DRD1, WORK PACKAGES

DRD1 proposal

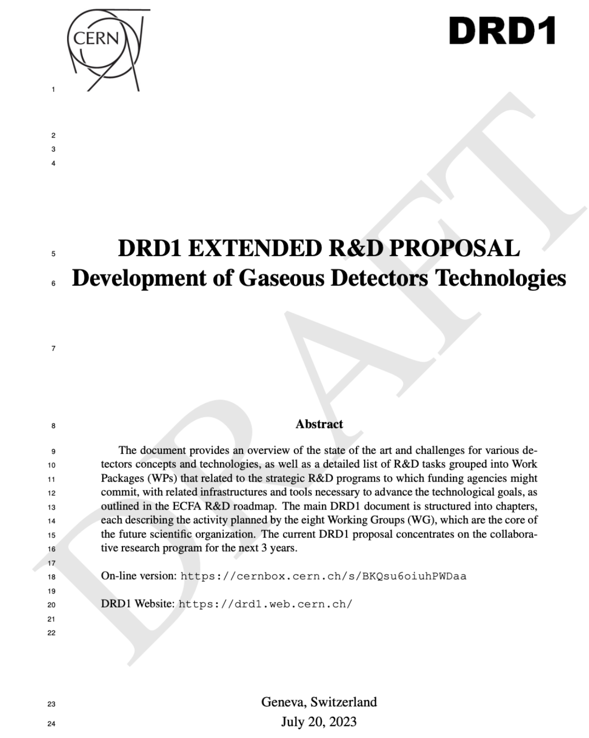
DRD1 document submitted for DRDC review on 31.07

https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa

Structure of the document:

- Introduction
- Scientific organization of DRD1 Collaboration
- Collaboration Organization
- Resources and Infrastructure
- Partners and Their Fields of Contributions
- Steps towards the formation of DRD1

- Research topics and Work plan
  - 8 sections: one per Working Group
  - WorkPackages described in 7.2



DRD1

DRD1 EXTENDED R&D PROPOSAL
Development of Gaseous Detectors Technologies

Abstract

The document provides an overview of the state of the art and challenges for various detectors concepts and technologies, as well as a detailed list of R&D tasks grouped into Work Packages (WPs) that related to the strategic R&D programs to which funding agencies might commit, with related infrastructures and tools necessary to advance the technological goals, as outlined in the ECFA R&D roadmap. The main DRD1 document is structured into chapters, each describing the activity planned by the eight Working Groups (WG), which are the core of the future scientific organization. The current DRD1 proposal concentrates on the collaborative research program for the next 3 years.

On-line version: https://cernbox.cern.ch/s/BKQsu6oiuhPWDaa

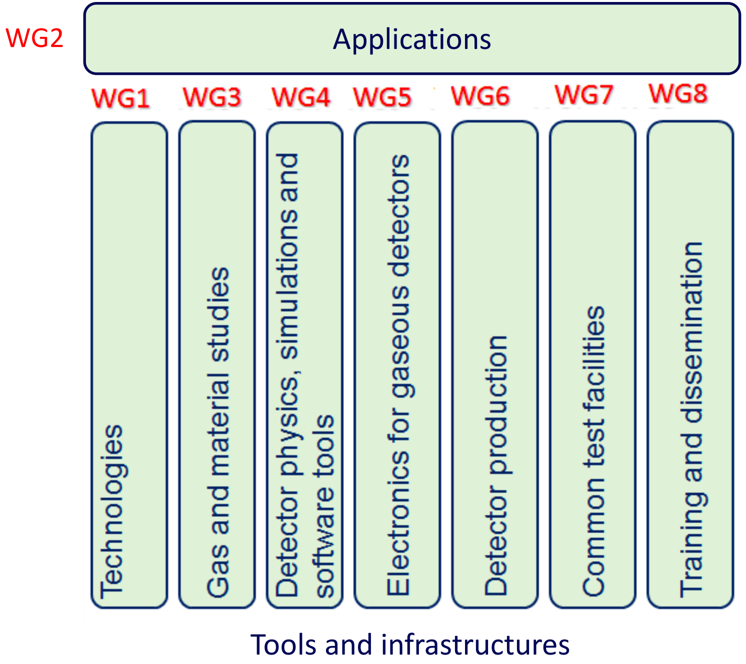
DRD1 Website: https://drd1.web.cern.ch/

Geneva, Switzerland
July 20, 2023

DRAFT

DRD1 structure

- Structure in Working Groups, forum for scientific discussions, coordinated by conveners:



DRD1 scientific organization: Working groups

Working Groups are the core of the scientific collaboration

- supporting the development of novel technologies and the consolidation of existing ones.
- facilitating the exchange of ideas and foster synergies between institutes
- playing a crucial role in identifying, guiding, and supporting strategic detector R&D directions, facilitating the establishment of joint projects between institutes
- serving as a knowledge and technology hub for developing gaseous detector technologies:
  - Technological Aspects and Developments of New Detector Structures, Common Characterization and Physics Issues
  - Applications
  - Gas and material studies, and link to the novel technologies
  - Detector Physics, Modelling and Simulation frameworks
  - Electronics for gaseous detectors
  - Production and Technology Transfer
  - Common Test Facilities and Infrastructures
  - Training and dissemination

→ **WGs will be recognized as a scientific reference for the community.**

Organization of the collaboration activities

Following the indication of ECFA Detector Panel two areas of Detector R&D :

- ”Blue-sky” R&D (competitive, short-term responsive grants, nationally organised)
- Strategic R&D via DRD Collaborations (long-term strategic R&D lines) (address the high-priority items defined in the Roadmap via the DRDTs)

Two types of DRD1 joint projects will be implemented:

Common projects

For low-TRL (blue sky) R&D, or other short term generic projects

Funding method:

- Metabolism of each group
- EU, National projects
- DRD1 common fund

Work Packages

Strategic R&D targeting the priority programmes outlined in the updated European Strategy for Particle Physics.

