T 67: Pixeldetektoren 3

Zeit: Dienstag 16:45–19:00 Raum: VSH 116

T 67.1 Di 16:45 VSH 116

Characterization and grading of the Pixel Vertex Detector modules — •Philipp Leitl for the Belle II-Collaboration — Max Planck Institute for Physics, Munich

For the upgrade of the Belle detector at the electron positron collider SuperKEKB in Tsukuba, Japan, the vertexing system is completed by a new pixel detector. This Pixel Vertex Detector (PXD) is based on the Depleted P-channel Field-Effect Transistor (DEPFET) technology.

The main production of the detector modules started at the end of 2016 and about 80 modules will be assembled until mid of 2017. During the numerous production steps, several quality assurance measurements are performed to monitor the production yield and to keep track of the performance of every single module.

After the last production step, a full characterization of each module is carried out. The module performance is analyzed with extensive tests and the results are documented in a database. Digital communication on the module and to the readout electronics as well as analog operation of the pixel matrix are covered. A radioactive Cd-109 source and an infrared laser system are used to optimize the response of the modules to signal.

According to the test results, the modules are categorized under a detailed grading scheme to identify the 40 best modules, which will finally form the full detector.

T 67.2 Di 17:00 VSH 116

Characterization of pixel detectors using X-ray fluorescence — •Doreen Achnitz, Fabian Hügging, David-Leon Pohl, Norbert Wermes, and Jochen Dingfelder — Physikalisches Institut der Universität Bonn

The ATLAS FE-I4 pixel readout chip was designed for the ATLAS pixel detector at the Large Hadron Collider (LHC). The pixel detector makes use of the analogue charge information to improve the track and vertex measurement performance. Therefore an absolute charge calibration of each pixel is desired. In general for the characterization and calibration of new pixel detector designs, a known charge deposition in the sensor is needed. In this context, an experimental setup is being built to produce high intensity X-ray spectra of different energies. An X-ray tube is used with different fluorescence targets to generate a variety of characteristic X-ray lines which can be reconstructed by the pixel detector. The intensity allows for sufficient per pixel statistics, in particular needed for small prototypes. The setup has been characterized with a planar 200 μm n-in-n sensor bump bonded to the ATLAS FE-I4 pixel readout chip. In this talk, the method and first results of the X-ray fluorescence spectroscopy measurements are presented. Additionally, further features of the ATLAS FE-I4 like the lowest achievable threshold and the maximal rate capabilities were investigated with the new setup.

T 67.3 Di 17:15 VSH 116

Charakterisierung von Pixelmodulen für den CMS Phase 1 Pixeldetektor — •Martin Lipinski, Lutz Feld, Katja Klein, Samuel Möller und Frederic Stepp — I. Physikalisches Institut B, RWTH Aachen University

Für das CMS-Experiment wurde im Rahmen des Phase-1 Upgrades ein neuer Pixeldetektor mit einer zusätzlichen vierten Lage gebaut. Durch eine Verbesserung des Auslesechips können mit diesem Detektor auch bei steigenden Teilchenflüssen weiterhin effizient Daten genommen werden.

An der RWTH Aachen wurden während der Serienproduktion 389 am KIT Karlsruhe gebaute Module qualifiziert. Dieser Vortrag stellt kurz die beiden dafür verwendeten Teststände und die Testprozeduren vor. Die Qualifikation beinhaltet elektrische Tests, thermisches Zyklieren sowie Hochratentests und eine Energiekalibration mit Röntgenstrahlung. Die Ergebnisse der Charakterisierung werden dargestellt.

T 67.4 Di 17:30 VSH 116

Characterization of Through Silicon Vias (TSVs) on the ATLAS Pixel Chip — Michael Daas, Florian Hinterkeuser, Fabian Hügging, •Nikolaus Owtscharenko, David-Leon Pohl, and Norbert Wermes — Physikalisches Institut der Universität Bonn

The high luminosity upgrade of the LHC requires new ATLAS detector systems. In particular the inner tracking system will be upgraded to an all-silicon detector covering an area of about $200m^2$, demanding new module technologies. New interconnection techniques allow area efficient optimisation module designs. A key element therein is the so-called through silicon via (TSV) applied through the FE-chip. It allows for minimized passive area, less or no wirebonds, and 4-side abuttable modules. We report on TSV fabrication and characterisation in a Bonn/IZM-Berlin collaboration.

Processing of a sample of FE-I4B bare chips, a readout chip for 26880 hybrid pixels designed in a 130nm CMOS process for use in the ATLAS IBL, has been completed.

In this talk the IZM via last process on ATLAS FE-I4B chips is presented with focus on via resistance and process yield.

T 67.5 Di 17:45 VSH 116

Vergleichsmessungen von planaren n-in-n und n-in-p Silizium Pixelsensoren — Silke Altenheiner[1], Karola Dette[1,2], •Sascha Dungs[1], Andreas Gisen[1], Claus Gössling[1], Marius Grothe[1], Reiner Klingenberg[1], Kevin Kröninger[1], Raphael Michallek[1] und Mareike Weers[1] — [1]TU Dortmund, Experimentelle Physik IV — [2]CERN

Pixelsensoren lassen sich aus verschiedenen Substraten realisieren. Bei planaren n-in-n Sensoren wird ein n-dotierter, bei den n-in-p Sensoren dagegen ein p-dotierter Silizium Wafer verwendet. Die Pixelimplantationen bestehen in beiden Fällen aus einem n-dotierten Substrat.
Um Gemeinsamkeiten und Unterschiede herauszustellen, wurden Design und Sensoren beider Arten untersucht und miteinander verglichen.

