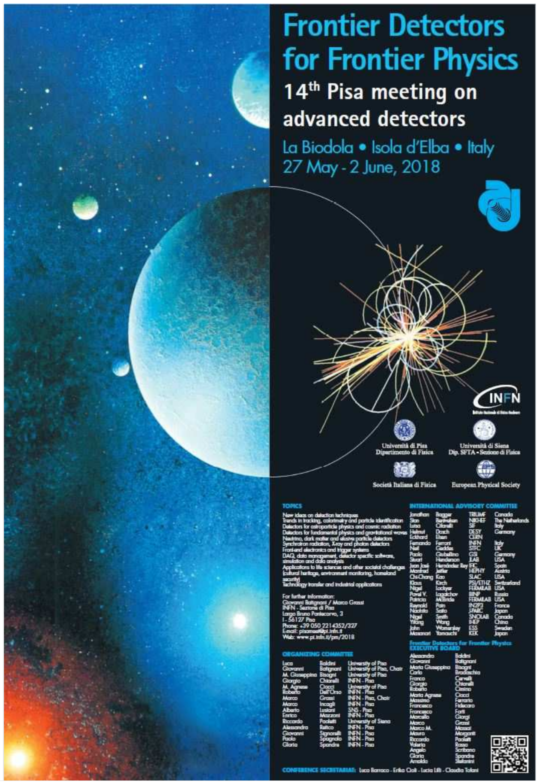


Malte Hildebrandt :: Laboratory for Particle Physics :: Paul Scherrer Institut

Session “Gaseous Detectors” – Poster Review

PM2018 – 14th Pisa Meeting on Advanced Detectors
01 June 2018, La Biodola, Isola d’Elba

Topics of Posters

- gaseous electronics (2)
- simulations (2)
- gaps: RPC (7), MicroMeGas (4)
- holes: end-to-end and tapped blind – GEM (9) and Well (2)
- single wire: Straw Tube (3)
- multi-wires: MWPC (1), Thin Gap Chamber (1), Drift Chamber (4)
- detector systems: present (5) and future (3)

→ in total 43 posters

→ please accept my apologies: I will be very brief for each poster…

Gaseous Electronics

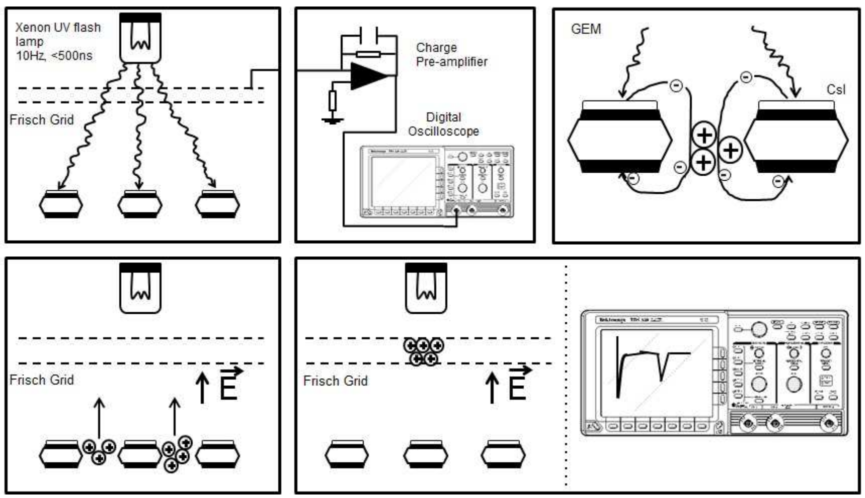
Experimental ion mobility measurements for the LCTPC Collaboration

ID 47

André F.V. Cortez, M.A.G. Santos, R. Veenhof, P.N.B. Neves, F.I.G.M. Borges and C.A.N. Conde

Contact: andre.cortez@coimbra.lip.pt

Experimental Set-up and Working Principle



Relevance

TPC
- Build-up of positive space-charge
- correction of the track distortions

MWPC
- Influences the rate capability

NITPC
- Signal formation

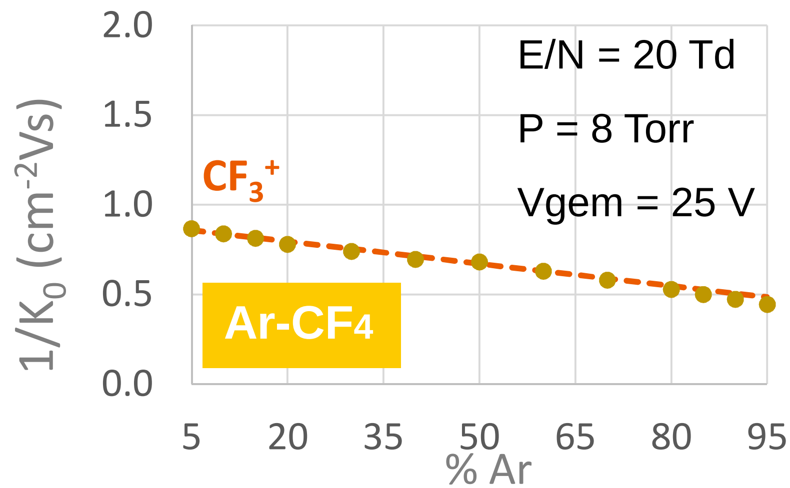
Novelty

Ion mobility is either scarce or inexistant on the relevant mixtures for the LCTPC;
The data used for positioning gating devices in the LCTPC – to neutralized the positive ions;

Important Concepts

- Drift Velocity $v_d = KE$
- Reduced Mobility $K_0 = KN/N_0$
- Langevin Limit $K_0 = 13.88\left(\frac{1}{\alpha\mu}\right)^{\frac{1}{2}}$
- Blanc's Law $\frac{1}{K_{0mix}} = \frac{f_1}{K_{0g1}} + \frac{f_2}{K_{0g2}}$

Results



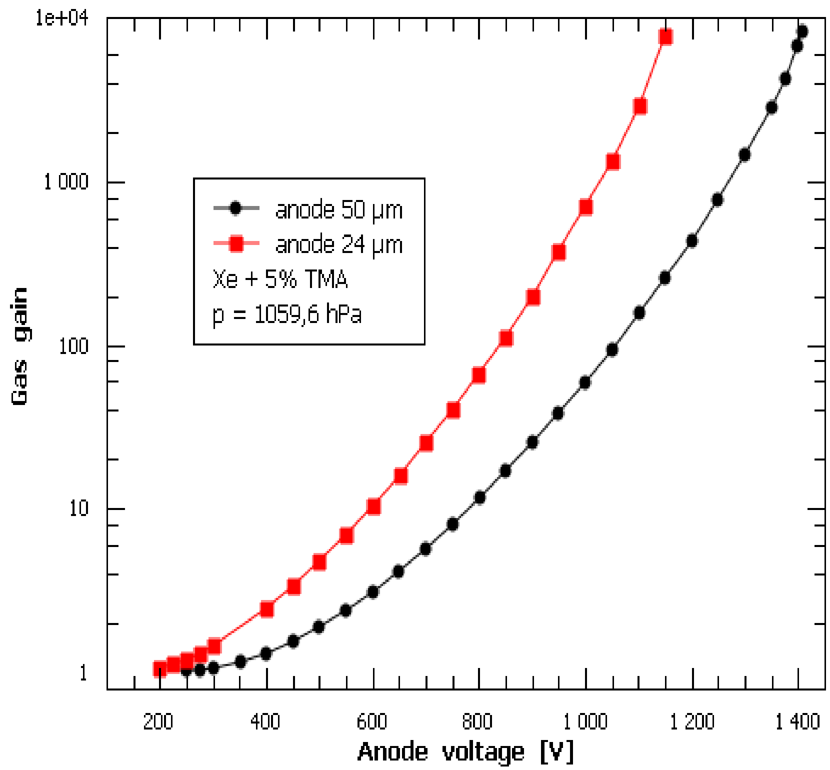
Performance of proportional counter filled with Xe + 5% TMA under high count rate

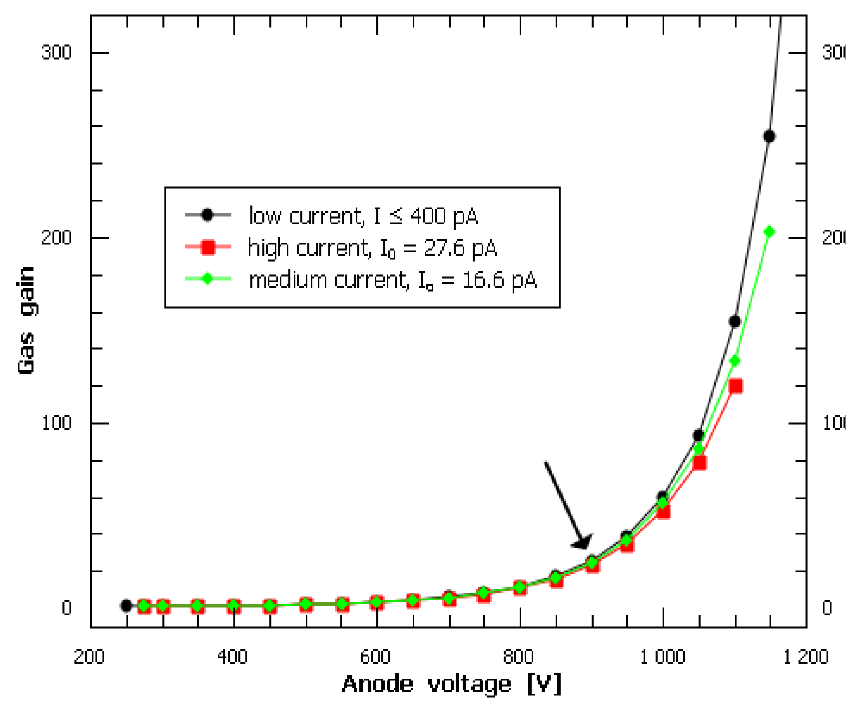
ID 84

T.Z. Kowalski

AGH University of Science and Technology
Al. Mickiewicza 30, 30-059 Kraków, Poland

selection and copies from poster





→ main interest:
- second Townsend coefficent
- gain reduction due to space charge effects

Simulations

Implementation of the code for the simulation of the response of a triple-GEM tracker and its comparison to the experimental data

Lia Lavezzi

ID 264

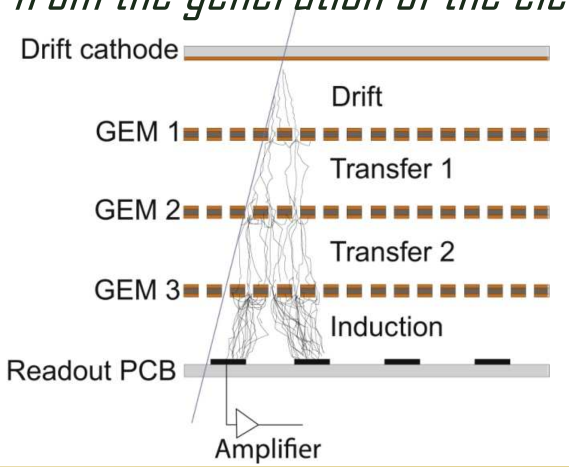
for the CGEM-IT group

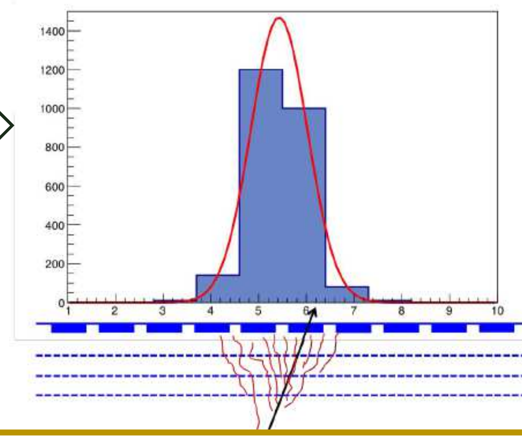
IHEP - INFN Torino

BESIII

simulate the tripleGEM response to the passage of the ionizing particle

from the generation of the electrons... *...to the signal formation*





Primary Ionization	GEM properties	Drift properties	Signal formation
# clusters # electrons/cluster	Gain Transparency	Lorentz angle & Diffusion [in the four gaps]	Induction Readout

A digitization standalone code has been implemented, based on GARFIELD/ANSYS simulations

The simulated data have been TUNED to MATCH EXPERIMENTAL data from testbeams

ID 343

Design of a gaseous beam monitor device using a GPU based code

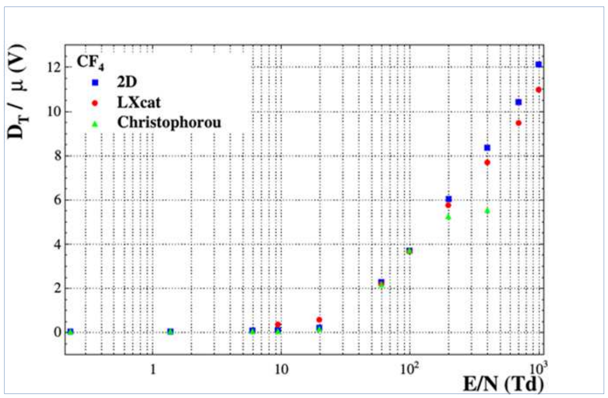
E. Barlerin, S. Salvador, M. Labalme, J. Perronnel

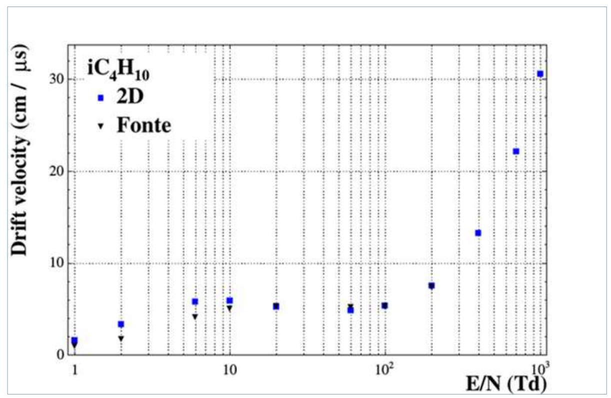
Corresponding author:
barlerin@lpccaen.in2p3.fr

Simulation of charged particles in a gas mixture in an electro magnetic field

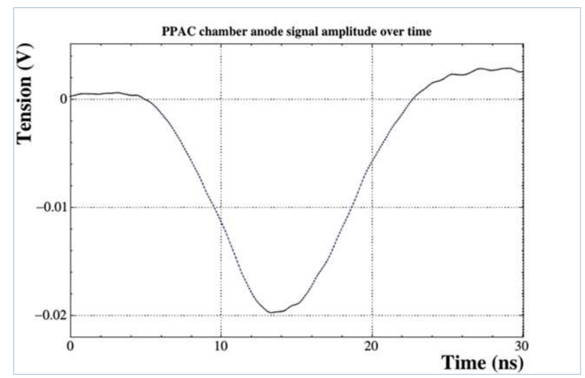
- Based on **CUDA**
- **Scattering cross-sections** used to evaluate electron interactions
- Extraction of the **swarm parameters (drift velocity, diffusion coefficients)** at the end of the simulation

Simulation of **the signal and the charge induced** on electrodes by the drifting particle using **Ramo fields maps**

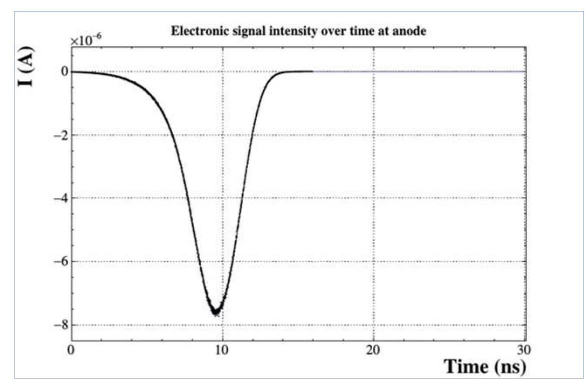




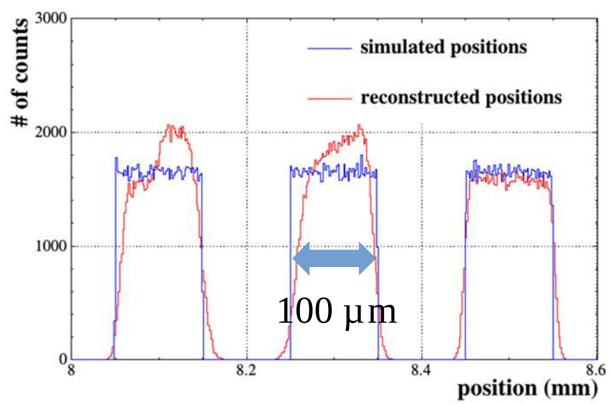
Real signal (bandwidth ~ 200 MHz)



Simulated signal



Design a stripped PPAC chamber with a resolution better than 100 µm



Gaps:
- Resistive Plate Chamber (RPC)
- Micro-Mesh Gaseous Structure (Micromegas)

Title : Timing Studies of Bakelite Multi-gap Resistive Plate Chamber

ID 378

Authors : Rajesh Ganai*, Mitali Mondal,
Zubayer Ahammed and Subhasis Chattopadhyay.




Main innovation :

- This effort is towards the successfull development of oil-free bakelite Multi-gap resistive Plate Chamber. We developed the detector so that it can be used in our prototype for Positron Emission Tomography using Time-Of-Flight technique.
- The developed MRPCs have shown an efficiency of >85% with cosmic rays.
- The time resolution of the detectors was measured to be ~154 ps.

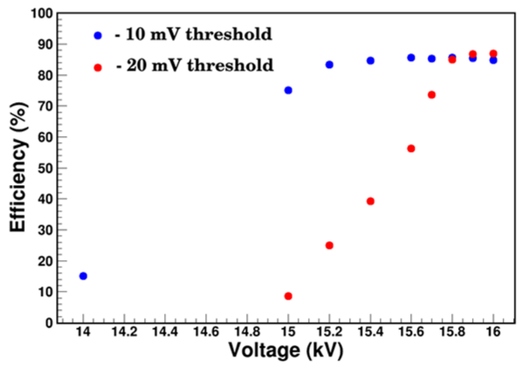


Fig.1 Efficiency of MRPC-1 measured with scintillator set up.

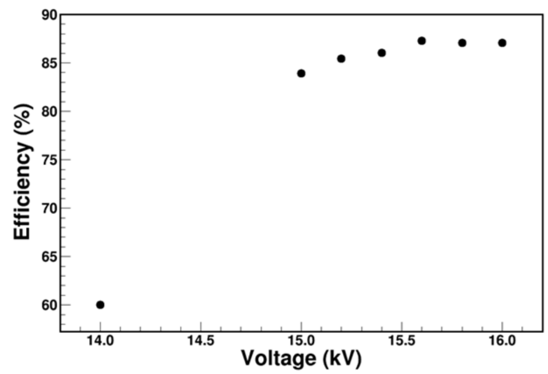


Fig.2 Efficiency of MRPC-2 measured with scintillator set up.

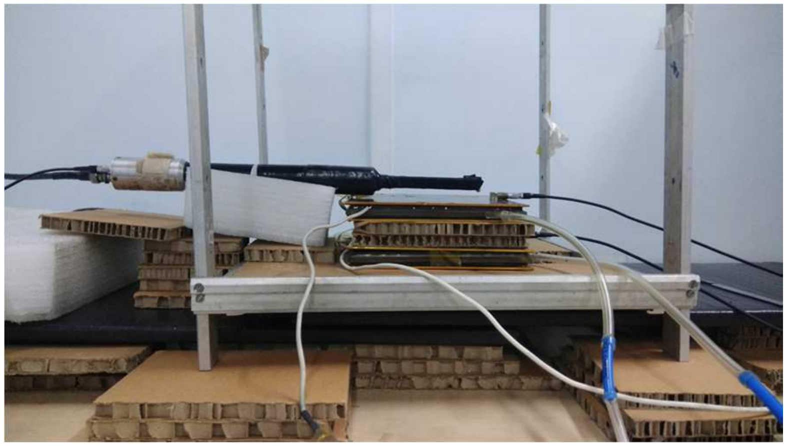


Figure 5: Cosmic ray test set up of both the MRPC with scintillators.

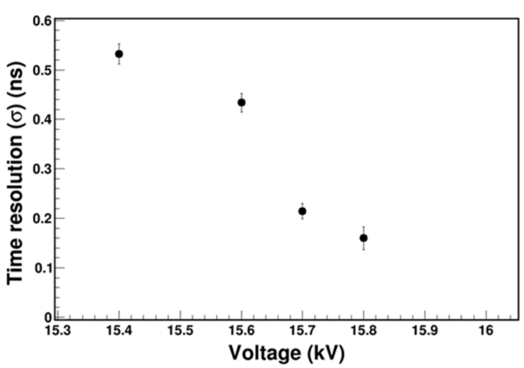


Fig.3 Time resolution of MRPC-1 measured with scintillator set up.

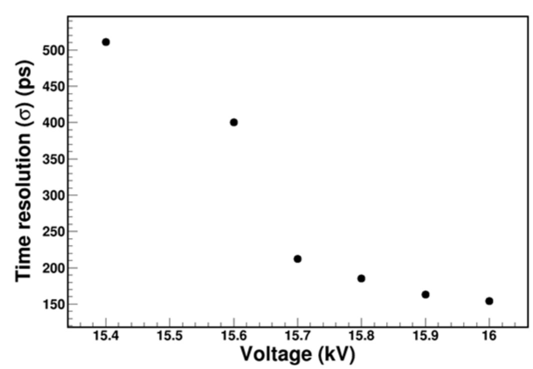


Fig.4 Time resolution of MRPC-2 measured with MRPC-1

For more details, please see the poster.

