T 11: Gaseous Detectors I

Time: Monday 16:15–18:15 Location: KH 01.014

T 11.1 Mon 16:15 KH 01.014

A Straw Tube Chamber Prototype — •Julia Okfen, Oliver Kortner, Sandra Kortner, Hubert Kroha, Max Lohrmann, Nick Meier, Giorgia Proto, and Jörg Zimmermann — Max Planck Institute for Physics, Munich, Germany

The future e^+e^- collider provides a unique opportunity for precision measurements of the Higgs boson. The Higgs-strahlungs process enables the detection of Higgs bosons through the recoil momentum and thereby allows the determination of its total width in a model independent way. To achieve this, the precise momentum measurement of the Z-boson decay particles is crucial, requiring an accuracy at the level of 0.1% for $p_T \approx 50$ GeV/c, commensurate with the narrow spread of the center-of-mass energy. As GEANT-4-based studies performed by the Straw Tracker community reveal, a tracking system consisting of a combination of silicon and gaseous detectors achieves the best momentum resolution. The gaseous detector can be realized using a drift chamber, however, a straw tube tracker also achieves a comparable performance, offering additional advantages, such as functioning as independent detector units. This contribution presents the development and production of a 1.5m-long Straw Tube chamber prototype. It also reports test beam results obtained at CERN's GIF++ facility, including key performance criteria such as efficiency and single tube resolution, which highlight the suitability of the Straw Tube tracker for an inner detector concept of a future e^+e^- collider experiment. In addition, important lessons learned are discussed that will be essential for designing and building the next 4m-long prototype.

T 11.2 Mon 16:30 KH 01.014

Spatial Resolution of the SHiP Decay Spectrometer Straw Tracker with SAMPIC Read-Out — •Wei-Chieh Lee, Caren Hagner, Daniel Bick, and Walter Schmidt-Parzefall — Institute of Experimental Physics, University of Hamburg, Hamburg, Germany

SHiP (Search for Hidden Particles) is a general-purpose beam-dump experiment currently in preparation at CERN SPS. The experiment is designed to look for feebly interacting particles (FIPs) predicted by several theoretical models of the hidden sector. From dumping the high-intensity proton beam from the SPS onto a target, hidden particles would be potentially produced and fly towards a 50 m long decay volume, where they decay into SM particles to be detected. The Decay Spectrometer Straw Tracker (DSST) downstream, consisting of about 10,000 straw tubes of 4 m length and 2 cm diameter, plays the role of tracking the charged decay products and measuring their momentum for the reconstruction of the decay vertex and mass of the hidden particles. A high spatial resolution of the DSST is essential and requires a precise drift time measurement. To achieve this, the use of a waveform time-to-digital converter (WTDC) for read-out, such as SAMPIC with its high timing precision and capability to sample the leading edge of a signal, is currently under investigation.

For testing, a small DSST prototype was taken to DESY and CERN PS for test beams. The results will be presented in this talk. Furthermore, a plan to test a full-scale prototype of 4 m long straw tubes will be discussed.

T 11.3 Mon 16:45 KH 01.014

Triplet assembly and certification of the new generation of RPC for the ATLAS phase-2 upgrade — Giorgia Proto, •Viktor Griniushin, David Schulteiss, Oliver Kortner, Pavel Maly, and Daniel Soyk — Max Planck Institute for Physics

A new generation of Resistive Plate Chambers have been developed for the ATLAS phase-2 upgrade in sight of the High-Luminosity phase of the Large Hadron Collider. These RPCs consist in three independent 1 mm gas gaps(singlets) equipped with a newly low-threshold Front-End electronics(1 fC), assembled in the same mechanical structure(triplet). The production of the phase-2 RPCs started and the detectors will undergo a certification test before the installation in the ATLAS cavern. The triplet assembly and the certification with cosmic rays of the BIS-type detectors is performed at the Max-Planck-Institute for Physics(MPI) in Munich. The architecture of the cosmic rays test stand has been built at MPI and has been studied in order to provide an efficient and robust structure to ensure an excellent quality control and study precisely the whole RPC performance needed to certify the detectors for the ATLAS experiment. In this presentation the assembly procedure, the architecture of the test stand and the first results on the performance of the Module 0 will be presented.

