HK 61: Instrumentation XVIII

Zeit: Freitag 14:00–15:45 Raum: HZO 90

Gruppenbericht HK 61.1 Fr 14:00 HZO 90

The Silicon Tracking System of the CBM Experiment at FAIR — •Evgeny Lavrik for the CBM-Collaboration — Universität Tübingen, Tübingen, Deutschland

The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) aims to study the properties of nuclear matter at high net-baryon densities and moderate temperatures.

The Silicon Tracking System (STS) is the key detector to reconstruct with a high efficiency up to 1000 charged particle trajectories created in heavy-ion collisions at interaction rates of up to 10 MHz. It will determine the momentum of the particles with a momentum resolution $\Delta p/p \approx$ 1-2% which requires ultra-low detector material budget of 0.3-1% X_0 per layer. The detector comprise eight layers of double-sided silicon microstrip sensors and will be placed inside the 1 Tm superconducting magnet which limits the space available, which in turn requires advanced cooling approaches and mechanical design with precise tracking layers alignment. The microstrip sensors have to be radiation hard and checked for their quality optically and electrically before the assembly.

This presentation summarizes the status of developments for the CBM STS as well as for the detector demonstrator in a framework of mCBM campaign at SIS18@GSI.

HK 61.2 Fr 14:30 HZO 90

Thermal Management of the CBM Silicon Tracking System — •Kshitij Agarwal for the CBM-Collaboration — Physikalisches Institut - Eberhard Karls Universität Tübingen, Tübingen, Germany

As the core detector of the CBM experiment, the Silicon Tracking System (STS) located in the dipole magnet provides track reconstruction & momentum determination of charged particles from beam-target interactions. Due to the expected irradiation damage, the sensors will dissipate some power and have to be kept at or below -5°C at all times by complete removal of the heat dissipated by the front-end electronics boards (∼40kW). The heat must be removed to avoid thermal runaway and reverse annealing of the irradiated silicon sensors. To achieve this, the STS will be operated in a thermal insulation box and will use bi-phase CO_2 cooling system for the FEE.

Given the space constraints for STS integration, a high-density feedthrough panel system for all services is needed while maintaining the thermal environment needed for detector operation. In this presentation, the assembly and thermal tests for HV-LV feedthrough panels will be shown. This is part of an effort towards building a cooling demonstrator for two STS half-stations to show that the CBM-STS cooling concept is viable. The respective future plan for its completion followed by the initial construction R&D will be presented.

This work is supported by GSI/FAIR.

HK 61.3 Fr 14:45 HZO 90

Report on Track Based Alignment Procedures of the CBM Silicon Tracking Detector — •Susovan Das for the CBM-Collaboration — Physikalisches Institut, Eberhard Karls Universität Tübingen

The CBM experiment at FAIR is being designed for the study of the QCD phase diagram in the region of the high baryon chemical potential at relatively moderate temperatures. The Silicon Tracking System (STS) is the central detector for momentum reconstruction of the produced charged-particles in the CBM experiment. It consists of 8 layers of altogether ∼900 double-sided silicon micro-strip sensors. Limited mechanical precision($>100\mu$m) during the mounting, temperature differences result in misalignment to the detector component positions. Therefore, the intrinsic spatial resolution($\sim 20\mu$m) of the detector components has to be recovered by a track based alignment method.
In this contribution, we will present the current status of the implementation of the alignment algorithm. For this work, We will employ GBL(General broken line)track refit model to create the necessary input data structure to provide to the standalone PEDE part of the χ^2 minimisation based MILLEPEDE alignment algorithm.
• This work was supported by grant BMBF-05P16VTFC1

HK 61.4 Fr 15:00 HZO 90

Testing of silicon strip detectors with a spatially resolved infrared laser test-stand* — •Martin Kesselkaul, Kai-Thomas Brinkmann, Tommaso Quagli, Robert Schnell, and Hans-Georg Zaunick for the PANDA-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gießen

