5th International Conference on Micro-Pattern Gas Detectors (MPGD2017)

Report of Contributions

https://indico.cern.ch/e/581417

Contribution ID: **2** Type: **Oral presentation**

GridPix detector with Timepix3 ASIC

Thursday, May 25, 2017 4:50 PM (20 minutes)

GridPix detectors combine the advantages of a high granularity readout based on a pixel ASIC with a Micromegas gas amplification stage. By producing the Micromegas with photolithographic postprocessing techniques directly on the ASIC a very good alignment of grid holes with readout pixels can be reached. Thus, the charge avalanche started by a single primary electron can be collected and digitized by a single pixel giving excellent spatial resolution. Also, the energy resolution improves because of the primary electron counting instead of charge summation.

After demonstrating the potential of the GridPix detector in several environments a new ASIC, Timepix3, has been designed and produced. It overcomes its predecessors limitations. Most notably it allows for multihit readout and for simultaneous charge and time measurement of each pixel. While preparing for the new generation of GridPix detectors, also the design and the production techniques of the grid were revised and improved.

A first detector was built with the new Timepix3-based GridPix. It was tested with different kinds of ionization sources among which are radioactive sources and a laser setup. These first measurements underline the improvements of the system and will be presented in the conference. As a possible application a design for a TPC endplate covered with GridPixes for an ILC experiment will be discussed.

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Presenter: KAMINSKI, Jochen (University of Bonn (DE))

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 2 (Chair: Bernd Surrow)

Contribution ID: **4** Type: **Poster presentation**

How many electrons can fit in a GEM hole?

Tuesday, May 23, 2017 3:00 PM (4 minutes)

The key parameters for a long-term operation of GEM-based detectors in the harsh environment of high-rate experiments are radiation hardness, ageing resistance and stability against electrical discharges. Therefore, a comprehensive understanding of the discharge mechanism is mandatory to assure a stable operation of the detector.

We report on discharge probability studies in single- and multi-GEM structures in Ar- and Ne-based gas mixtures. Our experimental findings are in line with a well-grounded hypothesis of charge density being the driving factor for a discharge formation in GEMs.

Results of the measurements are compared to the outcome of the GEANT simulations. The latter can be used to estimate a critical charge, which leads to a formation of a spark in a GEM hole.

Authors: GASIK, Piotr (Technische Universitaet Muenchen (DE)); MATHIS, Andreas (Technische Universität München (DE))

Presenter: GASIK, Piotr (Technische Universitaet Muenchen (DE))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **5** Type: **Oral presentation**

The micro-RWELL detector

Tuesday, May 23, 2017 8:50 AM (20 minutes)

Abstract

The R&D on the micro-Resistive-WELL (μ-RWELL) detector technology aims in developing a new scalable, compact, spark-protected, single amplification stage Micro-Pattern Gas Detectors (MPGD) for large area HEP applications as tracking and calorimeter device as well as for industrial and medical applications as X-ray and neutron imaging gas pixel detector. The novel micro-structure, exploiting several solutions and improvements achieved in the last years for MPGDs, in particular for GEMs and Micromegas, is an extremely simple detector allowing an easy engineering with consequent technological transfer toward the photolithography industry. Large area detectors (up 1x2 mˆ2) can be realized splicing μ-RWELL_PCB tiles of smaller size (about 0.5x0.5 mˆ2 –typical PCB industrial size). The detector, composed by few basic elements such as the readout-PCB (embedded with the amplification stage through the resistive layer) and the cathode defining the gas drift-conversion gap has been largely characterized on test bench with X-ray and beam tests.

Summary

The micro-resistive WELL (μ-RWELL) detector is a compact, spark-protected, single amplification stage Micro-Pattern Gas Detector (MPGD). The new micro-structure exploits several solutions and improvements implemented in the last years for MPGDs, in particular for GEMs and Micromegas. The μ-RWELL, based on the resistive technology concept leading to very efficient spark quenching, is a high reliable device. In addition, since does not require any complex and time-consuming assembly procedures (neither stretching nor gluing), it becomes extremely simple to be assembled. These features allow for an easy engineering of the detector opening the way towards industrial applications.

The detector is composed by only two elements, i.e. the readout-PCB, embedded with the amplification stage (the core of the detector, named μ-RWELL_PCB) and the cathode. The amplification stage of the detector, realized by photolithography as a matrix of wells (with a pitch of 140 μm and a diameter of 60-70 μm) on a 50 μm thick polyimide substrate, is embedded through a resistive layer with the readout board. The resistive layer can be realized by means DLC (Diamond Like Carbon) dry sputtering technology. The required surface resistivity, typically ranging from tens to hundreds MΩ/square, is clearly a crucial parameter that must be optimized as a function of detector performance, such as rate capability, charge spread on the readout electrodes, spark quenching and maximum achievable gain. A cathode electrode, defining the gas conversion-drift gap, completes the detector mechanics. The detector has been characterized on test bench with X-rays and its tracking performance measured on several beam test in different conditions. The device, robust against discharges, can be operated in a safe mode at a gas gain up to 10ˆ4, a rate capability up to few MHz/cmˆ2 (achieved for particular scheme of the resistive layer) and a space resolution down to 60 μm. The μ-RWELL technology, under development with industrial partners, is suitable for large area tracking devices and can be exploited as active device in digital hadron calorimetry in HEP experiments: the detector, recently proposed for the phase-2 upgrade of CMS and LHCb muon apparatus as well as for the neutrino detector of the SHIP experiment, is a technology suitable also for the muon apparatus at future colliders (CEPC, SppC and FCC –hh).

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Session Classification: MPGD detector technologies - 5 (Chair: Marcus Hohlmann)

Contribution ID: **6** Type: **Poster presentation**

On-line and real-time thickness and density measurement for quality control of thin films using GEMs

Thursday, May 25, 2017 3:38 PM (4 minutes)

This work presents a new industrial application of MPGDs for thin films characterization and quality control. This is made by the design and adaptation of an optimal electronics and other technical features of a 3GEM that take advantage of the great qualities of these detectors for the specific application. This work have been developed at the Laboratorio de Detectores of the Universidad Antonio Nariño using a 3GEM for an on-line and real-time apparatus to measure physical properties of thin films, such as thickness, density and grammage during the production processes in industry. This is very important for the production of polymers film extrusion, paper, textiles, aluminum foils, among many others, in order to improve quality and efficiency, reduce costs and reduce environmental impact.
Presently there are different types of on-line instrumentation to perform this type of measurements with different techniques; however all of them provide local measures implying inefficiency, inaccuracy and several sources of errors limiting the solution of the thin films quality control problem. In this work we take advantage of the performance of a 3GEM with an appropriated and controlled radiation source to measure small variations of the energy transmitted and reflected by the thin film under observation. The high gain and relative large detection area of the 3GEM provide an efficient, accurate and low cost quality control of thin films.

Authors: FUENTES ROBAYO, Freddy; GUTIERREZ, Rafael M (Universidad Antonio Nariño)

Presenter: GUTIERREZ, Rafael M (Universidad Antonio Nariño)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **7** Type: **Poster presentation**

Characterization of Micromegas detector with elongated pillars

Tuesday, May 23, 2017 3:08 PM (4 minutes)

We present a study of the performance of a resistive Micromegas detector with elongated pillars. The purpose of this study was to certify that these pillars do not deteriorate the resolution and detection efficiency while adding safety in the detector fabrication. It was motivated by the fact that in large-size Micromegas boards produced in industry missing or weakly attached pillars have been observed. In order to overcome this issue pillars with a larger surface and, therefore, better adhesion were proposed. We built a detector with two different pillar shapes. The pillars extend in the direction orthogonal to the readout strips. One region features pillars of 2 mm × 0.2 mm with 4.8 mm pitch while in the other region the pillars extend over the full width of the detector (100 mm). The detector has been characterized with 55Fe source and a high energy muon beam at CERN. Results on the detector performance for the two regions and in comparison with standard round pillars are presented.

Authors: SIDIROPOULOU, Ourania (Bayerische Julius Max. Universitaet Wuerzburg (DE)); ALVAREZ GONZALEZ, Barbara (CERN); BORTFELDT, Jona (CERN); FARINA, Edoardo Maria (Universita e INFN, Pavia (IT)); IENGO, Paolo (CERN); SAMARATI, Jerome (CERN); SEKHNIAIDZE, Givi (Universita e INFN, Napoli (IT)); WOTSCHACK, Joerg (Aristotle University of Thessaloníki (GR))

Presenter: SIDIROPOULOU, Ourania (Bayerische Julius Max. Universitaet Wuerzburg (DE))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **8** Type: **Poster presentation**

Radiation studies on resistive bulk-micromegas chambers at the CERN Gamma Irradiation Facility

Tuesday, May 23, 2017 3:04 PM (4 minutes)

Two resistive bulk-micromegas chambers were installed in May 2015 at the CERN Gamma Irradiation Facility exposed to an intense gamma irradiation with the aim to study the detector behavior under high irradiation and the long-term aging.

The chambers have an active area of 10 x 10 cm2, strip pitch of 400 μm, amplification gap of 128 μm and drift gap of 5 mm.

The desired accumulated charge of more than 0.2 C/cm2 has been reached for one of the chambers, equivalent to 10 years of HL-LHC operation. The efficiency, amplification, and resolution of the chamber after this long-term irradiation period will be compared with the performance of a non irradiated chamber.

In addition, the latest results of the measured particle rate as a function of the amplification voltage will be presented. These results will be compared with those obtained in October 2015 and presented in the last MPGD conference in 2015.

Authors: ALVAREZ GONZALEZ, Barbara (CERN); BORTFELDT, Jona (CERN); CAMERLINGO, Maria Teresa (Universita e INFN, Napoli (IT)); FARINA, Edoardo Maria (Universita e INFN, Pavia (IT)); IENGO, Paolo (CERN); SAMARATI, Jerome (CERN); SEKHNIAIDZE, Givi (Universita e INFN, Napoli (IT)); SIDIROPOULOU, Ourania (Bayerische Julius Max. Universitaet Wuerzburg (DE)); WOTSCHACK, Joerg (Aristotle University of Thessaloníki (GR))

Presenter: SAMARATI, Jerome (CERN)

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **9** Type: **Oral presentation**

Towards High Resolution Bulk Micromegas Detectors for Nuclear Physics Instruments.

Monday, May 22, 2017 4:30 PM (20 minutes)

Emanuel Pollacco a , Rui De Oliveira b, Bertrand Mehl b, Olivier Pizzirusso b , Mariam Kebbiri a and Esther Ferrer Ribas a

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Over the last five years we have been developing instruments based on Micro Pattern Gas Detectors, MPGD specifically designed for Astro and Nuclear Physics reactions and decay studies. Today a relatively large number of instruments have or are being build for this domain. To cover needs of these developments we have been developing Bulk Micromegas MPGD with enhanced in charge resolutions. Through surface treatment of the anode, use of conducting surface polished glass, use of electroformed meshes and detector design we have obtained detectors which approach theoretical limits. We will present preliminary results, applications for the different instruments and possible further developments in the use of glass based interfaces.

Authors: POLLACCO, Emanuel (IRFU CEA Saclay); DE OLIVEIRA, Rui (CERN); MEHL, Bertrand (CERN); PIZZIRUSSO, Olivier (CERN); FERRER RIBAS, Esther (DAPNIA, Saclay)

Presenter: POLLACCO, Emanuel (IRFU CEA Saclay)

Session Classification: MPGD detector technologies - 4 (Chair: Matt Posik)

Contribution ID: **10** Type: **Oral presentation**

From gated to continuous readout: the GEM upgrade of the ALICE TPC

Wednesday, May 24, 2017 10:10 AM (20 minutes)

The ALICE Collaboration is planning a major upgrade of its central barrel detectors to be able to cope with the increased LHC luminosity beyond 2019. In order to record at an increased interaction rate of up to 50 kHz in Pb–Pb collisions, the TPC will be operated in an ungated mode with continuous readout. This demands for a replacement of the currently employed gated Multi-Wire Proportional Chambers by GEM-based (Gas Electron Multiplier) readout chambers, while retaining the performance in particular in terms of particle identification capabilities via the measurement of the specific energy loss.

The present baseline solution for the TPC upgrade consists of a stack of four large-size GEM foils as amplification stage. This arrangement, under a specific high-voltage configuration, has been proven to fully meet the design specifications in terms of ion backflow, energy resolution and stable operation under LHC conditions. In order to further guarantee operational stability for the readout chambers during construction, commissioning and final operation in the TPC, a sophisticated quality assurance scheme has been established to thoroughly monitor the quality of the GEM foils throughout the whole production process.

The increase in interaction rate and the requirements of a trigger-less, continuous readout demand for newly developed front-end cards and significant modifications of the computing system and the corresponding calibration, reconstruction and simulation framework.

In this talk, the key aspects of the completed R&D phase will be presented, as well as the current status of the new readout electronics and the computing system. Furthermore, we will present an update on the mass production of the readout chambers.

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Presenter: MATHIS, Andreas (Technische Universität München (DE))

Session Classification: Applications at future nuclear and particle physics facilites - 4 (Chair: Kondo Gnanvo)

Contribution ID: **11** Type: **Oral presentation**

Implementation of the VMM ASIC in the Scalable Readout System

Thursday, May 25, 2017 4:30 PM (20 minutes)

In the context of the ATLAS New Small Wheel upgrade, a new frontend ASIC called VMM is developed. This chip will play a significant role in the readout of Micro-Pattern Gaseous Detectors not only in ATLAS, but also for other projects within the whole MPGD community and in particular for a detector for the macromolecular crystallography instrument NMX foreseen at the European Spallation Source (ESS).
The RD51 Collaboration has developed a multi-purpose and versatile readout system that can be scaled from a single laboratory detector to LHC-like experiments: The Scalable Readout System (SRS). Different frontend ASICs have been implemented in the SRS so far.

At the moment, the state of the art ASIC used by many groups (R&D for sPHENIX/EIC at the RHIC, SBS Back Tracker and PRad GEM detector at JLAB and detector upgrade R&D for LHC experiments) is the APV25. There is a strong interest of many groups using the SRS with the APV25, to upgrade their systems to the VMM. In several design iterations (VMM1, VMM2 and now VMM3), the capabilities of the VMM have been continuously extended. The VMM3 is intended to reach the final needs as defined in the specifications.

Within the BrightnESS project, the VMM is implemented in the SRS to read out a prototype GEM based neutron detector for the NMX instrument. New FPGA firmware, dedicated hardware and software is under development.

In the laboratory of the Gaseous Detector Development group at CERN we are operating several small scale versions of the final prototype to improve the detectors themselves and test the readout system and the data acquisition software. In addition, test beams with neutrons at the JEEP II reactor of IFE at Kjeller, Norway have been carried out. The current status of the developments, capabilities of the SRS based VMM readout and latest measurement results will be presented.

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Presenter: LUPBERGER, Michael (CERN)

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 2 (Chair: Bernd Surrow)

Contribution ID: **12** Type: **Oral presentation**

Characterisation of the charging up effect in Micromegas detectors

Monday, May 22, 2017 4:50 PM (20 minutes)

During the last decade, a major improvement in the field of the Micro-Pattern
Gaseous Detectors has been reached by adding a layer of resistive strips above the readout strips to reduce drastically the effect of discharges. The resistive strips are separated from the readout strips by a thin layer of insulator. When the detector is operated at high rate some gain reduction is observed over the first seconds or minutes after switch-on, stabilising after some time. Is this related to the presence of the insulator or are there other mechanisms at work?
We report here the results of a detailed study of this effect and compare resistive-strip and standard Micromegas detectors. We will present and quantify the main characteristics of this effect, i.e, the absolute and relative gain drop and the time to reach a stable regime, as a function of the detector configuration and current. In addition we measured the time to go back to initial conditions after stopping the exposure of the detector.