Funding method:

Each institute asks its funding agency and controls the funds

Common projects

Common Projects (CP) support **low TRL (blue-sky) R&D** considered of interest by the collaboration, **or generic projects (not related to experiments) that are vital for the community and require** special backing:

- Technology R&D projects towards developments of novel techniques, improvements of existing technologies, characterization methods and dedicated tools;
- Development and optimization for novel applications;
- Improvement of the technology transfer to industry.

This is a well-defined path (RD51 experience)

DRD1 Common Fund (details will be clearly defined in the MoU) supports CP with matching resources from participating Institutes.

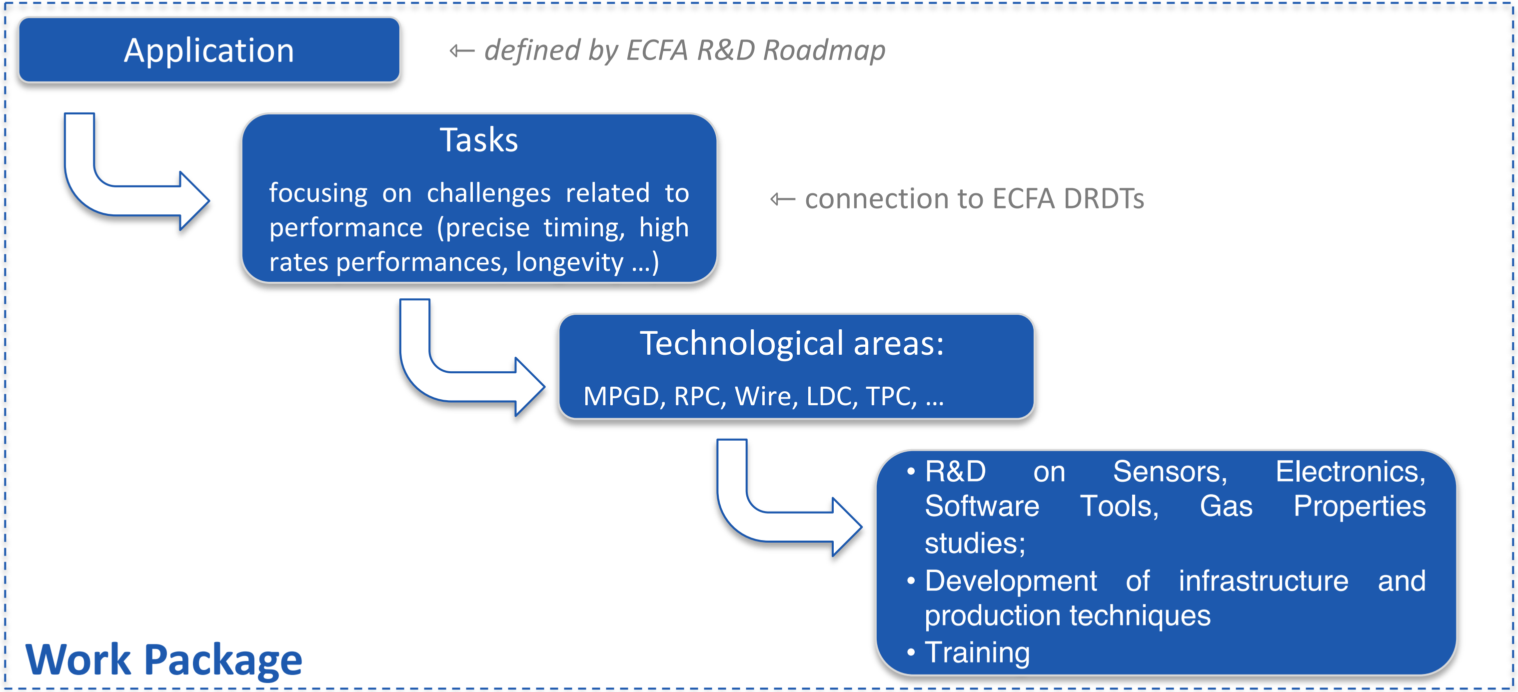
- a minimum number of participating Institutes to encourage collaborative effort between groups.
- limited in time
- limited funding support from the collaboration (example 20-30k/y)