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CMS-RPC upgrade project for HL-LHC

ID 251

Andrea Gelmi[1], **Elena Voevodina**[2]

[1]INFN & *Universitá* di Bari, [2]INFN & *Universitá* di Napoli

andrea.gelmi@cern.ch

INFN Sezione di Bari

INFN Sezione di Napoli

In the next decades, at High Luminosity LHC (HL-LHC), the instantaneous luminosity will increase up to $5{\cdot}10^{34}$ cm^{-2} s^{-1} (factor five more then the nominal LHC luminosity), and the expected integrated luminosity, over 10 years of running, will be 3000 fb^{-1}. The expected conditions in terms of background rate, pile-up and the probable aging of the present detectors will make the muon identification and correct p_T assignment a challenge for the muon system. In order to maintain the excellent performance and to ensure redundancy of the muon system also under the HL-LHC conditions, two upgrades are planned on the RPC system: longevity study of the present system, extension of the muon coverage up to $|\eta| < 2.4$.

- Two new RPC layers will be added in the innermost rings of stations 3 and 4 (RE3/1 and RE4/1). This leads to an increase of the efficiency for both trigger and offline reconstruction in a region where the background is the highest and the magnetic field is the lowest within the muon system.
- The estimation of the background hit rate expected during HL-LHC in the new RPC RE3/1 and RE4/1 stations has been done studying the iRPC sensitivity using a GEANT4 Monte Carlo simulation. The sensitivity value has been then used to scale the incident particles flux, simulated by FLUKA. The results show that the expected average hit rate will be ≈2 kHz/cm2 including a safety factor three.
- The performance of the new iRPC chambers have been validate with muon beam at different radiation condition at GIF++. The longevity study for the certification of the iRPC for the entire HL-LHC period is recently started and the main parameters are stable so far.

Gamma Irradiation Facility (GIF++) @ CERN, First RPC Test Beam, 09-16 May 2018

improved RPC: - lower resistivity
- reduced electrode thickness
- reduced gas gap

ELBA2018: 14th Pisa meeting on advanced detectors

MRPC with high time resolution for BESIII

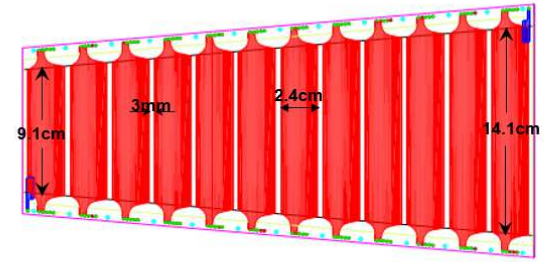
ID 54

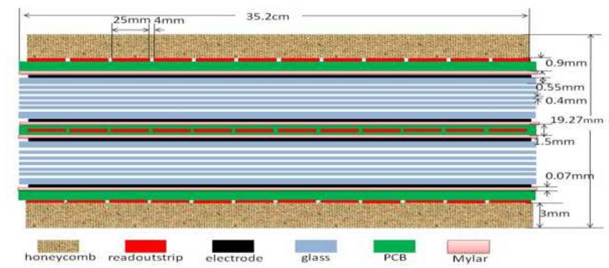
Yuekun Heng

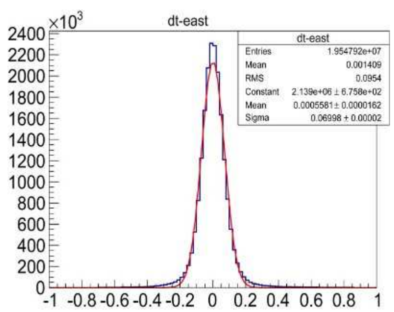
IHEP – Chinese Academy of Sciences, CHINA

- Old ETOF： BC404 scintillator + R5924 PMT
  - Time resolution 138ps for pion, worse than Barrel part(70ps)
  - Scattering effect; Higher multi-hit rate; positioning uncertainty
- New ETOF: targets and techniques of upgrade with MRPC (multi-gap Resistive Plate Chambers)
  - Higher granularity: to reduce the scattering and multi-hit effects.
  - Double end readout: to reduce the positioning uncertainty
  - TD and AD measurement in very front
  - Noise controlling: grounding/shielding/mirco-coax cables
  - Better time resolution：
    - MRPC with 12 thin gaps
    - Intrinsic: <55ps, Non-intrinsic: ~50ps, Total resolution <80ps

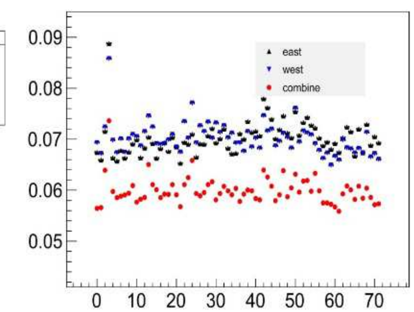
Structure of one MRPC module







Time resolution
70ps for one-end



Time resolution
60ps for combined

Results after installing

- Total time resolution~60ps
- Efficiency ~98%

CENTRO FERMI
MUSEO STORICO DELLA FISICA E CENTRO STUDI E RICERCHE ENRICO FERMI

Extreme Energy Events
Science inside Schools

ID 259

Performance of the Multigap Resistive Plate Chambers of the Extreme Energy Events Project

Marco Garbini,
Museo Storico della Fisica, Centro Studi e Ricerche E.Fermi, Roma, Italy
University & INFN Bologna
on behalf of the EEE Project Collaboration

The Extreme Energy Events (EEE) Project experiment is devoted to the detection and study of high-energy cosmic rays. It is a network of muon tracking telescopes made of three large area (~2 m^2) Multigap Resistive Plate Chambers (MRPC) synchronized by GPS.

The EEE array is composed, so far, of 56 telescopes organized in clusters and single telescope stations distributed all over the Italian territory and installed in high schools.

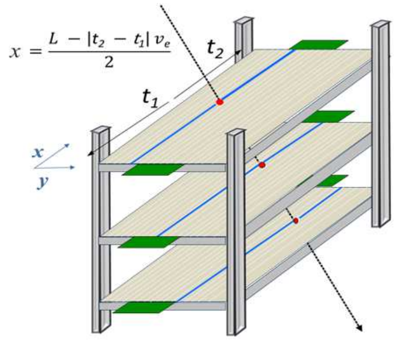
The schools are unconventional experimental sites and a unique test field for checking the robustness, the low-aging features and the long-lasting performance of the MRPC technology for particle tracking and timing purposes.

The data from recent coordinated data taking periods have been used to measure the performances in terms of time and spatial resolution, efficiency, and stability. The results of this study are reported in this poster

Test of new Eco-Gas mixtures for the Multigap Resistive Plate Chambers of the EEE Project

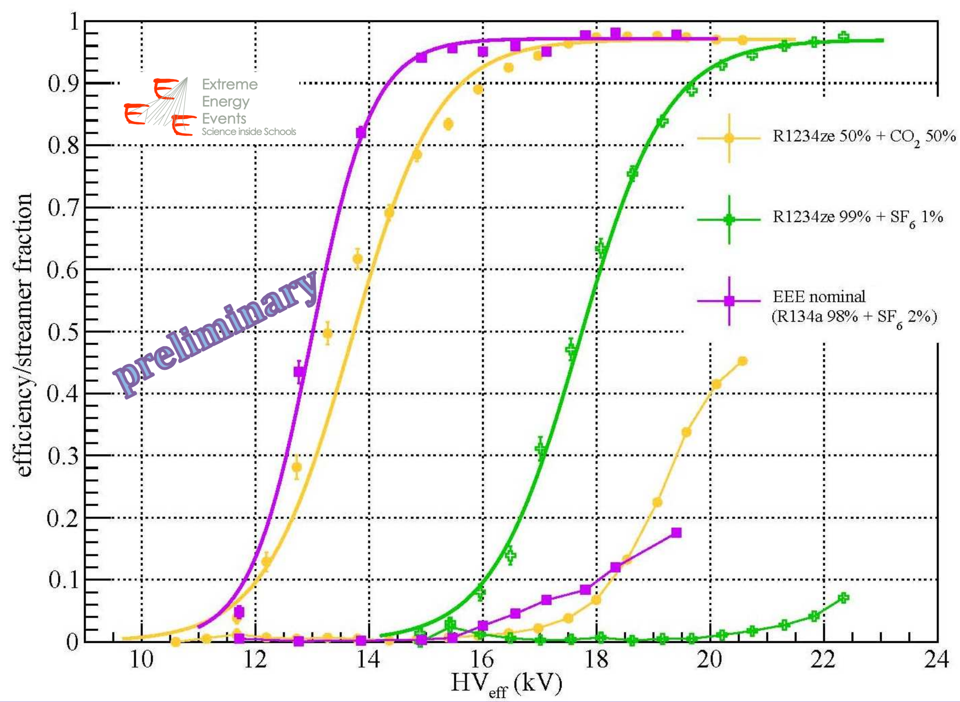
ID 202

Marina Trimarchi on behalf of the EEE Collaboration
Museo Storico della Fisica, Centro Studi e Ricerche E.Fermi, Roma, Italy
Dipartimento MIFT– Università degli Studi di Messina, Italy
INFN – Sezione di Catania, Italy



The **Extreme Energy Events** project is designed to study cosmic rays via a sparse network of 56 telescopes, based on **MRPC** detectors, filled since the beginning of the experiment with a *gas mixture of* ***98% of tetrafluoroethane*** and ***2% of sulfur hexafluoride.***

The performance of these chambers with **new gas mixtures** *of* ***tetrafluoropropene and carbon dioxide or sulfur hexafluoride*** have been studied *with* ***cosmic muons*** detected by one of the telescopes installed at CERN, under different conditions as a function of the applied HV.



Most promising configurations:

R1234ze(50%) + CO_2 (50%)

R1234ze(99%) + SF_6(1%)

Future Plans:

CF_3I ; **R1234ze(99,5%) + SF_6(0,5%);** R1234ze + He

ID 96

Development of gaseous particle detectors based on semi-conductive plate electrodes

Authors: Roberto Cardarelli (INFN Roma Tor Vergata)
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Alessandro Rocchi (Università di Roma Tor Vergata)
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Co-Authors: G. Aielli, S. Bruno, E. Alunno Camelia**,** P. Camarri, A. Caltabiano, A. Di Ciaccio, B. Liberti, L. Massa, L. Pizzimento (University and INFN Roma Tor Vergata)

Abstract

A new kind of particle detector based on RPC-like structure is under development. Semi-Conductive electrodes with resistivity ρ up to 10^8 Ω·cm have been used to improve the RPC rate capability. The aim is to obtain detector with sub-nanosecond time resolution capable of working in high rate environment (rate capability of the order of MHz/cm^2). In this poster the results on two different detector structures are presented: one with 1mm gas gap and both SI(Semi-Insulating)-Gallium Arsenide electrodes (ρ~10^8 Ω·cm), and the other characterized by 1.5mm gas gap, one SI-GaAs electrode and one intrinsic Silicon (ρ~10^4 Ω·cm) electrode.

A new type of RPC with very low resistive plates

S. Chakraborty[1*], S. Chatterjee[1], S. Roy[1+], A. Roy[2],
S. Biswas[1‡], S. Das[1], S. K. Ghosh[1], S. K. Prasad[1], S.Raha[1]

[1]Department of Physics and CAPSS, Bose Institute, EN-80, Sector V, Kolkata-700091, India
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ID 195

• MUCH in Compressed Baryonic Matter (CBM) @ FAIR

Highlights of the new RPC

•Material: carbon-loaded Polytetrafluoroethylene (PTFE) commonly known as Teflon.

•This particular sample is 25% carbon-filled

•Bulk resistivity of 10^5 Ω-cm

•Plate size: 150 mm x 150 mm x 1 mm

•Gas gap: 2 mm

•Surface resistivity: 20 kΩ/☐

•No graphite coating

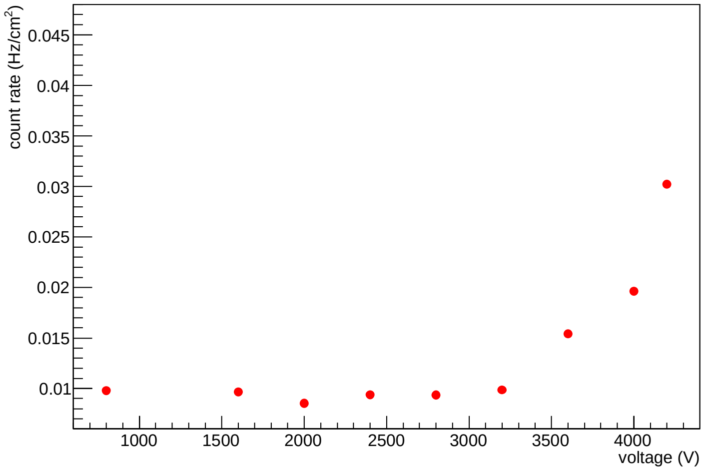
•The prototype is built without any oil coating inside

•100% R-134a as the sensitive gas for the chamber

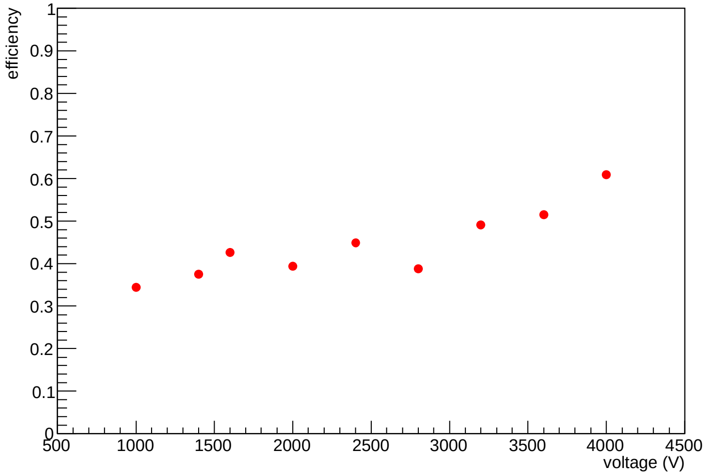
•A charge sensitive preamplifier with gain 2 mV/fC and shaping time 300 ns is used for signal collection.

•The motivation of using a low resistive plate is to improve the rate capability

•At a voltage of 4 kV an efficiency ~50% is achieved with cosmic ray



Noise rate Vs. voltage



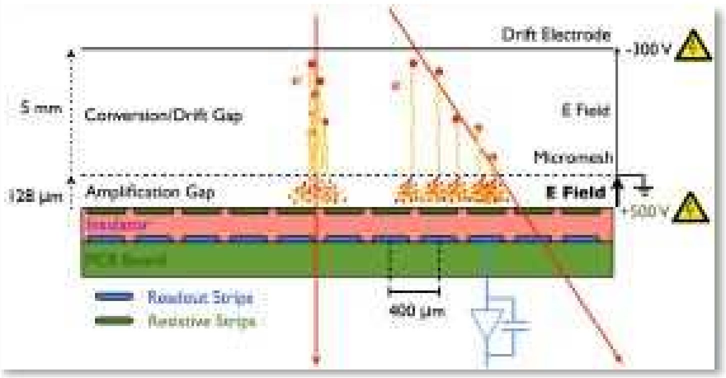
Efficiency Vs. voltage

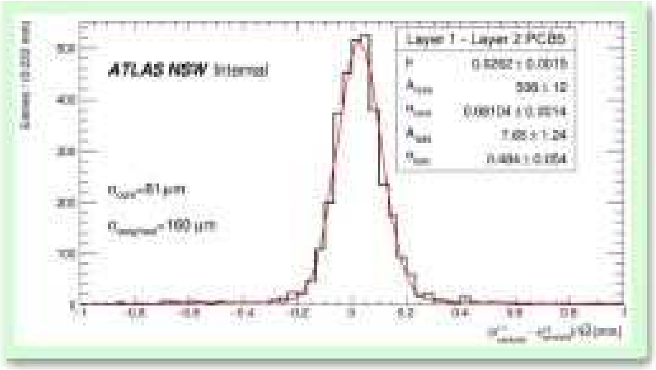
ID 231

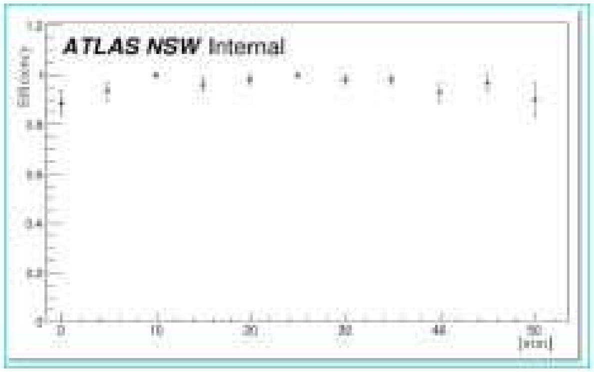
Construction and test of the SM1 MicroMegas chambers for the upgrade of the forward muon spectrometer of the ATLAS experiment

Giada Mancini (INFN-LNF)
on behalf of the ATLAS Muon Collaboration

- First studies on MicroMegas full scale prototypes for the NSW upgrade of the ATLAS Forward Muon Spectrometer
- INFN Italy responsible for the construction of 32 SM1 chambers
- Preliminary results on performances in agreement with expectations







ID 233

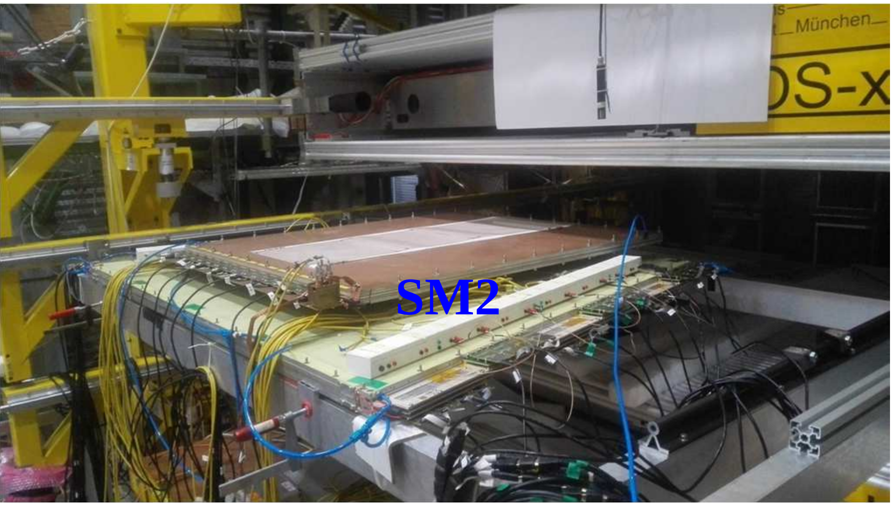
High Voltage stability and Cleaning procedure of 2m^2 Resistive Strip MicroMegas Detectors

Paolo Massarotti (University of Naples Federico II and INFN Naples)
on behalf of the ATLAS Muon Collaboration

MicroMegas HV stability studies for the SM2 full scale prototypes for the NSW upgrade of the ATLAS forward Muon Spectrometer

cleaning:
- wet cleaning with detergent
- washing off
- drying

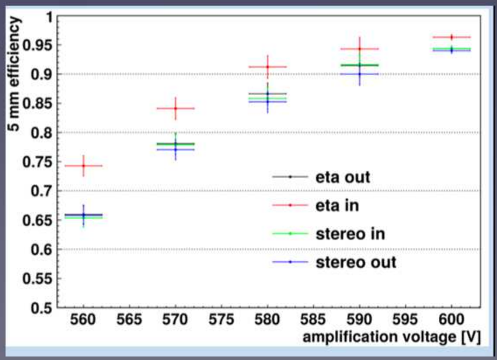
HV stability:
- 1st test in air
- then Ar/CO_2

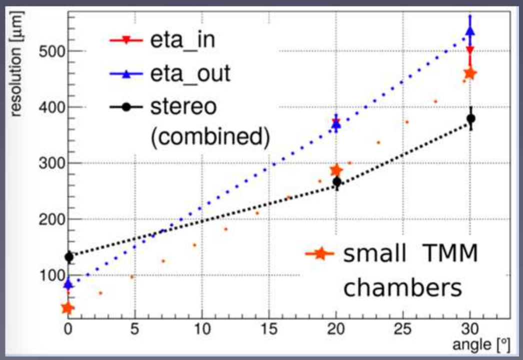


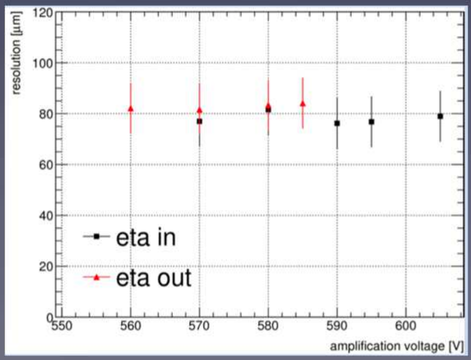
Performance and Calibration of 2 m^2 Micromegas Detectors for the ATLAS Muon Spectrometer Upgrade

ID 238

- The steadily increasing luminosity of LHC requires an upgrade to high rate and high resolution capable detector technology for the inner end cap of the muon spectrometer of the ATLAS experiment.
- For precision tracking 4 types of 2 and 3 m^2 micromegas quadruplets will provide 8 consecutive active layers, each with 100 µm spatial resolution per individual plane.
- 120 GeV SPS muon and pion data from Aug. 2017
- Charge weighted position reconstruction
- The full active area of the SM2 prototype quadruplet has been calibrated in the Munich Cosmic Ray Facility.
- Large Area Pulse Height and Efficiency Scans for all 4 Layers
- Spatial Resolution Using Charge Weighted Position Reconstruction







