

Towards a DRD1 proposal

Strong link with ECFA roadmap selected DRDTs.

WG2: Applications

Full alignment with the ECFA detector R&D roadmap

- Muon systems
- Inner and central tracking with particle identification capability
- Calorimetry
- Photon detection
- Time of Flight systems
- TPCs for rare event searches
- Precision experiments
- Straw chambers in vacuum
- Fundamental research applications beyond HEP
- Medical and industrial applications

Inputs for proposal document (see EDP guidance):

- The DRD proposal should establish a programme and a collaborative framework (organisation) to achieve the ECFA roadmap DRDTs
- Define performance parameters targeted by the deliverables in association with the applications at the future strategic programmes considered in the updated European Strategy for Particle physics and listed in the Roadmap document.
- For each DRDT and the associated technologies to be studied, key R&D deliverables during the coming three years, indicative deliverables planned for the following three years and longer-term ambitions should be identified
- The key R&D deliverables should be identified within each corresponding technology area and the associated resources in each technology area estimated. → **WG2 and synergy with other WG.**

Proposal guidance

Proposal for the DRD1 collaboration would cover a large number of Collaborative topics. But for the purpose of the DRDC review the guidance are:

2. Main Proposal

To keep the process manageable for both proponents and reviewers, it is recommended that the DRD proposal document should not exceed 20 pages, following a common outline template as suggested below:

- Introduction (objectives of the DRD collaboration)
- Planning technology area 1 (including a task/deliverable synoptic, resources and list of contributing institutes)
- ...
- Planning technology area n (including a task/deliverable synoptic, resources and list of contributing institutes)
- Common simulation tools and test facilities
- Partnerships (industrial, other research areas, other applications)
- Networking and training
- Proposal for the collaboration structure
- Resources (as discussed below) both existing and anticipated
- Summary (high level planning synoptic by DRDT broken-down to sub-areas)

Proposal guidance deliverables

For each DRDT and the associated technologies to be studied, key R&D deliverables during the coming three years, indicative deliverables planned for the following three years and longer-term ambitions should be identified (see Table 1)

Timeline of milestones and major deliverables per DRDT and technology					
Deliverables or milestones in appropriate years	2024	2025	2026	2027-2029	≥ 2030
DRDT 1					
Technology 1	List of deliverables in year due (if any)				
...					
Technology n	List of deliverables in year due (if any)				
...					
DRDT n					
Technology 1	List of deliverables in year due (if any)				
...					
Technology n	List of deliverables in year due (if any)				

- Breakdown by DRDT to feature goals and then TA options to achieve them
 - list of deliverables based on goals and community inputs (with an appropriate level of grouping)
 - first three years likely based on on-going activities
 - mid/longer term with coarser granularity based on perspective to achieve the strategic planning

Proposal guidance requested FTEs

The associated required resources for the outlined programme need to be split into effort in FTEs

Timeline of FTE per DRDT and technology					
Total FTE estimated to be required to deliver the outlined R&D programme	2024	2025	2026	2027-2029	≥ 2030
DRDT 1					
Technology 1	Total required FTE				
...					
Technology n	Total required FTE				
...					
DRDT n					
Technology 1	Total required FTE				
...					
Technology n	Total required FTE				

We need to **evaluate the “requested FTE” (not the available!) to accomplish the work every year.**

Of course we have to monitor that we will have enough FTE for that.

It is expected that the accompanying text will provide the justification for the required resources in terms of the outlined R&D programme by technology area, with specific reference to the listed deliverables.