➔ large number of groups in DRD1 ensures strong R&D

Reviewed by the DRD1 Collaboration

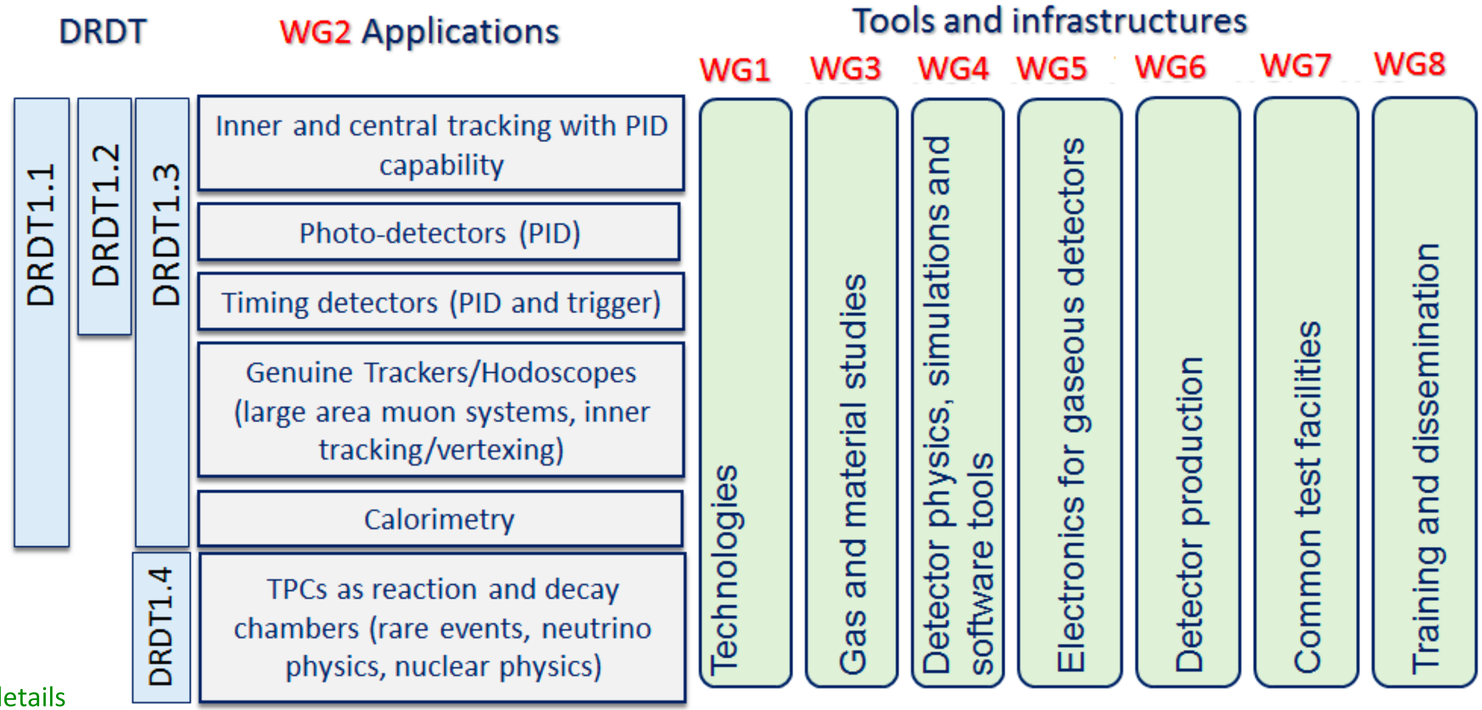
Work Packages

- **Strategic R&D** (according to the ECFA Detector R&D Roadmap) **is organized in Work Packages**
  - group activities of the Institutes with **shared research interests** around **Applications** with a focus on a **specific task(s)** devoted to a specific DRDT challenge, typically related to specific **Detector Technologies and** to the development of **specific tools or infrastructure**



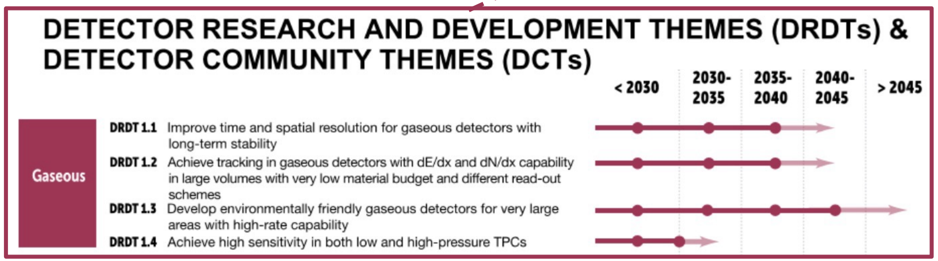
DRD1 structure incl. WPs

- Structure in Working Groups, forum for scientific discussions, coordinated by conveners:
  - aligned with the scientific program of the ECFA roadmap through the applications related to future facilities challenges, outlined by R&D Themes (DRDTs*), but also to the GSRs* (General Recommendation Strategies)

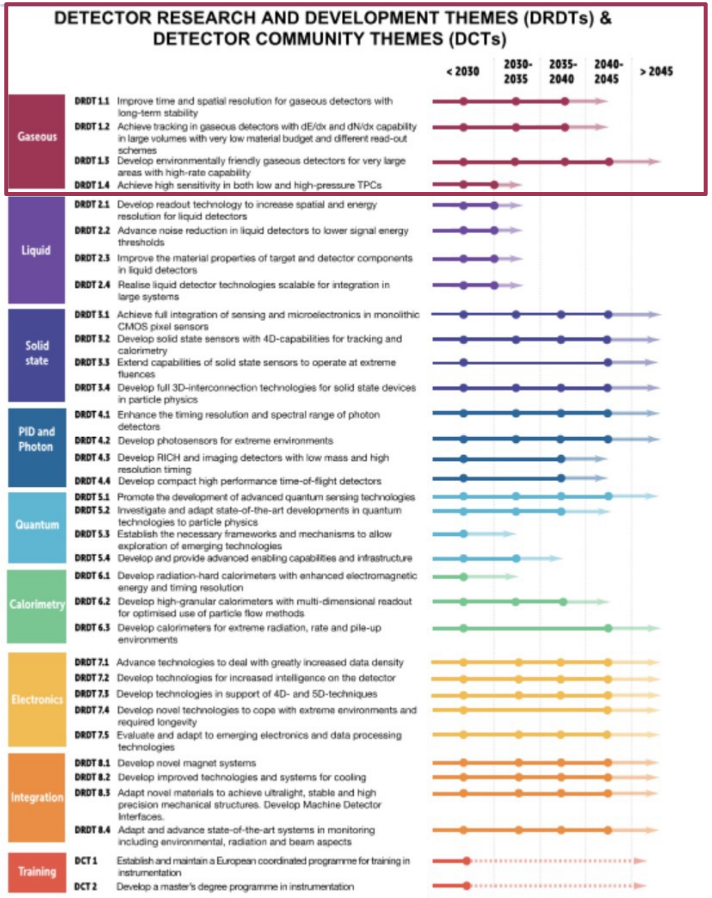


* See backup for details

DRD Themes



DETECTOR RESEARCH AND DEVELOPMENT THEMES (DRDTs) &
DETECTOR COMMUNITY THEMES (DCTs)
Gaseous
DRDT 1.1 Improve time and spatial resolution for gaseous detectors with long-term stability
DRDT 1.2 Achieve tracking in gaseous detectors with dE/dx and dN/dx capability in large volumes with very low material budget and different read-out schemes
DRDT 1.3 Develop environmentally friendly gaseous detectors for very large areas with high-rate capability
DRDT 1.4 Achieve high sensitivity in both low and high-pressure TPCs
< 2030
2030-2035
2035-2040
2040-2045
> 2045