Ioannis Maniatis, Aristotle University of Thessaloniki, for the ATLAS Muon Collaboration

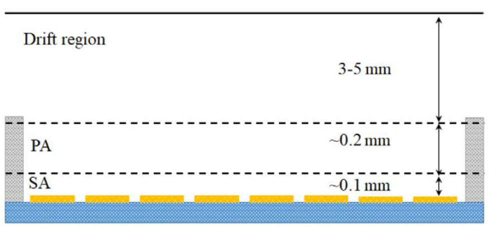
A high-gain, low ion-backflow double micro-mesh gaseous structure for single electron detection

ID 362

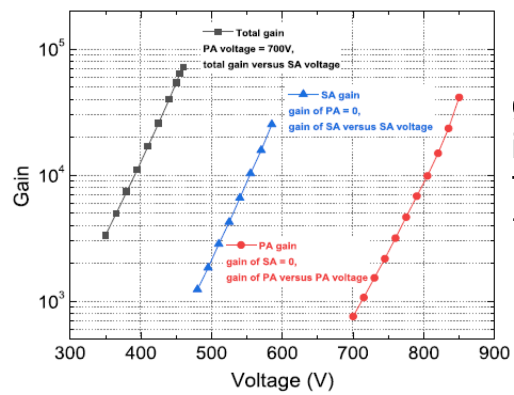
- A double-mesh Micromegas structure (**DMM**) was fabricated with thermal bonding technique (a lab-friendly MM fabrication method)
  - High gain and very low ion backflow
  - Very suitable for single photon detection when coupled with a photon convertor
  - A promising photon detector option for large-area RICH and readout of high-rate TPCs

Jianbei Liu
University of Science and Technology of China

Schematic of the DMM structure

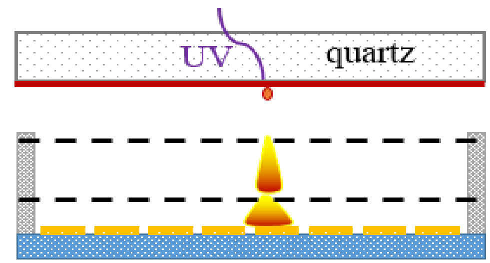


Gas Gain

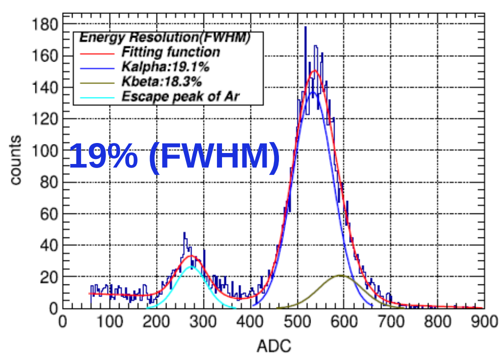


PA and SA gains > 10^4 individually. Total gain ~ 7×10^4

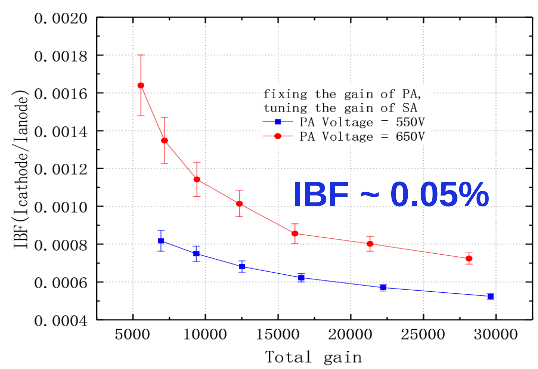
Configuration for single photon detection



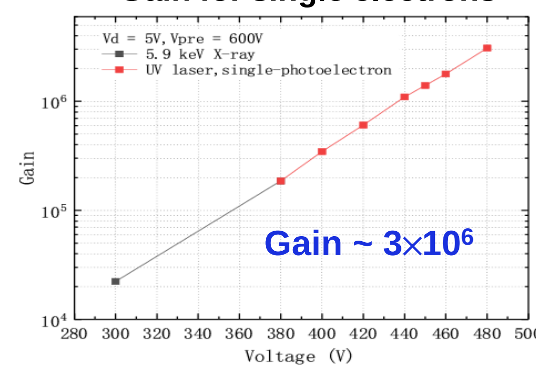
Energy resolution with 5.9KeV X-ray (Fe55)



Ion back-flow rate



Gain for single electrons



Holes: ▫ end-to-end → Gas Electron Multiplier (GEM)

▫ tapped-blind → WELL

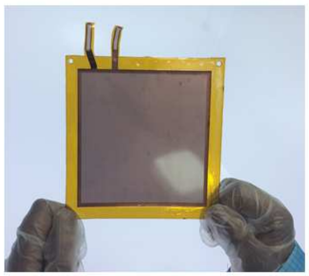
Production and Characterization of GEM Foils in India

ID 44

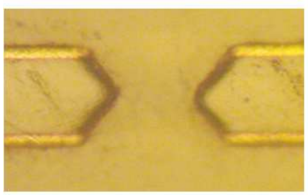
Aashaq Shah*, Ashok Kumar, and
Md. Naimuddin, Mohit Gola, Asar Ahmed, Shivali Malhotra
*aashaq.shah@cern.ch
University of Delhi, India

Various high energy experiments use GEM technology and CERN being the main distributor, the commercialization of the foils has been realized. Therefore an attempt was made and double-mask GEM foils were successfully produced for first time in India under TOT between CERN and Micropack Bangluru.

The measured optical and electrical properties of Micropack foils were found to reflect the desired parameters and are at par with the double mask foils produced at CERN.

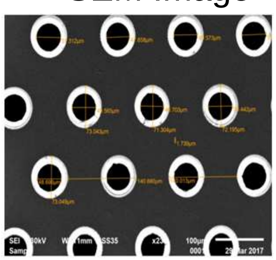


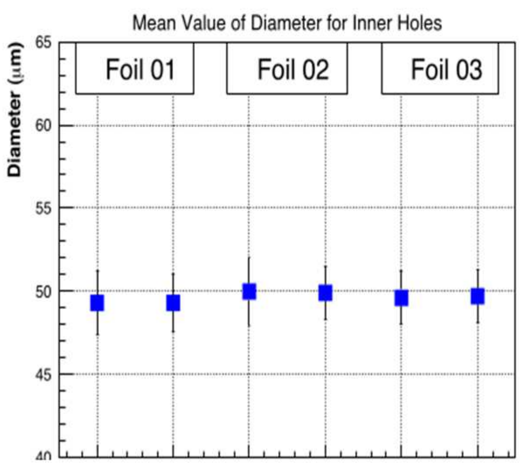
10 cm x 10 cm

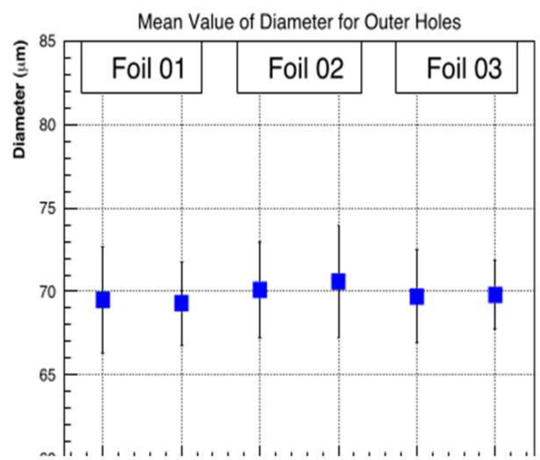


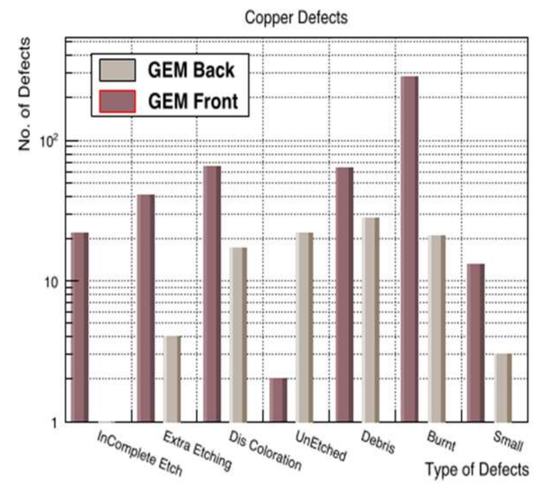
Double-mask
Single Hole

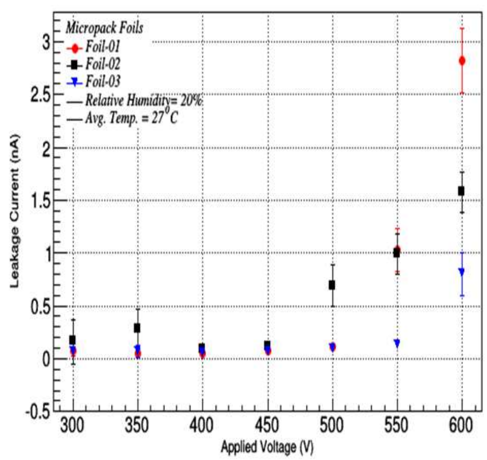
SEM Image

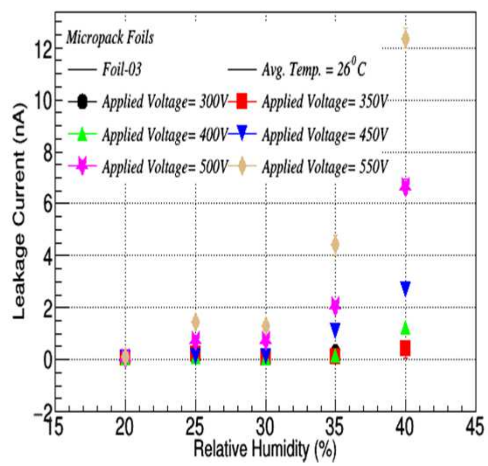


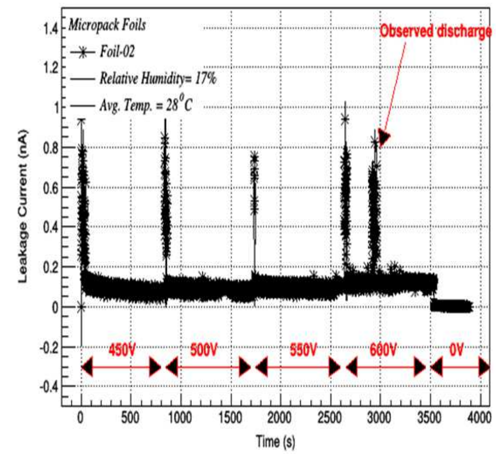












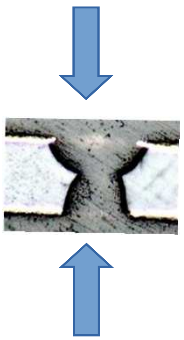
Impact of Single-Mask Hole Asymmetry on the properties of GEM Detectors

ID 52

Aashaq Shah*[1], Jeremie Merlin[2], Ashok Kumar[1] and Md. Naimuddin[1]
*aashaq.shah@cern.ch
On Behalf of the CMS Muon Group
[1]University of Delhi, India
[2]CERN, Switzerland

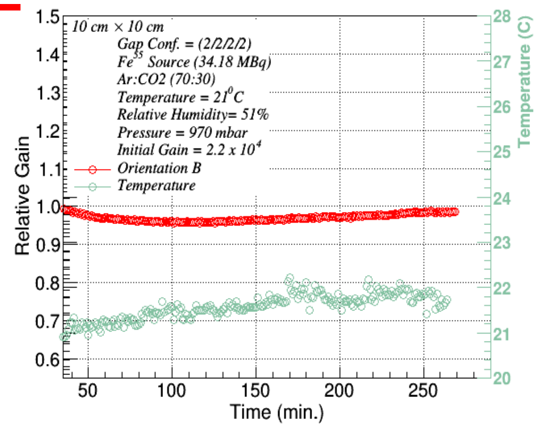
GE1/1 design requires large area asymmetric single mask GEM foils

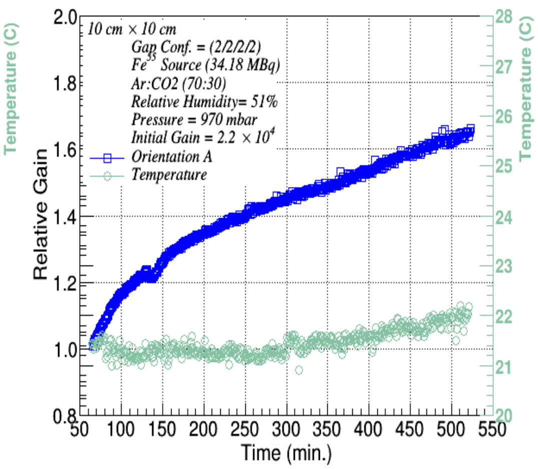
Question: *Is there any effect on the detector properties due to this hole Asymmetry?*

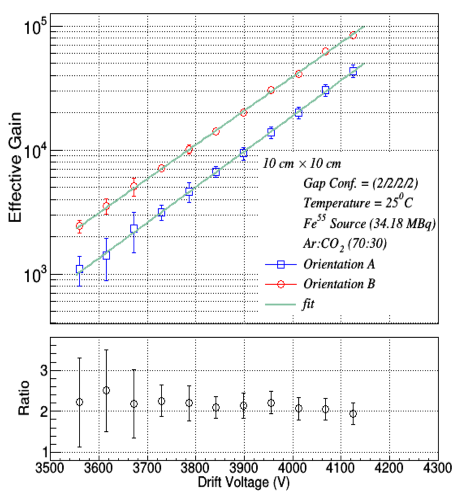


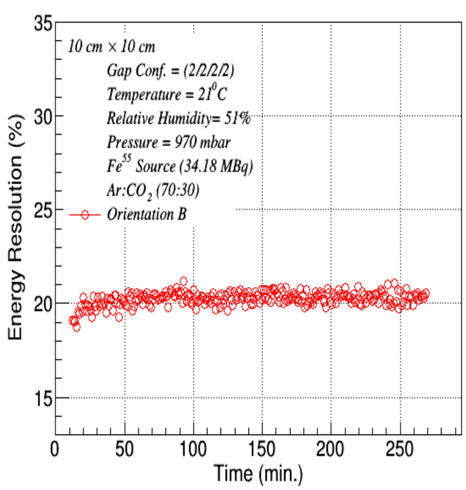
Effect of the asymmetry has been studied in detail and measured quantities like gain, charging up, resolution, rate capability etc. shows that hole asymmetry has a major impact on the properties of the detector.

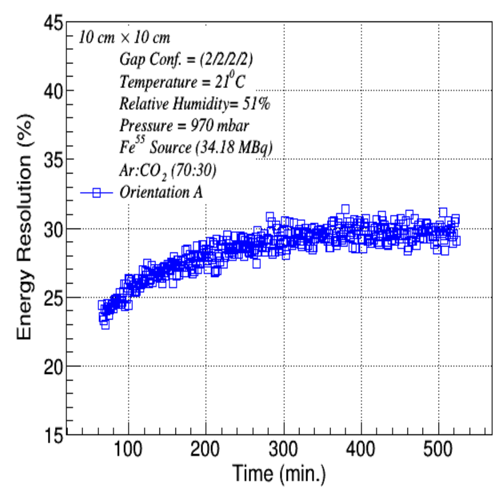
Conclusion: **"Orientaion B" is performing better**

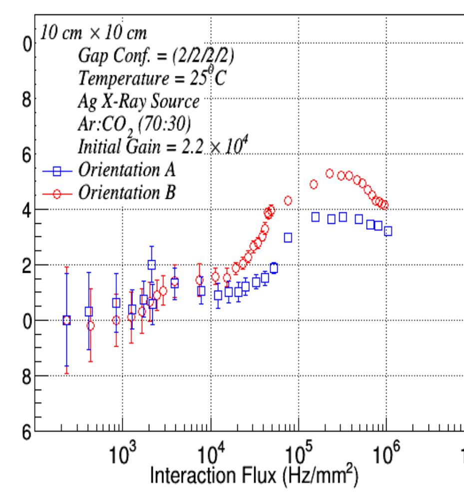












ID 32

Spatial resolution of triple-GEM detectors

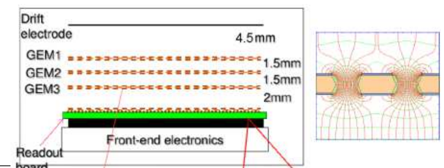
V. N. Kudryavtsev, T. V. Maltsev, L. I. Shekhtman
Budker Institute of Nuclear Physics, Novosibirsk State University, Russia

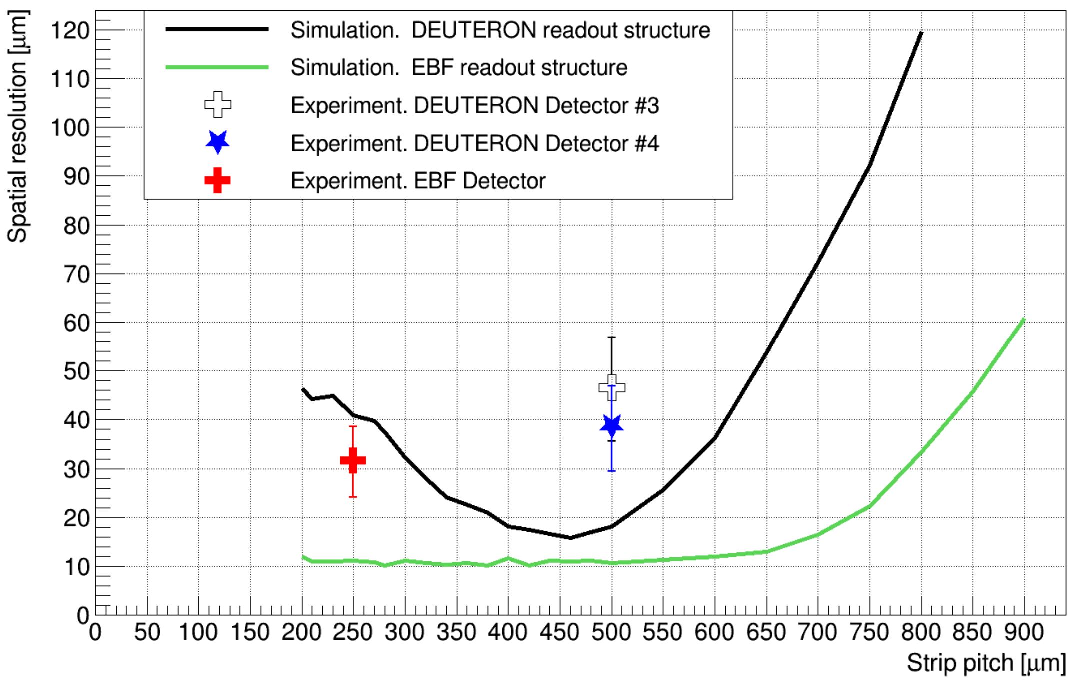
PM2018 - 14th Pisa Meeting on Advanced Detectors, Isola d'Elba, Italy

General results

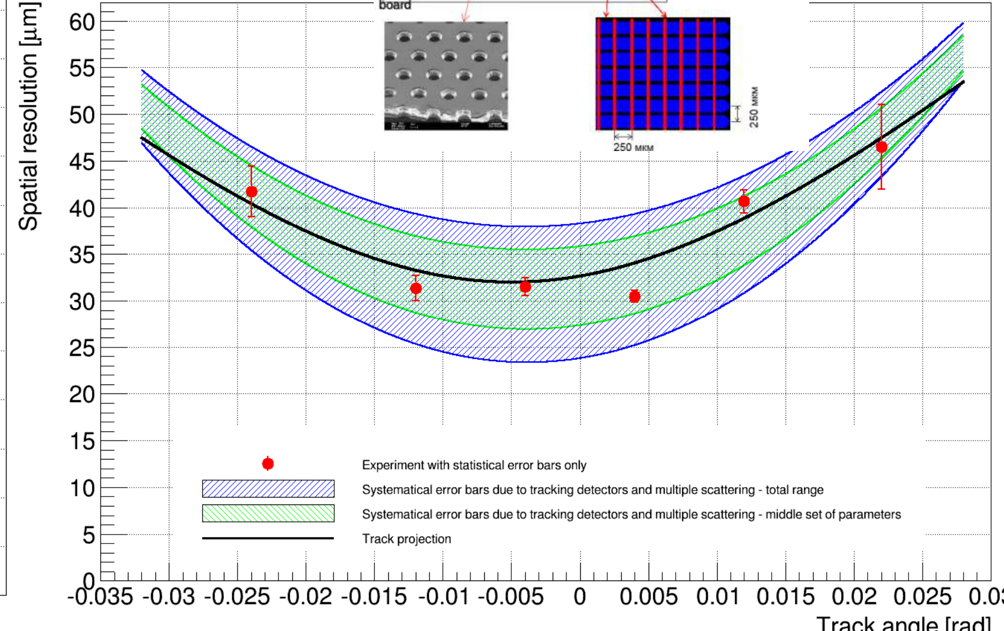
1. Detailed simulation of electron transport in the triple-GEM detector, filled with Ar-CO_2(25%), performed with ANSYS and Garfield++, demonstrates that coefficient of effective transverse diffusion is 300±20 $\mu m/\sqrt{cm}$.
1. Effect of electron cloud compression due to GEM operation up to 15% in comparison with uniform electric field was observed.
2. Simulation of detector response with GEANT4 and HEED shows essential influence of Centre Of Gravity calculation on the counted spatial resolution. At the same time, physical minimum of 10 – 15 μm spatial resolution level is determined by delta-electrons space distribution.
3. Assembled triple-GEM detector with 250 μm strip pitch for Extracted Beam Facility (EBF) at BINP demonstrates stable operation with gas gain up to 5×10^4 and the detection efficiency exceeding 99.5% for gain higher than 3×10^4.
4. Spatial resolution of EBF-detector for orthogonal electron tracks is measured as

$$\sigma_{EBF-detector} = 31.5 \pm 0.9\,(\text{stat.})^{+6.9}_{-7.5}(\text{syst.})\ \mu m$$





