T 19: Myondetektoren

Zeit: Montag 16:00–18:35 Raum: ST 3

Gruppenbericht T 19.1 Mo 16:00 ST 3

Overview of future muon upgrades for HL-LHC era and drift velocity monitoring system for barrel muon chambers of the CMS — •Archana Sharma, Hans Reithler, Kerstin Hoepfner, Markus Merschmeyer, and Thomas Hebbeker — III. Phys. Institute A, RWTH Aachen

Before being closed for LS2 (December 2018), the CMS detector performed efficiently during the whole LHC Run-I and Run-II data-taking periods and recorded 150.53 fb-1 of good quality 13 TeV proton-proton collisions data. During the HL-LHC era, the integrated luminosity will increase tenfold with respect to original design values, to be foreseen after LS3. To maintain its current excellent performance, the CMS muon detector system, besides other sub-detector systems, will undergo significant upgrades which are crucial to extend the sensitivity of the experiment towards precision measurements and new physics searches. This presentation gives an overview of the planned CMS muon detector system upgrades for LS2 and LS3 periods. Also, the drift velocity monitoring chambers developed at RWTH Aachen and being used in the CMS detector for DT chambers will be discussed.

T 19.2 Mo 16:20 ST 3

Surface commissioning of the BIS-78 sMDT chambers for the upgrade of the ATLAS muon spectrometer — •Šejla Hadžić, Oliver Kortner, Hubert Kroha, and Patrick Rieck — Max-Planck-Insitut für Physik

16 new so-called "BIS-78" sMDT chambers will be installed together with new thin-gap RPC chambers in the inner barrel layer of the ATLAS muon spectrometer in the transition region to the endcaps during the 2019/20 shutdown of the LHC in order to improve the rejection of fake muon triggers. The chambers have been constructed in 2018 and beginning of 2019. All chambers undergo extensive functionality tests with cosmic rays both before and after shipment to CERN. The noise rate and the efficiency of each drift tube are measured as well as the spatial resolution of the chamber. The presentation summarizes the results of these tests.

T 19.3 Mo 16:35 ST 3

Production and quality control of GEM chambers for the CMS Muon System — •Henning Keller, Thomas Hebbeker, Carsten Heidemann, Kerstin Hoepfner, Giovanni Mocellin, and Moritz Seidel — III. Physikalisches Institut A, RWTH Aachen University

In the next years, the LHC will experience a series of upgrades leading to an increased instantaneous luminosity of up to 5×10^{34} cm^{-2}s^{-1}. Along with the LHC, the CMS detector needs to be upgraded, where, in particular, the forward region will be subject to higher background rates and larger radiation doses.

The installation of GE1/1 detectors during Long Shutdown 2 marks the first major upgrade of the CMS Muon System. The endcaps will be complemented by 144 Gas Electron Multiplier (GEM) chambers representing a key component for the muon trigger and tracking performance at high luminosity.

Production sites in seven different countries around the world have been setup to assemble and test the required amount of detectors. GEM detectors with large dimensions of the order of 1 m^2 are built. Before installation, several quality control tests (QCs) are performed. Individual components of the chamber, such as the GEM foils and the gaps between the foils as well as outer frames and PCBs are tested (QC1-2). QC3 and QC4 cover checks of gas tightness and high voltage integrity. QC5 is dedicated to measure the gas gain uniformity.

The mass production of the CMS GEM detectors and the outcome of the quality control tests are discussed in this talk.