DETECTOR RESEARCH AND DEVELOPMENT THEMES (DRDTs) &
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< 2030
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Gaseous
DRDT 1.1 Improve time and spatial resolution for gaseous detectors with long-term stability
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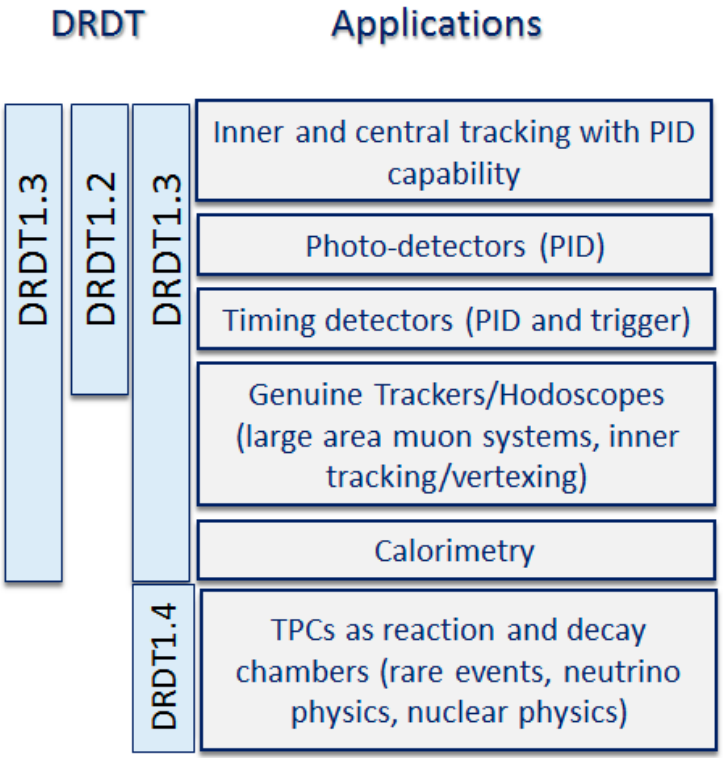
DRDT 1.3 Develop environmentally friendly gaseous detectors for very large areas with high-rate capability
DRDT 1.4 Achieve high sensitivity in both low and high-pressure TPCs
Liquid
DRDT 2.1 Develop readout technology to increase spatial and energy resolution for liquid detectors
DRDT 2.2 Advance noise reduction in liquid detectors to lower signal energy thresholds
DRDT 2.3 Improve the material properties of target and detector components in liquid detectors
DRDT 2.4 Realise liquid detector technologies scalable for integration in large systems
Solid state
DRDT 3.1 Achieve full integration of sensing and microelectronics in monolithic CMOS pixel sensors
DRDT 3.2 Develop solid state sensors with 4D-capabilities for tracking and calorimetry
DRDT 3.3 Extend capabilities of solid state sensors to operate at extreme fluences
DRDT 3.4 Develop full 3D-interconnection technologies for solid state devices in particle physics
PID and Photon
DRDT 4.1 Enhance the timing resolution and spectral range of photon detectors
DRDT 4.2 Develop photosensors for extreme environments
DRDT 4.3 Develop RICH and imaging detectors with low mass and high resolution timing
DRDT 4.4 Develop compact high performance time-of-flight detectors
Quantum
DRDT 5.1 Promote the development of advanced quantum sensing technologies
DRDT 5.2 Investigate and adapt state-of-the-art developments in quantum technologies to particle physics
DRDT 5.3 Establish the necessary frameworks and mechanisms to allow exploration of emerging technologies
DRDT 5.4 Develop and provide advanced enabling capabilities and infrastructure
Calorimetry
DRDT 6.1 Develop radiation-hard calorimeters with enhanced electromagnetic energy and timing resolution
DRDT 6.2 Develop high-granular calorimeters with multi-dimensional readout for optimised use of particle flow methods
DRDT 6.3 Develop calorimeters for extreme radiation, rate and pile-up environments
Electronics
DRDT 7.1 Advance technologies to deal with greatly increased data density
DRDT 7.2 Develop technologies for increased intelligence on the detector
DRDT 7.3 Develop technologies in support of 4D- and 5D-techniques
DRDT 7.4 Develop novel technologies to cope with extreme environments and required longevity
DRDT 7.5 Evaluate and adapt to emerging electronics and data processing technologies
Integration
DRDT 8.1 Develop novel magnet systems
DRDT 8.2 Develop improved technologies and systems for cooling
DRDT 8.3 Adapt novel materials to achieve ultralight, stable and high precision mechanical structures. Develop Machine Detector Interfaces.
DRDT 8.4 Adapt and advance state-of-the-art systems in monitoring including environmental, radiation and beam aspects
Training
DCT 1 Establish and maintain a European coordinated programme for training in instrumentation
DCT 2 Develop a master's degree programme in instrumentation

Work Packages

DRDT	Applications	Link to WG activities	Milestones/interested institutions
DRDT1.3, DRDT1.2, DRDT1.3	Inner and central tracking with PID capability	• Tools/infrastructures (WGs)	• Task1 – Milestones, Institutions • Task2 – Milestones, Institutions • ....
DRDT1.3, DRDT1.2, DRDT1.3	Photo-detectors (PID)	• Tools/infrastructures (WGs)	• Task1 – Milestones, Institutions • Task2 – Milestones, Institutions • ....
DRDT1.3, DRDT1.2, DRDT1.3	Timing detectors (PID and trigger)	• Tools/infrastructures (WGs)	• Task1 – Milestones, Institutions • Task2 – Milestones, Institutions • ....
DRDT1.3, DRDT1.3	Genuine Trackers/Hodoscopes (large area muon systems, inner tracking/vertexing)	• Tools/infrastructures (WGs)	• Task1 – Milestones, Institutions • Task2 – Milestones, Institutions • ....
DRDT1.3, DRDT1.3	Calorimetry	• Tools/infrastructures (WGs)	• Task1 – Milestones, Institutions • Task2 – Milestones, Institutions • ....
DRDT1.4	TPCs as reaction and decay chambers (rare events, neutrino physics, nuclear physics)	• Tools/infrastructures (WGs)	• Task1 – Milestones, Institutions • Task2 – Milestones, Institutions • ....

