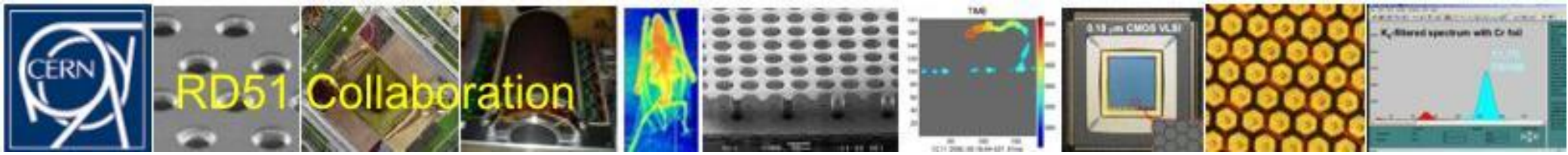
RD51

HEP2022 Conference

Eraldo Oliveri, CERN EP-DT GDD

on behalf of the RD51 Collaboration

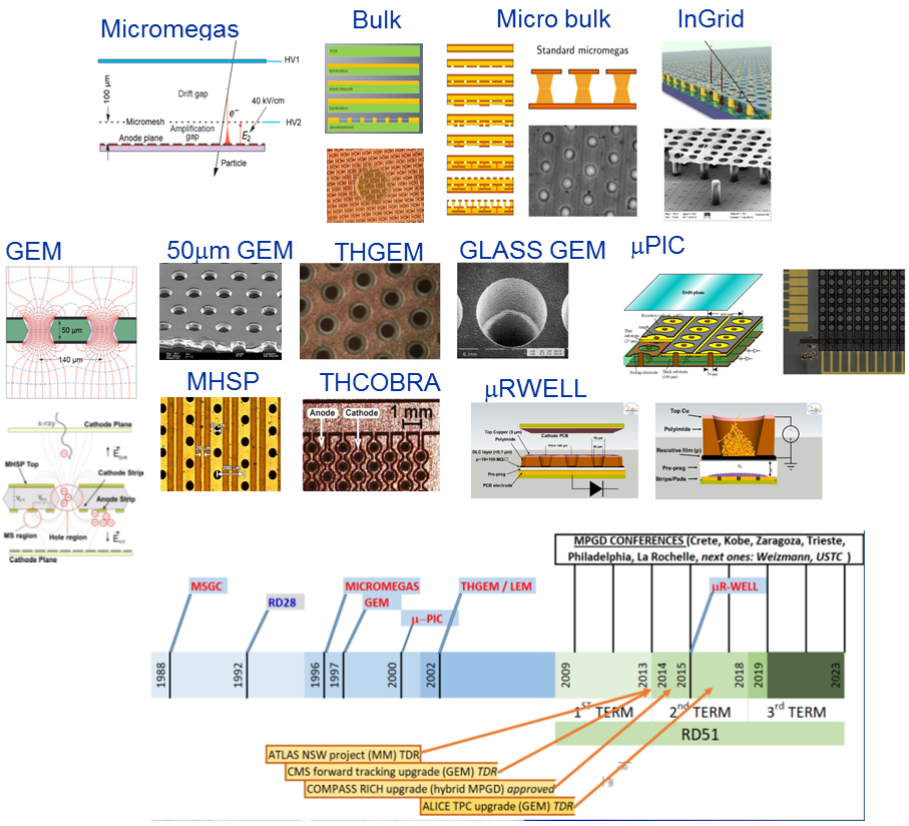


Outline

- Collaboration Overview
- RD51 R&D Framework
  - Scientific Cultural Reference, Knowledge Transfer and Dissemination
  - Common Projects
  - Common Tools
  - Common Facilities and Infrastructures
- MPGD Technologies and Dissemination
- Conclusions

The main objective of the R&D programme is to advance technological development and application of Micro Pattern Gas Detectors.

Micro Pattern Gas Detector Family



- High Rate Capability
- High Gain
- High Space Resolution
- Good Time Resolution
- Good Energy Resolution
- Excellent Radiation Hardness
- Good Ageing Properties
- Ion Backflow Reduction
- Photon Feedback Reduction
- Large size
- Low material budget
- Low cost
- …

- Up to MHz/mm^2 (MIP)
- Up to 10^5 -10^6
- <100µm
- In general few ns , sub-ns in specific configuration
- 10-20% FWHM @ soft X-Ray (6KeV)
- % level sort of easy, below % in particular configuration
- m^2

Collaboration Overview

Technology driven R&D collaboration..
Wide spectrum of applications (HEP and beyond)..
World wide distributed..
More than 90 institutes and 400 participants..

History (from conception to approval)

- **Jan 2006** (CERN) Micro-pattern Gas Detectors: status and perspectives (https://indico.cern.ch/event/473/)
- **Sept 2007** (CERN) Micro Pattern Gas Detectors. Towards an R&D Collaboration. (https://indico.cern.ch/event/16213/)
- **Apr 2008** (Nikhef) Micro-Pattern Gas Detectors (RD-51) Workshop (https://www.nikhef.nl/pub/conferences/rd51/) 1st Proposal (draft)
- **July 2008**, CERN, 94th LHCC, Proposal presented @ LHCC open session (https://indico.cern.ch/event/36159/)
- **Sept 2008**, CERN, 95th LHCC, Meeting with Referees (http://cdsweb.cern.ch/record/1132796/files/LHCC-095.pdf) (*).
- **Oct 2008**, Paris, 2nd RD51 Collaboration Meeting (https://indico.cern.ch/event/35172/timetable/?view=standard)
- **Dec 2008**, CERN, 186th Research Board, Approval (https://cds.cern.ch/record/1143639/files/M-186.pdf)(**).

(*)

9. REPORT FROM THE RD51 REFEREES

The Committee heard a report on the R&D proposal on the development of advanced gas-avalanche Micro-Pattern Gas Detector (MPGD) technologies and associated read-out systems for applications in basic and applied research (LHCC 2008-011 / P-001). The proposal is to develop techniques for such detectors so they can be capable of coping with high-flux rates while also improving the needed space-point resolution and the radiation hardness of the detectors. The proposed research is organised in seven working groups, each being structured through a set of tasks.

The Committee considers that the proposed experimental programme is sound and that the results of the R&D would be important for future high luminosity colliders, including an upgraded LHC. The proposal also has the potential to improve the collaboration between several institutes towards a common goal. However, the Committee asks the Collaboration to present a clearer definition of the resources and responsibilities of each institute, which will lead to the eventual signing of the Memorandum of Understanding.

The LHCC, therefore, **recommends** that the Collaboration carries out its programme of work, and encourages the Collaboration to define the resources and responsibilities of each participating institute. A status report should be submitted to the LHCC in one year.

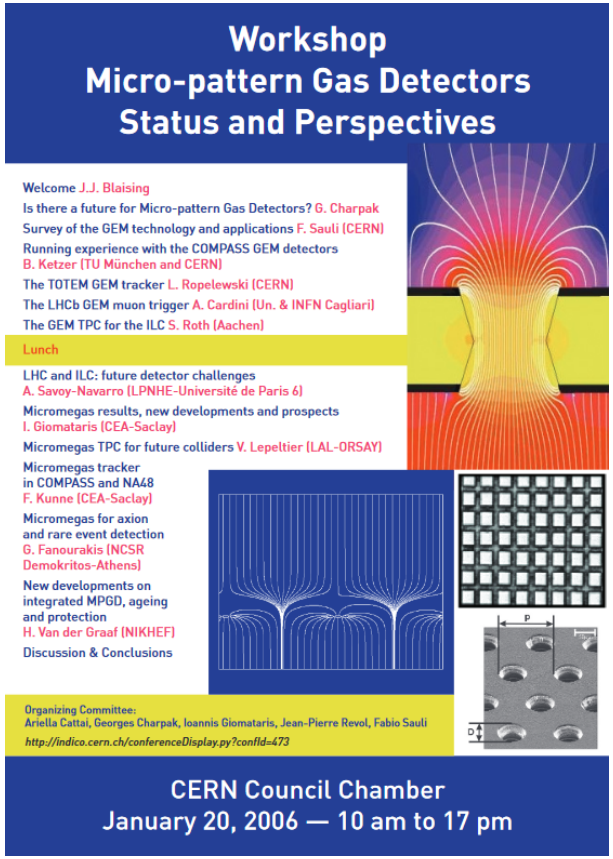
More or less 3 years

(**)

3. REPORT FROM THE LHCC MEETINGS OF 24-25 SEPTEMBER AND 19-20 NOVEMBER 2008

3.2 A new proposal for R&D on Micro-Pattern Gas Detector technology [3] was recommended for approval by the LHCC. It aims for a world-wide coordination of the research in this field. **The proposal was approved by the Research Board as RD51.**

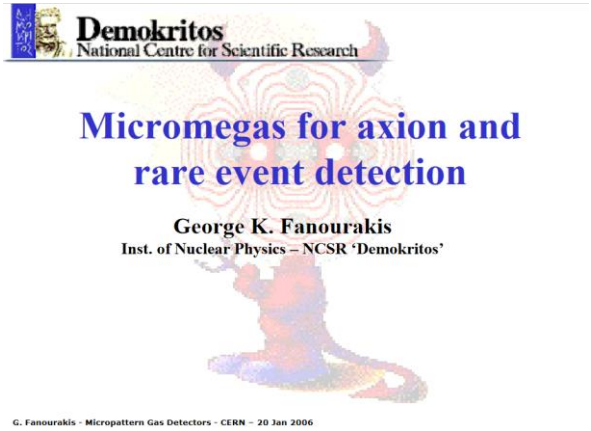
Micro-pattern Gas Detectors: status and perspectives, Jan 2006 (https://indico.cern.ch/event/473/)



https://indico.cern.ch/event/473/contributions/1983751/attachments/954018/1353770/presentation_fait_par_nicolas.ppt

https://indico.cern.ch/event/473/contributions/1983754/attachments/954020/1353773/SAULI.pdf

https://indico.cern.ch/event/473/contributions/1983757/attachments/954023/1353776/Giomataris.pdf



https://indico.cern.ch/event/473/contributions/1983749/attachments/954017/1353767/Fanourakis.pdf

(Today) 3rd five-years term (2019-2023)

RD51 R&D environment

People – core service; generic and support R&D group

Community:
- open information and experience exchange
- organization of the conferences, meetings, workshops, schools, lectures, trainings, AIMEs
- contribution to the development, maintenance and user support of the infrastructure, electronics and software tools
- education of the new generation of instrumental physicists

Common infrastructure – R&D lab and test beam facilities

Electronics support: dedicated to Detector R&D

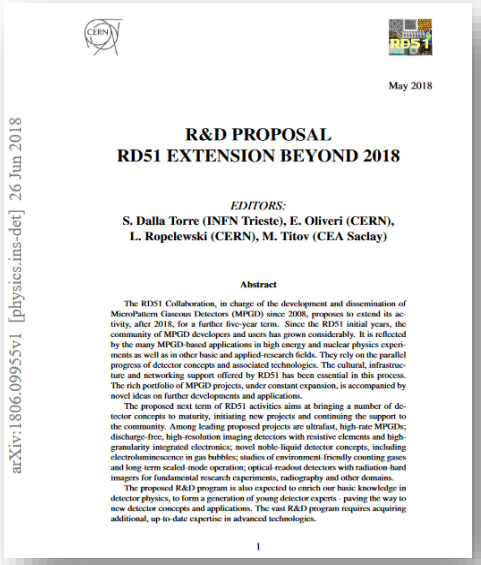
Software & simulation tools for detector physics

Diversified Resources
- CERN
- Collaborating institutions and projects contributions
- Industry
- EU projects
- Project synergies

Generic R&D
- Moving performance to the limits
- Developing new concepts and applications
- Support grants to explore innovative ideas

Project Oriented R&D
- R&D support to the projects and experiments
- Access to the R&D environment

Interdisciplinary CERN wide Instrumentation R&D
- Access to CERN and external facilities :
- MPT
- Thin Film Deposition
- Mechanics, designer office, 3D printing
- Metrology
- Nano Lab (EPFL)
- Industry (strategic partnership) and TT
- …



arXiv:1806.09955v1 [physics.ins-det] 26 Jun 2018

May 2018

R&D PROPOSAL
RD51 EXTENSION BEYOND 2018

EDITORS:
S. Dalla Torre (INFN Trieste), E. Oliveri (CERN), L. Ropelewski (CERN), M. Titov (CEA Saclay)

Abstract

The RD51 Collaboration, in charge of the development and dissemination of MicroPattern Gaseous Detectors (MPGD) since 2008, proposes to extend its activity, after 2018, for a further five-year term. Since the RD51 initial years, the community of MPGD developers and users has grown considerably. It is reflected by the many MPGD-based applications in high energy and nuclear physics experiments as well as in other basic and applied-research fields. They rely on the parallel progress of detector concepts and associated technologies. The cultural, infrastructure and networking support offered by RD51 has been essential in this process. The rich portfolio of MPGD projects, under constant expansion, is accompanied by novel ideas on further developments and applications.

The proposed next term of RD51 activities aims at bringing a number of detector concepts to maturity, initiating new projects and continuing the support to the community. Among leading proposed projects are ultrafast, high-rate MPGDs; discharge-free, high-resolution imaging detectors with resistive elements and high-granularity integrated electronics; novel noble-liquid detector concepts, including electroluminescence in gas bubbles; studies of environment-friendly counting gases and long-term sealed-mode operation; optical-readout detectors with radiation-hard imagers for fundamental research experiments, radiography and other domains.

The proposed R&D program is also expected to enrich our basic knowledge in detector physics, to form a generation of young detector experts - paving the way to new detector concepts and applications. The vast R&D program requires acquiring additional, up to date expertise in advanced technologies.

1

https://arxiv.org/pdf/1806.09955.pdf

CERN/LHCC-2018-018
LHCC-134
May 2018

LARGE HADRON COLLIDER COMMITTEE

of the one-hundredth-and-thirty-fourth meeting held on

Wednesday and Thursday, 30-31 May 2018

pment of Micro-Pattern Gas Detectors Technologies

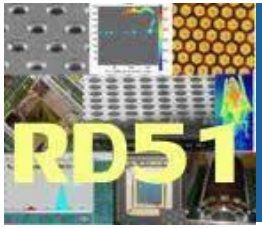
an established collaboration with the aim to develop Micro-Pattern Gas r (MPGD) technologies, to support experiments using this technology, and minate the technology within particle physics and in other fields. The ation is well organised into seven working groups covering activities from ector structures and electronics, to modelling, test facility management ustrialisation.

laboration has achieved major progress in MPGD technologies, some of which have already been picked up by experiments: ALICE TPC readout, ATLAS NSW, CMS GE1/1 forward detectors, Compass RHICH detector. The committee congratulated the collaboration for its progress since the last review session.

