T 2: Silizium-Streifen-Detektoren I

Zeit: Montag 16:00–18:30 Raum: Philo-HS2

T 2.1 Mo 16:00 Philo-HS2

Development and characterisation of a Service Hybrid prototype for CMS two-sided silicon strip modules — Lutz Feld[1], Christian Dziwok[2], Katja Klein[1], Martin Lipinski[1], •Alexander Pauls[1], Oliver Pooth[2], Marius Preuten[1], Max Rauch[1], Nicolas Röwert[1], and Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

The CMS collaboration is developing two-sided silicon strip Modules for the second phase of the CMS outer tracker upgrade. This upgrade will enable the CMS experiment to utilize the high luminosity provided by the future HL-LHC. The RWTH Aachen contributes to this effort with the development of the Service Hybrid, which is responsible for high and low voltage distribution on the module and the data connection via optical links to the back-end electronics. The main feature of the low voltage distribution is a two-stage DC-DC conversion scheme. The current project and prototype status of the Service Hybrid is presented together with results of electrical test measurements. During the production a test system for the Service Hybrid will be needed. The design for a first test system prototype is presented, as well as the status of the test software.

T 2.2 Mo 16:15 Philo-HS2

Wirebonding on 2S Modules of the Phase-2 CMS Detector — Christian Dziwok[1], Lutz Feld[2], Katja Klein[2], Oliver Pooth[1], Marius Preuten[2], Max Rauch[2], Nicolas Röwert[2], and •Tim Ziemons[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]I. Physikalisches Institut B, RWTH Aachen University

The LHC will be upgraded to the HL-LHC in the Long Shutdown 3 starting 2024. To fulfill the requirements, the CMS detector will be upgraded in the Phase-2 Upgrade. 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 its tracking information into the level-1 trigger. The new Outer Tracker will consist of 2S modules consisting of two strip sensors and PS modules with a macro-pixel sensor and a strip sensor. The electrical connection between the strip sensors and the front-end electronics is realized by thin aluminum wire bonds.

In this talk the process of wire bonding is introduced and its implementation in the 2S module series production is discussed. For this, a procedure of parameter optimization is developed and applied on a 2S dummy module.

T 2.3 Mo 16:30 Philo-HS2

Assembly of 2S-Module Prototypes for the Phase-2 Upgrade of the CMS-Tracker — Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], Marius Preuten[1], Max Rauch[1], •Nicolas Röwert[1], and Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

In the context of the Long Shutdown 3 around 2025 the current strip tracker of the CMS experiment will be replaced as required for the High Luminosity LHC (CERN) with a planned instantaneous luminosity of $5{\cdot}10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$. Around 8000 conceptually new silicon modules have to be built that will each be equipped with two identical vertically stacked silicon strip sensors. Through the difference in the hit position in the two sensors – caused by the magnetic field of 3.8 T inside the detector bending the tracks of charged particles – it is possible to select high transverse momentum tracks for the L1 trigger already on the module itself.

To manufacture these modules an assembly process is needed that guarantees high precision along with proper electrical isolation and can be realized with simple-to-use tools to facilitate mass production.

In this talk the current progress and selected challenges of the assembly will be presented.

T 2.4 Mo 16:45 Philo-HS2

Thermische Messungen mit 2S-Modulen für das Phase-2-Upgrade von CMS — Christian Dziwok[1], Lutz Feld[2], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], Marius Preuten[1], •Max Rauch[1], Nicolas Röwert[1] und Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

Im Rahmen des Phase-2-Upgrades von CMS am LHC (CERN) wird der derzeitige Siliziumspurdetektor (Tracker) ausgetauscht werden, voraussichtlich ab dem Jahr 2024. Im neuen Tracker werden u.A. etwa 8500 Stück der neuartigen 2S-Siliziumstreifenmodule eingesetzt werden. Ein 2S-Modul besteht aus zwei etwa 10 cm × 10 cm großen Siliziumstreifensensoren und drei Hybriden zur Spannungsversorgung und Auslese. Die 2S-Module werden mit einem zweiphasigen CO_2-System bei einer nominellen CO_2-Temperatur von $-35\,^{\circ}\mathrm{C}$ gekühlt. Das thermische Verhalten der 2S-Module wie z.B. der Effekt des „Thermal Runaway“ wird mit FE-Simulationen abgeschätzt. In diesem Vortrag werden thermische Messungen mit 2S-Dummy-Modulen vorgestellt, die die späteren Detektorbedingungen möglichst gut nachahmen, systematische Messfehler minimieren und durch die die in den FE-Simulationen gemachten Annahmen wie Klebeschichtdicken, Wärmeleitfähigkeiten, etc. überprüft werden.

T 2.5 Mo 17:00 Philo-HS2

Mini-2S-Module beam test for CMS Binary Chip 3 — •Christian Dziwok[1], Lutz Feld[2], Katja Klein[2], Oliver Pooth[1], Marius Preuten[2], Max Rauch[2], Nicolas Röwert[2], and Tim Ziemons[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]I. Physikalisches Institut B, RWTH Aachen University

For the upcoming CMS Phase-2 Upgrade the L1 trigger will receive in addition track information from the Outer Tracker. The Outer Tracker will be built from silicon dual-strips (2S) and pixel-strip (PS) combination modules, having a stack of silicon sensors in either configuration. The readout chips for the two sensor planes build coincident signals based on an chosen acceptance range. This talk presents the general program and setup used for the latest beam test at Fermi National Accelerator Laboratory. Using the 120 GeV proton beam on prototype mini-2S-modules, the CMS Binary Chip 3.0 (CBC3) was tested.