Note that the “available” resource are confidential matter

Proposal guidance requested funds

Timeline of Materials and Services (non-FTE) Funding per DRDT and technology					
Total non-FTE funds estimated to be required to deliver the outlined R&D programme	2024	2025	2026	2027-2029	≥ 2030
DRDT 1					
Technology 1	Total required funds				
...					
Technology n	Total required funds				
...					
DRDT n					
Technology 1	Total required funds				
...					
Technology n	Total required funds				

Note that the “available” resource are confidential matter

Confidential part

Timeline of FTE per DRDT and technology				
Estimate of expected total FTE from existing sources (not requiring new "strategic" support)	2024	2025	2026	≥ 2027
DRDT 1				
Technology 1	Total estimated FTE from existing sources			
...				
Technology n	Total estimated FTE from existing sources			
...				
DRDT n				
Technology 1	Total estimated FTE from existing sources			
...				
Technology n	Total estimated FTE from existing sources			
...				
Timeline of Materials and Services (non-FTE) Funding per DRDT and technology				
Estimate of expected total non-FTE funds from existing sources (not requiring new "strategic" funding)	2024	2025	2026	≥ 2027
DRDT 1				
Technology 1	Total estimated funds from existing sources			
...				
Technology n	Total estimated funds from existing sources			
...				
DRDT n				
Technology 1	Total estimated funds from existing sources			
...				
Technology n	Total estimated funds from existing sources			
...				
Timeline of FTE per DRDT and technology				
Estimate of total R&D programme FTE (sum of existing and hoped for given realistic assumptions)	2024	2025	2026	≥ 2027
DRDT 1				
Technology 1	Total number of FTE proposed			
...				
Technology n	Total number of FTE proposed			
...				
DRDT n				
Technology 1	Total number of FTE proposed			
...				
Technology n	Total number of FTE proposed			
...				
Timeline of Materials and Services (non-FTE) Funding per DRDT and technology				
Estimate of total R&D programme non-FTE funding (sum of existing and hoped for given realistic assumptions)	2024	2025	2026	≥ 2027
DRDT 1				
Technology 1	Total funding proposed			
...				
Technology n	Total funding proposed			
...				
DRDT n				
Technology 1	Total funding proposed			
...				
Technology n	Total funding proposed			
...				

- it will be needed to compile estimates of resources to be submitted confidentially to the DRDC to provide evidence that the proposed R&D programme is realistically achievable

Table 3 Confidential Compilation of Available and Required Resources

Confidential part

Proposed DRD input request to the community per DRDT				
Description/timeline/resources	Technology Deliverable 1	Technology deliverable n
DRDT 1				
Description of technology				
Strategic program(s) target				
Performance target				
Planned date, 2024-2025-2026, 2027-2029, ≥ 2030				
Existing R&D framework and/or list of contributors				
Description of contribution to the technology deliverable				
FTE contributions already covered or expected to continue				
"Materials" funding already covered or expected to continue				
Proposed FTE that would be needed to cover longer term strategic aspirations (≥ 2027)				
Proposed "Materials" that would be needed to cover longer term strategic aspirations (≥ 2027)				
...				
DRDT n				
Description of technology				
Strategic program(s) target				
Performance target				
Planned date, 2024-2025-2026, 2027-2029, ≥ 2030				
Existing R&D framework and/or list of contributors				
Description of contribution to the technology deliverable				
FTE contributions already covered or expected to continue				
"Materials" funding already covered or expected to continue				
Proposed FTE that would be needed to cover longer term strategic aspirations (≥ 2027)				
Proposed "Materials" that would be needed to cover longer term strategic aspirations (≥ 2027)				

Table 4 Suggested Template to Collect Community Input estimates. (A technology deliverable is a contribution to a physical object, it can be a component or a dedicated study prepared in collaboration with other contributors.)

Proposal how to proceed?

How to build our DRD1 table for deliverable (and FTE/funds).

We first need to agree on the performance target.

WG2 get in contact with experts from the facilities and identify the performance target