Triple-GEM detector spatial resolution as a function of strip pitch for the readout structure of DEUTERON and EBF detector types, obtained in the simulation for SNR = 150, in comparison with the experimental results



Spatial resolution as a function of track angle, determined in the experiments with 1 GeV electrons after correction for multiple scattering and limited resolution of the tracking detectors

Study of uniformity of characteristics over the surface for triple GEM detector

ID 146

S. Chatterjee*, S. Chakraborty, S. Roy+, S. Biswas‡, S. Das, S. K. Ghosh, S. K. Prasad, S. Raha

Department of Physics and CAPSS, Bose Institute, EN-80, Sector V, Kolkata-700091, India

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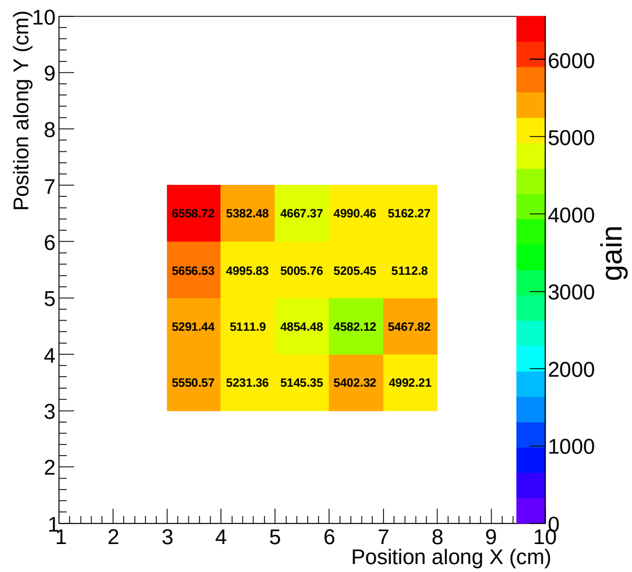
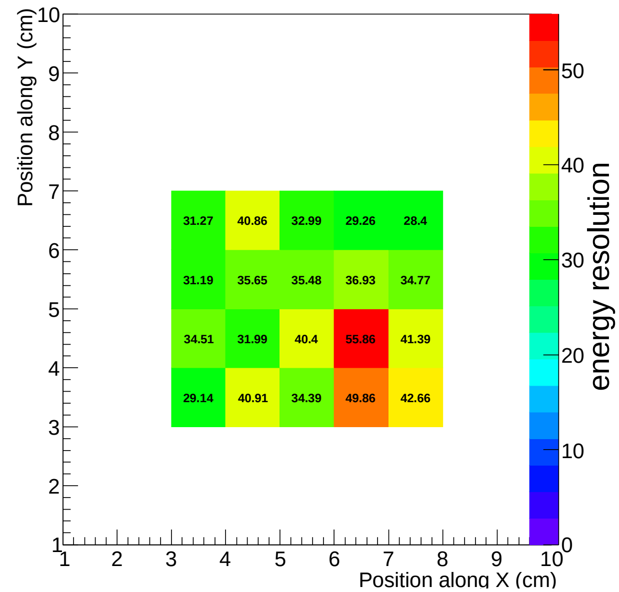
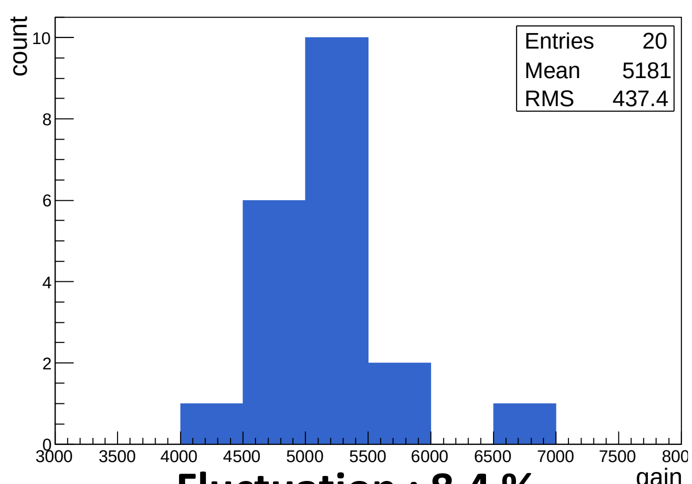
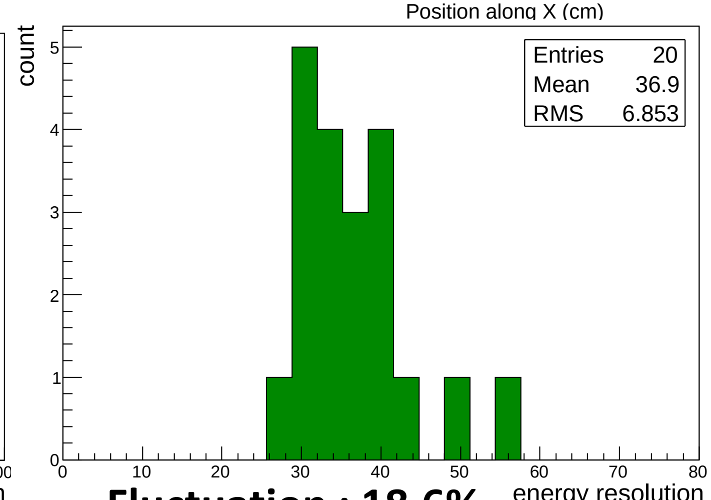
- MUCH in Compressed Baryonic Matter (CBM) @ FAIR
- The uniformity of gain, energy resolution and count rate is studied for a 10 cm × 10 cm triple GEM detector over its central active area
- Gain variation is found to be ~ 10% while variation of energy resolution and count rate is ~ 20%
- Similar studies are to be performed with different gas mixtures and flow rate







Fluctuation : 8.4 %



Fluctuation : 18.6%

Stability study of gain and energy resolution for GEM detector

ID 14

S. Roy[1], S. Rudra[2*], S. Shaw[3], S. Chakraborty[1], S. Chatterjee[1], R. P. Adak[1], S. Biswas[1‡], S. Das[1], S. K. Ghosh[1], S. K. Prasad[1], S. Raha[1]

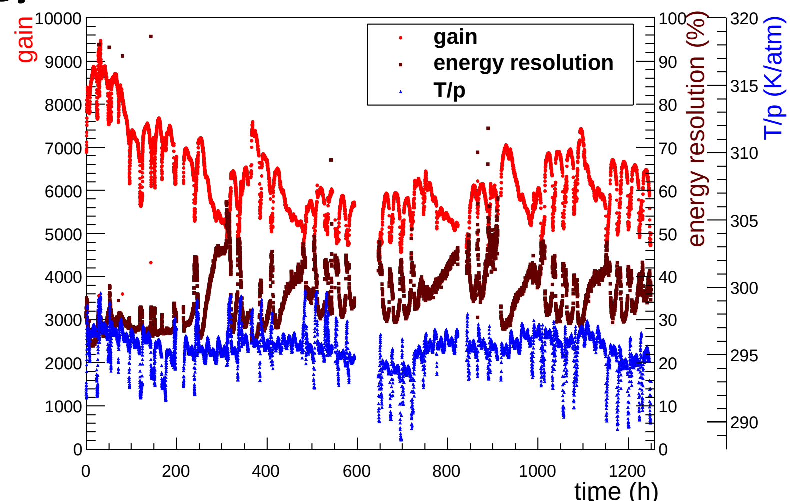
[1]Department of Physics and CAPSS, Bose Institute, EN-80, Sector V, Kolkata-700091, India

[2]Santragachi, Jagacha, G.I.P. Colony, Howrah-711 112, West Bengal, India

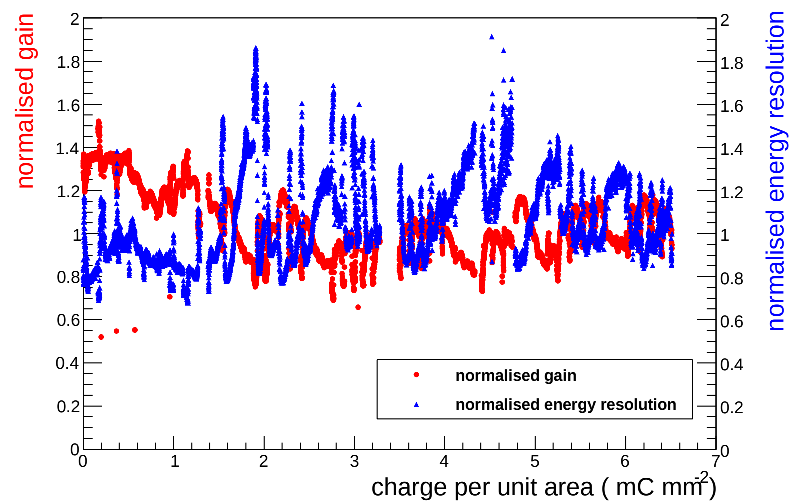
[3]Vidyasagar University, Vidyasagar University Road, Rangamati, Medinipur, West Bengal-721102, India

e-mail: *sr.phys@gmail.com, ‡saikat@jcbose.ac.in

- MUCH in Compressed Baryonic Matter (CBM) @ FAIR
- A systematic study on stability of the gain and energy resolution of a triple GEM detector in long term operation under high rate of X-ray irradiation is performed with Ar/CO_2 gas mixture in 70/30 ratio, using the conventional NIM electronics.
- In this study the same Fe^{55} source is used to irradiate the chamber as well as to measure the gain and energy resolution at an interval of 10 minutes.
- For the first time the detector has been continuously exposed to a high but realistic rate of X-ray (350 kHz in 50 mm^2 area) radiation for >1200 hours.
- In a continuous operation an equivalent accumulated charge per unit area of ~ 6.5 mC/mm^2 the mean normalised gain and the mean normalised energy resolution have been found to be 1.054 with a rms of 0.15 and 1.063 with a rms of 0.21 respectively.



Gain, energy resolution and T/p Vs. time



Normalised Gain and normalised energy resolution Vs. dQ/dA

ID 379

Aging Phenomena and Discharge Probability Studies of the triple-GEM detectors for future upgrades of the CMS muon high rate region at the HL-LHC

- ***Francesco Fallavollita***
- *Università degli Studi di Pavia & INFN sezione Pavia*
- *francesco.fallavollita@cern.ch*

The ongoing aging studies at GIF++ facility and in parallel at CMS-GEM Production Lab. aims to identify the possible aging of Triple-GEM detector for CMS experiment and understand the long-term operation in HL-LHC with its future upgrades.

The results presented in this poster indicates that the CMS Triple-GEM detector can sustain the continuous operation in the CMS endcap environment for over 10 HL-LHC years (with safety factor 3) without suffering any gain drop or instability.

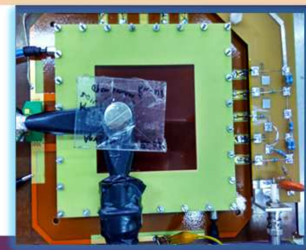
Due to the complexity of the neutron interactions with the GEM detectors and the dearth of experimental studies on this topic, a dedicated neutron test was done at the CHARM facility to confirm the robustness of the CMS Triple-GEM and evaluate the effect of discharges on the long-term chamber operation.

Gamma Irradiation Facility (GIF++) @ CERN

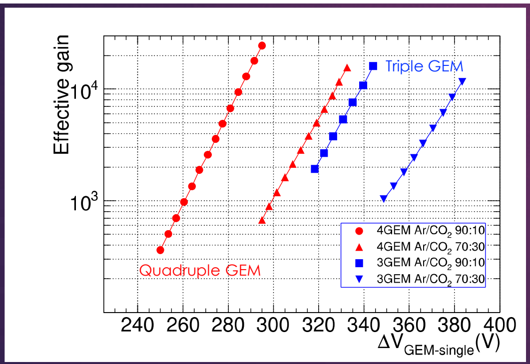
ID 430

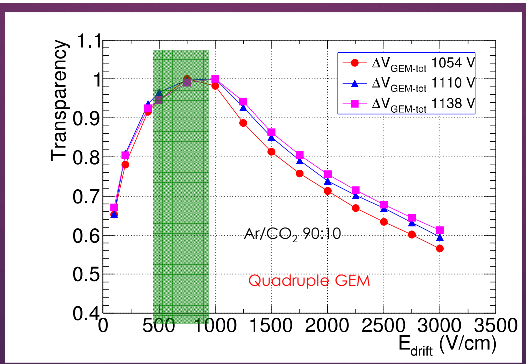
Comparative study of triple GEM and quadruple GEM detectors and effect of drift field on the electron transparency

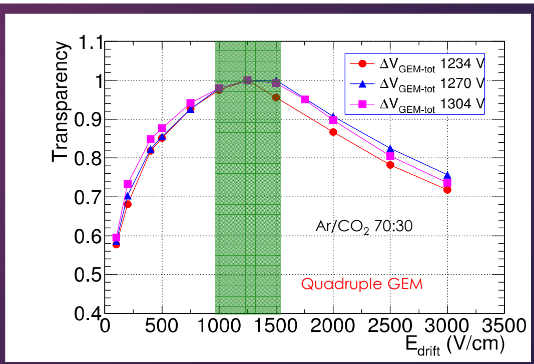
Rajendra Nath Patra[1,2],
R. N. Singaraju[1], S. Dalal[1], S. Biswas[3], T. K. Nayak[1,4], Y. P. Viyogi[1]
[1]Variable Energy Cyclotron Centre, Kolkata, INDIA
[2]GSI, Darmstadt, GERMANY
[3]Bose Institute, Department of Physics and CAPSS, Kolkata-700091, INDIA
[4]CERN, Geneva 23, SWITZERLAND



Summary of the work: Detector Gain, energy resolution, efficiency and time resolution of a quadruple GEM detector have been measured and compared with test results from a triple GEM detector [1]. Gain and energy resolution measurements are performed for two different field configurations (standard and ion back flow suppression voltages setting). Importance of the drift field in electron transparency has been studied. Results of these studies will be presented.







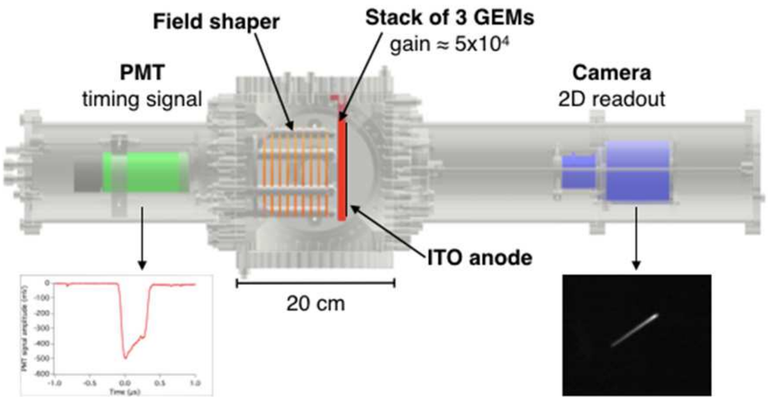
Ref:[1] R. N. Patra *et al.*, Measurement of basic characteristics and gain uniformity of a triple GEM detector, NIM A 862 (2017) 25.

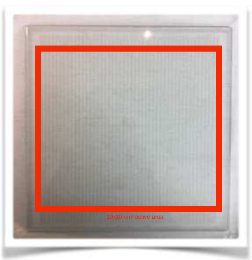
Combined Optical and Electronic Readout for Event Reconstruction in a GEM-based TPC

ID 9

Authors: F. M. Brunbauer, F. García, M. Lupberger, E. Oliveri, D. Pfeiffer, L. Ropelewski, P. Thuiner, and M. van Stenis[1]

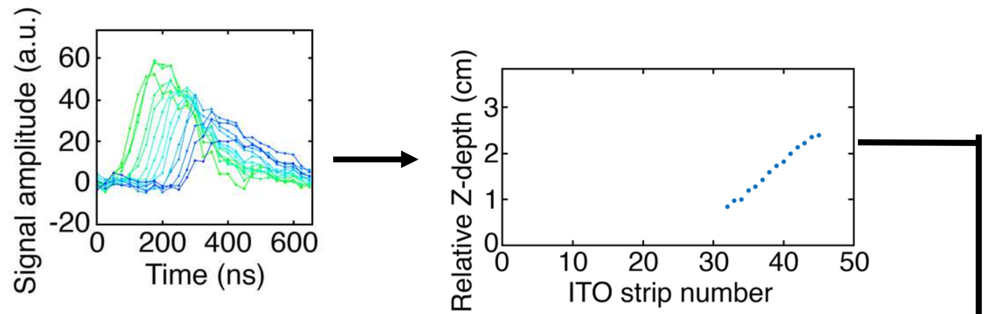
Presented by
F. M. Brunbauer



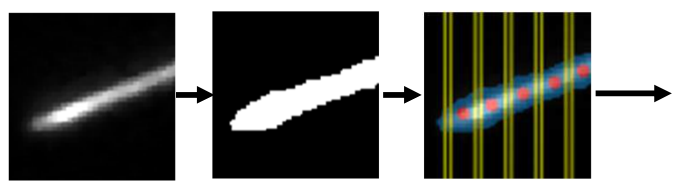


Optically transparent **ITO strip anode** permits simultaneous readout of electronic signals and secondary scintillation light.

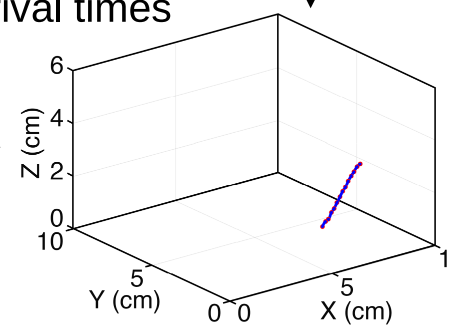
ITO can be structured with photolithography and etching in HCl.

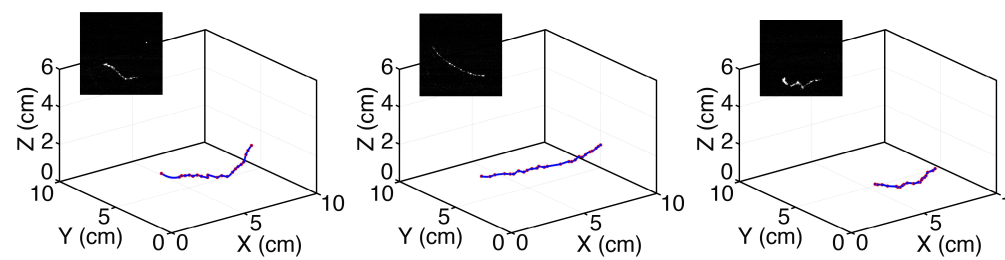


Depth information from electron arrival times



Optically read out 2D projection



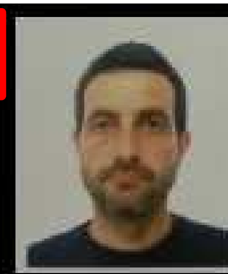


Combined optical and electronic readout extends 3D reconstruction capabilities to complex track geometries.

ID 38

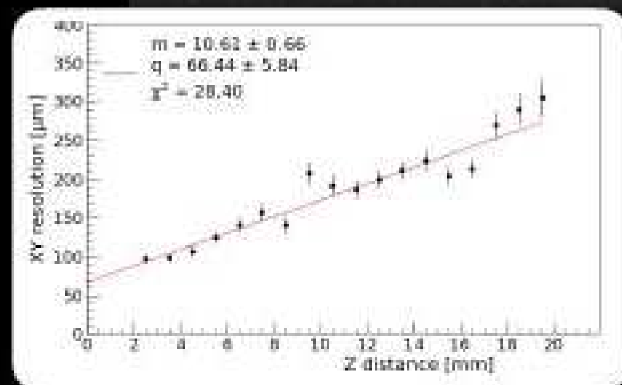
HIGH RESOLUTION TPC BASED ON OPTICALLY READOUT GEM

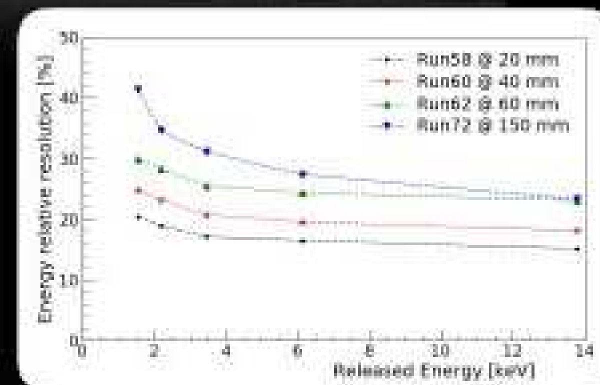
Davide Pinci



Results of test of a 7 litre volume TPC equipped with a Triple GEM amplification stage are presented;

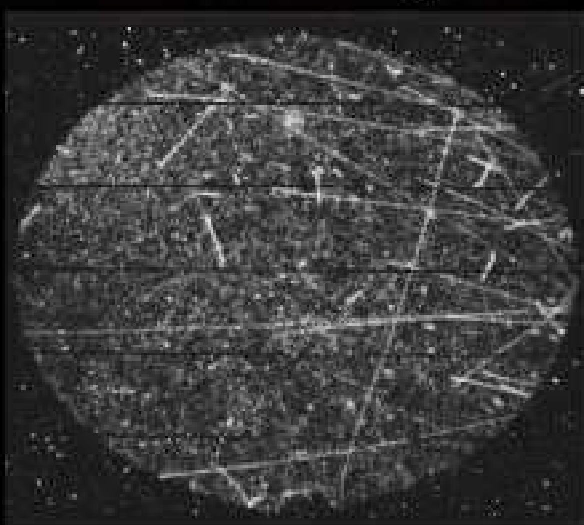
Sensitive volume with the field cage and the three GEM during the assembly





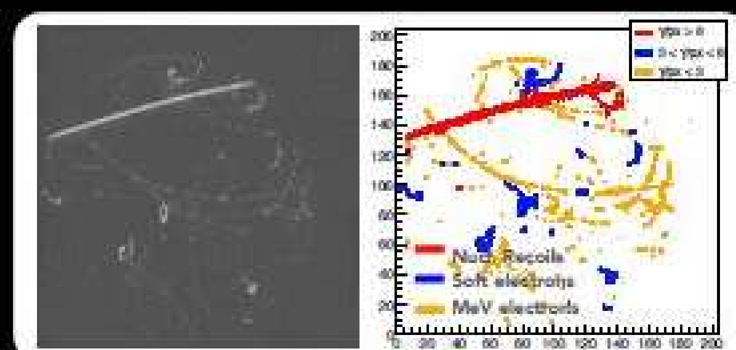
Space and Energy resolutions were evaluated with mips.

