T 96: Detector Systems 3

Time: Thursday 16:15–18:15 Location: T-H27

T 96.1 Thu 16:15 T-H27

Status of the Mu3e tile detector — •Hannah Klingenmeyer for the Mu3e-Collaboration — Kirchhoff-Institut für Physik, Universität Heidelberg

The aim of the Mu3e experiment is the search of the lepton-flavour violating decay $\mu \to eee$ down to a sensitivity of 10^{-16}. It will be operated at the Paul Scherrer Institute (PSI) in Switzerland and consists of dedicated tracking and timing detectors, which will provide precise spatial and time measurements in order to suppress any background mimicking the signal decay.

One of the timing systems is the Mu3e tile detector, which allows precise timing of individual electrons with a resolution below 100 ps. It uses plastic scintillator tiles and silicon photomultipliers that are read out by a custom-designed ASIC, and is currently in the pre-production phase. This talk will give an overview of the current status and development of the tile detector, as well as of the performance of individual detector components. The tile matrix production and quality assurance measurements will be discussed along with advancements in the readout electronics, the cooling system, and the integration into the full experiment. Furthermore, an outlook on the full detector production will be given.

T 96.2 Thu 16:30 T-H27

Simulation studies on the Mu3e tile detector - Time alignment & clustering — •Erik Steinkamp and Maximilian Köper for the Mu3e-Collaboration — Kirchhoff Institute for Physics, Heidelberg University

The Mu3e experiment aims to detect the charged lepton flavor violating decay $\mu \to eee$ with a target sensitivity of 10^{-16}, improving the existing limit by four orders of magnitude. A successful observation would be a strong indicator for physics beyond the Standard Model. Precise timing information is needed to correctly identify the vertices of the three decay electrons and to suppress background from internal conversion decays and combinatorics. The tile detector, which utilizes scintillator tiles and SiPMs, aims to provide this precise time measurement of better than 100ps. To achieve this precision on the detector system level, a time calibration scheme using different event topologies to determine time offsets for every tile, is required. The obtained single-tile timestamps are clustered and matched to tracks from the tracking detectors. We present simulation studies of the time calibration routine, as well as clustering and track-tile matching.

T 96.3 Thu 16:45 T-H27

Irradiation studies for the Mu3e tile detector — •Tiancheng Zhong for the Mu3e-Collaboration — Kirchhoff-Institut für Physik, Universität Heidelberg, Heidelberg, Germany

The Mu3e experiment is designed to search for the decay $\mu^+ \to e^+e^+e^-$ with a sensitivity of 10^{-16}, which would be a clear signal for new physics beyond the Standard Model. To reduce the combinatorial background from muon decays while efficiently identifying 3-electron final states, a scintillating-tile detector with a required timing resolution < 100 ps and efficiency close to 100% is under development.

Irradiation damage and effects on Silicon Photomultiplier (SiPM) used in the tile detector were investigated by exposing the sensors to the decay electrons from stopped muons at the PiE5 beamline at PSI. For the SiPMs irradiated with a dose up to 1.57×10^{11} 1 MeV n_{eq}/cm^2, corresponding to 70% of the maximum dose of the Mu3e Phase I run, the dark current increased by a factor up to 1000. We will report on the irradiation campaign performed, measurements of dark current and impact on annealing at different temperatures. The timing performance after irradiation was investigated in testbeam campaigns at DESY and will also be discussed.

T 96.4 Thu 17:00 T-H27

The detector system for the Stopping Target Monitor of the Mu2e experiment at Fermilab — •Anna Ferrari, Stefan E. Mueller, Oliver Knodel, and Reuven Rachamin for the Mu2e-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, which is currently under construction at the Fermi National Accelerator Laboratory near Chicago, will search for the neutrinoless conversion of muons to electrons in the field of an aluminum nucleus, with the aim to reach a sensitivity four orders of magnitude better than previous experiments . Observations of a signal would be an example of Charged Lepton Flavor Violation, which would require physics beyond the Standard Model.