"Technical" Start Date of Facility		DRDT	< 2030					2030-2035					2035-2040	2040-2045		> 2045				
			SPS Fixed Target (Amber, NA62+, NA60)	FAIR (PANDA, CBM)	Other fixed target (COMET, MU2E, ...)	Neutrino Near Detectors (DUNE)	Large Ton dual-phase (PandaX-4T, LZ, DarkSide-20k, Argo 200k, ARIADNE...)	Light dark matter, solar axion, 0nbb, rare nuclei/bions and astroparticle reactions, Ba tagging	LHCb (± LS4)	ATLAS/CMS (± LS4)	EIC	LHeC	R&D for 100-Ton scale dual-phase DM/neutrino experiments	R&D Ton scale 0nbb	ILC	FCC-ee	CLIC	STCF	FCC-hh	FCC-eh
Muons system	Proposed technologies: RPC, Multi-GEM, resistive-GEM, Micromegas, micro-pixel Micromegas, μ Rwell, μ PIC...	Rad-hard/longevity	1.1	1.1																
	Time resolution	1.1	100																	
	Fine granularity	1.1																		
	Gas properties (eco-gas)	1.3																		
	Spatial resolution	1.1	<1 mm																	
	Rate-capability	1.3	500kHz/cm ²																	
Inner/Central Tracking with PID capability	Proposed technologies: TPC (multi-GEM, Micromegas, Gridpix), Drift Chambers, Cylindrical layers of MPGD, Straw chambers	Rad-hard/longevity	1.1																	
	Low X0	1.2																		
	IBF (TPC only)	1.2																		
	Time resolution	1.1																		
	Rate-capability	1.3																		
	dE/dx	1.2																		
Preshower/Calorimeters	Proposed technologies: RPC, MRPC, Micromegas and GEM, μ Rwell, InGrid (integrated Micromegas grid with pixel readout), Pico-sec, FTM	Rad-hard/longevity	1.1																	
	Low power	1.1																		
	Gas properties (eco-gas)	1.3																		
	Fast timing	1.1																		
	Fine granularity	1.1																		
	rate-capability	1.3																		
Photon detectors/TOF	Proposed technologies: RICH+MPGD, TRD+MPGD, TOF: MRPC, Pico-sec, FTM	large array/integration	1.3																	
	Rad-hard (photocathode)	1.1																		
	IBF (RICH only)	1.2																		
	Precise timing	1.1																		
	Rate-capability	1.3																		
	dE/dx	1.2																		
TPC for rare decays	Fine granularity	1.1																		
	Low power	1.4																		
	Fine granularity	1.4																		
	Large array/volume	1.4																		
	Higher energy resolution	1.4																		
	Lower energy threshold	1.4																		
	Optical readout	1.4																		
	Gas pressure stability	1.4																		
	Radiopurity	1.4																		

Collecting some ideas here

https://docs.google.com/spreadsheets/d/16-hkiD0_eVwtiEKdn9Tdo7EwtzOI84VM78SkExqT5Yg/edit?usp=sharing

Proposal FTE table: by applications (I)

Starting from the TF1 matrix and organize by themes and applications

DRDT	Applications	Goal technology relateed	List of FTE					
			2024	2025	2026	2027-2030	> 2030	
1.1	Inner/Central Tracking with PID capability							
	Muon system							
	Photon detectors/TOF	See Piotr list						
	Preshower/Calorimeters							
1.2	Inner/Central Tracking with PID capability							
	Photon detectors/TOF	See Piotr list						
1.3	Inner/Central Tracking with PID capability							
	Muon system							
	Photon detectors/TOF	See Piotr list						
1.4	Preshower/Calorimeters							
	TPC for rare decays							

We need to write FTE needed to accomplish the work (not available)

4. PID-Photodetectors

Task 4.1: Development of large-area, high-rate, timing MRPCs

- Goal: rate and timing capabilities. 25 kHz/cm², $\sigma_t \sim 50$ ps

Task 4.2: Development of MPGD-based timing detectors

- Goal: 15-20 ps time resolution, large areas, stability

Task 4.3: Ultra high-rate MRPC development

- Goal: 100-150 kHz/cm², $\sigma_t \sim 50$ ps, MRPC technology in single cell/channel layout

Task 4.4: Position Sensitive Timing RPCs.