In the keV range an Energy resolution of 20%-30% is achieved



Detector was exposed to low and high energy photon and neutron source.

A simple PID algorithm based on light density allows to separate the three particles.



ID 120

The micro-Resistive WELL detector for the phase 2 upgrade of the LHCb muon detector

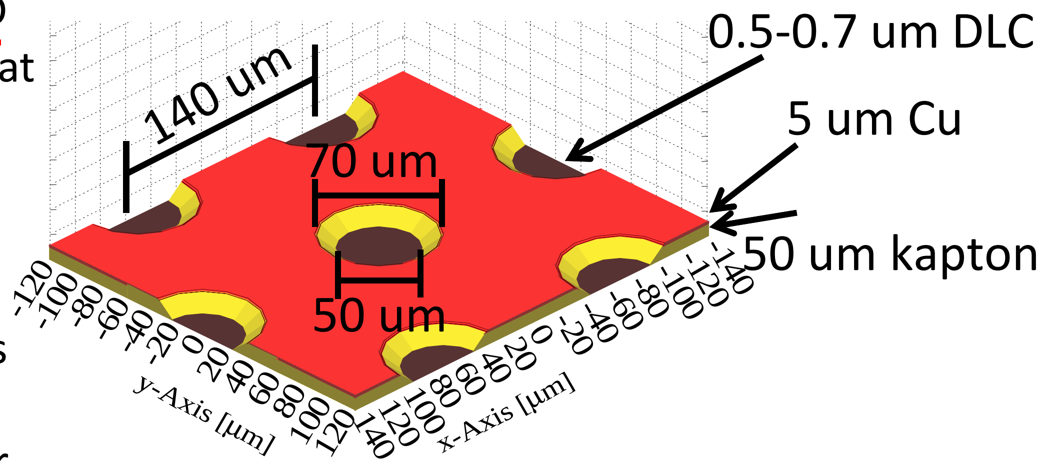
G. Bencivenni[1], R. De Oliveira[2], G. Felici[1], M. Gatta[1], G. Morello[1], M. Poli Lener[1], A. Ochi[3]

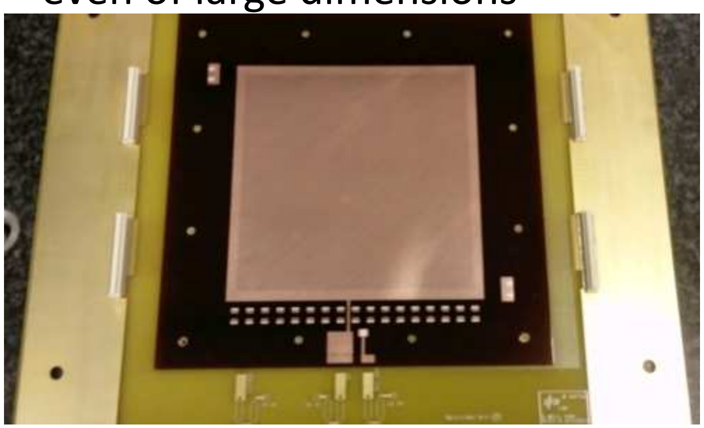
[1]Laboratori Nazionali di Frascati dell'INFN, Frascati, Italy

[2]CERN, Geneva, Switzerland

[3]University of Kobe, Kobe, Japan

- The micro-Resistive WELL detector is a novel MPGD developed by DDG (Detector Development Group) at LNF in collaboration with the Detector Technical division at CERN (EP-DT-EF)
- The presence of a resistive layer affects the rate capability, so different resistive layouts have been produced and tested to reach the LHCb M2 stations expected rate (3 MHz/cm^2)
- Thanks to the collaboration with companies all over the world, several prototypes have been realized, even of large dimensions





- The detector safely exhibits gain above 10^4, a measured time resolution of 5.7 ns, a spatial resolution well below 100 µm (combining CC and µ-TPC methods), a maximum rate capability over 1 MHz/cm^2 with 5.9 keV X-rays [measurement done in Ar:CO_2:CF_4 45:15:40]
- R&D on several high rate versions is ongoing
- Technology transfer to Industry in progress with very good results

A FAST TIMING MICRO-PATTERN GASEOUS DETECTOR FOR TOF-PET

ID 355

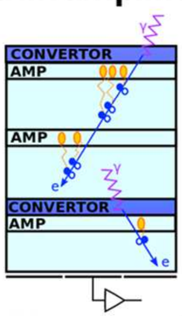
<u>Raffaella Radogna,</u> Piet Verwilligen,
Marcello Maggi
INFN- Bari, Italy

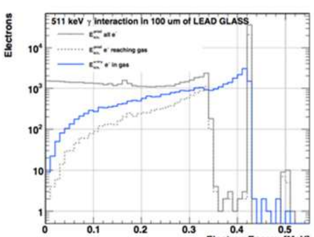
A new detector layout, named Fast Timing MPGD (FTM), has been recently proposed. The FTM would combine both the high spatial resolution (100um) and high rate capability (100MHz/cm^2) of the MPGDs with a high time resolution of 100ps. This new technology consists of a stack of several coupled layers where drift and multiplication stages alternate in the structure, yielding a significant improvement in timing properties due to competing ionization processes in the different drift regions. This contribution introduces the FTM technology as an innovative PET imaging device concept

FTM for photons proposals

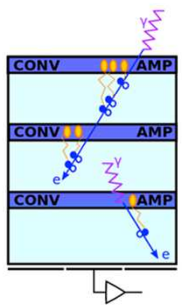
Scheme A: photon converted in high-Z resistive material + several thin amplification layers

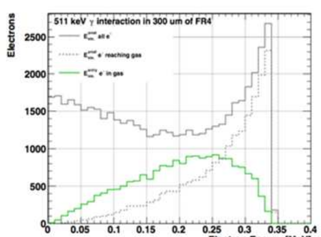
Scheme B: photon can convert in each amp. layer (only resistive material allowed)





Electron energy spectra.

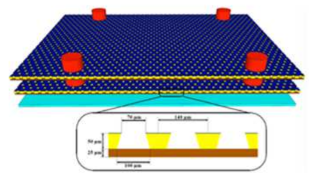




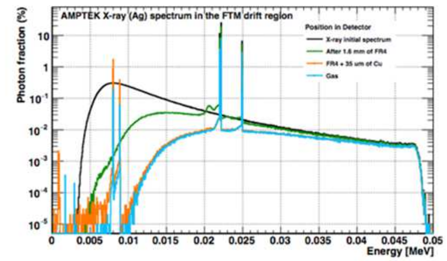
Electron energy spectra.

Fast Timing Micro Pattern Gaseous Detector

Simulation of AMPTEK X-ray (Ag) passing the drift board



arXiv:1503.05330

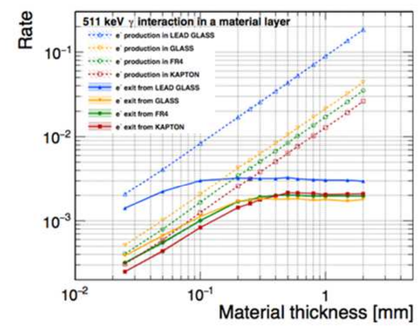


Photon Conversion

Adapt structure to detect 511 keV γ from PET

GEANT4.10.03 Simulation of 511 keV γ interaction in different materials and thicknesses: PCB (FR4), kapton, glass, lead glass

Electron production rate.



- Charged particles ionize the gas in the drift region producing e^- multiplied in the gain region
- Improve time resolution by reducing distance to the gain region + resistive structure→ split drift volume in N layers, each with own amp.
- sub-relativistic e^- has high ionization density

(Singe-Wire) Straw Tubes

Study of performances of a straw tube detector with high rate

ID 12

S. Roy*[1], N. Nandi[2], R. P. Adak[1], S. Biswas+[1], S. Das[1], S. K. Ghosh[1], S. K. Prasad[1], S. Raha[1]

[1]Department of Physics and CAPSS, Bose Institute, EN-80, Sector V, Kolkata-700091, India

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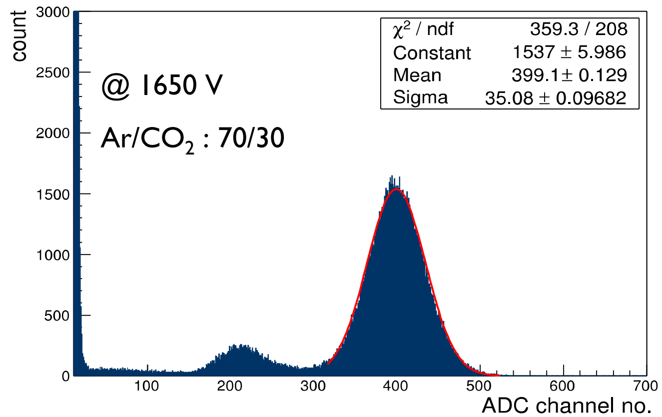
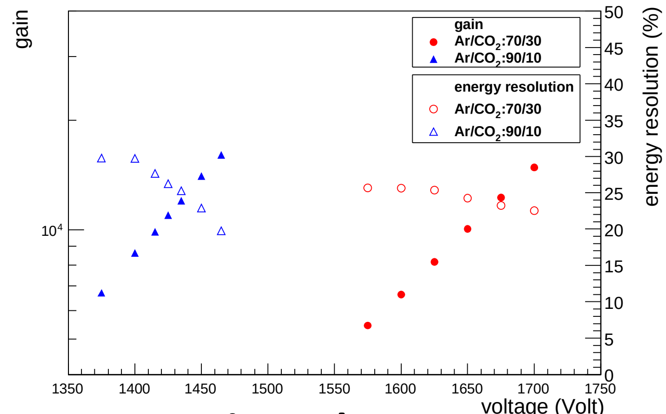
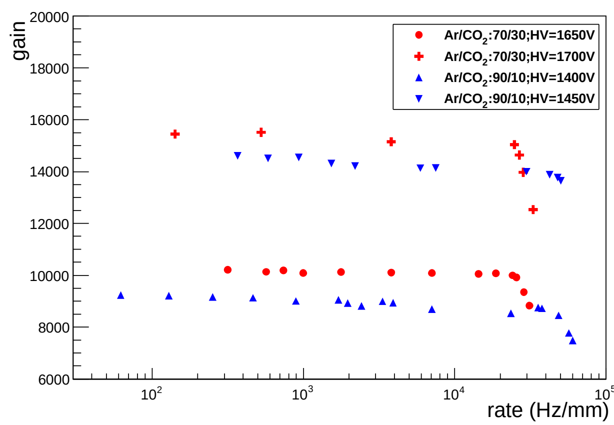
- MUCH in Compressed Baryonic Matter (CBM) @ FAIR
- Basic characteristic studies are performed for straw tube with Ar/CO_2 gas in 70/30 and 90/10 ratio using conventional NIM electronics.
- Count rate, gain, energy resolution, rate handling capacity are studied
- With 5.9 keV Fe^{55} X-ray the gain and the energy resolution remain constant up to a rate of about 20 kHz/mm and 32 kHz/mm for Ar/CO_2 70/30 and 90/10 respectively
- Use of the straw tube in CBM MUCH is under investigation.



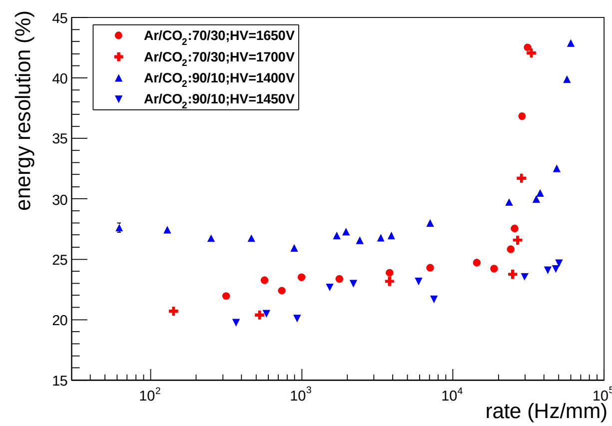
Fe^{55} Spectrum of the Straw Tube Detector



Gain and energy resolution Vs. voltage



Gain Vs. rate



Energy resolution Vs. rate

Upgrade of the ATLAS Muon Spectrometer with New Small-Diameter Drift Tube Chambers

O. Kortner, H. Kroha, S. Nowak, S. Podkladkin, P.Rieck, K. Schmdt-Sommerfeld, E. Takasugi, V. Walbrecht

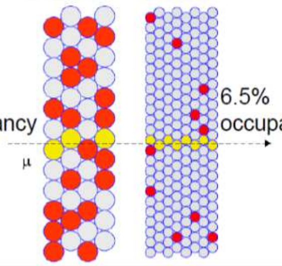
–Max-Planck-Institute for Physics, Munich, Germany -

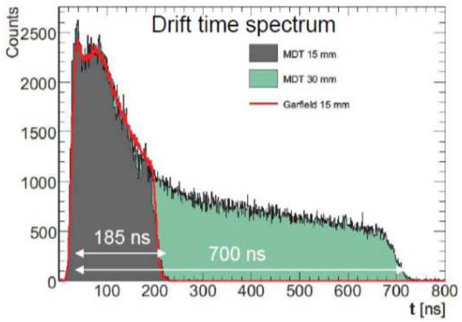
R. Fakhrutdinov, A. Kozhin - *Institute for High Energy Physics, Protvino, Russia*

ID 78

By reducing the drift tube diameter from 30 mm (MDT) to 15 mm (sMDT) at otherwise the unchanged operating conditions and while keeping all advantages of the MDTs as well as their services:

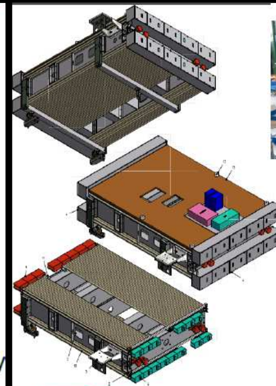
- 8 x lower background occupancy (4 x shorter maximum drift time, 2 x smaller tube cross section).
- Electronics deadtime (≈ max.drift time because of afterpulses) can be reduced by a factor of 4, thus the masking of muon hits by preceeding background hits.



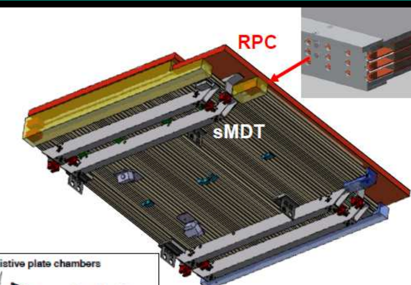


- Also, space for twice as many tube layers within the same available detector volume,

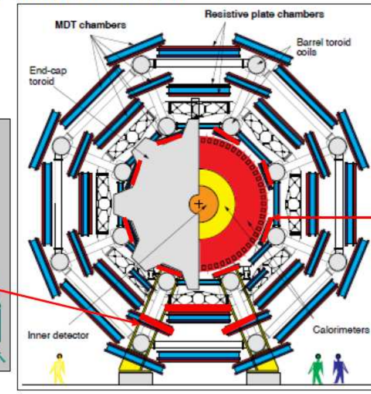
allowing for additional increase in muon tracking efficiency and resolution.

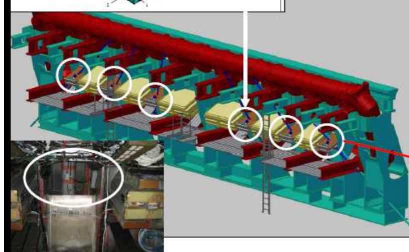


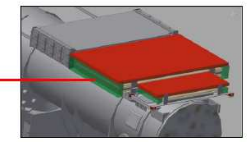
12 BMG chambers 2016 installed in the detector feet in the winter shutdown 2016/17



16 sMDT + triple thin-gap RPC at the ends of the BIS layer



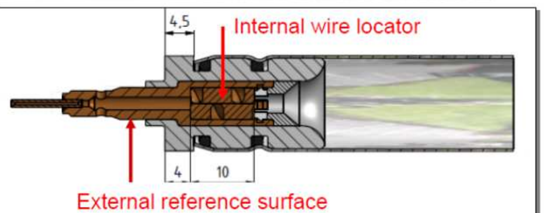


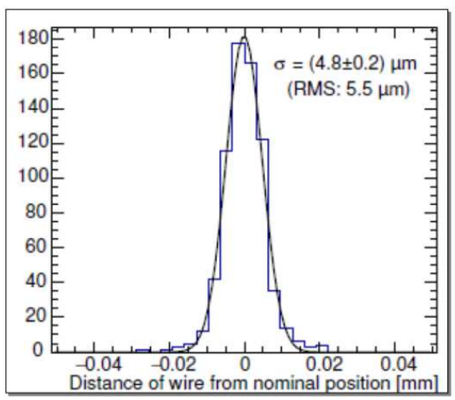


Installation June 2019. Pilot project for the Phase-2 upgrade.

- Measurement of individual sense wires and alignment sensor platform positions with with large 3D coordinate measuring machine (2 μm precision)

⇒ Wire positioning accuracy of better than 5 μm (MDTs: 20 μm).



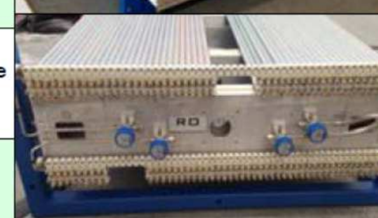


sMDT Chambers for ATLAS

sMDT chambers: Precisiosn muon tracking detectors with **35 μm spatial resolution** and **10 x higher background rate capability** than current MDT chambers. Robust and cost effective technology for HL-LHC and FCC-hh.

BIS78 chamber type under construction

BMG chamber type in operation in ATLAS



Assembly Method

Insertion of endplug reference surfaces into precision machined hole grid which directly defines the relative wire positions to **better than the required 20 μm rms**. Assembly procedure optimised for mass production. Use of automated glue dispenser (top). Complex chamber shapes feasible.

Protection of Straw Drift Chambers Operating in Vacuum against Vacuum Penetration

ID 138

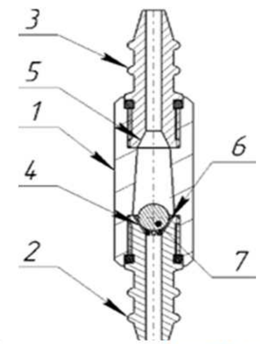
L.Glonti, G.Glonti, V.Kekelidze, S.Movchan, N.Ridinger, Yu.Potrebenikov, V.Samsonov, V.Chepurnov

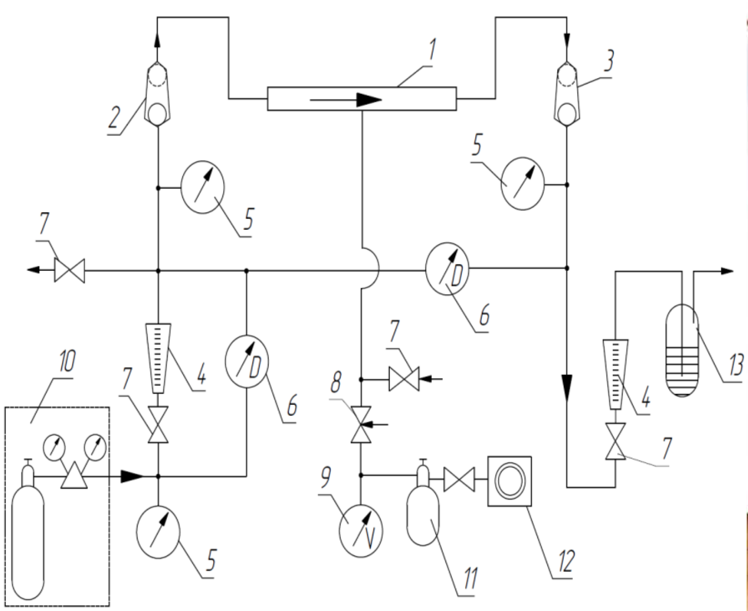
Joint Institute of Nuclear Research (Dubna)

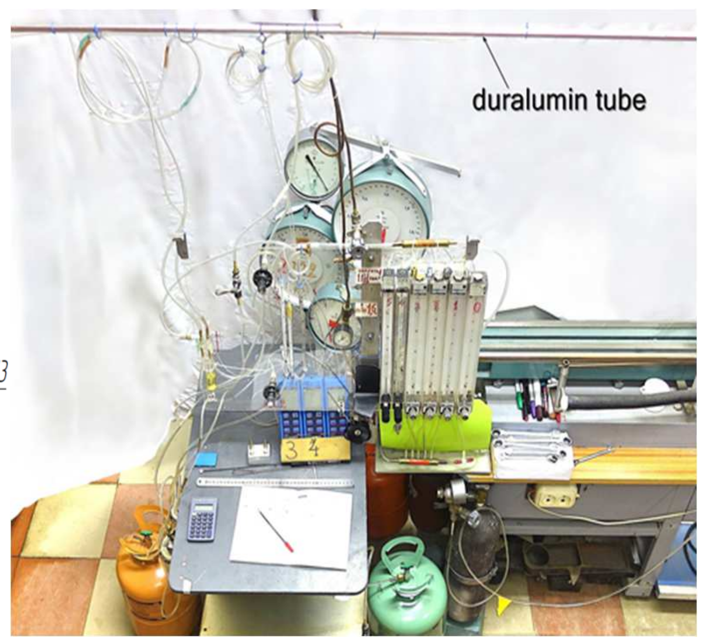
L.Glonti

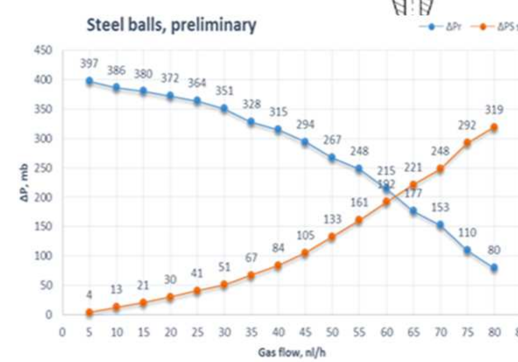
Straw drift chambers operating in high vacuum have become to be used in experimental studies of rare decays. Any drift tube of the operating chamber may suffer a mechanical or electrical damage and a subsequent leak. The complete failure of the tube is not excluded either.

