HK 18: Instrumentation VI

Time: Wednesday 16:30–18:30 Location: H2

Group Report HK 18.1 Wed 16:30 H2

High-D: F&E für hochsegmentierte mehrdimensionale Detektoren für zukünftige Experimente — •Silvia Masciocchi für die High-D-Kollaboration — Universität Heidelberg und GSI

Zukünftige Experimente für Higgs-Präzisionsmessungen, die Suche nach Physik über das Standardmodell hinaus, sowie für die Untersuchung des Quark-Gluon-Plasmas und die Erforschung des QCD-Phasendiagramms, verlangen eine neue Generation von Hochpräzisionsdetektoren mit beispielloser räumlicher, zeitlicher und energetischer Auflösung. Die Anforderungen an solche 5-dimensionale (5D) Messungen können nur durch die Kombination von Detektoren mit extremer Granularität und neuartigen Rekonstruktionsmethoden erreicht werden. Eine höhere Segmentierung wird durch neu zu entwickelnde mikroelektronische Technologien, Halbleiterdesigns, Segmentierungskonzepte und Ausleseelektronik möglich werden. Diese Forschung auf der Detektorseite muß von neuartigen Algorithmen begleitet werden, die die bereitgestellte 5D-Information effektiv nutzt. Sie geht darin weit über einen einzelnen Detektor hinaus, indem sich alle Komponenten von einem Detektorsystem ergänzen, um eine optimale Rekonstruktionspräzision zu gewährleisten. High-D ist ein neuer vom BMBF geförderter Verbund, in dem die Gemeinschaften der Elementarteilchen-, Kern- und Hadronenphysik erstmalig miteinander gemeinsam an der Entwicklung verschiedener grundlegender Technologien zu solchen 5D-Detektoren zusammenarbeiten. Der Vortrag gibt einen Überblick über die geplanten Arbeiten und Projekte.

HK 18.2 Wed 17:00 H2

In-beam characterisation of bent ALPIDE MAPS in view of the ALICE Inner Tracking System 3 — •Pascal Becht for the ALICE-Collaboration — Physikalisches Institut Heidelberg University, Germany

The ALICE Inner Tracking System (ITS) has been recently upgraded to a full silicon detector based on Monolithic Active Pixel Sensors (MAPS). Prospectively, ALICE intends to replace the three innermost layers of this new ITS with a novel vertex detector. The proposed design features wafer-scale, ultra-thin, truly cylindrical MAPS. The new sensors will be thinned down to 20–40 μm, leading to an unprecedented low material budget of below 0.05 % X_0 per layer and will be arranged around the beam pipe, as close as 18 mm from the interaction point.

An extensive R&D programme is established with active participation in the BMBF funded High-D consortium for future particle detector development efforts. Investigating the feasibility of curved MAPS, already existing 50 μm-thick ALPIDE sensors were successfully bent, even below the targeted innermost radius. Their particle detection performance was assessed using electron test beams at DESY. First results from the testbeam data analysis for curved ALPIDE sensors will be presented and show that the current ALPIDE technology (180 nm) retains its properties after bending. The results show an inefficiency that is generally below 10^{-4}, independent of the beam inclination with respect to the sensor surface. This outcome proves curved MAPS to be an exciting possibility for future silicon detector designs.

HK 18.3 Wed 17:15 H2

Developement of a cooling system for the PANDA Barrel - EMC * — •Thorsten Erlen for the PANDA-Collaboration — II. Physikalisches Institut, JLU Gießen, Deutschland and for the PANDA Collaboration

The Electromagnetic Calorimeter (EMC) of the future PANDA-Experiment at the FAIR complex in Darmstadt will use lead tungsten scintillator crystals (PWO II). In its barrel part two Large Area Avalanche Photo Diodes (LAAPD) per crystal will be used to measure the amount of scintillation light created. Main characteristics of both the scintillator and the photosensors are temperature dependent. With decreasing temperature the light yield (photons per MeV) of the scintillators increases and the noise of the photosensors is reduced, while their gain-factor at a fixed voltage increases. The nominal operating temperature for the EMC is -25 °C to meet the desired properties and allow the EMC to perform according to the needs of the experiment. Energy resolution and threshold depend on a system that is capable of achieving and maintaining stable crystal and photosensor temperatures. Topic of this talk will be the ongoing developement of the cooling and monitoring system for the barrel part of the calorimeter. Methods in CAD design and simulation as well as design solutions will be presented in detail.

*gefördert durch das BMBF, GSI und HFHF.

