T 12: Detector systems I

Time: Monday 16:30–18:05 Location: H-HS XIII

Group Report T 12.1 Mon 16:30 H-HS XIII

Status of the Mu3e experiment — •Sebastian Dittmeier for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The Mu3e experiment will search for the charged lepton flavour violating decay $\mu^+ \to e^+e^-e^+$ with a targeted branching ratio sensitivity of $10^{-15}(10^{-16})$ in Phase I (II). The sensitivity goal drives the experimental design: To distinguish the neutrino-less signal decay from background processes, excellent momentum, vertex and time resolutions of the detector system are required. An ultra-thin silicon pixel tracking detector will be constructed, complemented by a scintillating fibre and a scintillating tile detector which add precise time information to the tracks. To conduct the experiment within a reasonable time, the detector will have to cope with electrons and positrons originating from muon decays at rates up to $10^8(10^9)$ per second. The current status of the design and construction of the Mu3e experiment is presented. Plans for commissioning of first detector module prototypes are outlined.

T 12.2 Mon 16:50 H-HS XIII

Mu3e Tile Detector Prototype — •Tiancheng Zhong, Yonathan Munwes, Hannah Klingenmeyer, Wei Shen, and Hans-Christian Schultz-Coulon for the Mu3e-Collaboration — Kirchhoff-Institut für Physik, Universität Heidelberg, Heidelberg 69120, Germanny

The Mu3e experiment is designed to search for the charged Lepton Flavour Violation (cLFV) decay $\mu^+ \to e^+e^+e^-$ with detector sensitivity of 10^{-16}. The observation of this decay would be a clear signal for new physics beyond the Standard Model (SM). To suppress both accidental and physics background in the experiment, a precise measurement of the vertex position, the decay time and the particle momenta is required. The tile detector, which employs scintillation tiles, SiPMs and dedicated readout ASICs, aims at a timing resolution of better than 100 ps.

At the Kirchhoff-Institut für Physik (KIP), Universität Heidelberg, which is responsible for the tile detector research and development, four 16-channel technical prototypes have been assembled and tested at the DESY electron test beam in Hamburg in December 2019. The preliminary results show a single channel timing resolution below 50 ps, which clearly fulfills the requirement of 100 ps.

T 12.3 Mon 17:05 H-HS XIII

CLAWS: Monitoring Injection Backgrounds at SuperKEKB — •Hendrik Windel for the Belle II-Collaboration — Max-Planck-Insitut für Physik, München

The electron-positron collider SuperKEKB uses continuous injections at a rate of 50 Hz to achieve the highest possible luminosities. These injections result in periods of higher beam backgrounds which may impose constraints on the operation of the Belle II detector. To monitor the level and time structure of the injection backgrounds, CLAWS, a system based on plastic scintillator tiles read out with silicon photomultipliers connected to a readout system providing continuous readout over several thousand revolutions of the accelerator with subnanosecond time resolution, was installed as part of the inner commissioning detector of Belle II for the second phase of commissioning from February to July 2018. A modified version of the CLAWS detector system is now a permanent part of the beam background monitoring for the Belle II experiment and began regular physics operation in March 2019. This contribution will discuss the hardware installations of the second phase of commissioning and show results from background measurements during the second comissioning phase and physics phase of SuperKEKB.

T 12.4 Mon 17:20 H-HS XIII

A Scintillator Based Background and Beam Abort System for SuperKEKB — •Ivan Popov for the Belle II-Collaboration — Max Planck Institut für Physik, München, Deutschland

The asymmetric-energy collider SuperKEKB started its physics operation in March 2019. The usage of a nano-beam scheme will enable collisions of electrons and positrons at record-breaking luminosities, but requires continuous particle injections at a rate of 50 Hz. These injections result in periods of high backgrounds, which can negatively affect the operation of Belle II subdetectors. In order to monitor and mitigate such backgrounds, the CLAWS detector system, consisting of scintillator tiles read out by silicon photomultipliers, is in operation in various forms since 2016. Beginning with the first physics run in 2019, 32 sensor modules have been distributed along the final focusing magnets. The advantageous locations of these sensors make the CLAWS system ideal for rapid detection of disturbances in the particle beam. The joint usage of fast read out electronics and a smart trigger logic enables the generation of a beam abort trigger within a few 100 ns after the occurrence of excessive background, thus ensuring the safe operation of the experiment. In this report, the development of CLAWS system for its secondary use as a beam abort system is discussed.

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Test Beam Results from ATLAS ITk Strip End-Cap modules — •Arturo Rodriguez Rodriguez, Marc Hauser, Ulrich Parzefall, Frederik Ruehr, Dennis Sperlich, and Liv Wiik-Fuchs — Universität Freiburg - Physikalisches Institut, Hermann-Herder Str. 3a, 79104 Freiburg, Germany

To cope with the occupancy and radiation doses expected at the High-Luminosity LHC accelerator, the ATLAS experiment will replace its Inner Detector with an all-silicon Inner Tracker (ITk), consisting of pixel and strip subsystems. The strip subsystem will be built from modules consisting of n+-in-p silicon strip sensors, and PCB hybrids containing the front-end electronics glued directly to the sensor. A powerboard, including an HV switch, a monitoring and control ASIC, and a DC-DC converter, is also glued to the sensor. In the last year, two prototype strip modules have been tested using beams of high energy electrons produced at the DESY II test beam facility. The modules tested are built from the annular R0 sensor, which will be used in the forward End-Cap region. For the first time, the final production version of the readout electronics, known as ABCstar, has been used. One of the R0 modules has been tested after irradiation to 50% beyond the expected end-of-lifetime fluence. The data allow for thorough tests of the module performance, noise occupancy, detection efficiency, and tracking performance. Moreover, the excellent tracking resolution allows for detailed studies of various strip sensor features. The results give confidence that the ITk strip detector will meet the requirements of the ATLAS experiment.

T 12.6 Mon 17:50 H-HS XIII

Diamond sensors for the LHCb Beam Condition Monitor — •Martin Bieker, Lars Funke, and Dirk Wiedner — Experimentelle Physik 5, TU Dortmund

The LHCb experiment is a single-arm forward spectrometer at the LHC and it focuses on measurements in the b and c quark sector. Due to its unique geometry, featuring a sensitive tracking system located close to the LHC beam, the detector is at risk of adverse beam conditions. For this reason LHCb employs 16 diamond sensors that monitor the particle flux near the beam pipe at two locations close to the interaction point.

The so called Beam Conditions Monitor (BCM) successfully protected the LHCb defector during Run I and Run II of the LHC. However at the end of Run 2 in 2018 indications for possible ageing effect of the diamond sensors were observed. Therefore, the system is overhauled and will receive new diamond sensors and a new back end electronic matching the LHCb upgrade standards.

This talk will give an overview of the activities linked to the upgrade. Special emphasis is put on the characterization of diamond sensors and their use in the new BCM system.