

T 57: Silicon strip detectors

Time: Wednesday 16:30–18:15

Location: H-HS XVII

T 57.1 Wed 16:30 H-HS XVII

Design of a test system for Service Hybrids for CMS silicon strip modules — ALEXANDER BOGNER¹, CHRISTIAN DZIWKOW², LUTZ FELD¹, WACLAW KARPINSKI¹, KATJA KLEIN¹, MARTIN LIPINSKI¹, ALEXANDER PAULS¹, OLIVER POOTH², MARIUS PREUTEN¹, MAX RAUCH¹, MICHAEL WLOCHAL¹, and TIM ZIEMONS² — ¹I. Physikalisches Institut B, RWTH Aachen — ²3. Physikalisches Institut B, RWTH Aachen

The CMS Collaboration is developing two-sided 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.

A design for a standalone Service Hybrid test board, which has been produced for prototype qualification and active thermal cycling is presented. The choices in design are compared to a test card, which is compatible with a common infrastructure for CMS hybrid qualification during series production. Measurement results of Service Hybrid prototypes are also presented.

T 57.2 Wed 16:45 H-HS XVII

Qualifizierung von Silizium-Streifensensormodulen für das CMS-Experiment am HL-LHC — TOBIAS BARVICH, JUSTUS BRAACH, ALEXANDER DIERLAMM, ULRICH HUSEMANN, ROLAND KOPPENHÖFER, STEFAN MAIER, THOMAS MÜLLER, ANDREAS NÜRNBERG, HANS JÜRGEN SIMONIS und PIA STECK — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Zur Vorbereitung auf den HL-LHC wird im Rahmen des Phase-2-Upgrades des CMS-Experiments der gesamte Spurdetektor ausgetauscht.

Der Bereich bei Radien größer 60 cm wird mit Silizium-Streifensensormodulen bestückt, den sogenannten 2S-Modulen. 2S-Module bestehen aus zwei parallel übereinander angeordneten Streifensensoren, zwei Auslese-Hybriden und einem Service-Hybrid, auf welchem Stromversorgung und optische Auslese des Moduls integriert sind.

Im November 2019 wurde am ETP ein neuer 2S-Modul-Prototyp gebaut, welcher zum ersten Mal eine optische Kommunikation mit den Auslesechips ermöglicht, die auch der späteren Verwendung des Moduls im Detektor entspricht. Dieser Modulprototyp wird hinsichtlich der Herausforderungen des Betriebs bei CMS sowohl im Labor als auch bei Teststrahlungsmessungen am DESY intensiv getestet.

Der Vortrag gibt einen Einblick in das am ETP bestehende Programm zur Qualifikation von Silizium-Streifensensormodulen und diskutiert die Ergebnisse von Messungen mit dem Prototyp des 2S-Moduls.

T 57.3 Wed 17:00 H-HS XVII

Assembly of functional 2S-modules for the Phase-2 Upgrade of the CMS-Tracker — CHRISTIAN DZIWKOW², LUTZ FELD¹, KATJA KLEIN¹, OLIVER POOTH², NICOLAS RÖWERT¹, TIM ZIEMONS², and MICHAEL WLOCHAL¹ — ¹I. Physikalisches Institut B, RWTH Aachen University — ²III. Physikalisches Institut B, RWTH Aachen University

In the course of the Long Shutdown 3 the LHC will be upgraded to the High Luminosity LHC (CERN) with a planned increased instantaneous luminosity of $5 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$. For this purpose the current strip tracker of the CMS experiment will be replaced by innovative modules that are equipped with two vertically stacked silicon sensors each. In this sensor sandwich a measurable difference in the hit position is generated as the 3.8 T magnetic field inside the detector bends the particle tracks. This enables the selection of high transverse momentum tracks for the L1 trigger on a module basis.

The RWTH Aachen University as one of the assembly centers is responsible for manufacturing around 1000 of the so called 2S modules. A special assembly process is required to meet the high precision demands with simple-to-use tools to facilitate mass production. This talk presents the current progress and selected challenges of the procedure that appeared during the assembly of first functional modules.

T 57.4 Wed 17:15 H-HS XVII

Beam test of 2S module prototypes for the Phase-2 CMS Outer Tracker — CHRISTIAN DZIWKOW², LUTZ FELD¹, KATJA KLEIN¹, MARTIN LIPINSKI¹, ALEXANDER PAULS¹, OLIVER POOTH², MAX RAUCH¹, NICOLAS RÖWERT¹, and TIM ZIEMONS² — ¹I. Physikalisches Institut B, RWTH Aachen University — ²III. Physikalisches Institut B, RWTH Aachen University

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. 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, module related preparations for the test beam are presented and first results are shown.

T 57.5 Wed 17:30 H-HS XVII

Effizienzstudien von n-in-p Silizium-Makropixelensoren für das Phase-2-Upgrade des CMS-Experiments — TOBIAS BARVICH, ALEXANDER DIERLAMM, ALEXANDER DROLL, ULRICH HUSEMANN, THOMAS MÜLLER, JAN-OLE MÜLLER-GOSEWISCH, ANDREAS NÜRNBERG, HANS-JÜRGEN SIMONIS und FLORIAN WITTIG — 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. Es kommt ein neuer Modultyp zum Einsatz, der in der Lage ist Teilchen mit hohen Transversalimpulsen auf Modulebene zu identifizieren. Dies ermöglicht einen direkten Beitrag des Spurdetektors zur ersten Triggerstufe des CMS-Experiments (Level-1-Trigger).

Für eine Variante, dem PS-Modul, kommen siliziumbasierte n-in-p Streifen- und Makropixelensoren zum Einsatz. Letztere bilden mit ihrer Streifenlänge von etwa 1,5 mm einen Kompromiss zwischen Pixel- und Streifensensoren und weisen somit eine verbesserte Ortsauflösung als reine Streifensensoren auf.

In diesem Vortrag werden Ergebnisse aus Teststrahlungsmessungen am Deutschen Elektronen-Synchrotron (DESY) in Hamburg mit Prototypen der Makropixelensoren gezeigt und diskutiert.

T 57.6 Wed 17:45 H-HS XVII

Performance of the Lycoris large area strip telescope — UWE KRAEMER, MARCEL STANITZKI, MENGQING WU, RALF DIENER, and TIES BEHNKE — DESY, Hamburg, Germany

The Lycoris high precision large area silicon telescope was designed and commissioned for the DESY II Test Beam Facility as part of the AIDA2020 project.

The telescope consists of six $9.35 \times 9.35 \text{ cm}^2$ hybrid-less silicon micro-strip sensors with a pitch of $25 \mu\text{m}$. This strip pitch is made possible by routing all signals via extra metallization layers to the top surface where it is read out via an integrated pitch adapter and digital readout in the form of the KP1X readout ASIC as opposed to a more classical approach where each strip is read out via a wire bond at the end. The full system was tested in multiple test beam campaigns and first results of the sensor performance, including the achievable signal over noise ratio, hit efficiency, as well as the achievable single point resolution of the system will be presented.

T 57.7 Wed 18:00 H-HS XVII

Loading of strip silicon modules for the ATLAS ITk upgrade phase-II — ALESSIA RENARDI, SERGIO DIEZ CORNELL, and OTHMANE RIFKI for the ATLAS-Collaboration — DESY

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 is going to be built at DESY-Hamburg: semi-

electrical modules have been produced in different institutes of the ITk strip collaboration and are going to be glued on a petal core using an automatized procedure. The glue is dispensed on the local support structure and the pattern has to be 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.