HK 12: Instrumentation 4

Time: Monday 17:00–18:45 Location: M/HS1

Group Report HK 12.1 Mon 17:00 M/HS1

The Silicon Tracking System of the CBM Experiment at FAIR — •Minni Singla for the CBM-Collaboration — GSI Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment, one of the major scientific pillars at FAIR, will explore the phase diagram of strongly interacting matter at the highest net-baryon densities in nucleus-nucleus collisions with interaction rates up to 10 MHz. The Silicon Tracking System is the central detector system of the CBM experiment. Its task is to perform track reconstruction and momentum determination for all charged particles created in beam-target collisions at SIS 100 and SIS 300 beam energies. The technical challenges to meet are a high granularity matching the high track densities, a fast self-triggering read-out coping with high interaction rates, and a low mass to yield high momentum resolution of Δp/p = 1%. The detector system acceptance covers polar angles between 2.5 and 25 degrees and will be operated in the 1 T field of a super conducting dipole magnet. We introduce the concept of the STS, being comprised of eight tracking stations employing ∼1300 double-sided silicon microstrip sensors on modular structures that keep the read-out electronics outside the physics aperture. Ultra-thin-multiline micro-cables will be used to bridge the distance between the microstrip sensors and the readout electronics. Infrastructure such as power lines and cooling plates will be placed at the periphery of the stations. The status of the STS development is summarized in the presentation, including an overview on sensors, read-out electronics, prototypes, and system integration.

HK 12.2 Mon 17:30 M/HS1

Quality assurance database for the CBM Silicon Tracking System — •Anton Lymanets for the CBM-Collaboration — Physikalisches Institut, Universität Tübingen

The Silicon Tracking System is a main tracking device of the CBM Experiment at FAIR. Its construction includes production, quality assurance and assembly of large number of components, e.g., 106 carbon fiber support structures, 1300 silicon microstrip sensors, 16.6k readout chips, analog microcables, etc. Detector construction is distributed over several production and assembly sites and calls for a database that would be extensible and allow tracing the components, integrating the test data, monitoring the component statuses and data flow.

A possible implementation of the above-mentioned requirements is being developed at GSI (Darmstadt) based on the FAIR DB Virtual Database Library that provides connectivity to common SQL-Database engines (PostgreSQL, Oracle, etc.). Data structure, database architecture as well as status of implementation will be discussed.

*Supported by EU-FP7 HadronPhysics3 and BMBF.

HK 12.3 Mon 17:45 M/HS1

Development of carbon fiber staves for the strip part of the PANDA Micro Vertex Detector — •Tommaso Quagli[1], Kai-Thomas Brinkmann[1], Vincenzo Fracassi[2], Dirk Grunwald[2], and Eberhard Rosenthal[2] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig Universität Gießen, Gießen, Germany — [2]ZEA-1, Forschungszentrum Jülich GmbH, Jülich, Germany

PANDA is a key experiment of the future FAIR facility, under construction in Darmstadt, Germany. It will study the collisions between an antiproton beam and a fixed proton or nuclear target. The Micro Vertex Detector (MVD) is the innermost detector of the apparatus and is composed of four concentric barrels and six forward disks, instrumented with silicon hybrid pixel detectors and double-sided silicon microstrip detectors; its main task is the identification of primary and secondary vertices. The central requirements include high spatial and time resolution, trigger-less readout with high rate capability, good radiation tolerance and low material budget.

Because of the compact layout of the system, its integration poses significant challenges. The detectors in the strip barrels will be supported by a composite structure of carbon fiber and carbon foam; a water-based cooling system embedded in the mechanical supports will be used to remove the excess heat from the readout electronics. In this contribution the design of the barrel stave and the ongoing development of some hardware components related to its integration will be presented.

Supported by BMBF, HIC for FAIR and JCHP.