Work Packages



WP2: Drift Chambers, **WP3**: Straw Chambers, **WP4**: (Large Volume) Tracking TPCs

WP6

WP7

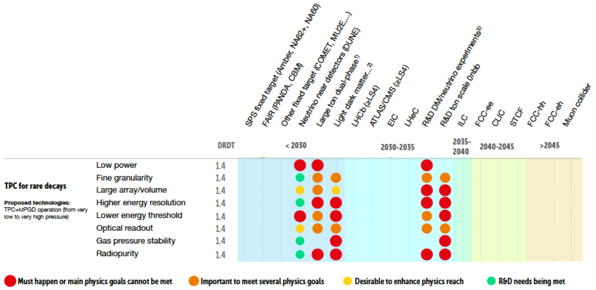
WP1

WP5

WP8

WP8: TPCs as reaction and decay chambers

(RARE EVENTS, NEUTRINO PHYSICS, NUCLEAR PHYSICS)



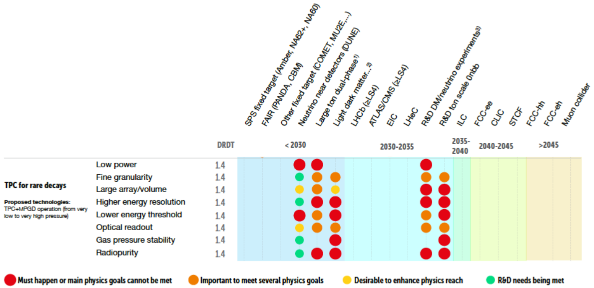
Challenges/tasks

- Reconstruct low-energy nuclear tracks (down to 10 keV energy-scale) with high granularity and close to the thermal diffusion limit.
- Low energy threshold (keV or less) far from atmospheric pressure (10mbar-20bar).
- Achieving high and uniform amplification in nearly pure or weakly-doped noble gases
- Increasing optical throughput (primary and secondary)
- Developing more suitably scintillating and/or eco-friendly gas mixtures as well as recuperation systems;
- Enhancing the radiopurity of the amplification structure and of the TPC as a whole

#	Task	Performance Goal	DRD1 WGs	ECFA DRDT	Comments	Deliv. next 3y	Interested Institutes
T1	Enhanced operation of optical readout across gas densities	- Achieve an ionization-energy threshold of at least ≈keV in the range 10 mbar to 10 bar (and, in the case of noble gases, to saturated vapours and even to the liquid state) with a scalable concept. - Reconstruction of MeV-nuclei of variable stopping power, with mm and sub-mm sampling.	WG1, WG6, WG7	1.2, 1.4	- High optical gain across gas densities in pure CF_4 and CF_4-based mixtures with keV-sensitivity. - Fine track sampling capabilities in the range of 10's of µm to few mm. - Adaptations in optics and camera readout to cover larger areas, at low granularity and with drift-time information (3D-readout). - Simultaneous detection of low and high ionization particles.	- Low-pressure nuclear track reconstruction at ≈10 keV. - Low-pressure electron-track reconstruction with the simultaneous reconstruction of nuclear tracks at ≈100 keV. - MIP tracking at 10 bar in argon-based gas mixture. - Reconstruction of MeV-nuclei with mm and sub-mm sampling at varying pressure and gas conditions. - Stability of reconstruction of nuclear-reaction byproducts over a large range of primary ionizations.	CERN, GANIL, ANU, IRFU/CEA, USC/IGFAE, GSSI, INFN-RM1, INFN-PD, INFN-BA, INFN-LNF, U New Mexico, STFC-RAL, IFIC, U Liverpool, U Genève, U Warwick, U Coimbra, Fermilab, MSU, HUJI, U Bursa, U Bolu-Abant, WIS, DIPC, U Hamburg, IFAE, AUTH
T2	Enhanced operation of charge readout across gas densities	- Achieve an ionization-energy threshold of at least ≈keV in the range 10 mbar to 10 bar (and, in the case of noble gases, to saturated vapours and even to the liquid state) with a scalable concept. - Reconstruction of MeV-nuclei of variable stopping power, with mm and sub-mm sampling.	WG1, WG5, WG6, WG7	1.2, 1.4	- High avalanche gain across gas densities in CF_4, H_2, He, Ar, Xe -based TPCs with keV-sensitivity. - Fine track sampling capabilities in the range of 10's of µm to few mm. - High-density and low-power electronics, with the ability to self-trigger. - TimePix-based charge readouts.	- Low-pressure nuclear track reconstruction at ≈10 keV. - 1 keV ionization-energy threshold at high pressure. - Few MeV's-proton tracking at 10 bar in argon-based gas. - Reconstruction of MeV-nuclei with mm and sub-mm sampling at varying pressure and gas conditions. - Stability of reconstruction of nuclear-reaction byproducts over a large range of primary ionizations.	IRFU/CEA, GANIL, U Bonn, ANU, U Zaragoza, U Colorado, Fermilab, UH Manoa, MSU, RWTH Aachen, HUJI, U Bursa, U Bolu-Abant, U Warwick, WIS, CNRS-IN2P3/UGA, ISNAP, U Coimbra, INFN-LNS, SINP Kolkata, U Hamburg, U Aveiro, U New Mexico, AUTH , U Kobe
T3	Enhanced operation of pure or trace-amount doped noble gases	- Operation of m^2 and ton-scale detectors with single-electron sensitivity and near-Fano level energy resolution	WG1, WG3 (3.2C) WG6, WG7	1.4 (and DRD2)	- Enhancement of electroluminescence (EL) yield in noble gases (scalability, light output). - Single-electron detection. - Near-Fano energy resolution. - Stabilization of trace-amount doping (mixing, purification). - Barium tagging. - Stable amplification in dual-phase detectors. - Develop novel amplification structures	- Developing large-area ($\geq m^2$-scale) EL amplification: keeping energy resolution and single-electron sensitivity. - Imaging in low-diffusion gas. - A viable concept for Barium tagging or a viable roadmap towards it. - Very large-area ($\geq 10m^2$-scale) camara-based 3D imaging. - Operation of resistive-protected detectors.	DIPC, IFIC, U Manchester, U Liverpool, U Coimbra, LIP-Coimbra, AstroCeNT, Ben-Gurion U, WIS, U Aveiro, AUTH