- Development of large area (\sim m²) position sensitive (< 1 mm) and timing (< 100 ps) RPCs

Task 4.5: Development of photocathodes for Cherenkov-based timing detectors

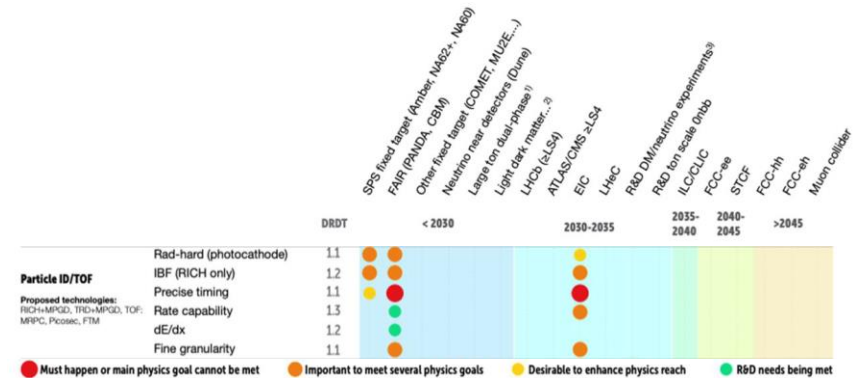
- Goal: preserve efficiency and lifetime

Task 4.6: Development of photoconverters for RICH

- Goal: robust photoconverters compatible with operation in gas detectors (hydrogenated nanodiamonds)

Task 4.7 New generation of TRDs

- Goal: differentiate response to X-ray and ionization



Proposal WorkPackages and deliverables (II)

With the goal of preparing WPs, starting from the TF1 matrix and organize by themes and performance tasks (transversal to the technologies), identify the WPs (including technology options, additional infrastructure required)

Some tasks can be merged (Ex. Fast timing+precision timing)

				List of deliverable/milestones				
				2024	2025	2026	2027-2030	> 2030
	Work packages based on performance (some can be grouped) : general starting point	Applications	possible common tasks in WPs (including Technology options)	possible deliverable? in due year	possible deliverable ? in due year	possible deliverable ? in due year		
1.1	Fast timing	Preshower/Calorimeters	electroncis/simulations/prototyping/infrastructure	...towards the target performance in first 3 years (working prototype?):				
	Fine granularity	Inner/Central Tracking with PID capability						
		Muon system						
		Photon detectors/TOF						
		Preshower/Calorimeters						
	Low power	Preshower/Calorimeters						
	Precise timing	Photon detectors/TOF						
	Rad-hard (photocathode)	Photon detectors/TOF						
	Rad-hard/longevity	Inner/Central Tracking with PID capability						
		Muon system						
	Preshower/Calorimeters							
	Spatial resolution	Muon system						
	Time resolution	Inner/Central Tracking with PID capability						
1.2	dE/dx	Inner/Central Tracking with PID capability						
		Photon detectors/TOF						
	IBF (RICH only)	Photon detectors/TOF						
	IBF (TPC only)	Inner/Central Tracking with PID capability						
	Low XO	Inner/Central Tracking with PID capability						
1.3	Gas properties (eco-gas)	Muon system					validation of eco-mixture	
		Preshower/Calorimeters						
	large array/integration	Preshower/Calorimeters						
	Rate-capability	Inner/Central Tracking with PID capability						
		Muon system						
		Photon detectors/TOF						
		Preshower/Calorimeters						
1.4	Fine granularity	TPC for rare dacays						
	Gas pressure stability	TPC for rare dacays						
	Higher energy resolution	TPC for rare dacays						
	Large array/volume	TPC for rare dacays						
	Low power	TPC for rare dacays						
	Lower energy threshold	TPC for rare dacays						
	Optical readout	TPC for rare dacays						
	Radiopurity	TPC for rare dacays						

We need to identify very “few reachable” deliverable per year, technology oriented

Proposal WorkPackages

Starting from the TF1 matrix and organize by themes and performance tasks, identify the WPs (transversal to the technologies):

WP can be organized in tasks

- Goals for each technology options (performance goal linked to technology → see from Piotr “4. PID-Photodetectors” in next slide)
- Additional infrastructure/electronics DAQ required (link to WP5, WP6, WP7)
 - Details of the new requests
- Additional software tool (licences, developments need) (WP4(

We need to identify very “few reachable” deliverable per year (technology oriented)

Proposal requested FTE

Starting from the TF1 matrix and organize by themes and performance tasks (transversal to the technologies)

Some tasks can be merged (Ex. Fast timing+precision timing..).