- A prolongation request for 5 years has been submitted to the present session of the LHCC. Apart from the support of the ongoing projects, the proposal included plans to explore new materials and technologies to achieve ever better resolution in space and time and open the door to new use cases both in HEP and elsewhere.

- The **LHCC recommends** granting RD51 the 5-year extension requested, including CERN support at the level currently provided. Progress will be reviewed every year by the LHCC. The **LHCC considers** the working mode of RD51, with a small but focussed core team and corresponding infrastructure at CERN, attracting contributions and bright ideas to be explored from collaborators around the world, to be an excellent setup. The **LHCC notes** that the CERN contribution to RD51 as listed in the proposal is crucial for the collaboration, and **strongly encourages** CERN to maintain its support of RD51.

https://cds.cern.ch/record/2621145/files/LHCC-134.pdf



RD51 Collaboration Meeting

Jun 13, 2022, 9:00 AM → Jun 17, 2022, 5:00 PM Europe/Zurich

160/1-009 (CERN)

Leszek Ropelewski (CERN), Silvia Dalla Torre (Universita e INFN Trieste (IT))

Internal discussion ongoing concerning the future of the collaboration

9:20 AM → 12:45 PM **RD51 Future**

Previous meeting w...

9:20 AM	ECFA detector R&D roadmap	Speaker: Silvia Dalla Torre (Universita e INFN Trieste (IT))
9:50 AM	Snowmass process	Speaker: Maxim TITOV (CEA Saclay)
10:10 AM	CERN EP detector R&D programme	Speaker: Eraldo Oliveri (CERN)
10:30 AM	INFN (Italy) - detector R&D	Speaker: Anna Colaleo (Universita e INFN, Bari (IT))
10:50 AM	Coffee break	
11:10 AM	Saclay (France) - detector R&D	Speaker: Paul Colas (Université Paris-Saclay (FR))
11:30 AM	US - detector R&D	Speaker: Andrew White (University of Texas at Arlington (US))
11:40 AM	China - detector R&D	Speaker: Jianbei Liu (University of Science and Technology of China (CN))
11:50 AM	Japan - detector R&D	Speaker: Atsuhiko Ochi (Kobe University (JP))
12:00 PM	India - detector R&D	Speaker: Supratik Mukhopadhyay (Saha Institute of Nuclear Physics (IN))
12:10 PM	Germany - detector R&D	

2:00 PM → 6:00 PM **RD51 Future**

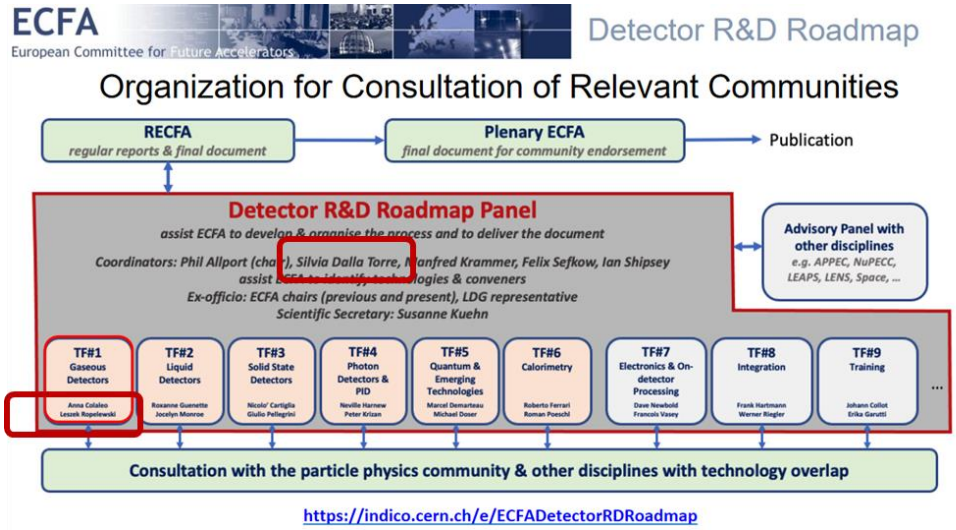
Previous meeting w...

2:00 PM	Impact of the ECFA detector R&D roadmap on RD51	Speaker: Leszek Ropelewski (CERN)
2:20 PM	WG1 - New structures and technologies	Speakers: Filippo Resnati (CERN), Paul Colas (Université Paris-Saclay (FR))
2:40 PM	WG2 - Detector physics and performance	Speakers: Florian Maximilian Brunbauer (CERN), Francisco Ignacio Garcia Fuentes (Helsinki Institute of Physics (FI))
3:00 PM	New working groups	
3:10 PM	WG4 - Modelling of physics processes and software tools	Speakers: Ozkan Sahin (Uludag University (TR)), Piet Verwilligen (Universita e INFN, Bari (IT)), Rob Veenhof (Uludag University (TR))
3:30 PM	Coffee break	
3:50 PM	WG5 - Electronics for MPGDs	Speakers: Hans Muller (University of Bonn (DE)), Jochen Kaminski (University of Bonn (DE))
4:10 PM	WG6 - Production and Industrialisation	Speakers: Fabien Jeanneau (Université Paris-Saclay (FR)), Rui De Oliveira (CERN)
4:30 PM	WG7 - Common test facilities	Speakers: Eraldo Oliveri (CERN), Yorgos Tsipolitis (National Technical Univ. of Athens (GR))
4:50 PM	Round table	

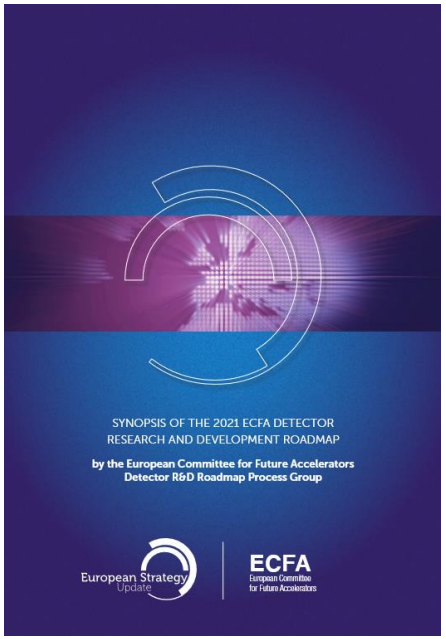
(Today's Agenda of the RD51 collaboration meeting @ CERN, https://indico.cern.ch/event/1138814)

ECFA Detector R&D Roadmap

Direct involvement of RD51 management (spokespersons) on Panel and Gaseous Detector Task Force



ECFA Detector R&D Roadmap & Synopsis



https://cds.cern.ch/record/2784893

Contribution from community in roadmap symposium

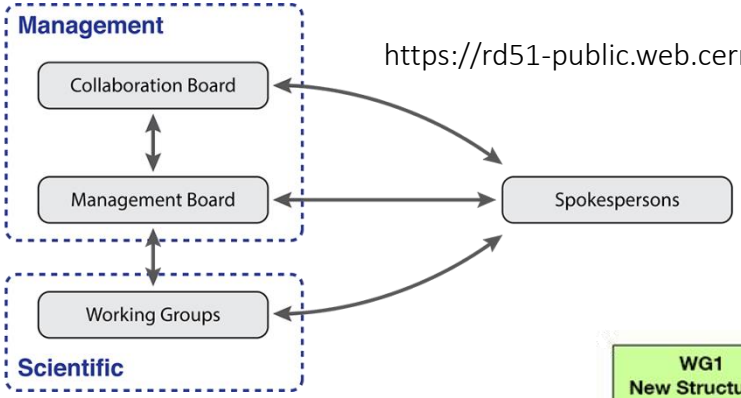
https://indico.cern.ch/event/999799/

Implementation and impact on RD51 under discussion

RD51 R&D Framework

- Scientific Structure: working groups
- Scientific Cultural Reference, Knowledge Transfer and Dissemination
- Common Tools
- Common Facilities and Infrastructures
- Common Projects

Scientific Structure



https://rd51-public.web.cern.ch/organisation-management

RD51 – Micropattern Gas Detectors

	WG1 New Structures and Technologies	WG2 Detector Physics and Performance	WG3 Training and Dissemination	WG4 Modelling of Physics Processes & Software Tools	WG5 Electronics for MPGDs	WG6 Production and Industrialisation	WG7 Common Test Facilities
Objectives	Design optimization Development of new geometries and techniques	Common test standards Characterization and understanding of physical phenomena in MPGD	Organisation of dissimination and training events for the MPGD community	Development of common software and documentation for MPGD simulations	Readout electronics optimization and integration with MPGD detectors	Development of cost-effective technologies and industrialization	Sharing of common infrastructure for detector characterization
Tasks	Large Area MPGDs	Common Test Standards	Topical Workshops	Algorithms	FE electronics requirements definition	Common Production Facility	Testbeam Facility
	Design Optimization New Geometries Fabrication	Discharge Protection	Schools (Eletronics, Simulation, ...)	Simulation Improvements	General Purpose Pixel Chip		
	Development of Rad-Hard Detectors	Ageing & Radiation Hardness	Academy-Industry Matching Events	Common Platform (Root, Geant4)	Large Area Systems with Pixel Readout	Industrialization	Irradiation Facility
	Development of Portable Detectors	Charging up and Rate Capability	Dissimination of MPGD applications	Electronics Modeling	Portable Multi-Channel System		
		Study of Avalanche Statistics			Discharge Protection Strategies	Collaboration with Industrial Partners	

Scientific Cultural Reference, Knowledge Transfer and Dissemination

Regular (3/y) meeting and Topical Workshops…

Workshops

- Workshop on Wide Dynamic Range Operation of MPGDs, CERN/remote (18 November 2021)
- Workshop on Front End Electronics for Gas Detectors, remote-only (15-17 June 2021)
- Mini-Workshop on gas transport parameters for present and future generation of experiments
- Workshop on Gaseous Detector Contributions to PID, remote-only, (16-17 February 2021)
- Workshop on DLC, CERN (12-13 February 2020)
- MPGD Stability workshop, Munich, Germany (18-22 June 2018)
- MPGD Applications Beyond Fundamental Science, Aveiro, Portugal (15-16 September 2016)

Topical Workshop: **New Horizons in Time Projection Chambers** (October 2020)

Organising committee

The meeting is organized by:
D. González-Díaz (NEXT/DUNE), chair
J. Benlliure (FAIR/LaserPET)
D. Cortina (FAIR)
A. Gallas (LHCb)
J. A. Garzón Heydt (HADES)
A. Saa-Hernández (NEXT/DUNE)
M. Seco (technical support)

Remote

not only RD51

not only MPGD

A topical workshop on "New Horizons in Time Projection Chambers" will take place in parallel to the RD51 Collaboration Meeting, from Monday to Friday

The purpose of this workshop is to discuss upcoming developments and applications of TPCs, in relation with the current state of the art of this technological field. By bringing together specialists from the fields of direct Dark Matter detection and other Rare Event searches, Neutrino physics, Nuclear and Particle physics, and applied research, we are certain to bring a vibrant and inspiring atmosphere to the meeting.

https://indico.cern.ch/event/889369

Charge-based
Scintillation-based
Electroluminescent
Active Targets
Next-generation accelerator-based

High pressure
Low pressure
Dual Phase

Charge amplification
Charge-sharing
Resistive-protection techniques
Optical amplification and photodetectors
Ion detection
FE Electronics

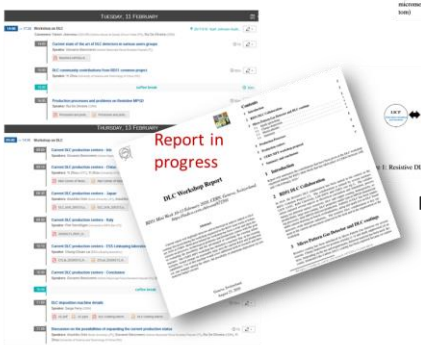
Overview on electron transport
Overview on scintillation
Overview on ion transport
Ion backflow mitigation
Space-charge distortions

Dosimetry
Medical applications

New ideas
Unusual geometries

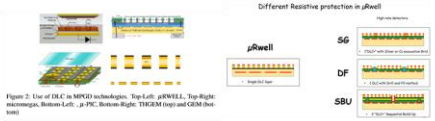
DLC workshop (Feb. 2020)

-> Discussion about the possibility of enlarging existing production capabilities with a DLC coater at CERN



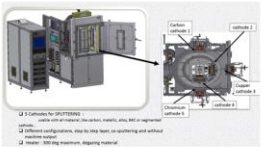
https://indico.cern.ch/event/872501

MPGD Technologies and Processes



Existing Research & Production Framework

Proposal for a machine at the CERN MPT workshop



Lectures…

RD51 Open Lectures and Mini Week

Dec 11 – 15, 2017
CERN
Europe/Zurich timezone

https://indico.cern.ch/event/676702/timetable/

Enter your search term

Lectures I , **Werner Riegler (CERN)**
Signals in Micro Pattern Gaseous Detectors, including resistive elements
Signal processing for precision timing applications

Lectures II, **Rob Veenhof (Uludag University)**
Electron transport, mean gain
Avalanche fluctuations
Ion transport

Lectures III , **Filippo Resnati (CERN)**
Computer modelling of gaseous detectors response - Part I
Computer modelling of gaseous detectors response - Part II

Lectures IV , **Spyros Tzamarias (Aristotle University of Thessaloniki)**
Paradigms of analysing MPGD data - Part I
Paradigms of analysing MPGD data - Part II

Purpose of the lectures is to discuss new developments on the methods and tools used to describe the signal generating processes as well as techniques of analysing data of gaseous detectors. The lectures are geared towards people who are doing, or intend to do, research and developments on gas-based detectors but are also open to anyone interested on the subject.

