Micro Pattern Gas Detectors 2022

Report of Contributions

https://indico.cern.ch/e/1219224

Contribution ID: **1** Type: **not specified**

Welcome remarks

Monday 12 December 2022 09:30 (10 minutes)

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

Contribution ID: **2** Type: **not specified**

Invited talk: Detector R&D road map

Monday 12 December 2022 09:40 (30 minutes)

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

Contribution ID: **3** Type: **not specified**

The MIGDAL Experiment

Monday 12 December 2022 15:00 (20 minutes)

Direct dark matter experiments exploit the Migdal effect to extend their sensitivity to low-mass WIMPs, yet the Migdal effect itself has not yet been observed to occur in nuclear scattering. The MIGDAL experiment aims to directly observe this effect in a low-pressure optical time projection chamber exposed to an intense beam of fast neutrons from DD and DT generators. The experiment uses an optical time-projection chamber filled with pure CF4 at 50 Torr - for its high scintillation yield and emission spectrum in the visible light. A fast CMOS ORCA-Fusion camera records high resolution track images generated by a stack of two Gas Electron Multipliers. Charge is collected at an Indium Tin Oxide (ITO) anode plane spanning 10 cm x 10 cm and segmented into 120 readout strips to obtain depth information about the track. These two readouts will be used for 3D reconstruction of the characteristic Migdal event topology containing two tracks - one belonging to a nuclear recoil and another belonging to a low energy Migdal electron. This talk details the efforts and commissioning phase of the MIGDAL experiment at the NILE facility, Rutherford Appleton Laboratory and will show preliminary results of calibration data.

Presenter: MARLEY, Tim

Session Classification: Session 3

Contribution ID: **4** Type: **not specified**

Invited talk: MPGD at the HL-LHC era

Monday 12 December 2022 14:30 (30 minutes)

Presenter: OLIVERI, Eraldo (CERN)

Contribution ID: **5** Type: **not specified**

RD51 MB

Monday 12 December 2022 18:30 (1 hour)

Contribution ID: **6** Type: **not specified**

Invited talk: Gas detectors other than MPGD

Tuesday 13 December 2022 10:30 (30 minutes)

Presenter: RADICIONI, Emilio (Universita e INFN, Bari (IT))

Contribution ID: **7** Type: **not specified**

Invited talk: Women in physics: Bound by the ropes of motherhood expectations and the gendered labor market

Tuesday 13 December 2022 15:30 (30 minutes)

Presenter: Dr ERAN JONA, Meytal (Weizmann Institute of Science)

Contribution ID: **8** Type: **not specified**

RD51 CB - Closed session

Tuesday 13 December 2022 20:30 (30 minutes)

Contribution ID: **9** Type: **not specified**

Invited talk: Development of wafer-scale, monolithic CMOS pixel sensors for particle detection

Wednesday 14 December 2022 11:30 (30 minutes)

Presenter: MAGER, Magnus (CERN)

Contribution ID: **10** Type: **not specified**

Invited talk: Nanophotonic particle detectors: how quantum optics can contribute to scintillators and Cherenkov detectors

Thursday 15 December 2022 11:40 (30 minutes)

Presenter: KAMINER, Ido

Contribution ID: **11** Type: **not specified**

Invited talk: MPGD in space applications

Thursday 15 December 2022 15:30 (30 minutes)

Presenter: Dr TAMAGAWA, Toru (RIKEN)

Contribution ID: **12** Type: **not specified**

Ready foLHC Run III - The ATLAS New Small Wheel and the MicroMegas chambers performances

Monday 12 December 2022 12:00 (20 minutes)

The two New Small Wheels (NSW) for the upgrade of the Atlas Muon Spectrometer are now installed in the experiment and ready to collect data in LHC Run III, started in July 2022. The NSW is the largest phase-1 upgrade project of ATLAS. Its challenging completion and readiness for data taking is a remarkable achievement of the Collaboration. The two wheels (10 meters in diameter) replace the first muon stations in the high-rapidity regions of ATLAS and are equipped with multiple layers of two new detector technologies: the small strips Thin Gap Chambers (sTGC) and the MicroMegas (MM). The latter, belong to the family of Micro Pattern Gaseous Detectors (MPGD), for the first time used in such a large scale in HEP experiments. Each detector technology will cover more than 1200 m2 of active area. The new system is designed to assure high tracking efficiency, reduction of fake trigger rates and precision measurement of muon tracks, also in view of the higher background environment foreseen for Hi-Lumi LHC. In this presentation, the motivation of the NSW upgrade and the steps from the commissioning to the data taking together with the first results using the Run III data will be presented, focusing on the MicroMegas performances.

Presenter: MANCINI, Giada (INFN e Laboratori Nazionali di Frascati (IT))

Session Classification: Session 2

Contribution ID: **13** Type: **not specified**

GEM Detectors for the CMS Endcap Muon System: status of three new detector stations

Monday 12 December 2022 12:20 (20 minutes)

In view of the LHC Phase-2, the CMS experiment is being upgraded with three stations of triple-GEM detectors (GE1/1, GE2/1 and ME0) to maintain the excellent trigger pT resolution of its muon spectrometer in the high-luminosity LHC environment and extending its coverage to the very-forward pseudorapidity region 2.4<|η|<2.8. The challenges faced for adapting the triple-GEM technology to a large-area detector have required the introduction of innovations such as discharge protection, an optimized GEM foil segmentation and the development of a complex front-end electronics. The CMS GEM detectors have been tested for the first time under beam irradiation in their final design with their complete front-end electronics and data acquisition software in 2021 and 2022 at the CERN North Area, with the goal of demonstrating the operation of their full readout chain, measuring their efficiency and space resolution under intense beam irradiation and verifying the operating principle of a novel foil sectorization. We describe the setup of the test beam, made of a GE2/1 detector and a second-generation ME0 detector and completed by a high-space resolution beam telescope made of four 10x10 cm2 triple-GEMs. We discuss the preparation of the full DAQ chain, made by the VFAT3 front-end ASIC, an OptoHybrid front-end FPGA and a custom back-end made of a commercial FPGA (CVP-13), all operated with the final CMS GEM acquisition software, and present the performance of both the large-area detectors and the tracker measured with muons and pions.

Presenter: VERWILLIGEN, Piet (Universita e INFN, Bari (IT))

Session Classification: Session 2

Contribution ID: **14** Type: **not specified**

Gain Calibration of the Upgraded ALICE TPC

Monday 12 December 2022 12:40 (20 minutes)

A large Time Projection Chamber (TPC) is the main tracking and particle identification device of the ALICE experiment at the Large Hadron Collider (LHC) at CERN. In order to cope with the foreseen Pb-Pb interaction rate of 50 kHz in the Run 3 of the LHC, the MWPC-based readout chambers of the ALICE TPC were replaced by a GEM-based amplification stage. Combined with the new front-end electronics and the new online/offline system O2, a trigger-less operation of the TPC is possible, resulting in a continuous readout of the three-dimensional track information without dead time. After the new GEM-based readout chambers had been installed, an extensive commissioning program was carried out. It comprised, inter alia, measurements for the calibration of gain variations. These measurements were based on the irradiation of the TPC with an intense X-ray source and on the injection of the radioactive and gaseous isotope 83mKr into the active volume. With them, the calibration of static gain variations (e.g. caused by variations of the hole sizes in the GEM foils) as well as dynamic ones (e.g. due to variations of pressure and temperature) was performed. The studies were essential for the upgraded TPC to reach its design performance, but also revealed some interesting features of the 4-GEM system (e.g. charging-up, wrinkles and sagging). In this talk, the results of the gain calibration of the upgraded ALICE TPC will be presented. The gain map of the detector as well as important parameters for the operation (e.g. the energy resolution) will be shown.

Presenter: HAUER, Philip (University of Bonn (DE))

Session Classification: Session 2

Contribution ID: **15** Type: **not specified**

TPOT : Micromegas detectors to reconstruct distortions of the sPHENIX TPC

Monday 12 December 2022 10:10 (20 minutes)

The sPHENIX detector is being constructed at the Relativistic Heavy Ion Collider (RHIC) at the Brookhaven National Laboratory in the USA. It will be commissioned for data taking in 2023. It will focus on measuring jets as well as open and hidden heavy flavor production in heavy ion collisions to study the properties of the Quark Gluon Plasma. The tracking of the sPHENIX apparatus is built around a TPC which needs a robust and efficient calibration. In particular, the distortions of the electrons drift in the sPHENIX TPC (the main tracking device of the experiment) due to imperfect field and space charge effects, must be accurately measured and corrected. The TPC Outer Tracker (TPOT) is a new detector subsystem that will be installed on the outside of the TPC and will greatly facilitate measuring the electron drift distortions in the TPC. The TPOT consists of 8 double layers Micromegas which provide an additional space point on the outside of the TPC in a limited fraction of its acceptance. This talk will cover the description of the TPOT, the Micromegas design and then the production which lasted a period of 4 months at Saclay. Then the performances of the detectors with cosmic rays and the integration of the detectors within the sPHENIX will be shown.

Presenter: VANDENBROUCKE, Maxence (Université Paris-Saclay (FR))

Session Classification: Session 1

Contribution ID: **16** Type: **not specified**

Development of Large Area µRWELL Detectors for CLAS12 High Luminosity Upgrade at Jefferson Lab

Monday 12 December 2022 10:30 (20 minutes)

The high-luminosity upgrade of the CEBAF Large Acceptance Spectrometer (CLAS12) will significantly enhance the physics reach of experiments in Hall B at JLab. However, at the current luminosity of L = 1 × 1035 cm-2 s-1, the reconstruction efficiency of charged particles in the forward region of the CEBAF Large Acceptance Spectrometer (CLAS12) is at the level of 85% and limited in part by the drift chambers inability to handle high occupancy, in the first tracking region (DC- R1) of the Forward Detector. The reconstruction efficiency is expected to drop even lower at higher luminosities with the current tracking technology. Various options under consideration to achieve the desired performance at a higher luminosity of L = 2 × 1035 cm-2 s-1 include the addition of fast tracking layers to complement DC-R1 or the replacement of DC-R1 with a different tracking detector technology altogether. In either case, a novel generation of compact, simple and robust Micro-Pattern Gaseous Detector (MPGD) known as the Resistive Micro-Well detector (µRWELL) is the ideal candidate to satisfy the requirements in terms of timing O (10 ns) and position O (100 µm) resolutions. A large µRWELL prototype, combined with a two-dimensional U-V strip readout layer based on the novel concept of capacitive-sharing approach has been developed as a proof of principle for fast tracking capabilities in the forward region of CLAS12 high-luminosity upgrade. In this talk, we will present the technical aspects of the design choices of the large µRWELL prototype under development and report on the detector assembly process and preliminary performance characteristic tests. We will also discuss the plans for the test and characterization of the prototype in beam during spring 2023 CEBAF run. Finally, we will report on ongoing R&D efforts on small prototypes with the goal to improve rate capability, spatial resolution performance and minimize material thickness.

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

Session Classification: Session 1

Contribution ID: **17** Type: **not specified**

The CLAS12 Barrel Micromegas Tracker: five years and counting of data taking

Monday 12 December 2022 10:50 (20 minutes)

In the central detector of the CLAS12 experiment at Jefferson Lab, the Barrel Micromegas Tracker (BMT) consists of six layers of low mass cylindrical resistive Micromegas tiles. The BMT surrounds three layers of silicon strip detectors to form the Central Vertex Tracker. The Micromegas tiles sit in a 5 T solenoid magnetic field, with the drift electric field orthogonal to the magnetic field, and they are operating at luminosities up to 1035cm-2s-1 in fixed target e-p collisions. The BMT has been installed in 2017, successfully taking data with a 11GeV electron beam impinging on targets of several kind, such as liquid hydrogen and deuterium, nuclear targets up to Tin and longitudinal polarized targets. A review of the BMT performance during the data taking, such as efficiency, resolution, and longevity in the CLAS12 challenging environment, will be presented.

