RD51 Common Project

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02/03/2023 DRD1 kick-off meeting

Overview of RD51 Common Projects

- The RD51 Common Project Funding is intended to support a project cost in the areas of common interest to the RD51/MPGD community
  - 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.
  - The program will fund only generic projects – not ones related to experiments.
- Transversal collaborations among groups from different countries, experiments, physics areas of interest encouraged and supported by RD51
- Started since 2011
- 24 projects are approved in these 12 years.

RD51 Common Project list

Year	Title	Contact person
2011	A low mass microbulk with real XY strips structure	Theo Geralis
	MPGDs technology laboratory for training, development, fabrication, applications and innovation	Rafael Gutierrez
	Thin and high-pitch laser-etched mesh manufacturing and bulking	Paul Colas
	Development of innovative resistive GEM alpha detectors for earthquakes	Guy Paic
	Large-area THGEM detector evaluation with SRS electronics	Amos Breskin
2012	R&D on large area GEMs for the ALICE TPC upgrade	Chilo Garabatos Cuadrado
	High resolution UV scanner for MPGD applications	Dezso Varga
2014	Measurement and calculation of ion mobility of some gas mixtures of interest	Chilo Garabatos
	Fast Timing for High-Rate Environments: A Micromegas Solution	Sebastian White
	Development of a novel Micro Pattern Gaseous Detector for Cosmic Ray Muon Tomography	Paolo Iengo
2016	Sampling Calorimetry with Resistive Anode MPGDs (SCREAM)	Maximilien Chedeville
	New Scintillating gases and structures for next-generation scintillation-based gaseous detector	Diego Gonzalez Diaz
2017	Development of modular multilayer GEM units	Alexander Milov
2018	Modular & General purpose Ultra Low Mass GEM Based Beam Monitors	Gabriele Croci
	DLC based electrodes for future resistive MPGDs	Yi Zhou
	Study of negative ion mobility and ion diffusion for Negative Ion TPCs	André Cortez
2019	Discharge Consortium in quest for Spark-Less-Avalanche-Microstructures	Piotr Gasik
	Pixelated resistive bulk Micromegas with integrated electronics	Fabrizio Petrucci
	Resistive materials and resistive-MPGD concepts & technologies	Shikma Bressler
2020	Optical readout studies for negative ion TPCs	Florian M. Brunbauer
	Large area high-granularity segmented mesh microbulk forfuture rare event searches	Javier Galan
2021	Comprehensive studies of the glass, ceramic- and kapton-THGEMs in high- and low-pressure TPCs	Pawel Majewski
	Development for Resistive MPGD Calorimeter with timing measurement	Piet Verwillligen
2022	Study of MPGD performance in liquefied noble gases	Vitaly Chepel

Collaborative work between different institutes

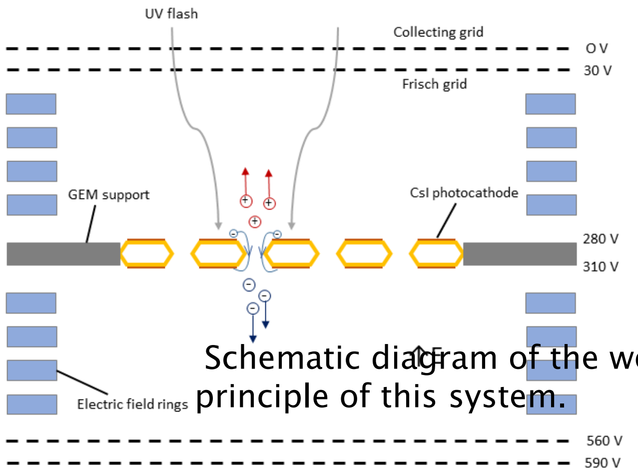
- More than 3 institutes should be joined in one project.
  - It makes good connections between different institutes in the RD51 collaborators in world wide

- For example; SCREAM project (2018 CP project)
  - Collaborative work between
    - IN2P3/LAPP (France) → Readout, Electrical tests
    - NCSR (Greece) → Detector caractarization
    - Saclay (France) → Test infrastructures
    - Weizmann (Israel) → Detector design, production
    - U. Aveiro (Portgal) → Detector development, simulation
    - U. Coimbra (Portgal) → Test beam, detector development

