T 11: Gaseous Detectors

Time: Monday 16:15–18:15 Location: T-H24

T 11.1 Mon 16:15 T-H24

Photon Detection by Structured Converter Layers in Micro-Pattern Gaseous Detectors — •Katrin Penski, Otmar Biebel, Stefanie Götz, Vitaliy Havrylenko, Ralf Hertenberger, Christoph Jagfeld, Maximilian Rinnagel, Chrysostomos Valderanis, and Fabian Vogel — LMU München

Micro-Pattern Gaseous Detectors are high-rate capable with excellent spatial and temporal resolution. Developed for the detection of charged particles, the low density in the active gas volume of these detectors exhibit only a poor detection efficiency for electrically neutral particles. For photons the detection via the photoelectric effect can be increased using a solid converter cathode, which is made of high-Z materials. With our novel approach the detection efficiency can be optimized by incorporating several converter plates, which are mounted parallel to the electric drift field in the detector. With an optimized electric field, the created electrons are guided out of the conversion volume. First measurement results are presented and compared to corresponding simulations. This technique allows for higher photon detection efficiencies and more sensitive equipment, which might be applied to modern astrophysics, material research or medical physics.

T 11.2 Mon 16:30 T-H24

Characterisation of a neutron source using MICROMEGAS detectors — •Stefanie Götz, Otmar Biebel, Vitalii Havrylenko, Ralf Hertenberger, Christoph Jagfeld, Katrin Penski, Maximilian Rinnagel, Chrysostomos Valderanis, and Fabian Vogel — LMU München

MICRO MEsh GAseous Structure detectors (Micromegas) are high-rate capable micro-structured gaseous detectors with high spatial resolution due to small-scale readout strip pitch. This study uses the Micromegas detector technology to characterise the intensity profile and the interaction probability of the radiation composition of a 10 GBq Am-Be neutron source. The detector response from the neutron source is evaluated for different source positions relatively to the detector. Pieces of plastic and lead for radiation shielding allow differentiating between neutrons and gamma radiation when placed on the detector, thus disentangling the detector response of photons and neutrons. The interaction rate of the MeV neutrons and gammas is determined using random triggers. From the source characteristics, an interaction rate of 12 MHz is expected in a $40 \times 150\,\mathrm{cm}^2$ Micromegas detector with 1000 strips which corresponds to 6 accidental hits per trigger. The goal is to resolve the beam profile of the neutron source in both horizontal and lateral direction.

T 11.3 Mon 16:45 T-H24

Particle position reconstruction using a segmented GEM foil in a micro-structured gaseous detector — •Christoph Jagfeld, Otmar Biebel, Stefanie Götz, Vitalii Havrylenko, Ralf Hertenberger, Katrin Penski, Maximilian Rinnagel, Chrysostomos Valderanis, and Fabian Vogel — LMU, München

In Micromegas (Micro-MEsh GAseous Structures) detectors, a modern form of micro-pattern gaseous detectors, the signal is usually read out via readout strips on the anode. The signal created at the mesh is usually neglected for the particle position reconstruction. By replacing the mesh with a GEM (Gas Electron Multiplier) foil, which is segmented into 0.5 mm wide readout strips on one side, the particle position can be determined from the GEM foil signal as well. If the strips on the GEM foil are orientated perpendicular to the anode readout strips, a particle position can be reconstructed in two spatial coordinates without adding a second layer of readout strips on the anode. CERN test beam measurement results are presented. These show a good good particle reconstruction efficiency, spatial and angular resolution of this GEM-Micromegas concept.

T 11.4 Mon 17:00 T-H24

Research and Development of an Electret based Gasseous Detector — •Vitalii Havrylenko, Otmar Biebel, Stefanie Götz, Ralf Hertenberger, Christoph Jagfeld, Katrin Penski, Maximilian Rinnagel, Chrysostomos Valderanis, and Fabian Vogel — LMU, München

Gaseous Electron Multiplier (GEM) detectors require a high electric field for the signal amplification. In order to simplify the operation of such a detector system, e.g. for use on X-ray astronomy satellites the GEM foil will be replaced by an electret GEM foil. An electret is a material that conserves an internal polarisation, thus creating an electrostatic potential on a long time scale. This detector does not need an external HV supply. Results of different techniques of electret production are presented. Different bipolar epoxies were hardened in strong electric fields yielding a static polarization which can be observed by the induced voltage. Furthermore, Teflon is charged via corona-discharges. The voltage dependence on time is measured for all electret samples and compared. Potential up to 1000 V stable over multiple days are reported.