Authors: SAMARATI, Jerome (CERN); ALVAREZ GONZALEZ, Barbara (CERN); BORTFELDT, Jona (CERN); FARINA, Edoardo Maria (Universita e INFN, Pavia (IT)); IENGO, Paolo (CERN); SEKHNIAIDZE, Givi (Universita e INFN, Napoli (IT)); SIDIROPOULOU, Ourania (Bayerische Julius Max. Universitaet Wuerzburg (DE)); WOTSCHACK, Joerg (Aristotle University of Thessaloníki (GR))

Presenter: SAMARATI, Jerome (CERN)

Session Classification: MPGD detector technologies - 4 (Chair: Matt Posik)

Contribution ID: **13** Type: **Oral presentation**

A large low-mass GEM detector with zigzag readout strips for forward tracking at EIC

Wednesday, May 24, 2017 9:50 AM (20 minutes)

We present design and first prototyping results for a low-mass Triple-GEM detector for forward tracking at a future Electron-Ion Collider (EIC). In the EIC environment, minimal multiple scattering of tracks must be ensured so that electron tracks can be cleanly matched to calorimeter clusters and so that hadron tracks can efficiently seed RICH ring reconstruction for particle identification. Consequently, the material budget of the forward tracking detectors must be minimized. The trapezoidal detector covers an azimuthal angle of 30.1 degrees and a radius from 8 cm to 103 cm. The construction of the detector builds on the mechanical GEM foil stretching and assembly technique pioneered by CMS for a muon endcap GEM upgrade. As an innovation, the EIC GEM prototype detector has drift and readout electrodes implemented on thin foils instead of on PCBs and omits a backing plate from the design to reduce detector material. The drift and readout foils get stretched mechanically together with three newly designed GEM foils in one stack. This assembly approach also aims at improving the uniformity of drift and induction gap sizes and consequently signal response uniformity. Thin outer frames made from carbon-fiber composite material take up the tension from the stretched stack and provide rigidity to the detector while keeping the detector mass low. The gas volume is closed with aluminized mylar foils. The detector is read out with optimized radial zigzag-strip structures of 1.4 mrad and 4.1 mrad azimuthal pitch that minimize the number of required electronics channels and associated cost while maintaining good spatial resolution below 100 microns. All front-end readout electronics is located at the wide end of the trapezoid.

Authors: HOHLMANN, Marcus (Florida Institute of Technology (US)); BOMBERGER, Matthew (Florida Institute of Technology); IZQUIERDO JIMENEZ, Francisco (Florida Institute of Technology); ZHANG, Aiwu (Florida Institute of Technology (US))

Presenter: HOHLMANN, Marcus (Florida Institute of Technology (US))

Session Classification: Applications at future nuclear and particle physics facilites - 4 (Chair: Kondo Gnanvo)

Contribution ID: **14** Type: **Oral presentation**

Beam Test Results from a GEM-based Combination TPC-Cherenkov Detector

Monday, May 22, 2017 5:10 PM (20 minutes)

A combination Time Projection Chamber-Cherenkov prototype detector has been developed for consideration at a future Electron Ion Collider and was tested at the Fermilab test beam facility in April 2016. The purpose of the test was to provide a proof of principle, demonstrating that the detector is able to measure particle tracks and provide particle identification within a common volume. The TPC portion consists of a 10x10x10cmˆ3 field cage, which delivers charge from tracks to a 10x10cmˆ2 quadruple GEM readout. Tracks are reconstructed by interpolating the hit position of clusters on an array of 2x10mmˆ2 zigzag pads, which can significantly enhance charge sharing across the active area of the readout. The Cherenkov component consists of a 10x10cmˆ2 readout plane segmented into 3x3 square pads, also coupled to a quadruple GEM. As tracks pass though the drift volume of the TPC, the generated Cherenkov light is able to escape through sparsely arranged wires making up one side of the field cage, facing the CsI photocathode of the Cherenkov detector. The Cherenkov detector is thus operated in a windowless, proximity focussed configuration for high efficiency. Pure CF4 is used as the working gas for both detector components, mainly due to its transparency into the deep UV, as well as its high N0. Results from the beam test as well as the applicability for such a detector at a future Electron Ion Collider will be discussed.

Authors: AZMOUN, Bob (Physics Dept., Brookhaven National Lab); Prof. HEMMICK, Thomas (Physics Dept., Stony Brook University); Dr MAJKA, Richard (Physics Dept., Yale University); Mr PHIPPS, Michael (Physics Dept., University of Illinois); Dr PURSCHKE, Martin (Physics Dept., Brookhaven National Lab); Dr SMIRNOV, Nikolai (Physics Dept., Yale University); Dr WOODY, Craig (Physics Dept., Brookhaven National Lab); Dr ZHANG, Aiwu (Florida Institute of Technology (US))

Presenter: AZMOUN, Bob (Physics Dept., Brookhaven National Lab)

Session Classification: MPGD detector technologies - 4 (Chair: Matt Posik)

Contribution ID: **15** Type: **Oral presentation**

Development of a thermal bonding technique for Micromegas fabrication

The micro-mesh gaseous structure (Micromegas) have been significantly developed during the decades since that it was proposed in 1995 at Saclay. Some new methods, like the thermal bonding technique which is much different from standard "bulk"etching technique are under R&D. In this paper, the manufacture processing of this new thermal bonding technique and its advantages, deficiencies will be discussed at first. In order to reduce the sparking rate, the resistant anodes by Germanium plating and carbon paste screen printing are studied. High absolute gas gain above 10000 which is much higher than 2000-4000 of standard chambers and a good resolution of 16% (FWHM) for 5.9 KeV x-rays are obtained. Some interesting applications of this technique, such as, development of a 2D position-sensitive Micromegas detector with four-corner readout, the back-to-back double avalanche structure, etc. will also be presented.

Authors: ZHANG, Zhiyong (USTC); Mr FENG, Jianxin (USTC); Mr WU, Libo; LIU, Jianbei (University of Science and Technology of China (CN)); WANG, Xiaolian (Univ. of Science & Tech. of China (CN))

Presenter: ZHANG, Zhiyong (USTC)

Contribution ID: **16** Type: **Oral presentation**

Cloud Computing for QA of MPGD GEM-foils using Image Analysis

Monday, May 22, 2017 4:10 PM (20 minutes)

This work presents the design and development of cloud computing services for Quality Assurance in GEM-foils (electrodes of a GEM-like detector) through the analysis of high resolution images. The platform analyzes images uploaded from anywhere through the web and executes an automatic measurement of the micro holes geometry presented in the GEM-foils, in order to detect and quantify different kinds of defects. Using techniques of High Performance Computing the platform performs this task in milliseconds for a standard GEM-foil of 10 x 10 cm. The diverse cloud services provided by the platform can detect variations of the micro holes geometry in a GEM-foil with an accuracy of one pixel = 1.75 μm or less, depending on the images resolution. The diverse measures extracted from every hole in the GEM-foil makes this service a valuable and functional tool for R&D which can help to define practical standards of correlations between GEM-foil qualities measured through high resolution images and its operation in a detector. The defect identification and Quality Assurance using cloud computing can also be used in the manufacture and industrial fabrication of GEM-foils.

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Presenter: RODRIGUEZ, C.A (UNIVERSIDAD ANTONIO NARIÑO)

Session Classification: MPGD detector technologies - 4 (Chair: Matt Posik)

Contribution ID: **17** Type: **Poster presentation**

RHIP, a Radio-Controlled High-Voltage Insulated Picoammeter and its usage in studying ion backflow in MPGD-based photon detectors

Thursday, May 25, 2017 2:54 PM (4 minutes)

A picoammiter system has been developed by prototyping and engineering. It consists in a current-voltage converter, based on an operational amplifier with very low input current, a high precision ADC, a radio controlled data acquisition unit and the computer-based control, visualization and storage. The picoammiter is characterized by a precision of the order of a tenth of picoamperes and it can measure currents between points laying at potentials of the order of a ten of kilovolts. The current-voltage converter and the radio transmitter are battery powered and a number of strategies have been implemented to limit the power consumption. The system is designed for multichannel application and up to 256 parallel channels can be controlled.
The overall implementation is cost-effective to make the availability of multichannel setups easily affordable.
The design, implementation and performance of the picoammiter system are described in detail.
This system has been a key tool in our studies of ion backflow in MPGD-based photon detectors; we include reporting about these results.

On behalf of the COMPASS RICH group

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Presenter: DALLA TORRE, Silvia (INFN, Trieste (IT))

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **18** Type: **Oral presentation**

The high voltage system for the novel MPGD-based photon detectors of COMPASS RICH-1

Wednesday, May 24, 2017 9:30 AM (20 minutes)

The detector architecture consists in a hybrid MPGD combination: two layers of Thick-GEMs (THGEM), the first of which also acts as a reflective photocathode thanks to a CsI film is deposited on its top face, are coupled to a bulk MICROMEGAS with pad segmented anode kept at positive high voltage (HV), while the micromesh is grounded; the signals are read-out via capacitive coupling from a second set of pads parallel to the anode ones. The THGEMs are segmented in order to reduce the energy released in case of occasional discharges. The architecture of the detectors implies nine different electrode types and more than 1000 electrodes supplied by more than 100 HV channels. The power supply system is based on commercial components by CAEN. Some original elements are present in the architecture of the HV power supply system:
(i) The distribution to the THGEM segments and to the MICROMEGAS anode pads has been optimized in order to minimize the propagation of occasional discharges to other detector sector;
(ii) The detector gain is kept stable in spite of the variation of the environmental parameters, namely pressure P and temperature T, compensating the HV according to the P and T evolution;
(iii) A sophisticated control software allows to protect the detectors against operator's error, to monitor voltages and current at 1Hz rate, to log all the sparks and to automatically react to detector misbehaviors.
The HV system and its performance are described in detail as well as the electrical stability of the detector during the first year of operation at COMPASS.

On behalf of the Trieste COMPASS group

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Session Classification: Applications at future nuclear and particle physics facilites - 4 (Chair: Kondo Gnanvo)

Contribution ID: **19** Type: **Oral presentation**

The novel photon detectors based on MPGD technologies for the upgrade of COMPASS RICH-1

Wednesday, May 24, 2017 9:10 AM (20 minutes)

The RICH-1 Detector of the COMPASS Experiment at CERN SPS has been upgraded for the physics run 2016: four new photon detectors, based on MPGD technologies and covering a total active area larger than 1.2 square meters replace the previously used photon detectors, namely MWPCs with CsI photocathodes, in order to cope with the challenging efficiency and stability requirements of the new COMPASS measurements. The new detector architecture consists in a hybrid MPGD combination: two layers of THGEMs, the first of which also acts as a reflective photocathode (its top face is coated with a CsI film) are coupled to a bulk Micromegas on a pad segmented anode; the signals are read-out via capacitive coupling by analog F-E based on the APV25 chip. The related R&D is shortly recalled. All aspects of the COMPASS RICH-1 photon detectors upgrade are presented and large emphasis is dedicated to the engineering aspects, the mass production and the quality assessment of the MPGD components. In particular, the design and production of the detector components, the assembling and the validation tests of THGEMs and Micromegas and the challenges of the detectors installation and operation are presented. The preliminary performance figures of the upgraded RICH-1 are provided.

Talk on behalf of the COMPASS RICH Group.

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Session Classification: Applications at future nuclear and particle physics facilites - 4 (Chair: Kondo Gnanvo)

Contribution ID: **20** Type: **Oral presentation**

Small-pad resistive Micromegas for operation at very high rates

Tuesday, May 23, 2017 9:10 AM (20 minutes)

We present the development of resistive micromegas with O(mm2) pad readout aiming at precision tracking in high rate environment without efficiency loss up to few MHz/cm2.
The anode copper pads (readout pads) are overlaid by an insulating layer carrying a pattern of resistive pads of the same size of the anode ones. The resistive pads are connected to the readout pads by intermediate resistors embedded in the insulating layer.
The signals are transmitted by capacitive coupling, while the charges are evacuated through the intermediate resistors.

A first prototype has been designed, constructed and tested. It consists of a matrix of 48x16 pads. Each pad with rectangular shape 0.8x2.8 mm2 and pitch of 1 and 3 mm in the two coordinates. The active surface is 4.8x4.8 cm2 with a total number of 768 channels.
The drift and amplification gaps of this micromegas prototype are 5 mm and 128 μm, respectively.
Characterization and performance studies of the detector have been carried out by means of radioactive sources, X-Rays, cosmic rays and test beam data.
Gain has been measured as a function of amplification and drift electric fields, also under high irradiation flux with radioactive sources and X-rays.
Measurements of the detector efficiency, cluster multiplicity, cluster size and spatial resolution using test beam data will be reported as well; in particular a spatial resolution of 190 μm has been obtained (in the 1 mm pad pitch view), as expected by detector construction parameters.

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Presenter: FARINA, Edoardo Maria (Universita e INFN, Pavia (IT))

Session Classification: MPGD detector technologies - 5 (Chair: Marcus Hohlmann)

Contribution ID: **21** Type: **Oral presentation**

Multi-layer Thick GEM (M-THGEM): New MPGD structure for high gain operation at low pressure

The operating principle and performances of a novel micro-pattern gaseous detector concept, the Multi-layer Thick Gaseous Electron Multiplier (MTHGEM), will be discussed. Inspired by the multi-cascade Thick Gaseous Electron Multiplier, The M-THGEM detector is made of a single, robust assembly comprising of several THGEM elements stacked together. The M-THGEM is produced by multi-layer printed-circuit-board (PCB) technique, consisting of mechanical drilling of alternate layers of copper and core material (i.e., FR-4, Kapton, Kevlar, ceramic etc.) laminated together. The electron avalanche processes occur along the successive multiplication stages within the M-THGEM holes, under the action of strong dipole fields resulting from the application of suitable potential differences between the electrodes.

We will report on the performance investigation of two different geometries: a two-layer M-THGEM (either as single or double-cascade detector) and a single three-layer M-THGEM element, tested in various low-pressure gas mixtures. The intrinsically robust confinement of the avalanche volume within the M-THGEM holes provides an efficient reduction of the photon-induced secondary effects, resulting in a high-gain operation over a broad pressure range, even in pure elemental gas. The operational principle, main properties (maximum achievable gain, long-term stability, energy resolution, etc.) under different irradiation conditions, as well as capabilities are presented and discussed.

Finally we will discuss potential applications of the M-THGEM, which include high-gain operation at low pressure such as for heavy-ion tracking/triggering, as well as operation in pure noble gas, such as needed for time projection chamber readout in active target mode. Other potential applications may include large-area UV photon detectors, muon trackers, hadron calorimetry, X-ray/neutron imaging, and secondary scintillation readout for rare event physics.

Authors: CORTESI, Marco (National Superconducting Cyclotron Laboratory); Dr AYYAD, Yassid (National Superconducting Cyclotron Laboratory); Prof. MITTIG, Wolfgang (National Superconducting Cyclotron Laboratory); Prof. BAZIN, Daniel (National Superconducting Cyclotron Laboratory); Mr YURKON, John (National Superconducting Cyclotron Laboratory); Prof. STOLZ, Andreas (National Superconducting Cyclotron Laboratory)

Presenter: CORTESI, Marco (National Superconducting Cyclotron Laboratory)

Contribution ID: **22** Type: **Poster presentation**

Characteristics of Micromegas detectors at high temperature

Tuesday, May 23, 2017 3:12 PM (4 minutes)

The behaviour of two resistive-strip bulk micromegas detectors has been studied up to a temperature of approximately 50℃. A strong increase of the dark current is observed at temperatures in excess of 40 degrees. Measurements, keeping the the gas or detector temperature constant and varying the other, show that the increase of the dark current is primarily related to the temperature of the detector. The results of a dedicated study of the resistivity of the pillars material as a function of temperature and humidity explain the observed effects. In addition to these studies, results on the detector performance in terms of response, resolution, and efficiency as a function of temperature will be presented.

Author: LONGO, Luigi (Universita del Salento (IT))

Co-authors: IENGO, Paolo (CERN); SAMARATI, Jerome (CERN); WOTSCHACK, Joerg (Aristotle University of Thessaloníki (GR))

Presenter: LONGO, Luigi (Universita del Salento (IT))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **23** Type: **Oral presentation**

Gas scintillation Glass GEM detector for high-resolution X-ray imaging and CT

Monday, May 22, 2017 3:50 PM (20 minutes)

A high resolution X-ray imaging gaseous detector has been successfully developed with Glass GEM. The imaging system consists of a chamber filled with scintillating gas (Ar/CF4, Kr/CF4, Xe/CF4), inside of which Glass GEM (G-GEM) is mounted for high gain gas multiplication. Since the gas gain of the G-GEM is much higher compared to conventional GEMs, ultra high yield scintillation photons are produced during the avalanche process. These photons can be easily detected by a mirror-lens-CCD-camera system and a high resolution X-ray radiograph is formed. We demonstrate X-ray imaging performance of Glass GEM based X-ray imager with 20 - 60 kV X-ray tube, and combination of various gas (Ar/CF4, Kr/CF4, Xe/CF4). High spatial resolution, high speed image forming and 3D CT is also demonstrated.