The PANDA experiment at the future accelerator facility FAIR will investigate proton-antiproton reactions at a stationary target. The Micro Vertex Detector (MVD), as the innermost detector of PANDA, will measure the tracks of charged particles and secondary decay vertices close to the interaction point with high precision. It is comprised of various layers of silicon-pixel and -strip sensors.
For the characterization and quality measurement of the double-sided silicon strip detectors used in the PANDA MVD, a laser test-stand has been developed. An automated xy-table with an position accuracy of 50 nm places an infrared laser above the sensor while recording the spatially resolved response of the sensor. This contribution will focus on the analysis of the data taken with this setup. The quantities of interest are the charge collection efficiency (CCE), as well as the charge sharing characteristics between adjacent strips, which are inferred for analysis of the sensor quality. The latter will be discussed in detail for different measurement parameters to deduce the spatial resolution of the sensor.
*Funded by BMBF and HIC for FAIR

HK 61.5 Fr 15:15 HZO 90

Radiation Hardness Test of Silicon Sensors under Realistic Conditions at the Tübingen Van-de-Graaf Accelerator — •Eduard Friske for the CBM-Collaboration — Universität Tübingen, Tübingen

The silicon strip sensors used in CBM will be subjected to high amounts of NIEL damage. The accumulated dose over several years of operation will be of the order of $10^{13} n_{\mathrm{eq}}(1MeV)/cm^2$. To investigate the effects of the damage under realistic conditions an irradiation setup employing neutrons has been designed and produced. The main feature of the setup at the Tübingen Van-de-Graaf accelerator is the capability to deliver a relativly high neutron flux over an extended period of time (in the order of weeks), thus being closer to the actual irradiation scenario as compared to instantaneous irradiation at reactors.

The setup uses a cryogenic gas target and a 2.4 MeV deuteron beam to produce neutrons via D-D fusion. The irradiated sensor can be read out in place by two beetle chips to assess the possible degradation in performance due to radiation damage. Preliminary data from the irradiation campaign will be presented.

HK 61.6 Fr 15:30 HZO 90

TRB basierte Ausleseelektronik für SKIROC ASICs zur Tiefenprofilanalyse — •Lukas Werner[1], Christian Berner[1], Michael Böhmer[1], Roman Gernhäuser[1], Ralph Gilles[2], Bastian Märkisch[1], Zsolt Revay[2] und Markus Trunk[1] — [1]Technische Universität München, Physikdepartment, James-Franck-Str., Garching — [2]Heinz-Maier-Leibniz Zentrum, Garching

Bei der Neutronentiefenprofilmessung wird z.B die Li6(n,He4)H3 Reaktion verwendet, um die räumliche Verteilung von Lithium in einer Probe zu untersuchen. Dazu muss einerseits die Energie der Teilchen mit spektroskopischer Auflösung über einen weiten Bereich bestimmt werden, andererseits will man in ortsauflösenden Verfahren auch hochsegmentierte Detektoren bei höchsten Neutronenflüssen verwenden. Im neuen N4DP Messplatz am NL4B Strahlrohr des FRM2 wird gerade dieses neue Konzept der orts- und zeitaufgelöste Tiefenprofilanalyse realisiert.

Eine Kombination von Silizium-Microstrip-Detektoren (DSSDs) mit extrem dünnen Eintrittsfenstern und ASICs der SKIROC Familie (SKIROC-2A , SKIROC-CMS) ist dafür ideal geeignet. Für die komplexe Ansteuerung, Datenvorverarbeitung und Auslese dieser ASICs wurde ein FPGA basiertes Frontendboard für das TRB-System (GSI, Darmstadt) entwickelt. Wir zeigen hier das Konzept der Präzisonsmessung niederenergetischer Ionen mit DSSDs und dessen vielseitige Einsatzmöglichkeiten.

Supported by BMBF Nr. 05K16WO1