T 19.4 Mo 16:50 ST 3

Validation of the CMS GEM Chambers with cosmic rays — •Giovanni Mocellin, Thomas Hebbeker, Kerstin Hoepfner, Henning Keller, Carsten Heidemann, and Moritz Seidel — III. Physikalisches Institut A, RWTH Aachen University

With the increase of the instantaneous luminosity delivered to the experiments by the LHC accelerator, reaching a value of $5{\times}10^{34}$ cm^{-2}s^{-1} after the Long Shutdown 3, the detectors have to be upgraded to improve the performance and to sustain higher particle fluxes. The forward regions, corresponding to the endcaps of the detectors, are the most affected parts. In the CMS experiment, to cope with the higher event rates and larger radiation doses, triple-layer Gas Electron Multipliers (GEM) will be installed in the Muon Endcaps. For the first time, such detectors will have large sizes of the order of 1 m^2, thus high requirements on the consistency of the performance across the detector are needed. Triple-GEM chambers will complement the existing Cathode Strip Chambers, leading to a better identification of the muon tracks and a reduction of the trigger rate due to the suppression of fake candidates. In addition, the forward coverage will be further extended. Before the final installation in the CMS detector, the GEM chambers undergo a quality control test with cosmic rays to check their integrity, quality and performance. The main parameters under study are the efficiency, the noise level and the tracking capabilities. This talk gives an introduction to GEM detectors and presents the status and the initial results of the cosmic rays test.

T 19.5 Mo 17:05 ST 3

Investigation of a high rate capable readout chip for Micromegas detectors — •Maximilian Rinnagel, Otmar Biebel, Bernhard Flierl, Maximilian Herrmann, Ralf Hertenberger, Christoph Jagfeld, Felix Klitzner, Philipp Lösel, Ralph Müller, and Chrysostomos Valderanis — LMU München

The VMM readout chip is designed to be a high rate capable readout chip specifically designed for charge information in gaseous detectors. It samples 64 input channels providing for each channel digital data on pulse height and timing of the pulse maximum. The features and performance of the VMM chip on Micromegas detectors is compared to the APV chip which was originally designed for silicon detector readout but which was adapted for Micromegas. Studies were performed with VMM chips attached on a square meter sized four layered Micromegas detector and small sized Micromegas detectors. These include efficiency studies, position and angular resolution using a muon and pion beam with straight and inclined tracks. The small sized detector has been investigated in a proton beam with the possibility to compare its performance to the APV readout systems.

T 19.6 Mo 17:20 ST 3

Test under high irradiation of new ASD chips for Phase II upgrade of the ATLAS muon spectrometer for the HL-LHC — •Catriona Bruce[1], Oliver Kortner[1], Hubert Kroha[1], Robert Richter[1], Korbinian Schmidt-Sommerfeld[1], and Chrysostomos Valderanis[2] — [1]Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Munich — [2]Ludwig-Maximilians-Universität, Munich

The muon spectrometer of the ATLAS detector selects muons originating from weak interactions ($p_T > 20$ GeV/c). The comparatively huge background of low-p_T muons should be rejected by an efficient trigger system based on the muon trajectory. When the LHC begins high luminosity operation in 2026, it will be necessary to switch to a more selective first level muon trigger based on fast track reconstruction, requiring continuous readout of the MDT precision tracking chambers. The front-end electronics have been redesigned with new amplifier-shaper-discriminator (ASD) and TDC chips for compatibility with the new trigger scheme and the 10 times higher first-level trigger rates.

The new ASD chip in 130 nm GF CMOS technology has been characterized in the laboratory and tested on a muon chamber in a muon beam under a high gamma radiation background in CERN's Gamma Irradiation Facility. The irradiation affects the drift tube occupancy and the pulse shape of the muon signals and therefore the efficiency and intrinsic spatial resolution. Tests were performed with a range of background fluxes, up to ten times the peak expected value at the HL-LHC.