Author: FUJIWARA, Takeshi (National Institute of Advanced Industrial Science & Technology)

Co-authors: MITSUYA, Yuki (The University of Tokyo); Prof. TAKAHASHI, Hiroyuki (The University of Tokyo); Dr TOYOKAWA, Hiroyuki (National Institute of Advanced Industrial Science and Technology (AIST))

Presenter: FUJIWARA, Takeshi (National Institute of Advanced Industrial Science & Technology)

Session Classification: MPGD detector technologies - 4 (Chair: Matt Posik)

Contribution ID: **24** Type: **Oral presentation**

Development of the BAND-GEM detector solution for the SANS experiments

Monday, May 22, 2017 3:30 PM (20 minutes)

New high count rate and large area detectors are needed for future spallation neutron sources. Indeed, the 3He-shortage limits the use of 3He tubes in present and future applications where large areas (several m2) and high efficiency (>50%) detectors are envisaged. In this framework, GEM (Gas Electron Multiplier) is one of the explored detector technologies. GEMs features good spatial resolution (< 0.5 cm) and timing properties. Moreover they have an excellent rate capability (MHz/mm2) and can cover large areas (⊠ 1 m2) at low cost. The GEM technique is well established for charged particle measurements in high energy physics applications at CERN and elsewhere. The new development concerns the neutron conversion to charged particles. In the BAND-GEM (Boron Array Neutron Detector) approach a 3D geometry for the neutron converter was developed that is expected to provide an average efficiency >40% in the wavelength of interest for SANS (Small Angle Neutron Scattering) measurements at spallation sources, while meeting the spatial resolution requirements for SANS. A system Aluminium grids with thin walls (200 μm) coated with 0.6 μm layer of boron carbide (on both sides) has been built and positioned in the first detector gap, orthogonal to the cathode. By properly tilting the grid system with respect to the beam, there is a significant increase of effective thickness of the borated material crossed by the neutrons. As a consequence, the interaction probability, as well as the detection efficiency, is increased while keeping the beam perturbation small due to the reduced volume of non-active material. A first experiment with this new detector (with an active area of 5x10 cm2), performed at EMMA-ISIS neutron beamline measured a detector efficiency of about 40% for tilting angles > 3° for neutron wavelength of 4 Å. Based on these results, which are in agreement with the simulations, a full-module (trapezoidal shape with an area of 860 cm2) for a SANS experiment is being realized at the moment and will be tested in the near future.

Authors: CROCI, Gabriele (Universita & INFN, Milano-Bicocca (IT)); BIRCH, Jens (Linköping University); CLAPS, Gerardo (Istituto Nazionale Fisica Nucleare (IT)); Dr PERELLI CIPPO, Enrico (IFP-CNR); GORINI, Giuseppe (Universita & INFN, Milano-Bicocca (IT)); Dr GROSSO, Giovanni (IFP-CNR); HALL-WILTON, Richard (ESS - European Spallation Source (SE)); HÖGLUND, Carina (ESS AB); HULTMAN, L. (Dept. of Physics, Chemistry and Biology (IFM), Thin Film Physics Division, Linköping University, Linköping, Sweden); KANAKI, Kalliopi (University of Bergen (NO)); MURARO, Andrea (CNR); MURTAS, Fabrizio (CERN & INFN); RASPINO, davide (STFC); ROBINSON, Linda (ESS AB); Dr REBAI, Marica (Università di Milano-Bicocca & INFN); Dr RHODES, Nigel (STFC); Dr SCHOONEVELD, Erik (STFC); ALBANI, Giorgia

Presenter: CROCI, Gabriele (Universita & INFN, Milano-Bicocca (IT))

Session Classification: MPGD detector technologies - 4 (Chair: Matt Posik)

Contribution ID: **26** Type: **Poster presentation**

Studies of GEM Detector as a Part of Tracker Development for the Storage Ring Proton EDM Experiment

The Center for Axion and Precision Physics Research (CAPP) of the Institute for Basic Science (IBS) participates in a storage ring experiment under development to measure the proton electric dipole moment (pEDM). This experiment is aiming to measure the proton electric dipole moment (pEDM) with the target sensitivity of 10ˆ-29 e·cm per year. GEM detector is chosen as a candidate of the tracker in the polarimeter system along with scintillation counters that measure asymmetrical proton hits. Final design of the GEM detector will have strip type anode structure for the trackers to measure the hit locations in polar and azimuth angles. This poster reports the current status of the detector development at CAPP and its performance test. The detector performance such as energy resolution, counting rate, and noise control is the main topic of this report. The CERN SRS is chosen as DAQ electronics for our detectors and corresponding software like DATE and AMORE are used for data acquisition and analysis. The application of the AMORE agent for online monitoring and data analysis is also discussed. (This work was supported by IBS-R017-D1-2017-a00.)

Authors: JEONG, Hoyong (Korea University, CAPP/IBS); Dr PARK, Seongtae (CAPP/IBS)

Presenter: JEONG, Hoyong (Korea University, CAPP/IBS)

Contribution ID: **27** Type: **Poster presentation**

Results of the longevity study with the triple-GEM technology for the upgrade of the CMS muon end-caps

Thursday, May 25, 2017 2:58 PM (4 minutes)

In order to maintain the physics performance and the detection efficiency of the CMS muon system in the future HL-LHC environment, the CMS muon group has proposed to instrument the vacant regions of the forward muon end-caps with the Gas Electron Multiplier (GEM) technology, which can operate in high-rate environment with detection performance fully compatible with the CMS requirements.

This ambitious upgrade program, named GEM End-cap station 1 ring 1 (GE1/1), started in 2009 with the development of the first world's largest triple-GEM chambers. Several years of R&D were then necessary to ensure that the detector's operating characteristics and performance would suit the CMS environment. One of the main R&D project consisted of studying the long-term operation of the GE1/1 detectors and the possible degradation of their performance after a long exposure in the CMS environment.

As for all gaseous detectors, the triple-GEM chambers might be subject to aging effects, in particular due to the production of polymers in the plasma surrounding the electron avalanches. This phenomenon, often referred as "Classical aging", is mainly triggered and enhanced by inappropriate operating conditions or by the presence of contaminants in the detector.

The goal of the longevity study was to reproduce the aging of the GE1/1 detectors in a realistic CMS environment. Three aging tests have been conducted at CERN in the Gamma Irradiation Facility (GIF) with different prototypes, operating conditions and gas mixtures. After several months of continuous exposure to a gamma source, the detectors accumulated a total charge equivalent to 10 years of real operation at HL-LHC (with safety factors). No aging effects were observed during the exposure and no traces of degradation or polymerization were found on the GEM structure.

In parallel to the classical aging test, a set of outgassing tests has been performed to ensure that none of the GE1/1's material could release pollutant in the gas mixture and trigger pre-mature aging. Seven critical materials have been tested, whose one was rejected after observing strong outgassing.

The results of the classical aging test and the outgassing study have been approved by the CMS muon group and will be used as a baseline for the future GEM upgrades in CMS.

Author: MERLIN, Jeremie Alexandre (CERN)

Presenter: MERLIN, Jeremie Alexandre (CERN)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **28** Type: **Oral presentation**

GEM single-mask characterization and influence of GEM foil orientation

Monday, May 22, 2017 2:40 PM (20 minutes)

The Gas Electron Multiplier (GEM) technology is used in CMS muon detectors to amplify the electronic charge left after the crossing of a particle. The GEM structure consists of a thin polyimide foil, coated with copper on both sides and perforated with a high density of microscopic holes. Several GEM foils can be associated together with a dedicated stretching structure to form the GEM detectors. The geometry of the holes and their uniformity over the detector define the performance of the detectors.

The upgrade of the CMS muon end-cap with GEM detectors, referred as GE1/1 project, requires the production of large GEM foils (up to 120 cm long) which can only be achieved by transferring the hole pattern using a unique mask on one side of the substrate. The so-called single-mask technique has been optimized during the last years to approach a perfect bi-conical shape obtained with the standard double-mask photolithography. However, a significant geometrical asymmetry is still present between the bottom and the top holes, which tend to be 20% larger in diameter.

The single-mask characterization performed by the CMS muon group aims to evaluate experimentally the single-mask asymmetry and to determine the influence of the GEM foil orientation in triple-GEM structures. A series of tests including effective gain, charging up and rate capability measurements have been conducted with a special prototype with three single-mask GEM foils (in both orientations) and with a standard set of double-mask foils for comparison.

The results have been compiled in order to define the most appropriate configuration for the large GE1/1 chambers, ensuring the best performance at lower supplied voltage.

Author: MERLIN, Jeremie Alexandre (CERN)

Presenter: MERLIN, Jeremie Alexandre (CERN)

Session Classification: MPGD detector technologies - 3 (Chair: Matt Posik)

Contribution ID: **29** Type: **Oral presentation**

First industrial production of large area Micromegas by ELVIA: status, applications and perspectives

Thursday, May 25, 2017 11:00 AM (20 minutes)

A know-how transfer was initiated in 2014 with the ELVIA company for the production of 50x50 cm², 2D resistive Micromegas. The project emerged after the successful test of such detectors equipped with the "genetic multiplexing"layout which reduces the number of electronics channels by a factor of 17 (and up to 30). The strong cost reduction allowed by these detectors made then possible the design of several, high-precision imaging instruments using the interactions of cosmic muons with matter. The number of such detectors to be built (>30) was too large for the CERN capabilities, and the ELVIA company was contacted for the manufacturing. In total, 36 such detectors were built (9m²), 24 being made by ELVIA.
We will report here on the different aspects of this know-how transfer and large scale production, from the PCB manufacturing to the final performance of these detectors, and including the delicate topic of resistive Kapton films. All these detectors are now operational in various setups, including 2 muon imagers of unprecedented resolution (deviation mode) and 3 muon telescopes used within the ScanPyramids mission (the performance and the results of these 3 telescopes will be discussed in a dedicated talk). These muon instruments elicited the interests of several industrials, and a new funded project has started with the aim to build several large telescopes, corresponding to the additional production of at least 50 detectors.

Authors: PROCUREUR, Sébastien (CEA-Saclay); Dr ATTIÉ, David (CEA-Saclay); Dr MANDJAVIDZE, Irakli (CEA-Saclay); Mr BOUTEILLE, Simon (CEA-Saclay); Mr MAGNIER, Patrick (CEA-Saclay); Mr RIALLOT, Marc (CEA-Saclay); Dr CALVET, Denis (CEA-Saclay)

Presenter: PROCUREUR, Sébastien (CEA-Saclay)

Session Classification: MPGD production and commercialization - 3 (Chair: Craig Woody)

Contribution ID: **30** Type: **Oral presentation**

Characterization and Validation of first GEM Foils produced in India

Monday, May 22, 2017 2:20 PM (20 minutes)

The Gas Electron Multipliers (GEM) foils have been successfully produced for the first time in Indian in collaboration with Indian Industry. The foil production process has been established successfully using the double-mask etching technique. We will present the first results on a comprehensive quality control (QC) and characterisation of these GEM foils involving optical (geometrical) and electrical properties. We will present the results on the inner and outer hole diameter studies as well as size uniformity and leakage current measurements. The measured mean diameter and uniformity of the holes and pitch are found to be consistent with the desired parameters. The electrical properties measurements results are well within the thresholds and in agreement with the double mask foils produced elsewhere. The preliminary results shows that the foils produced in India are of good quality and confirms with all the standard quality control. We will present the results from our comprehensive studies of these foils and will also explore about its possible usage in the LHC experiments.

Authors: KUMAR, Ashok (University of Delhi (IN)); NAIMUDDIN, Md (University of Delhi (IN))

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Presenters: KUMAR, Ashok (University of Delhi (IN)); NAIMUDDIN, Md (University of Delhi (IN))

Session Classification: MPGD detector technologies - 3 (Chair: Matt Posik)

Contribution ID: **31** Type: **Oral presentation**

Resistive Micromegas for the Muon Spectrometer Upgrade of the ATLAS Experiment

Wednesday, May 24, 2017 8:50 AM (20 minutes)

Large size multilayer resistive Micromegas detectors will be employed for the Muon Spectrometer upgrade of the ATLAS experiment at CERN. The current innermost stations of the muon endcap system, the 10 m diameter Small Wheel, will be upgraded in the 2019-2020 long shutdown of LHC, to retain the good precision tracking and trigger capabilities in the high background environment expected with the upcoming luminosity increase of the LHC.
Along with the small-strip Thin Gap Chambers (sTGC) the "New Small Wheel"will be equipped with eight layers of Micromegas (MM) detectors arranged in multilayers of two quadruplets, for a total of about 1200 m2 detection planes. All quadruplets have trapezoidal shapes with surface areas between 2 and 3 m2. The Micromegas system will provide both trigger and tracking capabilities.
In order to achieve a 15% transverse momentum resolution for 1 TeV muons, a challenging mechanical precision is required in the construction for each plane of the assembled modules, with an alignment of the readout elements (the strips) at the level of 30 μm along the precision coordinate and 80 μm perpendicular to the plane. Each Micromegas plane must achieve a spatial resolution better than 100 μm independent of the track incidence angle and operate in an inhomogeneous magnetic field (B < 0.3 T), with a rate capability up to ˜15 kHz/cm2.
In May 2017, all four types full size prototypes (modules-0) will be completed and will be subjected to a thorough validation phase.
The Modules-0 construction procedures will be reviewed along with the results of the quality controls results during constructions and the final validation tests obtained with X-rays, cosmic tracks and with high-energy particle beams at CERN.

Presenter: SIDIROPOULOU, Ourania (Bayerische Julius Max. Universitaet Wuerzburg (DE))

Session Classification: Applications at future nuclear and particle physics facilites - 4 (Chair: Kondo Gnanvo)

Contribution ID: **32** Type: **Oral presentation**

Muographies of the Giza's Great Pyramid with Micromegas trackers

Thursday, May 25, 2017 10:40 AM (20 minutes)

The recent development concerning MPGDs, in particular with the work done by the R&D51 collaboration, makes the industry able to build large and robust detectors. These characteristics suit well the needs of a lot of applications which use the cosmic rays muons to make the tomography of large objects. However, these applications need the muon telescope to be run in the field and with a low energy consumption. After multiplexing the readout of micromegas and miniaturizing the electronics needed to operate them, we made the very first micromegas-based muon telescope which was operated outside.

Three of these telescopes were brought at Giza's plateau, tracking muon that passed through the north-east edge of the Khufu's pyramid. During three month of data taking starting from early June 2016, the delicate operation of these instruments have been dealt with, including environmental instabilities and monitoring through 3G connection.

The five 5L gas bottles, each containing 110bars of T2K-gas, came to exhaustion after three month of data taking, at the end of August.

The analysis of the rock density showed a cavity known since 1819. Moreover, an extra cavity was revealed, this muography being the first proof of its existence. The remaining work is let to the egyptologists who have to find its original function.

Using the experience accumulated during this first campaign, the gas tightness of the detectors and the monitoring of the thermodynamic quantities of the gas were improved in order to smoothen the variability of the efficiency and gain through time and P/T variations.
After these enhancements, the tree telescopes were put again into operation at the end of January 2017. Each of them scanning one of the remaining edge, searching for unknown cavities.

Authors: BOUTEILLE, Simon (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR)); Dr PROCUREUR, Sébastien (CEA-Saclay); MANDJAVIDZE, Irakli (CEA/IRFU,Centre d'etude de Saclay Gif--sur-Yvette (FR)); ATTIE, David (CEA/DSM/DAPNIA/SPP); Dr CALVET, Denis (CEA-Saclay); Mr RIALLOT, Marc (CEA-Saclay); Mr MAGNIER, Patrick (CEA-Saclay)

Presenter: BOUTEILLE, Simon (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification: MPGD production and commercialization - 3 (Chair: Craig Woody)

Contribution ID: **33** Type: **Poster presentation**

VMM3, an ASIC for Micropattern Detectors

Tuesday, May 23, 2017 3:16 PM (4 minutes)

The VMM is a System on Chip (SoC) custom Application Specific Integrated Circuit (ASIC). It is intended to be used in the front end readout electronics of both Micromegas and sTGC detectors of the ATLAS Muon New Small Wheels upgrade. Due to its highly configurable parameters it can be used in a variety of tracking detectors. It is fabricated in the 130nm Global Foundries 8RF-DM process. The ASIC integrates 64 channels, each providing charge amplification, discrimination, neighbour logic, amplitude and timing measurements, analog-to-digital conversions, and either direct output for trigger or multiplexed readout within a data-driven readout system. The front-end amplifier can operate with a wide range of input capacitances, has adjustable polarity, gain and peaking time. The VMM3 is the third version of the VMM ASIC family fabricated in 2016. It has been tested on resistive Micromegas and sTGC prototypes in test beam campaigns at CERN. The specification and performance of the VMM3 as a pre-production stage will be presented as well as its performance on Micromegas detectors.

