HK 9: Instrumentation

Zeit: Montag 11:00–12:45 Raum: HSZ-405

Gruppenbericht HK 9.1 Mo 11:00 HSZ-405

Prototyping the CBM Micro Vertex Detector — •Michal KOZIEL for the CBM-MVD-Collaboration — University of Frankfurt, Frankfurt am Main, Germany

For the reconstruction of Open Charm Hadrons with the CBM experiment a Micro Vertex Detector (MVD) with an excellent resolution of the secondary decay vertex ($< 70\ \mu$m along the beam axis) is required. To achieve this vertex resolution a material budget of a few 0.1% X0 is mandatory for the individual detector stations positioned downstream in close vicinity to the target. To further reduce the multiple scattering the MVD operates in vacuum.

The need of prototyping and characterizing the CBM-MVD motivated the construction of an advanced device - a beam telescope - giving the opportunity to exercise the following aspects: handling and integration of ultra-thin CMOS sensors on advanced materials like CVD diamond, double sided sensor assembly for ultra-precise tracking, cooling, scalable readout and slow control, development of data analysis framework and first steps towards implementation of tracking algorithms into a FPGA-based hardware.

This group report aims to summarize the activity towards fabrication of the CBM-MVD prototype.

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HK 9.2 Mo 11:30 HSZ-405

Recoil Detector Test for the Day-One Experiment at HESR — •Qiang Hu[1,2], Huagen Xu[2], and James Ritman[2] — [1]Institute of Modern Physics,CAS,730000 Lanzhou,China — [2]Forschungszentrum Juelich,52425 Juelich,Germany

The proposed day-one experiment at HESR is a dedicated measurement of antiproton-proton elastic scattering. The aim of the day-one experiment is to determine the elastic differential parameters (total cross section σ_T, the ratio of real to imaginary part of the forward scattering amplitude ρ, and the slope parameter B) by measuring a large range of 4-momentum transfer squared t (0.0008 - 0.1 GeV^2). The conceptual design of the day-one experiment is to measure the elastic scattered antiproton and recoil proton, by a tracking detector in the small polar angle range and by an energy detector near 90°, respectively. The recoil arm covers a maximum polar angle range from 71° to 90° and consists of two silicon strip detectors (76.8 (length)×50.0 (width)×1.0 (thickness) mm^3) and two germanium detectors (80.4 (length)×50.0 (width)×5.0 (11.0) (thickness) mm^3). All detectors are single sided structure with 1.2 mm pitch. The silicon detectors will be used to detect recoil protons with energy up to about 12 MeV and the germanium detectors will be used to detect protons with energy from 12 MeV to 60 MeV. At present, one recoil arm is being constructed and the test for the detectors with radioactive sources is on-going. Preliminary test results indicate that all detectors are operational and work properly. The latest test results of these detectors will be presented.

HK 9.3 Mo 11:45 HSZ-405

Quality Assurance of double-sided silicon strip sensors for Silicon Tracking System in the CBM experiment at FAIR — •Pavel Larionov and Pradeep Ghosh for the CBM-Collaboration — Goethe Universität, Frankfurt am Main

Silicon Tracking System (STS) is the central tracking detector of Compressed Baryonic Matter (CBM) experiment that aims to explore the QCD phase diagram in the region of high net baryonic densities and moderate temperatures.

STS consists of 8 tracking layers of double-sided silicon strip sensors with self-triggered read-out system. The challenge is to cope with high hit rates up to 10 MHz/cm^2, high tracking density, high radiation load up to $1{\times}10^{14}$ n$_{eq}$/cm^2 and high momentum resolution for the physics case. Hence, the Quality Assurance (QA) procedures become important in the process of building up modules and stations of these sensors. This presentation describes the various QA tests and procedures that need to be performed to identify the viability, performance and efficiency of these sensors for tracking system in CBM experiment.In particular QA in CBM-STS includes visual inspection, bulk and interstrip parameters measurements, sensor efficiency and total signal to noise ratio tests, measurements of irradiated sensors, bonding, low temperature performance and current stability tests. Results of various QA tests of sensor prototypes will be shown.