T 19.7 Mo 17:35 ST 3

Effects of humidity on the gas gain in MicroMegas detectors — •Thorwald Klapdor-Kleingrothaus — Universität Freiburg

The Micro-Mesh-Gaseous Detectors (MicroMegas) are planar and high-rate capable detectors with a high spatial resolution of $\sim 100\mu$m. In the recent years, the MM technology was intensively studied to replace the innermost station of the ATLAS endcap muon spectrometer. The new detector assembly is known as the New Small Wheel Upgrade and will be installed in the next few years. The NSW will use the MicroMegas and sTGC detectors for triggering and track reconstruction. The performance and response of the MicroMegas detectors can be influenced by variations in the pressure or the gas mixture, like the admixing of humidity, of the operation gas. In addition, there is a further influence by the operation voltage, as the detectors are operated in proportional mode. In this context, MicroMegas prototypes (10x10cm^2) were used to study their performance and their behavior with respect to the mentioned influences. These effects are studied with an experimental setup and according simulations. A potential compensation by the adjustment of the applied operation voltage is investigated. The obtained results affect the design of detector-slow-control system at the New Small Wheel in ATLAS. The measurements, corresponding simulation studies and the detector-slow-control system will be presented.

T 19.8 Mo 17:50 ST 3

Testbeam Studies of a Large Micromegas Quadruplet for the ATLAS New Small Wheel Project — •Patrick Scholer, Ulrich Landgraf, and Stephanie Zimmermann — Physikalische Institut, Universität Freiburg

During the current shutdown of the LHC 2019/20, the innermost end cap of the Muon Spectrometer of the ATLAS detector will be replaced by the so called New Small Wheel (NSW). It will use Micro Mesh Gaseous Detectors (Micromegas) and small-strip Thin Gap Chambers (sTGCs) as its detector technologies; both providing a high spatial resolution at high incidence rates of 20 kHz/cm^2.

One of the first Micromegas detector modules of the NSW series production in combination with the final read-out electronics was studied in a test-beam campaign at the SPS accelerator at CERN last summer. In this talk, results of this test-beam campaign will be presented. The focus will be set on the reconstruction performance of inclined tracks. Different reconstruction methods, e.g. the so called uTPC method that uses the drift gap of the Micromegas detector as time projection chamber, and their application to the obtained data will be presented.

T 19.9 Mo 18:05 ST 3

Characterisation of 2 m^2 sized 4 layered Micromegas Modules with Cosmic Muons — •Maximilian Herrmann, Otmar Biebel, Bernhard Flierl, Ralf Hertenberger, Christoph Jagfeld, Felix Klitzner, Philipp Lösel, Ralph Müller, Maximilian Rinnagel, and Chrysostomos Valderanis — Ludwig-Maximilians Universität München

Micropattern gaseous detectors are ideal for track reconstruction of muons in high flux environments. They are high rate capable and have a spatial resolution below 100 μm. In high energy physics experiments large areas have to covered with such precision trackers. Therefore Micromegas modules with areas of 2 m^2 and with four active layers have been developed. The investigation of these modules is done in the Cosmic Ray Facility near Munich. Tracks of cosmic muons are used for the comparison between the performance of reference system and module. The active area of a Micromegas module is investigated with respect to homogeneity in pulse height, efficiency and resolution. Also deviations to the nominal design can be uncovered down to the order of 10 μm. We present results for these investigations with several modules and studies done for different gas mixtures.

T 19.10 Mo 18:20 ST 3

Investigation of a multiplexed readout for Micromegas detectors — •Christoph Jagfeld, Otmar Biebel, Bernhard Flierl, Maximilian Herrmann, Ralf Hertenberger, Felix Klitzner, Philipp Lösel, Ralph Müller, Maximilian Rinnagel, and Chrysostomos Valderanis — LMU, Munich

In Micromegas detectors (Micro-MEsh GAseous Structures), a modern form of micro-pattern gaseous detectors, every single micro strip is read out by a single electronic channel. For large scale Micromegas detectors this results in a huge number of electronic readout channels and corresponding electronics, leading to high power consumption and heat dissipation. To reduce the number of electronic readout channels by a factor of two a multiplexed readout scheme has been developed and investigated.
Tests at the tandem accelerator in Munich with 20MeV protons at an angle of incidence of 20° have been performed to observe the impacts of the multiplexed readout on the angular resolution and signal pulse height.
To observe the impacts on the efficiency and spacial resolution studies with cosmic muons have been done.
These tests, which will be presented show the usability of the multiplexed readout for the Micromegas detector.