Presenter: IAKOVIDIS, George (Brookhaven National Laboratory (US))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **34** Type: **Oral presentation**

Simulation of the ATLAS New Small Wheel (NSW) System

Wednesday, May 24, 2017 8:30 AM (20 minutes)

The instantaneous luminosity of the Large Hadron Collider (LHC) at CERN will be increased up to a factor of five with respect to the present design value by undergoing an extensive upgrade program over the coming decade. In order to benefit from the expected high luminosity performance that will be provided by the Phase-1 upgraded LHC, the first station of the ATLAS muon end-cap Small Wheel system will need to be replaced by a New Small Wheel (NSW) detector. The NSW is going to be installed in the ATLAS detector in the forward region of $1.3 < |\eta| < 2.7$ during the second long LHC shutdown. The NSW will have to operate in a high background radiation region, while reconstructing muon tracks with high precision as well as furnishing information for the Level-1 trigger. A detailed study of the final design and validation of the readout electronics for a set of precision tracking (Micromegas) and trigger chambers (small-strip Thin Gap Chambers or sTGC) that are able to work at high rates with excellent real-time spatial and temporal resolution will be presented. The simulation of the entire NSW system integrated in the common ATLAS trigger simulation and reconstruction chain is a necessary part of the performed Monte Carlo (MC) studies. A dedicated parametric digitization model based on the exhaustive standalone MC studies and experimental test beam results has been developed over the years to simulate the response of the NSW system. The simulated digital readout signals are used to build the cluster hits and reconstructed track-segments in the detector planes at both the trigger and off-line reconstruction levels. They have been included in the common ATLAS muon trigger and reconstruction algorithms. This contribution will summarize the developed simulation model and the importance of the NSW system for the improvement of the muon reconstruction efficiency and muon identification.

Author: BINI, Cesare (Universita e INFN, Roma I (IT))

Presenter: CAI, Huacheng (Univ. Illinois at Urbana-Champaign (US))

Session Classification: Applications at future nuclear and particle physics facilites - 4 (Chair: Kondo Gnanvo)

Contribution ID: **35** Type: **Poster presentation**

Level-1 Data Driver Card - A high bandwidth radiation tolerant aggregator board for detectors

Tuesday, May 23, 2017 3:20 PM (4 minutes)

The Level-1 Data Driver Card (L1DDC) was designed for the needs of the future upgrades of the innermost stations of the ATLAS end-cap muon spectrometer, the New Small Wheel project, based on Micromegas and sTGC technologies. The L1DDC is a high speed aggregator board capable of communicating with multiple front-end electronic boards. It collects the Level-1 data along with monitoring data and transmits them to a network interface through bidirectional and/or unidirectional fiber links at 4.8 Gbps each. In addition, the L1DDC board distributes trigger, time and configuration data coming from the network interface to the front-end boards. The L1DDC is fully compatible with the Phase II upgrade where the trigger rate is expected to reach the 1 MHz. Three different types of L1DDC boards will be fabricated handling up to 10.080 Gbps of user data. It consist of custom made radiation tolerant ASICs: the GigaBit Transceiver (GBTx), the FEAST DC-DC converter, the Slow Control Adapter (SCA), and the Versatile Tranceivers (VTRX) and transmitters (VTTX). The overall scheme of the data acquisition process and in particular the L1DDC board will be described. The results from the various system integration and radiation tests will be presented.

Presenter: GKOUNTOUMIS, Panagiotis (National Technical Univ. of Athens (GR))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **36** Type: **Poster presentation**

Imaging with glass GEM and dynamic time-over-threshold pulse processing method

Tuesday, May 23, 2017 3:24 PM (4 minutes)

We report on pulse counting imaging with glass GEM (G-GEM) combined with a newly developed electronic readout based on the dynamic time-over-threshold (dynamic ToT) pulse processing method.

The ToT is a pulse processing method to convert an analog pulse to a digital pulse whose width is proportional to the original analog pulse height, measuring the time while the analog pulse is over the preset threshold. The ToT system is composed of simple circuit and hence promising for front-end circuits of multi-channel data acquisition system. The dynamic ToT is a modified method of ToT; The threshold is dynamically changed over time and the linearity between analog pulse height and digital pulse width is greatly improved.

We newly developed a dedicated preamp-shaper-dToT circuit for G-GEM and demonstrated preliminary charge-division imaging of Fe-55 5.9 keV X-ray. The G-GEM was made of crystalized glass which has 100 mm x 100 mm sensitive area, 170 um of hole diameter, 280 um of hole pitch, and 680 um of glass thickness. A G-GEM was operated under Ar/CH4 gas mixture and biased at high gain of about 1.0E+4. A two-dimensional resistive charge-division board was placed under the G-GEM. The amplified charges divided by the board were processed by the 4 channels preamp-shaper-dToT circuit. The digital pulse widths of dToT were measured by an FPGA with the clock frequency of 8 ns, and were effectively stored in a high-speed 16 bits SRAM memory. The approximate position of Fe-55 source was successfully detected by charge-division calculation using pulse height information from the 4 channels. The maximum energy resolution from a dToT channel was 31.8 % at 5.9 keV peak.

We are also developing an individual-strip readout system with dToT to improve the spatial resolution. The imaging system will be applied for future neutron imaging of nuclear materials.

Authors: MITSUYA, Yuki (The University of Tokyo); FUJIWARA, Takeshi (National Institute of Advanced Industrial Science & Technology); Prof. TAKAHASHI, Hiroyuki (The University of Tokyo); Prof. UESAKA, Mitsuru (The University of Tokyo)

Presenter: MITSUYA, Yuki (The University of Tokyo)

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **37** Type: **Poster presentation**

A new self-stretching method for large size GEM assembly

Tuesday, May 23, 2017 3:28 PM (4 minutes)

We have improved the self-stretching GEM assembling technique that was initially developed at CERN for the CMS GEM upgrade project. With this improved technique, we can build GEM detectors at a scale of > 1m that still preserve very good gain uniformity. The stretching of GEM foils is of high quality and gas tightness is well ensured in GEM detectors built with the technique. This report presents details of the improved self-stretching technique for large-size GEM assembly and some test results of a large-size GEM prototypes built with the technique.

Authors: ZHOU, Yi (University of Science and Technology of China (CN)); Mr YOU, Wenhao (University of Science and Technology of China); LIU, Jianbei (University of Science and Technology of China (CN))

Presenter: ZHOU, Yi (University of Science and Technology of China (CN))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **38** Type: **Oral presentation**

Towards a 60 x 60 cm2 demonstrator for the NMX instrument at the European Spallation Source ERIC

Thursday, May 25, 2017 9:40 AM (20 minutes)

Neutron detectors based on solid converters in combination with Micro Pattern Gaseous Detectors (MPGDs) are a promising option for neutron scattering instruments at the European Spallation Source ERIC that require excellent spatial resolution combined with time resolution, high-rate capabilities and a good neutron detection efficiency.

The NMX macromolecular diffractometer will consist of three individual Gaseous Electron Multiplier (GEM) detectors mounted on robotic arms to allow positioning of the detectors in an optimal manner. The detectors will have an active area of 60 x 60 cm^2 each, with a gadolinium cathode acting as neutron converter. They are designed to minimize the dead area within the detector volume as well as the space between the individual detectors when placed in close proximity to each other.

Foils of natural gadolinium are currently commercially available with a maximum surface area of about 20 x 10 cm^2. To achieve large-area gadolinium cathodes as required by the NMX instrument, the foils need to be assembled with a number of restrictions: good electrical conductivity, solid mechanical connection to the supporting cathode frame and a minimum of dead area between each foil. The method employed should be fast, easily reproducible and –owed to the high price of gadolinium –allow easy recuperation at a minimum loss of material.

We present ultrasonic welding of gadolinium foils onto aluminium support structures as a method on how to fulfil the aforementioned restrictions. An introduction to the welding technique will be given, as well as an overview of the very first cathodes produced with this method. Measurements with a mixed Americium-241/Beryllium source demonstrate good overall uniformity and a lack of dead are in a 10 x 10 cm^2 demonstrator cathode comprising three individual gadolinium foils of 25 μm thickness.

The talk will be opened with an overview of the NMX detectors and their experimental requirements. Ongoing studies to improve the neutron detection efficiency with isotopically enriched Gd-157 converters, as well as the cost-effective production of Gd-157 ingots and foils are presented. A summary on the technical design and the current status of the full-scale demonstrator concludes the talk.

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Presenter: THUINER, Patrik (CERN)

Session Classification: MPGD production and commercialization - 2 (Chair: Craig Woody)

Contribution ID: **39** Type: **Oral presentation**

The first beam test for a GEM-readout TPC module with a large aperture GEM-like gating device

Monday, May 22, 2017 9:50 AM (20 minutes)

At the future International Linear Collider (ILC) project a GEM- or Micromegas-based Time Projection Chamber (TPC) is a candidate for the central tracker of the International Large Detector (ILD), which is one of the two detector concepts proposed for the ILC.

The TPC has a potential problem that many ions generated in avalanche processes for gas amplification flow back into the drift volume of the TPC and distort the electric field inside of it. Primary electrons drifting in the drift volume are affected by the distorted electric field, and the quality of reconstructed tracks is degraded consequently. The required position resolution that the ILD-TPC must achieve for the physics program of the ILC project is about 100 μm over the full drift length. A degree of degradation of position resolution due to generated ions was carefully estimated to be more than 60 μm at the innermost radius of the TPC, effect on the position resolution, thereby requiring some gating device to stop ions at the closed state. In addition, our study shows that an electron transmission rate of more than 80% is needed at the open state to accomplish required position resolution for the ILD-TPC. This issue related to the Ion Back Flow (IBF) is therefore crucial for realization of the ILD-TPC.

In order to fit to a detector module of the ILD-TPC where an MPGD is used for the gas amplification device, we have developed a GEM-like gating device (gating GEM), the idea of which was originally proposed by F. Sauli, to prevent ions from back-flowing to the drift volume. Since the motion of the drift electrons is strongly restricted to the direction of a high axial magnetic field, the gating GEM has to have a high geometric aperture of more than 80% as well as high stopping power for positive ions at the closed state. Based on these requirements, we manufactured a large aperture gating GEM with an aperture of 82% and a thickness of 25 μm. We had already confirmed the performance of a small prototype gating GEM using an ^{55}Fe source. The electron transmission rate was estimated to be more than 80%. After this first study, we developed a large real-size gating GEM. The iron stopping power at the closed state was estimated to be O(10^{-4}) using an ^{55}Fe source and a laser, with the gating GEM mounted on a GEM-based prototype ILD-TPC module. Then we evaluated its performance using 5-GeV electron beam. The measurement was carried out in the 1-T magnetic field of the Large Prototype TPC at DESY. We have measured the position resolution of the ILD-TPC module with the gating GEM and the electron transmission rate. This was the world first test beam experiment of a "wireless" TPC equipped with a high performance gating device.

We report on the results on the electron transmission rate and the ion stopping power.

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Presenter: AOKI, Yumi (KEK/SOKENDAI)

Session Classification: MPGD detector technologies - 1 (Chair: Klaus Dehmelt)

Contribution ID: **40** Type: **Poster presentation**

New results on COMPASS pixellized hybrid gaseous detectors for high muon and hadron flux

Thursday, May 25, 2017 3:02 PM (4 minutes)

New large size Micromegas gaseous detectors (40x40 cm² active area) were developed since 2009 in view of the COMPASS new physics programs started in 2015, which uses the CERN high intensity muon and hadron beams of a few hundred GeV scattered on thick fixed targets. The new detectors feature a huge reduction of the discharge rate compared to original COMPASS Micromegas by a factor of above 100 using the hybrid solution where a pre-amplifying GEM foil is placed 2mm above the micromesh electrode. The centers of detectors, in the beam area with intensities as high as a few hundred of kHz/mm², are also active with the same performances as the other part of the detectors thanks to a pixelized read-out adapted to the flux. The combination of the hybrid structure and the pixelized central read-out allow to detect particle flux above 10 MHz/cm² with very good detection efficiencies, above 96%, and spatial resolution around 70µm.

The delicate technology of making "bulk" detectors was transferred to the ELVIA company in the framework of this project, leading to high production rate and lower cost. The detectors are installed and in use in the different conditions of the COMPASS experiment since 2015. The 2015 COMPASS run was dedicated to Drell-Yan data taking with high flux hadron beam on a thick target, leading to a large rate of low energy hadrons in the detectors; while the 2016 and 2017 runs, dedicated to the DVCS data taking, use a muon beam at very high flux with strong demands on detector spatial resolutions at low angle.

The key characteristics of the detectors will be described, including the hybrid structure and the optimization of the printed circuit board design in order to connect a large number of pixels through a limited space. The performance during the last COMPASS runs both in high flux muon and hadron beam conditions will be presented.

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Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **41** Type: **Oral presentation**

Optical readout of MPGDs: Techniques and applications

Thursday, May 25, 2017 9:20 AM (20 minutes)

High position resolution, insensitivity to electronic noise and intuitive interpretation of results without the need for extensive data processing are among the key advantages of optical readout of MPGD-based detectors. Together with the high gain factors achievable by technologies such as GEMs, this allows for sensitive 2D detectors taking advantage of inexpensive and commercially available CCD or CMOS cameras. Selected gas mixtures such as Ar/CF₄ with secondary scintillation in the visible wavelength regime allow for a direct recording of the light emitted during avalanche multiplication and enriching the 2D optical readout with timing information enables full 3D reconstruction of particle tracks.

X-ray imaging, fluoroscopy and fluorescence measurements acquired with an optically read out GEM are presented, highlighting the possibility for energy resolved images by single-photon sensitivity. For applications requiring high interaction probabilities and consequently thick drift regions, a planispherical GEM detector is shown, which minimises parallax-induced broadening by radially focused drift field lines. This preserves the position resolution required for applications such as X-ray crystallography or fluorescence.
Augmenting 2D images obtained from cameras by optical readout of MPGDs with timing information from a tagging signal or a fast photon detector such as a PMT, full 3D track reconstruction is achievable. An optically read out GEM-based TPC combining information from primary and secondary scintillation to 3D reconstructed representations of alpha tracks has been constructed and operated and is shown as an example of the track reconstruction capabilities of optical readout.
Owing to the low-material budget of gaseous detectors, optically read out GEMs are an attractive candidate for online beam-profile monitoring. While the adjustable gain of GEMs allows for tuneable sensitivity and operation in a wide range of beam parameters, the immediate availability and intuitive interpretation of images acquired by a camera make optical readout a high-potential technology in high energy physics and radiotherapy instrumentation.
Exploring the possibility of portable detectors based on optically read out MPGDs, sealed mode stability measurements are presented along with gas purity and spectroscopic investigations related to the light yield achievable in GEM-based detectors.

The advances in imaging sensors and state-of-the-art CCD and CMOS cameras have facilitated the utilisation of optical readout of MPGD-based detectors for a variety of applications ranging from highly sensitive and energy-resolved imaging to particle track reconstruction and high-resolution beam monitoring. Application-specific techniques such as the usage of radially focussed drift field lines or low-material budget detectors promise a versatile readout approach for scintillation-based detectors and pave the way for employing optically read out MPGDs in future devices and experiments.

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Presenter: BRUNBAUER, Florian Maximilian (CERN, Vienna University of Technology (AT))

Session Classification: MPGD production and commercialization - 2 (Chair: Craig Woody)

Contribution ID: **42** Type: **Poster presentation**

Status of the continuous suppression ions detector module for CEPC TPC

To solved the ions back flow in TPC detector in linear collider, the gating grid is essential to prevent ions from reaching the drift volume. The gating grid switches to open state to allow the ionization electrons traveling into the gas amplification region. After the maximum drift time of about 100 μs(depending on the drift length, electric field and gas mixture), gating grid is closed to prevent positive ions from drifting back into the drift volume. Since it must remain closed until ions have been collected on the grid deviece, during this time, the ionization electrons are also blocked and the dead time increases consequently. TPC will have to be operated continuously and the backflow of ions must be minimized without the use of a gating grid at circular collider.