WP8: TPCs as reaction and decay chambers

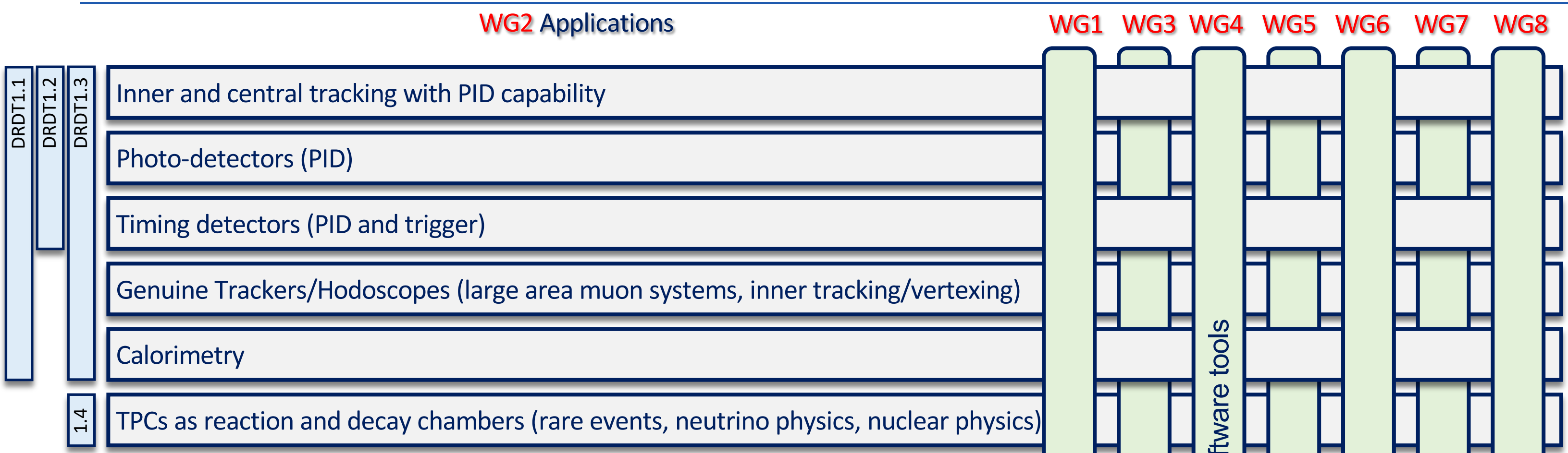
(RARE EVENTS, NEUTRINO PHYSICS, NUCLEAR PHYSICS)



Challenges/tasks

- Reconstruct low-energy nuclear tracks (down to 10 keV energy-scale) with high granularity and close to the thermal diffusion limit.
- Low energy threshold (keV or less) far from atmospheric pressure (10mbar-20bar).
- Achieving high and uniform amplification in nearly pure or weakly-doped noble gases
- Increasing optical throughput (primary and secondary)
- Developing more suitably scintillating and/or eco-friendly gas mixtures as well as recuperation systems;
- Enhancing the radiopurity of the amplification structure and of the TPC as a whole

#	Task	Performance Goal	DRD1 WGs	ECFA DRDT	Comments	Deliv. next 3y	Interested Institutes
T4	Ultra-low-energy reconstruction of highly ionizing tracks (including R&D on negative-ion readout)	- Tracking of ≈10keV nuclear tracks in a concept scalable to m^2 and beyond	WG1, WG5, WG6, WG7	1.2, 1.4	- Track reconstruction of nuclei down to 10 keV energies or below. - Simultaneous tracking of nuclei and electrons. - Accurate dE/dx-sampling for electron and nuclei identification. - ML for complex topologies. - Negative-ion TPCs for 3D-tracking on large areas, and associated electronics. - Optical readout in a negative ion TPC. - Track-reconstruction on spherical counters.	- A technology demonstrator in the m^2 scale, with ≈10keV tracking-threshold for nuclear tracks at ≈10's of µm sampling.	CERN, GANIL, ANU, IRFU/CEA, GSSI, INFN-RM1, INFN-PD, U New Mexico, STFC-RAL, MSU, UH Manoa, U Kobe, IHEP CAS, USTC, U Bolu-Abant, LIP-Coimbra, U Warwick, WIS, CNRS-IN2P3/UGA, ISNAP, U Coimbra, INFN-LNS, SINP Kolkata, U Hamburg, AUTH , U Kobe
T5	Determination of the interaction time (T_0)	- Achieve a viable timing signal while keeping low electron diffusion and high amplification of the ionization signal	WG3 (3.1A)	1.4 (and DRD2)	- T_0 sensitivity for accelerator-based neutrino TPCs. - T_0 sensitivity in the reconstruction of low-energy nuclear recoils, via scintillation light or minority carriers in case of negative-ion TPCs. - Explore the applicability of alternative methods (diffusion, positive ions) - T_0-determination on spherical counters.	- Demonstration of track reconstruction and T_0-tagging for minimum ionizing particles at ≈1MeV-threshold and high pressure.	IFIC, U Liverpool, AstroCeNT, Ben-Gurion U, U Zaragoza, GSSI, USC/IGFAE, Fermilab, DIPC, ANU, WIS, U Hamburg, U New Mexico
T6	Modelling	- Develop a microscopic framework for computing scintillation and negative-ion yields, and transport	WG3 (3.1A, 3.2A), WG4	1.3,1.4	- Modelling primary scintillation. - Modelling secondary scintillation. - Modelling ion transport and avalanche for electronegative mixtures. - Modelling space charge.	- Develop a framework for optical simulation that is integrated as part of the standard community tools, or develop a concrete implementation path towards it.	CERN, U Bursa, USC/IGFAE, IFIC, U Aveiro, Astro-CeNT, GSSI, U Kobe, INFN-BA, WIS, DIPC, U Coimbra, SINP Kolkata, U Hamburg, U Aveiro, AUTH
T7	Gas mixtures and gas handling	Study new gas mixtures, operated in conditions of high purity	WG3 (3.1B, 3.2C), WG6, WG7	1.3, 1.4	- New gas mixtures for optical readout. - New gas mixtures for negative-ion readout. - Recirculation and recuperation systems. - Purification of low-quenched mixtures.	- Develop alternatives to CF_4-based mixtures operated in open loop, or a viable path towards it.	USC/IGFAE, DIPC, U Coimbra, CERN, U Liverpool, GSSI, INFN-RM1, U Zaragoza, Fermilab, RWTH Aachen, U Warwick, WIS, DIPC, ISNAP, U Hamburg, U Aveiro, U New Mexico, AUTH
T8	Radiopurity	- Improve manufacturing process and purification as well as material-selection standards	WG3		- Radon emanation studies - Mitigation of gaseous radioactive isotopes - Material selection - Develop radiopure amplification structures and radiopure optical cameras.	- Develop MPGDs and manufacturing techniques with high radiopurity.	USC/IGFAE, DIPC, U Liverpool, GSSI, U Zaragoza, U Hamburg, U Kobe