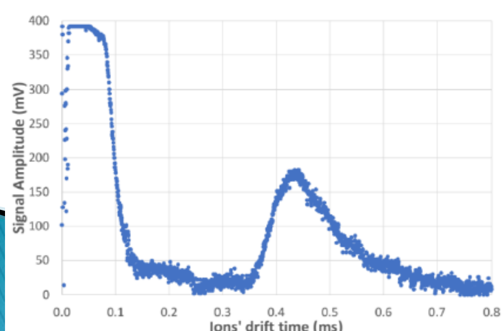
Highlights of the Blue sky

- Study of negative ion mobility and ion diffusion for Negative Ion TPCs (2018-)

RD51 Institutes: **1.** *University & INFN Milano-Bicocca, contact person: Giuseppe Gorini, giuseppe.gorini@unimib.it*
2. *INFN – Laboratori Nazionali di Frascati, contact person: Fabrizio Murtas, fabrizio.murtas@lnf.infn.it*
3. *European Spallation Source ERIC, contact person: Richard Hall-Wilton, Richard.hall-wilton@esss.se*



Schematic diagram of the workir principle of this system.



Typical time-of-arrival spectra in pure CF4 for a VGEM of 35V, a E/N of 30 Td and 8 Torr of total pressure at room temperature.

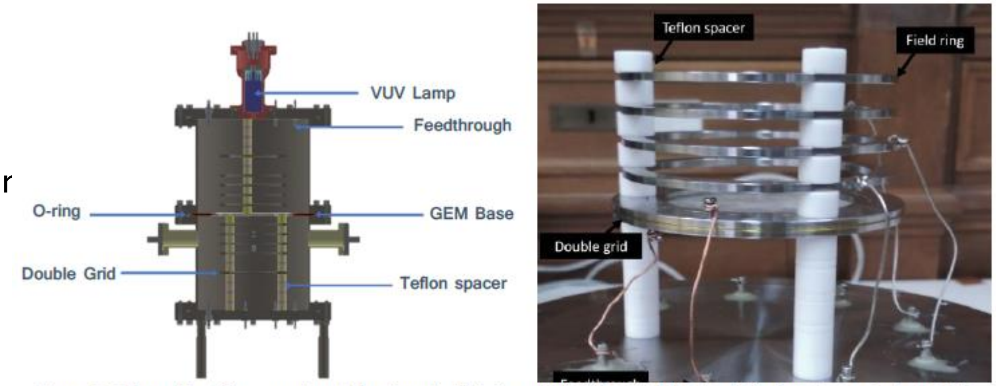


Figure 3- Schematic of the experimental system (left), internal view of one of the ion drift chamber modules (right).

Highlights of the Blue sky

- Study of MPGD performance in liquefied noble gases (2022–)

RD51 Institutes:

1. LIP-Coimbra, Vitaly Chepel, vitaly@uc.pt

2. Weizmann Institute of Science, Amos Breskin, skin@weizmann.ac.il and Shikma Bressler, ressler@weizmann.ac.il

ıys-University of Coimbra, Joaquim Marques Ferreira dos nf@uc.pt, Fernando Domingues Amaro, famaro@uc.pt and Maria Bernardes Monteiro, cristinam@uc.pt

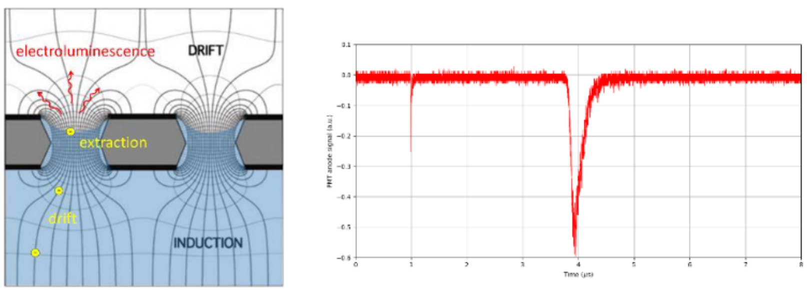


Figure 1. A double-phase TPC with a floating THGEM. (Left) – the principle; (Right) – preliminary results with a 0.4 mm thick THGEM, 0.3 mm holes and 1 mm pitch in liquid xenon. The ionization (in the liquid) is due to alpha-particles; the VUV photons are detected with a PMT. A fast pulse at $t = 1\ \mu s$, corresponding to primary scintillation in the liquid, is followed by the secondary scintillation in gas.

