T 73: Pixel/CMS

Time: Wednesday 15:50–16:50 Location: WIL/A317

T 73.1 Wed 15:50 WIL/A317

Measurements of the CMS Inner Tracker pixel assemblies for the Phase-2 upgrade — •Bianca Raciti, Massimiliano Antonello, Erika Garutti, Jörn Schwandt, and Georg Steinbrück — University of Hamburg, 22761, Luruper Chaussee 149, Hamburg, Germany

During Long Shutdown 3, the entire CMS Tracking System will be replaced to operate during the High Luminosity LHC running phase with considerably increased luminosity. The new pixel sensors will have to fulfill stringent requirements to operate in an extremely harsh radiation environment and cope with the high data readout rate.

An extensive campaign has taken place to characterize the first half-size pixel chip demonstrator (RD53A), which led to the submission and production of the first full-size prototype chip (RD53B-CMS).

The new sensor-readout chip modules have been extensively tested both in the laboratory and at the CERN and DESY testbeam facilities.

This study presents results on the performances of the two subsequent iterations of pixel assemblies with different irradiation levels, sensor designs and experimental conditions.

T 73.2 Wed 16:05 WIL/A317

Commissioning of a Burn-In Setup for PS and 2S Detector Modules for the Upgrade of the CMS Outer Tracker — •Ana Ventura Barroso, Paul Schütze, and Katerina Lipka — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, D-22607 Hamburg

The high luminosity LHC Upgrade will increase the instantaneous luminosity by a factor of five. The CMS detector will be upgraded in the so called Phase-2 Upgrade in order to meet the new requirements, among others the level of radiation tolerance and coping with larger pileup and thus higher data rates, as well as to add triggering capabilities. The entire silicon tracker will be replaced. The Outer Tracker (OT), consisting of macro-pixel and strip detectors, will be based on silicon modules that must operate at low temperatures ($-35\,^{\circ}$C) due to the exposition at high radiation levels. The probability for defective electronic components to fail is higher after few hours of operation. Moreover, temperature cycles can induce mechanical stress. Therefore a burn-in procedure as well as thorough quality control is needed to ensure the correct operation of each of the OT modules before installation.

For this, a burn-in system is being commissioned at DESY. This setup will perform thermal cycles from room to operation temperature and key measurements to ensure the good performance of the modules. In this talk, the status of the DESY burn-in setup as well as noise measurements and temperature test on a PS module will be presented.

T 73.3 Wed 16:20 WIL/A317

Optical Metrology for the PS module production — •Leonie Sommer[1,2] and Paul Schütze[1] — [1]DESY, Hamburg, Germany — [2]University of Wuppertal, Wuppertal, Germany

The High Luminosity LHC upgrade aims at increasing the instantaneous luminosity leading to various challenges for the detectors. The CMS detector will undergo an upgrade to cope with larger pileup, higher data rates and higher radiation dose. As the new Outer Tracker will contribute to the first trigger stage at 40MHz bunch crossing rate, on-module pT-discrimination is needed for data reduction. This is achieved by building dual-sensor modules, where the efficiency of the momentum discrimination depends on the alignment precision of the sensors which needs to be checked thoroughly during module assembly. Metrology systems are used by the assembly centers to monitor that the modules used in the final detector meet the required alignment precision. In this talk the optical metrology setup at DESY is introduced and measurement procedures are described. Measurement results of various prototype PS modules built and tested at DESY are summarized and the stability of the system is assessed.

T 73.4 Wed 16:35 WIL/A317

Position reconstruction of shallow angle tracks in irradiated pixel sensors for the CMS Inner Tracker Upgrade — •Lukas Eikelmann, Massimiliano Antonello, Erika Garutti, Bianca Raciti, Jörn Schwandt, Georg Steinbrück und Annika Vauth — Institut für Experimentalphysik Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany

The position reconstruction of shallow angle tracks in the CMS Phase-II inner barrel layers is studied for its planned pixel pitch of 25 μm by 100 μm. These tracks have incident angles on the sensor of up to 84° with respect to vertical incidence. At such incident angles, the deposited charge is shared between over 13 pixels of 100 μm length. An algorithm attempts to cluster these pixels. It assigns the cluster position as the track hit position in this layer. Hits in the four layers are used to reconstruct the track. One of the effects of radiation damage in silicon is charge trapping. This leads to a reduction in the recorded signal of a pixel. If it is below the threshold of the readout chip, no signal is recorded. A missing pixel affects the proper cluster reconstruction resulting in a wrong hit position. In this study, irradiated and non-irradiated pixel sensors bump-bonded to the RD53A prototype chip are tested with shallow angle tracks in the DESY-II electron beam. The cluster breakage and the impact on the position reconstruction of different cluster algorithms are analyzed.