T 124: Si-Strip/CMS, Pixel/DMAPS

Time: Thursday 15:50–17:20 Location: WIL/A124

T 124.1 Thu 15:50 WIL/A124

Performance of the latest Service Hybrid prototypes for CMS silicon strip modules — Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Daniel Louis[1], •Alexander Pauls[1], Oliver Pooth[2], Nicolas Röwert[1], Felix Thurn[1], Michael Wlochal[1], and Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

The CMS Collaboration is developing silicon strip modules for the second phase of the CMS tracker upgrade. This upgrade will enable the CMS experiment to utilize the high luminosity provided by the future HL-LHC. The modules' Service Hybrids are responsible for the sensor bias voltage and low voltage distribution on the module and the data transmission via optical links to the back-end electronics. For the first time, final versions of the required ASICs were assembled and tested on Service Hybrid prototypes with materials and geometries as foreseen in the detector. The measurements were performed with setups similar to the foreseen production test system. The gained experience is crucial for the design validation and in taking the final choices in the design process before series production.

T 124.2 Thu 16:05 WIL/A124

Influence of High-Frequency Magnetic Fields on the Noise Behavior of CMS 2S Module Prototypes — Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], and •Nicolas Röwert[1] — [1]I. Physikalisches Institut B, RWTH Aachen University, Germany — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany

For the CMS tracker Phase-2 upgrade new modules with silicon strip sensors are being developed. Each module features a Service Hybrid (SEH), which is responsible for the distribution of low voltages to the module components using a two-stage DC-DC conversion scheme. For modules equipped with the latest generation of SEHs an increase in module noise has been observed. A setup for inducing radiative noise with external magnetic fields that are frequency- and location-dependent is presented. Measurements carried out on modules from different prototyping phases show that the sensitivity is similar across generations, which indicates that radiative coupling into the sensor or readout electronics is not responsible for the observed noise increase.

T 124.3 Thu 16:20 WIL/A124

Systematic tests of the testing infrastructure for CMS Outer Tracker Service Hybrids — Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Daniel Louis[1], Alexander Pauls[1], Oliver Pooth[2], Nicolas Röwert[1], •Felix Thurn[1], Michael Wlochal[1], and Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

The CMS Collaboration is developing so-called 2S modules for the Phase-2 upgrade of the CMS tracker. This upgrade will enable the CMS experiment to utilize the high luminosity provided by the future HL-LHC. A 2S module consists of two silicon strip sensors, two support bridges and three electronics hybrids. One of these hybrids is the Service Hybrid (SEH), which supplies the power to all other parts of the module, aggregates the data lines from both sides of the module and is responsible for the data transmission via optical links to the back-end of the detector. During the production roughly 20,000 SEHs will undergo a vigorous quality control procedure. The test card for testing the functionality of the SEH is developed by RWTH Aachen and around 100 test cards were manufactured. These will be distributed to the manufacturer and collaborating institutes of the SEHs. Before that they have been tested and the statistical fluctuations of the measurements have been analyzed. A crate with several test cards was set up in a climatic chamber and the whole testing procedure including thermal cycling was exercised. Selected results from the commissioning and quality control of the test cards are presented.

T 124.4 Thu 16:35 WIL/A124

Characterization of TJ-Monopix2 - A depleted monolithic active pixel sensor with column drain readout architecture — •Christian Bespin[1], Ivan Caicedo[1], Jochen Dingfelder[1], Toko Hirono[2], Hans Krüger[1], Konstantinos Moustakas[3], and Norbert Wermes[1] — [1]Universität Bonn, Bonn, Deutschland — [2]DESY, Hamburg, Deutschland — [3]Paul Scherrer Institut, Villingen, Schweiz

The increasing availability of commercial CMOS processes with high-resistivity wafers has fueled the R&D of depleted monolithic active pixel sensors (DMAPS) for usage in high energy physics experiments. One of these developments is a series of monolithic pixel detectors with column-drain readout architecture and small collection electrode facilitating low-power designs: the TJ-Monopix series.

The latest iteration TJ-Monopix2 is designed in a 180 nm TowerJazz CMOS process and features a pixel size of 33 um x 33 um. Results from laboratory measurements and test beam campaigns demonstrating threshold and noise performance as well as hit efficiency measurements will be presented to discuss the suitability of TJ-Monopix2 for use in high-radiation environments.

T 124.5 Thu 16:50 WIL/A124

Characterisation of a DMAPS prototype for BELLE II a proposed Vertex Detector Upgrade — •Marike Schwickardi[1], Benjamin Schwenker[1], Ariane Frey[1], Yannik Buch[1], Maximilian Babeluk[2], Bernhard Pilsl[2], Patrick Sieberer[2], Christian Irmler[2], and Jérôme Baudot[3] — [1]Georg-August-Universität Göttingen, Deutschland — [2]HEPHY, Wien, Österreich — [3]IPHC, Straßburg, France

The SuperKEKB collider in Japan is an asymmetric electron-positron collider at a center-of-mass energy of 10.58 GeV. A world record peak luminosity of $4.7 \cdot 10^{34}$ cm^{-2}s^{-1} was achieved during the last run period in June 2022. The peak luminosity is planned to be ramped up incrementally to the design value of $6.5 \cdot 10^{35}$ cm^{-2}s^{-1}. During the long shutdown tentatively scheduled for 2026/2027 an upgrade for the vertex detector is planned, to improve the detectors performance, robustness against beam-induced backgrounds and simplify servicing the system. Proposed is a fully pixelated 5 layer vertex detector (VXD) concept, based on the CMOS-DMAPS technology. The proposed chip is named OBELIX and is a further development based of the TJ-MONOPIX2 produced in the Tower 180 nm process, as a replacement of the current pixel-and-strip vertex detector concept.

To ensure the design specification for the OBELIX chip are met, the predecessor TJ-MONOPIX2, was characterised in laboratory measurements and during a beam test at DESY in June 2022. The results obtained from these measurements are implemented in simulations in the Belle II Analysis Framework for more realistic performance studies.

T 124.6 Thu 17:05 WIL/A124

Test-beam campaign and characterization of irradiated depleted monolithic active pixel sensors (DMAPS) designed in 150nm CMOS technology — •Lars Schall[1], Christian Bespin[1], Ivan Caicedo[1], Jochen Dingfelder[1], Tomasz Hemperek[2], Toko Hirono[1], Fabian Hügging[1], Hans Krüger[1], Piotr Rymaszewski[2], Tianyang Wang[3], and Norbert Wermes[1] — [1]University of Bonn, Germany — [2]Dectris, Switzerland — [3]Zhangjiang National Lab, China

Monolithic active pixel sensors with depleted substrates are a promising option for pixel tracking detectors in high-radiation environments. The use of a highly resistive silicon substrate and short drift paths enhance the radiation tolerance, while a careful guard ring design facilitates high biasing voltages to deplete the sensor.

LF-Monopix2 is the latest prototype of a DMAPS development in 150 nm CMOS technology. It features a fully functional column-drain readout architecture in a 2x1 cm^2 matrix. A reduced pixel pitch of 50x150 μm^2 compared to its predecessor results in a smaller detector capacitance and an improved spatial resolution. Each pixel's digital electronics are integrated within the large collection electrode.

LF-Monopix2 chips thinned down to 100 μm have been tested and found to work successfully after being irradiated to 1e15 neq/cm^2. In this talk, results from recent characterization measurements and test-beam campaigns are shown. Focus is put on measurements with irradiated sensors and the comparison to unirradiated sensors.