# 2021 Snowmass Process: MPGD @ Instrumentation Frontier

This Snowmass 2021 IF5 (MPGD) topical group will document recent developments and identify future needs for Micro-Pattern Gaseous Detector (MPGD) technologies MPGD wiki webpage: https://snowmass21.org/instrumentation/mpgd

You could reach us (conveners): SNOWMASS-IF-05-MPGD-CONVENERS@fnal.gov

- ✓ Critical for growing US MPGD community to engage in Snowmass process to ensure future support
- ✓ Particularly important given that MPGDs not included in US Basic Research Needs (BRN) Report

### Some (most popular) questions:

- ✓ Do we encourage nuclear physics community contributions? YES !!! There is a strong synergy between HEP and NP MPGD's developments
- ✓ Do we encourage submissions from Europe/Asia YES !!! For any future project world-wide realized in a global context and/or projects with US involvement

We invite all MPGD groups to join this effort and to provide inputs:

- ✓ Subscribe to mailing list: SNOWMASS-IF-05-MPGD@FNAL.GOV (instructions: https://listserv.fnal.gov/users.asp)
- ✓ Submit a 2-page Letter of Interest: https://snowmass21.org/loi; submission until August 31, 2020
- ✓ Submit a contributed paper: https://snowmass21.org/submissions/start; submission until July 31, 2021

# **RD51 Model-Recognized: Recent Documents**

## **June 2018:**

✓ R&D PROPOSAL: RD51 Extension beyond 2018"— Approved by the CERN Research Board until 2023 https://arxiv.org/abs/1806.09955





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)

## **December 2018 (Europe):**

✓ Input for the EPPSUprocess: "Development of the MPGD Technologies: an overview of the CERN-RD51 Collaboration"

https://indico.cern.ch/event/765096/contributions/3295721/

Development of the Micro-Pattern Gaseous Detector Technologies: an overview of the CERN-RD51 Collaboration

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

Representing the RD51 Collaboration

Coordination through RD51 ("RD51 Model"): combination of generic and focused R&D with bottom-top decision processes, full sharing of "know-how", information, common infrastructures → can be exported to other detector domains

## **Summer 2019 (USA):**

✓ Document for the CPAD report "New Technologies For Discovery"

Progress of MPGDs and RD51 model https://arxiv.org/abs/1908.00194

the Simons Foundation and sun

Physics > Instrumentation and Detectors

#### New Technologies for Discovery

Z. Ahmed, A. Apresyan, M. Artuso, P. Barry, E. Bielejec, F. Blaszczyk, T. Bose, D. Braga, S.A. Charlebois, A. Chatterjee, A. Chavarria, H.-M. Cho, S. Dalla Torre, M. Demarteau, D. Denisov, M. Diefenthaler, A. Dragone, F. Fahim, C. Gee, S. Habib, G. Haller, J. Hogan, B.J.P. Jones, M. Garcia-Sciveres, G. Giacomini, K. Gilmore, G.K. Giovanetti, D. Glenzinski, S. Gleyzer, A.H. Goldan, S. Gollapinni, C. Grace, R. Guenette, O. Gutsche, U. Heintz, S.A. Hertel, N. R. Hutzler, S. Kolkowitz, T. Kovachy, F. Leonard, R. Lipton, M. Liu, J.F. Low, P. Madigan, S. Malik, J. Mates, Y. Mei, P. Merkel, T. Mohayai, A. Nomerotski, E. Oliveri, K. Palladino, E. Pantic, A. Para, K. Perez, M. Pyle, P. Riedler, L. Ropelewski, R. Rusack, M. Schleier-Smith, I Shipsey, K. Scholberg, B. A. Schumm, A. Slosar, W. Smith, B. Surrow, A. O. Sushkov, A. Suzuki, M. Szydagis, D. Temples, J. Thom, M. Titov, L. Tvrznikova, E. Usai, R. Van Berg, V. Velan, L. Winslow, T. Wongjirad, Q. Xia J. Xie, Z.F. You, A. Zani, J. Zhang, R.Y. Zhu (Submitted on 1 Aug 2019 (v1), last revised 10 Aug 2019 (this version, v2),

# **2021 Snowmass Process: MPGD @ Instrumentation Frontier**

### **SNOWMASS PROCESS is a GLOBAL EFFORT:**

- ✓ Input from the non-US community is essential
- ✓ Input from recent international studies, for example HL-LHC, European Strategy Particle Physics Update (ESPPU), future colliders (ILC, FCC, EiC), etc.