T 11.5 Mon 17:15 T-H24

Prototype of a Cherenkov position sensitive Micromegas — •Maximilian Rinnagel, Otmar Biebel, Stefanie Goetz, Christoph Jagfeld, Katrin Penski, Chrysostomos Valderanis, Fabian Vogel, and Ralf Hertenberger — LMU München

etectors utilizing the Cherenkov effect are well established for particle identification of charged particles in detector systems such as LHCb or HADES. In reverse it is possible to determine the momentum of a known particle by measuring the opening angle of the Cherenkov cone in Cherenkov media. Our goal with this $10 \mathrm{x} 10\,\mathrm{cm}^2$ prototype is a proof of principle using cosmic muons. A traversing muon creates around 1500 Cherenkov photons in our 19 mm thick ultra-violet transparent Lithium Fluoride (LiF) crystal (diameter 50 mm; UV optical refractive index 1.5). The conversion to electrons happens in transmission in a photosensitive CsI layer evaporated onto a 5 nm Cr layer, both applied to the bottom of the radiator. High voltage of -300 V, at the Cr layer, guides the ionization and photoelectrons into the drift region of a Micromegas gaseous micro pattern detector. First results utilizing muon tracks reconstructed from reference detectors will be shown. The typical signal shape of this detector as well as the spatial position reconstruction are compared to the Micromegas detector without the LiF Cherenkov radiator.

T 11.6 Mon 17:30 T-H24

Test of ATLAS Micromegas detectors with a ternary gas mixture at the CERN GIF++ facility — •Fabian Vogel, Otmar Biebel, Stefanie Götz, Vitaliy Havrylenko, Ralf Hertenberger, Christoph Jagfeld, Katrin Penski, Maximilian Rinnagel, and Chrysostomos Valderanis — LMU München

The ATLAS collaboration at LHC has chosen the resistive Micromegas technology, along with the small-strip Thin Gap Chambers (sTGC), for the high luminosity upgrade of the first muon station in the high-rapidity region, the New Small Wheel (NSW) project. Four different sizes of Micromegas quadruplets have been constructed at four construction sites in Italy (SM1), Germany (SM2), France (LM1) and CERN/Greece/Russia (LM2). Achieving the requirements for these detectors revealed to be even more challenging than expected. One of the main features being studied is the HV stability of the detectors. Several approaches have been tested in order to enhance the stability, among them the use of different gas mixtures. A ternary Argon-CO_2-iC_4H_{10} mixture has shown to be effective in dumping discharges and dark currents. It allows the operation of the Micromegas detectors at safe working points with high cosmic muon detection efficiency. The presence of Isobutane in the mixture required a set of aging studies, ongoing at the GIF++ radiation facility at CERN, where the expected HL LHC background rate is created by a ^{137}Cs 14 TBq source of 662 keV photons. Preliminary aging results and effectiveness of the ternary mixture will be shown.

T 11.7 Mon 17:45 T-H24

The Influence of Oxygen Defects at Measurements with a MicroMegas Detector Filled with an Ar-CO_2 Gas Mixture — •Burkhard Böhm[1], Deb Sankar Bhattacharya[1,2], Thorben Swirski[1], and Raimund Ströhmer[1] — [1]Universität Würzburg — [2]INFN Trieste

In particle physics, Micro-Pattern Gaseous Detectors (MPGD) find high usage in different experiments like ATLAS, CMS or ALICE. In this study MicroMegas (MM) - a special type of MPGDs - are researched in terms of O_2 contamination. They are well known for their simple single-stage amplification, high and stable gain and excellent spatial and temporal resolutions. These detectors can be contaminated by O_2 from the air and due to the electronegativity of O_2, electrons in the gaseous detector can be captured. Hence, even a low concentration of O_2 has an impact on the detector performance. By precisely controlled inflowing of O_2 inside a resistive MicroMegas chamber, the effect on the gas-gain,mainly due to attachment in the drift region, and the amplification of the number of primary electrons are studied. In parallel to the experimental study numerical investigations were done to estimate the amplification gap from the comparison of the simulated to the measured signal.

T 11.8 Mon 18:00 T-H24

A GridPix detector for IAXO — •Tobias Schiffer, Klaus Desch, Jochen Kaminski, Sebastian Schmidt, and Markus Gruber — Physikalisches Institut der Universität Bonn

In the scope of the search for axions with helioscopes, like the International Axion Observatory (IAXO) and its precursor BabyIAXO, detectors capable of measuring low energy X-rays down to the 200 eV range are necessary. For this purpose the GridPix detector, which was already successfully used at CAST, is an appropriate and constantly evolving solution.

The GridPix is a MicroMegas like readout consisting of a pixelized readout ASIC (Timepix/Timepix3) with a perfectly aligned gas amplification stage on top. Due to the very high granularity this detector is capable of detecting single electrons allowing the measurement of low energy X-rays. To convert these X-rays into electrons a gas volume is built above the readout sealed with a vacuum tight X-ray entrance window.

For the goals of IAXO and BabyIAXO a very low detector background needs to be achieved, therefore only a few radiopure materials are contemplable. Also a good offline separation of signal and background events is to be achieved, here the insights from the CAST detector are used. Further, to get more signal the X-ray entrance window needs to be as transparent as possible for the low energy X-rays. This is achieved with an ultra thin ($<$200 nm) silicon nitride membrane.

The challenges of the design process and some first results of the detector will be presented.