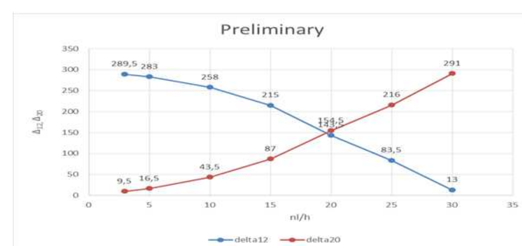
To protect the chambers against the above damage, we have developed and tested a simple protection system based on uniquely designed energy-independent devices. If air-tightness is broken and gas starts leaking from the tube into the vacuum, they automatically cut off the gas flow on both ends of the damaged tube and disconnect it from the gas supply.











Multi-Wire:

- Proportional Chamber
- Thin Gap Chamber
- Drift Chamber

Multi-Blade

The ^{10}B-based neutron detector for reflectometry at ESS

ID 127

F. Messi[1,2], G. Mauri[3,2], F. Piscitelli[2]

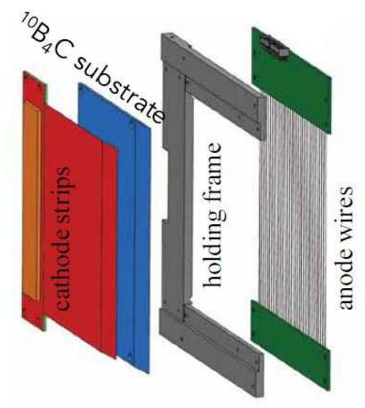
[1]Division of Nuclear Physics Lund University, [2]European Spallation Source ERIC, [3]Department of Physics University of Perugia

Multi-Blade:

- a 10B-based neutron detector conceived to face the arising challenge in neutron reflectometry at the European Spallation Source (ESS).
    - high counting rate
    - sub-millimetre spatial resolution

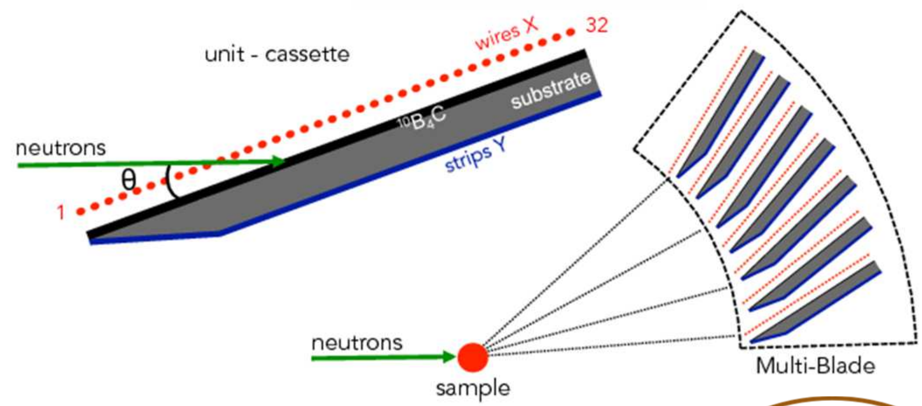
- a stack of Multi Wire Proportional Chambers
    - operated at atmospheric pressure with continuous gas flow (Ar/Co2 80/20)
    - with a 10B4C neutron converter and a 2D read-out system
    - inclined by 5 degrees with respect to the incoming neutron beam

modular design: a *cassette*



ESS: unprecedented requirements for neutron reflectometry:

ESS requirements:	Estia	Freia	state-of-art	Multi-Blade (MB16)
wavelength range (Å)	4 – 10	2.5 – 12	1 – 30	2.5 – 30
detection efficiency	> 45% @4Å	> 40% @2.5Å	80% @2.5Å	~ 44% @2.5Å
sample-detector distance (m)	4	3	-	4
local instantaneous rate @detector (n / mm² / s)	10^5	10^5	~ 10^2	1.6 x 10^3 (limited by Read-Out Electronics)
Spatial resolution wire Spatial resolution strip (mm)	0.5 4	0.5 2.5	2 8	0.6 2.5
Uniformity (%)	5	5	5	
window scattering	< 10^{-4}	< 10^{-4}	- ~5mm thick	< 1mm thick
gamma-sensitivity	< 10^{-6}	< 10^{-6}	10^{-7}	< 10^{-7}
fast-neutron sensitivity	-	-	10^{-3}	< 10^{-5}
number of channels	4800	2880	~ 128	~ 400



Author: Francesco Messi
francesco.messi@nuclear.lu.se

ID 226

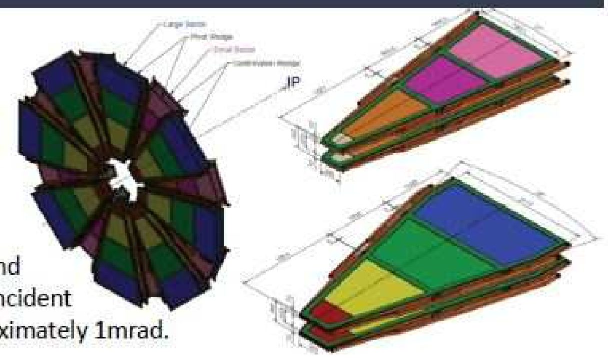
Small-Strip Thin Gap Chambers for the Muon Spectrometer Upgrade of the ATLAS Experiment

selected and copied from poster

Rimsky Rojas (UTFSM, Chile) on behalf of the Atlas Muon Collaboration

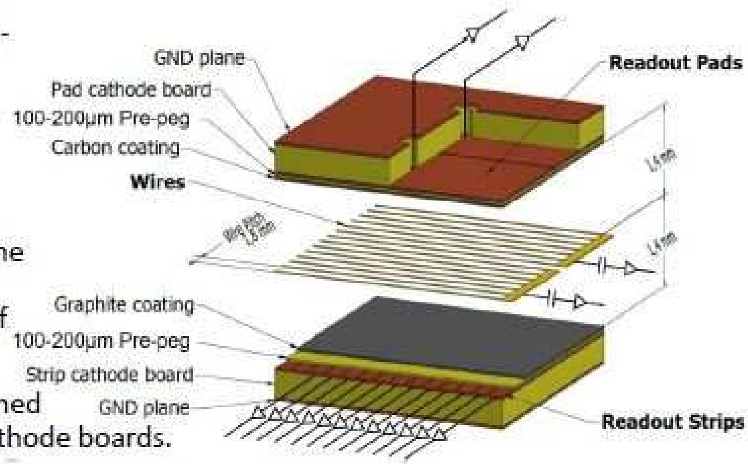
Introduction

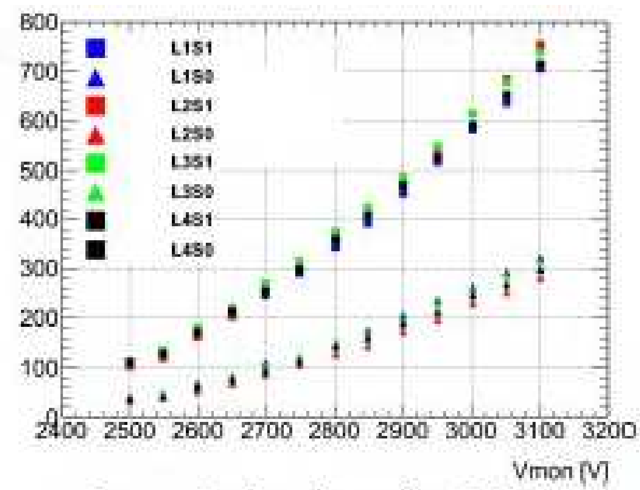
The instantaneous luminosity of the Large Hadron Collider at CERN will be increased by a factor of 5-7 with respect to the design value.
The largest phase-1 upgrade project for the ATLAS Muon System is the replacement of the present first station in the forward regions with the so-called New Small Wheels (NSWs) during the long-LHC shutdown in 2019/20.
Along with Micromegas, each side of the NSWs will be equipped with eight layers of small-strip thin gap chambers (sTGC) arranged in two quadruplets.
To reduce fake triggers, good precision tracking and trigger capabilities are required in the high background environment of LHC, each sTGC plane must achieve a **spatial resolution better than 100 μm** at normal incident angle to allow the Level-1 trigger track segments to be reconstructed with an angular resolution of approximately 1mrad.



sTGC structure & features

- The basic sTGC structure consists of a grid of gold-plated tungsten wires sandwiched between two resistive cathode planes at a distance of 1.4mm from the wire plane.
- The precision cathode plane has strips with a 3.2mm pitch for precision readout relative to a precision brass insert outside the chamber, and the cathode plane on the other side has pads which determine the timing of the collision and group of strips to be used for trigger.
- The gap is provided using precision frames machined and sanded to 1.4mm ±20μm and glued to the cathode boards.
- The Muon trigger is performed with a precise angle measurement in the NSW and in coincidence with the outer detectors (Big Wheel)





Current v/s voltage for QS1 quadruplet (2 HV line per layer)

ID 111

The new drift chamber of the MEG II experiment

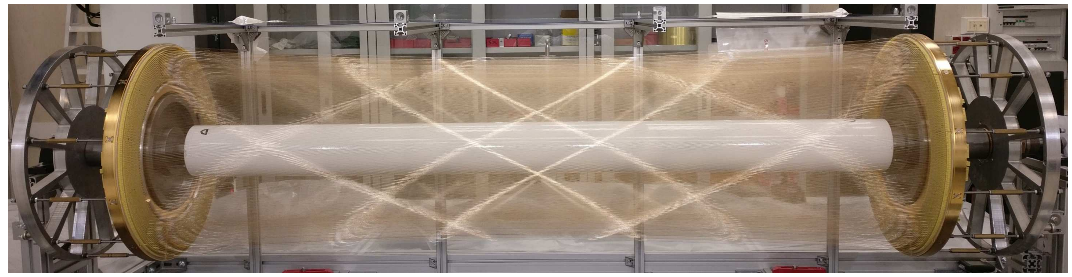
M. Chiappini[a,b] on behalf of the MEG collaboration

[a] INFN Sezione di Pisa, Largo B. Pontecorvo 3, 56127, Pisa

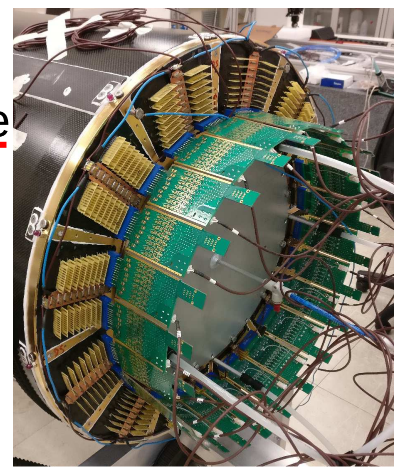
[b] Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente dell'Università, Via Roma 56, 53100, Siena, Italy

E-mail: marco.chiappini@pi.infn.it

Cylindrical Drift CHamber (CDCH), a key detector for the phase 2 of MEG, which aims at reaching a sensitivity level of the order of 6×10^{-14} for the $\mu^+ \rightarrow e^+ \gamma$ decay.



CDCH was built by INFN Pisa, Lecce and Rome groups and it is designed to overcome the limitations of MEG e^+ tracker and guarantee the proper operation at high rates with long-term detector stability. It features a unique volume 2 m long, covering the whole azimuthal angle around the muon stopping target and filled with a low-mass Helium:Isobutane (85:15) gas mixture which improves geometric acceptance for signal e^+ .The high granularity is ensured by 9 layers of drift cells, few mm wide, defined by 12000 wires (W / Al 20/40/50 μm) arranged in a stereo configuration for longitudinal hit localization. The total radiation length sums up to 1.5×10^{-3} X_0 and the Multiple Coulomb Scattering contribution, allowing for a single hit resolution of 110 μm and a momentum resolution of 130 keV/c. CDCH is currently in the HV test phase before the shipping to Paul Scherrer Institut.



The construction technique of the new MEGII tracker

ID 410

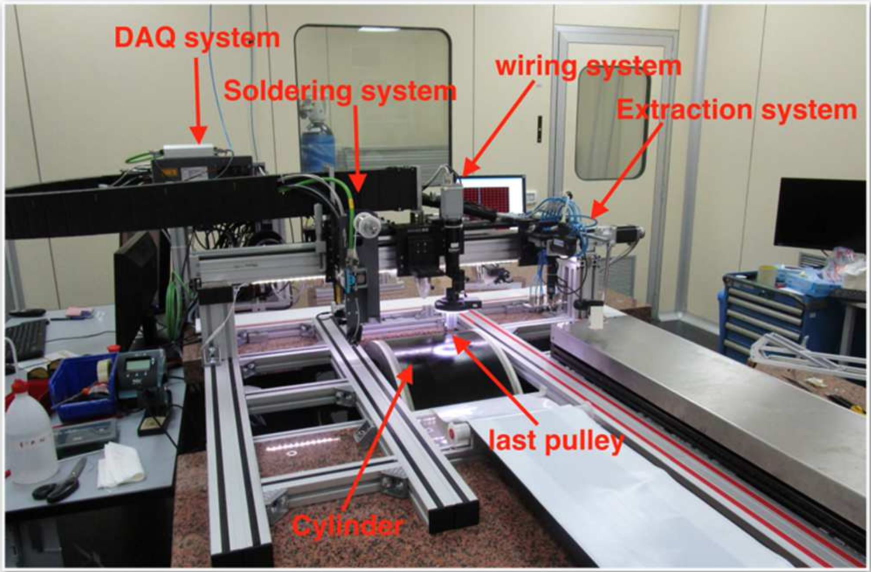
G. Chiarello [a,b,c,d], A. Corvaglia [a], F. Grancagnolo [a], A. Miccoli [a], M. Panareo [a,b], C. Pinto [a,b] and G.F. Tassielli [a,b]

(a)Istituto Nazionale di Fisica Nucleare Sezione di Lecce, Via Arnesano, Lecce, Italy (b)Dipartimento Matematica e Fisica Ennio De Giorgi, Università del Salento, Lecce, Italy

(c)Istituto Nazionale di Fisica Nucleare Sezione di Roma, Piazzale A. Moro, Roma, Italy. (d)Dipartimento di Fisica, Università Sapienza, Roma, Italy

A **wiring robot** has been designed and built:

- to wind continuously **variable wire pitches and stereo angles** configurations;
- to apply a **pre-defined mechanical tension** to the wires and to maintain it constant and uniform (±0.05g) through the whole wiring;
- to monitor the wires location and their alignments within a **few tens of μm**;
- to monitor **the solder quality** of the wire to the supporting Printed Circuit Boards;



The wiring robot consists of:

- **WIRING SYSTEM:** a semiautomatic wiring machine with a high precision on wire mechanical tensioning (<0.05 g) and on wire positioning (<20 μm) for a simultaneous wiring of multi-wire frames;
- **SOLDERING SYSTEM:** a contact-less infrared laser soldering tool for anchoring the wires to the supporting PCB;
- **EXTRACTION SYSTEM:** an automatic handling system for removing the multi- wire frames from the wiring system and for storing them under continuously adjustable wire tension.

The measuring systems of the wire resonant frequency for the MEG-II Drift Chamber

ID 376

G. Chiarello [c,d], A. Corvaglia [a], F. Grancagnolo [a], M. Panareo [a,b], P. Primiceri [a,b], F. Renga [c], G.F. Tassielli [a,b], C. Voena [c]

(a)Istituto Nazionale di Fisica Nucleare Sezione di Lecce, Via Arnesano, Lecce, Italy
(b)Dipartimento Matematica e Fisica Ennio De Giorgi, Università del Salento, Lecce, Italy
(c)Istituto Nazionale di Fisica Nucleare Sezione di Roma, Piazzale A. Moro, Roma, Italy
(d)Dipartimento di Fisica, Università Sapienza, Roma, Italy

selection and copy from poster

Wire Tension measurement theory

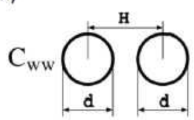
To monitor the wire mechanical tension of all the wires during the different assembling stages we developed a system to measure the wire fundamental resonance frequency:

$$f = \frac{1}{2L}\sqrt{\frac{Tg}{\rho}}$$

f - fundamental resonance frequency of the wire oscillations (Hz)
T - wire tension (g)
L - wire length (m)
ρ - mass (or weight) of one meter long wire (g/m)

The system of two nearby wires has a capacitance

C_{WW}= capacitance per unit length between two parallel wires of diameter d at distance H [F/m]



$$C_{ww} = \frac{\pi\varepsilon}{\ln\frac{2H}{d}}$$

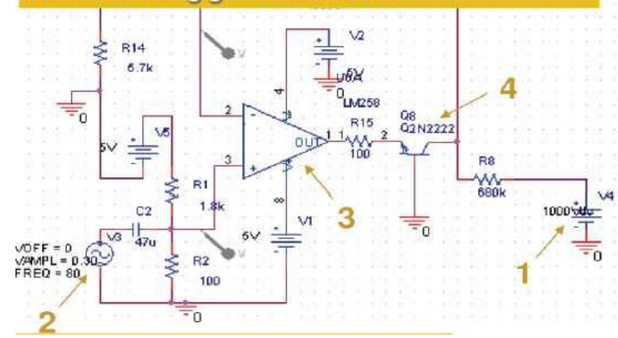
The two wires system is inserted as part of an auto-oscillating HV circuit. The HV signal forces the wire vibration thus producing a variation of the wires mutual capacitance and, therefore, of the frequency of the auto-oscillating circuit;

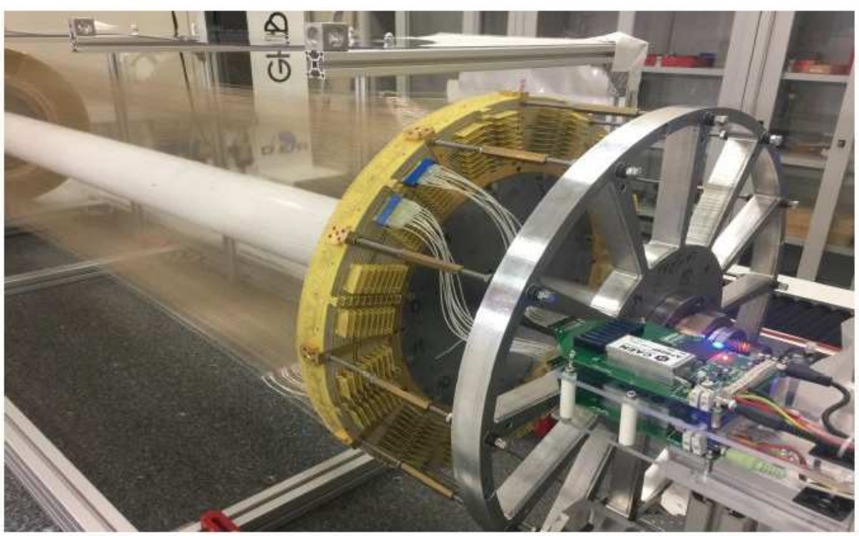
$$|df| \approx \frac{C_{ww}}{4\pi C\sqrt{LC}}\frac{k}{\ln\left(\frac{2H}{d}\right)}\frac{dH}{H}$$

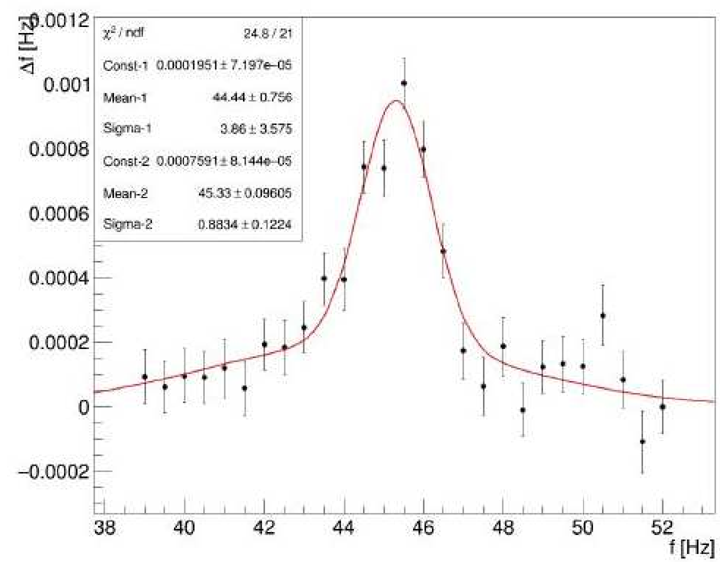
L, C – inductance and capacitance of the auto-oscillating circuit

The amplitude of the mechanical wire vibration (and then the value of the capacitance variation) is maximized at the wire resonant frequency.