Presenter: BOSSU, Francesco (Université Paris-Saclay (FR))

Session Classification: Session 1

Contribution ID: **18** Type: **not specified**

Development and production of low background and high energy resolution Micromegas detectors using the thermal bonding method for the PandaX-III experiment

Monday 12 December 2022 11:10 (20 minutes)

High pressure xenon time projection chamber (TPC) is an important detector technology to search neutrino-less double beta decays. The neutrino-less double beta decay search experiment of PandaX-III at the China Jinping Underground Laboratory uses a 10 bar 136Xe TPC with a readout plane consisting of 52 200×200 mm Micromegas detectors for high granularity, good energy resolution and a radio-purity background. In this report, we present the R&D work for the PandaX-III Micromegas detectors. The Micromegas detectors were fabricated using the thermal bonding method developed at USTC. The thermal bonding Micromegas detectors were designed and manufactured in an optimized way to form spark-resistant and dead-channel-free readout modules for the PandaX-III TPC while maintaining the radio-purity as good as the Micro-bulk Micromegas detectors. The thermal bonding Micromegas detectors were operated in a gas mixture of argon and isobutane (2.5%-3.5%) with pressure from 1 to 10 bar and characterized in detail with X-rays. Excellent performance including high gas gain of >104, good energy resolution of <20% (FWHM @5.9keV) at 1 bar, and long-term stability for 10 bar operation in a test of >10 days was demonstrated. These results have validated the thermal bonding Micromegas detector as a promising readout solution for the PandaX-III TPC. A fabrication process optimized for mass production of the Micromegas detectors was developed, and more than 52micromegasdetectors had been produced. Electron transparency, gas gain and non- uniformity of these detectors were tested with flowing gas at 1 bar and showed similarly. stability at gains of >2000 at 10 bar was also demonstrated for more than 24 hours. A PandaX- III TPC prototype containing approximately 140 kg of 136Xe was constructed and instrumented with the Micromegas detectors, and is currently being tested.

Presenter: Mr PENG, Yunzhi (University of Science and Technology of China)

Session Classification: Session 1

Contribution ID: **19** Type: **not specified**

Commissioning of a hadron blind detector for dielectron measurement in pA reactions at J-PARC

Monday 12 December 2022 15:20 (20 minutes)

The J-PARC E16 experiment measures mass spectra of low-mass vector mesons, ρ, ω, and φ, in a nucleus using p + A ⟶ ρ/ω/φ + X reactions at the J-PARC high-momentum beamline. The invariant mass of vector mesons is reconstructed with the e+e− decay. The branching ratio of e+e− decay is very low and a thin target of 0.5% radiation length must be used to reduce dielectrons from gamma conversion inside the target. Thus, a spectrometer with a large acceptance and high-intensity beam up to 1×1010 protons per 2-sec duration pulse are important to collect a sufficient number of vector mesons. We have developed the spectrometer, which has two types of electron identification detectors. The electron identification detectors comprise a hadron blind detector (HBD) and a lead-glass calorimeter. The goal of the pion rejection is 0.6% with the electron detection efficiency of 63% for the HBD. An HBD is a mirrorless and windowless Cherenkov detector. Our HBD consist of CF4 radiator and 30×30 cm2 GEMs. Three GEMs compose a single GEM stack with a CsI photocathode evaporated on the top surface of the top GEM. For the first physics run, 32 GEM stacks will be installed, resulting in total sensitive area of ~ 2.88 m2. Commissioning runs for the spectrometer have been performed at the J-PARC high-momentum beamline. The HBD successfully observed 11 ± 1 photoelectrons for an incident electron. In this presentation, we will show the obtained perfomance of the HBD.

Presenter: Dr KANNO, Koki (RIKEN)

Session Classification: Session 3

Contribution ID: **20** Type: **not specified**

Operation and readout of the CGEM Inner Tracker

Monday 12 December 2022 15:40 (20 minutes)

A recently approved ten-year extension of the BESIII experiment (IHEP, Beijing) motivated an upgrade program for both the accelerator and the detector. In particular, the current inner drift chamber is suffering from aging and the proposal is to replace it with a detector based on the cylindrical GEM technology. The CGEM inner tracker consists of three coaxial layers of triple GEM. The tracker is expected to restore efficiency, improve z-determination and secondary vertex position reconstruction with respect to the current inner tracker, with a resolution of 130 μm in the xy-plane and better than 300 μm along the beam direction. A dedicated readout system was developed for data acquisition. Signals from the detector strips are processed by TIGER, a custom 64-channel ASIC, designed using CMOS 110 nm UMC technology, that provides an analog charge readout via a fully digital output with a linear charge readout up to about 50 fC, less than 3ns jitter. TIGER continuously streams over-threshold data in trigger-less mode to an FPGA-based readout module, called GEM Read Out Card, specifically designed for this system. The module configures the ASICs and organizes the incoming data by building the event packets when the trigger arrives. Two of the three layers are in operation in Beijing since January 2020 remotely controlled. Due to the pandemic situation the integration activity has been continued by the Italian groups on a small-scale prototype. Recently, a test beam has been performed at CERN with the final electronics configuration. In this presentation, the general status of the CGEM-IT project will be presented with a particular focus on the results from the test beam data acquisition, showing that the detection performance is consistent with expectations.

Presenter: FARINELLI, Riccardo (Universita e INFN, Ferrara (IT))

Session Classification: Session 3

Contribution ID: **21** Type: **not specified**

Performance of the large-area micro-RWELL detectors.

Monday 12 December 2022 16:00 (20 minutes)

Large-area coordinate detectors based on micro-resistive WELL (muRWELL) technology are under development for the CMD-3 detector at the VEPP-2000 collider at Budker INP. The CMD-3 is general purpose detector that is intended to measure parameters of light vector mesons and their excited states with accuracy better than 1% and study dynamics of multihadron production. In order to increase acceptance for the trigger for charged particles and improve precision of track polar angle measurements the end-cap muRWELL discs are developed. Two muRWELL discs 50 cm in diameter are assembled and tested. The two-layer readout structure of the discs allow to measure track coordinates with accuracy about 1 mm in radius and 0.3 degrees in polar angle. The first disc has only thin Ni-Cr adhesion layer on top of the muRWELL structure, while the second disc has 5 micron thick copper layer. Both discs are partly equipped with readout electronics based on VMM3a ASICs. The first tests of the discs performance with radioactive source shows that the readout structure is properly designed, the charge is equally shared between layers. Effective gain, that can be calculated from the pulse height spectra measured with readout electronics, is about two times lower than total gain, extracted from the current measurements. The results of systematic measurements of the discs performance with readout electronics, including measurements with test beam will be reported at the Workshop.

Presenter: SHEKHTMAN, Lev (Budker Institute of Nuclear Physics (RU))

Session Classification: Session 3

Contribution ID: **22** Type: **not specified**

The FTD facility at Bonn

Monday 12 December 2022 17:10 (20 minutes)

Presenter: BALL, Markus (University of Bonn (DE))

Session Classification: Session 4

Contribution ID: **23** Type: **not specified**

The Mexico laboratory at Weizmann

Monday 12 December 2022 17:50 (20 minutes)

Presenter: SHOA, Meir (Weizmann Institute of Science (IL))

Session Classification: Session 4

Contribution ID: **24** Type: **not specified**

The Micro Pattern Technologies laboratory at CERN

Monday 12 December 2022 17:30 (20 minutes)

Presenter: DE OLIVEIRA, Rui (CERN)

Session Classification: Session 4

Contribution ID: **25** Type: **not specified**

GridPixes and their Applications

Tuesday 13 December 2022 09:30 (20 minutes)

A GridPix detector is made of a highly pixelized readout ASIC combined with a Micromegas as a gas amplification stage. The later one is realized by photolithographic postprocessing, which allows for a high precision and good alignment of each Micromegas hole with a readout pixel. Because of this arrangement, the charge signal of a primary electron can be detected separately leading to an excellent spatial and time resolution. The high resolution can be exploited in many different ways for example in tracking particles with high precision, in determining the energy loss of a particle or in evaluating the event shape. We are studying the performance of GridPixes for different applications such as tracking in a TPC, neutron detectors, low background X-ray detectors, polarimetry detectors or demonstrators for the general public. We will report on these detectors as well as the implementation of the Timepix3 readout in the Scalable Readout System (SRS) of the RD51 collaboration.

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

Session Classification: Session 5

Contribution ID: **26** Type: **not specified**

The state of art of the μRWELL technology

Tuesday 13 December 2022 09:50 (20 minutes)

Micro-Pattern Gaseous Detectors (MPGD) are the primary choice for the instrumentation of large area apparatus, with high detection efficiency in harsh environment, suitable for muon triggering and tracking at present and future accelerator facilities. They can indeed provide a precise standalone momentum measurement in combination with an inner tracking system. With the addition of a precise timing information (O(ns)) they allow control of uncorrelated background and then a mitigated pile-up. A big step in the direction of large-size applications and destructive spark suppression in hadron environments has been obtained with the consolidation and industrial cost-effective manufacturing of the micro-Resistive WELL (μ-RWELL) detectors [1]. This technology is envisaged to be used for the muon detection system of the LHCb experiment and as pre- shower and muon device of the apparatus at future high luminosity large leptonic colliders. The reduced impact in terms of material budget makes this technology suitable as a tracking device for the muon spectrometer upgrade of the CLAS12 experiment and as central tracker of X17 experiment at the n_TOF facility at CERN. In addition, the flexibility of the μ-RWELL base material allows the development of very light, full cylindrical fine tracking inner trackers at future high luminosity tau-charm factories, STCF in Russia and SCTF in China. With a proper choice of a cathode-converter, the technology has been exploited for neutron detection for the realization of Radiation Portal Monitor for homeland security and Environmental Monitoring for decommissioning of nuclear plants. The state of art of the μRWELL technology R&D will be presented focusing on both detector manufacturing and performance according to the different technological challenges required by the aforementioned experiments. [1] G. Bencivenni et al., The micro-Resistive WELL detector: a compact spark-protected single amplification-stage MPGD, JINST 10 (2015) P02008.

Presenter: POLI LENER, Marco (INFN e Laboratori Nazionali di Frascati (IT))

Session Classification: Session 5

Contribution ID: **27** Type: **not specified**

Proportional Counter array (PCa) - a new MPGD structure

Tuesday 13 December 2022 10:10 (20 minutes)

Many novel structures of the micro-pattern gaseous detector (MPGD) have been developed to adapt to different application needs since the advent of the MPGD technology. In this report we present a new MPGD structure and its preliminary test results. The new structure consists of an array of grooves, with an anode micro-strip placed at the bottom of each groove, and metal plated on the side walls. When setting the metalized wall to the ground potential, just the same as read-out pad, the electric field around the micro-strips, which is analog to anode wire, is significantly improved. Therefore, this structure combines the merits of proportional counter and micro-strip gaseous counter (MSGC). For this new type of gaseous detector, we call it proportional counter array (PCa). PCa can be fabricated readily with standard PCB process, which effectively reduces the production cost and operation difficulty. It's suitable for easy manufacturing and fast readout in large-area applications, where the requirements on spatial resolution and material budget are loose, while new structure featuring low cost and mass production are favored. The gas gain, ion feedback and collection efficiency of PCa structure with various geometric parameters are studied, by simulation and by experimental test. The results show very promising features of PCa: gas gain >5*10^4, low ion feedback <10^-3, high collection efficiency and spatial resolution of ~1mm. Significant charging-up effect is observed, which is cured by coating highly resistive DLC layers to the dielectric surfaces.

