics and the CRI-based backend. Each STS-ROB integrates three GBTx ASICs, a Versatile Link optical interface, and connectivity optimized for AC-coupled 320-Mb/s LVDS E-Links from front-end ASICs at different sensor bias potentials.

Recent work focused on commissioning and integration of the STS-ROB into the readout chain using the CBM Common Readout Interface (CRI) and the self-developed Readout-Powering Board (RPoB). Stable GBTx initialization, reliable optical and electrical communication, and robust power delivery were demonstrated, confirming that the STS-ROB meets the system's operational requirements.

In the final detector, the STS will comprise several hundred STS-ROB units with dedicated addon and powering boards; the concept, integration results, and current status of the STS-ROB will be presented.