To meet the critical physics requirements of the tracker detection in the future circular collider (CEPC),the new concept structure gaseous detector module as one option for the tracer detector has been developed and measured. It is a hybrid structure cascaded the singal GEM with Micromegas detector. Feasibility tests of the hybrid detector with active 50mm*50mm and active 100mm*100mm are performed using an 55Fe X-ray source. The energy resolution is better than 21% for 5.9 keV X-rays. A gain up to about 5000 can be achieved without any obvious discharge behaviour. The currents on the anode and drift cathode are measured precisely with an electrometer. It is demonstrated that the ions backow ratio better than 0.1% can be reached in the hybrid readout structure at a gain of about 5000, and the suppression ions should be continued. In this presentation, some preliminary UV light IBF study results of simulation and experiment would be given, and some estimation results at Z pole run in CEPC was analysed.

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Presenter: QI, Huirong (Insititue of high energy physics, CAS)

Contribution ID: **43** Type: **Poster presentation**

A wide energy range neutron spectrometer for fusion experiments or safety diagnostics applications

Thursday, May 25, 2017 3:06 PM (4 minutes)

From the heart of stars to laboratories, plasmas constitute one of the major objects of the physics in many research institutes. Very big research infrastructures aim at big advances in the understanding of the physics of plasmas. Some Fields of application of science, as inertial confinement fusion experiment or Magnetic confinement fusion for energy, produce very energetics particles that can create nulear fusion reactions. Many of these reactions lead to the creation of very fast neutrons.
Detection of very fast neutrons remains also a challenge for particles accelerators safety diagnostics (beam loss monitor ...).

We developped a new wide energy neutrons detector able to work in a large gamma background. This concept is based on a very fast electronics associated to a Micromegas detector and a charged to particle converter. The detector can be configurated according to energy spectrum of neutrons, it can sustend very high flux with a good efficency

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Presenter: LEGOU , Philippe (CEA Saclay DRF Irfu)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **44** Type: **Poster presentation**

A photoelectric-effect-based field calibration system for the Time Projection Chamber at the CBELSA/TAPS experiment

Tuesday, May 23, 2017 3:40 PM (4 minutes)

One challenge of gaseous tracking detectors, such as the Time Projection Chamber (TPC), is the calibration of the electric field inside the radiation sensitive volume. This is crucial since deviations from a perfectly homogeneous drift field have direct impact on the spatial resolution. Reasons for these deviations are static imperfections of the detector structure, on the one hand, and dynamic changes of the space charge inside the sensitive volume, on the other hand. The latter is collision rate dependent and mainly related to unwanted ion backflow from the amplification region near the readout plane. For the CBELSA TPC, a calibration system is planned, which is based on the T2K calibration system. Here, the photoelectric effect is used to release electrons at well-known positions on the cathode, which drift towards the readout plane and show the integrated spatial distortions. The concept of the calibration system as well as a dedicated test setup will be presented.

Supported by DFG SFB/TR16.

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Presenter: SCHAAB, Dimitri (University of Bonn)

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **45** Type: **Poster presentation**

A GEM-TPC for the CBELSA/TAPS experiment

Thursday, May 25, 2017 3:10 PM (4 minutes)

The CBELSA/TAPS experiment located at the Elektronen Stretcher Anlage (ELSA) in Bonn (Germany) aims to investigate the excitation spectrum of baryons and the properties of baryon resonances.
The high-resolution electromagnetic calorimeter is optimized for the study of reactions with photons in the final state.
In order to enhance the sensitivity of the detector system to charged particles, a Time Projection Chamber (TPC) is foreseen as a new tracking detector, which provides track and vertex reconstruction for charged particles.
Along with its particle identification power via the specific energy loss, the TPC will significantly increase the physics potential of the experiment, granting access to channels with charged pions in the final state, like omega photoproduction (dominant decay mode $\omega \to \pi^+\pi^-\pi^0$) or charged-meson photoproduction like $\gamma p \to n\pi^+$ or $\gamma p \to p\pi^+\pi^-$.

A cylindrical gaseous TPC will be mounted inside the electromagnetic calorimeterof CBELSA/TAPS.
In order not to compromise the energy resolution for neutral particles, the vessel has to have an extremely low material budget.
The fixed-target geometry of the experiment results in a strong forward boost of the reaction products.
Therefore, only a single-sided readout is foreseen on the upstream endcap of the TPC.
For the gaseous amplification stage, a stack of multiple Gas Electron Multipliers (GEMs) was chosen.
GEMs, in contrast to other techniques, as, for example, multiwire proportional chambers, have the advantage to intrinsically suppress the backflow of ions, which would otherwise distort the drift field and worsen the detector resolution.
This will allow us to operate the TPC in a continuous mode without dead time.
A careful optimization in terms of sufficient electron transmission, low ion backflow, spatial and energy resolution is sought.
This can be achieved by tuning the composition of the stack in terms of GEM geometries and electric field settings.
Detailed ANSYS and Garfield++ simulations were carried out and compared to measurements to find the optimum operation point.

The presentation will cover the implementation of a TPC at the CBELSA/TAPS experiment, the commissioning of the TPC-prototype and its related soft- and hardware infrastructure.
Furthermore results of comprehensive studies of GEM geometry and electric field setting effects will be shown.

Supported by DFG SFB/TR16.

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Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **46** Type: **Poster presentation**

A model of charge transfer processes in GEM foils

Tuesday, May 23, 2017 3:32 PM (4 minutes)

Tracking detectors based on GEM foils are widely used in ongoing experiments and are the choice for numerous upgrades in the near future. An example is ALICE at the LHC of CERN, where the use of GEM foils will allow the TPC to be employed in a high-rate environment.

In order to optimize and predict the performance of GEM detectors in terms of gain, energy resolution and ion backflow, a good and quantitative understanding of charge transfer processes of electrons and ions between the individual GEM foils is mandatory. Based on analytic electric flux calculations a model has been derived in order to describe the charge transfer for GEM foils in terms of the GEM geometry (hole size, pitch and thickness) and the electric field configuration. The obtained expressions inherently describe the characteristic curves of the charge transfer efficiencies and predict the asymptotic limits as found in simulations. The results will be presented and compared to simulations using Magboltz and Garfield++.

Supported by BMBF.

Authors: RATZA, Viktor (University of Bonn (DE)); OTTNAD, Jonathan (University of Bonn (DE)); BALL, Markus (University of Bonn (DE)); KETZER, Bernhard (University of Bonn (DE))

Presenter: RATZA, Viktor (University of Bonn (DE))

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **47** Type: **Poster presentation**

THE GEM QA PROTOCOL OF THE ALICE TPC UPGRADE PROJECT

Thursday, May 25, 2017 3:14 PM (4 minutes)

The ALICE experiment at the Large Hadron Collider at CERN is upgrading its central tracking detector, the Time Projection Chamber (TPC). The installation is foreseen during the second long shutdown of the Large Hadron Collider. The upgrade includes the complete exchange of the present MWPC readout chambers (ROC) with new ones based on Gas Electron Multiplier detectors. This is necessary due to the higher LHC luminosity and thus higher interaction rate. The new ROCs allow for continuous readout at 50 kHz compared to 500 Hz of the gated MWPC readout, while maintaining the particle identification capability of the present system.

During the R&D phase of the upgrade activities a baseline configuration was developed to simultaneously fulfill strict the design criteria on energy resolution, ion back flow and operational stability. The solution consists of a stack of four GEM foils each operated at a specific electric field configuration.

A thorough quality assurance scheme was developed to build reliable TPC ROCs. Moreover the collaboration has established a strict QA protocol to ensure that the production of the ROCs, which are distributed over several institutes in two continents, does not compromise the high quality standards.

The QA consists of two stages, the basic QA done close to the GEM production workshop at CERN and the advanced QA done at dedicated QA centers. Full traceability of detector components will be maintained throughout the process. A detailed description of the QA protocol will be given with emphasis on the high definition optical scanning and gain measurements of individual GEM foils.

The production of the new ALICE TPC ROCs has finally started. First QA experience under production conditions and workload will be presented.

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Presenter: BRUCKEN, Jens Erik (Helsinki Institute of Physics (FI))

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **48** Type: **Oral presentation**

GEM foil gain prediction

Monday, May 22, 2017 2:00 PM (20 minutes)

An optical Quality Assurance (QA) system has been developed at the Detector Laboratory of the Helsinki Institute of Physics. The diameters of the holes in a Gas Electron Multiplier (GEM) -foil, both in the copper and in the polyimide, can be measured with the system. The system is utilized for the QA of the GEM foils of the TPC Read-Out Chambers (ROC) being assembled for the upgrade of the TPC readout chambers of the ALICE experiment at CERN.
The correlation between the GEM hole size variation and the corresponding gain variation has been studied with several different gas compositions and operating voltages. A clear correlation has been shown to exist between the size of the GEM holes and the gain of the foil. Furthermore the relative gain of the foil can be estimated within 10 % based solely on the GEM hole size variation. The current correlation results are shown, as well as the progress towards a quantitative prediction of the gain of individual GEM foils. The possibility of predicting the gain of a full GEM stack is discussed. This study has been made in collaboration between Helsinki Institute of Physics and Wigner Research Centre in Budapest as part of the QA effort of the ALICE TPC upgrade project.

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Session Classification: MPGD detector technologies - 3 (Chair: Matt Posik)

Contribution ID: **49** Type: **Poster presentation**

GEM based alternatives for ion backflow suppression

Tuesday, May 23, 2017 3:44 PM (4 minutes)

Gas Electron Multipliers have undergone a very consistent development since their invention in 1997. Their production procedures have been tuned in such a way that nowadays it is possible to produce foils with areas of the order of the square meter that can operate at a reasonable gain with a very good stability. For the 3rd run of LHC, they will be included in the CMS and ALICE experiments after two significant upgrades of the detectors, confirming that these structures are suitable for very large experiments. In the special case of Time Projection Chambers, (in the ALICE TPC the multiwire proportional chambers will be replaced by quadruple GEM stacks) the ion backflow and the energy resolution are sensitive issues that must be addressed and the GEM has shown very good capabilities on dealing with both of them.

In this work, two different triple GEM stacks have been studied, one of them using three different hole pitch and the second one with a stainless steel mesh between the first and the second foils, with two different hole pitch. Both approaches will be discussed and compared, based on lab and simulation results, presenting two promising alternatives for ion backflow suppression in TPCs using GEMs.

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Presenters: BATTACHARYA, Purba (The Weizmann Institute of Science); GAMEIRO MUNHOZ, Marcelo (Institute of Physics, University of São Paulo)

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **50** Type: **Oral presentation**

A custom readout electronics for the BESIII CGEM detector

Tuesday, May 23, 2017 5:40 PM (20 minutes)

Design and test of a custom front-end electronics for the readout of the new inner tracker of the BESIII experiment, carried out at BEPCII in Beijing, is presented.
An innovative cylindrical GEM detector with analog and time readout is under development to upgrade the Inner Tracker of the BESIII experiment at the BEPC-II e+e- collider of the Institute of High Energy Physics in Beijing.
The analogue readout of the CGEM enables the use of a charge centroid algorithm to improve the spatial resolution to better than 130 μm while loosening the pitch strip to 650 μm, which allows to reduce the total number of channels to about 10 000. The channels are readout by 160 dedicated integrated 64-channel front-end ASICs, providing a time and charge measurement and featuring a fully-digital output.
The analogue and time readout of the CGEM-IT exploit the full potentiality of the charge centroid algorithm and allows to use a more innovative technique, called microTPC. The combination of the two readout allows to improve the spatial resolution to better than 130 um with a pitch strip of 650 um, that represent a good compromise between the number of total channels and performance. The channels are readout by 160 dedicated integrated 64-channel front-end ASICs, featuring a fully digital output.
The energy measurement is extracted either from the time-over-threshold (ToT) or the 10-bit digitisation of the peak amplitude of the signal. The time of the event is generated by quad-buffered low-power TDCs, allowing for rates up to 60 kHz per channel. The TDCs are based on analogue interpolation techniques and produce a time stamp (or two, if working in ToT mode) of the event with a time resolution better than 100 ps. The front-end noise, based on a CSA and a two-stage complex conjugated pole shapers, dominate the channel intrinsic time jitter, which is less than 5 ns r.m.s.. The time information of the hit can be used to reconstruct the track path, operating the detector as a small TPC and hence improving the position resolution when the distribution of the cloud, due to large incident angle or magnetic field, is very broad.
Event data is collected by an off-detector motherboard, where each GEM-ROC readout card handles 4 ASIC carrier PCBs (512 channels). Configuration upload and data readout between the off-detector electronics and the VME- based data collector cards are managed by bi-directional fibre optical links.
This talk will cover the design aspects of the detector electronics, the front-end ASIC and will review the silicon results of the chip prototype and the chip test with a CGEM-IT prototype.

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Presenter: GRECO, Michela (INFN-UniTO)

Session Classification: Applications at future nuclear and particle physics facilites - 3 (Chair: Tom Hemmick)

Contribution ID: **51** Type: **Oral presentation**

Test beam results of a Cylindrical GEM detector for BESIII experiment

Tuesday, May 23, 2017 5:20 PM (20 minutes)

Gas detector are very light instrument used in high energy physics to measure the particle properties: position and momentum.
Through high electric field is possible to use the Gas Electron Multiplier (GEM) technology to detect the particles and to exploit the its properties to construct a large area detector, such as the new IT for BESIII. The state of the art in the GEM production allow to create very large area GEM foils (up to 50x100 cm2) and thanks to the small thickness of these foil is it possible to shape it to the desired form: a Cylindrical Gas Electron Multiplier (CGEM) is then proposed.

The innovative construction technique based on Rohacell, a PMI foam, will give solidity to cathode and anode with a very low impact on material budget. The entire detector is sustained by permaglass rings glued at the edges. These rings are use to assembly the CGEM together with a dedicated Vertical Insertion System and moreover there is placed the On-Detector electronic. The anode has been improved w.r.t. the state of the art through a jagged readout that minimize the inter-strip capacitance.

The mechanical challenge of this detector requires a precision of the entire geometry within few hundreds of microns in the whole area.
In this presentation will be presented an overview of the construction technique and the validation of this technique through the realization of a CGEM and its first tests.
These activities are performed within the framework of the BESIIICGEM Project (645664), funded by the European Commission in the action H2020-RISE-MSCA-2014.

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Session Classification: Applications at future nuclear and particle physics facilites - 3 (Chair: Tom Hemmick)

Contribution ID: **52** Type: **Poster presentation**

The importance of LAr TPC in neutrino experiments.

Tuesday, May 23, 2017 3:36 PM (4 minutes)

Presently, neutrinos are one of the most mysterious and interesting particles in physics, they seem to be the ones that can explain different processes of high energy physics, antimatter, conservation of energy and momentum in radioactive decay, and contribute with important data for cosmology and astrophysics. To better understand their different properties such as mass, parity, oscillations, among others, there are several experiments such as ICARUS, MicroBoone, CAPTAIN-MINERVA, NEXT, T2K and currently under construction the Deep Underground Neutrino Experiment (DUNE). The liquid Argon Time Projection Chamber (LAr TPC) is common in these experiments, particularly important for DUNE. A LAr TPC allows to obtain an exact three-dimensional reconstruction of neutrino interactions, provides precise time of each event, has a large sensitive area, a high operational stability, and good light detection systems, among other important performance qualities that make it almost indispensable for neutrino detection. The importance and functioning of LAr TPC in neutrino experiments are summarized in this poster in particular its application in DUNE.

KEYWORDS: liquid argon Time projection chambers (LArTPC), neutrino experiments

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Presenters: GUTIÉRREZ, Rafael M.; DELGADO, Maritza

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **53** Type: **Oral presentation**

High rate GEM readout and tracking for SBS

Tuesday, May 23, 2017 5:00 PM (20 minutes)

Large areaGas Electron Multiplier (GEM) tracking detectors for the Super Bigbite Spectrometer (SBS) in Hall A at Thomas Jefferson National Laboratory (JLab) have been built at the GEM Detector Lab of the University of Virginia(UVa). The Proton Polarimeter Back Tracker of the SBS consists of 40 GEM modules, each with an active area of 60×50 cm^2. Given the open configuration of SBS, the background hit rates in the GEM modules is expected to be as high as 500 kHz/cm2. Correctly reconstructing the particle tracks of interest in this very high background conditions poses a challenging problem. Furthermore, moving and recording large amounts of data generated in the GEM modules at the required readout rate of a few kHz requires innovative solutions in data reduction and data transfer. In this presentation we report on the newly designed APV25 based fast GEM readout system for SBS and on the techniques to handle the high rate background.