Presenter: Mr XIANGQI, Tian (University of Science and Technology of China)

Session Classification: Session 5

Contribution ID: **28** Type: **not specified**

Would MPGDs revolutionize noble-liquid detectors?

Tuesday 13 December 2022 14:30 (20 minutes)

Some novel ideas of ionization-electron and scintillation-photon sensing concepts in single-phase noble-liquid detectors are presented. They rely on immersed micro-structured electrodes, including ones undercoated with VUV photocathodes. Both, radiation-induced electrons from the liquid and primary-scintillation photoelectrons emitted by the photocathode are collected on thin anode strips or micro-patterned surfaces. This results in combined electroluminescence and small charge multiplication in the liquid. The resulting fast UV-photon flashes are detected by near-by photosensors, e.g. SiPM or CMOS arrays, above their dark noise. Some of the proposed concepts permit conceiving single-phase detectors of various geometries. They are expected resolving current liquid-to-gas interface issues in large-area dual-phase detectors e.g. in future dark-matter searches, neutrino experiments and in other fields.

Presenter: BRESKIN, Amos (Weizmann Institute of Science (IL))

Session Classification: Session 7

Contribution ID: **29** Type: **not specified**

A novel concept for dual-phase noble liquid detectors ? Floating Hole Multiplier

Tuesday 13 December 2022 14:50 (20 minutes)

We describe a novel concept for dual-phase noble liquid detectors, the Floating Hole Multiplier (FHM). It consists of a perforated electrode freely floating on the surface of the liquid. The concept has been validated with a Thick Gas Electron Multiplier (THGEM) on the surface of liquid xenon. First experimental results will be reported showing that the electrons, liberated in liquid xenon due to ionization by alpha-particles, are focused into the THGEM holes, extracted under the electric field from liquid to gas and generate electroluminescence of the gas in the hole and its vicinity. Both primary scintillation of the liquid and secondary scintillation in the gas were measured with a quartz window photomultiplier thus showing the potentiality of operation of this configuration in the regime used in the noble liquid dual- phase time projection chambers for low background experiments such as WIMP search and neutrino physics. The advantages of the new concept of floating electrodes will be discussed in view of its application in both liquid xenon and liquid argon detectors, among which are the complete absence of the electrode sagging (critical for large detectors), no need for a fine tilt and liquid level control, significant reduction of surface mechanical and electrical instabilities, reduction of single electron noise from the surface.

Presenter: TCHEPEL, Vitali (Universidade de Coimbra (PT))

Session Classification: Session 7

Contribution ID: **30** Type: **not specified**

The MPGD-based bubble-free Liquid Hole-Multiplier concept for charge and light detection in dual-phase noble-liquid TPCs

Tuesday 13 December 2022 15:10 (20 minutes)

The Bubble-free Liquid Hole-Multiplier (Bf-LHM) concept has been proposed for the simultaneous detection of scintillation-photons and ionization electrons, in dual-phase noble-liquid detectors. In a simpler version of the Bubble-assisted Liquid Hole-Multiplier (Ba-LHM), the gas bubble trapped under a perforated electrode is replaced by a liquid-to-vapor interface located between two perforated (e.g., THGEM) ones. The bottom electrode (L-THGEM) is immersed in the noble liquid with a CsI VUV photocathode deposited underneath, and the top one (G-THGEM) is located in the gas phase. Ionization electrons deposited in the liquid and scintillation-induced photoelectrons emitted from the photocathode are focused into the L-THGEM holes and efficiently transmitted to the vapor phase under an intense field where they are collected into the G-THGEM holes and induce fast electroluminescence photons that are detected by photosensors located above. In this contribution, we will describe the basic operation principles of the new concept and summarize our current experimental results in LXe, emphasizing on the high transfer efficiency of ionization electrons and photoelectrons across THGEM holes, their detection efficiency in the gas phase and the enhanced photon detection efficiency (PDE) of the Bf-LHM compared to the Ba-LHM.

Presenter: ROY, Arindam (Ben Gurion University)

Session Classification: Session 7

Contribution ID: **31** Type: **not specified**

Third generation Nuclear Physics instruments with MPGD gas technology

Tuesday 13 December 2022 11:30 (20 minutes)

Spectroscopy of nuclei far from stability and astrophysics studies are of major interests in a number of nuclear physics laboratories. In view of limiting beam intensities and the low energy multiparticle emission, (examples: n+12C = 3a (Ref 1), 14N(paaa) Ref 2 or 20Mg(βpα) Ref 3), the instrumentation calls for gas detection medium with a 4p solid angular cover and precise tracking capacities. As a result, TPCs devices are widely deployed in nuclear laboratories. Nevertheless, some difficult issues have yet to be resolved. Specifically, beams entering the reaction corridor in the gas volume have dE/dx which are considerably larger than reaction other products to be tracked. This leads to a very large dynamic ranges which rapidly reaches the sparking levels at amplification zone. Other issues like gas mixtures for active targets are present. We will present third generation instruments which are being developed (TeBAT (Texas A&M) , GADGET2(FRIB USA), PUMA(TUD Germany) , ATOM-X(IBS, N. Korea)). They attempt to reach very safe and stable operating conditions to measure full kinematic and particle ID of the reaction products for a wider range of incident beams. This on-going evolution is the outcome of experience gained with MPGD detectors over the years combined with recent developments in particle physics (resistive mircomegas, capacitive spreading, sectorised GEM with different gains) and very wide dynamic range micro-electronics. In this paper we will give a brief account of four developments and the present status for four instruments. TeBAT and ATOM-X are portable TPCs having Silicon/CsI auxiliary envelop to study a wide range of reaction and decay studies. GADGET2 is a novel TPC setup within a Ge 4p cover to investigation astrophysics via particle decay studies. PUMA-TPC/Barrel is the detection for a unique experiment to study anti-proton annihilate on exotic nuclei at CERN. 1. Nature Communications volume 13, Article N°: 2151 (2022) 2 J. Bishop et al., Publication in press 3. C. Wrede et al., accepted experiment at FRIB, US

Presenter: POLLACCO, Emanuel (CEA)

Session Classification: Session 6

Contribution ID: **32** Type: **not specified**

Status and Future Developments of Micro-pattern Gas Detectors for low-energy nuclear physics applications at FRIB

Tuesday 13 December 2022 11:50 (20 minutes)

Rare isotope (RI) beam facilities are now important tools for nuclear physics. The Facility for Rare Isotope Beams (FRIB), located on the campus of the Michigan State University, is a new world-leading user facility for the study of RIs using the in-flight fragmentation method. The unprecedented potential discovery of a modern rare isotope beam facility, such as FRIB, can only be realized by implementing state-of-the-art experimental equipment capable of studying these isotopes at a high beam rate and high performance. Originally developed for high-energy physics (HEP), implementation of MPGD technology as gas avalanche readouts has expanded to other fields, including nuclear physics, astrophysics, neutrino physics, material science, neutron detection, and medical imaging. MPGDs offer large flexibility and allow geometry and performance to be tailored to specific working conditions and performance. The requirements of a typical low-energy nuclear physics experiment (LENP) with rare isotope beam are generally very different from the ones that characterized HEP fixed-target experiments, so that new efforts and resources are necessary to develop new MPGD architectures optimized for LENP environments. In this work, we will describe recent results and progress obtained with new gas avalanche concepts designed to target applications at the Facility for Rare Isotope Beam (FRIB). In particular, we will describe recent progress in the development of Multi-layer THGEM (M- THGEM) structures, for application in active-target TPC readout, as well as tracking at the focal-plane of high-rigidity spectrometers. This also includes a new recent performance evaluation of the Multi-mesh THGEM in terms of gas gain and ion backflow suppression. Further, we present a measurement of the secondary scintillation yield produced in multi- layer Thick Gas Electron Multipliers (M-THGEMs) in low-pressure (20-100 Torr) Tetrafluoropropane gas (CF4), which is of particular importance for the design of next generation of optical-readout Time Projection Chamber (TPC) operated at low-pressure CF4. Potential applications include experimental nuclear physics with rare isotope beams or direct detection of dark matter based on the Migdal effect approach.

Presenter: Dr CORTESI, Marco (Facility for Rare Isotope Beams)

Session Classification: Session 6

Contribution ID: **33** Type: **not specified**

TMM: A Triple Micro-Mesh gaseous structure with ultra-low ion backflow for gaseous photon detectors sensitive to visible light

Tuesday 13 December 2022 12:10 (20 minutes)

Gas photomultiplier tubes (gas-PMT) for visible light detection using micro-pattern gas detectors have been widely studied owing to their potential advantages, such as large detection area with low cost, high spatial and time resolutions, and resistance to magnetic field. But photocathodes sensitive to visible light exhibit a significant aging effect when subjected to excessive ions bombardment. Approximately 20% degradation of quantum efficiency was reported even for low accumulated charge of 0.4 μC/mm2 on the bialkali photocathode. Therefore, very low ion-backflow (IBF) is crucial to visible light-sensitive gas-PMTs, and both high gas gain and photoelectron collecting efficiency are required for single photon detection. we have previously reported the design, fabrication and optimization of a double micro-mesh gaseous structure (DMM). An IBF ratio as low as 3 × 10−4 was obtained with a DMM detector prototype. In this detector, the most backflow ions come from the secondary gas amplification stage of the DMM. Thus, a triple micro-mesh gaseous structure (TMM) becomes a natural extension of the DMM to further suppress the IBF. In this report, we present the design and fabrication of the TMM based on the DMM experience. Multiple TMM prototypes were built and characterized with X-rays and UV light. A gas gain over 4 × 104 and an IBF ratio of lower than 3 × 10−5 were achieved in the X-ray test. The achieved IBF of the TMM is one order of magnitude better than that of the DMM. Furthermore, a very high gain with ultra-low IBF ratio for single electrons was obtained with the TMM using UV light. The energy resolution of the TMM for X-rays was optimized by enhancing electron collecting efficiency. The demonstrated performance of the TMM shows that it is a very promising technology for electron amplification for visible-light gas-PMTs.

Presenter: LIANG, Kunyu (University of Science and Technology of China (CN))

Session Classification: Session 6

Contribution ID: **34** Type: **not specified**

A large area 100 channel PICOSEC Micromegas detector with sub 20 ps time resolution

Tuesday 13 December 2022 12:30 (20 minutes)

The PICOSEC Micromegas precise timing detector is based on a Cherenkov radiator coupled to a semi-transparent photocathode and a Micromegas amplification structure. The first proof of concept single-channel small area prototype was able to achieve time resolution below 25 ps. One of the crucial aspects in the development of the precise timing gaseous detectors applicable in high-energy physics experiments is a modular design that enables large area coverage. The first 19-channel multi-pad prototype with an active surface of approximately 10 cm2 suffered from degraded timing resolution due to the non-uniformity of the preamplification gap. A new 100 cm2 detector module with 100 channels based on a rigid hybrid ceramic/FR4 Micromegas board for improved drift gap uniformity was developed. Initial test beam measurements with 80 GeV muons showed large improvements in timing response over measured pads and a time resolution below 25 ps. More recent measurements with a new thinner drift gap detector module and newly developed RF pulse amplifiers show that the resolution can be enhanced to a level of 16 ps. This work will present the development of the detector from simulations, design, production, and test beam commissioning with a focus on the timing performance of a thinner drift gap detector module in combination with new electronics using an automated timing scan method.