Schools…

GEM & Micromegas detector design & assembly training: Lecture Session

Monday Feb 16, 2009, 8:00 AM → 8:00 PM Europe/Zurich

513/1-024 (CERN)

RD51 Electronics school

Feb 3, 2014, 8:00 AM → Feb 5, 2014, 6:00 PM Europe/Zurich

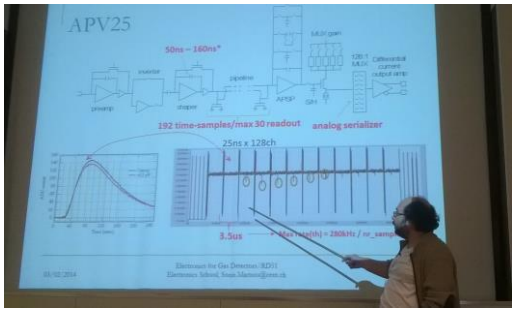
30/7-018 - Kjell Johnsen Auditorium (CERN)

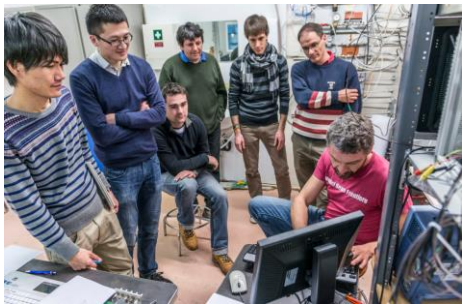
Hans Muller (CERN), Leszek Ropelewski (CERN), Maksym Titov (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR)),

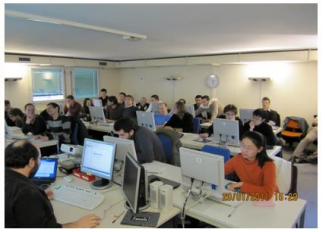
Maksym Titov (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR)), Maxim TITOV (CEA Saclay),

Serge Duarte Pinto (Technische Universiteit Delft (NL))

Description The RD51 Electronics School will take place at CERN on February 3-5, 2014. The total number of participants is limited to ~ 30. Because of the very large interest we have to limit the number of participants to one person per institute. If you are interested to apply, please contact Hans Muller (hans.muller@cern.ch), Leszek Ropelewski (leszek.ropelewski@cern.ch) and Maxim Titov (maxim.titov@cea.fr) and ask your supervisor to send a formal letter





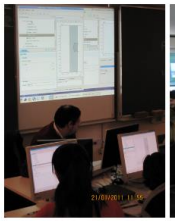


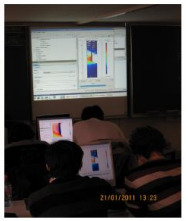
RD51 Simulation School

Jan 19 – 21, 2011

CERN

Europe/Zurich timezone





https://rd51-public.web.cern.ch/index.php/meetings-workshops

Conferences…

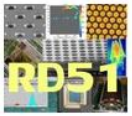
- **MPGD2022** - 7th International Conference on Micro Pattern Gaseous Detectors (Rehovot, Israel)
- **MPGD2019** - 6th International Conference on Micro Pattern Gaseous Detectors (La Rochelle, France)
- **MPGD2017** - 5th International Conference on Micro Pattern Gaseous Detectors (Philadelphia, USA)
- **MPGD2015** - 4th International Conference on Micro Pattern Gaseous Detectors (Trieste, Italy)
- **MPGD2013** - 3rd International Conference on Micro Pattern Gaseous Detectors (Zaragoza, Spain)
- **MPGD2011** - 2nd International Conference on Micro Pattern Gaseous Detectors (Kobe, Japan)
- **MPGD2009** - 1st International Conference on Micro Pattern Gaseous Detectors (Kolympari, Crete)

https://www.weizmann.ac.il/conferences/MPGD2022/

Academia-Industry Matching Events…

Academia-Industry Matching Event
Special Workshop on Neutron Detection with MPGDs

Neutron Detection 1st



Prospects in MPGDs development for neutron detection

Bruno Guerard (ILL), Richard Hall-Wilton (ESS), Fabrizio Murtas (INFN & CERN)

Summary based on presentations during RD51
Academia Industry Matching Event, CERN October 14-15, 2013
RD51-NOTE-2014-003

Introduction

The market of neutron detectors has increased significantly during the last decade in two domains: instrumentation for Neutron Scattering Science, and prevention against nuclear terrorism. Before the emerging of the so-called "^{3}He shortage crisis" , detection systems used in portal monitors to detect fissile elements were based mainly on ^{3}He proportional counters, whereas linear ^{3}He PSDs (Position Sensitive Detectors), ^{3}He MWPCs, and ^{6}Li scintillators were the most current techniques for scientific applications. Two large-scale neutron facilities, SNS in the US and J-PARC in Japan, have recently started their operation, and the future ESS (European Spallation Source) will produce first neutrons in 2019-2020. Detectors with better performance are urgently needed to take full benefit of the high intensity neutron beams produced by these sources. An additional constraint comes from the fact that the volume of ^{3}He available is by far insufficient to cope with the demand for large area detectors, and the cost of this gas has increased considerably.

Compared to Multi Wires Proportional Chambers (MWPC), Micro-Pattern Gas Detectors (MPGD) used in HEP to detect MIPs offer better spatial resolution, counting rate capability, and radiation hardness; their fabrication is also more reproducible. Provided similar advantages are applicable to detect neutrons, MPGDs might contribute significantly to the development of neutron scientific instrumentation. In order to evaluate the prospects of neutron MPGDs, it is worth knowing the applications which would benefit from a gain in performance, and if they offer a competitive alternative to conventional ^{3}He detectors. These questions have been at the focus of the workshop "Neutron Detection with Micro-Pattern Gaseous Detectors" organized by RD51 in collaboration with HEPTech, which took place at CERN on October 14-15, 2013. The goal of this workshop was to help disseminating MPGD technologies beyond High Energy Physics, and to give the possibility to academic institutions, potential users and industry to meet together. 26 speakers gave presentations on the following topics:

https://indico.cern.ch/event/265187/

Academia-Industry Matching Event
Second Special Workshop on Neutron Detection with MPGDs

Neutron Detection 2nd

Dear Colleagues,

In continuity with the first Accademia-Industry Matching event dedicated to neutron MPGDs (Micro-Pattern Gas Detectors), organized the 14-15 October 2013 at CERN, the RD51 collaboration will organise the
Second Accademia-Industry Matching event dedicated to neutron MPGDs
Date: 16-17 march 2015
Location : CERN
Additional information is available on this page: https://indico.cern.ch/event/365840/page/0
This event provides a platform for discussing prospects of the MPGDs use for the thermal and fast neutron detection, commercial requirements and possible solutions. It aims to foster collaboration between the particle physics community and the users and fabricants of neutron detectors, and to discuss the potential of the MPGD technologies for the field.
The topics to be covered are :
- Academic and Industrial Applications
- GEM, Micromegas and other MPGD neutron
- Neutron Converters
- Simulations and Performance
- Electronics

The Neutron Scattering Community was well
will be also the case for the second one. We b
the HEP community in order to broaden the
strongly encourage you to participate, to pres
part to the discussion during the round table
presentation does not necessarily have to be
challenges (for example, ^{3}He alternative, hig
Short presentation (5-10 min) are foreseen fo
are we with the ^{3}He shortage ?", "future detec
We would appreciate if you would like to pro
Please send us your abstract, 10-20 lines max
present some results or a subject to be discus
The detailed program will be available at the
You can see the presentations of the first wo
and a summary is available here: http://ar

Starts 16 Mar 2015 10:00
Ends 17 Mar 2015 19:05
Europe/Zurich

HEPTech

PRESS RELEASE

Research in Micro-Pattern Gaseous Detector-Related Technologies and Applications Attracts Larger and Smaller Industrial Players

The RD51 collaboration event dedicated to neutron detection with MPGDs (Micro-Pattern Gas Detectors), held at CERN on March 16th -17th, 2015, brought together prominent representatives of the particle physics community as well as already established and relatively young industrial players in the field of neutron detectors.

The aim of the event was to help disseminating MPGD technologies beyond fundamental physics, where academic institutions, potential users and industry could meet together.

The shortage of Helium-3 in the world brings new challenges to neutron detection, especially in the areas of homeland security, non-proliferation, neutron scattering science and other fields. Micro-Pattern Gas Detectors offer attractive alternative solutions for neutron detection, complementing Helium-3 based proportional counters. The event provided a platform for discussion of the prospects of the MPGD use for thermal and fast neutron detection, commercial requirements and possible solutions.

It was organised jointly by HEPTech and RD51 Collaboration at CERN as a follow-up of a similar event that took place in October, 2013. "Our cooperation with HEPTech has already a long history", says Dr. Maxim Titov from CEA Saclay/Irfu, co-spokesperson of the RD51 Collaboration, together with Leszek Ropelewski from CERN.

RD51 is a technology based collaboration which addresses the technological development of Micro-pattern gas detectors. MPGDs are not only used in LHC experiments but also in numerous applications outside the high energy physics. The RD51 was created in 2008 and in 2013 it was approved for another 5-year term. The organization of such academia-industry matching events (AIMEs), disseminating MPGD applications beyond fundamental physics, was one of the major new activities when the continuation of the RD51 programme was discussed. "As a key point of being a technological collaboration, for us it was very important somehow to link our collaboration to potential users and industrial companies that might be

1

https://indico.cern.ch/event/365840/

RD51 Academia-Industry Matching Event
Special Workshop on Photon Detection with MPGDs

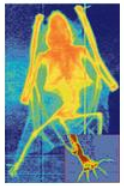
Photon Detection

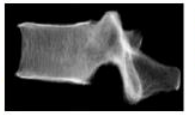
The specialized workshop "Photon Detection with Micro-Pattern Gaseous Detectors" organised by RD51 in collaboration with HEPTech, will take place at CERN on June 10-11, 2015.

The goal of the workshop is to help disseminating MPGD technologies beyond fundamental physics, where academic institutions, potential users and industry could meet together.

This workshop aims to foster collaboration between the particle physics community and the industry of photon detection, and to discuss the potential of the MPGD technologies for the field. This event is jointly organized by the RD51 collaboration, the HEPTech Network and CERN KT Group. It is open to all researchers and commercial partners interested or working in the field of photon detection.

Dates: 10th and 11th June 2015
Venue: The Council Chamber, CERN
Route de Meyrin 385, 1217 Meyrin





https://indico.cern.ch/event/392833/

Internal Notes…

https://espace.cern.ch/test-RD51/RD51 internal notes

RD51 Collaboration ▸ RD-51 internal notes ▸ All Documents

internal notes on R&D work of RD-51

Home | Help | Search this site...

Pictures
- RD51 Collaboration Pictures

Documents
- MB Meetings Minutes
- RD51 Documents
- New Institutes Survey
- Proposal skeleton
- Old Documents Library
- LHCC
- RD51 Beam Schedule
- RD-51 internal notes
- CB meeting minutes

Discussions
- Conveners Discussion
- WG1: Technological Aspects and Development of New detector Structures
- WG2: Common Characterization and Physics Issues
- WG3: Applications
- WG4: Simulations and Software Tools

Type	Name	Modified	Modified By	No
	1_RD51-NOTE-SUMMARY-13052022	14/05/2022 04:05 AM	Maksym Titov	1_RD51-NOTE-SUMMARY
	RD51-NOTE-2022-004	14/05/2022 04:00 AM	Maksym Titov	RD51-NOTE-2022-004
	RD51-NOTE-2022-003			
	RD51-NOTE-2022-002			
	RD51-NOTE-2022-001			
	RD51-NOTE-2021-005			
	RD51-NOTE-2021-004			
	RD51-NOTE-2021-003			
	RD51-NOTE-2021-002			
	RD51-NOTE-2021-001			
	RD51-NOTE-2020-006			
	RD51-NOTE-2020-005			
	RD51-NOTE-2020-004			
	RD51-NOTE-2020-003			
	RD51-NOTE-2020-002			
	RD51-NOTE-2020-001			
	RD51-NOTE-2019-006			
	RD51-NOTE-2019-005			
	RD51-NOTE-2019-004			
	RD51-NOTE-2019-001			

RD51 INTERNAL NOTES

YEAR 2022

RD51-NOTE-2022-004 – "Novel electron and photon recording concepts in noble-liquid detectors" (by A. Breskin)

RD51-NOTE-2022-003 – "REST-for-Physics, a ROOT-based framework for event oriented dataanalysis and combined Monte Carlo response" (by K. Altenmüller, S. Cebrián, T. Dafni, D. Díez-Ibáñez, J. Galán, J. Galindo, J. Antonio García, I. Irastorza, G. Luzón, C. Margalejo, H. Mirallas, L. Obis, O. Pérez, K. Han, K. Ni, Y. Bedfer, B. Biasuzzi, E. Ferrer-Ribas, D. Neyret, T. Papaevangelou, C. Cogollos, E. Picatoste)

RD51-NOTE-2022-002 – "Performance of Angle-of-Arrival Algorithms for an Inflight Triple-GEM Detector" (by M. Luntz, M. Hohlmann, D. Madden)

RD51-NOTE-2022-001 – "Resistive Micromegas high-rate and long-term ageing studies at the CERN Gamma Irradiation Facility" (by B. Alvarez Gonzalez, E. Farina, P. Iengo, L. Longo, J. Samarati, G. Sekhniaidze, O. Sidiropoulou, J. Wotschack)

YEAR 2021

RD51-NOTE-2021-005 – "Development of a Simulation Model and Precise Timing Techniques for PICOSEC-Micromegas Detectors" (by A. Kallitsopoulou, Master Thesis)

RD51-NOTE-2021-004 – "Micro-Pattern Gaseous Detectors in High-Energy and Astroparticle Physics" (by F. Sauli)

RD51-NOTE-2021-003 – "MBGEM: a stack of borated GEM detector for high efficiency thermal neutron detection" (by A. Muraro, G. Claps, G. Croci, C. C. Lai, R. De Oliveira, S. Altieri, S. Cancelli, G. Gorini, R. Hall-Wilton, C. Höglund, E. Perelli Cippo, L. Robinson, P. Svensson, F. Murtas)

RD51-NOTE-2021-002 – "RD51 DLC Workshop Report, RD51 Mini Week 10-13 February 2020" (by RD51 Resistive DLC collaboration, RD51 Management Board)

RD51-NOTE-2021-001 – "Medical Applications of the GEMPix" (by J. Leidner, F. Murtas, M. Silari)

YEAR 2020

RD51-NOTE-2020-006 – "Report on DLC Applications" (by A. Valentini)

RD51-NOTE-2020-005 – "Development of Micromegas detectors with resistive pads" (M. Chefdeville, C. Drancourt, N. Geffroy, T. Geralis, A. Kalamaris, Y. Karyotakis, D. Nikas, F. Peltier, A. Psallidas, M. Titov, G. Vouters)

RD51-NOTE-2022-004

Novel electron and photon recording concepts in noble-liquid detectors

A. Breskin

Dept. of Astrophysics and Particle Physics
Weizmann Institute of Science
Rehovot, Israel

E-mail: amos.breskin@weizmann.ac.il

ABSTRACT:

We present several novel ionization-electron and scintillation-photon recording concepts in noble-liquid detectors, for future applications in particle and astroparticle physics and in other fields. These involve both single- and dual-phase detector configurations with combined electroluminescence and small charge multiplication in gas and liquid media.