Author: DI, Danning

Presenter: DI, Danning

Session Classification: Applications at future nuclear and particle physics facilites - 3 (Chair: Tom Hemmick)

Contribution ID: **54** Type: **Oral presentation**

GEM Detectors of Proton Charge Radius (PRad) Experiment

Tuesday, May 23, 2017 4:40 PM (20 minutes)

The PRad experiment was recently performed
at Jefferson Lab in Hall B. It was designed
to measure the proton charge radius up to
a sub-percent precision through elastic electron
proton scattering process.
It reached very small 4-momentum
transfer squared region
(Q^2 from 2×10^{-4} to 0.1 $(GeV/c)^2$) for the first time.
To achieve the
experimental goal, a pair of large area
GEM detectors were designed and constructed at the University of Virginia.
These two GEM detectors are the largest active area GEM detectors ever built.
Both GEM detectors worked very well through out the experiment,
yielding excellent performance, meeting design parameters.
GEM detectors improved the experimental
resolution by a factor of at least 20.
In this talk,
we will present the performance, such as efficiency,
spatial resolution, etc, of these GEM detectors during experiment,
and also
a short introduction to PRad experiment.

Author: BAI, Xinzhan (University of Virginia)

Presenter: BAI, Xinzhan (University of Virginia)

Session Classification: Applications at future nuclear and particle physics facilites - 3 (Chair: Tom Hemmick)

Contribution ID: **55** Type: **Poster presentation**

R&D and related Simulation Studies for the sPHENIX Time Projection Chamber

Thursday, May 25, 2017 3:18 PM (4 minutes)

The proposed sPHENIX detector design is focused mainly on a physics program of precise upsilon spectroscopy and jet measurements, which require a high tracking efficiency and excellent momentum resolution. A time projection chamber (TPC) is proposed as the outer tracking detector for sPHENIX, which has a rapidity coverage of $|\eta|<1.1$ and full azimuthal coverage. The sPHENIX TPC design has to be optimized for operation in the high rate, high charged particle multiplicity environment that is anticipated at RHIC in 2022. In this poster, we show the results of R&D, its related simulations and describe the ongoing efforts to optimize the design of the sPHENIX TPC.

Author: GARG, Prakhar

Presenter: GARG, Prakhar

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **56** Type: **Poster presentation**

sPHENIX Compact TPC for Tracking and Particle Identification

Thursday, May 25, 2017 3:22 PM (4 minutes)

Heavy ion collisions provide a direct experimental framework to study the properties of the Quark Gluon Plasma.
The sPHENIX detector will be the next state-of-the-art system to measure hard processes observables with high accuracy in a broad p_T range.
The sPHENIX tracking system will feature a compact Time Projection Chamber working in continuous read-out mode as the main tracking detector.
The compact TPC combines both good spatial resolution, below 2% at 5 GeV/c, together with high rate withstand, as high as 100 kHz. It spans geometrically in a volume covering 2.2 units of pseudorapidity and 20 < R < 78 cm.
One of the technologies considered is a quad-GEM configuration connected to 200k readout channels using SAMPA chips able to read ˜4Gbit/s.
For such configuration one of the key aspects of the design will be the ability to mitigate spacecharge distortion due to ion back flow. Several studies on this regard were done and will be shown here.

Author: PEREZ LARA, Carlos Eugenio (Stony Brook University)

Presenter: PEREZ LARA, Carlos Eugenio (Stony Brook University)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **58** Type: **Poster presentation**

The physical requirements analysis and simulation research of the Time Projection Chamber in the circular collider

The accurate measurement of Higgs is bringing us much more higher physical requirements. We need to deal with many problems of the detectors in different collision models, especially the IBF (ion backflow) in the Time Projection Chamber. The circular collider is different with the linear collider in the collision model and the beam structure. The linear collider can use the controlled gating to reduce the IBF. But the circular collider's beam structure is consecutive, working in a long time operation and nonstop model, with 301ns, a shorter time interval, cannot adopt the controlled gating to reduce the IBF. So we propose an approach that using the hybrid detector to realize the detection and reduce the IBF in the same time. In this paper, it mainly described the problems between the circular collider and the linear collider, and then proposed the analysis method, the research of the prototype-detector and the preliminary simulation work.

Authors: WANG, Haiyun (IHEP, CAS); QI, Huirong (IHEP); ZHANG, Yulian (IHEP, CAS); WEN, Zhiwen (IHEP, CAS)

Presenter: WANG, Haiyun (IHEP, CAS)

Contribution ID: **59** Type: **Oral presentation**

HARPO, a Micromegas+GEM TPC for gamma polarimetry above 1 MeV.

Monday, May 22, 2017 1:40 PM (20 minutes)

Gamma-ray Compton telescopes lack sensitivity above 1 MeV and polarimetry is hampered by multiple scattering in calorimetric telescopes below 100 MeV. To fill the gap and use pair creation between 1 and a few tens of MeV, a high-pressure Argon TPC was proposed as a gamma-ray detector. A (30 cm)^3 demonstrator read out by a hybrid Micromegas+GEM has been built and exposed to polarized photon beams at the NewSUBARU facility in Japan. A report on the operation and preliminary results on polarization asymmetry will be given. Before and after the beam test, the sealed detector operation has been monitored with cosmic rays during several months and the learning from this experience will be presented.

Author: COLAS, Paul (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Presenter: COLAS, Paul (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification: MPGD detector technologies - 3 (Chair: Matt Posik)

Contribution ID: **60** Type: **Oral presentation**

Performance of the CAST Micromegas detectors detectors and perspectives for IAXO

Tuesday, May 23, 2017 4:20 PM (20 minutes)

During 2013 to 2015 the CERN Axion Solar Telescope (CAST) has effectuated its final phase of solar axion searches providing a world leading limit on the axion photon coupling strength for ma< 0.02 eV. This sensitivity has been reached thanks to the development of novel detection systems, notably new Micromegas detectors with lower background levels, as well as a new X-Ray Telescope built specifically for axion searches. The background level achieved is below 10-6 keV-1 cm-2 s-1. These innovations serve as pathfindnders for a possible next-generation axion helioscope, notably the proposed International Axion Observatory (IAXO). The planned developments of the Micromegas IAXO detectors will also be shown.

Author: FERRER RIBAS, Esther (CEA (Saclay))

Presenter: FERRER RIBAS, Esther (CEA (Saclay))

Session Classification: Applications at future nuclear and particle physics facilites - 3 (Chair: Tom Hemmick)

Contribution ID: **61** Type: **Oral presentation**

Possible Options for Gain Elements in a High Rate Time Projection Chamber.

Thursday, May 25, 2017 4:10 PM (20 minutes)

Abstract—A brief overview will be presented of the performance of Time Projection Chamber (TPC) gas amplification elements that have been utilized and proposed for next generation central tracking detectors, including an option with continuous readout at high luminosity. The presentation will concentrate on issues critical for high rate detector operation, such as the positive ion backflow (IBF) and energy resolution of these structures, but will not include track finding and momentum reconstruction performance. Both single- and multi-stage Gating Grid (MGG) structures and use of various combinations of micro-pattern gas detectors will be considered as an approach to minimize IBF and the resultant space charge build-up in the main TPC drift volume. A MGG+MWPC structure has been proposed* as an option to minimize TPC dead time. Our first preliminary results will be presented on measurements of the positive ions collection timing, with a comparison to simulations. We have proposed, simulated, and measured the properties of a combination of a MicroMeGas (MMG) detector with two Gas Electron Multipliers (GEM) for TPC application. We have measured the positive ion backflow (IBF) and energy resolution of this structure at various settings of the gains of the elements and the electric field between the elements with different chamber gases. At a gain of 2000, this configuration allows achievement of both an IBF below 0.4% and an energy resolution better than 12% (standard deviation) for 55Fe x-rays. Spark rates were measured for a variety of conditions and will also be presented, including a setup with a resistive layer for protection with a TPC application in mind.
Index Terms—TPC, Gating Grid, MicroMegas, GEM.

Author: SMIRNOV, Nikolai (Yale University)

Presenter: SMIRNOV, Nikolai (Yale University)

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 2 (Chair: Bernd Surrow)

Contribution ID: **62** Type: **Oral presentation**

Preliminary Results of GEM based Transition Radiation Detector/ Tracker in Test Beam at JLab

Monday, May 22, 2017 1:20 PM (20 minutes)

A high luminosity polarized Electron Ion Collider (EIC) is envisioned as a next-generation US facility, as recommended by US Nuclear Science Advisory Committee in its 2015 Long Range Plan. An intensive and comprehensive detector R&D is currently being carried out to address the experimental challenges of future physics programs of EIC. One such challenges is the electron identification, especially in the forward hadron-endcap region, where large QCD hadron background is expected. Transition radiation detectors are used for electron identification in various particle physics experiments. The high granularity GEM detectors provide precise tracking information for the charged particles when used in the micro-drift or micro-TPC configuration. Combined with a transition radiation options and taking into account low material and low cost of GEM detector technologies, GEM based transition radiation detector/tracker is the ideal candidate for large area end-cap detectors.
A small prototype GEM-TRD with an ionization gap of 20 mm was built and tested in an electron beam in Hall D at Jefferson Lab. We present the preliminary results from the test beam data and the proof of concept for GEM-TRD. Finally, we will discuss the future plan for GEM-TRD R&D including GEANT4 simulation for the motivation in the context of an EIC detector.

Author: GNANVO, Kondo (University of Virginia (US))

Co-authors: LIYANAGE, Nilanga (University of Virginia (US)); SURROW, Bernd (Temple University); POSIK, matt; FURLETOVA, Julia (University of Bonn); FURLETOV, Serguei (Moscow Physical Engineering Institute (MePhl)); Dr PENTCHEV, Lubomir (Jefferson Lab)

Presenter: GNANVO, Kondo (University of Virginia (US))

Session Classification: MPGD detector technologies - 3 (Chair: Matt Posik)

Contribution ID: **63** Type: **Poster presentation**

Mechanical Construction of the field cage of sPHENIX TPC

Thursday, May 25, 2017 3:26 PM (4 minutes)

SPHENIX plans to build a world class jet detector at RHIC. Previously inaccessible measurements include jets reconstructed with hadronic calorimeters and fully resolved upsilon states. The current plan includes a highly granular silicon pixel detector (MAPS), a silicon strip detector (INTT) and a time projection chamber (TPC). The tracking system will work in continuous read out, at high data collection rates -15kHz- and will be able to provide momentum resolution below 2% at 5 GeV/c, which is suitable for upsilon reconstruction. The TPC will span a radius from 20 to 78 cm and 2.2 units in pseudorapidity, smaller than TPCs used in current heavy ion experiments, and will be exposed to high electric and magnetic fields. In this poster we present the work done towards the mechanical design and construction of the outer field cage of the TPC

Author: RAM, Niveditha (Stony Brook University)

Presenter: RAM, Niveditha (Stony Brook University)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **64** Type: **Oral presentation**

Numerical predictions of GEM sheet nonlinear mechanical properties under large deformations

Monday, May 22, 2017 11:10 AM (20 minutes)

The deformed shape of the perforated holes in the Gas Electron Multiplier (GEM) are proven to have great effect on the electron gain. Numerical calculations are required to optimized the GEM sheet configuration for maximum gain. In this paper, three methods are used to numerically predict the nonlinear mechanical properties of the GEM foil using finite element method. The hexagonal pattern of the perforated holes creates orthotropic response on the GEM sheet under deformation. In all methods, the properties are measured under large strains up to 0.1. In the first method, isotropic properties are predicted in the direction of the longitudinal alignment of the GEM sheet. In the second method, directional normal and shear moduli as well as the directional Poisson ratios are calculated using solid brick elements. In the third method, shell elements are used to predict the flexure rigidity of the GEM sheet and the equivalent sectional moment of inertia. The results show variation of about 25% of the normal and shear moduli in longitudinal and transvers directions. However, the directional Poisson rations are nearly similar. The results show that the GEM sheet stiffens with deformations.

Authors: BOUHALI, Othmane (Texas A & M University (US)); Dr EL SAYED, Khaled (Texas A&m University at Qatar)

Presenter: MERLIN, Jeremie Alexandre (CERN)

Session Classification: MPGD detector technologies - 2 (Chair: Klaus Dehmelt)

Contribution ID: **65** Type: **Oral presentation**

The RPWELL detector –its physics and potential applications

Monday, May 22, 2017 11:30 AM (20 minutes)

The Resistive-Plate WELL (RPWELL) detector is a single-element gas-avalanche multiplier, combining a single-faced THGEM electrode coupled to the segmented readout anode through a sheet of large bulk resistivity. Laboratory and accelerator studies, performed in Ne- and Ar-based gas mixtures, have demonstrated its large dynamic range (from one to several thousand electrons), high achievable gains, and discharge-free operation with high detection efficiency over a broad particle-flux range.
In this work, we present recent studies aiming to understand the underlying physics processes governing the operation and performance of the RPWELL detector. The focus is on gain stability, energy and spatial resolutions and edge-related effects. Experimental data are compared to simulation results.

While the main potential applications focus on particle tracking over large areas (at moderate localization resolution), we will also discuss two other topics:

- RPWELL-based UV-photon detectors, comprising one or more amplification stages with a reflective CsI photocathode on the first stage. We show that such detectors offer a high single-photon detection efficiency, exhibiting clear Polya-like spectra at stable operation conditions, also under high primary-charge background.
- A RPWELL detector, investigated for UV-photon and charge recording in dual-phase noble-gas TPCs. Here we will present our first results in cryogenic operation of such devices.

Authors: BRESSLER, Shikma (Weizmann Institute of Science (IL)); ARAZI, Lior (Weizmann Institute of Science); BHATTACHARYA, Purba (Saha Institute of Nuclear Physics (IN)); BRESKIN, Amos (Weizmann Institute of Science (IL)); COIMBRA, Artur Cardoso (Weizmann Institute of Science (IL)); ERDAL, Eran (Weizmann Institute of Science (IL)); MOLERI, Luca (Weizmann Institute of Science (IL)); Dr ROY, Arindam (WEizmann Institute of Science); SHAKED, Dan (Weizmann Institute of Science (IL))

Presenter: BRESSLER, Shikma (Weizmann Institute of Science (IL))

Session Classification: MPGD detector technologies - 2 (Chair: Klaus Dehmelt)

Contribution ID: **66** Type: **Oral presentation**

The sPHENIX TPC Project

Tuesday, May 23, 2017 4:00 PM (20 minutes)

A state-of-the-art detector, called sPHENIX is being planned at RHIC for measuring jets, jet correlations and upsilons to study the microscopic nature of the QGP. Precision vertexing and tracking, as well as calorimetry, will be provided over full azimuth and pseudorapidities of |eta| < 1.1. The data will be continuously recorded making use of the 15 kHz RHIC collision rate in the region of interest.

A high resolution and low mass tracking system for reconstructing the three upsilon states is needed. The tracking system comprises silicon pixel and strip detectors and a compact TPC.

The TPC at the present planning stage will be using quadruple-GEM detectors as a readout, following the path of the ALICE-TPC upgrade, with a modified Neon-based gas mixture. The main tasks of this configuration are the achievement of sufficient momentum resolution and combating ion back-flow.

The motivation and the design of the technology choices will be presented along with the present status of the project. Furthermore, alternative readout structures, like hybrids of MicroMegas and GEMs will be discussed.

Author: DEHMELT, Klaus (Stony Brook University USA)

Presenter: DEHMELT, Klaus (Stony Brook University USA)

Session Classification: Applications at future nuclear and particle physics facilites - 3 (Chair: Tom Hemmick)

Contribution ID: **67** Type: **Oral presentation**

Construction of Triple-GEM Detector Using Commercially Manufactured Large GEM Foils

Thursday, May 25, 2017 9:00 AM (20 minutes)

Many experiments are currently using or proposing to use large area GEM foils in their detectors, which is creating a need for commercially available GEM foils. Currently CERN is the only main distributor of large GEM foils, however with the growing interest in GEM technology keeping up with the increasing demand for GEMs will be difficult.

We present here an update on the assembly and testing of triple-GEM tracking detectors utilizing single-masked 40×40 cm^2 commercial GEM foils produced by Tech-Etch. The triple-GEM detectors will allow us to characterize the overall quality of these Tech-Etch foils through gain, efficiency, and energy resolution measurements. This will be done by constructing four single-mask triple-GEM detectors, using foils manufactured by Tech-Etch, which follow the design used by the STAR Forward GEM Tracker (FGT). The stack is formed by gluing the foils to the frames and then gluing the frames together. The stack also includes a Tech-Etch produced high voltage foil and a 2D $r - \phi$ readout foil. While one of the four triple-GEM detectors will be built identically to the STAR FGT, the other three will investigate ways in which to further decrease the material budget and increase the efficiency of the detector by incorporating perforated Kapton spacer rings rather than G10 spacing grids to reduce the dead area of the detector.

