

DRD1 Logo  
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# Working Group 5: Electronics for gaseous detectors **Introduction**

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1<sup>st</sup> DRD1 Collaboration Meeting, CERN

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*For the first time, electronics has become an enabling, but potentially also limiting, aspect. (ECFA Detector R&D Roadmap)*

# WG5 conveners

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Maxime Gouzevitch – CNRS-IN2P3 Lyon / CERN CMS

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+ DRD7 Liasons Persons:

Marco Bregant – University of São Paulo

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# WG5 mandate



**DRD1**

**DRD1 EXTENDED R&D PROPOSAL  
Development of Gaseous Detectors Technologies  
v1.5**

## Contents

Executive Summary	18
<b>I Executive Summary</b>	<b>18</b>
Executive Summary	19
<b>I.1 Introduction</b>	<b>19</b>
<b>I.2 Scientific Organization of the DRD1 Collaboration</b>	<b>21</b>
I.2.1 Scientific Organization	22
I.2.1.1 Working Groups	23

## **WG5: Electronics for Gaseous Detectors**

Working Group 5 is dedicated to developing, applying, and disseminating electronic components necessary for advancing, qualifying, and operating Gaseous Detectors. WG5 serves as a hub for pooling interests and resources among DRD1 groups. This includes optimizing analog front ends for specific needs, designing new front-end ASICs (from specifications to pre-production prototyping and testing), supporting the development of DAQ systems for R&D and application in small- to mid-size experiments (like the RD51 Scalable Readout System), implementing spark protections, managing high- and low-voltage systems, and deploying monitoring equipment.

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**DRD1**

**DRD1 EXTENDED R&D PROPOSAL**  
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**v1.5**

<b>II Scientific Proposal &amp; R&amp;D Framework</b>	<b>54</b>
<b>Scientific Proposal &amp; Research Framework</b>	<b>55</b>
<b>II.1 Detailed Description of Research Topics and Work Plan</b>	<b>55</b>
II.1.1 Technological Aspects and Developments of New Detector Structures, Common Characterization and Physics Issues [WG1]	55
II.1.1.1 Introduction	55
II.1.1.2 Challenges	58
II.1.2 Applications [WG2]	59
II.1.2.1 Introduction	59
II.1.2.2 Applications based on gaseous detectors technologies	59
II.1.2.3 Common Activities	66
II.1.3 Gas and Material Studies [WG3]	66
II.1.3.1 Introduction	66
II.1.3.2 Common Research Interests	68
II.1.3.3 Infrastructure and Facilities	71
II.1.4 Modelling and Simulations [WG4]	72
II.1.4.1 Introduction	72
II.1.4.2 State of the Art	72
II.1.4.3 Needs of the Communities	74
<b>II.1.5 Electronics for Gaseous Detectors [WG5]</b>	<b>80</b>
II.1.5.1 Introduction	81
II.1.5.2 Status of Readout Systems for Gaseous Detectors	81
II.1.5.3 Front-End Challenges for Future Facilities, Experiments and Applications	86
II.1.5.4 Plan for Modernized Readout Systems	88
II.1.5.5 Topics Beyond the Readout Systems	90

## II.1.5 Electronics for Gaseous Detectors [WG5]

The DRD1 Working Group 5 (WG5) takes responsibility for the development, application and dissemination of electronic components required to operate and further advance Gaseous Detectors (GDs). As an integral part of the detector system, the tools of WG5 are developed together with detector amplification structures in order to achieve the best performances. After the introduction in Section II.1.5.1 and a summary of the state-of-the-art (Section II.1.5.2) the major tasks are outlined in Sections II.1.5.3 to II.1.5.5 and summarised in Tables 16-18.

WG5 topically differentiates itself from ECFA DRD7 in the sense that it focuses on GDs and the electronics required for their R&D and application in small- to mid-size experiments. Methodologically, WG5 is based on the specific requirements of DRD1, developments by the community for the community and dissemination opportunities to future facilities and their experiments. Close exchange with DRD7 is achieved through the membership of electronic experts in both collaborations. DRD1 access to ASIC technologies, licenses, test resources and experts of DRD7 is deemed of mutual benefit for DRD7 since some basics of GD detectors are different, or non-existing in Silicon detectors.