HK 18.4 Wed 17:30 H2

FAIR Phase-0 Readiness of the PANDA Backward Calorimeter — Luigi Capozza[1], Alaa Dbeyssi[1], Alexander Greiner[1], Samet Katilmis[1], Dong Liu[1], Frank Maas[1,2,3], Julian Moik[1], •Oliver Noll[1], Peter Otte[1], David Rodriguez Pineiro[1], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg University, Mainz, Germany — [3]Prisma Cluster of Excellence, Mainz, Germany

The $\bar{\text{P}}$ANDA FAIR Phase-0 experiment at the Mainz Microtron Facility (MAMI) is set to determine the double-virtual transition formfactor (TFF) of the pion. As a consequence, the uncertainty in the hadronic light-by-light (HLbL) calculation for the anomalous magnetic moment of the muon can be reduced. The detector system for the experiment is a modified version of the $\bar{\text{P}}$ANDA backward calorimeter, which was developed by the group at HI-Mainz. In contrast to the $\bar{\text{P}}$ANDA experiment, the detector will operate in forward direction at a fixed target electron scattering experiment. Thus, new challenges arise for the radiation load of the components and the handling of high rates with the data acquisition. The talk addresses the major hardware, electronics, and data acquisition modifications to the $\bar{\text{P}}$ANDA backward calorimeter to achieve Phase-0 readiness.

HK 18.5 Wed 17:45 H2

Calibration of Pt100-temperature sensors in an electromagnetic calorimeter — •Samet Katilmis[1], Frank Maas[1,2,3], Alexander Greiner[1], Julian Moik[1], Oliver Noll[1], David Rodriguez Pineiro[1], Sahra Wolff[1], Luigi Capozza[1], Alaa Dbeyssi[1], Peter-Bernd Otte[1], and Dong Liu[1] for the PANDA-Collaboration — [1]HI-Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

The PANDA Backward Endcap Calorimeter (BWEC) consists of tightly packed PbWO scintillators with a highly temperature dependent light yield (LY). The LY increases by 3% per °C with decreasing temperature to a value of 500 photons per MeV at -25°C and thus has to be monitored to avoid a deterioration of the energy resolution. The flat sensors consist of a thin Platinum wire covered by two kapton sheets. They fit between the tight structure of the scintillator matrix of the calorimeter because of their low thickness. The resistance of the platinum wire changes with its temperature and can be measured with the method of "four terminal sensing" which allows the use of long cable lengths. All the flat sensors show a different characteristic resistance-temperature relation and must be calibrated. The flat sensors are calibrated inside subunits (submodules) of the calorimeter (in-situ calibration) with the help of multiple reference temperature sensors and a climate chamber which approaches different temperature plateaus. At the temperature plateaus, calibration points are taken to calibrate the flat sensors with an accuracy of 0.14 °C .

HK 18.6 Wed 18:00 H2

A new calibration system for 180° electron scattering experiments — •Maximilian Spall, Maxim Singer, Johann Isaak, Jonny Birkhan, Peter von Neumann-Cosel, and Norbert Pietralla — Institut für Kernphysik, Technische Universität Darmstadt

An electron scattering experiment at 180° is an excellent tool to investigate magnetic excitations of nuclei, due to the minimum of the longitudinal differential cross section at this angle. The 180° electron scattering system at the QCLAM spectrometer [1] is presently upgraded. A new system for the calibration of the scattering angles has been designed and is currently under construction, since precise knowledge of the horizontal and vertical scattering angles is necessary to reconstruct the experimental scattering angle. With the help of the new calibration system, it is possible to measure the transport matrix for the whole magnetic system, including the QCLAM spectrometer, without the need to change to a normal configuration as described in [1]. In this talk the new calibration system will be presented.

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[1] C. Lüttge et al., Large-aperture system for high-resolution 180° electron scattering. Nuclear Inst. and Methods in Physics Research, A. 366, 325-331 (1995).

HK 18.7 Wed 18:15 H2

Design of a cryopump for PANDA at FAIR — •Christian Mannweiler, Benjamin Hetz, Daniel Bonaventura, Jeremy Runge, Philipp Brand, Sophia Vestrick, and Alfons Khoukaz for the PANDA-Collaboration — Westfälische Wilhelms Universität, Münster, Deutschland

The PANDA experiment at the future HESR accelerator at FAIR will explore open questions about the strong interaction, the existence of exotic particles as well as other topics by utilising anti-proton-proton collisions. For these studies, optimal vacuum conditions are crucial for event reconstruction, background suppression as well as for antiproton beam lifetime.

To this end, a custom designed cryopump is in development for the antiproton beam line of the PANDA experiment. In a cryopump, activated charcoal is cooled down to cryogenic temperatures of well below 20K. At these temperatures, even hydrogen molecules are adsorbed, creating a highly efficient pumping mechanism.

Several different cryopump geometries were studied with respect to their impact on the vacuum situation at PANDA and the attainable minimum temperatures using the software packages MOLFLOW+ and Autodesk CFD, respectively. Additionally, experimental studies were performed with regard to the capacity and pumping speed of such a cryopump. The results obtained through these studies will be presented and discussed.

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