HK 2: Instrumentation 1

Time: Monday 14:30–16:15 Location: M/HS1

Group Report HK 2.1 Mon 14:30 M/HS1

The Micro Vertex Detector for the $\overline{\text{P}}$ANDA Experiment — •Simone Esch for the PANDA-Collaboration — Forschungszentrum Jülich

The $\overline{\text{P}}$ANDA detector is one of the main experiments at the upcoming Facility for Antiproton and Ion Research (FAIR), which is under construction in Darmstadt, Germany. The fixed-target experiment will explore $\bar{p}p$ annihilations with intense, phase space-cooled beams with momenta between 1.5 and 15 GeV/c. One aim of the detector is to perform high precision measurements of particles like excited charmonium and D mesons.

Essential for background suppression is the tagging of D mesons by measuring their decay point. Therefore, a Micro Vertex Detector (MVD) is planned at $\overline{\text{P}}$ANDA as the innermost tracking detector. The MVD aims to reconstruct vertices with a resolution better than 100 μm to cope with the decay length of the $D^{\pm}$ mesons ($c\tau$=315 μm) produced with a mean $\beta\gamma$=2. The detector consists of silicon pixel and double-sided silicon strip detectors, arranged in four barrel layers and six disk layers.

An overview of the MVD will be given in this talk. Recent developments like laboratory and testbeam results of the current pixel front-end ASIC prototype ToPix 4 will be shown. The concept of the newly developed strip front-end ASIC PASTA will be presented.

This work was supported by BMBF and HIC4FAIR

HK 2.2 Mon 15:00 M/HS1

An improved detector response simulation for the CBM Silicon Tracking System — •Hanna Malygina[1] and Volker Friese[2] for the CBM-Collaboration — [1]Goethe University Frankfurt, Germany — [2]GSI, Darmstadt

The Compressed Baryonic Matter experiment(CBM) at FAIR is designed to explore the QCD phase diagram in the region of high net-baryon densities. The central detector component the Silicon Tracking System (STS) is build from double-sided micro-strip sensors. To achieve realistic simulations the response of the silicon strip sensors should be precisely included in the digitizer which simulates a complete chain of physical processes caused by charged particles traversing the detector, from charge creation in silicon to a digital output signal. The new version of the STS digitizer comprises in addition non-uniform energy loss distributions (according to the Urban theory), thermal diffusion and charge redistribution over the read-out channels due to interstrip capacitances.

The improved response simulation was tested with parameters reproducing the anticipated running conditions of the CBM experiment. Two different method for cluster finding were used. The results for hit position residuals, cluster size distribution, as well as for some other parameters of reconstruction quality are presented. The achieved advance is assessed by a comparison with the previous, simpler version of the STS detector response simulation.

Supported by HIC for FAIR and HGS-HIRe.

HK 2.3 Mon 15:15 M/HS1

A custom made wafer probe for strip detector quality assurance of the CBM — •Iaroslav Panasenko for the CBM-Collaboration — Physikalisches Institut, Universität Tübingen — Institute for Nuclear Research, Kiev, Ukraine

The CBM experiment will investigate the properties of nuclear matter at extreme conditions created in ultrarelativistic heavy-ion collisions. Its key detector — the Silicon Tracking System (STS) — will reconstruct particle tracks with momentum resolution of ∼1% and charged particle multiplicity up to 600 within the detector aperture covering the polar angle between 2.5° and 25°. High track density as well as stringent requirements to the momentum resolution require system with high channel granularity and low meterial budget. The STS will be constructed of about 1300 double-sided silicon microstrip detectors with total area of $\sim 4\,\text{m}^2$ and have 2.1 million channels. The microstrip sensors with 58 μm pitch and $62\times62\,\text{mm}^2$ area will have pad size of $180\times60\,\mu\text{m}^2$.

Due to the large size, the CBM microstrip sensors are not well suited for the characterization at conventional probe stations. Therefore, a custom probe station is beeing developed at Tübingen University. One of the main requirements is a repeatability better than 1 μm to allow an automatic succesive positioning on all 1024 pads of a sensor. The construction of the probestation and first measurements will be presented.

HK 2.4 Mon 15:30 M/HS1

Radiation tolerance of microstrip sensors for the CBM Silicon Tracking System — Minni Singla[1], Pavel Larionov[2], •Ievgeniia Momot[2,3], Tomas Balog[1], Johann Heuser[1], Iurii Sorokin[1,3], and Christian Sturm[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität, Frankfurt — [3]KINR, Kyiv, Ukraine

The Silicon Tracking System (STS), the core detector of CBM experiment located in the dipole magnet, provides track reconstruction and momentum determination of charged particles originating from beam-target interactions. The STS will consist of eight planar tracking stations. A response of double-sided silicon micro-strip sensors to the hits by charged particles will be used for the track reconstruction. Radiation load expected in the CBM experiment may significantly influence this response. The development of radiation tolerant prototype STS microstrip sensors irradiated up to $2\text{x}10^{14}$ 1-MeV n_{eq}/cm^2 will be overviewed. Results of charge collection efficiency studies with the latest silicon sensor prototypes with double metallization or external interstrip cables for connecting strips at their edges will be presented.

Supported by HIC for FAIR and HGS-HIRe.

HK 2.5 Mon 15:45 M/HS1

Untersuchung von Silizium-Streifen-Detektoren mit einem automatischen Infrarot-Laser-Teststand* — •Benjamin Wohlfahrt, Kai-Thomas Brinkmann, Martin Kesselkaul, Tommaso Quali und Robert Schnell für die PANDA-Kollaboration — II. Physikalisches Institut, Justus-Liebig- Universität Gießen

Am zukünftigen Beschleunigerzentrum FAIR werden Reaktionen von Antiprotonen im HESR-Beschleunigerring mit Protonen eines stationären Targets (Wasserstoff und schwere Kerne) am $\overline{\text{P}}$ANDA-Experiment untersucht werden. Der Mikro-Vertex-Detektor wird als Teil des Trackingdetektors hoch auflösendes Tracking und das Erkennen sekundärer Vertizes ermöglichen.

Zur Charakterisierung und Qualitätskontrolle von doppelseitigen Silizium-Streifen-Detektoren für den $\overline{\text{P}}$ANDA MVD wurde ein Laserteststand entwickelt. Dieser beinhaltet einen in der xy-Ebene nm-verschiebbaren Laserkopf und eine FPGA-gestützte Auslese der APV-ausgelesenen Detektoren. Erste Anwendungsbeispiele dieses Symtems bei der Untersuchung von Streifensensoren werden diskutiert.

* Gefördert durch BMBF und HIC for FAIR.

HK 2.6 Mon 16:00 M/HS1

Development of optical quality assurance procedures for the sensors of Silicon Tracking System (STS) detector of the Compressed Baryonic Matter Experiment (CBM) at FAIR — •Evgeny Lavrik for the CBM-Collaboration — Eberhard-Karls Universität Tübingen, Tübingen, Deutschland

The CBM experiment aims to study the properties of nuclear matter at high net-baryon densities. The STS is the key detector to reconstruct charged particle tracks created in heavy-ion interactions. In order to assure the quality of about 1300 silicon sensors, highly efficient and highly automated procedures need to be developed.

In this contribution we report on a microscope camera based optical inspection system, used to scan along the individual sensors to recognize and classify sensor defects. Examples of these defects are: photo-resist residues, top metallization layer lithography defects, surface scratches. In order to separate and classify these defects various image-processing algorithms are used, including: pattern recognition, object classification, etc.