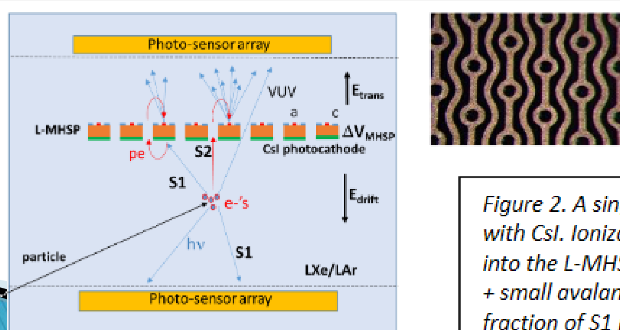


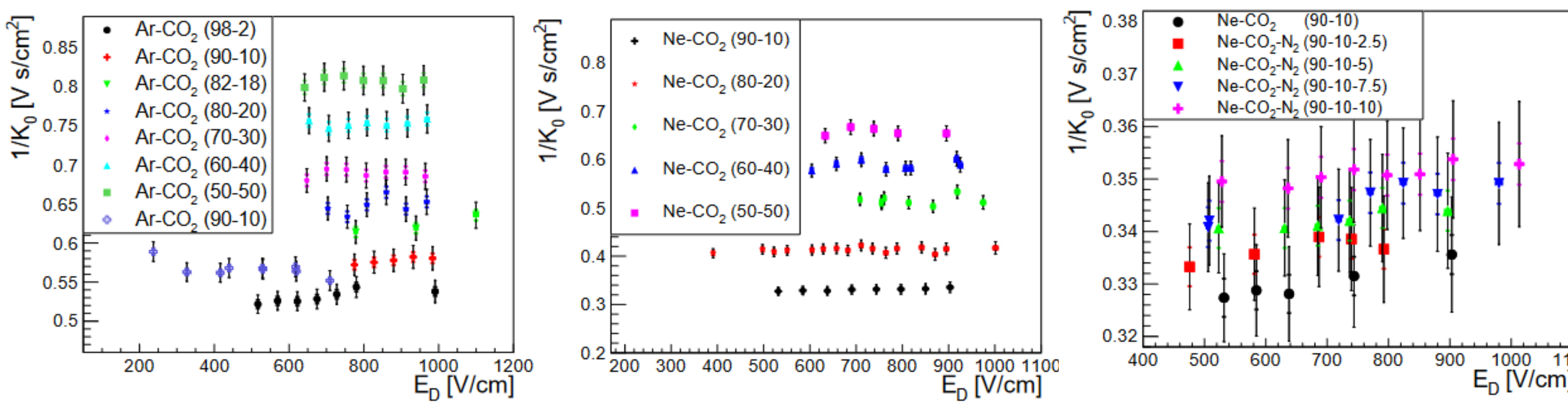
Figure 2. A single-phase TPC with a L-MHSP (or L-COBRA, shown) coated underneath with CsI. Ionization electrons and UV-induced photoelectrons from CsI are collected into the L-MHSP holes, and drift towards the anode strips. VUV photons emitted by EL + small avalanche near the strips, are detected by the top photo-sensors. Another fraction of S1 photons are detected by bottom photo-sensors.

