DRD1 Logo placeholder ;)



# Working Group 5: Electronics for gaseous detectors Introduction

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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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### WG5 mandate



#### DRD1

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

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#### WG5: Electronics for Gaseous Detectors

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

### WG5 mandate



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#### 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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#### **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-specif electrics as e.g. ASICs, radiation hardness, high-speed links, data reduction, dense integration (latter mainly in DRD7)



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#### Involved in almost all current Work Packages (WP)

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

#	Task	Performance Goal	DRD1	ECFA	Milestones/Deliverable			Institutes
"	1458.		WGs	DRDT	12M	24M	36M	mstitutes
TI	IBF reduction	<ul> <li>Reduce IBF in case of gated operation</li> <li>Reduce IBF in case of</li> </ul>	WG1,	1.1,	M1	M2.1	D	IFUSP,
		ungated operation	WG2,	1.2,	Evaluation of various readout	Improvement of dE/dx perfor-	Prototype TPC A small scale pro-	U Carleton,
T2	pixelTPC	- Develop different tech-	WG3,	1.3,	technologies: stud-	mance: experimen-	totype detector with	IHEP CAS,
	development	nologies for pixelized readout	WG4,	1.4	ies of various gas amplification and	tal tests to optimize the dE/dx resolution	good spatial and dE/dx resolution to	U Tsinghua,
		<ul> <li>Build small prototypes to verify spatial resolu- tion</li> </ul>	WG5,		readout technologies including pixelised structures to estimate	in various gas mix- tures.[T1, T2, T5]	fulfil the require- ments of future accelerators with	HIP,
		- Study dE/dx resolution	WG6,		their potential per- formance in a TPC.	M2.2	a gated or ungated operation mode of	U Jyväskylä,
Т3	Optimization	- Reduce material bud-	WG7		[T1, T2, T4, T5]	Improvement of	the TPC. [T1-T5]	IRFU/CEA,
	of mechanical structure	get of mechanical and electrical field cage				IBF performance: experimental tests to reach an IBF		TUDa,
		<ul> <li>Reduce material bud- get of the endcap, in par-</li> </ul>				performance optible		U Bonn,
		ticular, the cooling in- frastructure				with gain×IBF < 5. [T1, T2, T5]		GSI,
T4	FEE for TPCs	- Develop a low-power				M2.3		Wigner,
		ASIC for TPC readout - Implement a readily available ASIC, which				Electronics im- plemented in the		INFN-BA, UniBA, PoliBA,
		fulfils MPGD-TPC requirements in the				SRS and ready for operation with small-scale proto-		INFN-RM1,
		Scalable Readout Sys- tem				small-scale proto- types. [T4]		U Iwate,
		<ul> <li>Increase the readout rate of TPC-readout with SRS</li> </ul>						CERN,
TO E	Commission	with SRS						PSI



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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 de-
		sign
D5.1.5	Front-end ASIC for MPGDs - WP1	Community survey on chip
		requirements





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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 migra-
		tion
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 ß
D5.2.9	Portable, Connected µSRS nodes	readout of distributed, small detec-
		tors over long distance

: Talk in this session

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#### Common Objectives from inside WG5:

#### 5.3 Beyond Readout System

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

## WG5 Synergies to other DRDs

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 largevolume gaseous detectors (MPGD, TPC, drift chambers, straw tubes, RPC, ...)

Natural personal overlap and exchange with DRD7 🛨

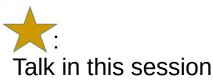


- Profit from general developments and initiatives in DRD7
  - Access to foundries, design kits, tools, technologies, and services
  - Address potential technology limitations
  - Set up proper cooperation frameworks between groups from different institutes and countries
- Try to put DRD1 challenges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



DRD1

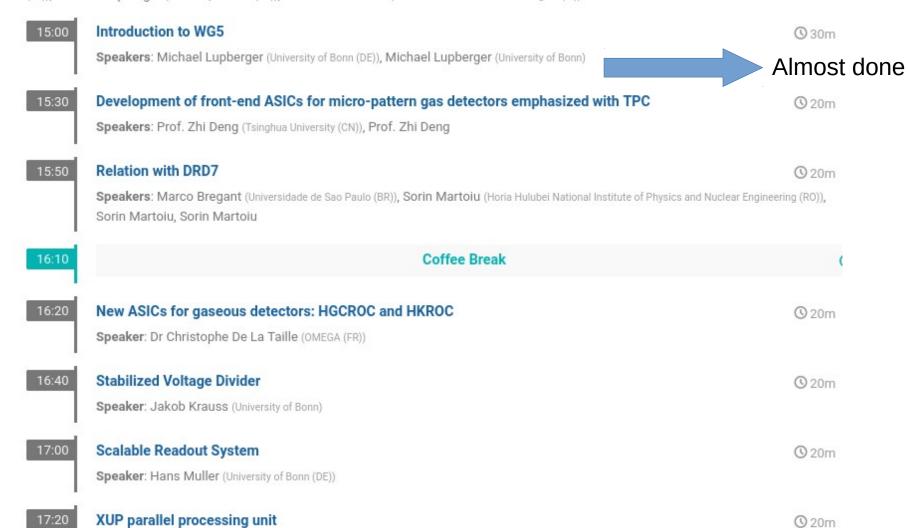
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#### PRELIMINARY

- 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))



## 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?