HK 21: Instrumentation V

Zeit: Dienstag 14:00–15:45 Raum: S1/01 A2

Gruppenbericht HK 21.1 Di 14:00 S1/01 A2

The Micro Vertex Detector of the $\overline{\text{P}}$ANDA Experiment — •Tommaso Quagli — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, 35392 Gießen

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 its main task is the precise identification of primary and secondary vertices. The central requirements include high spatial and time resolution, triggerless readout with high rate capability, good radiation tolerance and low material budget. The detector is composed of four concentric barrels and six forward disks, instrumented with silicon hybrid pixel detectors and double-sided silicon microstrip detectors.

This talk will provide an overview of the design and the status of the MVD. Recent developments of prototypes of the hardware components for the pixel and strip parts, including the silicon sensors, the readout electronics and the mechanical and electrical infrastructure, will be presented along with the latest test results.

This work was supported by BMBF, HIC for FAIR, HGS-HIRe, JCHP and INFN.

HK 21.2 Di 14:30 S1/01 A2

Ein Röntgenspektrometer auf der Basis von hochspannungstauglichen CMOS-Sensoren mit hochdotiertem Dopiniggradienten im aktiven Medium* — •Dennis Doering für die CBM-MVD-Kollaboration — Goethe-Universität, Frankfurt

Eine Materialanalyse, welche feinste Konzentrationen von Verunreinigungen nachweisen kann, ist die Röntgenfluoreszenzanalyse. Gesucht wird hierfür eine passende Detektortechnologie. Hierzu schlagen wir CMOS-Sensoren vor, wie sie am IPHC Straßburg für Anwendungen in der Schwerionen- und Teilchenphysik entwickelt werden. CMOS-Sensoren zeichnen sich durch ihr geringes Rauschen aus, wodurch sie besonders geeignet sind, Röntgenstrahlung mit einer Energie von wenigen keV nachzuweisen. Weiterhin zeichnen sie sich durch ihre hohe Granularität als ratenfest aus, können unabhängig von aufwändiger (Kühl)-Infrastruktur betrieben werden sowie auch in kommerziellen CMOS-Fertigungsstraßen kostengünstig hergestellt werden.
Wir zeigen in diesem Beitrag, wie aus der Signalantwort eines konventionellen CMOS-Sensors eine Energieinformation mit guter Präzision extrahiert werden kann. Weiterhin demonstrieren wir, wie der Nachteil der geringen Quanteneffizienz durch die seit kurzem verfügbaren, hochspannungstauglichen CMOS-Sensoren mit hochdotiertem Dopiniggradienten im aktiven Medium verbessert werden kann.
Eine mögliche Anwendung kann schließlich die Echtzeitüberwachung auf Spurenverunreinigungen im Trinkwasser mittels Röntgenfluoreszenzanalyse sein.
*gefördert durch das BMBF (05P12RFFC7), HIC for FAIR und GSI.

HK 21.3 Di 14:45 S1/01 A2

Status of the radiation hardness of CMOS Monolithic Active Pixels Sensors for the CBM experiment* — •Benjamin Linnik for the CBM-MVD-Collaboration — Goethe-Universität, Frankfurt

The Compressed Baryonic Matter Experiment (CBM) is one of the core experiments of the future FAIR facility. It will explore the phase diagram of strongly interacting matter in the regime of high net baryon densities with numerous probes, among them open charm. Therefore, a dedicated vertex detector is required which will be equipped with CMOS Monolithic Active Pixels Sensors (MAPS). A joined research activity of the Goethe University Frankfurt and the IPHC Strasbourg explores strategies to match the radiation hardness of these sensors with the requirements.
In the past, it could be shown that combining an improved high resistivity ($1-8$ kΩcm) sensitive medium with the features of a 0.18 μm CMOS process can improve the radiation hardness of the sensors. In 2015, it was tried to further improve the radiation hardness by applying a external depletion voltage. Two prototype sensors were studied. Furthermore, the first full-integrated 0.18 μm CMOS-sensor FSBB was tested in beam and laboratory. We will show first results from irradiated samples at low operation temperatures.
*supported by BMBF (05P12RFFC7), HGS-HIRe, HIC for FAIR und GSI.

