

# 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**

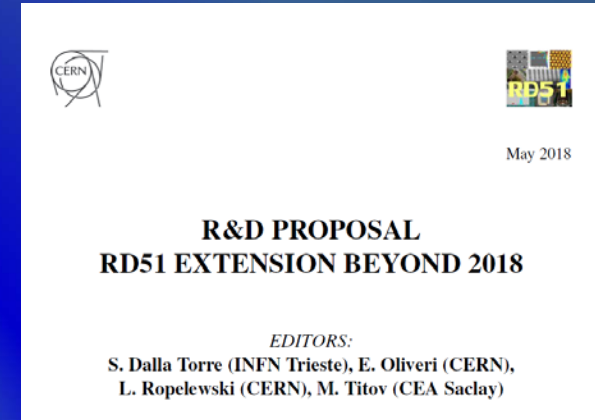
We **invite all MPGD groups** to join this effort and to provide inputs:

- ✓ **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

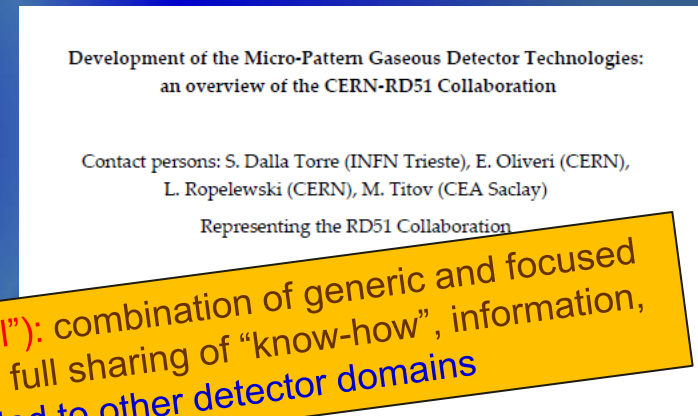
June 2018:

- ✓ R&D PROPOSAL: RD51 Extension beyond 2018”– Approved by the CERN Research Board until 2023  
<https://arxiv.org/abs/1806.09955>



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/>

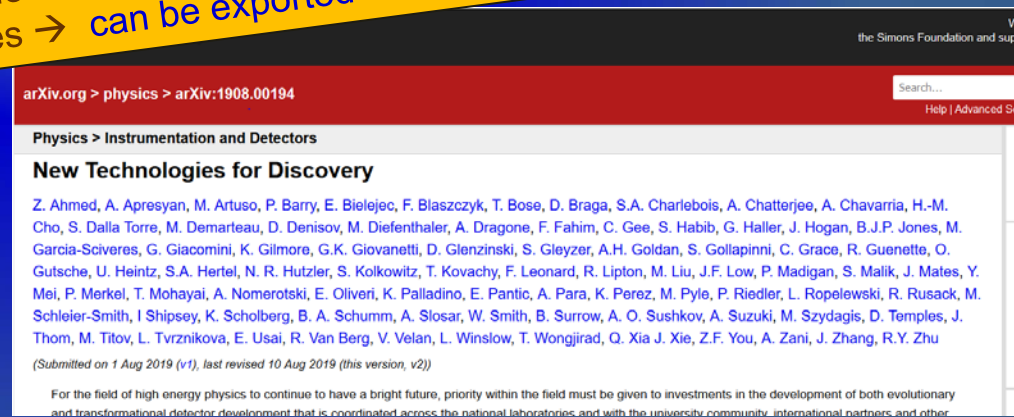


Summer 2019 (USA):

- ✓ Document for the CPAD report  
“New Technologies For Discovery”

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

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



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## 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 corresponding 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	Total detector size / Single module size	Operation Charact. Performance Rad. Environment	Special Requirements / Remarks

- ✓ *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
<b>COMPASS TRACKING</b>  > 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>	<b>Max.rate:</b> ~100kHz/mm <sup>2</sup> <b>Spatial res.:</b> ~70-100μm (strip), ~120μm (pixel) <b>Time res.:</b> ~ 8 ns <b>Rad. Hard.:</b> 2500 mC/cm <sup>2</sup>	Required beam tracking (pixelized central / beam area)
<b>TOTEM TRACKING:</b>  > 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>	<b>Max.rate:</b> 20 kHz/cm <sup>2</sup> <b>Spatial res.:</b> ~120μm <b>Time res.:</b> ~ 12 ns <b>Rad. Hard.:</b> ~ mC/cm <sup>2</sup>	Operation in pp, pA and AA collisions.
<b>LHCb MUON DETECTOR</b>  > 2010	Hadron Collider / B-physics (triggering)	3-GEM	Total area: ~ 0.6 m <sup>2</sup>  Single unit detect: 20-24 cm <sup>2</sup>	<b>Max.rate:</b> 500 kHz/cm <sup>2</sup> <b>Spatial res.:</b> ~ cm <b>Time res.:</b> ~ 3 ns <b>Rad. Hard.:</b> ~ C/cm <sup>2</sup>	Redundant triggering
<b>COMPASS RICH UPGRADE</b>  > 2016	Fixed Target Experiment (RICH - detection of single VUV photons)	Hybrid (THGEM + CsI and MM)	Total area: ~ 1.4 m <sup>2</sup> Single unit detect: ~ 0.6 x 0.6 m <sup>2</sup>	<b>Max.rate:</b> 100 Hz/cm <sup>2</sup> <b>Spatial res.:</b> <~ 2.5 mm <b>Time res.:</b> ~ 10 ns	Production of large area THGEM of sufficient quality
<b>ATLAS MUON UPGRADE</b>  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>	<b>Max. rate:</b> 15 kHz/cm <sup>2</sup> <b>Spatial res.:</b> <100μm <b>Time res.:</b> ~ 10 ns <b>Rad. Hard.:</b> ~ 0.5C/cm <sup>2</sup>	Redundant tracking and triggering; Challenging constr. in mechanical precision
<b>CMS MUON UPGRADE</b>  CERN LS2	Hadron Collider (Tracking/Triggering)	3-GEM	Total area: ~ 143 m <sup>2</sup>  Single unit detect: 0.3-0.4m <sup>2</sup>	<b>Max. rate:</b> 10 kHz/cm <sup>2</sup> <b>Spatial res.:</b> ~100μm <b>Time res.:</b> ~ 5-7 ns <b>Rad. Hard.:</b> ~ 0.5 C/cm <sup>2</sup>	Redundant tracking and triggering
<b>ALICE TPC UPGRADE</b>  CERN LS2	Heavy-Ion Physics (Tracking + dE/dx)	4-GEM / TPC	Total area: ~ 32 m <sup>2</sup>  Single unit detect: up to 0.3m <sup>2</sup>	<b>Max.rate:</b> 100 kHz/cm <sup>2</sup> <b>Spatial res.:</b> ~300μm <b>Time res.:</b> ~ 100 ns <b>dE/dx:</b> 11 % <b>Rad. Hard.:</b> 50 mC/cm <sup>2</sup>	- 50 kHz Pb-Pb rate; - Continues TPC readout - Low IBF and good energy resolution