T 85: Silicon Strip Detectors II

Time: Thursday 16:00–18:00 Location: Tj

T 85.1 Thu 16:00 Tj

Development of a GUI for a test stand for silicon detector modules of CMS 2S modules for the Phase-2 Upgrade of the CMS Tracker — •Anna Becker, Lutz Feld, Waclaw Karpinski, Katja Klein, Martin Lipinski, Alexander Pauls, Nicolas Röwert, and Michael Wlochal — 1. Physikalisches Institut B, RWTH Aachen

The CMS Collaboration is developing so-called 2S 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. One of the module assembly centres is RWTH Aachen, where 1000 2S modules will be built. During the production, a test stand based on a probe station is needed to monitor the quality of the silicon sensors in between the various assembly steps. To simplify, secure and accelerate the workflow a GUI for this test stand has been developed. After each assembly step various control measurements are performed. This GUI enables a user-friendly automatization, especially of the sensor's leakage current measurement and its surface inspection. Moreover, various environmental conditions are monitored to guarantee constant measurement conditions. Both the GUI itself and selected measurement results of 2S modules built at RWTH Aachen are presented.

T 85.2 Thu 16:15 Tj

A Test Card for Service Hybrids of CMS silicon strip modules — Christian Dziwok[2], Lutz Feld[1], Waclaw Karpinski[1], Katja Klein[1], Martin Lipinski[1], Daniel Louis[1], •Alexander Pauls[1], Oliver Pooth[2], 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 high and low voltage distribution on the module and the data transmission via optical links to the back-end electronics. During the production a test system for roughly 20,000 Service Hybrids will be needed. The design of a test card compatible with a common infrastructure for CMS hybrid qualification during series production is presented. It features a USB controlled micro controller for slow control monitoring, control and readout. The hybrid's e-links are tested via a connected FC7 advanced mezzanine card, while the test card provides the necessary buffers and level translators. Measurement results of the commissioning are presented.

T 85.3 Thu 16:30 Tj

The Coldbox for Thermal Testing of ATLAS ITk Modules — Sören Ahrens, Sergio Diez Cornell, Ruchi Gupta, Torsten Külper, and •Jonas Neundorf — Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg

During the upcoming Long Shutdown 3 of the Large Hadron Collider, the ATLAS experiment will receive a new tracking detector. As part of the quality control process, the new Detector modules will have to undergo tests both at -35 °C and +40 °C. This ensures that they do not only function well at the operating temperature of the detector, but are also able to operate under a variety of conditions. DESY is developing a dedicated test setup called "coldbox" for this. This talk will introduce the setup, show it's thermal performance and briefly introduce the testing procedure.

T 85.4 Thu 16:45 Tj

Myonenhodoskop aus Siliziumsensormodulen für das CMS-Experiment — •Lea Stockmeier, Tobias Barvich, Alexander Dierlamm, Ulrich Husemann, Roland Koppenhöfer, Stefan Maier, Thomas Müller, Marius Neufeld, Andreas Nürnberg, Hans Jürgen Simonis, Julian Stanulla und Pia Steck — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Im Rahmen des Phase-2-Upgrades werden in den zukünftigen äußeren CMS-Spurdetektor neuartige Siliziumsensormodule eingebaut. Jedes Modul besteht aus zwei Sensorschichten, die je nach Lage im Detektor entweder aus Pixel- oder Streifensensoren bestehen. Module mit zwei Schichten aus Streifensensoren heißen 2S-Module.

Im Rahmen der Prototyp-Phase der 2S-Module werden diese in einem Hodoskop aus drei übereinander angeordneten 2S-Modulen getestet. Durch das Triggern mit Szintillatoren auf kosmische Myonen können die Module synchron ausgelesen und Auflösungsstudien durchgeführt werden. Außerdem wird das Modulverhalten unter verschiedenen Einfallswinkeln der Myonen analysiert. Der Vortrag stellt die Ergebnisse der Messungen mit diesem Hodoskop vor.