### We plan to organize bi-weekly meeting of the MPGD-IF5 Working Group (Jul. 24, Aug. 7, 21):

- → discuss potential MPGD usage in future projects, promising areas for future R&Ds, and corresponsing Lol submissions
  - ✓ If you are interested to give a talk at one of the next meetings please VOLUNTEER (under the assumption you later submit a Lol)
- ✓ Submit a 2-page Letter of Interest: submission deadline August 31, 2020
- ✓ Complete table (one entry per subdetector, which uses MPGD)

Experiment / Timescale	Application Domain	MPGD Technology	size / Single	Operation Charact. Performance Rad. Environment	Requirements /

✓ Please add paper references

We encourage to complete forms also for generic "blue-sky" R&D

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## Example of table entries:

→ Summary of the Micro-Pattern Gaseous Detector Technologies employed/proposed for CERN Experiments

Experiment / Timescale	Application Domain	MPGD Technology	Total detector size / Single module size	Operation Characteristics / Performance	Special Requirements / Remarks
COMPASS TRACKING > 2002	Fixed Target Experiment (Tracking)	3-GEM Micromegas w/ GEM preampl.	Total area: 2.6 m <sup>2</sup> Single unit detect: 0.31x0.31 m <sup>2</sup> Total area: ~ 2 m <sup>2</sup> Single unit detect: 0.4x0.4 m <sup>2</sup>	Max.rate: ~100kHz/mm² Spatial res.: ~70-100μm (strip), ~120μm (pixel) Time res.: ~8 ns Rad. Hard.: 2500 mC/cm²	Required beam tracking (pixelized central / beam area)
TOTEM TRACKING: > 2009	Hadron Collider / Forward Physics (5.3≤ η  ≤ 6.5)	3-GEM (semicircular shape)	Total area: ~ 4 m <sup>2</sup> Single unit detect: up to 0.03m <sup>2</sup>	Max.rate:20 kHz/cm <sup>2</sup> Spatial res.: ~120μm Time res.: ~ 12 ns Rad. Hard.: ~ mC/cm <sup>2</sup>	Operation in pp, pA and AA collisions.
LHCb MUON DETECTOR > 2010	Hadron Collider / B-physics (triggering)	3-GEM	Total area: ~ 0.6 m²  Single unit detect: 20-24 cm²	Max.rate:500 kHz/cm <sup>2</sup> Spatial res.: ~ cm Time res.: ~ 3 ns Rad. Hard.: ~ C/cm <sup>2</sup>	Redundant triggering
COMPASS RICH UPGRADE > 2016	Fixed Target Experiment (RICH - detection of single VUV photons)	Hybrid (THGEM + Csl and MM)	Total area: ~ 1.4 m² Single unit detect: ~ 0.6 x 0.6 m²	Max.rate:100 Hz/cm <sup>2</sup> Spatial res.: <~ 2.5 mm Time res.: ~ 10 ns	Production of large area THGEM of sufficient quality
ATLAS MUON UPGRADE CERN LS2	Hadron Collider (Tracking/Triggering)	Resistive Micromegas	Total area: 1200 m <sup>2</sup> Single unit detect: (2.2x1.4m <sup>2</sup> ) ~ 2-3 m <sup>2</sup>	Max. rate:15 kHz/cm <sup>2</sup> Spatial res.: <100μm Time res.: ~ 10 ns Rad. Hard.: ~ 0.5C/cm <sup>2</sup>	Redundant tracking and triggering; Challenging constr. in mechanical precision
CMS MUON UPGRADE CERN LS2	Hadron Collider (Tracking/Triggering)	3-GEM	Total area: ~ 143 m² Single unit detect: 0.3-0.4m²	Max. rate:10 kHz/cm <sup>2</sup> Spatial res.: ~100μm Time res.: ~ 5-7 ns Rad. Hard.: ~ 0.5 C/cm <sup>2</sup>	Redundant tracking and triggering
ALICE TPC UPGRADE CERN LS2	Heavy-lon Physics (Tracking + dE/dx)	4-GEM / TPC	Total area: ~ 32 m² Single unit detect: up to 0.3m²	Max.rate:100 kHz/cm <sup>2</sup> Spatial res.: ~300μm Time res.: ~ 100 ns dE/dx: 11 % Rad. Hard.: 50 mC/cm <sup>2</sup>	<ul> <li>50 kHz Pb-Pb rate;</li> <li>Continues TPC readout</li> <li>Low IBF and good energy resolution</li> </ul>