Presenter: UTROBICIC, Antonija (Rudjer Boskovic Institute (HR))

Session Classification: Session 6

Contribution ID: **35** Type: **not specified**

Towards robust PICOSEC Micromegas precise timing detectors

Tuesday 13 December 2022 12:50 (20 minutes)

The PICOSEC Micromegas detector is a precise timing gaseous detector based on a Cherenkov radiator coupled to a semi-transparent photocathode and a Micromegas amplifying structure. First single-pad prototypes, equipped with a non-resistive Micromegas and a Cesium Iodide (CsI) photocathode, demonstrated a time resolution below = 25 ps. However, to make the concept appropriate to physics applications, several developments are required. The objective of this work is to improve the PICOSEC Micromegas detectors robustness aspects, including the integration of resistive Micromegas and robust photocathodes, while maintaining high time resolution. New prototypes are being tested in the laboratory and successfully operated with an 80 GeV/c muon beam. Studies on resistive Micromegas are being performed to limit the destructive effect of discharges and achieve stable operation in intense pion beams with a resistive anode. Preliminary results from a single-pad device equipped with a resistive Micromegas of 292 kΩ/□ and a CsI photocathode showed a time resolution of = 24.1 ps. CsI photocathode, although characterised by its high quantum efficiency, can be easily damaged by ion back flow. Detailed measurements of alternative robust photocathodes including Diamond Like Carbon (DLC), Boron Carbide (B4C) and nanodiamonds are ongoing. Additionally, a detector with a thinner 12 μm thick steel wires mesh is considered to be tested in order to achieve more uniform electric fields in both drift and amplification gaps. Finally, the excellent timing performance of the single-pad proof of concept is expected to be transferred to a new 100-channel PICOSEC detector with 10×10 cm2 resistive Micromegas and an anode with surface resistivity of 20 MΩ/□, making the device more suitable for large-area experiments in need of detectors with high time resolutions.

Presenter: Ms LISOWSKA, Marta (European Organization for Nuclear Research (CERN))

Session Classification: Session 6

Contribution ID: **36** Type: **not specified**

Development of DLC-RPC for Radiative Decay Counter of MEG II Experiment

Wednesday 14 December 2022 09:00 (20 minutes)

The RPC with very thin material budget using MPGD technology has been developed for MEG-II experiment; muon to positron + gamma rare decay experiment. To improve the background rejection, low energy (< a few MeV) positrons coming from radiative decay should be detected under intense muon beam (around 4 x 106 muons per unit cm2) penetrating in the detector. Very small material budget (<0.001 x radiative length), high counting tolerance (> 4 MHz / cm2) and fine timing resolution (< 1 nano second) are required for this counter. We have developed thin RPC detectors that consist of polyimide film as substrate and DLC (Diamond Like Carbon) as resistive electrodes with around 10 MW/sq. of surface resistivity. The thin RPC is stacked to four layers by small pillars (400-micron height) as support structures using photo lithographic technology. The prototype small detectors are produced and tested using muon beam, X-rays and fast neutrons, and results are very promising. The test chamber with segmented HV feeder is now producing and testing. This RPC will be installed in MEG-II experiment in early next year (2023). Recent development status and results of performance tests will be presented.

Presenter: OCHI, Atsuhiko (Kobe University (JP))

Session Classification: Session 8

Contribution ID: **37** Type: **not specified**

The surface Resistive Plate Counter (sRPC): an MPGD technology based RPC

Wednesday 14 December 2022 09:20 (20 minutes)

The Surface Resistive Plate Counter (sRPC) is a novel RPC based on surface resistivity electrodes, a completely different concept with respect to traditional RPCs that use electrodes characterized by volume resistivity. The electrodes of the sRPC exploit the well-established industrial Diamond-Like-Carbon (DLC) sputtering technology on thin (50μm) polyimide foils, already introduced in the manufacturing of the resistive MPGDs such as μ-RWELL and MicroMegas. With this scalable and cost-effective DLC technology it should be possible to realize large area (up to 2x0.5 m2) electrodes with a resistivity spanning over several orders of magnitude (0.01÷10 GΩ/□). The DLC foil is then glued on a 2mm thick float-glass, characterized by excellent planarity. In the baseline detector layout the DLC is connected to the HV by a single dot connection outside the active area. With this layout we measured an efficiency of 95-97% and a time resolution of 1ns. Performance that are quite standard for 2mm gas gap RPCs. In addition, exploiting the concept of the high density current evacuation scheme, first introduced for the μ- RWELL, we realized the first prototypes of high-rate electrodes by screen printing a conductive grid onto the DLC film. With this high-rate layout, with 7GΩ/□ DLC resistivity and 10mm grounding-pitch, we measured a rate capability of about 1kHz/cm2 with X-ray, corresponding to a m.i.p. flux of about 3kHz/cm2. By lowering the DLC resistivity and optimizing the current evacuation scheme, a rate capability of the order of 10kHz/cm2 seems to be achievable. The sRPC, based on innovative technologies, open the way towards cost-effective high-performance muon devices for applications in large HEP experiments for the future generation of high luminosity colliders.

Presenter: GIOVANNETTI, Matteo (INFN e Laboratori Nazionali di Frascati (IT))

Session Classification: Session 8

Contribution ID: **38** Type: **not specified**

Studying signals in particle detectors with resistive elements such as the 2D resistive-strip bulk Micromegas.

Wednesday 14 December 2022 09:40 (20 minutes)

The uninterrupted advancements of modelling and simulation tools, such as Garfield++, has guided the widespread development and understanding of particle detector technologies. Since novel detector structures are proposed regularly, with resistive detectors becoming an ever-increasing fraction of these, it is vital to reflect this progress in the capabilities of the modelling tools. This talk covers the applying of an accurate and universal way of calculating the signals induced in structures with restive elements using an extended form of the Ramo-Shockley theorem to detector configurations such as the 2D resistive-strip bulk Micromegas. Re-introduced by the ATLAS New Small Wheel (NSW) community with their Micromegas design, resistive electrodes are now applied to different detectors within the Micro Pattern Gaseous Detector (MPGD) family to improve their performance and robustness. In a test beam campaign at the H4 beam line of the CERN SPS, two 2D resistive-strip bulk Micromegas with different surface resistivities (100 kΩ/□ and 1 MΩ/□) were studied. Their recorded signals are used to highlight the effect of the resistive strips on the signal shapes as well as to compare them to the modelling results. For this geometry, the dynamic weighting potential needed for the simulations was obtained numerically using a finite element solver. COMSOL Multiphysics provides the needed time-dependent solutions, which, coupled with Garfield++, allows for the targeting of a universal modelling toolkit for the microscopic modelling of the signal induction in particle detectors. Besides this benchmark study, the presentation will focus on how these tools are used to characterize other geometries, such as the 3D Diamond sensor. In addition to deepening the understanding of existing structures, these studies are important for designing and optimising the next generation of particle detectors and their application to specific needs driven by HEP experiments and other applications.

Presenter: JANSSENS, Djunes (Vrije Universiteit Brussel (BE))

Session Classification: Session 8

Contribution ID: **39** Type: **not specified**

Design, production and performances of the Encapsulated Resistive Anode Micromegas detectors for the readout of the High-Angle TPCs of the upgrade of the T2K Near Detector

Wednesday 14 December 2022 10:00 (20 minutes)

The long baseline neutrino experiment T2K will upgrade its near detector (ND280) next year to reduce the systematic uncertainty to less than 4% by adding an active highly segmented neutrino target (Super Fine Grained Detector) surrounded by two new gaseous Time Projection Chambers (High-Angle TPCs) and a 4p TOF veto. The required performances of these TPCs for momentum measurement and particle identification are a 3D track reconstruction with better than 600 µm space point resolution and an energy loss resolution better than 10%. These 2x1.8x0.8 m3 TPCs, operated with the 95%Ar/2%isobutane/3%CF4 T2K gas with 270 V/cm drift electric field will be readout on both sides of their central cathode by an anode endcap of 8 MPGD detectors called ERAM (Encapsulated Resistive Anode Micromegas). These 34x42 cm2 ERAM detectors are 128 µm gap bulk-micromegas with an anode of 1152 square centimeter copper pads readout by a new AFTER ASIC based electronic readout architecture. In order to reach the required space point resolution with such large pads, the anode is covered with a ˜400 kOhm/sq. Diamond Like Carbon (DLC) layer to spread the primary charge over multiple pads. This charge spreading is driven by the RC constant of the gap defined by the anode copper plane and the DLC layer. After an introduction on the ND280 upgrade and the HA-TPCs, we will present the result of the 3 years of development leading to the tuning of the track reconstruction software tools and the final design of the ERAM detector, the production and qualification of the 20 detectors produced so far with an automated 55Fe X-ray test bench (gain and 5.9 keV resolution), and the performances (spatial resolution and dE/dx) of some of them operated in the HA-TPC mode conditions with cosmic rays and particle beams.

Presenter: DELBART, Alain (Université Paris-Saclay (FR))

Session Classification: Session 8

Contribution ID: **40** Type: **not specified**

A neutron detector with RWELL in 3He-CF4 gas mixtures

Wednesday 14 December 2022 10:20 (20 minutes)

The MSGC was the earliest MPGD and the only type found able to operate in 3He-CF4 gas mixtures with a CF4 partial pressure of several atmospheres. This was until our work on the μRWELL, the most recently developed MPGD. Our investigations were the first to test 3He as a neutron converter with the μRWELL and we found we could safely use at least six bar of CF4. Despite the 3He shortage, it is essential to persevere in the development of detectors for neutron scattering applications based on this gas as it provides the easiest method of obtaining high detection efficiency. To achieve sub-millimetre position resolution, at least 4 bar of CF4 is required as a stopping gas in order to adequately reduce the range of the charged particles emitted after the neutron absorption reaction. High-efficiency and sub-millimetre position resolution together with the high-rate capabilities typical of an MPGD make the μRWELL used with a 3He-CF4 gas mixture the ideal solution for many applications in neutron scattering instruments, such as small angle scattering, reflectometry and imaging. Here we report on gain measurements from the μRWELL using gas mixtures of up to six bar of CF4 and 1 bar of 3He, as well as stability and rate capability measurements done on the prototype used for these measurements. Additionally, we report on the optimisation of the drift field, which needs to be sufficiently high to prevent primary electron attachment in the drift volume but not at a level which restricts primary electrons from entering the holes of the μRWELL.

Presenter: RASPINO, Davide (STFC)

Session Classification: Session 8

Contribution ID: **41** Type: **not specified**

Cryogenic RWELL: high gain with quenched discharges

Wednesday 14 December 2022 10:40 (20 minutes)

"Large volume Liquid Argon (LAr) Time Projection Chambers (TPC) are the technology of choice to study the elusive nature of neutrinos and to search for dark matter (DM) particles. Within the volume of noble liquid, neutrino or DM interactions produce prompt scintillation light and ionization electrons. The former is readout using UV light sensors while the latter are drifted under the influence of an electric field to the detection elements. In a single phase TPC, these detection structures are immersed in LAr, with no feasibility to amplify the primary light or charge. In dual-phase (liquid and vapor) TPCs, electrons are extracted from the liquid into the vapor phase and detected either through electroluminescence or after moderate avalanche multiplication. Studies with Large Electron Multipliers (LEMs) have shown the ability to reach charge gains of the order of 100 at 87K. However, the presence of occasional discharges could damage the readout electronics and cause significant deadtime to the detector. In this presentation we discuss the "Cryogenic Resistive WELL"(RWELL) concept. It is a single-sided THGEM (WELL) electrode coupled to readout electronics through an insulating sheet coated with resistive layer optimized for operation at LAr temperature. Similar to the RWELL operation at room temperature, higher maximum gain can be achieved also at cryogenic temperature. Relative to standard LEM and standard WELL detectors, the magnitude of the discharges measured with the cryo-RWELL is much smaller, thus potential damage to the readout electronics and discharges-related dead times are mitigated.