			Requested FTE				
			2024	2025	2026	2027-2030	> 2030
	Work packages based on performance (some can be grouped)	Applications					
1.1	Fast timing	Preshower/Calorimeters					
	Fine granularity	Inner/Central Tracking with PID capability					
		Muon system					
		Photon detectors/TOF					
		Preshower/Calorimeters					
	Low power	Preshower/Calorimeters					
	Precise timing	Photon detectors/TOF					
	Rad-hard (photocathode)	Photon detectors/TOF					
	Rad-hard/longevity	Inner/Central Tracking with PID capability					
		Muon system					
		Preshower/Calorimeters					
	Spatial resolution	Muon system					
Time resolution	Inner/Central Tracking with PID capability						
	Muon system						
1.2	dE/dx	Inner/Central Tracking with PID capability					
		Photon detectors/TOF					
	IBF (RICH only)	Photon detectors/TOF					
	IBF (TPC only)	Inner/Central Tracking with PID capability					
Low X0	Inner/Central Tracking with PID capability						
1.3	Gas properties (eco-gas)	Muon system					
		Preshower/Calorimeters					
	large array/integration	Preshower/Calorimeters					
	Rate-capability	Inner/Central Tracking with PID capability					
		Muon system					
		Photon detectors/TOF					
Preshower/Calorimeters							

Proposal requested funds

Starting from the TF1 matrix and organize by themes and performance tasks (transversal to the technologies)

Some tasks can be merged (Ex. Fast timing+precision timing..).

			Requested funds				
			2024	2025	2026	2027-2030	> 2030
	Work packages based on performance (some can be grouped)	Applications					
1.1	Fast timing	Preshower/Calorimeters					
	Fine granularity	Inner/Central Tracking with PID capability					
		Muon system					
		Photon detectors/TOF					
		Preshower/Calorimeters					
	Low power	Preshower/Calorimeters					
	Precise timing	Photon detectors/TOF					
	Rad-hard (photocathode)	Photon detectors/TOF					
	Rad-hard/longevity	Inner/Central Tracking with PID capability					
		Muon system					
		Preshower/Calorimeters					
	Spatial resolution	Muon system					
Time resolution	Inner/Central Tracking with PID capability						
	Muon system						
1.2	dE/dx	Inner/Central Tracking with PID capability					
		Photon detectors/TOF					
	IBF (RICH only)	Photon detectors/TOF					
	IBF (TPC only)	Inner/Central Tracking with PID capability					
	Low X0	Inner/Central Tracking with PID capability					
1.3	Gas properties (eco-gas)	Muon system					
		Preshower/Calorimeters					
	large array/integration	Preshower/Calorimeters					
		Inner/Central Tracking with PID capability					
	Rate-capability	Muon system					
		Photon detectors/TOF					
	Preshower/Calorimeters						

Proposal requested funds

Starting from the TF1 matrix and organize by themes and performance tasks (transversal to the technologies)

Some tasks can be merged

			Requested Funds				
			2024	2025	2026	2027-2030	> 2030
1.4	Fine granularity	TPC for rare decays					
	Gas pressure stability	TPC for rare decays					
	Higher energy resolution	TPC for rare decays					
	Large array/volume	TPC for rare decays					
	Low power	TPC for rare decays					
	Lower energy threshold	TPC for rare decays					
	Optical readout	TPC for rare decays					
	Radiopurity	TPC for rare decays					

We need to **evaluate the “requested FTE” (not the available!) to accomplish the work every year.**

Of course we have to monitor that we will have enough FTE for that.

It is expected that the accompanying text will provide the justification for the required resources in terms of the outlined R&D programme by technology area, with specific reference to the listed deliverables.

Note that the “available” resource are confidential matter

Proposal guidance: list of contributors

List of deliverables per technology and DRDT				
List of Contributing Institutes	Technology 1	Technology n
DRDT 1	List of contributors			
...				
DRDT n	List of contributors			

Table 2 List of Institutes in Matrix of Technology Area vs DRDT