# WG5 main topics (from proposal)



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**v1.5**

## Devices

- Electronic readout system
  - Service electronics
  - Goal: direct use in R&D (lab, test beams) and small to mid-size experiments
- ⇒ HV- / LV systems, monitoring equipment, standardised DAQ systems, support & training
- ⇒ Partially front-end ASICs development, support DRD1 groups who design gaseous detector ASICs

## Attitude

- Common R&D developments for and with DRD1 users
- Qualification and iterative improvement with DRD1 teams
- Long-term vision: Initial test systems can be scaled for experiments

Less important role: Experiment-specific electronics as e.g. ASICs, radiation hardness, high-speed links, data reduction, dense integration (latter mainly in DRD7)

# WG5 Tasks

Involved in almost all current Work Packages (WP)

⇒ Key to many Milestones and Deliverables (example WP4 - TPCs)



#	Task	Performance Goal	DRD1 WGs	ECFA DRDT	Milestones/Deliverable			Institutes
					12M	24M	36M	
T1	IBF reduction	- Reduce IBF in case of gated operation - Reduce IBF in case of ungated operation	WG1, WG2, WG3, WG4, WG6, WG7	1.1, 1.2, 1.3, 1.4	<b>M1</b>  <b>Evaluation of various readout technologies:</b> studies of various gas amplification and readout technologies including pixelised structures to estimate their potential performance in a TPC. [T1, T2, T4, T5]	<b>M2.1</b>  <b>Improvement of dE/dx performance:</b> experimental tests to optimize the dE/dx resolution in various gas mixtures. [T1, T2, T5]  <b>M2.2</b>  <b>Improvement of IBF performance:</b> experimental tests to reach an IBF performance optible with $gain \times IBF < 5$ . [T1, T2, T5]	<b>D</b>  <b>Prototype TPC</b> A small scale prototype detector with good spatial and dE/dx resolution to fulfil the requirements of future accelerators with a gated or ungated operation mode of the TPC. [T1-T5]	IFUSP, U Carleton, IHEP CAS, U Tsinghua, HIP, U Jyväskylä, IRFU/CEA, TUDa, U Bonn, GSI, Wigner, INFN-BA, UniBA, PoliBA, INFN-RM1, U Iwate, CERN, PSI
T2	pixelTPC development	- Develop different technologies for pixelized readout - Build small prototypes to verify spatial resolution - Study dE/dx resolution	WG5			<b>M2.3</b>  <b>Electronics</b> implemented in the SRS and ready for operation with small-scale prototypes. [T4]		
T3	Optimization of mechanical structure	- Reduce material budget of mechanical and electrical field cage - Reduce material budget of the endcap, in particular, the cooling infrastructure						
T4	FEE for TPCs	- Develop a low-power ASIC for TPC readout - Implement a readily available ASIC, which fulfils MPGD-TPC requirements in the Scalable Readout System - Increase the readout rate of TPC-readout with SRS						

# WG5 Tasks





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Common Objectives from inside WG5:

## 5.1 Front End Challenges

Reference	Description	Common Objective
D5.1.1	High-rate RPC electronics	Survey on low-threshold discriminators
D5.1.2	Front-end ASIC for TPCs - WP4 	Description of parameters
D5.1.3	Front-end ASIC for straw chambers - WP3	Description of VMM3/3a
D5.1.4	Front-end ASIC for straw chambers - WP3	VMM3b or new ASIC design
D5.1.5	Front-end ASIC for MPGDs - WP1 	Community survey on chip requirements

 : Talk in this session

# WG5 Tasks



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Common Objectives from inside WG5:

## 5.2 Modernised Readout System

Reference	Description	Common Objective
D5.2.1	SRSe WP1-8	eFEC
D5.2.2	SRSe WP1-8	VMM software and firmware migration
D5.2.3	SRSe - WP1-8	DAQ and reconstruction software
D5.2.4	SRSe	Testing and integration
D5.2.5	Common DAQ/SRS WP1,4	SAMPA implementation
D5.2.6	Common DAQ/SRS - WP4	Timepix3 implementation
D5.2.7	Common DAQ/SRS - RPC	RPC front-end implementation needs, potential and feasibility evaluation (report)
D5.2.8	SRS upgrades	2.5 Gbit Ethernet and L0 trigger $\beta$
D5.2.9	Portable, Connected $\mu$ SRS nodes	readout of distributed, small detectors over long distance



