T 48: Pixel detectors III

Time: Wednesday 16:30–18:30 Location: H-HS V

T 48.1 Wed 16:30 H-HS V

Optimization of the new Pixel Vertex Detector for Physics Running in the Belle II Experiment — •Markus Reif for the Belle II-Collaboration — Max Planck Institute for Physics

The Pixel Vertex Detector (PXD) is the innermost subdetector of the new Belle II detector at the asymmetric energy electron positron collider SuperKEKB in Tsubkuba, Japan. For Phase 3, 20 modules were installed, arranged cylindrically around the interaction point. Each module contains 192000 Depleted P-channel Field-Effect Transistor (DEPFET) pixels.

In Phase 3, which started in March 2019, for the first time physical data was taken with the 'full' detector.

To cope with inhomogeneities between pixels of PXD modules a dedicated software calculates a specific current that is added to each pixel to shrink the pedestal distribution. Since the modules suffer radiation damages in physics runs, these offsets have to be recalibrated frequently.

As a preparation step for the offset calibration, the pedestals of the modules have to be shifted to the lower region of the dynamic range, which is currently done by hand.

In this talk a newly developed software, which speeds up and simplifies this preparation step, is presented.

T 48.2 Wed 16:45 H-HS V

Powering studies for the Mu3e tracking detector — •Thomas Theodor Rudzki for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The tracking detector for the Mu3e experiment will use 50 μm thin high-voltage monolithic active pixel sensors (HV-MAPS). Facing the construction of first prototype modules the powering of the sensors was examined in detail. The active components for the power supply will be situated up to 1 m away from the sensors inside the 1 T magnetic field provided by a superconducting solenoid. Power is provided by DC-DC converters based on air coils. The converters provide power with an intrinsic ripple of a few 10 mV. The modules consist of sensors mounted on high-density interconnects without any additional filters.

It was tested if MuPix8 is tolerating this ripple in the digital and analog part. Therefore, the MuPix setup was stripped down to operate the sensor with as few as possible filters on the supply inputs. This talk will present lab as well as testbeam measurements on the dependence of this powering scheme on the jitter in the serial links, noise, and efficiency.

T 48.3 Wed 17:00 H-HS V

Development of a Laboratory Readout System for a DEPFET Pixel Detector Module — •Patrick Ahlburg, Florian Bernlochner, Jochen Dingfelder, Tomasz Hemperek, Hans Krüger, Botho Paschen, and Norbert Wermes — University of Bonn

The DEPFET PiXel Detector (PXD) is successfully operated in the innermost layers of the Belle II experiment at the SuperKEKB e^+e^-collider in Japan. The PXD-DAQ is optimized for the requirements of a full scale detector operating in Belle II. In this talk, the development of a laboratory readout system (BDAQ-PXD) for a single PXD module is shown. BDAQ-PXD is intended as an easily accessible lab test system for irradiation- and testbeam setups using a custom designed readout board (BDAQ53). The lab test system will help gather information about the behavior of DEPFET pixel detector modules in dedicated tests which may also go beyond the requirements of the detector in the running Belle II experiment. The implementation of the firmware and first measurements are presented in this talk.

T 48.4 Wed 17:15 H-HS V

Development of a serial data link IC in 65nm CMOS for the RD53B HL-LHC pixel readout chip — Tomasz Hemperek, Hans Krüger, Konstantinos Moustakas, •Piotr Rymaszewski, Marco Vogt, Tianyang Wang, and Norbert Wermes — Physikalisches Institut Universität Bonn, Bonn, Germany

The LHC High Luminosity upgrade will result in a significant change of environment in which particle detectors are going to operate, especially for devices very close to the interaction point like pixel detector electronics. The performance requirement for the pixel readout chip resulting from these changes are very similar for ATLAS and CMS experiments, therefore the groups decided to work together on the design. This collaboration, named RD53, already delivered a first large scale prototype (RD53A) and is now close to finishing the second one (RD53B). This talk presents the I/O interface of RD53B chip, focusing especially on some timing-critical circuit blocks: CDR (Clock Data Recovery), serializer and CML (Current Mode Logic) output driver. The CDR recovers clock from 160 Mbps incoming data stream and produces a 1.28 GHz clock to be used by the serializer. The double data rate serializer combines 20 data streams into a single 1.28 Gbps stream, which is sent off-chip by a CML driver. The talk will include the circuit description, explanation of the main differences between RD53A and RD53B implementations, and measurement results, especially on radiation hardness (TID and SEE) from a small scale I/O prototype chip.

