HK 40: Accelerators and Instrumentation I

Time: Tuesday 16:30–19:00 Location: H-ZO 80

Group Report HK 40.1 Tu 16:30 H-ZO 80

The Micro-Vertex-Detector of the PANDA-Experiment — •Tobias Stockmanns for the PANDA-Collaboration — Institut für Kernphysik I, Forschungszentrum Jülich GmbH, Germany

The Micro-Vertex-Detector (MVD) is the key component of the PANDA experiment to identify open charm and strangeness by detecting secondary decays of particles displaced from the primary interaction point. These decay lengths vary from a few 100 *m for charmed mesons and baryons up to several cm for strange hadrons. In addition, the MVD significantly improves the momentum resolution of the large volume central tracker. To achieve the required resolution and to be operational in a harsh radiation environment the MVD is made of position sensitive silicon pixel and strip detectors, which are arranged in four barrel layers and six disk layers around the interaction point of the anti-proton beam and the target material. The total size of the MVD is 40 cm in length and 30 cm in diameter. With more than 10 million readout channels, a continuous untriggered readout and the highest requirements for spatial resolution and material budget within PANDA, the MVD faces many technological challenges. The presentation includes all technical aspects necessary to construct such a complex detector, starting from the physical requirements, the necessary simulation steps up to the first prototypes of subcomponents. This work is supported in part by BMBF, EU, FZ-Jülich

HK 40.2 Tu 17:00 H-ZO 80

A custom pixel detector for the PANDA experiment — •Daniela Calvo[1], Paolo De Remigis[1], Thanushan Kugathasan[1,2], Simonetta Marcello[1,2], Giovanni Mazza[1], Angelo Rivetti[1], and Richard Wheadon[1] — [1]INFN - Sezione di Torino, P. Giuria 1, 10100 Torino, Italy — [2]Universita' di Fisica, P. Giuria 1, 10100 Torino, Italy.

For the PANDA Collaboration

In the PANDA experiment, foreseen at the future FAIR facility at GSI, the Micro Vertex Detector (MVD), with a design involving both pixel and microstrip silicon sensors, is envisaged for the detection of secondary vertices from the decay of charmed mesons as well as those from kaons and hyperons.

The primary task of the MVD is the detection of charged particle hits with a resolution that yields an overall spatial accuracy better than the characteristic decay lengths of the involved particles, as D mesons. The MVD must also provide energy loss information to aid particle identification. The wide momentum spectra of the particles, which starts at only a few hundred of MeV/c put strong limits on the material budget and also the radiation hardness is an important issue. Besides the triggerless design asks for particular architecure design for the detector electronics. Therefore, custom solution of the pixel detector for both sensor and front-end chip based on the 130nm CMOS technology is underway.

Results concerning study and characterization of epitaxial silicon sensors and chips using time-over-threshold (TOT) approach will be presented.

HK 40.3 Tu 17:15 H-ZO 80

Design Optimisation for the Silicon Micro-Strip Part of the PANDA Micro-Vertex-Detector * — •Thomas Würschig, Ralf Kliemt, René Jäkel, and Kai-Thomas Brinkmann for the PANDA-Collaboration — Rheinische Friedrich-Wilhelms-Universität Bonn, HISKP, Nussallee 14-16, D-53115 Bonn, and Technische Universität Dresden, IKTP, Zellescher Weg 19, D-01069 Dresden (both Germany)

The PANDA experiment is one of the key projects at the future FAIR facility, which is under construction at GSI, Darmstadt. The Micro-Vertex-Detector (MVD) is the innermost detector part of the experiment. Silicon sensors are used for high precision tracking. The outer detector layers are equipped with double-sided silicon strip detectors. An optimisation has been accomplished for the layout of the MVD starting with the extraction of design parameters to qualify the physics performance of the detector. A clear definition of the requirements for the frontend electronics, and a precise description of the detector modules, the cooling system and the support structure are necessary to obtain realistic values concerning the material budget, the thermal load and space requirements. Altogether, this data can be taken as input for physics and engineering simulations. In parallel, prototypes for the detector modules and support structures are under development allowing the measurement of key parameters and the demonstration of the technical feasibility for the proposed concept. In consequence, the optimization process to be illustrated for the silicon micro-strip part of the MVD is based on both simulation results and experimental data. (* Supported by BMBF and EU.)

HK 40.4 Tu 17:30 H-ZO 80

Design of a test station for silicon strip sensors for PANDA* — •Felix Krüger, Kai-Thomas Brinkmann, Hans-Georg Zaunick, Robert Schnell, and Lars Ackermann — Universität Bonn, HISKP, Nussallee 14-16 and TU Dresden, IKTP, Zellescher Weg 19

At PANDA, which is being planned at the international accelerator facility FAIR in Darmstadt, silicon strip sensors will play an important role for the micro vertex detektor (MVD). The design of the micro-strip sensor modules is a process of hardware and software development, which is combined with simulation studies to compare the results. Therefore a test station was set up and first module prototypes have been constructed and tested. Data from sensor modules with single and double sided readout are available to make first hit recognition and tracking analysis. Database structures have been developed to collect sensor and frontend characteristics for assembled sensor modules. (*Supported by BMBF and EU.)

HK 40.5 Tu 17:45 H-ZO 80

SiΛViO - Ein Trigger für Λ-Hyperonen — •Robert Muenzer, Martin Berger, Laura Fabbietti und Olaf Hartmann für die FOPI-Kollaboration — Technische Universität München

In einem dedizierten Experiment mit dem FOPI-Spektrometer am SIS-Beschleuniger der GSI soll die Produktion von gebundenen Kaon-Nukleon Zuständen (Kaonischen Clustern) (siehe [1]) in der Reaktion p+p → $[ppK^-] + K^+$ untersucht werden. Dabei wird nach dem Zerfall der Cluster in Λ p gesucht.

