WP5

Innovative gaseous detectors for calorimetry

- To develop precise gaseous detectors as active media for future calorimeters
- Several technologies are of interest : (M)RPC, MPGD
- The boundaries with DRD6 are well defined

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#	Task	Performance Goal	DRD1 WGs	ECFA DRDT	Milestones/Deliverable 12M	Milestones/Deliverable 24M	Milestones/Deliverable 36M	Institutes
T1	Conception, construction and characterization of large sampling elements for calorimeters	- High efficiency with thin large detectors - Compactness of the active unit including cassettes and possible cooling system - Uniformity in terms of thickness, resistivity and gas circulation	WG1, WG2, WG4, WG7	1.1, 1.3	**M1.1** Construction of medium-sized gaseous detector fulfilling the requirements on efficiency and small dead zones [T1].	**M2.1** Uniformity study including efficiency and cluster size distribution with medium-size detectors. Expected timing performance better than 3 ns in the case of MPGD, 0.7 ns for RPC and 0.15 ns for MRPC with 4 gaps [T2]. **M2.2** Construction of large and thin (few mm) detectors of different technologies (MRPC, RPC, MM, µRWELL, RPWELL) with small dead zones ($<$ 2% dead zone). We propose to build detectors larger than 50 cm $\times$ 50 cm in the case of MPGD and larger than 100 cm $\times$ 100 cm for (M)RPC, featuring dead zones $<$ 2%. The detectors should feature an efficient gas circulation to be used as active layers in granular calorimeters [T1].	**D1.1** **Performance and uniformity** studies of the large and thin detectors of different technologies. Performance goals in terms of: - detector uniformity: $<$ 10% in terms of efficiency an in terms of cluster size [T1], - time resolution below few ns [T2], - high detection rate capabilities up to a few kHz/cm^2 [T4], to be obtained with different kinds of gas mixtures. **D1.2** **The readout electronics** [T3] associated with pickup pads of the order of 1 cm^2: - threshold down to a few fC for MPGD and tens of fC for (M)RPC - time resolution better than 100 ps	IP2I, CIEMAT, VUB and UGent, GWNU, SJTU, MPP, WIS, INFN-BA, UniBA, PoliBA, INFN-RM3, INFN-NA
T2	Timing performance of gaseous detectors for calorimeters	- Timing performance of different technologies - Uniformity of the detector response in terms of timing						
T3	Readout electronics for calorimeter gaseous detectors	- Low-jitters readout electronics - Low power consumption per channel - Active Sensitive Unit (ASU) of large size with good flatness						
T4	High-rate capability gaseous detectors for circular collider calorimeters	- High-rate capability exceeding a few KHz in case of (M)RPC and tens of KHz in case of MPGD - Impact of high particle rate on the detector performance (efficiency, spatial resolution, timing..etc)						

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- **How the WP covers the topics in the ECFA roadmap**

DRDTs

❖ DRDT 1.1 - Precise timing detectors with rate capability, spatial resolution.

❖ DRDT 1.3 – Study eco-friendly solutions for gaseous timing detector

Challenges

-Realization of thin and large surface detectors with high efficiency, excellent uniformity and high-rate capabilities operated with eco-friendly gases

- Very good time resolution

-Embedded readout electronics

Goals

To provide high granular hadronic calorimeters with active media made of gaseous detectors to efficiently apply the PFA techniques and at the same time provide good energy resolution

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Strategy: One project associating different technologies

Two Deliverables

D1.1- Performance and uniformity study of **large detectors built** with different technologies ((M)RPC, MPGD) : **Uniformity** (efficiency&cluster size), **high rate, time** resolution.

D1.2 – Production of panels equipped **with low-noise, low time-jitter readout electronics** to read out large detectors of different technologies in collaboration with **DRD6**

Two milestones

M1.1 : Performance and uniformity study with prototypes of medium size

M1.2: Conception and construction of large surface detectors

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- ***Institutes***
  - → 10 institutes from 8 countries
  - → Most of all are also involved in DRD6 (calorimetry)
  - → Most of them have already worked together on a given technology but in this proposal common studies will be an essential feature

- Institut de la physique des 2 infinis (IP2I)
- Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)
- Vrije Universiteit Brussel (VUB)
- Gangneung-Wonju National University (GWNU)
- Shanghai Jiao Tong University (SJTU)
- Max-Planck Institute for Physics (MPP)
- Weizmann Institute of Science (WIS)
- Bari INFN & University (INFN-ba)
- ROME3 University (ROME3)
- Naples INFN (INFN-Na)

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- ***Funding***

→ The foreseen developments on detectors is already available or almost sure to be available

→ existing readout electronics could be used to characterize but new and more performant ones need to be produced in common with other WPs in DRD1 and DRD6.

Existing

Country	FTE/2024	FTE/2025	FTE/2026	Total
France	2	2	2	6
Italy	2	2	2	6
Spain	0.6	0.6	0.6	2.4
Belgium	0.7	0.7	0.7	2.1
Germany	0.35	0.35	0.35	1.05
Israel	1.5	1.5	1.5	4.5
China	1.5	1.5	1.5	4.5
South Korea	0.6	0.6	0.6	1.8

Country	Funding (k€)
France	40
Italy	10
Spain	15
Belgium	25
Germany	10
Israel	300
China	20
South Korea	30

Additional (not existing)

Country	FTE/2024	FTE/2025	FTE/2026	Total
Spain	0.6	0.6	0.6	2.4

Country	Funding (k€)
Italy	150

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Next steps

Fist step will be to organize the first official meeting of WP5. The major points to be discussed will be:

- Update on the current activities and funding perspectives
- Inventory of the available local facilities and tools
- Discussion of the common activities across the different technologies
  Mechanics, gas, cooling, electronics…

The goal is to build on current R&D activities with available fundings and provide the needed arguments to obtain more fundings and to extend the network to new comers