T 11.4 Mon 17:00 KH 01.014

Influence of gap parameters in a triple-GEM detector — Erik Ehlert, Kerstin Hoepfner, •Stella Israel, Daniel Klee, Markus Merschmeyer, Alexander Schmidt, and Shawn Zaleski — III. Physikalisches Institut A, RWTH Aachen University

Triple Gas Electron Multiplier (GEM) detectors are used in various experiments with different gap configurations, most notably 3/2/2/2 mm and 3/1/2/1 mm. While previous studies have shown that shorter drift gaps can improve the time resolution in different gas mixtures, a systematic comparison for the commonly used Ar/CO_2 (70/30) mixture is still missing. To investigate the influence on the signal, the gap spacings are varied in a dedicated $10\times10\,cm^2$ test chamber.

This talk offers a first look into the comparison of the different gap configurations operated with the same electric fields. The aim is to clarify the role of the gap parameters in the signal formation of triple-GEM detectors.

T 11.5 Mon 17:15 KH 01.014

Impact of environmental pressure and temperature variations on triple-GEM detector gas gain — •Erik Ehlert, Kerstin Hoepfner, Francesco Ivone, Giovanni Mocellin, Alexander Schmidt, and Shawn Zaleski — III. Physikalisches Institut A, RWTH Aachen University

The gas electron amplification factor of Gas Electron Multiplier (GEM) detectors depends on the mixture, the temperature and the pressure. While the gas mixture can be adjusted precisely, the gas temperature and pressure are influenced by the fluctuations of the environmental parameters. Correcting for such variations is therefore crucial to maintain stable operating conditions or to compare performance measured in different conditions. The talk presents the experimental setup which was used to study the dependence of triple-GEM gas gain on temperature and pressure. The results of the experimental study are shown alongside a results from simulation studies.

T 11.6 Mon 17:30 KH 01.014

Characterisation of a multi-anode ACHINOS sensor for Spherical Proportional Counters — •Itxaso Beatriz Antolín, Konstantinos Nikolopoulos, Ioannis Manthos, Isabella Oceano, and Theodoros Avgitas — University of Hamburg, Hamburg, Germany

The Spherical Proportional Counter (SPC) is a gaseous detector that combines intrinsic low capacitance with high gain, enabling energy detection thresholds down to the single ionization electron level. These features make the SPC a promising technology for searches for low-mass dark matter. In this talk the characterisation of a multi-anode ACHINOS sensor, consisting of 11 individually readout anodes, is presented. Moreover, the latest developments in SPC readout are discussed.

T 11.7 Mon 17:45 KH 01.014

Research and Development of a micro-pixel capacitive sharing Micromegas detector — •Eshita Kumar, Otmar Biebel, Valerio D'Amico, Ralf Hertenberger, Nick Schneider, Lilla Schneider, Chrysostomos Valderanis, and Fabian Vogel — Ludwig Maximilians University, Munich

MICRO MEsh GAseous Structure (Micromegas) detectors are micro patterned gaseous detectors that have high rate capability due to the fast evacuation of positive ions and excellent spatial resolution due to a small scale readout strip pitch. However, large scale detectors need thousands of channels which leads to increased power consumption and significant heat generation, often requiring dedicated cooling systems. This talk explores a way to reduce the number of readout channels without compromising position measurement accuracy by encoding the precise position information of the particle's passage through the detector via capacitive sharing using multiple stacked layers of signal electrodes. A prototype of this detector was tested at CERN's SPS beam of 120 GeV muons and the results of the performance and efficiency of this detector will be presented. Comparison with the simulation

results using ANSYS and Garfield++ will also be discussed.

T 11.8 Mon 18:00 KH 01.014

Amplification properties of gaseous tetramethylsilane (TMS) for antineutrino-based nuclear safeguards — •Adhitya Sekhar[1], Nick Thamm[2], Sarah Friedrich[1], Robin Mentel[1], Stefan Roth[2], and Yan-Jie Schnellbach[1] — [1]Technische Universität Darmstadt — [2]RWTH Aachen University

In recent years there has been growing interest in antineutrino-based nuclear safeguards for monitoring reactor operation and spent fuel containment through the low-MeV antineutrinos emitted in beta-decay of fission fragments. Following previous promising simulations, a prototype for a novel antineutrino detection concept utilising a liquid organic time projection chamber (LOr-TPC) is now being developed. This study presents the initial phase of this project, showcasing investigations into the amplification properties of gaseous tetramethylsilane (TMS).

NMR-grade liquid TMS was boiled and flushed through an experimental chamber using a simple gas circulation system, with the exhaust gas condensed and recollected for future repurification efforts. A first test was conducted using a single-wire proportional counter in a ∼5mL cylindrical chamber and a ^{55}Fe source, with current amplification of up to three orders of magnitude observed at just under 4kV. Subsequently, a second test is being planned using a Thick Gaseous Electron Multiplier (THGEM). The results of these tests will be shown, along with comparisons made to previous measurements of amplification in other standard gases using the same setup.