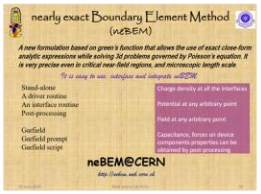
KEYWORDS: Noble liquid detectors (scintillation, ionization, double-phase); Dark Matter detectors (WIMPs, axions, etc.); Neutrino detectors; Micropattern gaseous detectors (MSGC, GEM, THGEM, RETHGEM, MHSP, MICROPIC, MICROMEGAS, InGrid, etc.);

Common Tools (Modelling/Simulation and Electronics)

Modelling and simulation

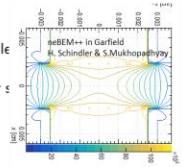
neBEM interface available in Garfield++

http://nebem.web.cern.ch/nebem /



https://indico.cern.ch/event/911950/contributions/3898133/attachments/2062186/3459881/BEMlectureRD51_Supratik.pdf

-----Original Message-----
From: Heinrich Schindler <Heinrich.Schindle
Sent: Friday, July 17, 2020 3:27 PM
To: garfield-users (Users of Garfield detector s
<garfield-users@cern.ch>
Cc: supratikmukhopadhyay.sinp@gmail.com
Subject: **Garfield++/neBEM interface**



Dear colleagues,
we are happy to announce that a working version of the neBEM interface is now available in the master branch of Garfield++, including a number of examples illustrating its use:
https://gitlab.cern.ch/garfield/garfieldpp/-/tree/master/Examples/neBEM
http://garfieldpp.web.cern.ch/garfieldpp/examples/nebem/

Please note that we had to add GSL (https://www.gnu.org/software/gsl/) as an additional prerequisite to build the project.
We hope that you will find the tool useful for your applications and are looking forward to your feedback.
There is still some room for improvement (in particular in terms of performance optimisation); if you have any suggestions please do let us know.
Best regards,
Supratik, Rob, Heinrich

Garfield++ and delayed weighting fields in the calulcation of the induced signal

Implementing delayed weighting fields in GARFIELD++

NB.. RD50, not RD51...
IMPACT on several communities, not only MPGD

J. Hasenbichler, W. Riegler, H. Schindler, A. Wang

RD50 Workshop, 13 June 2019

R&D framework and tools cross technologies and can boost synergies

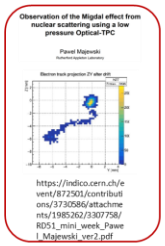
Summary and outlook

- GARFIELD++ is a toolkit that can be used for the detailed simulation of silicon sensors.
- We have implemented the calculation of induced signals in resistive geometries based on the delayed weighting field formalism.
- Some optimisation in terms of speed and accuracy remains to be done.
- As a next step, apply the method to realistic devices.

New EP-RD PHD students working on this field of research with the goal of testing realistic devices and clustering groups of our community

Garfield++ & modelling the photon production

https://indico.cern.ch/event/911950/contributions/3879503/attachments/2062895/3461258/pinci_CYGNO_RD51.pdf



https://indico.cern.ch/event/872501/contributions/3730586/attachments/1985262/3307758/RD51_mini_week_Pawel_Majewski_ver2.pdf

https://indico.cern.ch/event/716539/contributions/3245957/attachments/1798495/29353/80/OpticalReadout_Brunbauer.pdf

Several research lines (2019) interested in MPGD readout optically..

Large interest in the photon production processes..

Previous studies (2010) implemented and available in our modelling framework

http://garfieldpp.web.cern.ch/garfieldpp/examples/electroluminescence/

Collaboration grants collaborative developments and sharing of "common tools" developed by individual groups but made available for everyone, even after several years...

Modelling Ions

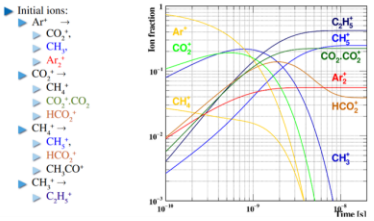
Simulating ion motion

- Lines found in most Garfield++ avalanche programs:

```
// Load the ion mobilities.
gas->LoadIonMobility("/afs/cern.ch/user/r/rjd/GemGain/Charge/mob_Ar_Ar+");
```

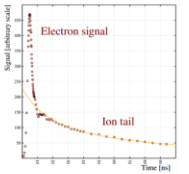
- What do they do ?
- Why are they often inappropriate ?
- Detectors like Micromegas and wire chambers get their signal mostly from ion motion.
- Hence we better know the basics of ions:
  - *which ions* are produced in the avalache ?
  - *which ions* generate the signal ?
  - *how fast* do the ions move ?
  - are they subject to *diffusion* ?

Evolution in Ar-CO_2-CH_4 (90-7-3)



Atlas TRT signals

- Data:
  - Xe-CO_2-CF_4 70/10/20
  - Straw tube
  - V_w=1530 V
  - r_w = 15 µm, r_t = 2 mm
- Fit:
  - $1/(t+t_0)$



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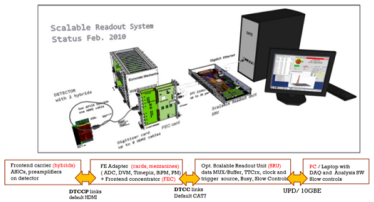
[Data from Романюк Анатолий Самсонович]

Electronics for MPGDs

Here focused on Scalable Readout System (SRS) & BNL VMM3a but wider…



- Interface of the RD51 SRS with the BNL VMM3a FE ASIC
  - Overview
  - Production and procurement
  - Laboratory and beam measurements
  - RD51 Sub-working group WG5.1 focused on SRS/VMM

H. Muller
https://indico.cern.ch/event/843711/contributions/3613180/attachments/1931440/3199037/New_SRS_Hardware_.pdf

Logically following the large (more than expected) success of the RD51 SRS/APV25 developments where the system has been used for:

- generic R&D (several lab. and beam campaign, not only RD51 test beam),
- medium and large scale experiments (e.g. PRAD@JLAB),
- LHC upgrades (e.g. R&D for ATLAS mm NSW, QA for CMS GEM)

Hardware available soon for the community

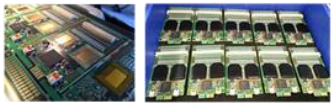
Production

Successful pre-production using CERN facilities

Firs fully commercial production done via SRS-Technology spin-off.

New and large production ongoing.

Large involvement in design, pilot production and debugging from SRS Technology



First large production totally outside CERN

Passive cooling and DVMM card

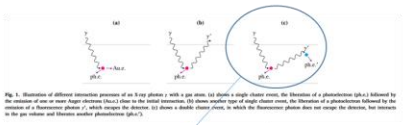
https://www.srstechnology.ch/

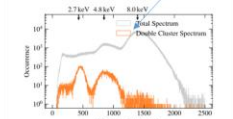
- CERN support needed for proper integration in CERN store (as we had for SRS/APV25)
- Procurement for groups not at CERN or without team account via SRS Technology

Laboratory tests

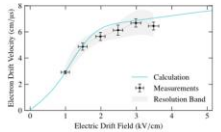
Past year results using proto-systems:
Laboratory (x-ray) Measurements

Fluorescence Processes

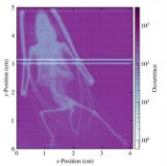




Drift velocities measurement

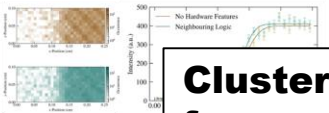


Imaging (high rate)



Sauli's bat

Space resolution



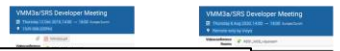
L. Scharenberg et al.: *Resolving soft X-ray absorption in energy, space and time in gaseous detectors using the VMM3a ASIC and the SRS*, Nucl. Instrum. Methods Phys. Res. A **977** (2020) 164310.
https://doi.org/10.1016/j.nima.2020.164310

https://indico.inp.nsk.su/event/2[illegible]
553/638/instr20-lucian-scharenb[illegible]

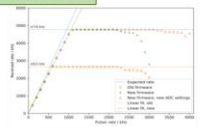
Scalable Readout System (SRS) and VMM3a (BNL) ASIC
WG5.1 sub-working group

Synchronise activities and developments related to RD51's Scalable Readout System and its integration of the VMM3a ASIC
Group people and institutes who are interested in next-generation readout electronics for MPGDs and exchange on developments and research interests:

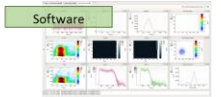
- Common developments on firmware, software and hardware (improvement of existing SRS hardware, development of auxiliary devices and components)
- Provide the developments from the community to the community!
- Coordination of hardware production and testing with CERN KT Spin-Off: SRS Technology



Firmware



Software



Testing SW/HW, procedures

Clustering RD51 member for common developments

Common Facilities (laboratory and testbeam) and infrastructures (MPT workshop)

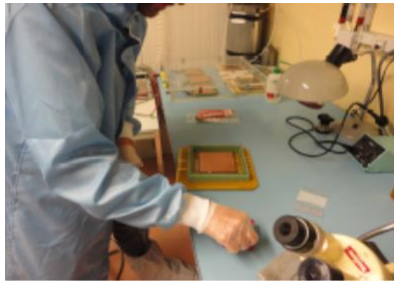
CERN 154/R-007 GDD Laboratory



EP-DT-DD Gas Detector Development (GDD) lab

Common facility at CERN for the collaboration to perform detector R&D (design, mounting, testing and measuring). Technical (detector, electronics, instrumentation,..) and scientific (meetings, links, collaboration,..) support. Support during the RD51 test beam campaign. Access to technical CERN facilities. Close to Micro Pattern Technology Workshop and Thin Film and Glass laboratory. Vital and important support from CERN (EP-DT) on maintenance and operation.

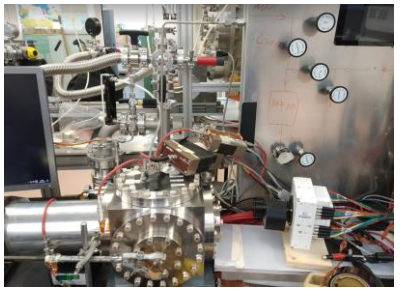
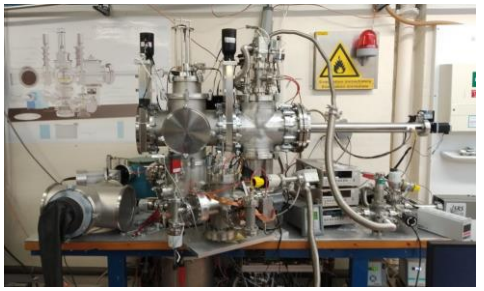
- Expertize and links
- Equipment
- Close to MPT workshop
- Close to North Area Test beam



Clean Room

Irradiation

Charge and Optical readout

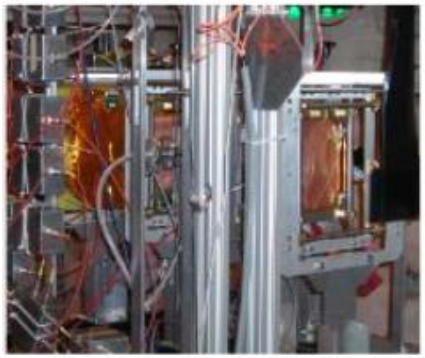



UV photocathode characterization

Test Beam @ CERN (SPS, North Area Extr. Lines)

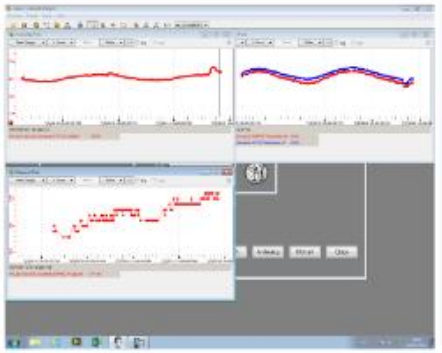
About three periods of two weeks each per year with more than 10 setup running in total. Since few years beam time shared with GIF++

RD51 Trackers and SRS/APV25 DAQ



RD51 DCS (Control and monitoring)

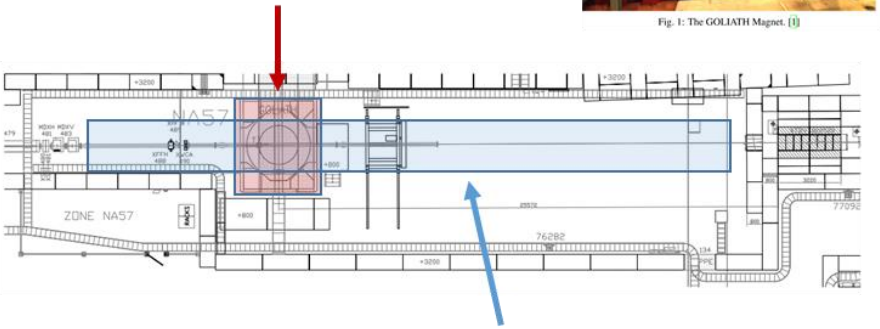
Environmnelal plots during Test Beam



GOLIATH magnet (1.5T, about 3Tm, Opening: about 1m height and 2.4m wide)

https://cds.cern.ch/record/2310483/files/CERN-ACC-NOTE-2018-0028.pdf

Fig. 1: The GOLIATH Magnet. [1]



SPACE to allows the operation of several setup in parallel

SERVICES (gas, power, signals, supports) organized in several years of works done together with the North Area teams.