HK 21.4 Di 15:00 S1/01 A2

Radiation tolerance of microstrip sensors for the CBM Silicon Tracking System — •Ievgeniia Momot[1,3], Hanna Malygina[1,3], and Johann Heuser[2] for the CBM-Collaboration — [1]Goethe-Universität, Frankfurt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [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 response of double-sided silicon micro-strip sensors to hits by charged particles will be used for the track reconstruction. The radiation load of the CBM experiment is expected to be 10^{14} 1-MeV n_{eq}/cm^2, which may have significant influence on the detector response. The development of radiation tolerant prototype STS microstrip sensors irradiated up to 10^{14} 1-MeV n_{eq}/cm^2 will be reviewed. Results on charge collection efficiency studies with the latest silicon sensor prototypes with double metallization or external inter-strip cables for connecting strips will be presented.
Supported by HIC for FAIR and HGS-HIRe.

HK 21.5 Di 15:15 S1/01 A2

High Voltage Active Pixel Sensors for the PANDA Luminosity Detector — •T. Weber, F. Feldbauer, P. Jasinski, A. Karavdina, R. Klasen, H. Leithoff, S. Maldaner, C. Motzko, S. Pflüger, and M. Fritsch — Institut für Kernpysik und Helmholtz Institut Mainz

The PANDA-Experiment will be part of the new FAIR accelerator center at Darmstadt, Germany. It is a fixed target experiment using a antiproton beam with very high resolution for precision measurements in the field of hadron spectroscopy. For a variety of measurements like energy-scans the precise determination of the luminosity is needed.

The luminosity detector will determine the luminosity by measuring the angular distribution of elastically scattered antiprotons very close to the beam axis (3-8 mrad). To reconstruct antiproton tracks four layers of silicon monolithic active pixel sensors (HV-MAPS) will be used. Those sensors are currently under development by the Mu3e-collaboration in Heidelberg.

In the talk the concept of the luminosity measurement is shortly introduced before results of laboratory and beam time measurements with a tracking station consisting of HV-MAPS prototypes are presented.

HK 21.6 Di 15:30 S1/01 A2

Measurements of Proton-Proton Elastic Scattering by the KOALA Experiment at COSY — •Qiang Hu[1,2], James Ritman[2], and Huagen Xu[2] — [1]Institute of Modern Physics, CAS, 730000 Lanzhou, China — [2]IKP and JARA-FAME, Forschungszentrum Juelich, 52425 Juelich, Germany

The KOALA experiment is being built to measure the differential cross section spectrum for antiproton-proton elastic scattering in the squared 4-momentum transfer region ($|t| \sim [0.0008, 0.1]$ $(GeV/c)^2$) at HESR. That data is an essential input to enable the $\overline{\text{P}}$ANDA luminosity determination to obtain the desired absolute precision of 3%. The complete KOALA experiment setup will be composed of one forward arm to measure the scattered projectile and two recoil arms to measure the recoil target. In a first step, one recoil detector has been constructed and commissioned at COSY by measuring proton-proton elastic scattering at 2.5, 2.8 and 3.2 GeV/c. The differential cross-section spectrum as a function of t has been reconstructed at each beam momentum after background subtraction and efficiency correction. The resulting spectra are parameterized in terms of the total cross section σ_t, the ratio of the real to imaginary part of the forward amplitude ρ and the nuclear slope b. These parameters, as well as the normalization coefficient have been extracted by analyzing the characteristic shape of the t spectra with the parameterized expression and the optical theorem. The relative differential cross sections have been obtained after normalization. The methods and the final differential cross section spectra will be presented in this talk.