HK 24: Instrumentation VII

Time: Wednesday 14:00–15:30 Location: SCH/A251

Group Report HK 24.1 Wed 14:00 SCH/A251

Advances in CMOS MAPS for the next generation of collider detectors — •Bogdan-Mihail Blidaru for the ALICE Germany-Collaboration — Heidelberg University, Germany

CMOS Monolithic Active Pixel Sensors (MAPS) are continuously proven to comply with the severe constraints set by present and future collider detectors which require high granularity, low mass, excellent spatial resolution, as well as moderate radiation hardness and timing. Moreover, their ease of integration and cost effectiveness for large areas makes them alluring for almost all particle detection applications.

The first large scale MAPS-based silicon tracker is the new 10 m^2 ALICE Inner Tracking System (ITS2). Results from its first in-beam operation at the LHC confirm the excellent performance of the single ALPIDE MAPS chips that span its surface.

To profit from the advances in the field of CMOS technology, the ITS collaboration is pioneering the usage of bent, wafer-scale pixel sensors for the replacement of the innermost tracking layers of ITS2 in the next upgrades. This roadmap is accompanied by a change in the technology node from 180 nm (ALPIDE) to 65 nm which allows the stitching of sensors and paves the path to an almost massless detector.

This contribution will give an overview of some of the ongoing developments in the field of CMOS MAPS, specifically the research done in the context of the ALICE collaboration for its future upgrades. Performance of bent sensors, 65 nm test structures and progress towards wafer-scale sensors, as well as the motivation of building such devices from a physics and detector performance point of view will be reviewed.

HK 24.2 Wed 14:30 SCH/A251

Towards the Pre-Production Module of the Largest Station of the CBM MVD — •Franz Alexej Matejcek for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD) of the Compressed Baryonic Matter Experiment (CBM) consists of four planar stations, each built of four independent quadrants (modules), that are equipped with dedicated CMOS pixel sensors (MIMOSIS) and will operate in vacuum. Each detector plane features a material budget x/X_0 ranging between 0.3 and 0.5 %, depending on size. The sensors are 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 well below 0 °C. The sensor are then wire-bonded to dedicated flex cables connecting the front end electronics which are 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 focus on integration aspects of the pre-production module of the largest quadrants.

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HK 24.3 Wed 14:45 SCH/A251

Performance of the MIMOSIS-1 CMOS Monolithic Active Pixel Sensor — •Hasan Darwish for the CBM-MVD-Collaboration — Goethe University Frankfurt, Frankfurt, Germany

MIMOSIS is a CMOS Monolithic Active Pixel Sensor designed to be used for the Micro Vertex Detector (MVD) of the future CBM experiment at FAIR in Darmstadt. The 50 μm thin sensor featuring 1024×504 pixels with a pitch of 27×30 μm^2 will combine a spatial resolution of ~ 5 μm with a time resolution of 5 μs and provide a peak rate capability of 80 MHz/cm^2. The first full size prototype, MIMOSIS-1, was tested with beams at CERN, DESY, COSY and GSI. Sensor performance including detection efficiency, spatial resolution and fake hit rate was tested for 12 different combinations of pixel micro-circuits and sensing elements. Moreover, the sensor tolerance to radiation doses of up to 5 MRad and $3 \times 10^{14} n_{eq}/cm^2$ was evaluated. The design and technology of the sensor is introduced and results from the beam tests are shown.

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HK 24.4 Wed 15:00 SCH/A251

Beam test studies of bent MAPS for ALICE ITS3 — •Lukas Lautner for the ALICE Germany-Collaboration — Technische Universität München — CERN

Bent Monolithic Active Pixel Sensors (MAPS) provide the basis for the next generation of ultra low material budget, fully cylindrical tracking detectors. In this contribution, results of beam campaigns with 5.4 GeV electrons will be presented. They verify the performance of bent 50 μm thick ALPIDE chips in terms of efficiency and space point resolution after bending them to the ALICE ITS3 radii of 18, 24, and 30 mm. In particular, an efficiency larger than 99.9% and a space-point resolution of approximately 5 μm are observed, both in line with the nominal operation of flat ALPIDE sensors. These values are found to be independent of the bending radius and thus demonstrate the feasibility of the planned ITS3 detector in crucial aspects.

HK 24.5 Wed 15:15 SCH/A251

Test and characterization of an experimental apparatus with bent MAPS and CsI scintillators — •Laszlo Varga[1,2], Christopher Ehrich[1], Tobias Jenegger[1,2], Lukas Lautner[1,3], Lukas Ponnath[1], Isabella Sanna[1,3], Berkin Ulukutlu[1], Roman Gernhäuser[1], and Laura Fabbietti[1] for the ALICE Germany-Collaboration — [1]Technische Universität München, Germany — [2]Excellence Cluster ORIGINS, Garching, Germany — [3]European Organisation for Nuclear Research (CERN), Geneva, Switzerand

Particle detectors based on Monolithic Active Pixel Sensors (MAPS) provide the basis for the next generation of vertex detectors with ultra low material budget and truly cylindrical geometry. Arrays of sensor elements stitched into wafer-scale and curved in a barrel geometry serve as the next upgrade of the inner tracking system (ITS3) of the ALICE experiment at CERN. A test environment hosting six bent sensors in the uITS3 geometry and their read out synchronized with CsI scintillator crystals has been recently employed in the test beam experiment at the Bronowice Cyclotron Facility (CCB) in Poland.

In this talk, the sensors technique, the experimental setup and preliminary results of the CCB experiment will be discussed.

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