T 98: Gas-Detecors, Detector Systems

Time: Wednesday 17:30–19:00 Location: WIL/A120

T 98.1 Wed 17:30 WIL/A120

X-ray Polarimetry with GridPixes — Klaus Desch, •Markus Gruber, and Jochen Kaminski — Physikalisches Institut, Universität Bonn

In astrophysics and material science on synchrotron light sources the measurement of X-ray polarisation can be an useful instrument. Therefore, a direct measurement would be beneficial. It can be directly measured by tracking photoelectrons created in photoelectric interactions. This is possible because their emission angle depends on the direction of the electric field vector of the photons. Within a gaseous detector these electrons have a sufficiently long mean free path such that tracking is possible - if the granularity of the readout is high enough. For this a GridPix - a combination of a Timepix(3) ASIC with 55 μm pixel pitch and a photolithographically postprocessed amplification stage (integrated grid) can be used. Within the GridPix the holes of the grid are perfectly aligned with the pixels. Thus, it is possible to detect the avalanches of individual primary electrons.

The talk will focus on the working principle and the design of a GridPix based X-ray polarimeter. Based on testbeam data taken at PETRA III and simulations the performance of the detector at different X-ray energies as well as the dependence on different detector parameters like gas choice and geometry will be discussed. Additionally challenges and possible improvements of such a detector will be presented.

T 98.2 Wed 17:45 WIL/A120

Development of a GridPix detector for IAXO — •Johanna von Oy, Klaus Desch, Jochen Kaminski, Tobias Schiffer, Sebastian Schmidt, and Markus Gruber — Physikalisches Institut der Universität Bonn

To search for the yet undiscovered particle axion, the helioscope experiment International AXion Observatory (IAXO) and its intermediate experimental stage BabyIAXO have been proposed. In these experiments, axions coming from the sun are converted into X-rays in a magnet utilizing the inverse Primakoff effect.

The then focused X-rays can be detected with a gas-filled GridPix detector. The base of this detector is a pixelated readout chip with a perfectly aligned mash on top that acts as a gas amplificication stage. This allows individual electrons, produced by the X-rays in the gas volume to be detected.

Due to the low probability of axions converting into X-rays thanks to their small interaction strength, the detector background has to be very low. For that purpose, the materials used have to be as radiopure as possible. A first prototype, using the materials in their non-radiopure form has been build and is being tested.

This talk explains the detector in detail and discusses first test results.

T 98.3 Wed 18:00 WIL/A120

Prototype of a Cherenkov position sensitive Micromegas — •Maximilian Rinnagel, Otmar Biebel, Valerio D'Amico, Florian Egli, Stefanie Goetz, Christoph Jagfeld, Eshita Kumar, Katrin Penski, Nick Schneider, Chrysostomos Valderanis, Fabian Vogel, and Ralf Hertenberger — LMU München

Detectors utilizing the Cherenkov effect are well established for particle identification of charged particles in detector systems such as LHCb. 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 D =100 mm 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 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 with two dimensional position readout, spatial resolution below 100 μm and good timing resolution. This will allow to distinguish between muon and photon signals.

T 98.4 Wed 18:15 WIL/A120

Prototype of a Cherenkov detector for the LUXE Experiment — •Antonios Athanassiadis[1,2], Louis Helary[1], Ruth Magdalena Jacobs[1], Jenny List[1], Gudrid Moortgat-Pick[2,1], Evan Ranken[1], and Stefan Schmitt[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [2]Universität Hamburg, Germany

The aim of LUXE (Laser Und XFEL Experiment based at DESY, Hamburg) is to measure strong-field QED effects with high precision. In order to create electric fields stronger than the so-called Schwinger limit, it is planned to collide a high-intensity laser pulse with either high-energy electrons up to 16.5 GeV or high-energy photons.

These two configurations either result in non-linear Compton scattering or Breit-Wheeler interactions which can be studied by measuring rates and kinematics of secondary particles created at the interaction point like high-energy electrons, positrons and photons.

For the detection of electrons, with expected fluxes of the order of 10^4 to 10^9 particles in an area of $15\,\mathrm{cm} \times 1\,\mathrm{mm}$ per event, a Cherenkov detector in combination with magnetic deflection for high-precision spectrometry will be used.

This contribution will present the simulation-based design of the Cherenkov detector, as well as first operation experience obtained with a prototype. Further optimisation of the various components as well as reconstruction algorithms will be discussed.

T 98.5 Wed 18:30 WIL/A120

Monte Carlo simulation studies of background contributions in the Mu2e experiment — •Reuven Rachamin[1], Stefano Di Falco[2], Anna Ferrari[1], Valerio Giusti[3], Stefan Müller[1], and Vitaly Pronskikh[4] for the Mu2e-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]INFN Pisa, Pisa, Italy — [3]University of Pisa, Pisa, Italy — [4]Fermi National Accelerator Laboratory, Batavia, IL, USA

The Mu2e experiment is currently being constructed at Fermilab to search for the direct conversion of muons into electrons in the field of a nucleus without the emission of neutrinos. The experiment aims at a sensitivity of four orders of magnitude higher than previous related experiments, which implies highly demanding accuracy requirements both in the design and during the operation. Hence, it is essential to estimate precisely the backgrounds that could mimic the monoenergetic conversion electron signal and the particle yields relevant to the experiment sensitivity. In that regard, Monte Carlo simulations were performed to investigate key yields and beam-related and cosmic rays-related backgrounds. The investigation includes: (I) an evaluation of the antiproton and charged pion yields from an 8 GeV proton pencil beam impinging on a tungsten cylindrical target, (II) an evaluation of the transmission of cosmic neutrons and neutral kaons in a block of concrete. The simulations were performed using the FLUKA2021, MCNP6, GEANT4, PHITS, and MARS15 codes. The presentation will show the simulation results with a focus on the prediction obtained from each code and their impact on the experiment.

T 98.6 Wed 18:45 WIL/A120

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

The Mu2e experiment, currently under construction at the Fermi National Accelerator Laboratory near Chicago, will search for the neutrinoless direct conversion of a muon to an electron in the field of an aluminum nucleus, aiming for a sensitivity four orders of magnitude better than previous experiments. The observation of a clear signal would imply Charged Lepton Flavor Violation, and hint at physics beyond the Standard Model.

The normalization of the signal events will be done by monitoring the rate of muons stopping on aluminum target discs. This will be accomplished with a detector system made of an HPGe detector and a Lanthanum Bromide detector, which detect the characteristic X- and γ-rays of energies up to 1809 keV produced when the muons are stopped or captured on the aluminum.

At the Helmholtz-Zentrum Dresden-Rossendorf, we have used a pulsed Bremsstrahlung photon beam at the ELBE radiation facility to study the performance of the detectors under conditions very similar to the ones expected at Mu2e.

In the presentation, a short overview of design and status of the Mu2e experiment and its detectors will be given, and results of the ELBE beamtime campaigns will be presented.