T 149: Detector Systems / Muon

Time: Thursday 17:30–19:00 Location: WIL/C133

T 149.1 Thu 17:30 WIL/C133

The commissioning of the new SciFi tracking detector for LHCb — Johannes Heuel and •Jan-Marc Basels — I. Physikalisches Institut B, RWTH Aachen University

The LHCb Upgrade I detector at the Large Hadron Collider (LHC) at CERN includes a new and unique scintillating fibre tracker (SciFi) with a silicon photo-multiplier (SiPM) readout system. The SciFi tracker is organised in 12 detector planes. Each, with an area of $30\,\mathrm{m}^2$ and a radiation length of only 1 %, provides spatial measurements with a resolution of 0.07 mm and an efficiency of more than 98 %.

A real-time and offline monitoring system enables the optimisation of the detector performance and early detection of potential issues during operation. The signal detection efficiency is dominated by the time-alignments and the definition of the signal thresholds for the 4096 SiPM arrays, each with 128 channels. For long term operation, the expected degradation of the performance of the SiPMs due to radiation damages is of particular importance.

The detector assembly has been completed in 2022 and its commissioning is still ongoing. We present the status of the commissioning work.

T 149.2 Thu 17:45 WIL/C133

Understanding the alignment of LHCb's SciFi Tracker — •Nils Breer, Sophie Hollitt, and Johannes Albrecht — TU Dortmund, Germany

As part of the LHCb upgrade, the Scintillating Fibre Tracker (SciFi) replaces the previous Outer and Inner Tracker detectors. A well-aligned detector is crucial in order to measure the physics performance as precisely as possible. Understanding which constraints and which parts of the SciFi have the most impact on the overall alignment will be important for monitoring the reconstruction quality of each fill.

With the commissioning of the SciFi in 2022 we are able to perform misalignment tests on simulated samples and compare the results to the real misaligned detector. As part of the initial alignment of the SciFi, configuration tests on the best estimate for the detector position were performed. In particular, performance tests are used to compare alignments of the full length modules compared to half modules. An overview of the current preparation for further SciFi alignment commissioning in 2023 is presented in this talk.

T 149.3 Thu 18:00 WIL/C133

LHCb Upgrade II - Mighty Tracker Sci-Fi Readout — Thomas Kirn, Thomas Oeser, Stefan Schael, and •Sebastian Schmitt — I. Phys. Inst. B RWTH Aachen

The LHCb experiment at the Large Hadron Collider (LHC) at CERN is an experiment designed to perform precise measurements of CP-Violation and rare decays of b-hadrons. With its configuration during Run I and Run II of the LHC, many measurements are statistically limited, hence more data are required to improve their sensitivity.

The LHCb Upgrade II detector will operate with increased instantaneous luminosity, $\mathcal{L}_{\mathrm{int}}$, in order to collect more data in a shorter time interval. This increases pile-up and the occupancy of the detector subsystems with respect to the current setup. As a result, the current detector needs to be upgraded in order to withstand the higher radiation damage and track multiplicity.

The downstream tracking stations will therefore be replaced by the Mighty Tracker, a tracker that comprises an inner silicon tracker and an outer Scintillating-Fibre (Sci-Fi) tracker. A design for the readout system of the Sci-Fi tracker is proposed that relies on coupling the Sci-Fi mats to a cryogenous chamber that houses Silicon Photomultipliers (SiPMs). This talk focuses on how to perform the coupling of the Sci-Fi mats to the cryogenous cooling chamber readout system.

T 149.4 Thu 18:15 WIL/C133

Impact of residual misalignment of the ATLAS' New Small Wheel on muon reconstruction performance — •Stefanie Götz[1], Otmar Biebel[1], Valerio D'Amico[1], Florian Egli[1], Ralf Hertenberger[1], Christoph Jagfeld[1], Eshita Kumar[1], Katrin Penski[1], Maximilian Rinnagel[1], Nick Schneider[1], Patrick Scholer[2], Chrysostomos Valderanis[1], and Fabian Vogel[1] — [1]LMU München — [2]Uni Freiburg

Highly accurate alignment of the ATLAS detector's New Small Wheel (NSW) is crucial to fully exploit the wheels precision tracking capability as required for the high luminosity upgrade of the Large Hadron Collider (LHC) at CERN. Therefore, precise information on the true NSW chamber positionings and shapes is included in the muon reconstruction software, but only with a certain degree of accuracy as caused by measurement uncertainties of the optical alignment sensors. This study investigates the impact of the NSW residual misalignment on the muon reconstruction performance in comparison to the ideal detector geometry. Translations, rotations and deformations described by specific alignment parameters are studied on Monte Carlo samples generated by the simulation software of the ATLAS experiment both at native detector geometry and with misaligned NSW detector components. Their effect is evaluated isolated for each alignment parameter and in a realistic scenario for which the residual chamber misalignment is determined using specific information on the alignment uncertainties. The final goal is to estimate the order of magnitude of the residual misalignment and its impact on the muon reconstruction performance.

T 149.5 Thu 18:30 WIL/C133

Reconstruction Performance of the ATLAS New Small Wheel — •Patrick Scholer — University of Freiburg

Before the start of the 2022 data-taking period, the innermost end cap of the ATLAS muon spectrometer was replaced by the so-called New Small Wheel (NSW). Micromegas and small-strip Thin Gap Chambers (sTGCs) detectors are used to maintain the precise particle tracking capabilities of the ATLAS muon spectrometer and to improve the rejection of false trigger signals at the rates expected after the high luminosity LHC upgrade.

This talk will discuss the tracking performance of the NSW for its first year of data-taking in ATLAS. First studies on the reconstruction of clusters and their properties on the individual detector layers will be presented for different settings of the detector working point and the readout system. This will be followed by a discussion of the track reconstruction performance using the 16 NSW detector layers and the combination of those tracks with the rest of ATLAS.

T 149.6 Thu 18:45 WIL/C133

Certification of sMDT chambers for the phase II upgrade of the ATLAS muon spectrometer — Oliver Kortner, Hubert Kroha, and •Nick Meier — MPI für Physik, München, Deutschland

For operation at the HL-LHC, the ATLAS experiments will upgrade the inner muon spectromater barrel layer with stations of thin-gap resistive plate chambers (RPCs) and small diameter muon drift-tube (sMDT) chambers in order to increase the acceptance of the first level muon trigger from current 80% to 95%. The MPI for Physics in Munich produced 49 sMDT chambers for this upgrade. The performance of all 49 chambers was measured with cosmic-ray muons: dark currents, electronics noise, muon detection efficiency, and the spatial resolution of all chambers were determined. The methods used for this certification and the results of the tests will be explained and shown in this presentation.