T 90: Silicon Detectors VII (ATLAS + CMS phase-2)

Time: Friday 9:00–10:30 Location: VG 0.111

T 90.1 Fri 9:00 VG 0.111

The ATLAS ITk cell integration site in Bonn — •Alexandra Wald, Klaus Desch, Matthias Hamer, Florian Hinterkeuser, Nico Klein, and Dominik Hauner — PI, Uni Bonn, Germany

In conjunction with the high luminosity upgrade of the Large Hadron Collider at CERN, the current tracking system of the ATLAS experiment will be replaced by the Inner Tracker (ITk), an all-silicon detector consisting of 5 layers of pixel detectors and 4 layers of strip detectors. More than 8000 modules will be installed in the pixel layers, which together have an active area of approximately $13m^2$ and cover a pseudorapidity of up to 4. In order to build such a large detector in time, the integration of the ITk Pixel modules on their local support structures (so-called longerons or inclined halfrings(IHR)), as well as the quality control of individual loaded local supports will be distributed over many institutes. One of the assembly lines will be setup at the University of Bonn, with technicians from other German locations also helping with cell integration. Due to the serial powering scheme of the ITk Pixel Detector, the quality control of a loaded local support is challenging in several aspects, as the simultaneous operation of multiple modules is necessary for any tests. A large number of different components must hence be integrated into the quality control setup, such as an optical readout system, an interlocks system, industrial power supplies and a scalable DCS. In this talk, the current status of the LLS assembly line in Bonn is presented, and results from the integration of the first inclined half-ring are shown.

T 90.2 Fri 9:15 VG 0.111

Electrical testing of loaded cells for the ATLAS ITk Pixel loaded local support pre-production — •Nico Klein, Desch Klaus, Matthias Hamer, Florian Hinterkeuser, Alexandra Wald, and Dominik Hauner — Physikalisches Institut, Universität Bonn, Deutschland

The high luminosity upgrade for the Large Hadron Collider at CERN requires a complete redesign of the current tracking detector of the ATLAS experiment. The new Inner Tracker, the ITk Detector, will consist of a silicon pixel detector and a silicon strip detector. The ITk Pixel Detector is divided into three subsystems, the Outer Barrel (OB), Outer Endcaps and Inner System. In the OB, modules are loaded on thermally conducting cells (now called loaded cells) before they are mounted on the local supports (so-called longerons and halfrings). Before the loaded cells are mounted on the support structures, they are individually tested for basic functionality after shipment. In this talk I will present the results of the reception tests of the loaded cells for the first pre-production half-ring that has been assembled in Bonn.

T 90.3 Fri 9:30 VG 0.111

Assembly and test procedures of silicon detector modules for the Phase-2 Upgrade of the CMS Outer Tracker and the current status of production — •Stefan Maier, Tobias Barvich, Bernd Berger, Alexander Dierlamm, Ulrich Husemann, Markus Klute, Kai Kraemer, Waldemar Rehm, Hans Jürgen Simonis, and Lea Stockmeier — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

In preparation for the High Luminosity LHC, the entire tracker of the CMS experiment will be exchanged within the Phase-2 Upgrade until 2029. The new outer tracker will be made of approximately 13000 silicon sensor modules which come in two types: 2S modules (consisting of two parallel silicon strip sensors) and PS modules (one pixel and one strip sensor combined in a module). With these modules the tracker provides tracking information to the Level-1 trigger. By correlating the hit information of both sensor layers in the magnetic field of CMS and, thus, allowing to suppress charged particles with low transverse momentum ($<$2GeV/c), the corresponding hit data can be read out every 25 ns. To guarantee successful operation of the CMS detector at the HL-LHC, the production of the outer tracker modules has to fulfil strict requirements. The production is distributed among several institutes all around the world to achieve the required module assembly rates. The talk will shortly explain the assembly and test procedures of 2S modules at KIT and summarize the status of the production which started recently.

T 90.4 Fri 9:45 VG 0.111

Thermal Integration Test with 2S Module Prototypes for the Phase-2 Upgrade of the CMS Outer Tracker — •Lea Stockmeier[1], Alexander Dierlamm[1], Ulrich Husemann[1], Stefan Maier[1], and Cristiano Turrioni[2] — [1]Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT) — [2]National Institute for Nuclear Physics (INFN), Perugia Unit

To deal with the increased luminosity of the HL-LHC, the CMS experiment will be upgraded until 2029. During this Phase-2 Upgrade, the CMS Outer Tracker will be equipped with modules each assembled with two silicon sensors. Depending on the position in the tracker, these silicon sensors are pixel or strip sensors. The modules with two strip sensors are called 2S modules. In the barrel region, they are placed on mechanical structures called ladders. A fully equipped ladder contains twelve modules.

During the prototyping phase of the modules, integration tests are performed with the purpose of testing the integration procedure itself as well as the module functionality on the final detector structures. Investigations focus on the cooling performance as well as on electrical performance of the modules on the supporting structures.

This talk summarizes an integration test with twelve 2S modules on a ladder performed at CERN in cooperation with other CMS working groups. The test focuses on thermal aspects of the performance of a 2S module built with sensors irradiated with protons to the expected lifetime fluence.

T 90.5 Fri 10:00 VG 0.111

Thermal Cycling of Modules for the Upgrade of the CMS Outer Tracker — •Aenne Abel[1,2], Ana Ventura Barosso[1], Günther Eckerlin[1], and Andreas Mussgiller[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]University of Hamburg, Hamburg, Germany

At the high-luminosity LHC the CMS Tracker will be faced with unprecedented instantaneous luminosity. To cope with this harsh environment, the existing tracker will be replaced with a completely new system that will operate at -35 degree C. As a final step of quality control each module has to undergo several thermal cycles between room and operation temperature, which is called burn-in. The presentation will introduce the burn-in setup at DESY and discuss the current status and foreseen testing procedures.

T 90.6 Fri 10:15 VG 0.111

In-Time Efficiency of ITk pixel modules using the ITkPixV1.1 front end — •Christopher Krause, Kevin Kröninger, Jens Weingarten, and Tobias Bisanz — TU Dortmund, Germany

The ATLAS Inner Tracker (ITk) will replace the Inner Detector of the ATLAS experiment for the High-Luminosity phase of the LHC. To ensure an excellent tracking performance of the silicon pixel and strip sensors of the ITk under the harsh HL-LHC environment, their performance has to be thoroughly tested and validated in testbeam facilities before installation. A crucial property of the pixel modules is their efficiency in regard to the phase of the 40 MHz clock of the LHC and the detector systems. As these modules can only record hits during the single 25 ns long readout time frame, evaluating their performance in dependence on the time is important to ensure a high tracking efficiency. To determine the in-time efficiency of an ITk pixel module, the clock of the DUT and the BDAQ system that is used to read out the data were synchronized. This talk presents the beam test results of In-Time efficiency measurements of an unirradiated 3D pixel module using the ITkPixV1.1 front end. The collected data was analysed with the track reconstruction framework Corryvreckan.