In order to normalize the result, a stopping target monitor will measure the number of stopped and captured muons in the aluminum target. The detector system includes a HPGe and a Lanthanum Bromide detector, which with different capabilities will measure x- and gamma-ray lines up to 1809 keV, in presence of high rate Bremsstrahlung and other backgrounds. At the Helmholtz-Zentrum Dresden-Rossendorf, we use the Bremsstrahlung photon beamline at the ELBE radiation facility to study the detector system performance in the pulsed conditions similar to that expected in Mu2e.

In the presentation, after an overview of the design and status of the Mu2e experiment, the main results of the ELBE campaign will be presented and discussed.

T 96.5 Thu 17:15 T-H27

Track reconstruction for the Mu3e experiment — •Alexandr Kozlinskiy for the Mu3e-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The *Mu3e* experiment is designed to search for the lepton flavor violating decay $\mu^+ \to e^+e^-e^+$. The ultimate aim of the experiment is to reach a branching ratio sensitivity of 10^{-16}. The experiment is located at the Paul Scherrer Institute (Switzerland) and an existing beam line providing 10^8 muons per second will allow to reach a sensitivity of a few 10^{-15} in the first phase of the experiment. The muons with a momentum of about 28 MeV/c are stopped and decay at rest on a target. The decay products (positrons and electrons) with energies below 53 MeV are measured by a tracking detector consisting of two double layers of 50 μm thin high-voltage monolithic active pixel sensors. The high granularity of pixel detector with a pixel size of 80×80 μm together with the small material budget allows for a precise track reconstruction. The track reconstruction is based on 3-dimensional multiple scattering fit and uses special methods to remove incorrectly reconstructed tracks, which is made possible by high efficiency and low noise rate of the pixel detector. This talk will present the details of the track reconstruction including the methods that are used to reduce the number of fake tracks.

T 96.6 Thu 17:30 T-H27

Commissioning of the LHCb Scintillating Fibre Tracker — Sebastian Bachmann, Daniel Berninghoff, Xiaoxue Han, Blake Leverington, Ulrich Uwer, and •Lukas Witola — Universität Heidelberg, Heidelberg, Deutschland

The LHCb detector underwent a major upgrade in the past years. The modifications enable the detector to operate at an increased instantaneous luminosity and to read out data at the LHC bunch crossing rate of 40MHz. The new operating conditions required the replacement of the complete tracking system. The main tracking stations are replaced by the SciFi Tracker, a large high granular scintillating fibre tracker readout by arrays of silicon photomultipliers (SiPMs). A custom ASIC is used to digitise the SiPM signals at 40MHz. Further digital electronics perform clustering and data-compression before the data is sent via optical links to the DAQ system.
The detector modules together with the readout electronics and all services are mounted on so-called C-Frames. The serial assembly and commissioning of frames is in its last stages before the start of the LHC in early 2022. The talk will give an overview of the detector and present experiences from the serial production and the latest commissioning results.

T 96.7 Thu 17:45 T-H27

Alignment studies of the LHCb SciFi Tracker — •Nils Breer[1] and Sophie Hollitt[2] — [1]TU Dortmund, experimentelle Physik 5 — [2]TU Dortmund, experimentelle Physik 5

As part of the LHCb upgrade, the Scintillating Fibre Tracker (SciFi) will replace the previous Outer and Inner Tracker detectors. It is crucial to understand which constraints and which parts of the SciFi have the most impact on the alignment quality.

In order to align the SciFi, several configurations of degrees of freedom and alignment constraints are studied. Further analysis is used

to search for possible weak modes and confirm that the alignment configuration produces stable results. In this talk, we will present results from misalignment tests using the current best configuration.

T 96.8 Thu 18:00 T-H27

Monitoring alignment performance for LHCb's Scintillating Fibre Tracker — Nils Breer and •Sophie Hollitt — Experimentelle Physik 5, TU Dortmund

During the LHC upgrade period, the LHCb experiment has replaced the majority of its subdetectors and extensively upgraded its trigger system. Before the physics data collection period late in 2022, careful commissioning of the full system is required. The Scintillating Fibre Tracker (SciFi) is the first detector after the LHCb magnet, and its alignment will be crucial for the final mass and momentum resolution of the upgraded experiment.

In this talk, we discuss how misalignment effects in the SciFi detector can be monitored via tracking and physics performance, and give an overview of the alignment and calibration procedures for the commissioning period of the detector.