Presenter: TESI, Andrea (Weizmann Institute of Science (IL))

Session Classification: Session 8

Contribution ID: **42** Type: **not specified**

The industrial production of Micro Pattern Gaseous Detector: experience from the ATLAS Micromegas

Thursday 15 December 2022 09:30 (20 minutes)

Resistive Micromegas is one of the detector technologies chosen by ATLAS for the Phase-1 upgrade of the Muon Spectrometer, completed in 2022 in view of the LHC Run3 start. It is the largest MPGD-based detector system ever built, covering an active area of 1280 mˆ2, providing trigger and precise tracking capabilities to the ATLAS Muon system and able to stand a radiation background rate up to 20 kHz/cmˆ2. The heart of the ATLAS Micromegas detectors is the anode board, which carries the resistive protection layer, the readout electrodes and the insulating spacers supporting the micro-mesh. The production of the 2048 readout boards of size up to 0.5x2.2 mˆ2 has been assigned to high- technology PCB industries and required dedicated efforts for technology transfer, production follow- up and quality assurance and control. The talk will review the main challenges from the design phase to the completion of the project which spanned over several years. Emphasis will be put on the technical improvements introduced during the industrial production, the thorough QA/QC protocol established, the achieved results, as well as on logistic, supply and schedule constraints. The lessons learned from this unprecedented MPGD project will also be drawn.

Presenter: IENGO, Paolo (CERN)

Session Classification: Session 9

Contribution ID: **43** Type: **not specified**

Integration of CVD graphene in Gaseous Electron Multipliers for high energy physics experiments

Thursday 15 December 2022 09:50 (20 minutes)

To enhance the performance of micro-patterned gaseous detectors (MPGDs) to meet the challenging requirements of future HEP experiments, 2D materials are attractive candidates to address the backflow of positive ions (ion backflow, IBF), which affects detector performance by distorting electric field lines. A single or few layers of graphene are promising to work as selective filter for IBF suppression [1,2]. Thanks to its delocalized carbon's π-orbitals, graphene may block any ions while it is expected to be transparent to electrons traversing the sheet in a perpendicular direction. Here we present an approach to integrate chemical vapor deposition (CVD) graphene [3] on gaseous electron multipliers (GEMs) prototypes via a wet transfer procedure. Typical hole diameters of tens of μm diameter make the suspension of single or few layer graphene membranes across such areas challenging due to process steps involving liquids mostly related with the capillary effects during drying and evaporation of them. In order to overcome the risk of damaging the membrane and decreasing the yield of suspended 2D material membranes, critical point drying (CPD) and inverted floating method procedures are investigated, see figure1 [4]. In addition to the necessity to cover the full holes in the active area, polymeric residuals have to be minimized in order to evaluate the graphene transparency at the electron energies (i.e., <15 eV) typically obtained in MPGD operating conditions, measurements in these energy ranges are still missing. The advantages of having graphene membranes to physically separate drift and amplification regions of the detectors in order to profit from additional flexibility in the choice of gas mixtures, thus allowing independent optimizations of detector sensitivity and electron multiplication processes will be also discussed. Figure1. SEM images of a GEM foil after graphene bilayer transfers. (a) 2D material membranes are completely broken after the natural drying of the solvents; (b) Fully covered sample after removing the polymeric layer via an inverted floating method procedure; (c) Micrograph of a single hole showing the residuals left on top of the membrane during the transfer procedure. References: [1] Michael Doser et al., Front. Phys. https://doi.org/10.3389/fphy.2022.887738, 2022 [2] S. Franchino et al., Nuclear Instruments and Methods in Physics Research Section A, https://doi.org/10.1016/j.nima.2015.11.077 [3] V Miseikis et al 2015 2D Mater. 2 014006 https://doi.org/10.1088/2053-1583/2/1/014006 [4] Afyouni Akbari et al., Sci Rep 10, 6426 (2020). https://doi.org/10.1038/s41598-020-63562-y

Presenter: ORLANDINI, Giorgio (Friedrich Alexander Univ. Erlangen (DE))

Session Classification: Session 9

Contribution ID: **44** Type: **not specified**

Progress on coupling MPGD-based photon detectors with nanodiamond photocathodes A Bari-Trieste Collaboration

Thursday 15 December 2022 10:10 (20 minutes)

Hydrogenated nonodiamond grains represent an alternative to CsI for detection of single VUV photons in gaseous detectors. A dedicated R&D study on of nanodiamond photocathodes coupled to THGEM-based photon detectors is ongoing. The first phase of these studies includes the comparison of QE in vacuum and in gaseous atmospheres and measurement of aging effects under irradiation and exposure to moisture: promising values for the VUV sensitivity and high robustness have been observed. The second phase consists in the characterization of the performance as electron multipliers of THGEMs coated with a variety of nanodiamond photoconverting layers: preliminary encouraging results from the ongoing systematic studies have been obtained. For the third phase, a photon detector prototype with hybrid Micromegas and THGEMs architecture has been built and equipped with hydrogenated nanodiamond photocathode on the first THGEM layer. We report on the status and perspective of this R&D programme.

Presenter: Mr CHATTERJEE, Chandradoy (INFN Trieste (IT))

Session Classification: Session 9

Contribution ID: **45** Type: **not specified**

Transmission through Graphene of Electrons in the 30 - 900 eV Range

Thursday 15 December 2022 10:30 (20 minutes)

The study of 2D materials, and in particular their interaction with low-energy electrons, is of great interest in surface physics, as well as in several applications ranging from the development of electronic devices to novel detectors for particle physics. The concept of graphene as a pressure-tight membrane transparent to electrons can be employed for the upgrade of MPGD detectors, like Micromegas and GEMs, and for the development of novel ones. We report on the in-vacuum transmission of low-energy electrons through monolayer and trilayer graphene suspended on transmission electron microscopy (TEM) grids. Polycrystalline graphene was grown on copper via chemical vapor deposition (CVD) and transferred onto the TEM grids at the CNI@NEST of Pisa. The custom-made monochromatic electron gun of the LASEC laboratory at Università Roma Tre has been employed to perform the transmission measurements. The electron beam has tuneable energy in the 30 -900 eV range with a resolution of 45 meV and a very good current stability. We measured the in-vacuum (˜10-9 mbar) transmission of graphene layer(s) suspended on the grids as a function of the electron energy with currents in the 200 pA range. The experimental apparatus allows to measure with a Faraday cup either the electron gun emitted current or the current transmitted through the graphene. Thus the transmission is obtained as the ratio of these two measured values. Moreover, a thorough characterisation of the graphene samples has been performed in order to check the quality and the grids coverage with three spectroscopic techniques: micro-Raman, X-ray photoemission and electron energy loss.

Presenter: APPONI, Alice (Università Roma Tre)

Session Classification: Session 9

Contribution ID: **46** Type: **not specified**

New (TH)GEM coating materials characterised using spectroscopy methods

Thursday 15 December 2022 10:50 (20 minutes)

Gas Electron Multiplier (GEM) has become a widely employed technology in modern particle and nuclear physics experiments. Despite great advancements in their construction and performance, the formation of electrical discharges remains one of the major factors limiting the long-term stable operation of GEM detectors and it is crucial to develop methods to mitigate them. In this work GEM and Thick GEM structures, incorporating conductive layers made of copper, aluminium, molybdenum, stainless steel, tungsten and tantalum, are studied. The focus of the study is to determine material dependence on the formation of electrical discharges in GEM-based detectors. For this task, in addition to the discharge probability measurements conducted using a basic electronics readout chain, also optical spectroscopy methods are employed to study the light emitted during discharges from the different foils. It is observed that the light spectra of GEMs include emission lines from the conductive layer material. This indicates the presence of the foil material in the discharge plasma after the initial spark. However, no lines associated with the coating material are observed with THGEMs. Furthermore, it was observed that the used conductive layer material does not substantially affect the stability against primary discharges. This agrees with the expectations from the streamer theory of primary discharge formation. However, strong material dependence is observed in the case of delayed secondary discharge formation. Especially, molybdenum stands out as an attractive (TH)GEM cladding material for increasing stability against secondary discharge formation. This could be beneficial for, among others, photon detectors in which operation with highly asymmetric fields above and below the (TH)GEM in a multi-foil stack geometry would allow to further reduce ion backflow. In addition to results published in NIM A (2021) 165829, new results with a full-scale molybdenum multi-hole THGEM will be discussed in the presentation.

Presenter: KLEMENZ, Thomas (Technische Universitaet Muenchen (DE))

Session Classification: Session 9

Contribution ID: **47** Type: **not specified**

Optical negative ion drift operation at nearly atmospheric pressure

Thursday 15 December 2022 12:10 (20 minutes)

We are going to present for the first time Negative Ion Drift (NID) operation in He:CF4:SF6 at nearly atmospheric pressure within a Time Projection Chamber (TPC) with optical readout via PMTs and scientific CMOS camera (sCMOS). These results have been obtained in the context of the CYGNO/INITIUM project, for the development of high precision 3D TPC for directional direct Dark Matter searches. NID operation is a peculiar modification of the TPC principle by which, thanks to the addition of an highly electronegative dopant to the gas mixture, anions act as image carriers rather than electron, reducing down to the thermal limit the diffusion during drift. This characteristics allows for the use of longer drift distances, combined with improved tracking. We are going to illustrate the analysis of both PMTs and sCMOS data, that are not only able to reproduce He:CF4:SF6 mobility as from previously published papers with charge readout, but also display an impressive reduction of the diffusion during drift, as much as half of classical electron drift with He:CF4 along 12.5 cm. We are going to present NID measurements with various concentration of the elements in the He:CF4:SF6 mixture and a preliminary explanation of the observed extremely low diffusion from classical arguments. The observed features can significantly boost the performances of any experimental approach that requires high precision imaging TPCs, such as, among the others, X-ray polarimetry, neutron spectroscopy, Migdal effect measurements and tracking in high energy physics.

Presenter: BARACCHINI, Elisabetta (Gran Sasso Science Institute)

Session Classification: Session 10

Contribution ID: **48** Type: **not specified**

Development of negative-ion gaseous TPC using micro pattern readout for direction-sensitive dark matter search

Thursday 15 December 2022 12:30 (20 minutes)

NEWAGE is the experiment of direction-sensitive dark matter search using low pressure gaseous TPC with micro pattern strip readout (μ-PIC). It allows to measure the distribution of angles of WIMP-nuclear recoil by track reconstruction, and it leads a positive signature of dark matter. In recent years, large size (˜1 m3) TPC filled with SF6 gas, which is so called "negative-ion gas", is under development. A TPC with negative- ion is a novel technology for the measurement of absolute position of drift direction coordinates for self- triggering systems. It enables to reduce backgrounds coming from detector surface. Furthermore, diffusion of negative-ion drift is expected to be lower than that of nominal electron drift, which allows to improve angular resolution. This presentation reports the status of the development of negative-ion gaseous TPC with prototype small chamber. In addition, we started to develop O(100) μm pitch gaseous TPC detector with pixel type readout system to achieve reconstruction of short track nuclear recoils with good angular resolution. It enables to explore lower mass region of direction-sensitive dark matter searches. We also report about the status of the pixel detector development.