HV oscillating generator circuit







Improving spatial and PID performance of the high transparency Drift Chamber by using the Cluster Counting and Timing techniques

G. Chiarello [a,b,c,d], A. Corvaglia [a], F. Grancagnolo [a], A. Miccoli [a], M. Panareo [a,b], C. Pinto [a,b], F. Renga[c,d], G.F. Tassielli [a,b] and C. Voena [c,d].

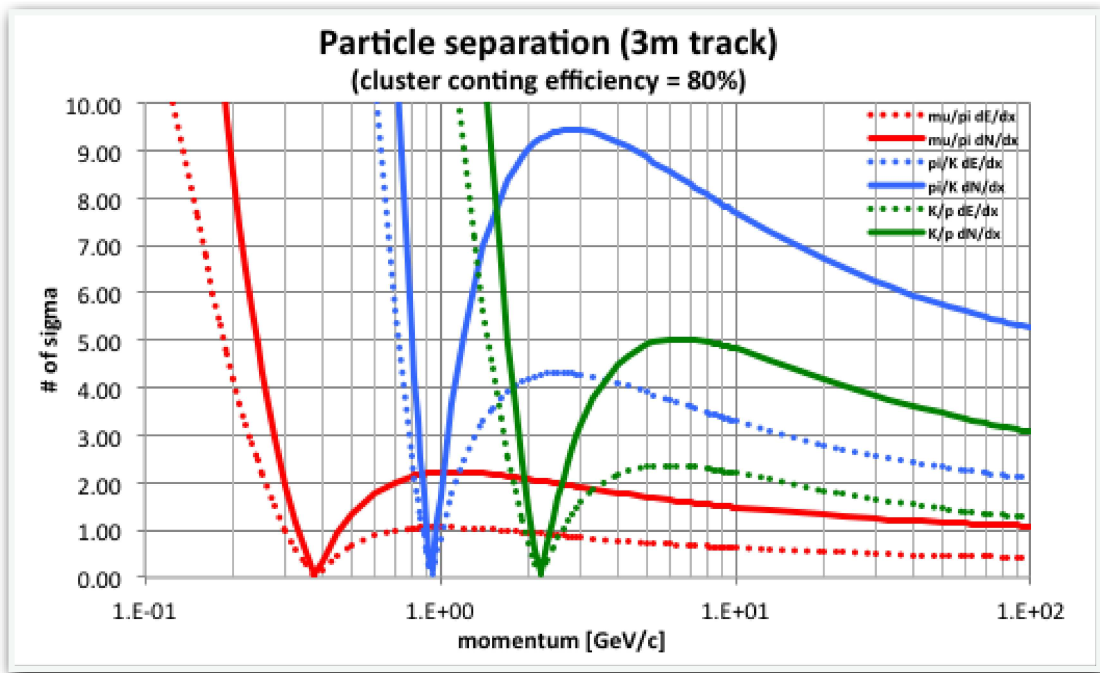
(a)Istituto Nazionale di Fisica Nucleare Sezione di Lecce, Via Arnesano, Lecce, Italy (b)Dipartimento Matematica e Fisica Ennio De Giorgi, Università del Salento, Lecce, Italy

(c)Istituto Nazionale di Fisica Nucleare Sezione di Roma, Piazzale A. Moro, Roma, Italy. (d)Dipartimento di Fisica, Università Sapienza, Roma, Italy

We present how, in Helium based gas mixtures, by counting and measuring the arrival times of each individual ionization cluster and by using statistical tools it is possible to have a bias free estimate of the impact parameter and a better PID by using the dN/dx technique instead of the dE/dx.

In a conventional drift chamber, only the time of the first cluster is used to estimate the track impact parameter, resulting in a systematic biased overestimate.
Cluster timing technique use statistical tools in order to improve the bias estimate by using the information of different clusters

expected PID performance comparison with dE/dx for a track length of L=3m
Assuming a C.C. efficiency ε = 80%



Detector Systems – present and future

Design and Construction of Integrated Small-Diameter Drift Tube and Thin-Gap Resistive Plate Chambers for the Phase-1 Upgrade of the ATLAS Muon Spectrometer

Hubert Kroha – Max-Planck-Institute for Physics, Munich, Germany --- on behalf of the ATLAS Muon Collaboration

ATLAS EXPERIMENT

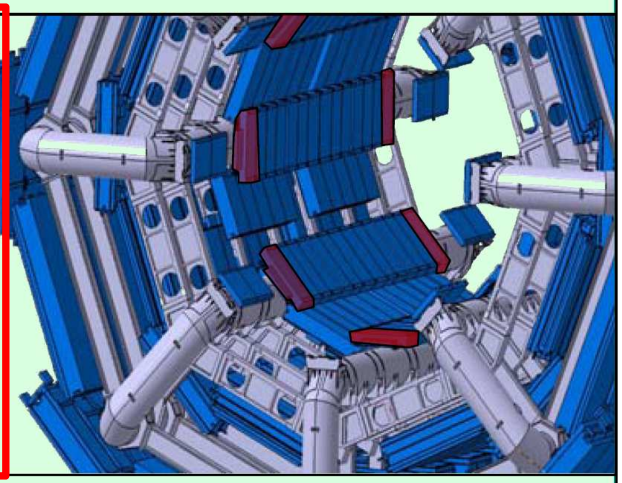
ID 228

Max-Planck-Institut für Physik

New ATLAS Muon Chambers for LHC Run-3

Installation of **32 new Resistive Plate (RPC) muon trigger chambers** in combination with **16 new sMDT precision muon tracking detectors** on the toroid magnet coils at the ends of the barrel inner layer (red) in the Long Shutdown 2 of the LHC in 2019-2020.

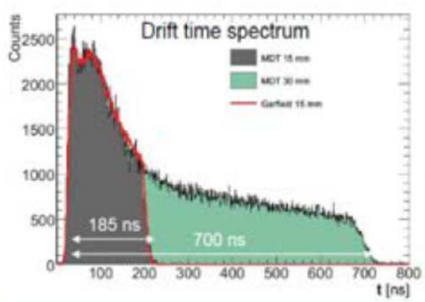
Goal: Improvement of the trigger selectivity and fake trigger suppression in the region 1.0 < |η| < 1.3 together with endcap trigger chambers for Phase-1 and 2.

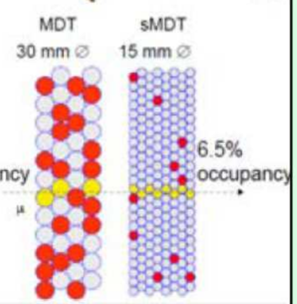


Small-Diameter Drift Tube (sMDT) Chambers

By reducing the drift tube diameter from 30 mm (MDT) to 15 mm (sMDT) at otherwise the unchanged operating conditions and while keeping all advantages of the MDTs as well as their services:

- 8 x lower background occupancy (4 x shorter maximum drift time, 2 x smaller tube cross section).
- Electronics deadtime (≈ max.drift time because of afterpulses) can be reduced by a factor of 4, thus the masking of muon hits by preceeding background hits.

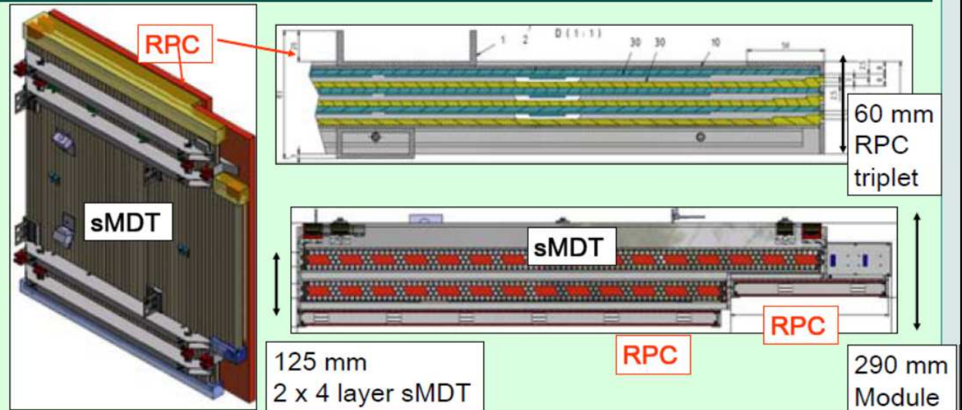




- Also, space for twice as many tube layers within the same available detector volume,

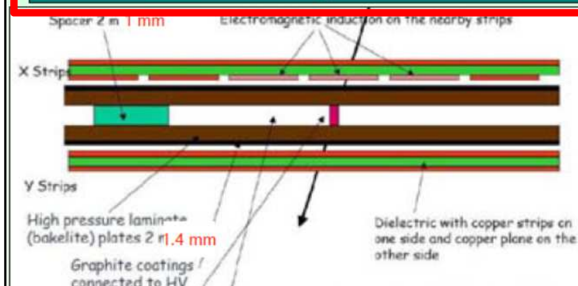
allowing for additional increase in muon tracking efficiency and resolution.

Integrated sMDT and Thin-Gap RPC Chambers



New RPC chambers require replacement of existing MDT chambers by sMDT chambers to provide sufficient radial space. Nevertheless tight spatial constraints on new detectors. Optical sensors for global alignment system on top and bottom of sMDT drift tube layers.

Thin-Gap Resistive Plate Chambers



Prototype of a new RPC triplet in the light but stiff support frame. Deformations must stay below 2 mm.

Twice thinner gas gaps (1 mm) and thinner HPL electrodes
+ new highly sensitive amplifiers

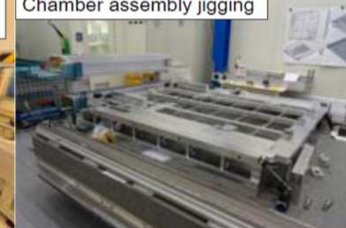
- improve the time resolution from 1 ns to 0.4 ns,
- allow for operation at substantially lower voltage, 5.4 instead of 9.6 kV, and ~15 x lower gas gain and avalanche charge.

⇒ increase of the lifetime well beyond 10 years at HL-LHC background rates.

sMDT chambers under construction

Drift tube production and test (10k tubes). Class 1000 clean room.

Chamber assembly jigging



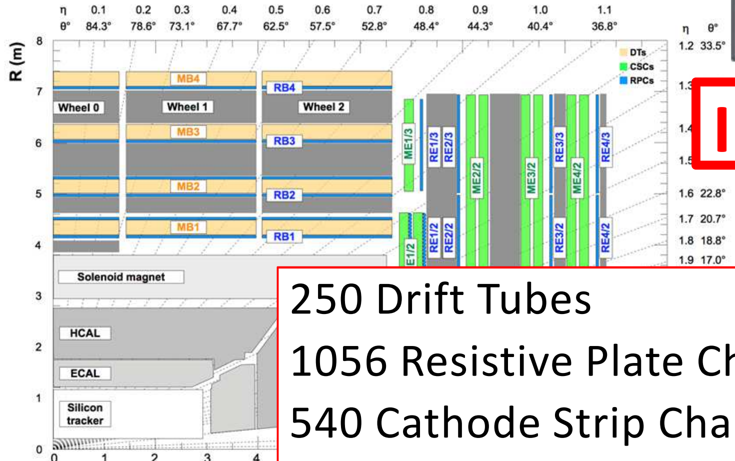
Precision hole grid of the jig for drift tube insertion.

Performance of the CMS Muon System in LHC Run-2

Carlo Battilana (Università di Bologna and INFN) on behalf of the CMS Collaboration

ID 234

The CMS muon system consists of different type of gaseous detectors. It is located outside the CMS magnet solenoid, and is organised in detection layers sliced within the magnet flux-return yoke.

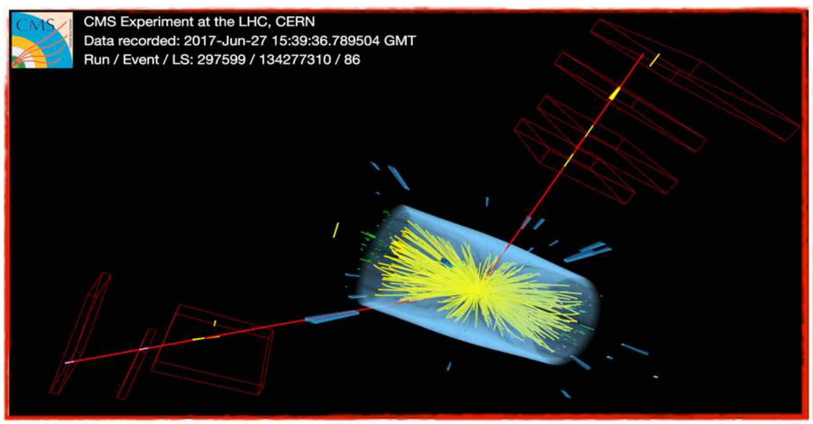


250 Drift Tubes
1056 Resistive Plate Chambers
540 Cathode Strip Chambers

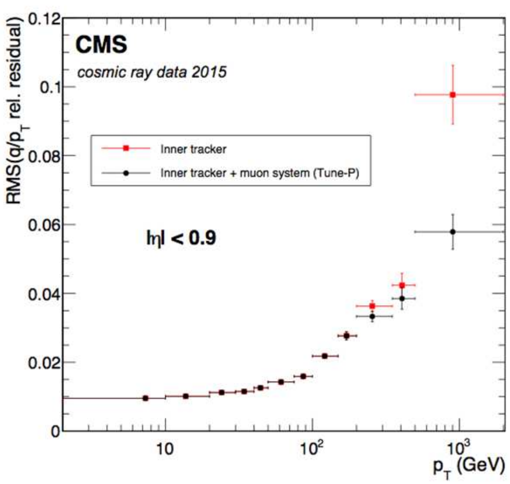
Muons are a signature of many CMS physics analyses. The muon system is essential for such analyses as:

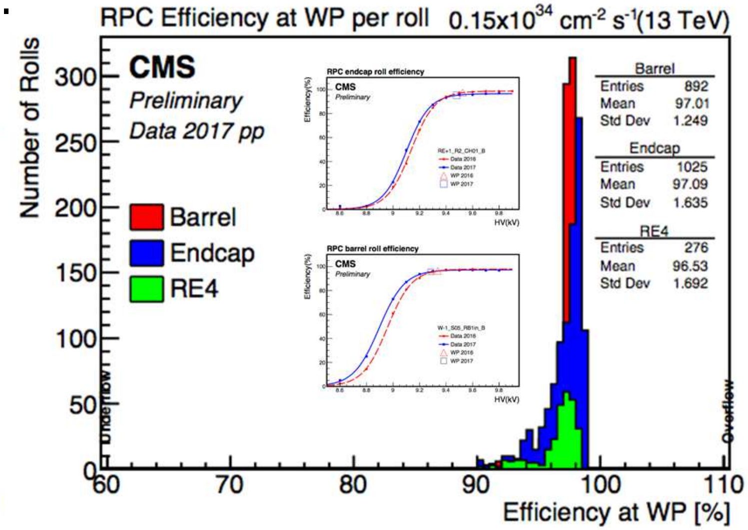
- it provides standalone Level-1 trigger capabilities,
- it is used, together with the inner tracker, for offline reconstruction and identification of muons,
- it improves the measurement of the transverse momentum for muons with energies above few hundreds of GeVs.

Performance results from data collected during the second LHC run are presented for the different sub-detectors equipping the muon system. The tuning of the operational working points of each detector, performed to maximise its longevity, is also discussed.



High invariant-mass event from Z' search with $\mathbf{m_{\mu\mu} \sim 2.4}$ **TeV**



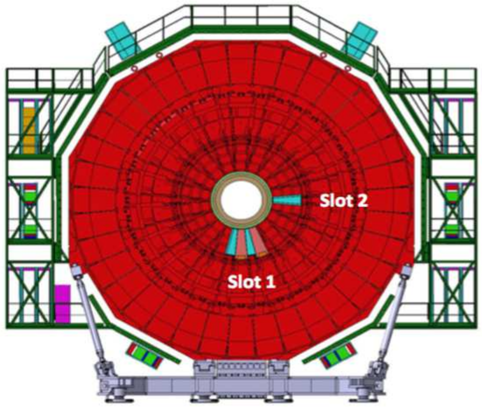


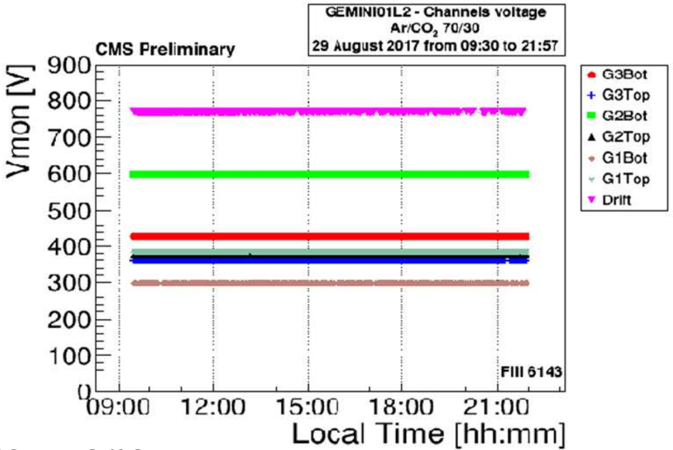
Commissioning and performance of the GE1/1 slice test detectors

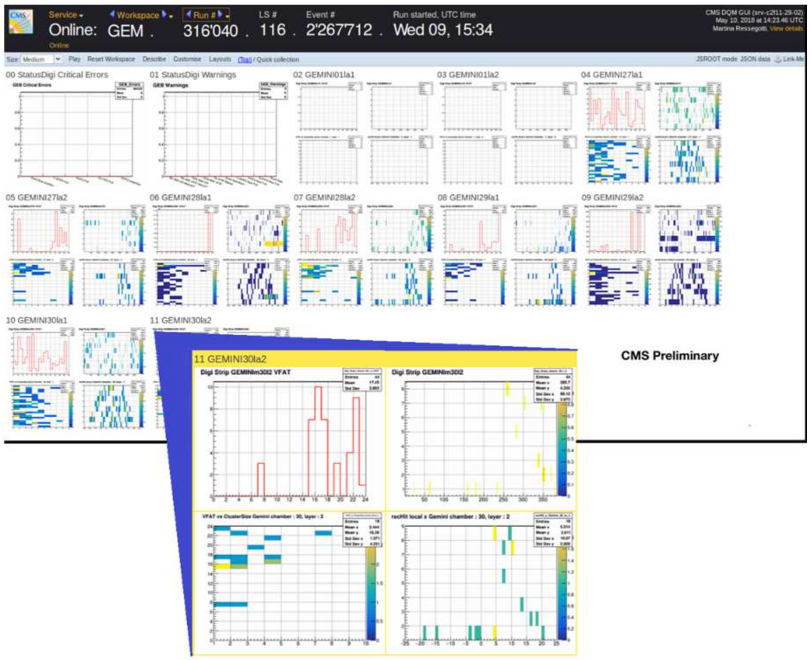
ID 125

Ilaria Vai[1,2] on behalf of the CMS Muon Group
[1]Università di Pavia, Dipartimento di Fisica
[2]Istituto Nazionale di Fisica Nucleare, Sezione di Pavia

The GE1/1 station will be installed in the region $1.6 < \eta < 2.2$ by 2020 to keep the muon trigger rate below 5 kHz without increasing the muon momentum threshold and to improve the redundancy.







10 Triple-GEM detectors were installed in the negative CMS endcap at the beginning of 2017 to acquire operational experience and demonstrate the integration of GEMs into CMS.

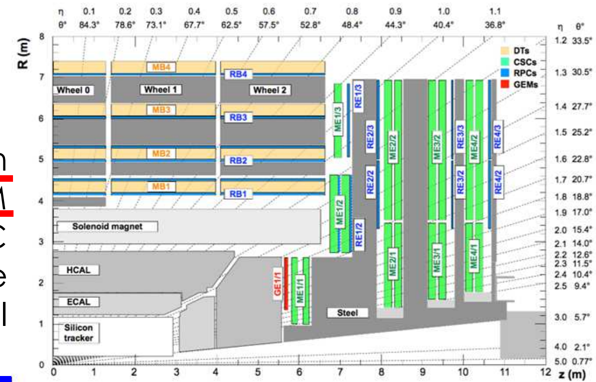
The poster shows the results of the first tests performed in 2017 as well as the status of the integration. The plans for 2018 are also outlined.