Authors: POSIK, Matt; SURROW, Bernd (Temple University)

Presenter: POSIK, Matt

Session Classification: MPGD production and commercialization - 2 (Chair: Craig Woody)

Contribution ID: **68** Type: **Oral presentation**

A new design of Micro Pixel Chamber using DLC electrodes

Monday, May 22, 2017 10:50 AM (20 minutes)

The new design concept of the Micro Pixel Chamber (μ-PIC) has been developed and tested for charged particles tracking. The μ-PIC is a 2D gaseous imaging detector made by the PCB technique. One of the most important property is that the μ-PIC does not require any floating structures and stretching processes.

For protecting the μ-PIC from discharges, the resistive electrode layer is formed on the top substrate. Recently, Diamond Like Carbon (DLC), made by the carbon sputtering and the lift-off process, has been developed for resistive electrodes. This novel material has excellent properties that fine patterning (<10 μm), strong adhesion on the polyimide, wide range resistivity setting (100k /sq. - 1G /sq.), uniform resistivity at large detection area, and so on. High gas gains (>10000) were observed with the prototype of the μ-PIC with DLC cathodes. This prototype was operated stably in the high rate fast neutrons environment more than 1MHz/cm^2. Also, two dimensional tracking performances of charged particles have been measured using SRS.

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Presenter: YAMANE, Fumiya (Kobe Univ.)

Session Classification: MPGD detector technologies - 2 (Chair: Klaus Dehmelt)

Contribution ID: **69** Type: **Oral presentation**

Status of the BONuS12 Radial Time Projection Chamber

Thursday, May 25, 2017 3:50 PM (20 minutes)

Part of the experimental program in Hall B of the Jefferson Lab, Virginia, USA is dedicated to studying neutron structure functions using deep inelastic scattering on nuclei. For this purpose, the BONuS12 experiment will detect low momentum recoil protons in coincidence with scattered electrons. The protons will be detected by a second-generation Radial Time Projection Chamber (RTPC) using triple GEM foils for amplification while the scattered electrons will be detected by the CLAS12 spectrometer installed in Hall B. I will present the status of the BONuS12 RTPC detector that will take data within the next 2 years. I will detail the main improvements made from the previous BONuS RTPC as well as the hardware and simulation developments currently ongoing.

Author: CHARLES, Gabriel (Old Dominion University)

Presenter: CHARLES, Gabriel (Old Dominion University)

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 2 (Chair: Bernd Surrow)

Contribution ID: **70** Type: **Oral presentation**

Performance of the chromium GEM detector

Monday, May 22, 2017 10:30 AM (20 minutes)

MPGD technology has recently been adopted for soft X-ray fluorescence detection techniques. The MPGD are relatively cheap detectors with capability of detection not only a deposited energy (inside its active volume) but also a position of an absorbed photon or a charged particle. Nevertheless, the MPGD's development is mainly driven by HEP experiments needs, recently many new application in very diverse fields have been presented. Simultaneous measurement of the position together with the information about deposited energy (and a time) makes MPGD very attractive in case of soft X-ray fluorescence detection and imaging. Moreover, flexibility in adjusting the signal amplitudes by changing the gas gain with possibility of employment variety of active gas mixtures provides additional level of freedom, which is making that type of detectors well suitable for that application.

Here, we present studies on GEM detectors with particular focus on their properties and appropriateness for soft X-ray detection. Due to the fact that variety of gas mixture were tested (some of them are quite expensive), first of all we evaluated the properties of the standard GEM detector with various active gas flow rats, especially low ones. These measurement have been done with a standard Ar/CO_2 (70/30) gas mixture. In the field of X-ray detection, one also has to take into account fluorescence radiation induced inside the detector by its inner components. Therefore, to get rid of the most of the induced fluorescence radiation, for studies with variety of gas mixtures, we have prepared copper depleted GEM detector. The detector was equipped with a drift and GEM copper (almost) free foils, only the readout structure was left untouched. The gas gain high voltage dependence, gas gain variation across the detector active area, energy resolution for Ar-, Kr- and Xe-based gas mixture were studied. Additionally, a long-term gas gain and energy resolution stability of the detector were evaluated. All these results will be presented during the Conference.

This work was supported by the Polish National Science Centre, grant no. DEC-2013/10/M/ST7/00568.

Authors: MINDUR, Bartosz (AGH University of Science and Technology (PL)); Dr FIUTOWSKI, Tomasz Andrzej (AGH University of Science and Technology (PL)); KOPERNY, Stefan Zenon (University of Mining and Metallurgy); DABROWSKI, Wladyslaw (AGH University of Science and Technology (PL))

Presenter: MINDUR, Bartosz (AGH University of Science and Technology (PL))

Session Classification: MPGD detector technologies - 2 (Chair: Klaus Dehmelt)

Contribution ID: **71** Type: **Oral presentation**

Micromegas Tracker for the CLAS12 experiment and for a future EIC

Tuesday, May 23, 2017 2:40 PM (20 minutes)

The CLAS12 experiment at Jefferson Lab will soon begin using a Micromegas Vertex Tracker (MVT) in its central tracking system. The MVT is composed of 6 cylindrical layers and 6 flat disks of resistive bulk detector Micromegas. The detectors have been designed to withstand the high particle flux environment and the high magnetic field using a low material budget of less than 0.5% of a radiation length per detector. The MVT is read out using front-end electronics based on the DREAM ASIC developed at IRFU. The low material budget requirements and very stringent space restrictions of the central tracking system surrounded by a 5T solenoid prevent the use of on-detector frontend electronics. The ability of the DREAM chip to work with high-capacitance detectors allows deploying the electronics some 2 m away using flat micro-coaxial cables.
A full description of the detector system, the production of the detectors, and the readout electronics will be given in this talk. Possible future developments towards an EIC detector will be presented.

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Presenter: VANDENBROUCKE, Maxence (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification: Applications at future nuclear and particle physics facilites - 2 (Chair: Tom Hemmick)

Contribution ID: **72** Type: **Oral presentation**

GEMROC2 –a self-triggered ASIC

Thursday, May 25, 2017 2:30 PM (20 minutes)

The Gas Electron Multiplier (GEM) detector technology allows building large area position sensitive detectors though 2-D readout of such detectors at high rate is a challenging task. In the paper we report on the design and performance of the prototype GEMROC2 ASIC designed for high count rate applications of GEM detectors. The primary application of the ASIC is readout of $10\times10\text{cm}^2$ GEM detector. However, it could also be used for read out of other types of Micro Pattern Gas Detectors (MPGDs).

The GEMROC2 design follows the concept of the previously designed GEMROC ASIC [1]. It consists of 64 independent channels, allowing for simultaneous recording of the amplitudes (energy channel) and time stamps (timing channel) of incoming signals. Thanks to the implemented token-based read out of derandomizing buffers, the ASIC also provides data sparsification and full zero suppression. Reconstruction of the hit positions is performed in an external data acquisition system by matching the time stamps of signals recorded in X- and Y-strips. The amplitude information is used for centres of gravity finding in clusters of signals on neighbouring strips belonging to the same detection events. The ASIC could work in one of eight gain modes and one of two speed modes. In a slower mode the maximum count rate is 10^5/s while in a faster mode it is three times higher.

Any front-end electronics for readout of MPGDs requires an input protection circuit against possible random discharges inside active detector volume. Input protection circuits built of discrete Surface Mount Device (SMD) components are used as a standard. In case of a high density readout with a pitch of the readout strips below 1mm the very first problem with such a solution is caused by the assembly area needed for SMD components. The GEMROC2 provides integrated, silicon proven [2], input protection circuits so it could be used without any additional input components.

The ASIC has been designed in 0.35μm CMOS process. The basic functionality and parameters have been evaluated using the testability functions implemented in the ASIC design. The ASIC has been also tested in a fully equipped GEM detector module with X-rays source.

This work was supported by the National Science Centre (NCN) Poland, grant number DEC2013/10/M/ST7/00568.

[1] T. Fiutowski et al., *Design and performance of the GEMROC ASIC for 2-D readout of Gas Electron Multiplier detectors*, IEEE Nucl. Sci. Symp. Conf. Rec. (2011) 1540.

[2] T. Fiutowski et al., *Integrated input protection against discharges for Micro Pattern Gas Detectors readout ASICs.* 2017 JINST 12 C02021.

Authors: FIUTOWSKI, Tomasz Andrzej (AGH University of Science and Technology (PL)); DABROWSKI, Wladyslaw (AGH University of Science and Technology (PL)); MINDUR, Bartosz (AGH University of Science and Technology (PL)); SWIENTEK, Krzysztof Piotr (AGH University of Science and Technology (PL)); WIACEK, Piotr (AGH University of Science and Technology)

Presenter: FIUTOWSKI, Tomasz Andrzej (AGH University of Science and Technology (PL))

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 1 (Chair: Bernd Surrow)

Contribution ID: **73** Type: **Oral presentation**

R&D on Large GEM for the Forward Tracking at the Future Electron Ion Collider

Tuesday, May 23, 2017 2:20 PM (20 minutes)

A vigorous tracking and particle identification detector R&D (eRD6 / eRD3) program administered at the Brookhaven National Laboratory (BNL) is currently being carried out to address some of the detector challenges of the future high luminosity polarized Electron Ion Collider (EIC) envisioned to be next-generation US facility for the Nuclear Physics programs. We present the status of the R&D on large GEM for the EIC Forward Trackers (EIC-FT) focus on the design of 1-meter-long, trapezoidal shape triple-GEM prototype and the new two-dimensional stereo-angle (U-V) strip readout developed to specifically address the spatial resolution requirement ($r\Phi < 100$ μm) for an EIC-FT detector. A new connection scheme to connect the front-end electronics to the detector (U-V) readout strips, based on zebra strip contacts was investigated. The advantages of zebra connection, largely used for electrical contact in commercial application such as LCD display, are presented and preliminary test results of the proof of concept on a small prototype are discussed. To conclude, we also present new areas of investigation of our detector R&D such as the Chromium GEM foil (Cr-GEM) being tested as potential candidate for for low mass triple-GEM detector

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Presenter: GNANVO, Kondo (University of Virginia (US))

Session Classification: Applications at future nuclear and particle physics facilites - 2 (Chair: Tom Hemmick)

Contribution ID: **74** Type: **Oral presentation**

Operation of a sealed Kr based micropatterned detector

Tuesday, May 23, 2017 9:30 AM (20 minutes)

Stand alone operation of gaseous detectors is a very desirable feature that is not easy to implement for some configurations/applications. However, some strategies can be implemented in order to achieve high level of portability when considering the use of getters to keep the gas clean in a sealed envelope. In this work we implemented a simple purification system in a pure Kr based detector using a 2D - ThickCobra as the electron amplification structure. The detector body and parts are made on clean materials and the purification is done through convection. The reason of using Kr as the filling gas is due to its high detection efficiency in an interesting X-ray energy range (1-30 keV) and its intrinsic capability to achieve high gains. Preliminary results indicate that no pulse amplitude deviation was observed during several weeks. The detector performance as a function of the functional parameters were studied. Together with these results, long term stability of the detector energy resolution and pulse amplitude, in sealed mode, for different purification conditions, will be presented.

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Presenter: VELOSO, Joao (i3N, Physics Department, University of Aveiro)

Session Classification: MPGD detector technologies - 5 (Chair: Marcus Hohlmann)

Contribution ID: **76** Type: **Oral presentation**

Charged particle timing based on Micromegas in the sub-50 picosecond regime

Monday, May 22, 2017 9:30 AM (20 minutes)

Physics experiments use time to measure physical quantities or to apply selection conditions. The required precision is driven by each specific case. Tens of picoseconds for minimum ionizing particle is what the future physics at the HL-LHC is requiring in time precision for pile-up and background subtraction. In some circumstances, high precision timing has to coexist with high rates and high dose conditions. Assuming this context as one of the highest motivating force, numerous applications outside high-energy physics will profit form this precision. New developments and research in detector technologies and readout electronics are the key points.

Gaseous detectors are widely used in experiments because of their cost effective solution for large area coverage. Excellent properties have been achieved on large surfaces with the recent developments on Micro Pattern Gaseous Detectors (MPGD): gain, space and energy resolution, stability, radiation hardness, low material budget and operation in high rate environments. Time wise, few nanoseconds of time resolution are achievable with the existing MPGD detectors where ionization of the gas itself is the source of primary charge. Sub nanosecond resolution has been obtained in gaseous detectors using solid converter (primary ionization localized in time and space), but the results are still far from aimed time resolution of tens of picosecond.

Our detection concept to obtain this precision is a thin drift Micromegas coupled to a Cerenkov-radiator front window and a semi-transparent UV photocathode. A 1cm2 prototype has been built in order to prove the principle. Single-photoelectron response better than 100ps has been measured with a femtosecond UV laser at IRAMIS. Time resolution better than 50 ps, with a mean yield of about 10 photoelectrons, has been measured at the CERN SPS extraction lines with minimum ionizing particles. Results and potential improvements will be presented.

The excellent results achieved justify the need of addressing now numerous topics in view of the use of the Picosec detector in experiments: lifetime (of the photocathodes in particular), robustness (spark protection), scaling to multichannel readout, large area coverage, front end electronics, high rate and so on so forth. Preliminary results on ongoing developments (resistive micromegas, multi anode readout) will be presented. R&D on solid converter (photocathodes, secondary emitter) will represent clearly one of the most important subjects of our next R&D lines and it will necessarily involve various expertize from different fields. This item will be discussed going through the status of the project and the future research plans.

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Presenter: OLIVERI, Eraldo (CERN)

Session Classification: MPGD detector technologies - 1 (Chair: Klaus Dehmelt)

Contribution ID: **77** Type: **Poster presentation**

The GEM stability test against frequent high voltage on and off switching.

Tuesday, May 23, 2017 3:48 PM (4 minutes)

We report the performance stability of the gas electron multiplier (GEM) against frequent high voltage on and off switching.

We have been developing a GEM, which is included in the X-ray polarimeter by utilizing a micropattern time projection chamber. Our GEMs are adopted by some coming satellite missions (e.g., Imaging X-ray Polarimetry Explore, IXPE) which have a low Earth orbit with a high inclination and pass through the South Atlantic Anomaly (SAA) region where the flux of charged particles increases by a few orders of magnitude. The detector systems must repeat powering down and up every time the satellite passes through SAA. Therefore, the GEM is required to have a stability against powering high voltage on and off repeatedly. In this study we performed the test to confirm that the GEM is robust enough for the situation.

The GEM was tested in dimethyl ether (DME) at 190 Torr, which is the same gas condition in the polarimeter. In the test, we increased the applied high voltage up to 500 V in 25 seconds and then decreased to 0 V in 30 seconds. We repeated this on/off sequence 17 thousand times with continuous irradiation of 8.0 keV X-rays produced by an X-ray generator for 20 days. We took an energy spectrum for 60 seconds once in 50 on/off sequences. As a result, the GEM operated normally and was able to detect X-rays during this test. The gain decreased only 2% and the energy resolution showed no significant change. Therefore, we confirmed the GEM has a tolerance against powering high voltage on and off repeatedly for the satellite operation.

Author: ODA, Sonoe (RIKEN/Tokyo University of Science)

Co-authors: Dr HAYATO, Asami (RIKEN); Mr NISHIDA, Kazuki (RIKEN); Ms KUBOTA, Megu (RIKEN/Tokyo University of Science); Dr KITAGUCHI, Takao (RIKEN/Hiroshima University); Dr ENOTO, Teruaki (RIKEN/Kyoto University); Prof. TAMAGAWA, Toru (RIKEN/Tokyo university of science); Dr NAKANO, Toshio (RIKEN); Dr IWAKIRI, Wataru (RIKEN); Mr ZHOU, Yuanhui (RIKEN)

Presenter: ODA, Sonoe (RIKEN/Tokyo University of Science)

Session Classification: Coffee Break and Poster Session - 1

Contribution ID: **78** Type: **Poster presentation**

sPHENIX TPC simulation studies

Thursday, May 25, 2017 2:50 PM (4 minutes)

Proposed upgrade of PHENIX to sPHENIX at RHIC is focused on measuring jets, jet correlations and three states of upsilons to determine the temperature dependence of transport coefficients of the quark-gluon plasma and complementing measurements being made at LHC. The sPHENIX detector will have GEM based Time Projection Chamber (TPC) as an outer tracking detector with a length of 211 cm and outer radius of 78 cm spanning phase space of full azimuth and 2.2 units in pseudo rapidity. Space charge due to the accumulation of less mobile positive ions within TPC volume is considered one of the important factor determining the performance of GEM-based TPC in Heavy Ion collision environment. Also, selection of suitable gas mixture is important to achieve high mobility of ionized electrons and ions within TPC gas volume. This poster is intended to present the simulation of the effect of space charge and diffusion coefficients of different gas mixtures in TPC on tracking performance.