Presenter: HIGASHINO, Satoshi (Kobe University (JP))

Session Classification: Session 10

Contribution ID: **49** Type: **not specified**

Ultra low background Micromegas detectors for BabyIAXO solar axion search

Thursday 15 December 2022 12:50 (20 minutes)

IAXO is a large scale axion helioscope that will look for axions and axion-like particles produced in the Sun with unprecedented sensitivity. BabyIAXO is an in intermediate experimental stage that will be hosted at DESY (Germany) and that will test all IAXO subsytems serving as a prototype for IAXO but at same time as a fully-fledged helioscope with relevant physics at reach in itself and with potential for discovery. One of the crucial components of the project is the ultra-low background X-ray detectors that will image the X-ray photons produced by axion conversion in the experiment. The baseline detection technology for this purpose are Micromegas (Microbulk) detectors. We will show the quest and the strategy to attain the very challenging levels of background targeted for BabyIAXO that need a multi-approach strategy coming from ground measurements, screening campaigns of components of the detector, underground measurements, background models, in-situ background measurements as well as powerful rejection algorithms. First results from the commissioning of the BabyIAXO prototype will be shown.

Presenter: FERRER RIBAS, Esther (Université Paris-Saclay (FR))

Session Classification: Session 10

Contribution ID: **50** Type: **not specified**

Measurement of Detector Properties in a Spherical Proportional Counter

Thursday 15 December 2022 13:10 (20 minutes)

NEWS-G (New Experiments With Spheres-Gas) is an experiment searching for dark matter using Spherical Proportional Counters (SPCs). SPCs are low capacitance detectors which allow the detection of gas ionisation with very low (single electron) thresholds. It consists in a grounded metal sphere with a small sensing anode at the center, creating a radial electric field. Its low capacitance, and the possibility to use low mass target gases such as neon, helium and methane, make it an interesting candidates to detect low mass dark matter. It also has potential for the detection of low energy neutrinos through coherent nucleus electic scattering (CEvNS). Energy calibration is critical for these experiments, and multiple techniques are used to characterise the response of the detector. Using a UV laser, we extract electrons from the sphere surface, which allows a fine calibration of gain, diffusion and drift time of electrons in the SPC. When combining this with the signal X-ray sources such as gaseous 37 Ar, we can measure the mean ionisation for our gas mixtures. Additional measurements are done using nuclear recoils from neutron scattering. We will present characterisation methods and results, as well as early results of dark matter search underground at LSM and SNOLAB.

Presenter: GROS, Philippe

Session Classification: Session 10

Contribution ID: **51** Type: **not specified**

Neutron and beta imaging with Micromegas detectors with optical readout

Thursday 15 December 2022 16:00 (20 minutes)

Recent developments have shown that coupling a Micromegas gaseous detector on a glass substrate with a transparent anode and a CMOS camera enables the optical readout of Micromegas detectors. Efficient X-ray radiography has been demonstrated due to the integrated imaging approach inherent to optical readout. Spatial resolutions of better than σ = 200 µm have been demonstrated for low-energy X-rays from radioactive sources and X-ray generators taking advantage of image sensors with several megapixel resolution. This test opens the way to different applications. Here we will focus on two applications: neutron imaging for non-destructive examination of highly gamma-ray emitting objects and a beta imaging for the single cell activity tagging in the field of oncology drug studies. Both applications require gas simulations for the optimization of photon yields and sensitive camera as well as design of the detectors in view of the specific constraints of reactor dismantling and medical applications: spatial resolution and strong gamma suppression for neutron imaging and precise rate and energy spectrum measurements for the beta. A dedicated system consisting of a glass Micromegas detector and a low-noise camera has been designed and assembled. Results from the characterization of the detectors using X-rays, tritium and neutrons will be shown. First measurements investigating the achievable spatial resolution and rapid imaging capabilities of the Micromegas glass detector at the SOLEIL synchrotron facility with a high-intensity, flat irradiation field will be shown.

Presenters: COOLS, Antoine; COOLS, Antoine (CEA - IRFU DEDIP)

Session Classification: Session 11

Contribution ID: **52** Type: **not specified**

3D track reconstruction of low-energy electrons in the MIGDAL low pressure optical time projection chamber

Thursday 15 December 2022 16:20 (20 minutes)

We will demonstrate three-dimensional track reconstruction of electrons in a low pressure (50 Torr) optical TPC consisting of two glass GEMs with an ITO strip readout in CF4 and CF4/Ar mixtures. These reconstructed tracks show a variety of event topologies, including short tracks from photoelectrons induced by 55Fe 5.9 keV X-rays and long tracks from gamma ray interactions and beta decays. Algorithms for event identification and track ridge detection will be discussed as well as multiple methods for integrating information from the camera image and ITO waveforms with the goal of full 3D reconstruction of the track. We will also discuss challenges faced in the reconstruction of complex track topologies and how to mitigate these in producing accurate results.

Presenter: Ms TILLY, Elizabeth (University of New Mexico)

Session Classification: Session 11

Contribution ID: **53** Type: **not specified**

The CYGNO Experiment: A Directional Dark Matter Detector with Optical Readout

Thursday 15 December 2022 16:40 (20 minutes)

We are going to discuss the R&D and the prospects for the CYGNO/INITIUM project, towards the development of an innovative, high precision 3D tracking Time Projection Chamber with optical readout using He:CF4 gas at 1 bar. CYGNO uses a stack of triple thin GEMs for charge multiplication, this induces scintillation in CF4 gas, which is readout by PMTs and sCMOS camera. High granularity and low readout noise of sCMOS along with high sampling of PMT allows CYGNO to have 3D tracking with head tail capability and particle identification down to O(keV) energy for directional Dark Matter searches and solar neutrino spectroscopy. INITIUM, which is an ERC Consolidator project, aims at developing negative ion drift operation within the CYGNO optical TPC approach. We will present the most recent R&D results from the CYGNO/INITIUM project, and in particular the overground commissioning of the largest prototype developed so far, LIME with a 33x33 cm2 readout plane and 50 cm of drift length, for a total of 50 litres active volume. We will illustrate the LIME response characterisation between 3.5 and 35 keV by means of multiple X-ray sources, and the data Monte-Carlo comparison of simulated sCMOS images in this energy range. We will discuss the expected background rejection capabilities evaluated on simulated data using multivariate techniques and Machine Learning models. We will finally present current LIME installation, operation and data taking at underground Laboratori Nazionali del Gran Sasso (LNGS), serving as demonstrator for the development of a 0.4 m3 CYGNO/INITIUM detector. We will conclude by illustrating the technical choices and the prospects of the 0.4 m3 detector towards a O(30)m3 project, as laid out in the Technical Design Report (TDR) recently produced by our collaboration.

Presenter: PETRUCCI, Fabrizio (Universita e INFN Roma Tre (IT))

Session Classification: Session 11

Contribution ID: **54** Type: **not specified**

FAT-GEM detectors for operation in noble elements

Thursday 15 December 2022 17:00 (20 minutes)

We introduced in 2019 a new concept for electroluminescence in noble elements, based on very-thick acrylic-based perforated structures (Field-Assisted Transparent Gas Electroluminescence Multipliers, or FAT-GEMs in short). Although the structure had the potential for increased light collection thanks to its transparent substrate, such a possibility was not exploited and efforts were put on demonstrating that the technology was already competitive off-the-shelf. In this work we will present our latest results for wavelength-shifting FAT-GEMs made on substrates based on PEN as well as PMMA with TPB-coated holes. In the same configuration, we measured for our FAT-GEMs up to 70% of the light collected with meshes, and we will show how, even if counter- intuitive, it is in principle possible to overcome the 100% physical limit. Measured yields in xenon gas are well in excess of 3 phe/e/bar up to 3.6 kV/cm/bar, with energy resolutions extrapolating to below the values reported by leading experiments. Operated in argon at around the gas density of dual-phase argon detectors, an encouraging value of 1.4 phe/e was obtained. We will present these results comprehensively, together with simulations of the structure response.

Presenter: LEARDINI, Sara (Universidade de Santiago de Compostela (ES))

Session Classification: Session 11

Contribution ID: **55** Type: **not specified**

Towards Large Size Pixelized Micromegas for operation beyond 1 MHz/cm2

Friday 16 December 2022 09:00 (20 minutes)

In recent years, an R&D project has been conducted to consolidate resistive Micromegas technology for operations well beyond the current ones in HEP experiments, with the aim of a stable, reliable, and high gain operation up to particle rates above 1 MHz/cm2, on large surfaces. To achieve this goal, while maintaining a low occupancy on the readout elements, a configuration with small pads readout (only few mm2) has been adopted, which requires innovative solutions for the spark protection resistive scheme. Two main resistive patterns were investigated, expanding the scope of the developments made in previous projects. The main difference between the adopted technical solutions is that in one case (embedded resistors) the charge evacuates through independent pads in a pad patterned layout, while in the other case a continuous and uniform double DLC resistive layer has been adopted and the charge evacuates through vertical dot-connections, several mm apart. A detailed performance comparison will be reported, showing the optimisations and benefits of this latest configuration. More recently, this year, moving towards a larger scale, a new detector with an active area of 400 cm2 has been built, implementing a double layer of DLC foils with a surface resistivity around 30 MOhm/square. The first results will be reported on rate capability, robustness, dependence on the irradiated area, tracking efficiency and energy and spatial resolution following laboratory measurements and the next tests at CERN SPS with high energy particle beams. With the proven high performance of this large area detector, and with the construction of even larger small-pad resistive micromegas next year, our R&D is reaching the goal of establishing the technology for future use under hard and high-rate employment in the field of particle physics and other applications.

Presenter: IODICE, Mauro (INFN - Sezione di Roma Tre)

Session Classification: Session 12

Contribution ID: **56** Type: **not specified**

Optimizing Structure and Operating of Gas Electron Multiplier (GEM) Detectors for High Particle Rate at Jefferson Lab

Friday 16 December 2022 09:20 (20 minutes)

The Gas Electron Multiplier (GEM) detectors built at the University of Virginia are used for both front and rear tracking systems in the Super Bigbite Spectrometer (SBS) experiments at Jefferson Lab (JLab). These GEM detectors include some of the largest area GEM detectors to be used in an experiment. Furthermore, with over 50 large area GEM modules, this is one of the largest ever sets of GEMs in the world. Many new techniques were developed for the fabrication and operation of these GEMs. They meet all critical requirements of the SBS program, including being able to handle rates as high as 500 kHz/cm2 while providing an excellent spatial resolution of 70 μm. However, a higher than expected background resulting from the intense low-energy photon environment in SBS leads to reduced efficiency and increased difficulty in track reconstruction using the GEM detectors. To rectify these issues, our research focuses on optimizing the structure of GEM detectors to reduce the background hits, as well as modifying the high voltage distribution of the detector to improve efficiency. A GEANT4 simulation of a 10cm x 10cm GEM module has been developed to optimize the cathode foil structure by varying its material, thickness, and effective area to lower the background rates. Prototype 10cm x 10cm GEM modules are constructed with different cathode foil structures and data is taken while the prototypes are exposed to an X-ray beam to validate the simulated results. Modifications of the high voltage distribution in the GEM detector were tested using a 50 cm x 60 cm GEM chamber exposed to an X-ray beam and then tested during the upcoming GEn experiment at JLab. Preliminary results on the detector efficiency measured at the GEn experiment and in the simulated high-rate environment using an X-Ray beam will be presented.