Supported by HIC for FAIR, HGS-HIRe and H-QM.

HK 9.4 Mo 12:00 HSZ-405

Development of radiation-hard double-sided silicon microstrip sensors for the CBM silicon tracking system — •Sudeep Chatterji for the CBM-Collaboration — GSI, Darmstadt

We give an overview of the prototypes microstrip sensors fabricated for the CBM Silicon Tracking System at CiS, Erfurt and Hamamatsu, Japan. The full-size sensors are double-sided with double metal and have strips oriented under a stereo angle of $\pm 7.5^0$. Also test structures were produced with orthogonal strips. The strip pitch is 58 μm. The radiation load in the detector is expected to not exceed $1{\times}10^{14}$ n$_{eq}$cm^{-2} in several years of operation, after which they would be replaced. The charge collection behaviour of the sensors has been studied in simulations using the TCAD Synopsys package. A design optimization has been worked out to reduce the Equivalent Noise Charge (ENC) and to maximize the breakdown voltage and Charge Collection Efficiency. Various isolation techniques have been explored and a detailed comparison has been studied to optimize the detector performance. An operating scenario for the CBM experimental run has been developed taking into account periods of shutdown, warm maintainance and cold maintainance. Transient simulations have been performed to estimate the charge collection performance of the irradiated detectors and simulations have been verified with experimental data. Supported by EU-FP7 HadronPhysics3 and BMBF.

HK 9.5 Mo 12:15 HSZ-405

Verbesserte ionisierende Strahlenhärte von CMOS Monolithic Active Pixel Sensors* — •Dennis Doering und Michael Deveaux für die CBM-MVD-Kollaboration — Goethe-Universität, Frankfurt

Die Strahlenhärte von monolithischen CMOS-Pixelsensoren (MAPS), wie sie im ILC, im Heavy-Flavour-Tracker von STAR, ITS-Upgrade von ALICE und Mikro-Vertex-Detektor von CBM verwendet werden sollen, ist im vergangenem Jahrzehnt stark verbessert worden. So konnte vor zwei Jahren unter Verwendung eines hochohmigen aktiven Volumens bereits die nichtionisierende Strahlenhärteanforderungen des CBM-Experimentes von $10^{13} n_{eq}/cm^2$ erfüllt werden. Die ionisierende Strahlenhärte von wenigen hundert krad blieb damit als limitierender Faktor offen. Denn pro Strahlendosis von $10^{13} n_{eq}/cm^2$ werden ebenfalls 1 $Mrad$ ionisierende Strahlenbelastung in den Experimenten erwartet. Vor kurzem jedoch wurde ein neuer Prozess verfügbar, der die Strukturgröße von 0.35 μm auf 0.18 μm verringert. Erwartet wird davon neben der Möglichkeit mehr Transistoren in ein Pixel zu integrieren vor allem auch eine verbesserte Strahlenhärte gegen ionisierende Strahlung.

Um dies zu überprüfen, sollen in diesem Beitrag die Ergebnisse der ersten in dem neuen 0.18 μm-Prozess hergestellten Prototypsensoren vorgestellt und ihre ionisierende Strahlenhärte bis zu einer Dosis von 3 $Mrad$ diskutiert werden.

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HK 9.6 Mo 12:30 HSZ-405

Integration of the CBM Silicon Tracking System — •Ulrich Frankenfeld — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Silicon Tracking System of the CBM experiment will be installed into the superconducting dipole magnet, sharing the confined space of about 2 m^3 with the target and the micro-vertex detector, operating in a separate vaccum vessel, and the beam pipe. The STS stations will be surrounded by a thermal enclosure to minimize radiation damage to the silicon sensors.

For the system integration task, a top-down approach has been chosen, starting from the physics requirements of the CBM experiment: interaction rates, radiation environment, tracking aperture and detector segmentation. A functional plan of the STS and its surrounding structural components is being worked out from which the STS system shape is derived and the power need, cooling, the connector and cable space requirements, live span of components, and installation/

repair aspects etc. are determined. The presentation will outline the technological options under study and progress made with the system integration of CBM's central detector.

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