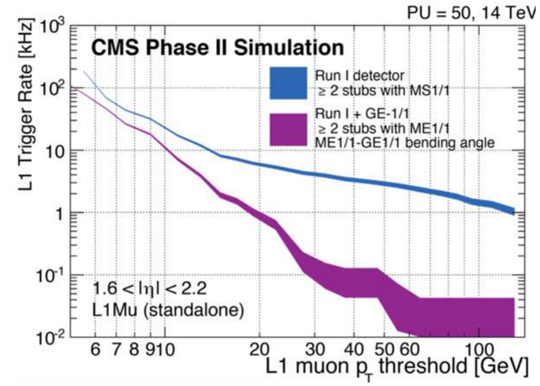
Production and Quality Control of the new chambers with GEM technology in CMS Muon System

Rosamaria Venditti on behalf of the CMS Muon Collaboration

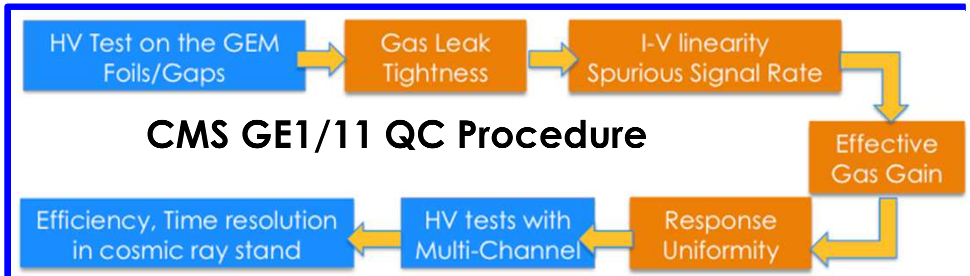
ID 193

During the next LHC run, the instantaneous luminosity will approach twice the design value leading to an increased number of pile-up interactions per event.



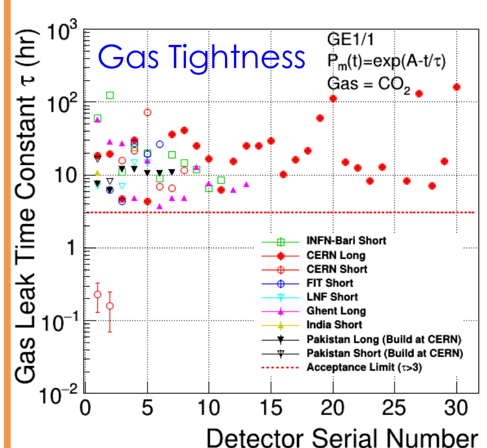


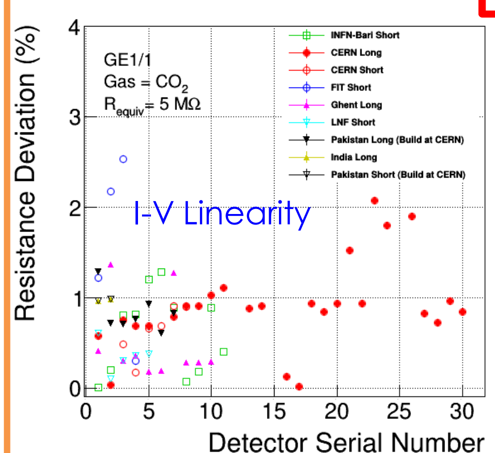
<u>The CMS collaboration thus approved the installation of an additional Muon station (GE1/1), based on 144 triple-GEM detectors.</u> The GE1/1 will be installed in front of the first CSC station (ME1/1) in 2019, improving the measurement of the muon tranverse momentum, thus reducing the first level trigger rate.

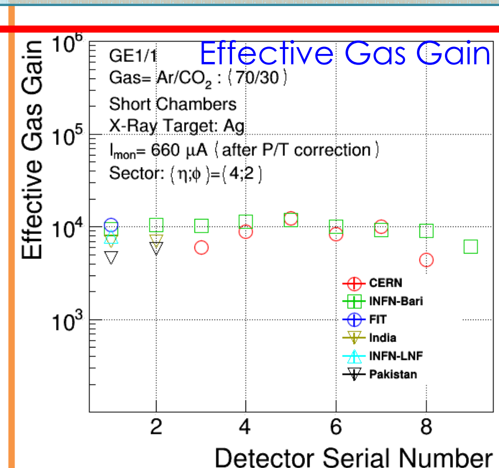


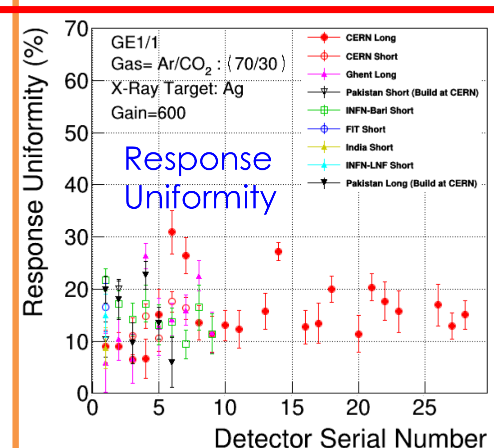
Several institutions from six countries spread all over the world will be involved in the assembly and test process of the chambers.
A detailed procedure for the quality control test is thus mandatory, before the final installation in CMS.

The quality control procedure of GE1/1 chambers ensures robust results and reliable performance during the operation.
This has been demonstrated during the CMS Slice Test (I.Vai poster).









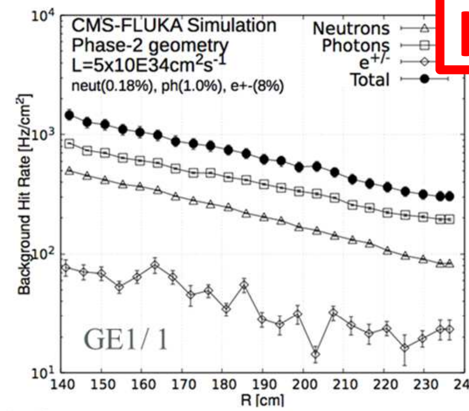
CMS approved the installation of two additional muon stations based on GEM technology in 2023: the GE2/1 and ME0 (J.Wang talk).

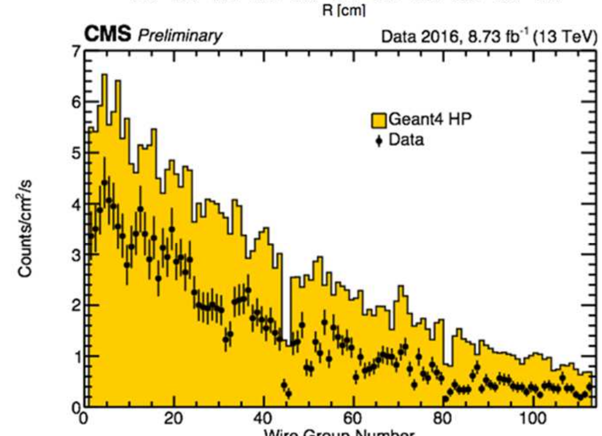
MEASUREMENT AND SIMULATION OF THE BACKGROUND IN THE CMS MUON DETECTORS

CESARE CALABRIA ON BEHALF OF THE CMS COLLABORATION

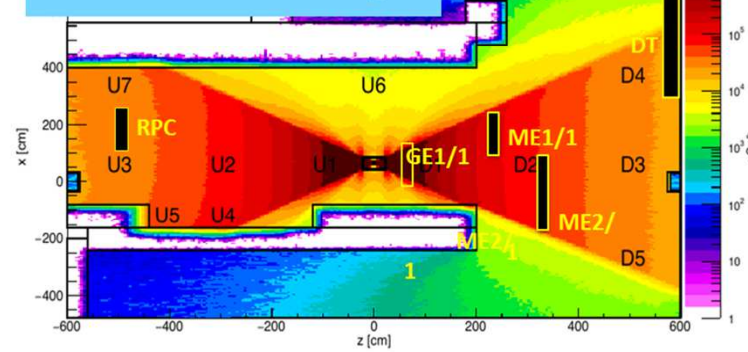
ID 128

- **The high rate expected at HL-LHC is a major challenge for the particle muon detector longevity and the muon reconstruction**
- **It is of primary importance to study the background expected in the muon system for the design of the new detectors and to estimate the damage to the existing detectors and electronics**
  - FLUKA, GEANT4 and a detailed description of the CMS detector and cavern are used to simulate and study the neutron background
  - Agreement within a factor of 2 is found comparing simulation with data
- **Longevity tests are ongoing at specific facilities**
  - Re-certifying existing equipment to HL-LHC: 6x integrated radiation doses and 5x signal and background rates w.r.t LHC
  - Longevity of new detectors (GEM, iRPC) are being also tested
  - Until now no evidences of aging in any detector





The GIF++ facility

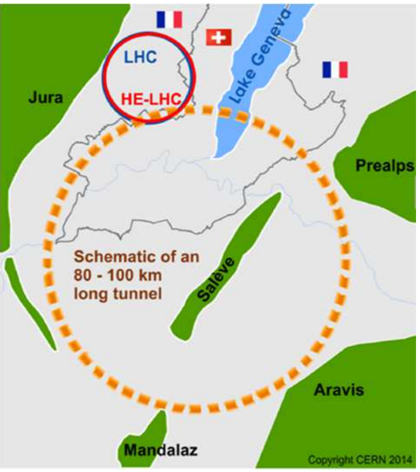


Design of the FCC-hh Muon Detector and Trigger System

Oliver Kortner, Sandra Kortner, Sergey Podkladkin, Robert Richter

Max-Planck Institute for Physics, Munich, Germany

ID 79



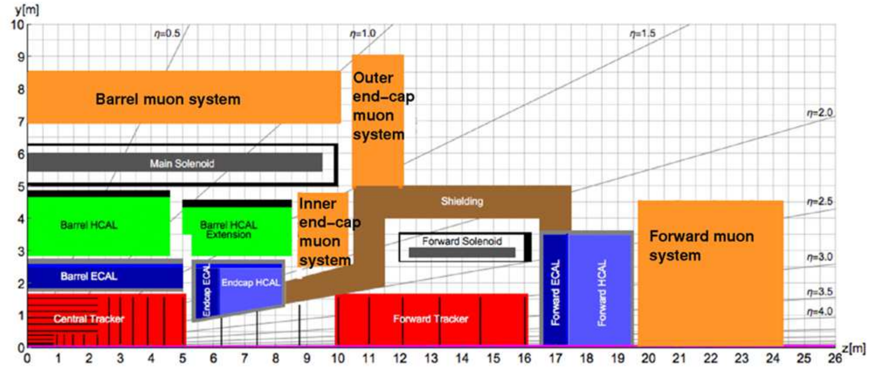
Concept for a future circular pp collider

- 16 T dipole magnets in a tunnel of 100 km circumference.

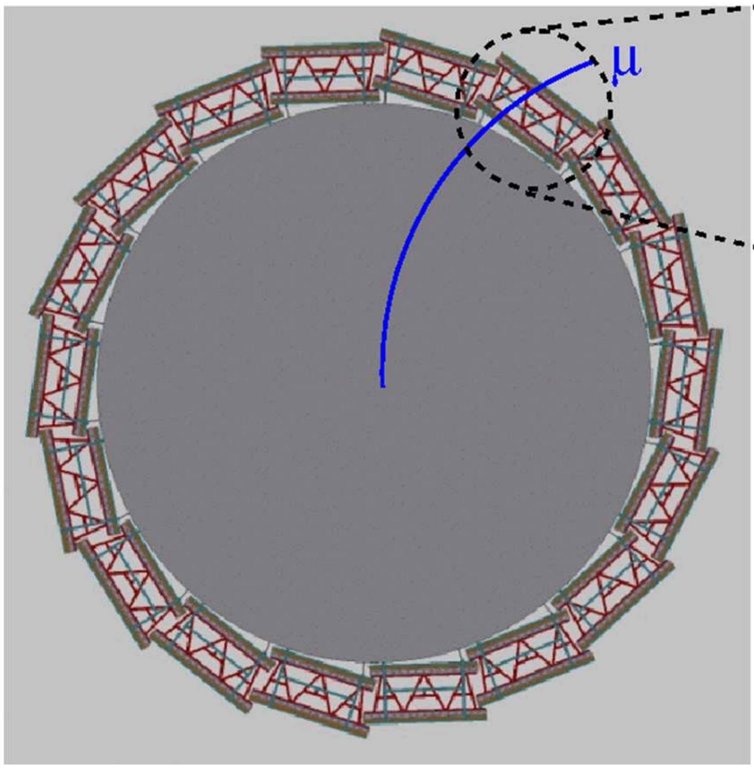
⇒**100 TeV** centre-of-mass energy.

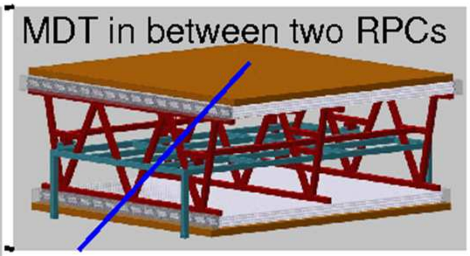
- Peak luminosity: $3\cdot10^{35}$ cm^{-2}s^{-1}.
- Integrated luminosity: 20 ab^{-1}.

Conceptual detector design



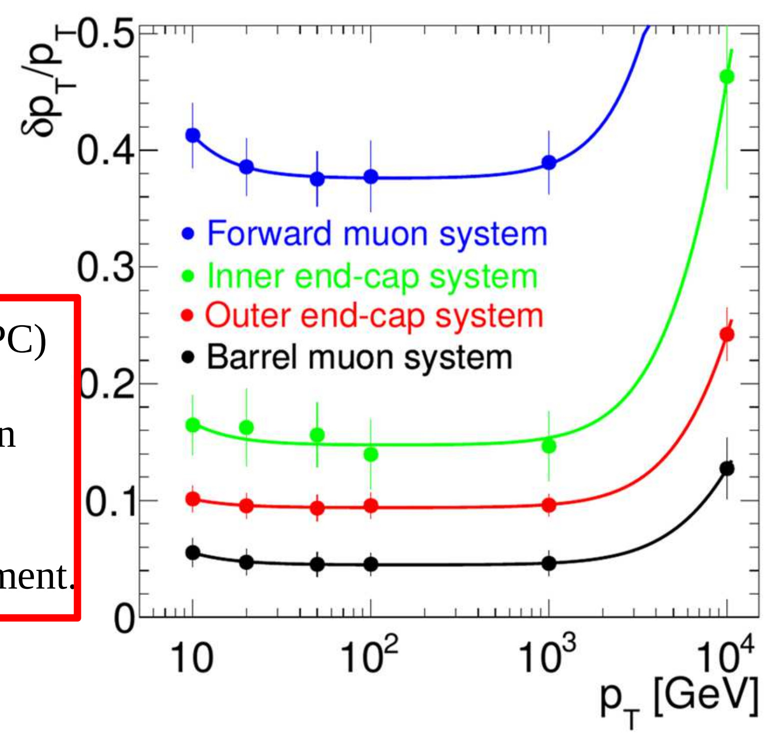
Proposal for the istrumentation of the muon system





- Resistive Plate Chambers (RPC) for precise timing
  → buchcrossing identification (BCID)
- Muon Drift Tubes (MDT) for precise direction measurement.

Achievable momentum resolution



Ultra long-lived particles searches with MATHUSLA

ID 39

G. Marsella on behalf of MATHUSLA Coll.

- Many extensions of the Standard Model (SM) include particles that are neutral, weakly coupled, and long-lived that can decay to hadronic and leptonic final states. Long-lived particles (LLPs) can be detected at colliders as displaced decays from the interaction point (IP), or missing energy if they escape. ATLAS, CMS, and LHCb have performed searches at the LHC and significant exclusion limits have been set in recent years.

- In this poster, we describe the MATHUSLA surface detector (MAssive Timing Hodoscope for Ultra Stable neutraL pArticles) [1], which can be implemented with existing technology in time for the turn-on of the high luminosity LHC (HL-LHC). The MATHUSLA detector will consist of an air-filled decay volume surrounded by charged particles detectors (top, bottom, and sides) that provide timing and a robust multilayer tracking system located in the upper region. Ref. [1] proposes covering a total sensitive area of 200 x 200 square meters on the surface in the region near the interaction point of ATLAS or CMS detectors for the beginning of the HL-LHC run.

[1] *New Detectors to Explore the Lifetime Frontier*, J. P. Chou, D. Curtin, H. J. Lubatti, arXiv:1606.06298 [hep-ph]

The tracking system for the IDEA detector at future lepton colliders

G. Chiarello [c,d], A. Corvaglia [a], F. Grancagnolo [a], A. Miccoli [a], M. Panareo [a,b], P. Primiceri [a,b] and **G.F. Tassielli** [a,b]

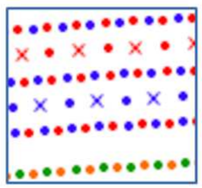
(a)INFN Sezione di Lecce, Via Arnesano, Lecce, Italy (b)Dipartimento Matematica e Fisica, Università del Salento, Lecce, Italy (c)INFN Sezione di Roma, Piazzale A. Moro, Roma, Italy (d)Dipartimento di Fisica, Università Sapienza, Roma, Italy

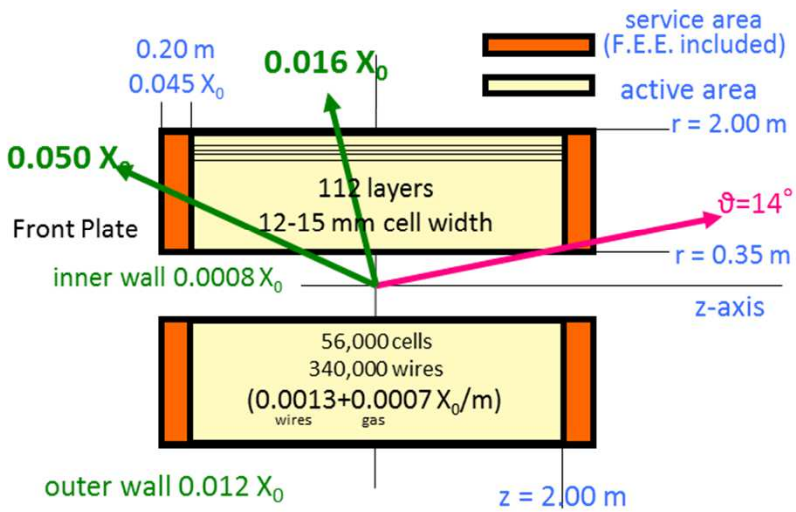
ID 374

The proposed ultra-light He based Drift Chamber is 4m long, starting at a radius of ~30cm and extending up to 2m, with ~<1.5cm drift cells, arranged in a full stereo configuration (50-250mrad) and instrumented with the Cluster Counting/Timing technique. The total material budget is approximately 0.016 X_0 for tracks in the barrel region and of 0.05 X_0 for forward tracks, providing a momentum resolution of ~5×10^{-4} for <10GeV/c and of <4×10^{-3} for 100GeV/c tracks. Moreover, the use of the Cluster Counting technique will allow for a PID resolution <3%, a factor two better than the resolution attainable with dE/dx technique.

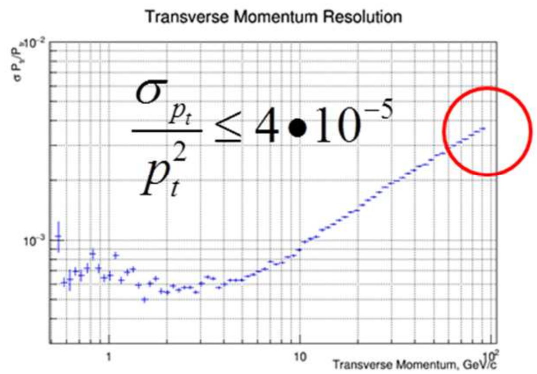
The IDEA Central Drift Chamber:

- Full stereo layout, two alternating stereo views from 50 to 250 mrad
- 12÷15 mm wide square cells
- 56,448 cells
- 14 co-axial super-layers, 8 layers each (112 total) in 24 equal azimuthal (15°) sectors

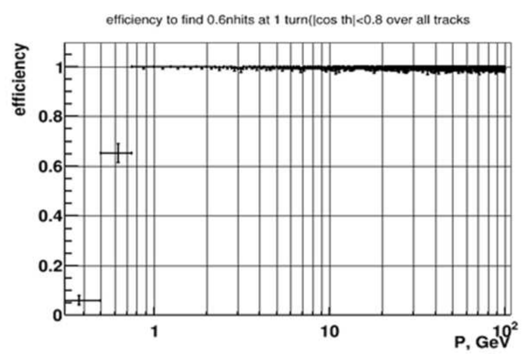




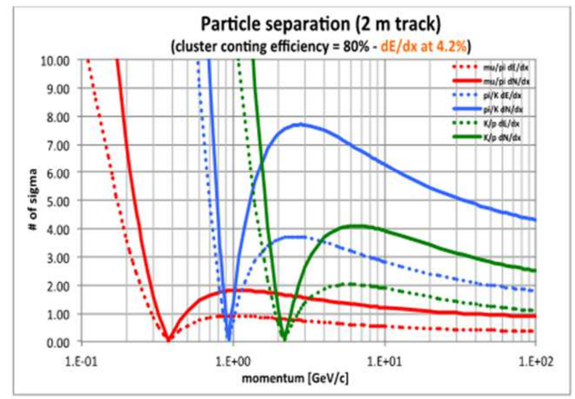
examples of expected single track resolution

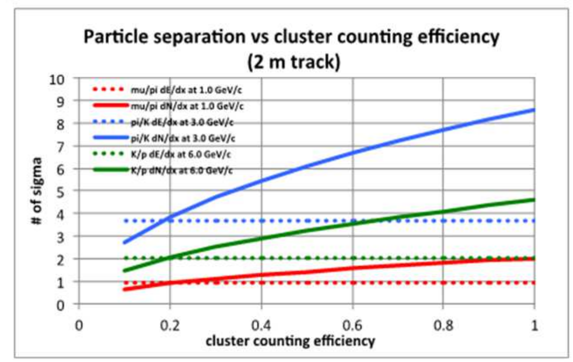


track finding efficiency ~ 99.5%



The IDEA DCH will use C. C./T. Technique to improve the P.Id. performance





- thanks to all authors for providing a summary slide
- enjoy the coffee break
- enjoy the poster session
- please appreciate and acknowledge the efforts each poster presenter has taken preparing the poster

Thank you very much!