HK 35: HK+T Joint Session V: Silicon Strip Detectors

Zeit: Mittwoch 16:45–19:00 Raum: F 102

HK 35.1 Mi 16:45 F 102

Bau von 2S-Modul-Prototypen für das Phase-2-Upgrade des CMS-Trackers — Lutz Feld, Waclaw Karpinski, Katja Klein, Marius Preuten, Max Rauch, •Nicolas Röwert und Michael Wlochal — RWTH Aachen, 1. Physikalisches Institut B

Im Rahmen des Phase-2-Upgrades von CMS am LHC (CERN) wird der derzeitige Siliziumspurdetektor (Tracker) ausgetauscht werden, voraussichtlich ab dem Jahr 2023. Im neuen Tracker werden u.A. etwa 8000 Stück der neuartigen 2S-Siliziumstreifenmodule eingesetzt werden.
Das Grundgerüst eines 2S-Moduls besteht aus zwei ca. 10 cm × 10 cm großen Siliziumstreifensensoren, die auf zwei Abstandshalter (Spacer) aus einem Aluminium-Kohlefaser-Verbundmaterial geklebt sind. Die Klebeschichtdicken sollen aus thermischen Gründen 20 μm oder weniger betragen und die Sensoren müssen gegenüber den Spacern gegen Hochspannung isoliert sein. Für den Winkel zwischen den beiden Streifensensoren wird eine Toleranz von 400 μrad verlangt. Es wird ein auf einer mechanischen Vorrichtung basierendes Verfahren zum Bau von 2S-Modulen vorgestellt und die Ergebnisse vom Bau erster Prototypen werden diskutiert.

HK 35.2 Mi 17:00 F 102

Wirebonding auf den 2S Modulen des Outer Trackers für das Phase-2-Upgrade des CMS Experiments — Lutz Feld[1], Katja Klein[1], Oliver Pooth[2] und •Tim Ziemons[2] — [1]I. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen — [2]III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

Vor dem Start des HL-LHC müssen am CMS-Detektor aufgrund von Strahlenschäden und den bevorstehenden höheren Luminositäten Upgrades vorgenommen werden. Im sogenannten Phase-2-Upgrade des CMS-Detektors werden viele Subdetektoren durch solche mit moderneren Technologien ersetzt. Dazu zählt auch der neue Silizium Outer Tracker, in dem sogenannte PS Module (pixel and strips) und 2S Module (strips and strips) Signale liefern sollen, die in den Level-1 Trigger integriert werden.

Ein 2S Modul besteht aus zwei Silizium-Streifen Sensoren, die durch Wire-Bonds mit der Ausleseelektronik verbunden werden. Im Vortrag werden die 2S Module im Hinblick auf Machbarkeit der Wire-Bonds vorgestellt und erste Schritte in Richtung des Bondings bei einer Massenproduktion diskutiert. Die Optimierung der Bondqualität und der Schutz vor Beschädigung der Bondverbindungen sind wichtig, um die Lebensdauer der Detektormodule zu maximieren.

HK 35.3 Mi 17:15 F 102

A high resolution tracker for (p,2p) reactions — •Lukas Werner for the TUM-RIKEN-p2p-Collaboration — Technical University of Munich

Models of the r-process predict a strong influence of fission barrier heights on the distribution of r-process nuclei, manly through termination of the r-process and simultaneously by a recycling of the fission products , refueling the r-process with neutron rich , medium mass nuclei.

The (p,2p)-reaction in inverse kinematics allows for the study of fission barrier heights for even the most exotic, experimentally available nuclei. For this purpose a missing mass spectroscopy of the reaction has to be performed. A silicon tracker system has been developed using highly segmented, thin silicon detectors with an APV25 based low noise readout. Tests of the system have been performed at the HIMAC facility in Japan, using a stable 16-O beam at energies of E=290 MeV/u.

Even at a readout speed of up to 100 kiloevents per second the experimental resolution of a vertex reconstruction is in excellent agreement with expectations from Geant4 simulations.

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HK 35.4 Mi 17:30 F 102

Test-beam results of an unirradiated and an irradiated module for the ATLAS ITk Strip detector — •Edoardo Rossi — DESY, Hamburg, Germany

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 be subject to a radiation more than one order of magnitude higher than the maximum radiation fluence expected for the SCT, the current strip detector. For this reason, new radiation-hard sensors and front-end chips will be used and are now under development. Among other measurements, a test-beam campaign is on going to determine the performance of the new modules at the end of the lifetime of the HL-LHC. Some strict requirements are set on the performance to provide efficient pattern recognition and track reconstruction and to fulfill the needs of the physics program.

In this presentation, test-beam results obtained with unirradiated and proton-irradiated prototype barrel modules are compared. The measurements were performed at DESY and CERN. The main focus is on the degradation of the efficiency, collected charge and noise occupancy after irradiation.