Test Beam Coordinators: Y. Tsipolitis, E. Oliveri

CERN MPT Workshop

(I) R&D

Secured future of the MPGD technologies development

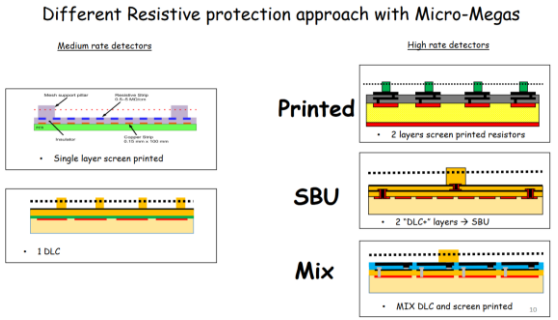
https://indico.cern.ch/event/791893/

- UV exposure up to 2.2m x 1.4m
- Resist developers, stripper, etcher, dryer up to 1.2m width
- GEM electro etch up to 2m
- GEM polyimide etch up to 2m
- Ovens up to 2.2m x 1.4m
- Laminator up to 1.2m

→ GEM up to about (2x0.5)m^2, mm up to (2x1)m^2

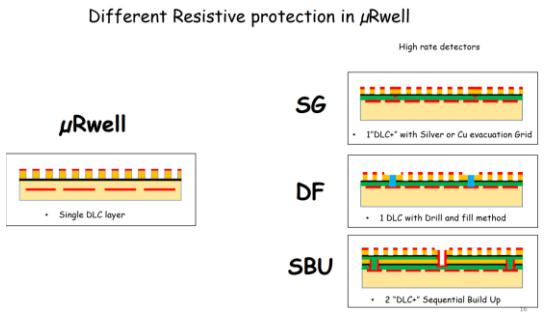
Almost all families of MPGD produced…
GEM, THGEM, MM-THGEM,
Micromegas, mRWELL, RPWELL, DLC with MPGDs, …

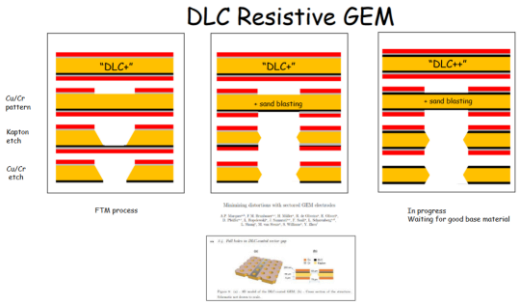
Several ongoing R&D lines (here resistive layers and detectors based on DLC as one example)

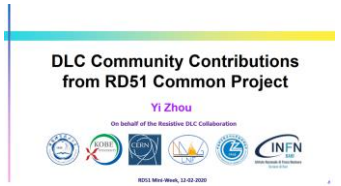


https://indico.cern.ch/event/872501/contributions/3723342/attachments/1986258/3309780/Processes_and_problems.pdf

In synergy with:







https://indico.cern.ch/event/872501/contributions/3723338/attachments/1985981/3509025/DLC%20community%20contributions%20from%20RD51%20common%20project-TV.pdf

CERN MPT Workshop

(II) Production


EP Newsletter of the EP department

A new home for GEM detectors at CERN

DT GEM detectors

Jun 19 2019

by Rui De Oliveira (CERN)

https://indico.cern.ch/event/791893/

GEM production for ALICE GEM TPC and CMS GE1/1


Fig. 3: GEM production team handling different type of GEMs

More than 1400 GEMs produced in the EP/DT/MPT

Production was spread over a period of 2 years and required the constant effort of a team of five people, up to seven at the peak of production.

The production yields of about 70% initially, reached 90% in average at the end of production, with peaks at 100% for some batches.

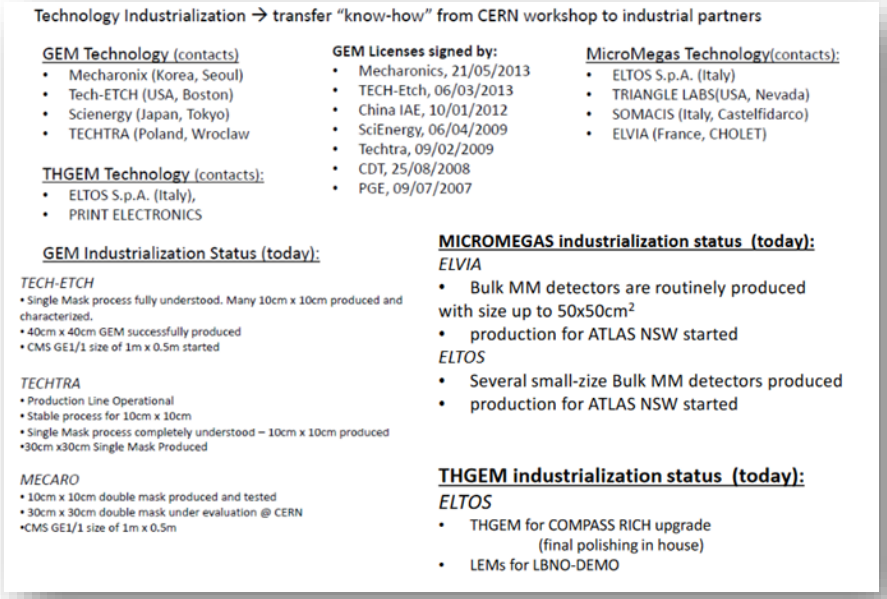
The deadlines fully respected.

Several experiments

COMPASS, LHC-B, KLOE, CBM @FAIR, BM @ N, Phoenix TPC, SBS tracker, T2K, Compass tracker, Compass RICH, ILC TPC prototypes, ILC Calorimeter prototypes, ATLAS NSW …

(III) Industrialization

- Crucial role of the MPT workshop.
- Quite stable (↑/↓) scenario
- Several companies involved in he past years. "Difficult" market.
- Long-lasting Effort


Technology Industrialization → transfer "know-how" from CERN workshop to industrial partners

GEM Technology (contacts)
- Mecharonix (Korea, Seoul)
- Tech-ETCH (USA, Boston)
- Scienergy (Japan, Tokyo)
- TECHTRA (Poland, Wroclaw

THGEM Technology (contacts):
- ELTOS S.p.A. (Italy),
- PRINT ELECTRONICS

GEM Licenses signed by:
- Mecharonics, 21/05/2013
- TECH-Etch, 06/03/2013
- China IAE, 10/01/2012
- SciEnergy, 06/04/2009
- Techtra, 09/02/2009
- CDT, 25/08/2008
- PGE, 09/07/2007

MicroMegas Technology(contacts):
- ELTOS S.p.A. (Italy)
- TRIANGLE LABS(USA, Nevada)
- SOMACIS (Italy, Castelfidarco)
- ELVIA (France, CHOLET)

GEM Industrialization Status (today):

TECH-ETCH
- Single Mask process fully understood. Many 10cm x 10cm produced and characterized.
- 40cm x 40cm GEM successfully produced
- CMS GE1/1 size of 1m x 0.5m started

TECHTRA
- Production Line Operational
- Stable process for 10cm x 10cm
- Single Mask process completely understood – 10cm x 10cm produced
- 30cm x30cm Single Mask Produced

MECARO
- 10cm x 10cm double mask produced and tested
- 30cm x 30cm double mask under evaluation @ CERN
- CMS GE1/1 size of 1m x 0.5m

MICROMEGAS industrialization status (today):

ELVIA
- Bulk MM detectors are routinely produced with size up to 50x50cm²
- production for ATLAS NSW started

ELTOS
- Several small-zize Bulk MM detectors produced
- production for ATLAS NSW started

THGEM industrialization status (today):

ELTOS
- THGEM for COMPASS RICH upgrade (final polishing in house)
- LEMs for LBNO-DEMO

Some lessons learned:
- Industrialization possible if large involvement from large project
- Important to involve the industrial partner from the beginning (see µRWELL with ELTOS, Techtra already in initial R&D phase)

Common Projects

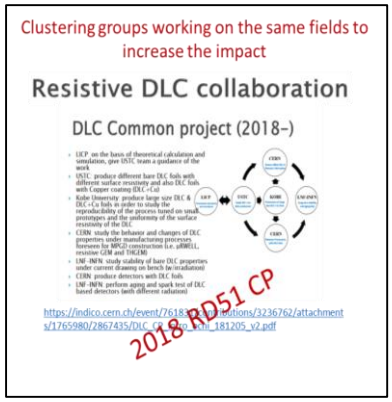
Common Projects

Supporting “Blue-Sky” projects and research lines that could have difficulties to be funded elsewhere (too generic or too risky or too..)

- Technology R&D projects towards developments of novel techniques, improvements of existing technologies, characterization methods and dedicated tools;
- Development and optimization of MPGDs for novel applications;
- Improvement of the MPGD technology transfer to industry.

As well a tool for:

- promoting collaboration between institutes
- promoting self-sustaining collaborations with large potential and impact



Comprehensive studies of the glass, ceramic- and kapton-THGEMs in high- and low-pressure TPCs
2021, P. Majewski
Development for Resistive MPGD Calorimeter with timing measurement
2021, P. Verwillligen
Optical readout studies for negative ion TPCs
2020, F. Brunbauer
Large area high-granularity segmented mesh microbulk for future rare event searches
2020, J. Galan
Discharge Consortium in quest for Spark-Less-Avalanche-Microstructures
2019, P. Gasik
Pixelated resistive bulk Micromegas with integrated electronics
2019, F. Petrucci
Resistive materials and resistive-MPGD concepts & technologies
2019, S. Bressler
Modular & General purpose Ultra Low Mass GEM Based Beam Monitors
2018, G. Croci
DLC based electrodes for future resistive MPGDs
2018, Y. Zhou
Study of negative ion mobility and ion diffusion for Negative Ion TPCs
2018, A. Cortez
Development of modular multilayer GEM units
2017, A. Milov
Sampling Calorimetry with Resistive Anode MPGDs (SCREAM)
2016, M. Chefdeville
New Scintillating gases and structures for next-generation scintillation-based gaseous detector
2016, D. Gonzalez Diaz

https://rd51-public.web.cern.ch/commonprojects

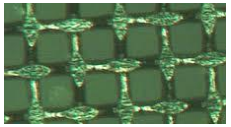
MPGD technologies and dissemination

The aim of the RD51 collaboration is to provide an appropriate framework to support and advance technological developments and applications of Micro Pattern Gas Detectors **(previous slides)**

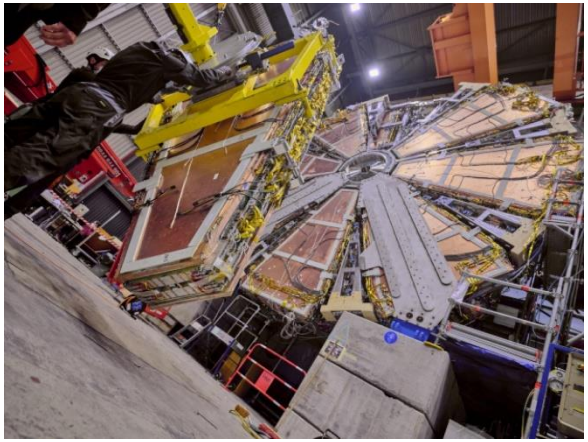
Each member of the collaboration preserve scientific freedom, its own identity and will perform its own research… Very diversified “portfolio” of R&D lines and applications….

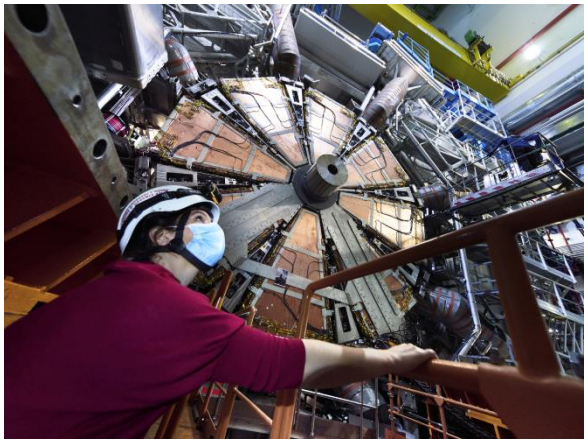
I have selected **(next slides)** a few examples (surely not a complete set.. I apologize) of “fresh” activities shown in HEP2022 and during the ongoing RD51 Collaboration Meeting, activities linked to R&D lines carried on by Institutes from Greece

MPGD for LHC LS2 Upgrades



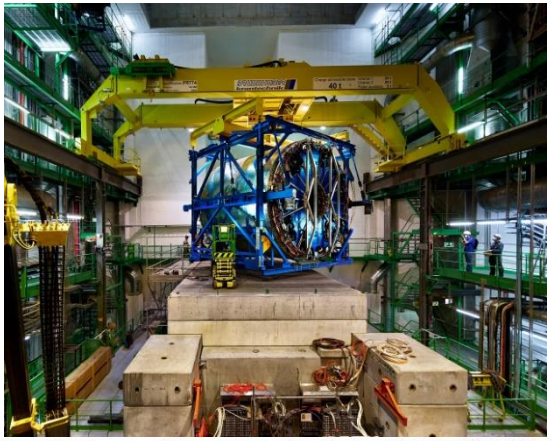
ATLAS NSW MicroMegas





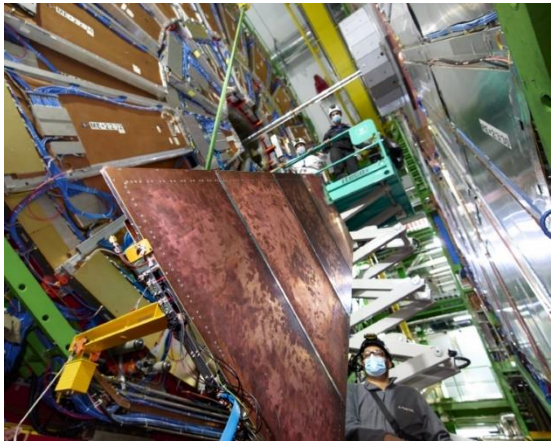
https://ep-news.web.cern.ch/content/atlas-new-small-wheel-upgrade-advances-0

ALICE GEM-TPC



https://ep-news.web.cern.ch/upgraded-alice-tpc

CMS GEM muon endcaps

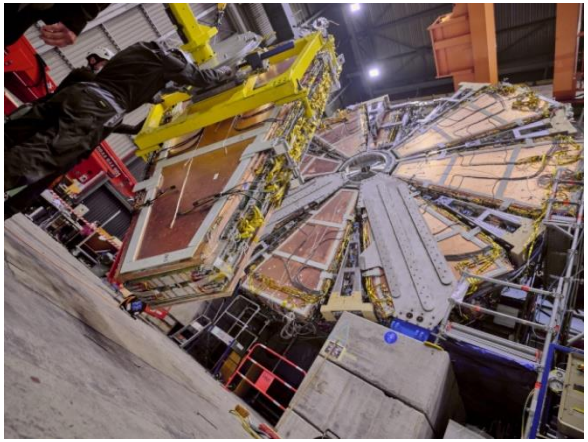


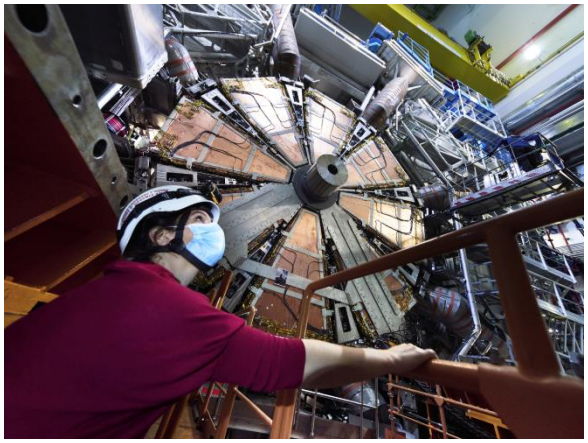
https://ep-news.web.cern.ch/content/demonstrating-capabilities-new-gem