Highlight the support to basic activities of common interest

- Measurement and calculation of ion mobility of some gas mixtures of interest (2014-)

RD51 Institutes:

1. GSI, contact person: Chilo Garabatos, chilo.garabatos.cuadrado@cern.ch
2. LIP Coimbra (Portugal), contact person: André Cortez, andre.cortez@coimbra.lip.pt
3. University of Bursa (Turkey), Rob Veenhof, rob.veenhof@cern.ch
4. VECC, Kolkata (India), Tapan Nayak, tapan.nayak@cern.ch



(a) Ar-CO_2 mixtures

(b) Ne-CO_2 mixtures

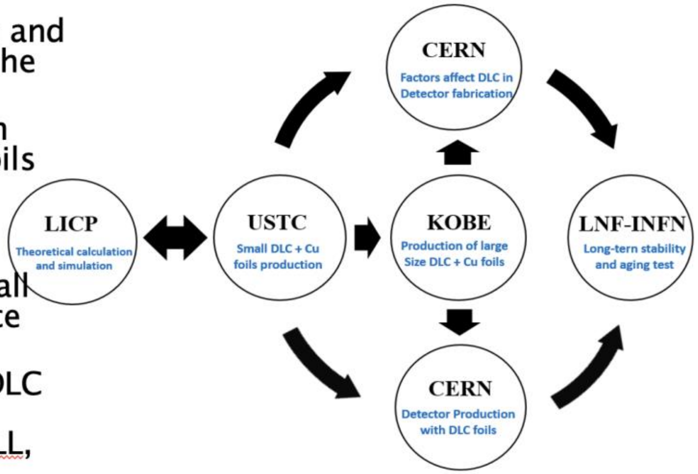
Figure 5: Inverse reduced ion mobility for Ar-CO_2 (Ne-CO_2, respectively) mixtures. All closed (open, respectively) points are measured with a drift length of 21.35 mm (25.31 mm, respectively). The water content in different measurements ranges from 34 ppm to 98 ppm (120 ppm to 180 ppm, respectively) for the Ar-CO_2 (Ne-CO_2, respectively) mixtures. The coloured error-bars represent the error due to the drift length uncertainty, while the black error bar represents the combined uncertainty of all other sources.

[ArXiv:1804.10288v2]

Highlight the clustering research teams

DLC Common project (2018-)

- LICP: on the basis of theoretical calculation and simulation, give USTC team a guidance of the work
- USTC: produce different bare DLC foils with different surface resistivity and also DLC foils with Copper coating (DLC+Cu)
- Kobe University: produce large size DLC & DLC+Cu foils in order to study the reproducibility of the process tuned on small prototypes and the uniformity of the surface resistivity of the DLC
- CERN: study the behavior and changes of DLC properties under manufacturing processes foreseen for MPGD construction (i.e. µRWELL, resistive GEM and THGEM)
- LNF-INFN: study stability of bare DLC properties under current drawing on bench (w/irradiation)
- CERN: produce detectors with DLC foils
- LNF-INFN: perform aging and spark test of DLC based detectors (with different radiation)



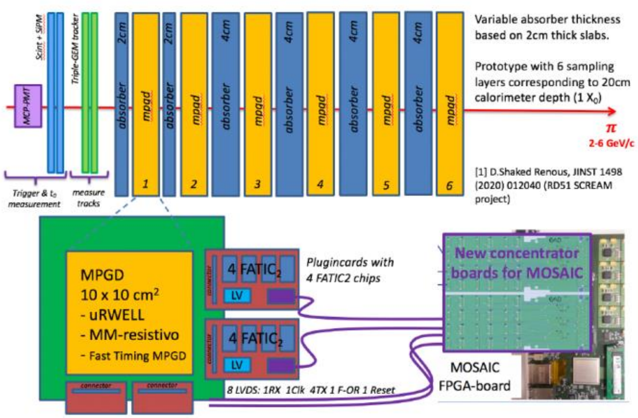
- Clustering group working on the same fields to increase the impact
- Now Resistive DLC electrodes are grown to one of common technology in MPGD community

Connections & Synergies between CPs

- Development of Resistive MPGD Calorimeter with timing measurement (2021-)

RD51 Institutes:
1. *INFN sez. Bari, contact person: piet.verwilligen@ba.infn.it*
2. *INFN sez. Roma III, contact person: mauro.iodice@roma3.infn.it*
3. *INFN LNF Frascati, contact person: giovanni.bencivenni@lnf.infn.it*
4. *INFN sez. Napoli, contact person: massimo.dellapietra@na.infn.it*