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Long Term Annealing Studies on ATLAS12 Sensors — •Leena Diehl, Riccardo Mori, Marc Hauser, Susanne Kühn, Ulrich Parzefall, Ines Messmer, and Karl Jakobs — Albert-Ludwigs-Universität Freiburg

Non-ionizing energy loss (NIEL) causes damage to silicon particle detectors, resulting for p-type sensors in an increased effective doping concentration, growing depletion voltage and leakage current. Defects in the lattice are mobile with an exponential temperature dependence.

Therefore, a long-term study of damage parameters is performed as a function of time at Room Temperature and 60°C, using irradiated p-type sensors up to a fluence of 2e15 n_{eq}/cm^2. Measurements include the charge collection and leakage current behavior, the scaling factor between the two temperatures and the behavior of the effective doping concentration. A strong deviation from the conventional scaling factor is found.

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Cold IV measurements of highly irradiated silicon strip detectors — •Sven Mägdefessel[1], Eva Sicking[1,2], Ulrich Parzefall[1], and Karl Jakobs[1] — [1]Albert-Ludwigs-Universität Freiburg, Germany — [2]now at CERN, Switzerland

Highly irradiated silicon strip detectors show a strong increase of the leakage current. Thus a intense cooling is nescessary to perform an IV measurement. On the one hand it has to be ensured that the detector is kept at the lowered temperature and on the other hand the heat being produced by the leakage current has to be removed.

We present a actively cooled and temperature stabilized setup which provides temperatures down to -40°C for detectors up to 8" size. Furthermore we show the latest results of planar and 3D silicon strip detectors.

HK 35.7 Mi 18:15 F 102

Electrical quality assurance of silicon microstrip sensors for the CBM experiment — •Iaroslav Panasenko for the CBM-Collaboration — Physikalisches Institut, Universität Tübingen, Germany — Institute for Nuclear Research, Kiev, Ukraine

The CBM experiment at FAIR will investigate the properties of nucler matter at extreme conditions created in ultrarelativistic heavy-ion collisions. Its core detector — the Silicon Tracking System (STS) — will determine the momentum of charged particles from beam-target interactions.

The STS will be constructed from about 900 double-sided silicon microstrip sensors with 58 μm pitch and a total area of about 4 m^2 with all together 2.1 million channels will be read out.

In this talk the electrical quality assurance of double-sided silicon microstrip sensors will be discussed. For this purpose dedicated equipment including a custom-built probe station has been set up in the clean room at Tübingen University. Results of the electrical characterization of prototype microstrip sensors CBM06 will be presented, which include basic checks like current-voltage and capacitance-voltage measurements, as well as specific tests like coupling and interstrip capacitances.

Work supported by BMBF under grant 05P12VTFCE.

HK 35.8 Mi 18:30 F 102

Optical quality assurance procedures for the sensors of the CBM Silicon Tracking System — •Evgeny Lavrik for the CBM-Collaboration — Physikalisches Institut der Universität Tübingen, Tübingen, Deutschland

The Compressed Baryonic Matter (CBM) experiment at FAIR aims to study the properties of nuclear matter at high net-baryon densities. The Silicon Tracking System is the key detector to reconstruct charged particle tracks created in heavy-ion interactions. In order to assure the quality of more than 1000 silicon sensors including spares, highly efficient and highly automated procedures need to be developed.

In this contribution we report on the optical quality assurance setup built at the University of Tübingen and the progress in the development preparing for the mass inspection of the silicon sensors arriving from the manufacturers in 2017. We will as well as summarize the results and experience obtained from inspecting prototype sensors.

This work was supported by grant BMBF-05P16VTFC1

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DC-DC Powered Silicon Microstrip Modules for the CMS Phase-II Tracker — Lutz Feld, Waclaw Karpinski, Katja Klein, •Marius Preuten, and Max Rauch — I. Physikalisches Institut B - RWTH Aachen

To prepare the CMS experiment for the High Luminosity LHC and its planned instantaneous luminosity of $5 \cdot 10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$ the CMS Silicon Tracker will be replaced in the Long Shutdown 3 (around 2025). The new Tracker will comprise about 15000 conceptually new modules: Two identical vertically spaced silicon microstrip sensors are integrated into a single module and read out by the same front-end chip. The displacement of the hits between both sensors - caused by the bending of charged particle tracks within the 3.8 T magnetic field - can be used to infer a lower bound on the pT of the track within a single module. In order to satisfy the increased power demand of the new front-end electronics at minimal material budget an on-board DC-DC converter scheme was chosen. These converters, the high voltage circuit and the electro-optical conversion are merged into a single PCB (Service Hybrid) and are an integral part of the new tracker modules. First full size module prototypes have been produced and are currently tested. Results on the electrical performance during system tests including a Service Hybrid, will be presented in this talk.