Next EP DETECTOR SEMINARS: ATLAS NSW (Theodoros Vafeiadis , June 17), ALICE GEM-TPC (Robert Helmut Munzer, June 24), CMS GEM (Michele Bianco, July 8) https://indico.cern.ch/category/84/

MPGD for LHC LS2 Upgrades

ATLAS NSW MicroMegas





https://ep-news.web.cern.ch/content/atlas-new-small-wheel-upgrade-advances-0

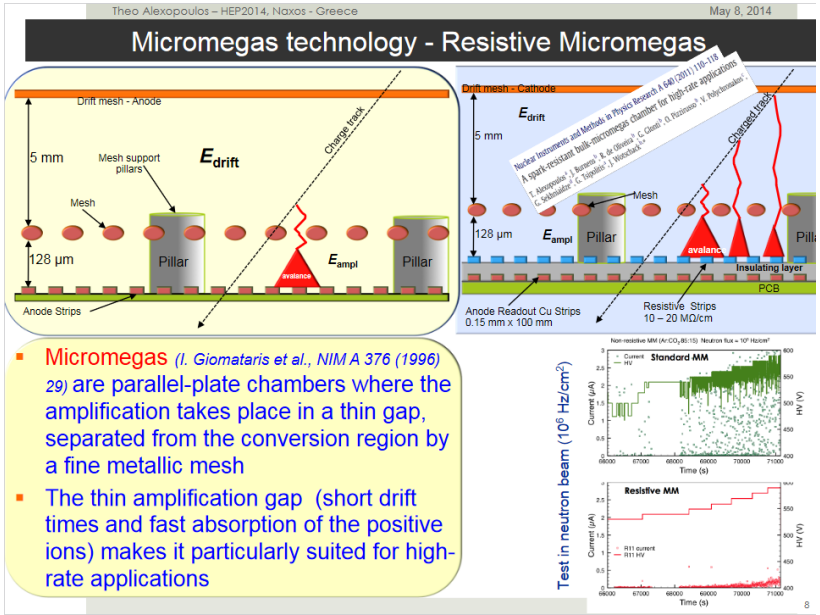
Relevant involvement of Institutes from Greece on all phases from R&D to construction, installation, operation and commissioning,…

(*) @HEP2022 (Wednesday)…

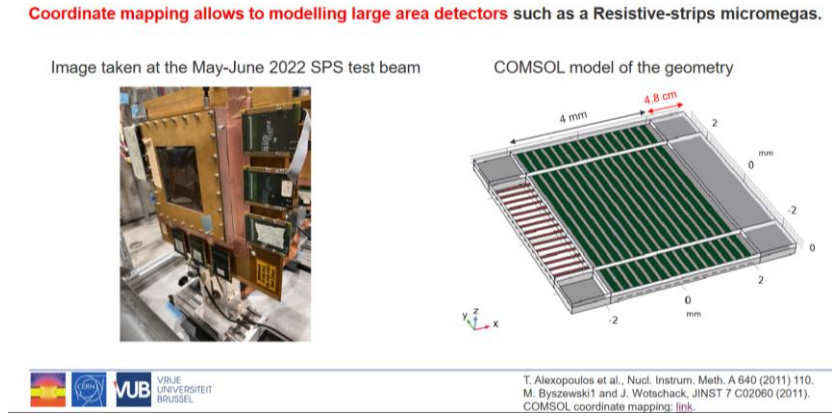
- The Control System of the New Small Wheel Electronics for the ATLAS experiment, **Polyneikis Tzanis** (NTUA)
- Performance studies of Micromegas electronics in a high radiation environment at the CERN Gamma Irradiation Facility (GIF++), **Foteini Kolitsi** (University of West Attica)
- The NSW High Voltage Infrastructure, **Ioannis Drivas-Koulouris** (NTUA)

Modelling: Detector with Resistive elements

From ongoing RD51 Coll. Meet…



Numerical signal modelling of induced signal (Djunes Janssens, CERN)



Signal Formation in Various Detectors

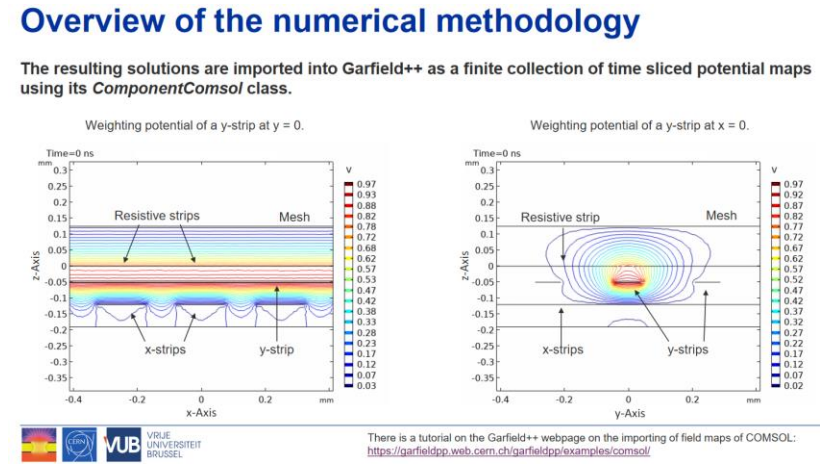
Manolis Dris and Theo Alexopoulos

National Technical University of Athens, Department of Physics,
9 Heroon Polytechniou Street, GR 157 80, Athens, Greece

September 29, 2017

Abstract

In this write-up we present the general theory of the signal formation in various detectors. We follow a pedagogical analysis and presentation such that the results could be easily understood and applied by the interested reader to the different detector configurations. We include few applications to gaseous detectors, namely, Monitored Drift Tubes (MDT) and micro-pattern gaseous detectors of the Micromegas type.



MPGD and Calorimetry (DHCAL)

Nuclear Inst. and Methods in Physics Research, A 1003 (2021) 165268

Contents lists available at ScienceDirect

Nuclear Inst. and Methods in Physics Research, A

journal homepage: www.elsevier.com/locate/nima

Development of Micromegas detectors with resistive anode pads

M. Chefdeville [a,*], R. de Oliveira [d], C. Drancourt [a], N. Geffroy [a], T. Geralis [b], P. Gkountoumis [b], A. Kalamaris [b], Y. Karyotakis [a], D. Nikas [b], F. Peltier [a], O. Pizzirusso [d], A. Psallidas [b], A. Teixeira [d], M. Titov [c], G. Vouters [a]

[a] Univ. Savoie Mont Blanc, CNRS, Laboratoire d'Annecy de Physique des Particules, Annecy, France
[b] INPP, NCSR Demokritos, Agia Paraskevi, Attiki, Greece
[c] IRFU, Saclay CEA, Gif-sur-Yvette, France
[d] Micro Pattern Technology workshop, DT group, ET department, CERN, Geneva, Switzerland

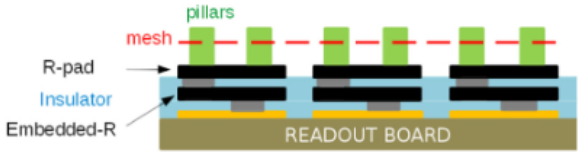


Fig. 1. Sketch of Micromegas with embedded resistors (not to scale).

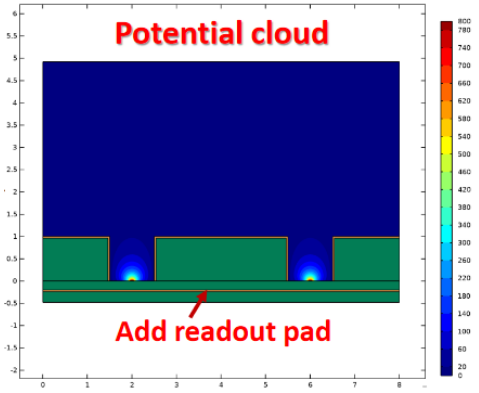
Vertical Charge Evacuation introduced on resistive micromegas

https://doi.org/10.1016/j.nima.2021.165268

INPP, NCSR Demokritos, Agia Paraskevi, Attiki, Greece

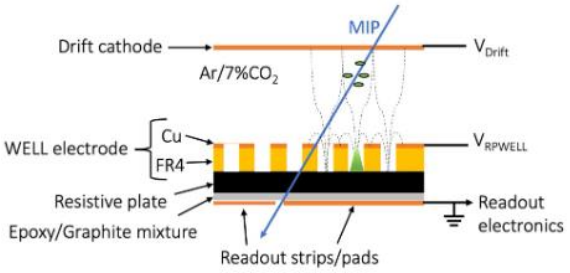
From ongoing RD51 Coll. Meet…

Proportional Counter Array (PCA), USTC



https://indico.cern.ch/event/1138814/contributions/4904132/attachments/2461636/4220584/PCa-RD51-Final.pdf

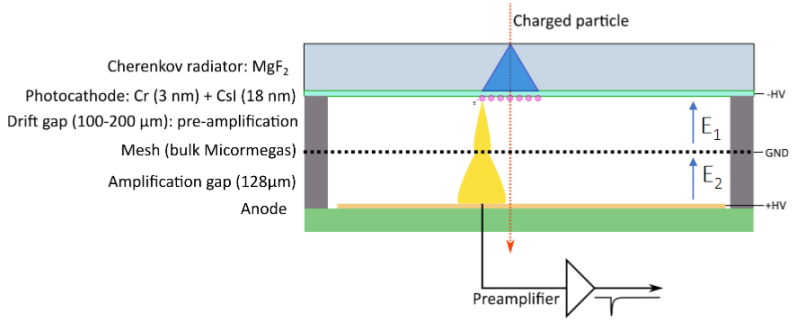
Resistive Plate WELL (RPWELL), Weizmann

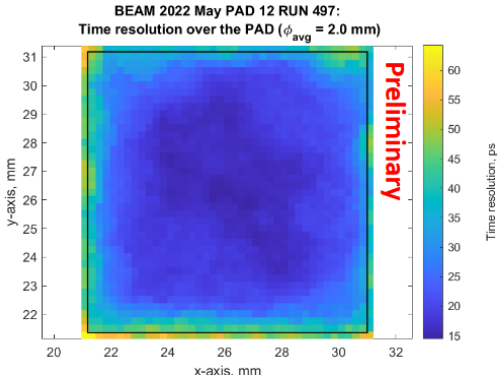


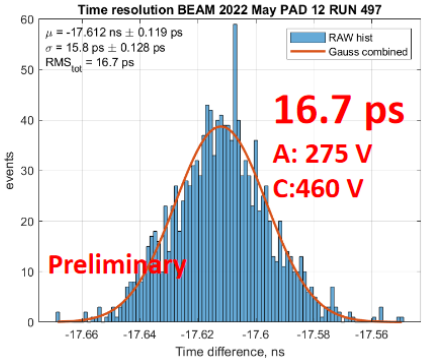
https://indico.cern.ch/event/1138814/contributions/4914236/attachments/2461793/4220894/RD51_June2022_Darina_WIS.pdf

MPGD and Precise Timing: PICOSEC mm (*)

From ongoing RD51 Coll. Meet…

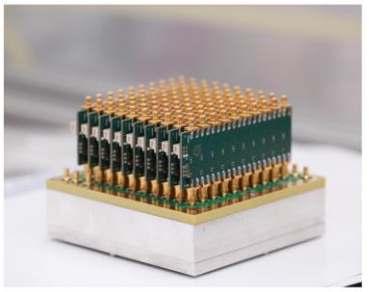


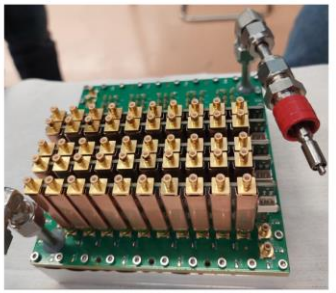


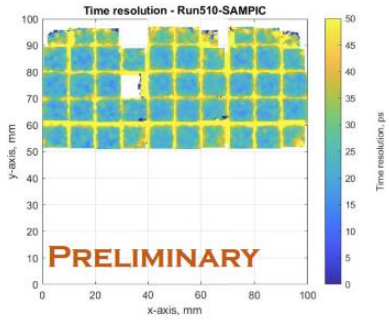


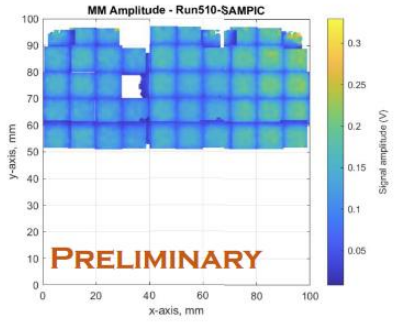
https://indico.cern.ch/event/1138814/contributions/4915978/attachments/2462081/4221391/Picosec_Advacments_f_AU.pdf

100 pads, 10cm x 10cm active area









Custom Amp. developed by M. Kovacic (CERN SY-EPC-HPM), based on RF amplifier (C. Hoarau et al 2021 JINST 16 T04005)

+

Multi-channel digitizer- SAMPIC (D. Breton, J. Maalmi et al.)

