HK 39: Instrumentation IX

Time: Wednesday 15:45–17:15 Location: HBR 19: C 1

Group Report HK 39.1 Wed 15:45 HBR 19: C 1

Advancements and application of Monolithic Active Pixel Sensors (MAPS) for future tracking detectors using the example of the ALICE ITS3 — •Pascal Becht for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

This talk provides an insight in cutting-edge developments of Monolithic Active Pixel Sensors (MAPS) and the potential for their application in future tracking detectors. Offering mechanical flexibility and a low power consumption in combination with a high detection efficiency and good position resolution, these CMOS pixel sensors pave the way for novel detector concepts. A prominent example is the planned truly cylindrical, bent-silicon tracker (ITS3) for the ALICE experiment in LHC Run 4. Featuring wafer-scale, stitched sensors, the ITS3 pushes the limits in terms of detection performance while dramatically reducing the material budget.

Starting from the basic detector concepts, via the characterisation of small-scale pixel sensor prototypes produced in 65 nm CMOS technology node, to first results of large-area (1.4 cm x 26 cm) stitched sensors, milestones of the ITS3 development are presented. Here, the focus will be on the radiation hardness and the power consumption of the prototypes as well as in-beam characterisation of wafer-scale sensors. Furthermore, a perspective for MAPS being used for material budget imaging or the measurement of the proton interaction cross section is given.

HK 39.2 Wed 16:15 HBR 19: C 1

An Improved Integration and Reparation Technique for the CBM MVD* — •Franz Matejcek for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD) of the Compressed Baryonic Matter Experiment (CBM) will consist of four planar stations, each built of four independent quadrants, that will be equipped with dedicated CMOS pixel sensors (MIMOSIS) and will operate in vacuum. Each detector plane will feature a material budget x/X_0 ranging between 0.3 and 0.5 %. The sensors will be glued onto 380 μm thick TPG (Thermal Pyrolytic Graphite) carriers that provide the necessary mechanical stiffness and a high thermal conductivity in the geometrical acceptance to cool the sensors below 0 °C. The sensor will then be wire-bonded to dedicated flex cables connecting the front end electronics which will be mounted on a heat sink sitting outside the acceptance. The integration is mechanically challenging as the sensors have to be glued and bonded on both sides of the carrier to maximize the acceptance.

This contribution will present an improved integration technique that is based on laser-hatched pockets in the carrier rather than dedicated jigs. The hatches allow for a simple placement of the thinned sensors with very high precision and great alignment of front- and back-side using laser-cut fiducial marks. Using the same technique even allows to rework single sensors on modules to significantly improve on the integration yield.

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HK 39.3 Wed 16:30 HBR 19: C 1

Characterizing Cluster Behavior and Alignment Strategies in Cylindrical MAPS Detectors for ALICE at the LHC — •Berkin Ulukutlu — Technische Universität München, Munich, Germany

The ALICE experiment at CERN is upgrading its Inner Tracking System (ITS) to ITS3, replacing tracking layers with wafer-scale, cylindrically bent MAPS chips. This innovation significantly reduces material, enhancing vertexing resolution. Extensive R&D addresses challenges with this unique geometry. The ITS3, a miniature telescope with five bent ALPIDE chips, underwent testing at the Bronowice Cyclotron Center. This experiment assessed bent detectors with 80, 120, and 200 MeV protons, investigating cluster size response from highly ionizing particles. Alignment strategies, including novel machine learning approaches, were extensively investigated. The aligned detector achieved a vertexing resolution near 50 micrometers, nearing the lower limit due to scattering effects. The research was funded by the DFG Sachmittel FA 898/5-1

HK 39.4 Wed 16:45 HBR 19: C 1

Cooling studies for the Outer Barrel of ALICE3 — •Laszlo Varga for the ALICE Germany-Collaboration — Technische Universität München, Munich, Germany

In the upcoming ALICE3 experiment a completely new large area tracker fully based on MAPS technology will be installed. The largest area will be covered by the Outer Tracker (OT) which consists of four large barrels around mid rapidity and discs in forward and backward direction. The barrel part will be built from a stave structure approximating a cylindrical geometry. The layout of these staves and especially the cooling of 33 square meters of active surface will have a strong influence on the total design of the device. In this contribution, possible cooling methods for the OT barrel layers will be discussed. Large scale simulations have been carried out using the COMSOL Multiphysics finite element tool. We will discuss different concepts which have to balance strict constraints in temperature, material budget and complexity of the integration.

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HK 39.5 Wed 17:00 HBR 19: C 1

Development of a Dummy Chip for the ALICE 3 Outer Tracker — •Lars Döpper[1,2], Malte Grönbeck[1,2], Philip Hauer[1,2], and Bernhard Ketzer[1,2] for the ALICE Germany-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn

The ALICE Collaboration currently plans a complete overhaul of the whole experiment for LS4 called ALICE 3. In this new setup tracking of charged particles will be done by a full pixel detector based on 65 nm MAPS technology.

The unprecedented estimated active area of around 60m^2 calls for new production approaches in collaboration with partners from industry, as it is not feasible to test and produce the necessary amounts of sensors in the involved institutes alone. In order to test different gluing and bonding processes and also evaluate various cooling approaches we plan to design and produce a simple dummy chip at Bonn. This chip has the same dimensions as the final sensor chip and is able to generate a realistic heat profile, which can be used to test the effectiveness of various cooling solutions.

In this talk, we will present design considerations for the dummy chip, their implementation, and discuss the production at the FTD. In addition, we will report on our plans for industrialization of module production.