T 2.6 Mo 17:15 Philo-HS2

Messung der Interstripkapazität von ATLAS-ITk-R0-Streifen-Sensoren — Silke Altenheiner, Claus Gössling, •Marius Hötting, Kevin Kröninger, Jonas Lönker und Felix Wizemann — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Um die gesteigerten Anforderungen durch das Upgrade auf den High-Luminosity LHC erfüllen zu können, ist geplant, den Inneren Detektor des ATLAS-Experiments zu ersetzen. Der neue Spurdetektor, genannt Inner Tracker (ITk), soll in den äußeren Lagen aus Silizium-Streifenmodulen bestehen. Ein Bestandteil dieser äußeren Lage sind die R0-Module. Der R0-Sensor eines solchen Moduls besteht aus einem Teilstück eines Kreisbogens, wobei dieses Teilstück in vier weitere Segmente unterteilt ist. Aufgrund der Strukturierung unterschieden sich somit die einzelnen Segmente im Bezug auf den Flächeninhalt und den Streifenabstand voneinander.

Vorgestellt werden die Ergebnisse der IV- und Interstrip-Messung von R0-Sensoren. Insbesondere wurde die Interstripkapazität in Abhängigkeit der Frequenz und der Betriebszeit in Labormessungen untersucht. Im Rahmen der Bachelorarbeit wurden zudem die Ergebnisse mit den geforderten ITk-Spezifikationen verglichen.

T 2.7 Mo 17:30 Philo-HS2

Infrared tests on the ATLAS thermomechanical petal prototype built at DESY. — •Yasiel Delabat Diaz, Claire A. David, Ingrid-Maria Gregor, Jan-Hendrik Arling, and Sergio Diez Cornell — Deutsches Elektronen-Synchrotron (DESY)

The infrared measurements on the thermomechanical petal prototype of the ATLAS end-cap strip detector were performed using a customized thermal chamber built at DESY. Using for the first time CO_2 cooling for the prototype's thermal cycles, temperatures of around -25 $^{\circ}C$ were reached. After each cycle, it was observed that the sensors tend not to keep thermal memory (i.e. they are not damaged). Preliminary comparisons with FEA simulations also showed fairly similar behaviour with respect to the measurements performed on both sides of the petal. In addition, a thermographic correction squeme was investigated, aiming to use a mathematical approach for emissivity correction that would eliminate the necesity of covering the petal surface with high emissivity black tape. With that purpose, the IR camera's spectral response scale factor was estimated and the viewing angle in-

fluence in the measurements was studied founding it to be negligible.

T 2.8 Mo 17:45 Philo-HS2

Study of a silicon strip sensor with embedded pitch adapters using electron testbeam data — •Sam Yanwing Ng, Heiko Lacker, and Laura Rehnisch — Humboldt-Universität zu Berlin

In the early prototyping stage of the high-luminosity upgrade of the ATLAS inner tracker, silicon strip sensors with embedded pitch adapter (EPA) structures were proposed as an approach to improve the challenging wire-bonding condition in the end-cap region due to different bond-pad layout on sensors and readout chips. Silicon strip sensors of an end-cap prototyping layout (petalet) with various EPA structures have been produced by embedding a second metal-track layer at Centro Nacional de Microelectrónica (IMB-CNM, CSIC), Barcelona, Spain. Introducing the second metal layer may lead to performance loss, e.g. signal loss due to the increase of the inter-strip capacitance, or unwanted capacitive coupling between the two metal layers (cross talk) or between the silicon bulk and second the metal layer (pick up). Prototype detector modules built with EPA petalet sensors were subjected to test-beam experiments at DESY using the 4.4 GeV electron beam with EUDET pixel telescope. First preliminary results will be reported.

T 2.9 Mo 18:00 Philo-HS2

Test Beam Studies of Silicon Strip Detectors for the ATLAS ITk-Upgrade — •Moritz Wiehe — Albert-Ludwigs-Universität Freiburg

The inner tracking detector of the ATLAS-experiment will be upgraded for the application at the High Luminosity LHC. The current silicon tracker (SCT) and transition radiation tracker (TRT) will be replaced by an all silicon tracker (Inner Tracker, ITk).

To verify the functionality and performance of silicon strip detector modules, test beam studies are carried out. Results of a test beam at DESY in 2017 are presented, where two devices, a short strip barrel module and an R0 endcap module, were tested. The most important figures of merit are the efficiency, the noise level and tracking accuracy. Of special importance is, how the efficiency and spatial resolution depend on the track position.

T 2.10 Mo 18:15 Philo-HS2

Test-beam results of a prototype module with radial strips for the ATLAS ITk Strip Detector — •Edoardo Rossi and Xiaocong Ai — DESY, Hamburg

Starting in 2022, the LHC will be upgraded to the High Luminosity-LHC which will have a luminosity almost five times larger than the present luminosity. In order to cope with the higher radiation level and with the higher pile up, the ATLAS experiment needs a complete replacement of the current tracking system with an all silicon detector, the Inner Tracker (ITk).

The ITk Strip Detector will implement four barrel layers and six end-caps on each side. Each end-cap will be built with modules with implemented radial strips.In this presentation, test-beam results obtained with an unirradiated prototype module with radial strips are described. The measurements were performed at DESY. The techniques used for the track reconstruction and for the analysis of the data are described in detail.