(*) @HEP2022 (Friday)…

- AUTH contribution in the development of the multipad PICOSEC-MicroMegas, ***Ioannis Maniatis*** *(AUTH)*

- Contribution to the waveform analysis of the ENUBET calorimeter, ***Ioannis Angelis*** *(AUTH)*

- Development of a Simulation Model and Precise Timing Techniques for PICOSEC-MicroMegas Detectors, ***Alexandra Kallitsopoulou*** *(AUTH)*

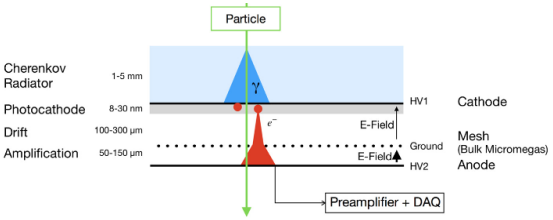
PICOSEC micromegas data analysis

Nuclear Inst. and Methods in Physics Research, A 903 (2018) 317–325
Contents lists available at ScienceDirect
Nuclear Inst. and Methods in Physics Research, A
journal homepage: www.elsevier.com/locate/nima

PICOSEC: Charged particle timing at sub-25 picosecond precision with a Micromegas based detector

J. Bortfeldt [b], F. Brunbauer [b], C. David [b], D. Desforge [a], G. Fanourakis [c], J. Franchi [b], M. Gallinaro [g], I. Giomataris [a], D. González-Díaz [i], T. Gustavsson [j], C. Guyot [a], F.J. Iguaz [a,*], M. Kebbiri [a], P. Legou [a], J. Liu [c], M. Lupberger [b], O. Maillard [a], I. Manthos [d], H. Müller [b], V. Niaouris [d], E. Oliveri [b], T. Papaevangelou [a], K. Paraschou [d], M. Pomorski [k], B. Qi [c], F. Resnati [b], L. Ropelewski [b], D. Sampsonidis [d], T. Schneider [b], P. Schwemling [e], L. Sohl [b,1], M. van Stenis [b], P. Thuiner [b], Y. Tsipolitis [f], S.E. Tzamarias [d], R. Veenhof [h,2], X. Wang [c], S. White [b,3], Z. Zhang [c], Y. Zhou [c]

[a] IRFU, CEA, Université Paris-Saclay, F-91191 Gif-sur-Yvette, France
[b] European Organization for Nuclear Research (CERN), CH-1211 Geneva 23, Switzerland
[c] State Key Laboratory of Particle Detection and Electronics, University of Science and Technology of China, Hefei 230026, China
[d] Department of Physics, Aristotle University of Thessaloniki, Thessaloniki, Greece
[e] Institute of Nuclear and Particle Physics, NCSR Demokritos, 15341 Agia Paraskevi, Attiki, Greece
[f] National Technical University of Athens, Athens, Greece
[g] Laboratório de Instrumentação e Física Experimental de Partículas, Lisbon, Portugal
[h] RD51 collaboration, European Organization for Nuclear Research (CERN), CH-1211 Geneva 23, Switzerland
[i] Instituto Galego de Física de Altas Enerxías (IGFAE), Universidade de Santiago de Compostela, Spain
[j] LIDYL, CEA Saclay, CNRS, Université Paris-Saclay, F-91191 Gif-sur-Yvette, France
[k] CEA LIST, Diamond Sensors Laboratory, CEA Saclay, F-91191 Gif-sur-Yvette, France



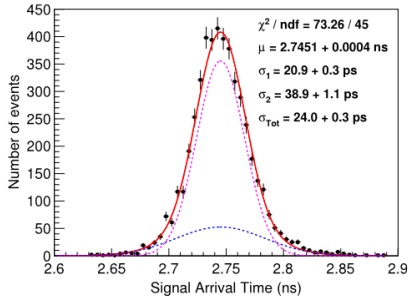


Fig. 13. Beam test: An example of the signal arrival time distribution for 150 GeV muons, and the superimposed fit with a two Gaussian function (red line for the combination and dashed blue and magenta lines for each Gaussian function), for an anode and drift voltage of 275 V and 475 V, respectively. Statistical uncertainties are shown. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Nuclear Inst. and Methods in Physics Research, A 993 (2021) 165049
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Modeling the timing characteristics of the PICOSEC Micromegas detector

J. Bortfeldt [b,1], F. Brunbauer [b,1], C. David [b,1], D. Desforge [a,1], G. Fanourakis [c,1], M. Gallinaro [g,1], F. García [a,1], I. Giomataris [a,1], T. Gustavsson [i,1], F.J. Iguaz [a,1], M. Kebbiri [a,1], K. Kordas [d,1], C. Lampoudis [d,1], P. Legou [a,1], M. Lisowska [b,1], J. Liu [c,1], M. Lupberger [b,1,2], O. Maillard [a,1], I. Manthos [d,1], H. Müller [b,1], V. Niaouris [d,1], E. Oliveri [b,1], T. Papaevangelou [a,1], K. Paraschou [d,1], M. Pomorski [j,1], B. Qi [c,1], F. Resnati [b,1], L. Ropelewski [b,1], D. Sampsonidis [d,1], L. Scharenberg [b,3], T. Schneider [b,1], L. Sohl [a,1], M. van Stenis [b,1], Y. Tsipolitis [f,1], S.E. Tzamarias [d,*,1], A. Utrobicic [b,1], R. Veenhof [h,1,3], X. Wang [c,1], S. White [b,1], Z. Zhang [c,1], Y. Zhou [c,1]

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[k] Helsinki Institute of Physics, University of Helsinki, FI-00014, Helsinki, Finland

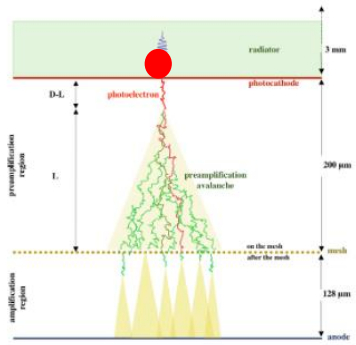

Figure 1. Illustration of the main PICOSEC detector components (dimensions are only indicative): the radiator of typical thickness ≈ 3 mm, the photocathode, the pre-amplification (drift) region of depth D (200 μm), the mesh, the amplification region (128 μm) and the anode. A photoelectron, after drifting a length D-L, produces a pre-amplification avalanche, of length L, ending on the upper surface of the mesh (on the mesh). A fraction of the avalanche electrons traverses the lower surface of the mesh (after the mesh) and produces avalanches in the amplification region.

Nuclear Inst. and Methods in Physics Research, A 993 (2021) 165076
Contents lists available at ScienceDirect
Nuclear Inst. and Methods in Physics Research, A
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Timing performance of a multi-pad PICOSEC-Micromegas detector prototype

S. Aune [a], J. Bortfeldt [b], F. Brunbauer [b], C. David [b], D. Desforge [a], G. Fanourakis [f], M. Gallinaro [b], F. García [1], I. Giomataris [a], T. Gustavsson [1], F.J. Iguaz [a], M. Kebbiri [a], K. Kordas [d,e], C. Lampoudis [d,e], P. Legou [a], M. Lisowska [b], J. Liu [c], M. Lupberger [b,1], O. Maillard [a], I. Maniatis [d,e], I. Manthos [d,e], H. Müller [b], E. Oliveri [b], T. Papaevangelou [a], K. Paraschou [d], M. Pomorski [b], B. Qi [c], F. Resnati [b], L. Ropelewski [b], D. Sampsonidis [d,e], L. Scharenberg [b], T. Schneider [b], L. Sohl [a], M. van Stenis [b], A. Tsiamis [d,e], Y. Tsipolitis [g], S.E. Tzamarias [d,e,*], A. Utrobicic [b], R. Veenhof [1,2], X. Wang [c], S. White [b], Z. Zhang [c], Y. Zhou [c]

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[d] Department of Physics, Aristotle University of Thessaloniki, University Campus, GR-54124, Thessaloniki, Greece
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[f] Institute of Nuclear and Particle Physics, NCSR Demokritos, GR-15341, Agia Paraskevi, Attiki, Greece
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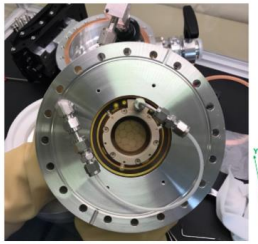
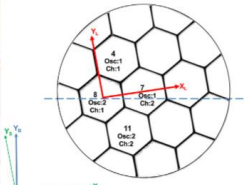




Estimated arrival time for shared signals

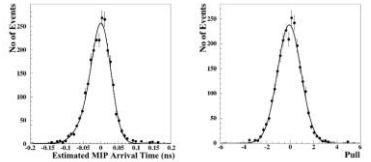
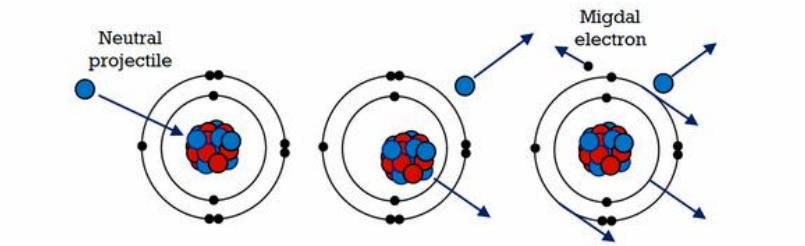


Fig. 19. (left) Distribution of the arrival time of MIPs, passing within 2 mm of a common pad corner (pads No. 4, 7 and 8), estimated by Eq. (9) combining the individual single-pad measurements and their expected errors. The solid line represents a fit to the data points by a sum of two Gaussian functions corresponding to an RMS of 22.2 ± 0.5 ps. (right) Pull distribution of estimated arrival times by Eq. (9). The solid line represents a Gaussian fit to the data points, consistent with mean and σ values equal to 0 and 1 respectively.

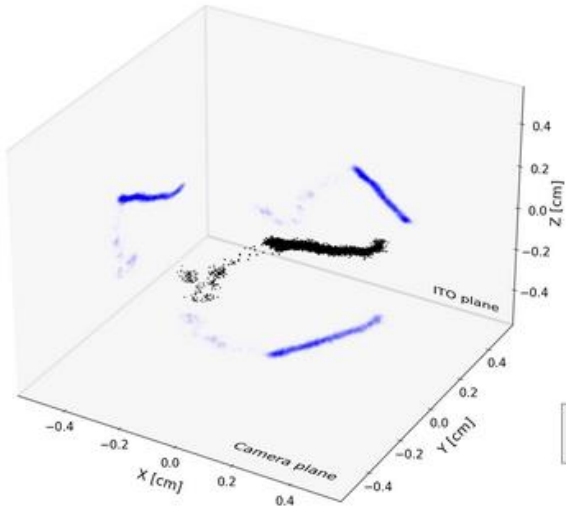
AUTH: I Angelis, A. Kallitsopoulou , K. Kordas, C. Lampoudis, I. Maniatis, I. Manthos, K. Paraschou, D. Sampsonidis, A. Tsiamis, S.E. Tzamarias

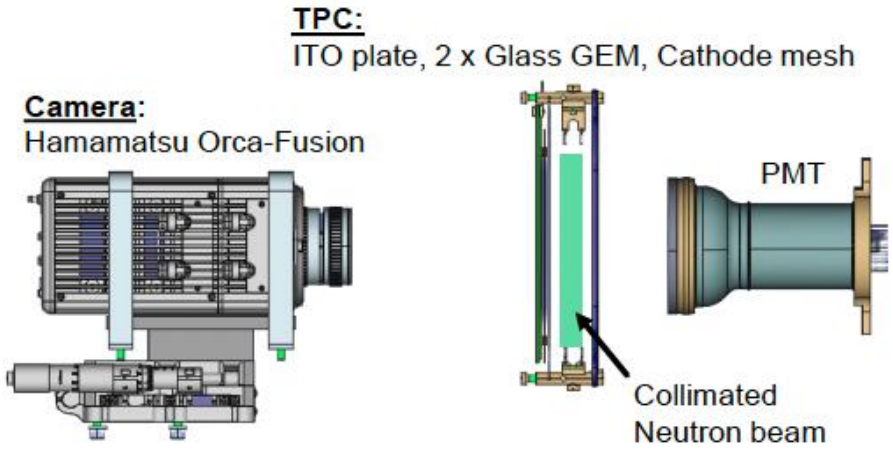
MPGD and Optical Readout TPC: MIGDAL Experiment (*)

RD51 mini week, Feb. 2022 (P. Majewski)



Migdal event topology involves a nuclear recoil and electron recoil originating from the same vertex.





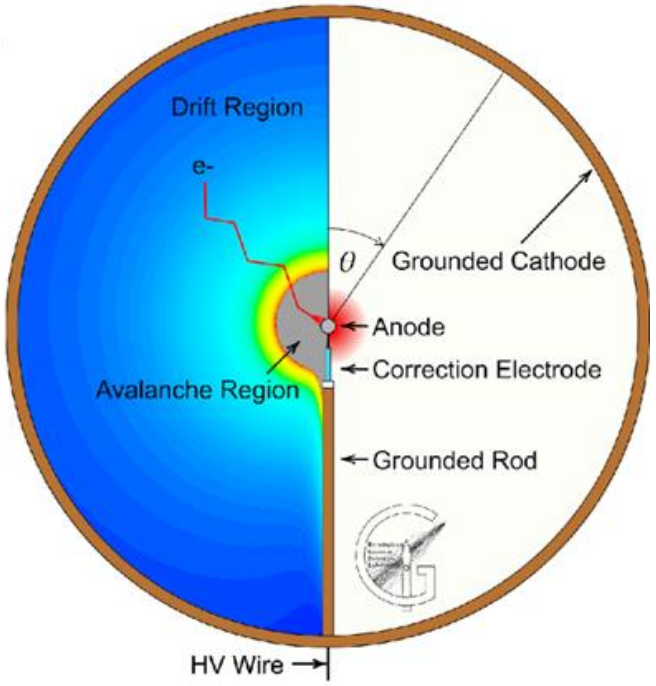
https://docs.google.com/presentation/d/1RHUdCuiRFnfVFWRq2xX1JBmRlROCJA5RuOefguH8VBk/edit#slide=id.g112cfdfe628_4_17

(*)@HEP2020 (Wednesday)

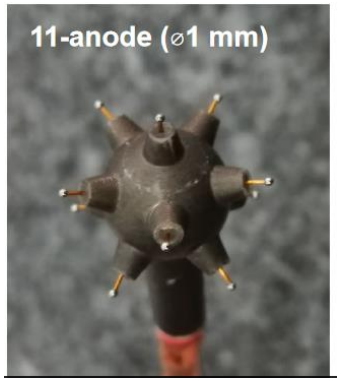
MIGDAL: Towards an unambiguous observation of the Migdal effect in nuclear scatteringSpeaker: **Ioannis Katsioulas** (University of Birmingham)

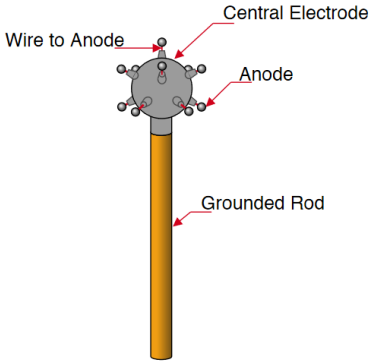
DM searches: Spherical Proportional Counter (~ MPGD)

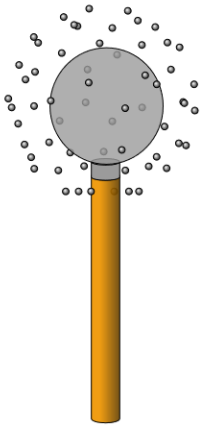
From RD51 topical workshop "**Wide Dynamic Range Operation of MPGDs**"