T 48.5 Wed 17:30 H-HS V

Übersicht über Messungen im Rahmen der ATLAS-ITk-Pixel Marktrecherche — Andreas Gisen, •Valerie Hohm, Kevin Kröninger, Mareike Wagner und Jens Weingarten — TU Dortmund, Experimentelle Physik IV

Nach dem Upgrade des LHC zum HL-LHC werden eine höhere Luminosität und ein größerer Teilchenfluss erwartet. Daher muss das Trackingsystem des ATLAS-Experiments eine höhere Okkupanz und Strahlendosis aushalten können. Aus diesem Grund wird während des LS2 das neue Trackingsystem, der Inner Tracker (ITk), im ATLAS-Experiment eingebaut. Dieses wird im äußeren Teil aus einem Streifendetektor und im inneren Teil aus einem Pixeldetektor bestehen. Beide Detektoren werden Sensoren aus Silizium enthalten. Die innerste Lage des Pixeldetektors wird mit 3D-Sensoren ausgestattet, während die anderen Lagen aus planaren Sensoren gebildet werden.

Aufgrund der Vielzahl von benötigten Sensoren wurde eine globale Marktrecherche gestartet, um Hersteller für die Produktion zu gewinnen. Während eines Teils der Marktrecherche werden die Funktionalität und Qualität der gelieferten Sensoren von einer Gruppe von Universitäten getestet. Diese Tests beinhalten sowohl Labor- als auch Testbeam-Messungen. Die Universität Dortmund beteiligt sich an diesen Messungen für planare Silizium-Pixel-Sensoren.

Dieser Vortrag präsentiert einen Überblick über die bisherigen Messungen und den aktuellen Stand und gibt einen Ausblick auf zukünftige Messungen.

T 48.6 Wed 17:45 H-HS V

ITk-Pixel prototype module assembly and testing — Jörn Grosse-Knetter, Jörn Lange, •Silke Möbius, and Arnulf Quadt — II. Physikalisches Institut, Georg-August-Universität Göttingen

For the upgrade of the LHC to the High-Luminosity-LHC, the ATLAS tracking detector will be replaced with a pure silicon detector, the Inner Tracker (ITk), as the higher luminosity asks for radiation hard components that can deal with higher occupancies and radiation. Given the close proximity to the interaction point, the environment is especially challenging for the pixel detector, which features 3D and planar sensors.

A global market survey on the sensors as well as the bonding to the readout chip has been started. Several institutes are involved in sensor testing with laboratory as well as testbeam measurements. Our working group contributes to the planar sensor market survey.

Additionally, a new readout chip is under development, allowing a faster and reliable readout of the sensors. In order to characterize and test ITk-Pixel prototype modules with the RD53A, a prototype chip, up to 200 modules are built and tested at several institutes. At a later stage, modules will be integrated into a demonstrator to test the system. Our working group in Göttingen is involved in the development of the tooling, needed for the assembly of the module and the assembly and testing itself.

This talk will give an overview of the measurements performed so far and focus on the ITk-Pixel module assembly and tests in our group.

T 48.7 Wed 18:00 H-HS V

System Integration of ATLAS ITK Pixel DCS ASICs — •Ahmed Qamesh for the ATLAS-Collaboration — University of Wuppertal

During the LHC phase II shutdown, the entire tracking system of the ATLAS experiment will be replaced by an all-silicon detector called the ITk (Inner Tracker). with a pixel detector as the most inner part. Therefore a new DCS (Detector Control System) is being developed at the University of Wuppertal to fulfill the control and monitoring requirements of the new pixel detector. The new DCS has an on-detector component DCS ASIC to monitor the voltages and temperatures of the sub-detector components. For the communication between the off-detector DCS server and the DCS ASIC a modified CAN (Controller Area Network) bus is used. The powering scheme of the ASICs is supported by direct power lines from the power supplies . In this talk testing results for the proposed communication system (CAN) and Integration plans of the new chip will be presented.

T 48.8 Wed 18:15 H-HS V

ATLASPix3 results from the laboratory — H. Augustin[1], F. Ehrler[2], D.M. Immig[1], D. Kim[1], •L. Mandok[1], L.O.S. Noethe[1], I. Perić[2], M. Prathapan[2], T.T. Rudzki[1], R. Schimassek[2], A. Schöning[1], A. Weber[1,2], and H. Zhangh[2] — [1]Physikalisches Institut der Universität Heidelberg — [2]Karlruher Institut für Technologie

In the context of the High Luminosity upgrade of the LHC, several components of the ATLAS detector will be renewed and improved to keep up with the increasing luminosity. In particular, High-Voltage Monolithic Pixel Sensors (HV-MAPS) are considered an alternative to conventional hybrid silicon pixels for the outer layers of the ATLAS Inner Tracker. HV-MAPS are based on HV-CMOS technology. It allows integrating an active pixel matrix that collects signal charges via drift and the full readout logic in a monolithic architecture.
The ATLASPix3 is the latest prototype of an ATLAS demonstrator chip. It is the first full-size version with an active area of $19.8\times18.6\,cm^2$ integrating pixels of size $150\times50\,\mu m^2$. It also features time walk correction possibilities using ToA and ToT measurements.
In this talk, the latest results from the laboratory with a special focus on time resolution studies are discussed.