Presenter: NGUYEN, Huong (University of Virginia)

Session Classification: Session 12

Contribution ID: **57** Type: **not specified**

Studying MPGDs simultaneously in energy, space and time at high rates: performance of the new RD51 VMM3a/SRS beam telescope

Friday 16 December 2022 09:40 (20 minutes)

The RD51 collaboration organises up to three times per year joint test beam campaigns at the H4 beam line of the CERN SPS. Following the integration of the VMM3a front-end ASIC into the RD51 Scalable Readout System (SRS), the combination of VMM3a and SRS was adapted to read out a new beam telescope for the RD51 collaboration. Furthermore, the beam telescope was used as Beam Position Detector (BPD) in the NA61/SHINE experiment for neutrino studies. Due to the electronics'capabilities, the beam telescope is operated in a self-triggered continuous readout mode, allowing it to record MHz particle interaction rates with close to 100% efficiency. At the same time, this allows almost live feedback on the structure and quality of the particle beams. Due to the electronics'time resolution of around 1 ns, the system is well suited to characterise the time resolution of most MPGD structures. Being able to access the charge information due to the analogue capabilities of the VMM3a, the system allows also to provide the energy information of the particles'interactions, as well as the usage of position reconstruction algorithms to improve the spatial resolution. In this presentation, the beam telescope and its capabilities in terms of energy and time resolution are shown. Further, spatial resolution studies are presented, where the beam telescope is used to study its optimisation in software (alternative position reconstruction algorithms) and hardware (recovering charge information below the threshold level). Further, the ability to read out different kinds of detectors is demonstrated (GEMs, MicroMegas, µRWELL, Straw Tubes, NIM signals). In the end, the successful application of the beam telescope as BPD in the NA61/SHINE experiment and its performance there are highlighted.

Presenter: SCHARENBERG, Lucian (CERN, University of Bonn (DE))

Session Classification: Session 12

Contribution ID: **58** Type: **not specified**

Gaseous Detectors for Preclinical Proton Beam Monitoring, Characterization and Imaging

Friday 16 December 2022 10:00 (20 minutes)

At LMU Munich a proton irradiation platform for preclinical research with tumor bearing mouse models has been developed and commissioned. It converts injected clinical proton beams to low energies of 20 to 50MeV and small diameters of O(1mm) to enable precise, image-guided irradiation of mice. The profile of the produced beam has been in depth characterized with an optically read out bulk Micromegas detector with ITO glass anode, coupled to a pixel Electron Multiplying CCD. The device has been operated at particle rates from single to 107Hz and proton energies between 20 to 70MeV in multiple testbeams. Clinical and preclinical beam are monitored with identical ionization chambers. They feature two perpendicular 40nm thick aluminum strip readout planes and an unsegmented plane for beam current measurement. Latter is read out with an in-house developed, FPGA controlled gated integrator, also enabling control of the clinical accelerator. A proton computed tomography system (pCT) will enable object imaging, by combining particle position information with a residual energy measurement of the transmitted particles. We have developed ultra-thin floating strip Micromegas detectors with two-dimensional strip readout structures, consisting of 9µm thick aluminum electrodes on a 32µm Kapton substrate. For determining the residual energy with high precision, we have built a Time Projection Chamber (TPC) with a discharge insensitive floating pad Micromegas readout structure. Transmitted particles are successively slowed down and then stopped by 65 0.6mm thick, field-shaping Mylar absorbers inside the TPC drift region, alternating with 8mm gas layers. The pCT detectors are read out with the VMM3a SRS. All detectors were developed and built at LMU. The sub-systems were successfully tested individually and recently all together in a beam test at DCPT. We present and discuss construction methods and performance in several test beam campaigns for all detector systems in comparison to reference data.

Presenter: BORTFELDT, Jona (Ludwig Maximilians Universitat (DE))

Session Classification: Session 12

Contribution ID: **59** Type: **not specified**

NitroGEM, a beam monitor for high-intensity neutron beamlines

The NitroGEM is a neutron beam monitor optimised for high-intensity beamlines. It is under development at ISIS in the UK for use on the Loki instrument at the ESS neutron source in Sweden. The Loki instrument is built by ISIS as part of the UK's in-kind contribution to the ESS. The beam monitors play a crucial role during the commissioning and operations of a neutron instrument like Loki. Loki will use five NitroGEM monitors. Three monitors are positioned upstream of the sample to measure how many neutrons arrive at the sample position. Two monitors are installed downstream of the sample. They measure the neutrons transmitted through it. Here we discuss the two most upstream monitors which operate in the v a cuu m o f the neutron beam guide. These are the first two monitors to be installed on Loki. These monitors require a low efficiency in the range between 10-5 and 10-7. NitroGEM monitors achieve these efficiencies using Nitrogen as a neutron converter since it h as a low neutronabsorptioncross-section(1.9barnsfor1.8Åneutrons).We show how we control the efficiency of NitroGEM with great precision by setting the nitrogen content in the gas mixture and how we obtainedan extremelylow gamma sensitivity crucial for the operation at the ESS. Despite the low efficiency, the expected rate of neutron detection on these monitors is about 1MHz. This is the main reason for using GEMs for the electron multiplication.The monitor supstream of the sampler equire very high neutron transparency, higher than 95% for neutrons of wavelengths up to 12Å. NitroGEM can achieve this transparency by placing in the neutron beam only a single GEM inside a sealed aluminium vessel with a 0.5mm thick entrance and exit windows. NitroGEM does not use any additional electrode as a cathode or anode to maximise the monitor transparency. We discuss NitroGEM's engineering layout designed to achieve this transparency and the impact on its operations and the electronics readout.

Presenter: RASPINO, davide (STFC)

Session Classification: Session 12

Contribution ID: **60** Type: **not specified**

The Effects of a Passive Bi-Polar Grid on Ion Back Flow & Resolution

Friday 16 December 2022 10:20 (20 minutes)

Time Projection Chamber (TPC) tracking detectors measures 3D space points of charged particle to give position, dE/dx & Particle Identification (PID). The gain stages create large amounts of Ion Back Flow (IBF), which is the dominant source of space charge & distorts the drift E⃗-field, and thus resolution. IBF can be reduced by manipulating field ratios above and below the gain struc- ture to absorb the ions. However, higher ratios towards the bottom cause gain fluctuations, lowering resolution. A passive structure can be considered as an alternative. A Bi-Polar Grid (BPG) can block practically all ions by simply absorbing them on the negative wires. Avoiding electron loss on the positive wires can be done either with an active grid, losing luminosity, or passively with a B⃗-field exploiting that F⃗ = q⃗v × B⃗ will provide a ”kick”to the electrons while the heavier ions aren’t affected. Our DOI: 10.1109/TNS.2020.3042311 IEEE paper shows that as voltage between the BPG increases, all ion transparency goes zero while electrons maintain 30%-80% transparency depending on the gas, source strength, etc. The sPhenix TPC for BNL, with a quad-GEM stack, uses unique zig-zag shaped radial pads, with DNL corrections. The BPG’s affect on resolution was studied with linear & equidistant wires, regardless of the pad position, & with radial wires aligned with each pad. A prototype TPC, with ≈40cm drift length and ≈43cm diameter, will have been studied at ANL using their 4T MRI mag- net. I’ll present both BPG experiments with IBF results from our paper, and resolution results.

Presenter: ZAKHAROV, Vladislav

Session Classification: Session 12

Contribution ID: **61** Type: **not specified**

Impact of the gas choice and the geometry on the breakdown limits in MPGD detectors

Friday 16 December 2022 11:10 (20 minutes)

In this study we investigate the intrinsic stability limits of GEM, Thick GEM and Micromegas detectors upon irradiation with alpha particles. The measurements are performed in Ar- and Ne-based mixtures with different CO2 content to study the influence of the gas on discharge probability and critical charge limits. The latter are evaluated by comparing the experimental data to results obtained within a Geant4 simulation framework. The measurements provide a direct comparison between GEMs and THGEMs and allow us to evaluate the influence of geometrical parameters, such as hole size, pitch and (TH)GEM thickness, on the stability of a structure and the resulting critical charge value, estimated to be within a range of (3-7)´106 electrons. Surprisingly, the results for both amplification structures nicely agree with each other, in spite of the clear geometrical differences and different electric field configuration inside GEM and THGEM holes. We observe that the breakdown limit is strongly dependent on the gas, and that and that a higher amount of quencher in the mixture does not necessarily correlate with higher stability. The results obtained with Micromegas detectors, employing meshes with different optical transparency and geometry of wires, confirm the observed gas dependency on the discharge stability. In addition, we observe discharge probability scaling with the wire pitch which suggests that a Micromegas mesh cell can be treated as an independent amplification unit, similar to a hole in a GEM foil. The outcome of these studies provides a valuable input for further optimization of MPGD detectors, multi-layer stacks in particular.

Presenter: GASIK, Piotr (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Session Classification: Session 13

Contribution ID: **62** Type: **not specified**

Studies of HV discharges in GEM detectors for the CMS Endcap Muon System

Friday 16 December 2022 11:30 (20 minutes)

From 2018 to the first months of 2022, the Large Hadron Collider (LHC) and the experiments installed on the accelerator ring have performed the Long Shutdown 2 (LS2) upgrade campaign, to cope with the challenges offered by the High Luminosity LHC project. This phase will consist in an increase of the luminosity delivered to the experiments, aiming at enlarging the data statistics, for search of physics beyond the Standard Model. In particular during LS2, the muon spectrometer of the CMS experiment has been upgraded, installing the GE1/1 station based on the Gas Electron Multiplier (GEM) technology. This station is positioned in the endcap region of CMS muon system and covers the pseudorapidity range $1.55 < |\eta| < 2.18$. On 5th July 2022, Run-3 LHC phase has begun, performing collision at the energy of 13.6 TeV. In this context, the newly installed GEM detectors started to experience the creation of discharges, when the beams are colliding inside of CMS. To monitor these events and to understand how to safely operate the detectors, a study on these phenomena became necessary. It analyzes the current intensity of discharges and their rate in the different detectors in terms of discharges recorded per unit of registered luminosity and per hour. It has been observed that some chambers produce a number of events significantly higher than the modal value of rate over the whole chambers population. The reasons responsible for this behavior are currently under investigation. In this talk, the status of the analysis of discharges will be presented, illustrating the evolution of rates observed with different LHC beam configurations and varying the High Voltage working point of GE1/1 chambers.

Presenter: CALZAFERRI, Simone (Università degli studi di Pavia - INFN Pavia)

Session Classification: Session 13

Contribution ID: **63** Type: **not specified**

Discharges and their effect in WELL detectors with and without resistive anodes

Friday 16 December 2022 11:50 (20 minutes)

Resistive anodes are employed in gaseous detectors to avoid or minimize the damaging effects of discharges and to protect the readout electronics. We have characterized discharges in Thick-GEM-based WELL configurations with and without resistive anodes, employing different charge evacuation mechanisms. We used a new method for the resistive detectors to identify gas breakdowns that occur when the total avalanche charge crosses a critical value. We measured the critical charge limit for the investigated detectors as a few 106 electrons, similar to the reported Raether limit for MPGDs. The discharge intensity and probability have been measured as a function of the applied voltage and the total produced charge (ref: arXiv:2204.09445). To study the effect of discharges, we developed a tool to produce controlled, localized discharges inside a detector. I will describe the method and present the effect of discharges on the detector performance.