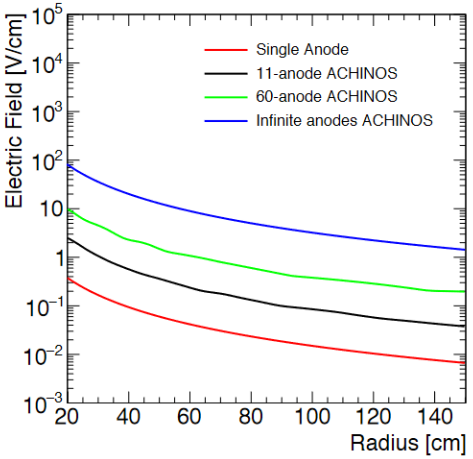


ACHINOS, Multi-Anode Readout





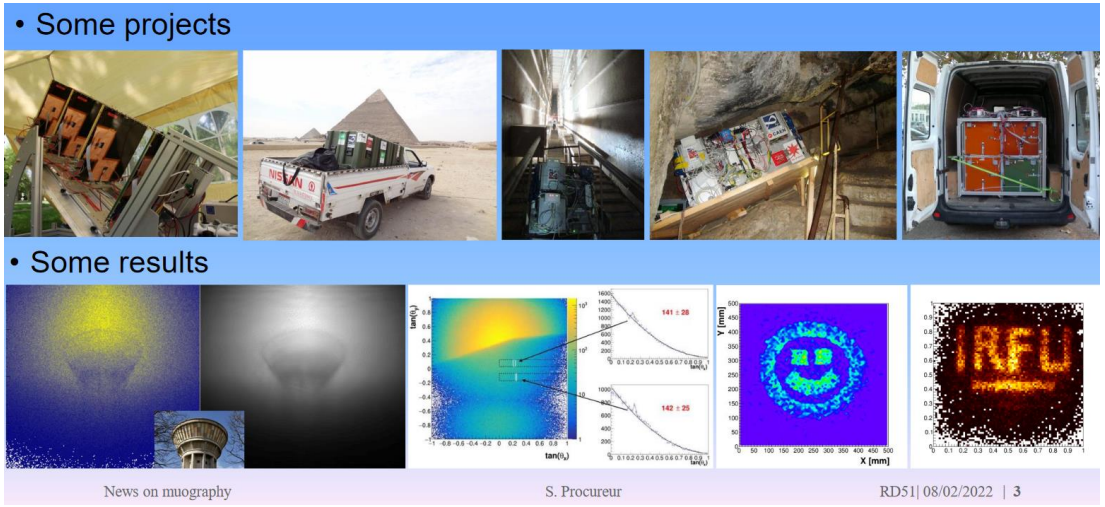




https://indico.cern.ch/event/1071632/contributions/4617237/attachments/2348787/4005845/rd51_spc_knights.pdf

(*) @HEP2022 (Wednesday) NEWS-G: Search for Light Dark Matter with a Spherical Proportional Counter, Patrick Knights

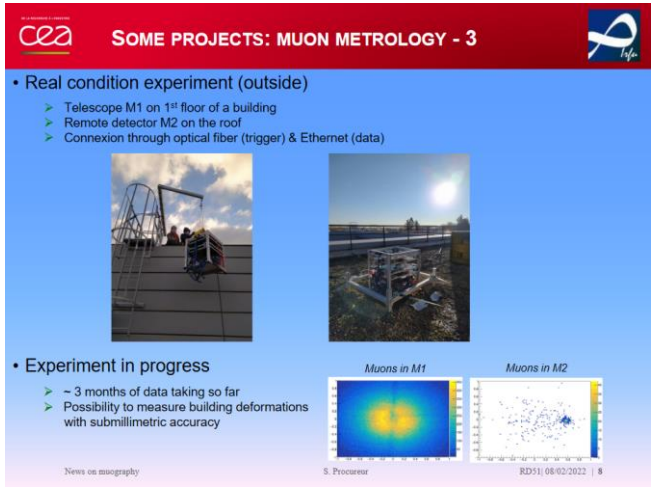
MPGD and Muon tomography(*)

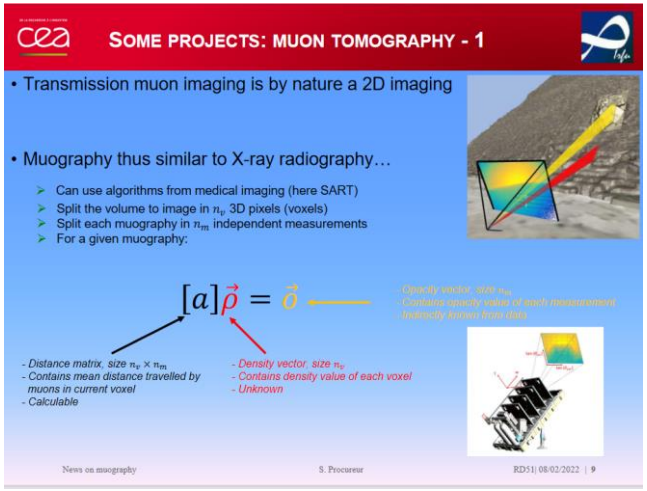


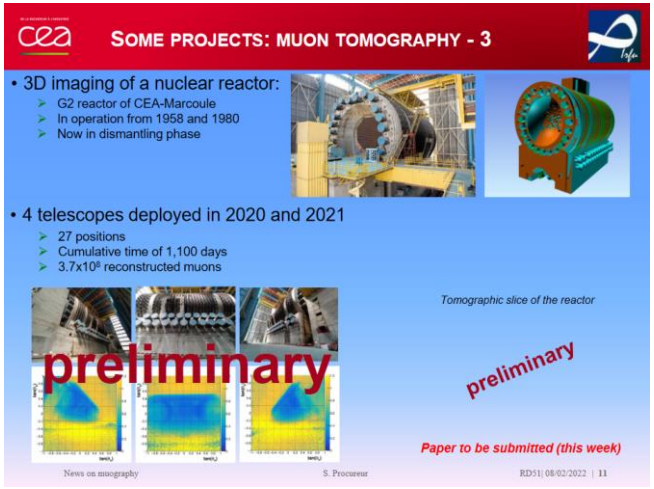
RD51 mini-week Feb. 2022

S. Procureur et al.

https://indico.cern.ch/event/1110129/contributions/4714212/attachments/2386499/4078780/2022-02-07_RD51_Procureur_public.pdf







(*) *@HEP2022 (Friday)…Muon tomography with MicroMegas detectors,* ***Dimitra Amperiadou*** *(AUTH)*

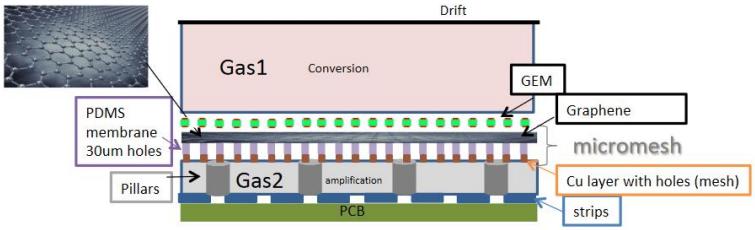
MPGD and new materials: Graphene

R&D on double gas phase Micromegas Using graphene

Theodoros Geralis
NCSR Demokritos
26/2/2018

R&Ds on MPGDs at Demokritos

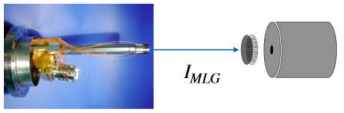
- **Micromegas with embedded resistors for High Rate applications (presentation by Max Chefdeville)**
  LAPP Annecy, NCSR Demokritos, CEA Saclay
- **Real x-y Microbulk with segmented mesh (Common Fund project)**
  NCSR Demokritos, CEA Saclay, Univ. of Zaragoza
- **R&D on double gas phase Micromegas Using Graphene**
  NCSR Demokritos (Institutes of Nuclear and Particle Physics, Institute of Nanoscience and Nanotechnologies), FORTH ICE-HT Patras Research Center – dedicated to Graphene studies.

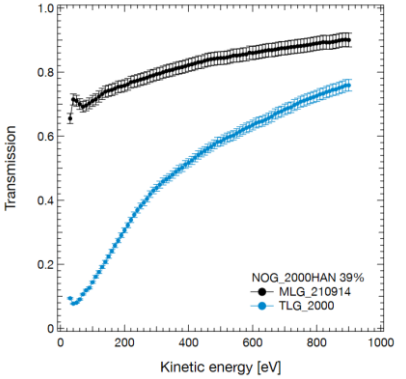


https://indico.cern.ch/event/702148/contributions/2907959/attachments/1606409/2549020/Geralis_mM_Graphene.pdf

From ongoing RD51 Coll. Meet…

Transmission through graphene of electrons in the 30 - 900 eV range





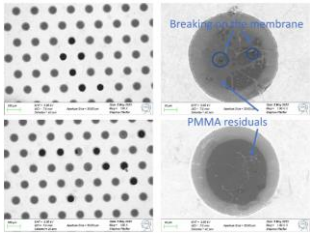
Alice Apponi, Domenica Convertino, Neeraj Mishra, Camilla Coletti, Mauro Iodice, Franco Frasconi, Federico Pilo, Gianluca Cavoto, Alessandro Ruocco

Collaboration meeting RD51 - 14.06.2022

https://indico.cern.ch/event/1138814/contributions/4901243/attachments/2461673/4220653/AA_Rd51_2022_06_14.pdf

Integration of Graphene-based nanostructures for novel gaseous detectors

Giorgio Orlandini
On behalf of CERN GDD group
RD51 collaboration meeting 13-17 June 2022

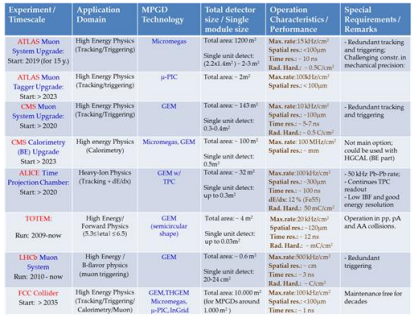


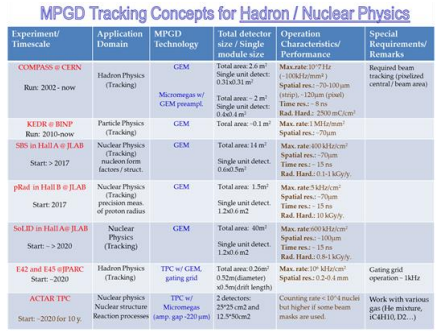
https://indico.cern.ch/event/1138814/contributions/4922756/attachments/2463381/4223761/220615_RD51.pdf

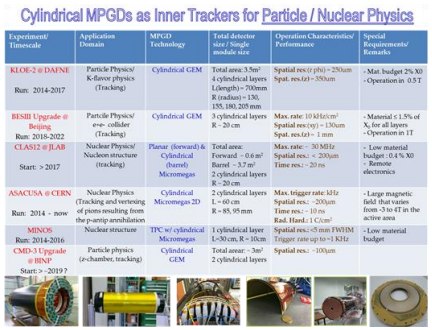
Before going to conclusions… a good link for MPGD dissemination

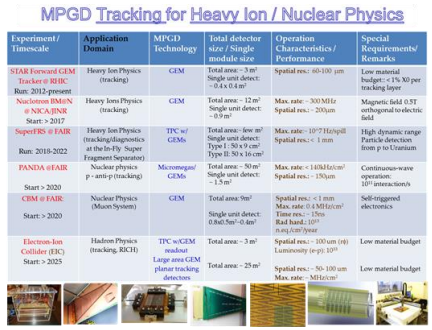
Maksym Titov, Conference Summary, 5th International Conference on Micro-Pattern Gas Detectors (MPGD2017), Temple University, Philadelphia

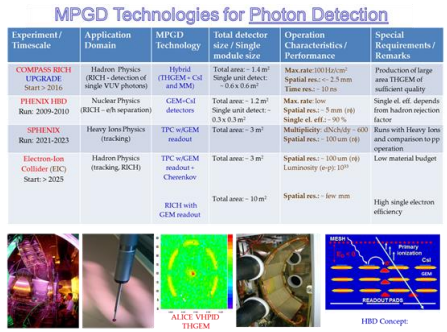
https://indico.cern.ch/event/581417/contributions/2558346/attachments/1465881/2266161/2017_05_Philadelphia_MPGD2017-ConferenceSummary_25052017_MS.pdf











Conclusion

- RD51 started in 2008, now in the third five-years term that will end in 2023. Discussion concerning the future ongoing in the collaboration and in the context of the ECFA implementation…

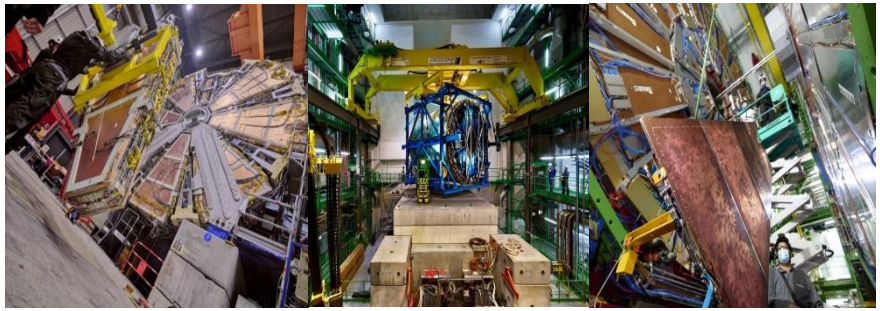
- Keeping the original scientific structure (7 working groups) in the past 15 years the collaboration strengthened its own model for R&D, developing a framework to facilitate R&D on MPGD technologies, granting scientific freedom of the members and supporting generic and project driven R&D…

- Large dissemination of the technology in different fields. In HEP, three major upgrades during LS2 @ LHC (ATLAS NSW micromegas, ALICE TPC-GEM and CMS GEM) are good example of the maturity reached…

A warm invitation…

CERN Detector Seminars
(series on LHC LS2 upgrades)

- ATLAS NSW (Theodoros Vafeiadis , **June 17**)
- ALICE GEM-TPC (Robert Helmut Munzer, **June 24**)
- CMS GEM (Michele Bianco, **July 8**)



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MPGD2022 (December 11-16)

https://www.weizmann.ac.il/conferences/MPGD2022/