Working Groups (research line) are the core of the collaboration

- physics driven; promoting open environment, young researchers…

Working Groups participate in Work Packages

Work packages communicate to and with DRD1 community

- Don't operate in a vacuum
- Funded by funding agencies

NEXT STEPS

Work Packages – basic facts

Work Packages

- Encompass long-term projects with significant strategic R&D goals and corresponding funding lines.
- Way to get funding
- Way to get involved in strategic R&D

DRD1 proposal: Institutes can still be added/removed from the individual WP and their tasks

- It is not required to be involved in a WP to be a member of DRD1
- It is required to be a member of DRD1 to contribute to a WP

WP - formalities

From the proposal

A Work Package:

- Can be initiated at any time and will be internally organized and coordinated by the participating institutes (WP Coordinator should be defined from an active WP member)
- The participating institutes will define the WP scope, deliverables, work plan, and the necessary resources in detail.
- The participating institutes will have complete control and operational authority over the allocated resources.

To establish the proposed activities and secure the required resources,

- a formal agreement will be established among the participating institutes, funding agencies, DRD1 management, and the host lab (CERN) → being detailed by CERN management
- Each Work Package Agreement will be included as an annex in the DRD1 MoU → being detailed by CERN management
- WPs will report to DRD1 and undergo review by the Detector Research and Development Committee (DRDC).
- The funding for WPs will be provided to the participating institutes by their respective Funding Agencies.
- The involved Funding Agencies will be responsible for approving the WPs and overseeing their progress

News from the research director

MoU

Proposal

- One MoU per DRD collaboration
- Collaboration board as (scientific and technical) representation of collaborating institutions
- Resources board as representation of funding agencies
  - Funding agency: Collaborating institution or a body acting on behalf of one or several institutions in the conclusion of the MoU
- Creation (and termination?) of working groups and work packages require
  - Approval by collaboration board and by resource board
  - No funding agency involved must object

Proposal (cont'd)

- MoU to contain one Annex for working groups, another Annex for work packages
- Per working group / work package:
  - Participating institutions
  - Participating funding agencies
  - Detailed description of working group / work package
  - Persons with key management roles in working group / work package
  - Commitments of institutions/funding agencies in terms of
    - deliverables
    - person-power
    - financial resources (including common fund-like contributions, e.g. for working groups, if applicable)

Institute contributions

- We need to finalize the WP tables incl. more detailed information, on tasks, deliverables and contributed resources;

  WP Coordinators defined: https://drd1.web.cern.ch/wp
- What we have now in the proposal (e.g. tasks) is a draft, we (community) are **free to further modify**
- A threshold to join a WP
  - DRD1 membership
  - Well-defined task to which an institute will contribute and be responsible for
  - Committed resources (existing or requested)
- **Think collaborative**! WP is a tool to get funding, but also strengthen our community, increase success of strategic R&D developments

Towards the final DRD1 and WP proposals

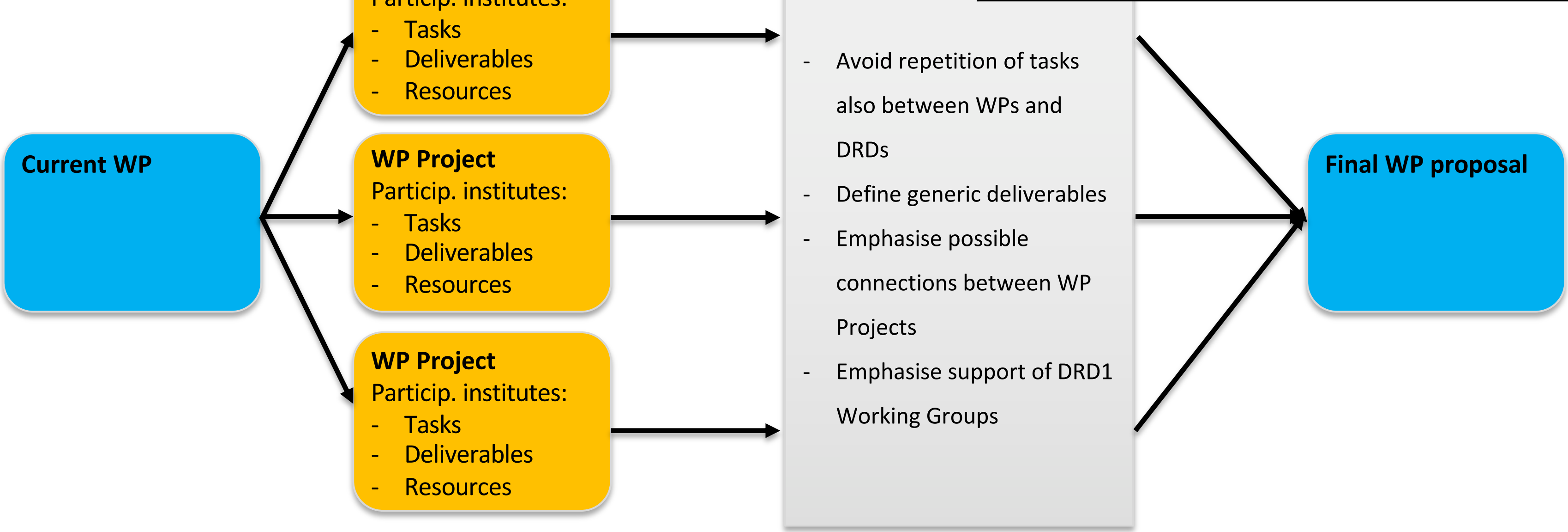
- **WP8**: define ”WP Projects” clustering institutes around well defind **project**, **application**, **techonology development, etc**. All WP Projects are part of one, final (in terms of proposal) WP.