T 67.6 Di 18:00 VSH 116

Characterization of a depleted monolithic active pixel sensor prototype in 130nm Toshiba technology — •Christian Bespin, Tomasz Hemperek, Toko Hirono, Fabian Hügging, Tetsuichi Kishishita, Hans Krüger, Piotr Rymaszewski, and Norbert Wermes — Physikalisches Institut der Universität Bonn

For future applications of pixel detectors in high luminosity environments such as the HL-LHC new demands for detectors arise. While dealing with high data rates they need to withstand high radiation doses and keep the material budget low. A promising approach are CMOS silicon devices which are expected to perform better in future experiments than present day hybrid pixel detectors. A prototype of a depleted monolithic active pixel sensor (DMAPS) in 130 nm Toshiba technology is characterized.

It consists of three different flavors with a pixel pitch of 20 μm and two with 40 μm pitch. The pixels are read out using a 3T circuit. Results from gain and noise measurements are presented together with measurements with radioactive sources and a 3.5 GeV electron beam.

T 67.7 Di 18:15 VSH 116

Design of a Depleted Monolithic CMOS Pixel sensor in a 150 nm CMOS Technology for the ATLAS Inner Tracker Upgrade — Marlon Barbero[2], Patrick Breugnon[2], Yavuz Degerli[3], Stephanie Godiot[2], Fabrice Guilloux[3], Tomasz Hemperek[1], Toko Hirono[1], Hans Krüger[1], Jian Liu[2], Fabienne Orsini[2], Patrick Pangaud[2], Alexandre Rozanov[2], •Piotr Rymaszewski[1], Philippe Schwemling[3], Tianyang Wang[1], and Norbert Wermes[1] — [1]University of Bonn, Bonn, Germany — [2]CPPM, Marseille, France — [3]CEA-IRFU, Saclay, France

During the long shutdown the LHC will undergo an upgrade allowing for a big increase in luminosity, which will have a huge impact on the operation of the inner tracking detectors. Within ATLAS CMOS Pixel Collaboration a "CMOS demonstrator" initiative has been started with the goal of qualifying available CMOS technologies to build high performance, cost efficient detectors. This works presents one of designed prototypes - a monolithic particle sensor named LFMonopix-01. This device, designed in LFoundry 150nm CMOS quadruple well process, features 250μm×50μm pixels organized into a matrix of 129×36 pixels. The design exploits high bias voltage and high wafer resistivity to allow for a quick charge collection through drift. Signal is amplified and shaped in-pixel, obtained information is readout using "column drain" architecture. During the talk an overview of the design will be presented with a special focus on some of the faced challenges e.g. low noise operation, fast signal processing, design verification. Simulation

results will be compared with first measurement results.

T 67.8 Di 18:30 VSH 116

High granularity low power monolithic active pixel detector in 180nm CMOS technology for the ATLAS ITK upgrade — •Konstantinos Moustakas[1], Tianyang Wang[1], Ivan Berdalovic[2], Thanushan Kugathasan[2], Walter Snoeys[2], Tomasz Hemperek[1], Hans Krüger[1], and Norbert Wermes[1] — [1]Physikalisches Institut der Universität Bonn, Nussallee 12, Bonn, Germany — [2]CERN, Geneva, Switzerland

Active monolithic CMOS sensors (DMAPS) are emerging as a promising alternative for the HL-LHC upgrade. A low capacitance, high granularity DMAP sensor is currently being developed in a commercial TowerJazz 180nm process. The technology incorporates a p-epitaxial high resistivity substrate, full CMOS circuitry by deep p-well isolation and TID durability by usage of a thin gate oxide. The pixel pinch is smaller than 50μm, facilitating very high efficiency under the deep p-well through process modification and backbiasing to achieve full depletion. Instead of including the electronics inside the collection well, a separate n-well collection diode is implemented. The extremely small detector capacitance significantly reduces input noise and allows the use of a low power ALPIDE-like analog front-end. The front end circuit is modified and optimized for ToT enablement and the hit information is read-out by a token-based column drain architecture. A leakage current compensation scheme is also proposed to improve performance, allowing for independent input reset current setting from the collection diode leakage. Simulation results demonstrate high performance in terms of very low ENC and threshold dispersion (<20e)

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Quellenmessungen und ortsaufgelöste Untersuchungen zur Ladungssammlung in bestrahlten monolitischen Sensoren der 180nm TowerJazz Technologie im Rahmen der Entwicklung des neuen ATLAS Inner Tracker. — •Christian Riegel[1,2], Douglas Schaefer[1], Marco Dalla[3], Enrico Junior Schioppa[1], Heinz Pernegger[1] und Wolfgang Wagner[2] — [1]CERN, Meyrin, Switzerland — [2]Bergische Universität Wuppertal, Wuppertal, Germany — [3]Universita e INFN, Bologna, Italy

Im Rahmen des zukünftigen Upgrades des ATLAS Detektors wird ein komplett neuer Inner Tracker (ITk) entwickelt. Zu den vielversprechenden Technologien zählen depleted monolithic active pixel sensor (DMAPS) aus Silizium. Dieser Vortrag präsentiert die laufenden Messungen an einem Forschungschip, der im 180nm TowerJazz Process hergestellt ist. Der Chip ist mit verschiedenen Pixelgrößen und Elektrodengeometrien ausgestattet. Die im letzten Jahr vorgestellten Ergebnisse in Bezug auf Strahlenhärte und Geschwindigkeit der Ladungssammlung waren der Auftakt zu weiteren, intensiven Quellenmessungen im Labor, sowie zu ortsaufgelösten Untersuchungen in der Diamond Synchrotron Einrichtung und einem CERN SPS Testbeam mit Pionen. Diese Messungen eröffneten einen tieferen Einblick in die Eigenschaften der Ladungssammlung für Pixel verschiedener Größen und die Effizienz der Ladungssammlung vor und nach Bestrahlung.