Presenter: Dr JASH, Abhik (Weizmann Institute of Science (IL))

Session Classification: Session 13

Contribution ID: **64** Type: **not specified**

Development of TPC prototype integrated with UV laser tracks for CEPC

Monday 12 December 2022 16:20 (20 minutes)

Presenter: QI, Huirong (IHEP)

Session Classification: Session 3

Contribution ID: **65** Type: **not specified**

Invited talk: The way the simulation developed

Friday 16 December 2022 12:10 (20 minutes)

Presenter: VEENHOF, Rob (CERN)

Contribution ID: **66** Type: **not specified**

RD51 CB - Opened session - please join

Tuesday 13 December 2022 16:00 (30 minutes)

Contribution ID: **67** Type: **not specified**

Avalanche Gain and Its Effect on Energy Resolution in GEM-based Detectors

Tuesday 13 December 2022 16:30 (3 minutes)

Presenter: THORPE, Tom

Session Classification: Poster session + Wine & Beer

Contribution ID: **68** Type: **not specified**

Soft X-ray Performance Studies of GEM Detectors with Reduced Copper Content

Tuesday 13 December 2022 16:33 (3 minutes)

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

Session Classification: Poster session + Wine & Beer

Contribution ID: **69** Type: **not specified**

Development and test of the Micromegas detector prototype and its readout electronics for the AMBER experiment at CERN

Tuesday 13 December 2022 16:36 (3 minutes)

Presenter: ALICE, Chiara

Session Classification: Poster session + Wine & Beer

Contribution ID: **70** Type: **not specified**

Puzzling time properties of electroluminescence in two-phase argon detector with THGEM readout

Tuesday 13 December 2022 16:39 (3 minutes)

Presenter: BORISOVA, Ekaterina

Session Classification: Poster session + Wine & Beer

Contribution ID: **71** Type: **not specified**

Status of the construction of an experiment for the measurement of angular correlation between light charged particles

Tuesday 13 December 2022 16:42 (3 minutes)

Presenter: NATAL DA LUZ, Hugo (Czech Technical University in Prague)

Session Classification: Poster session + Wine & Beer

Contribution ID: **72** Type: **not specified**

Algebraic methods for reconstruction of coordinates in strip detectors

Tuesday 13 December 2022 16:45 (3 minutes)

Presenter: SMIRNOV, Igor (NRC Kurchatov Institute PNPI (RU))

Session Classification: Poster session + Wine & Beer

Contribution ID: **73** Type: **not specified**

Production and characterization of random electrode sectorization in GEM foils

Tuesday 13 December 2022 16:48 (3 minutes)

Presenter: BIANCO, Michele (CERN)

Session Classification: Poster session + Wine & Beer

Contribution ID: **74** Type: **not specified**

GADGET - a Gaseous Detector with Germanium Tagging

Tuesday 13 December 2022 16:51 (3 minutes)

Presenter: FRIEDMAN, Moshe (The Hebrew University of Jerusalem)

Session Classification: Poster session + Wine & Beer

Contribution ID: **75** Type: **not specified**

Accelerated longevity test of Resistive Micromegas detectors operated with and without small amount of hydrocarbons.

Tuesday 13 December 2022 16:54 (3 minutes)

Session Classification: Poster session + Wine & Beer

Contribution ID: **76** Type: **not specified**

Reconstruction and trigger performance studies of Micromegas detectors for the ATLAS New Small Wheel project

Tuesday 13 December 2022 16:57 (3 minutes)

Session Classification: Poster session + Wine & Beer

Contribution ID: **77** Type: **not specified**

Configuration and Calibration of the Front-End Electronics of the ATLAS New Small Wheel Micromegas Detectors

Tuesday 13 December 2022 17:00 (3 minutes)

Session Classification: Poster session + Wine & Beer

Contribution ID: **78** Type: **not specified**

uRANIA: a micro-Resistive WELL for neutron detection

Tuesday 13 December 2022 17:03 (3 minutes)

Presenter: FARINELLI, Riccardo (Universita e INFN, Ferrara (IT))

Session Classification: Poster session + Wine & Beer

Contribution ID: **79** Type: **not specified**

The high voltage system the novel MPGD-based photon detectors of COMPASS RICH-1 and its development towards a scalable HVPSS for MPGDs

Tuesday 13 December 2022 17:06 (3 minutes)

Presenter: Dr LEVORATO, Stefano (INFN Trieste (IT) and CERN)

Session Classification: Poster session + Wine & Beer

Contribution ID: **80** Type: **not specified**

Intelligent analysis of element distribution maps acquired with a full-field XRF imaging spectrometer

Tuesday 13 December 2022 17:09 (3 minutes)

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

Session Classification: Poster session + Wine & Beer

Contribution ID: **81** Type: **not specified**

Cluster Ions in Ne-CO2 gas mixture

Tuesday 13 December 2022 17:12 (3 minutes)

Presenter: Dr KALKAN, Yalcin (Muş Alparslan University (TR))

Session Classification: Poster session + Wine & Beer

Contribution ID: **82** Type: **not specified**

A new gaseous UV detector design

Tuesday 13 December 2022 17:15 (3 minutes)

Presenter: Dr KALKAN, Yalcin (Muş Alparslan University (TR))

Session Classification: Poster session + Wine & Beer

Contribution ID: **83** Type: **not specified**

Research on fast grounding simulation method for the MPGD with resistive layer

Tuesday 13 December 2022 17:18 (3 minutes)

Presenter: FANG, Zhujun

Session Classification: Poster session + Wine & Beer

Contribution ID: **84** Type: **not specified**

A KiCad toolbox for particle detector design

Tuesday 13 December 2022 17:21 (3 minutes)

Presenter: GRABAS, Aude Marie (Université Paris-Saclay (FR))

Session Classification: Poster session + Wine & Beer

Contribution ID: **85** Type: **not specified**

New Resistive Materials for cryogenic operation of particle detectors

Tuesday 13 December 2022 17:24 (3 minutes)

Presenter: VEGAS-GALICIAN, Olano

Session Classification: Poster session + Wine & Beer

Contribution ID: **86** Type: **not specified**

Development of a Multi-layer Boron-coated GEM detector for slow neutron detection at spallation sources

Tuesday 13 December 2022 17:27 (3 minutes)

Presenter: CANCELLI, Stephanie (Milano-Bicocca University)

Session Classification: Poster session + Wine & Beer

Contribution ID: **87** Type: **not specified**

New technique of ion identification in Accelerator Mass Spectrometry using low-pressure TPC with GEM readout

Tuesday 13 December 2022 17:30 (3 minutes)

Presenter: SHAKIROVA, Tamara (Budker Institute of Nuclear Physics of Siberian Branch Russian Academy of Sciences (BINP SB RAS))

Session Classification: Poster session + Wine & Beer

Contribution ID: **88** Type: **not specified**

Missing data reconstruction using CNN in the gaseous TPC PandaX-III experiment

Tuesday 13 December 2022 17:33 (3 minutes)

Presenter: LOBASENKO, Andrii (CEA-Saclay/IRFU/DPhN)

Session Classification: Poster session + Wine & Beer

Contribution ID: **89** Type: **not specified**

Preliminary analyses of X-Rays from vacuum discharges during HV conditioning experiments at HVPTF with a GEM detector

Tuesday 13 December 2022 17:36 (3 minutes)

Presenter: CARUGGI, Federico

Session Classification: Poster session + Wine & Beer

Contribution ID: **90** Type: **not specified**

Electroluminescence in He/CF4 and hydrocarbons gas mixtures for directional dark matter searches with the CYGNO Optical Time Projection Chamber

Tuesday 13 December 2022 17:39 (3 minutes)

Presenter: AMARO, Fernando (LIBPys - Coimbra University)

Session Classification: Poster session + Wine & Beer

Contribution ID: **91** Type: **not specified**

The SAMPA-SRS integrated readout for radiation gaseous detectors.

Tuesday 13 December 2022 17:42 (3 minutes)

Presenter: Mr GROSSI ARAUJO DE SOUZA, Geovane

Session Classification: Poster session + Wine & Beer

Contribution ID: **92** Type: **not specified**

Studying the impact of humidity on the performance of MPGDs

Tuesday 13 December 2022 17:45 (3 minutes)

Presenter: FRIBERT, Henrik

Session Classification: Poster session + Wine & Beer

Contribution ID: **93** Type: **not specified**

The novel XYU-GEM for ambiguity reduced tracking

Tuesday 13 December 2022 17:48 (3 minutes)

Presenter: FLOETHNER, Karl Jonathan (University of Bonn (DE))

Session Classification: Poster session + Wine & Beer

Contribution ID: **94** Type: **not specified**

Effect of Multiple Discharges on Accumulated Damage to the DLC Anode Layer of a Resistive Well Electron Multiplier

Tuesday 13 December 2022 17:51 (3 minutes)

Presenter: AFANACIEV, Konstantin (NC PHEP BSU)

Session Classification: Poster session + Wine & Beer

Contribution ID: **95** Type: **not specified**

HYDRA-TPC with a hybrid GEM-Micromegas detector

Tuesday 13 December 2022 17:54 (3 minutes)

Presenter: JI, Liancheng (Technische Universität Darmstadt)

Session Classification: Poster session + Wine & Beer

Contribution ID: **96** Type: **not specified**

A Segmental 2D readout board for GEM detectors

Tuesday 13 December 2022 17:57 (3 minutes)

Presenter: BABIJ, Michał (TTA Techtra)

Session Classification: Poster session + Wine & Beer

Contribution ID: **97** Type: **not specified**

Development of miniaturized circuit boards for GEM detectors onboard the CubeSat X-ray observatory NinjaSat

Tuesday 13 December 2022 18:00 (3 minutes)

Presenter: OTA, Naoyuki

Session Classification: Poster session + Wine & Beer

Contribution ID: **98** Type: **not specified**

Primary Scintillation in Argon-CF4 mixtures

Tuesday 13 December 2022 18:03 (3 minutes)

Presenter: AMEDO MARTINEZ, Pablo (Universidade de Santiago de Compostela (ES))

Session Classification: Poster session + Wine & Beer

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

Investigation of the uniformity in performance of a single mask triple GEM chamber

Tuesday 13 December 2022 18:06 (3 minutes)

Presenters: Mr CHATTERJEE, Sayak (Bose Institute (Kolkata)); CHATTERJEE, Sayak

Session Classification: Poster session + Wine & Beer

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

Performance study of novel micro-Resistive WELL (uRWELL) detector in different gas mixtures and geometries

Tuesday 13 December 2022 18:09 (3 minutes)

Presenter: CHAKRABORTY, Soham (University of York)

Session Classification: Poster session + Wine & Beer

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

Spark detection at sPHENIX TPC

Tuesday 13 December 2022 18:12 (3 minutes)

Presenter: MAJOROS, Tamás (University of Debrecen)

Session Classification: Poster session + Wine & Beer

Contribution ID: **102** Type: **not specified**

Detectors and electronics for high precision measurements of thermal neutrons

Tuesday 13 December 2022 18:15 (3 minutes)

Presenter: BLOCK, Thomas

Session Classification: Poster session + Wine & Beer

Contribution ID: **103** Type: **not specified**

DLC Surfaces for Photon Detection with THGEMs

Tuesday 13 December 2022 18:18 (3 minutes)

Presenter: KLEMENZ, Thomas (Technische Universitaet Muenchen (DE))

Session Classification: Poster session + Wine & Beer

Contribution ID: **104** Type: **not specified**

Discharge Consortium in quest for Spark-Less-Avalanche-Microstructures

Tuesday 13 December 2022 18:21 (3 minutes)

Presenter: WALDMANN, Tobias Yannick (Technische Universitaet Muenchen (DE))

Session Classification: Poster session + Wine & Beer

Contribution ID: **105** Type: **not specified**

Gas selection for Xe-based LCP-GEM detectors onboard the CubeSat X-ray observatory NinjaSat

Tuesday 13 December 2022 18:24 (3 minutes)

Presenter: TAKEDA, Tomoshi

Session Classification: Poster session + Wine & Beer

Contribution ID: **106** Type: **not specified**

Further optimization studies of Resistive Plate WELL detector

Tuesday 13 December 2022 18:27 (3 minutes)

Presenter: ZAVAZIEVA, Darina

Session Classification: Poster session + Wine & Beer

Contribution ID: **107** Type: **not specified**

Fabrication, characterization and charging up studies of THick Gas Electron Multipliers

Tuesday 13 December 2022 18:30 (2 hours)

Presenter: MAJUMDAR, Nayana (Saha Institute of Nuclear Physics (IN))

Session Classification: Poster session + Wine & Beer