Authors: TARAFDAR, Sourav (Vanderbilt University); SPHENIX COLLABORATION

Presenter: TARAFDAR, Sourav (Vanderbilt University)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **79** Type: **Poster presentation**

Improvement of GEM gain uniformity: production and verification techniques

Thursday, May 25, 2017 3:30 PM (4 minutes)

We have developed a gas electron multiplier (GEM), which is mainly applied to the X-ray polarimeter with a micro pattern TPC. The GEM has a hole diameter of 70 μm, a hole pitch of 140 μm, an insulator thickness of 100 μm, and a size of an effective area of 30 × 78 mm^2. We adopted a liquid crystal polymer (LCP) sheet as the GEM insulator. To simplify a polarimeter response, the GEM is required to have a high gain uniformity. In order to improve the gain uniformity, a thickness variation of the insulator should be reduced because we found a negative correlation between the gain and the insulator thickness, and already reported it in the previous conference, MPGD 2015. In this presentation, we report selection procedure for the smooth LCP sheet and improvement the GEM gain uniformity by using the selected sheet.

In order to measure the gain uniformity, we scanned the whole GEM effective area in 1-atm Ar/CO_2 (70%/30%) mixture gas. The scan was performed at 2 mm intervals by irradiating the GEM with collimated 8.0 keV X-rays in the direction perpendicular to the GEM plane from an X-ray generator. A thickness scanning of the LCP was also performed across the effective area. The GEM gain and the insulator thickness show a negative correlation with a correlation coefficient of -0.96. The GEM gain exponentially decreases with the insulator thickness. A thickness increase of 1% is corresponding to a GEM gain decrease of 5%. This result means that the high uniformity of the GEM gain is achievable by using the LCP sheet with a small thickness variation.

In this study we propose the selection procedure to increase the gain uniformity of the GEM. A thickness measurement had been performed to select the LCP sheet on both side of the effective area. Some GEMs was developed with the selected LCP sheet. Then the two-dimensional gain scanning was performed for these GEMs. From this scan, a standard deviation of the gain variation was about 10% smaller than previous GEMs as we expected. Therefore, a GEM quality can be predictable by selecting the smooth LCP sheet before a manufacturing process of the GEM.

Author: KUBOTA, Megu

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Presenter: KUBOTA, Megu

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **80** Type: **Oral presentation**

Status and progress of the future neutrino-less double beta decay search with the PandaX-III experiment

Tuesday, May 23, 2017 2:00 PM (20 minutes)

The search for the neutrinoless double beta decay (NLDBD) is one of the most important quests nowadays in neutrino physics. Among the different techniques used, high pressure Xenon (HPXe) gas time projection chambers (TPC) stand out because they allow to image the topology of the NLDBD event (one straggling track ending in two blobs), and use it to discriminate signal from background events. Recent results with Microbulk Micromegas in Xe + trimethylamine (TMA) mixtures show high promise in terms of gain, stability of operation, and energy resolution at high pressures (up to 10 bar). The addition of TMA at levels of ˜1% reduces electron diffusion in up to a factor of 10 with respect to pure Xe, improving the quality of the topological pattern and therefore the discrimination capability. Moreover Microbulk Micromegas have very low levels of intrinsic radioactivity. All these results show that a Micromegas-read HPXe TPC can be a competitive technique in the search for NLDBD. The recently proposed PandaX-III experiment, based on these results, aims at building a large TPC of 200kg of enriched 136-Xe, to be located at Jinping Underground laboratory (Sichuan province, China). In this talk the main features of this experiment, status and progress will be presented.

Authors: GALAN LACARRA, Javier (Shanghai Jiao Tong University (SJTU)); NEYRET, Damien (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Presenter: NEYRET, Damien (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification: Applications at future nuclear and particle physics facilites - 2 (Chair: Tom Hemmick)

Contribution ID: **81** Type: **Oral presentation**

Detailed simulations for estimating time resolution of gaseous ionization detectors

HL-LHC and similar other high luminosity experiments demand detectors capable of providing timing resolution of 100s, or even 10s, of picoseconds in order to resolve the interactions and get rid of the background induced by pileup. While it is expected that fast detectors will have important applications in other fundamental and applied fields, the present study is motivated by the requirements of high rate particle physics experiments.

In the earlier version of the same Conference Series, we presented our initial efforts to develop a numerical model of the physical processes determining the timing resolution of Micro-Pattern Gaseous Detectors (MPGD). In the present version, we plan to report further progress in terms of improving the computational model and its applications to a much wider range of gaseous detectors, including recently proposed MPGDs such as the picosec and MRPCs.

In a series of detailed simulations for estimating time resolution of different gaseous detectors, we have made an attempt to include the effects of most of the important factors, including statistics and distribution of primary electrons, fluctuations related to transport, gain fluctuation, and finally, contribution of signal collection and processing. From the presented studies, we will try to draw general conclusions about the parameters determining the temporal resolution of gaseous detectors.

Authors: MUKHOPADHYAY, Supratik (Saha Institute of Nuclear Physics (IN)); MAJUMDAR, Nayana (Saha Institute of Nuclear Physics); BHATTACHARYA, Purba (Saha Institute of Nuclear Physics (IN)); JASH, Abhik (Saha Institute of Nuclear Physics)

Presenter: MUKHOPADHYAY, Supratik (Saha Institute of Nuclear Physics (IN))

Contribution ID: **82** Type: **Oral presentation**

Construction and test of the large GEM tracking detector for the Super BigBite Spectrometer at JLab

Tuesday, May 23, 2017 1:40 PM (20 minutes)

The Super BigBite Spectrometer (SBS) is currently being instrumented at JLab to investigate nucleon structure at high 4-momentum transfer Q^2 offered by the 12 GeV electron beam upgrade. Being an optimally cost-effective solution for precision tracking over large areas in a high-rate environment, the large Gas Electron Multiplier (GEM) detector has become the key component in SBS tracking system. Our group at UVa is responsible for the design, construction, and implementation of ten 2D GEM tracking layers for the SBS. Each tracking layer has an active area of 60×200 cm^2 and is made out of four 60×50 cm^2 GEM modules. Forty 60×50 cm^2 GEM modules have been successfully fabricated and tested in our laboratory and meet SBS design requirements. Fabricating procedures, quality controls used in each construction step, and testing of the GEM module will be reported in detail.

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Presenter: NGUYEN, H. (Department of Physics, University of Virginia (UVa), Charlottesville, VA 22903, USA)

Session Classification: Applications at future nuclear and particle physics facilites - 2 (Chair: Tom Hemmick)

Contribution ID: **83** Type: **Poster presentation**

Performance of GEM Detectors in the DarkLight Experiment at LERF

Thursday, May 25, 2017 3:34 PM (4 minutes)

The DarkLight experiment has been proposed to search for a heavy photon, A' in the mass range of 10-100 MeV/c^2 produced in electron-proton collisions. Phase-I of DarkLight has started to take place in 2016 at the Low Energy Recirculator Facility (LERF) at Jefferson Lab. LERF delivered a 100 MeV electron beam onto a windowless hydrogen gas target. The phase-I detector tracks leptons inside the DarkLight solenoid with a set of Gas Electron Multiplier (GEM) detectors, combined with segmented scintillators for triggering. The GEM telescope consists of four 10x10 cm^2 triple layer GEM chambers with 2D readout strips, mounted in a slightly angled fixed frame about 12 cm tall. The GEM data are read out with analog pipeline front-end cards (APV-25) each of which can process 128 readout channels. Each GEM chamber has 250 channels for each coordinate axis, read out with two APVs on each side, resulting in 2000 readout channels for the GEM stack, processed by 16 APVs. One Multi Purpose Digitizer (MPD) module is used to read out all of the 16 APV-25 cards. The current run status of DarkLight experiment and the performance of GEMs in the experiment will be discussed.

This work is presently supported by NSF PHY-1436680 and PHY-1505934.

Author: NAZEER, Jesmin (Hampton University)

Co-authors: Dr LIYANAGE, Anusha (Hampton University); Dr MICHAEL, Kohl (Hampton University)

Presenter: NAZEER, Jesmin (Hampton University)

Session Classification: Coffee Break and Poster Session - 2

Contribution ID: **84** Type: **Oral presentation**

Development of GEM Detectors at Hampton University

Tuesday, May 23, 2017 1:20 PM (20 minutes)

Two GEM telescopes, each consisting of three 10x10 cm^2 triple-GEM chambers were built, tested and operated by the Hampton University group. The GEMs are read out with APV25 frontend chips and FPGA based digitizing electronics developed by INFN Rome.

The telescopes were used for the luminosity monitoring system at the OLYMPUS experiment at DESY in Hamburg, Germany, with positron and electron beams at 2 GeV. The GEM elements have been recycled to serve in another two applications: Three GEM elements are used to track beam particles in the MUSE experiment at Paul Scherrer Institute in Switzerland. A set of four elements has been configured as a prototype tracker for phase 1a of the DarkLight experiment at the Low-Energy Recirculator Facility (LERF) Jefferson Lab in Newport News, USA, in a first test run in summer 2016.

The Hampton group is responsible for beam particle tracking in the MUSE@PSI and for the DarkLight phase-I lepton tracker in preparation. Further efforts are ongoing to optimize the data acquisition speed for GEM operations in MUSE and DarkLight. An overview of the group's GEM detector related activities will be given.

This work is presently supported by NSF PHY-1436680 and HRD-1649909.

Author: LIYANAGE, Anusha (Hampton University)

Co-authors: Ms NAZEER, Jesmin (Hampton University); Dr KOHL, Michael (Hampton University)

Presenter: LIYANAGE, Anusha (Hampton University)

Session Classification: Applications at future nuclear and particle physics facilites - 2 (Chair: Tom Hemmick)

Contribution ID: **85** Type: **Oral presentation**

Welcome Address (Dean Michael Klein) / Opening

Monday, May 22, 2017 8:30 AM (30 minutes)

Presenters: SURROW, Bernd (Temple University); KLEIN, Michael (Temple University)

Session Classification: Opening

Contribution ID: **86** Type: **Oral presentation**

Status and Future Developments of Micro-pattern Gas Detectors

Monday, May 22, 2017 9:00 AM (30 minutes)

Invited talk

Presenter: OLIVERI, Eraldo (CERN)

Session Classification: MPGD detector technologies - 1 (Chair: Klaus Dehmelt)

Contribution ID: **88** Type: **Oral presentation**

Applications of Micropattern Gas Detectors at BNL./JLAB and a future EIC facility

Tuesday, May 23, 2017 10:30 AM (30 minutes)

Invited talk

Presenter: K HEMMICK, Thomas

Session Classification: Applications at future nuclear and particle physics facilites - 1 (Chair: Marcus Hohlmann)

Contribution ID: **89** Type: **Oral presentation**

Applications of Micropattern Gas Detectors at FRIB

Tuesday, May 23, 2017 11:00 AM (30 minutes)

Invited talk

Presenter: CORTESI, Marco (National Superconducting Cyclotron Laboratory)

Session Classification: Applications at future nuclear and particle physics facilites - 1 (Chair: Marcus Hohlmann)

Contribution ID: **90** Type: **Oral presentation**

Applications of Micropattern Gas Detectors at Dark Matter and Neutrino Physics related Experiments

Tuesday, May 23, 2017 11:30 AM (30 minutes)

Invited talk

Presenter: GALAN, Javier

Session Classification: Applications at future nuclear and particle physics facilites - 1 (Chair: Marcus Hohlmann)

Contribution ID: **91** Type: **Oral presentation**

ATLAS MPGD production status

Wednesday, May 24, 2017 10:50 AM (30 minutes)

Invited talk

Presenter: SCHIOPPA, Marco (Universita della Calabria (IT))

Session Classification: MPGD production and commercialization - 1 (Chair: Kondo Gnanvo)

Contribution ID: **92** Type: **Oral presentation**

Status and Future Directions of RD51 Activities

Invited talk

Presenter: OLIVERI, Eraldo (CERN)

Session Classification: MPGD production and commercialization - 1 (Chair: Kondo Gnanvo)

Contribution ID: **93** Type: **Oral presentation**

Japan MPGD community

Wednesday, May 24, 2017 11:20 AM (30 minutes)

Invited talk

Presenter: OCHI, Atsuhiko (Kobe Univ.)

Session Classification: MPGD production and commercialization - 1 (Chair: Kondo Gnanvo)

Contribution ID: **94** Type: **Oral presentation**

Summary

Thursday, May 25, 2017 5:10 PM (30 minutes)

Invited presentation

Presenter: TITOV, Maksym (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification: Closing

Contribution ID: **95** Type: **Oral presentation**

Exploiting Psec Time Resolution

Thursday, May 25, 2017 1:30 PM (30 minutes)

Invited talk

Presenter: FRISCH, Henry (university of chicago)

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 1 (Chair: Bernd Surrow)

Contribution ID: **96** Type: **Oral presentation**

Precision Timing Measurement with MicroPattern Detectors

Thursday, May 25, 2017 1:00 PM (30 minutes)

Invited talk

Presenter: WHITE, Sebastian (CERN/Princeton University (US))

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 1 (Chair: Bernd Surrow)

Contribution ID: **97** Type: **Oral presentation**

Status and Future Developments of TPC's with MPGD readout systems

Thursday, May 25, 2017 2:00 PM (30 minutes)

Invited talk

Presenter: COLAS, Paul (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification: Related detector technologies (e.g. RPC's and TPC's) - 1 (Chair: Bernd Surrow)

Contribution ID: **98** Type: **Oral presentation**

Review of results and measurements obtained with GEMPIX detector

Tuesday, May 23, 2017 9:50 AM (20 minutes)

GEMpix is a gas detector obtained by the arrangement of a triple Gas Electron Multiplier (GEM) chamber with an C-MOS front-end electronic based on four Timepix chips, with 512 x 512 squared pixels, 55 micron wide. It was designed at CERN in the framework of the European M.Curie ARDENT project for detector developments in radio protection. A new software based on the pre-existent Pixelman has been written to obtain online cluster reconstruction and an optimized readout. Since then it has been used for the measurements of 55Fe presence in radioactive waste and for the 3D reconstruction of the energy released in a water phantom by an hadron therapy treatment beam. In addition good results, in comparison with the gafchromic films, have also been obtained for the beam spot reconstruction in external beam radiotherapy with photons.
Recently the detector has been used for studying soft X-ray emissivity from laser produced plasmas and has been tested on the ABC laser facility (ENEA, Frascati) and the Eclipse laser facility (CELIA, Bordeaux, France). In this second case, in particular, the detector has been tested using different laser targets, in order to study its capability to discriminate different energy spectra. Its spatial resolution, instead, has been studied first by evaluating the detector response to single fluorescence X-ray photons in our lab and then by means of an Uttner mask placed before the detector window directly on the laser plasma X-ray emission. Some preliminary measurements have been performed also at the KSTAR Tokamak in South Korea in order to reconstruct the time evolution of the burning plasma observed through a pin-hole camera system along a tangential line of sight. Finally the GEMpix is used for small TPC in the preliminary studies for Darkmatter research.

Author: MURTAS, Fabrizio (CERN & INFN)

Presenter: MURTAS, Fabrizio (CERN & INFN)

Session Classification: MPGD detector technologies - 5 (Chair: Marcus Hohlmann)

Contribution ID: **99** Type: **not specified**

WG5

Friday, May 26, 2017 10:30 AM (45 minutes)

SUMMARY OF ACTIVITIES
VMM3
APV zero suppression

Presenters: MULLER, Hans; KAMINSKI, Jochen (University of Bonn (DE)); LUPBERGER, Michael (CERN)

Session Classification: Plenary Session 2 - RD51

Contribution ID: **100** Type: **not specified**

WG6

Friday, May 26, 2017 11:15 AM (15 minutes)

Presenters: JEANNEAU, Fabien (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR)); DE OLIVEIRA, Rui (CERN)

Session Classification: Plenary Session 2 - RD51

Contribution ID: **101** Type: **not specified**

WG7

Friday, May 26, 2017 8:30 AM (15 minutes)

Presenters: OLIVERI, Eraldo (CERN); TSIPOLITIS, Yorgos (National Technical Univ. of Athens (GR))

Session Classification: Plenary Session 2 - RD51