HK 12.4 Mon 18:00 M/HS1

Development of a Compton Camera for online ion beam range verification via prompt γ detectio — •S. Aldawood[1,2], S. Liprandi[1], T. Marinsek[1], J. Bortfeldt[1], L. Maier[3], C. Lang[1], H. van der Kolff[1,4], I. Castelhano[1,5], R. Lutter[1], G. Dedes[1], R Gernhäuser[3], D. R. Schaart[4], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Garching, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]TU Munich, Garching, Germany — [4]TU Delft, The Netherlands — [5]University of Lisbon, Lisbon, Portugal

Precise and preferably online ion beam range verification is a mandatory prerequisite to fully exploit the advantages of hadron therapy in cancer treatment. An imaging system is being developed in Garching aiming to detect promptγ rays induced by nuclear reactions between the ion beam and biological tissue. The Compton camera prototype consists of a stack of six customized double-sided Si-strip detectors ($DSSSD, 50 \times 50mm^2, 0.5\ mm\ thick, 128strips/side$) acting as scatterer, while the absorber is formed by a monolithic $LaBr_3$:Ce scintillator crystal ($50 \times 50 \times 30\ mm^3$) read out by a position-sensitive multi-anode photomultiplier (Hamamatsu H9500). The on going characterization of the Compton camera properties and its individual components both offline in the laboratory as well as online using proton beam will be presented.

*This work is supported by the DFG Cluster of Excellence MAP (Munich-Centre for Advanced Photonics)

HK 12.5 Mon 18:15 M/HS1

Development of large area diamond detectors for time of flight measurements of heavy ions — •Fabio Schirru[1], Chiara Nociforo[1], Mladen Kiš[1], Jochen Frühauf[1], Mircea Ciobanu[2], Michael Träger[1], and Robert Visinka[1] — [1]GSI, Darmstadt, Germany — [2]ISS, Bucharest, Romania

The interest in using diamond for radiation detection applications stems from its unique properties. In particular, radiation hardness, low leakage current (no need of cooling), fast rise time of the induced signals (in the order of 100 ps) and high electron/hole saturation velocity (up to 10^7 cm/s) make it an excellent candidate for serving as a high-resolution timing detector.

We present the Time of Flight (ToF) properties of new developed radiation detectors based on two 20x20 mm^2 and 0.3 mm thick polycrystalline diamonds. Electrodes were fabricated in house at GSI by depositing on both sides of the diamond samples Cr/Au layers of thickness 50/100 nm respectively.

Strip diamond detectors, irradiated with ^{197}Au beam at 1 GeV/u and coupled with integrated electronics, showed very good timing performances of ∼50 ps over a particle path of flight of ∼34 m. It is the first time that timing properties of diamond sensors are evaluated at experimental conditions very similar to those expected at the in-flight separator Super-FRS[1], under construction at FAIR.

[1] - M. Winkler et al., Nucl. Instr. and Meth. B 266 (2008) 4183.

HK 12.6 Mon 18:30 M/HS1

Development of a Compton Camera for online ion beam range verification via prompt γ detectio — •S. Aldawood[1,2], S. Liprandi[1], T. Marinsek[1], J. Bortfeldt[1], L. Maier[3], C. Lang[1], H. van der Kolff[4], I. Castelhano[5], R. Lutter[1], G. Dedes[1], R. Gernhäuser[3], D. Schaart[4], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Garching, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]TU Munich, Garching, Germany — [4]TU Delft, The Netherlands — [5]University of Lisbon, Lisbon, Portugal

A real-time ion beam verification in hadron-therapy is playing a major role in cancer treatment evaluation. This will make the treatment interuption possible if the planned and actual ion range are mismatched. An imaging system is being developed in Garching aiming to detect promptγ rays induced by nuclear reactions between the ion beam and biological tissue. The Compton camera prototype consists of a stack of six customized double-sided Si-strip detectors ($DSSSD, 50 \times 50mm^2, 128strips/side$) acting as scatterer, while the absorber is formed by a monolithic $LaBr_3$:Ce scintillator crystal ($50 \times 50 \times 30mm^3$) read out by a position-sensitive multi-anode photomultiplier (Hamamatsu H9500). The study of the Compton camera properties and its individual component are in progress both in the laboratory as well as at the online facilities.