T 85.5 Thu 17:00 Tj

Qualitätskontrolle von Siliziumsensoren für das Phase-2-Upgrade des CMS-Experiments — •Florian Wittig, Tobias Barvich, Alexander Dierlamm, Ulrich Husemann, Roland Koppenhöfer, Stefan Maier, Thomas Müller, Jan-Ole Müller-Gosewisch, Marius Neufeld, Andreas Nürnberg, Hans Jürgen Simonis, Julian Stanulla und Pia Steck — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Im Rahmen des Phase-2-Upgrades des CMS-Experiments wird der äußere Spurdetektor komplett ausgetauscht. Im neuen Spurdetektor kommen drei unterschiedliche Varianten von Siliziumsensoren zum Einsatz. 2S-Sensoren, mit einer Fläche von $10\times10\,\mathrm{cm}^2$, die in 2032 Streifen der Länge 5 cm segmentiert sind, sowie die halb so großen PSs-Sensoren mit insgesamt 1920 Streifen der halben Länge. Die dritte Sensorvariante, die PSp-Sensoren, bildet mit etwa 30.000 Makropixeln mit 1,5 mm Länge, verteilt auf einer Fläche von $5\times10\,\mathrm{cm}^2$, einen Kompromiss zwischen Streifen- und Pixelsensoren. Die Serienproduktion der Sensoren hat Mitte 2020 begonnen und wird bis in das Jahr 2024 andauern. Innerhalb dieses Zeitraums werden insgesamt etwa 30.000 Sensoren produziert. Die Qualitätssicherung der Sensoren ist hierbei von großer Bedeutung, um deren uneingeschränkte Funktionalität im Detektor zu gewährleisten.
Dieser Vortrag gibt einen Überblick über die Qualitätskontrolle der Streifensensoren während der Serienproduktion. Es wird das allgemeine Vorgehen beschrieben und erste Messergebnisse diskutiert.

T 85.6 Thu 17:15 Tj

Beam test of 2S module prototypes for the Phase-2 CMS Outer Tracker — Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], Nicolas Röwert[1], and •Tim Ziemons[2] — [1]I. Physikalisches Institut B, RWTH Aachen University — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany

The CMS detector will be upgraded in the Phase-2 Upgrade for the operation at the HL-LHC. Among others, the silicon tracking system will be completely replaced by a new system providing an extended acceptance, an improved granularity and the feature to include tracking information into the level-1 trigger. The new Outer Tracker will consist of 2S modules with two strip sensors and PS modules with a macro-pixel sensor and a strip sensor, specialized detector modules with onboard p_T discrimination.

The functionality of current generation prototype 2S modules has been tested at the test beam facility at DESY Hamburg in November 2019. With a 4 GeV electron beam, various studies are performed like efficiency scans at different positions of the module or at varying inclination angles to mimic different p_T particles. In this talk, efficiency studies are presented.

T 85.7 Thu 17:30 Tj

Beam test with the final readout scheme of Phase-2 CMS Outer Tracker 2S prototype modules — •Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], Nicolas Röwert[1], and Tim Ziemons[2] — [1]I. Physikalisches Institut B, RWTH Aachen University — [2]III. Physikalisches Institut B, RWTH Aachen University

For the upcoming Phase-2 Upgrade for the operation of CMS at the HL-LHC a new silicon tracker design will be implemented. With extended acceptance and giving additional input of track p_T to the level-1 trigger, the new Outer Tracker will consist of 2S modules with two coplanar strip sensors and PS modules with a macro-pixel sensor and a strip sensor. Therefore, for these specialized detector modules the pT information of a track is already available online. Based on cluster

size and position in a module's sensors and its sensor spacing, a first pT trigger information is generated in its front-end ASIC and then constantly streamed to the back end at bunch crossing rate.

The final front-end ASIC CBC 3.1 was used alongside the concentrator ASIC CIC v1 and the serializer- and slow control ASICs GBTx and SCA without additional interface card for the first time. This final readout scheme of 2S modules has been tested with two modules at once at the test beam facility of DESY Hamburg using a 4 GeV electron beam and the DATURA telescope. This talk will showcase the efficiency of the new p_T discrimination mechanism and the test on synchronicity of modules.

T 85.8 Thu 17:45 Tj

Loading and testing of strip silicon modules for the ATLAS ITk upgrade phase2 — •Alessia Renardi, Sergio Diez Cornell, and Ruchi Gupta — DESY, Hamburg, Germany

The upgrade of the central tracking system of the ATLAS experiment is required for the operation at the High Luminosity LHC (HL-LHC) starting in the middle of 2027. It needs to be completely replaced for the Phase II upgrade due to increased radiation environment, detector occupancy and trigger rate, as well as aging and radiation damage of the existing inner detector. The most basic unit, a module, of the new Inner Tracker (ITk) strip detector consists of a single silicon sensor, one or two flex hybrid circuit boards where the read-out chips are located, and a power-board. For the ATLAS ITk strip End-cap six flavors of modules have been designed, different in shape and structure. All of them are glued on both sides of a low-mass carbon-fibre support structures with embedded CO2 cooling, so-called petal core. A semi-electrical petal was built at DESY-Hamburg: semi-electrical modules have been produced in different institutes of the ITk strip collaboration and glued on a petal core using an automatized procedure. The glue is dispensed on the local support structure and the pattern was investigated in order to aim for a good glue coverage as well as the required thickness and sensor flatness. The whole procedure will be shown explaining how the robot is able to pick and place every single module and glue it on the petal core. The talk includes the results of the electrical quality control test too.