: Talk in this session



# WG5 Tasks

Common Objectives from inside WG5:

## 5.3 Beyond Readout System



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**Development of Gaseous Detectors Technologies**  
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Reference	Description	Common Objective
D5.3.1	MPGD HV - WP1 ★	Stabilised voltage divider
D5.3.2	MPGD LV - WP1-8	PBX
D5.3.3	Monitoring - WP1-8 ★	SoC investigation

★ : Talk in this session

# WG5 Synergies to other DRDs

## I.5.2.5 DRD7: ELECTRONICS AND ON-DETECTOR PROCESSING

In general terms and not to be considered as a request for DRD7, a comprehensive list of the desired electronics advancements in the DRD1 Collaboration is the following:

- High-performance charge-sensitive front-end circuit specific for medium and large-volume gaseous detectors (MPGD, TPC, drift chambers, straw tubes, RPC, ...)

...

Natural personal overlap and exchange with DRD7 

- Profit from general developments and initiatives in DRD7
  - Access to foundries, design kits, tools, technologies, and services
  - Address potential technology limitations
  - Set up proper cooperation frameworks between groups from different institutes and countries
- Try to put DRD1 challenges of general interest on DRD7 agenda
- Clarify responsibilities and duties, use/develop synergies

⇒ DRD1-DRD7 Liason Persons: Marco Bregant and Sorin Martoiu



Talk in this session



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## PRELIMINARY

- Overview of needs, available and potential solutions in the field of electronics for gaseous detectors.
- Working Group Objectives and plan

**Conveners:** Hans Muller (University of Bonn (DE)), Jochen Kaminski (University of Bonn (DE)), Maxime Gouzevitch (Centre National de la Recherche Scientifique (FR)), Michael Lupberger (University of Bonn (DE)), Roberto Cardarelli (INFN e Universita Roma Tor Vergata (IT))

15:00

**Introduction to WG5**

🕒 30m

**Speakers:** Michael Lupberger (University of Bonn (DE)), Michael Lupberger (University of Bonn)



Almost done

15:30

**Development of front-end ASICs for micro-pattern gas detectors emphasized with TPC**

🕒 20m

**Speakers:** Prof. Zhi Deng (Tsinghua University (CN)), Prof. Zhi Deng

15:50

**Relation with DRD7**

🕒 20m

**Speakers:** Marco Bregant (Universidade de Sao Paulo (BR)), Sorin Martoiu (Horia Hulubei National Institute of Physics and Nuclear Engineering (RO)), Sorin Martoiu, Sorin Martoiu

16:10

**Coffee Break**

16:20

**New ASICs for gaseous detectors: HGCROC and HKROC**

🕒 20m

**Speaker:** Dr Christophe De La Taille (OMEGA (FR))

16:40

**Stabilized Voltage Divider**

🕒 20m

**Speaker:** Jakob Krauss (University of Bonn)

17:00

**Scalable Readout System**

🕒 20m

**Speaker:** Hans Muller (University of Bonn (DE))

17:20

**XUP parallel processing unit**

🕒 20m

**Speaker:** Dr Calin Bira (Universitatea Nationala de Stiinta si Tehnologie Politehnica Bucuresti (RO))

# WG5 Organisatorics

Main means of official communication via Mailing list:

- Self-subscription via <https://e-groups.cern.ch/e-groups/> → search: DRD1-WG5
- Direct link: <https://e-groups.cern.ch/e-groups/EgroupsSubscription.do?egroupName=drd1-wg5>  
(being logged in with CERN account required)
- Conveners can also add mail addresses manually

Other resources:

SRS: [Documentation/entry point](#) , [User support Discord channel](#)  
[git repository \(firmware / software\)](#)

Note: Download files & software is public, firmware code is access-controlled

General (see WG8): [DRD1 web page](#), [Forum section?](#), [Mattermost channel?](#)

# WG5 Organisatorics

Open points?

Questions?

Suggestions?

Actions required by conveners?