Zur Selektion solcher Endzustände wurde das Detektorsystem SiΛViO (Silicon for Λ-Vertexing and Identification Online) als Trigger für Λ-Hyperonen gebaut. Dieses System besteht aus zwei Ebenen Silizium-Streifendetektoren auf welchen die Teilchenmultiplizität online gemessen wird. Die erste Ebene ist dicht hinter dem Target angebracht. Die Zweite befindet sich 9,5cm hinter dieser, so dass möglichst viele Λ-Hyperonen ($c\tau = 7.89cm$) zwischen beiden Ebenen zerfallen. Durch Multiplizitätsvergleich der beiden Ebenen wird ein Triggersignal erzeugt.

Der Vortrag beschäftigt sich mit dem Aufbau des Detektorsystems und der Diskussion der in verschiedenen Testexperimenten gesammelten Ergebnissen.

Diese Arbeit wird durch die HGF und dem Excellence Cluster of Universe unterstützt.

[1]Y.Akaishi und T.Yamazaki, PR C 76, 045201 (2007)

HK 40.6 Tu 18:00 H-ZO 80

The HERMES Recoil Detector — •Inti Lehmann for the HERMES-Collaboration — University of Glasgow, Glasgow, Scotland/UK

It was recently suggested that Generalised Parton Distributions (GPDs) have the potential to extend our description of the nucleon structure beyond standard parton distributions. The Recoil Detector at the HERMES experiment at DESY, Hamburg has been installed to improve the capability to study hard exclusive processes in a kinematic region relevant to GPDs at HERMES.

I will detail the experimental set up consisting of three detector systems housed inside a solenoidal field of 1 T: two layers of silicon strip detectors inside the ring vacuum, two barrels of scintillating fibre detectors, and a photon detector. In addition, I will give an update on the detector performance and conclude with physics topics currently under study.

HK 40.7 Tu 18:15 H-ZO 80

The silicon tracking system of the CBM experiment at FAIR: Detector development and first in-beam applications. — •Anton Lymanets for the CBM-Collaboration — FIAS, University of Frankfurt

The CBM experiment will explore the QCD phase diagram at high net baryon densities and moderate temperatures. Its key component - the silicon tracking system STS - will reconstruct the trajectories of all charged particles created in collisions of heavy ions with a nuclear target, at typical beam energies of 25 GeV/nucleon. The central requirements of the STS are a particularly low-mass construction, imposed by the necessary momentum resolution of about 1%, as well as radiation hard sensors and a fast readout matching the high interaction rates of up to 10 MHz.

First silicon microstrip detectors have been developed that are compatible with a thin modular structure of the STS tracking stations. The characterization of the detectors in the laboratory and in-beam tests will be described. A demonstrator tracking station comprising a double-sided silicon detector prototype with 2×256 orthogonal strips of 50 μm pitch has been integrated into the beam tracker of the SVD-2 experiment at IHEP, Protvino, Russia. It was tested in a 50 GeV proton beam, yielding performance parameters as detector efficiencies, spatial resolution, cluster sizes and signal-to-noise ratios.

* Supported by EU-FP6 HadronPhysics

HK 40.8 Tu 18:30 H-ZO 80

Concept and simulation of the CBM-Micro Vertex Detector* — •Christina Dritsa for the CBM-Collaboration — GSI, Darmstadt, Germany — IKF, Frankfurt, Germany — IPHC, Strasbourg, France

The future CBM (Compressed Baryonic Matter) experiment aims to explore the properties of nuclear matter at high net baryonic densities. It will measure rare and penetrating probes such as open charm, which is produced close to the production threshold. The identification of open charmed particles is done by separating their displaced decay vertices from the event vertex. This approach calls for a performant micro vertex detector (MVD), which will consist of several layers of pixel sensors. Monolithic Active Pixel Sensors (MAPS) are currently considered to be the most promising sensor technology for the MVD as they provide an excellent single point resolution together with low material budget and appropriate radiation hardness and time resolution.

We will discuss the concept of the MVD. Hereafter, we will introduce the simulation tools used for the detector simulation. A focus will be laid on the digitizer for the MAPS. The simulated response of the MAPS will be compared with data obtained from beam tests at the CERN-SPS. *Supported by BMBF(06FY1731)

HK 40.9 Tu 18:45 H-ZO 80

Der COMPASS Recoildetektor 2008 — •Johannes Bernhard für die COMPASS-Kollaboration — Institut für Kernphysik, Johann-Joachim-Becher-Weg 45, 55099 Mainz

Ein Schwerpunkt des COMPASS-Experiments am CERN ist die Untersuchung des Spektrums von leichten Mesonen. Dazu wurden 2008 Daten mit einem 190GeV/c Hadronstrahl an einem $l\mathrm{H}_2$-Target genommen. Der COMPASS Recoildetektor (RPD) selektiert als Element des Triggersystems langsame Rückstoßprotonen aus dem Target, die eine klare Signatur für diffraktive Streuung und zentrale Produktion sind. Im Vortrag soll auf die Rolle des RPD im Trigger sowie auf die Performance als Flugzeitdetektor eingegangen werden. Dazu sollen Kalibrationsmethoden und Analyse von elastischen und diffraktiven Prozessen diskutiert werden.