Design of MPGD-based HCAL cell

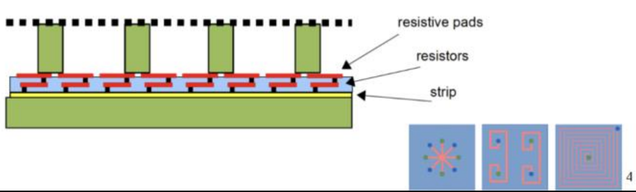


- Sampling Calorimetry with Resistive Anode MPGDs (SCREAM) (2016-)

RD51 Institutes

1. CNRS/IN2P3/LAPP, Maximilien Chefdeville chefdevi@lapp.in2p3.fr
2. Weizmann Institute of Science, Shikma Bressler shikma.bressler@weizmann.ac.il
3. NCSR Demokritos/INP, Theodoros Geralis geral@inp.demokritos.gr
4. CEA/IRFU, Maxim Titov maxim.titov@cea.fr
5. University of Aveiro, Joao Veloso joao.veloso@ua.pt
6. University of Coimbra, Fernando Amaro famaro@uc.pt

- Control of the resistance through R-pattern: tuned for minimal charge-up & spark suppression



Highlight the seed of long term collaboration and activities

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

Clustering groups around new ideas

RD51 PICOSEC-MicroMegas Collaboration

- **CEA Saclay (France):** D. Desforge, I. Giomataris, T. Gustavsson, C. Guyot, F.J. Iguaz[1], M. Kebbiri, P. Legou, O. Maillard, T. Papaevangelou, M. Pomorski, P. Schwemling, L. Sohl.
- **CERN (Switzerland):** J. Bortfeldt, F. Brunbauer, C. David, J. Frachi, M. Lupberger, H. Müller, E. Oliveri, F. Resnati, L. Ropelewski, T. Schneider, P. Thuiner, M. van Stenis, R. Veenhof[2], S. White[3].
- **USTC (China):** J. Liu, B. Qi, X. Wang, Z. Zhang, Y. Zhou.
- **AUTH (Greece):** K. Kordas, I. Maniatis, I. Manthos, V. Niaouris, K. Paraschou, D. Sampsonidis, S.E. Tzamarias.
- **NCSR (Greece):** G. Fanourakis.
- **NTUA (Greece):** Y. Tsipolitis.
- **LIP (Portugal):** M. Gallinaro.
- **HIP (Finland):** F. García.
- **IGFAE (Spain):** D. González-Díaz.

1) Now at Synchrotron Soleil, 91192 Gif-sur-Yvette, France
2) Also MEPhI & Uludag University.
3) Also University of Virginia.

VCI2019, 20/2/2019 K. Kordas - RD51-PICOSEC 35

https://indico.cern.ch/event/716539/contributions/3246636/attachments/1798790/2933615/Kordas_PICOSEC_VCI2019.pdf

2015 RD51 CP

Clustering groups working on the same fields to increase the impact

Resistive DLC collaboration

DLC Common project (2018-)

- LICP: on the basis of theoretical calculation and simulation, give USTC team a guidance of the work
- USTC: produce different bare DLC foils with different surface resistivity and also DLC foils with Copper coating (DLC+Cu)
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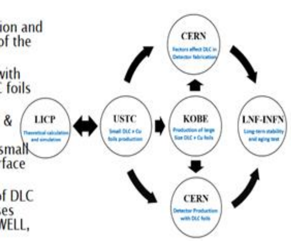

https://indico.cern.ch/event/761831/contributions/3236762/attachments/1765980/2867435/DLC_CP_Atsuhiko_Ochi_181205_v2.pdf

2018 RD51 CP

Conclusion

- The RD51 Common Project Funding is intended to support a project (not only cost) in the areas of common interest to the RD51/MPGD community
- RD51 CP supports blue sky projects, basic activities of common interests, clustering research items and seeds of long term activities.
- Transversal collaborations among groups from different countries, experiments, physics areas of interest encouraged
- We strongly believe that RD51 CP structure should be implemented in DRD1.