A. High Pressure TPCs for precision studies of neutrino interactions

B. TPCs for low-energy nuclear physics

C. Electroluminescence-based TPCs for Rare-Event Searches and other R&D on pure noble-gas amplification

D. Radiopure TPCs for precise track imaging and/or calorimetry with avalanche-based readouts



Extended WP tables

- ”Extended WP tables” have been created together with institutes which declare their contribution to specific WPs
  - The institutes intrtested to contribute to a given WP need to provide FTE and non-FTE resources in the extended WP tables
  - We differentiate between “existing” and “requested” resources.
  - WP can help in acquiring strategic funding, however, it is not mandatory for an institute to apply for extra funding. One can contribute with the exiting resources only

Extended WP template

A. Aaaa, B. Bbbbb, C. Ccccc, …

On behalf of the groups described in the annex

Work package project title: …..

DESCRIPTION OF THE PROJECT (AND POSITIONING W.R.T. THE ROADMAP)

….

Tasks/deliverables/milestones (example):

T1: IBF reduction

- D1.1: Provide a full-scale prototype with uniform IBF distribution of G*IBF=5
  - M1.1.1: Small-scale prototype measurements
  - M1.1.2: Define the structure, working point
  - M1.1.3: Produce a full-scale prototype
  - M1.1.4: Measurement
- D1.3: "Piece of hardware"
- D1.2: Publication, report…
- …

T2: Pixel-TPC development

- D2.1: Large-are pixel based readout module

LIST OF PARTICIPATING INSTITUTES/LABS WITH A SHORT DESCRIPTION

INSTITUTE 1

The contact person of Institute 1 is …. (mandatory)

Institute 1 has xxx members. It has an extensive track record in ….

Main R&D interests…

INSTITUTE 2 ….

APPENDIX: PARTICIPATING INSTITUTES AND THEIR RESOURCES

In the following, we ask for sufficient information about your contribution to the project. This information will be used in the final proposal of the DRD1 (see current WP tables).

The information on "Resources" will be kept confidential, i.e. won't be a part of the public proposal. This information will help us substantiate the proposal, create MoU annexes, etc. We will integrate the number of available/requested resources in the public proposal.

The main period until consideration is 2024-2026. In order to indicate long-term plans we can provide an outlook for years 2027-2029 and ≥ 2030

SUMMARY TABLE:

Project name ……… - input to WPx on …	
Task(s)	
Deliverable(s)	2024 2025 2026 2027-2029 ≥2030
Description of Technology	….
Targeted DRDT	1.2
Supporting DRD1 WGs	
Connection to other DRDs	
Performance goals	

Resources	
Existing R&D Framework and/or list of contributors	**E.g. AIDA, Institute 1, Institute 2, ….**

Description of contribution to technological task/deliverable	**Institute 1:**
	- *T1: IBF studies*
	  - *Deliverables/milestones, e.g.*
	  - *Perform simulation*
	  - *10x10 cm2 prototype measurements*
	- *T2: Low-noise FEE*
	  - *Characterisation with 10x10 cm2 prototype*
	- …
	
	Institute 2:
	
	Institute 3:

FTE Contributions already covered or expected to continue (Phys., Eng./Dev. and Techn.).	**Institute 1:** - **Institute 2:** **Institute 3:**
Proposed new FTE request (Phys., Eng./Dev. and Techn.)	**Institute 1:** **Institute 2:** **Institute 3:**
“Materials” and facilities (in terms of funding and/or existence) already covered or expected to continue	**Institute 1:** **Institute 2:** **Institute 3:**
Proposed “materials” (non-FTE) funding to be requested	**Institute 1:** **Institute 2:** **Institute 3:**

Here we can be more detailed

Resources **needed** to accomplish the goals/deliverables

- FTE available per year for 2024-2027(9) and later
- Non-FTE available per year for 2024-2027(9) and later
- FTE and non-FTE requested per year for 2024-2027(9) and later

Resources	
Existing R&D Framework and/or list of contributors	E.g. AIDA, Institute 1, Institute 2, ….

Description of contribution to technological task/deliverable	**Institute 1:**
	- *T1: IBF studies*
	  - *Deliverables/milestones, e.g.*
	  - *Perform simulation*
	  - *10x10 cm2 prototype measurements*
	- *T2: Low-noise FEE*
	  - *Characterisation with 10x10 cm2 prototype*
	- …
	Institute 2:
	Institute 3:

FTE Contributions already covered or expected to continue (Phys., Eng./Dev. and Techn.).	**Institute 1:** - **Institute 2:** **Institute 3:**
Proposed new FTE request (Phys., Eng./Dev. and Techn.)	**Institute 1:** **Institute 2:** **Institute 3:**
"Materials" and facilities (in terms of funding and/or existence) already covered or expected to continue	**Institute 1:** **Institute 2:** **Institute 3:**
Proposed "materials" (non-FTE) funding to be requested	**Institute 1:** **Institute 2:** **Institute 3:**

Confidential information available to:

- WP (Project) members
- WP Coordinators
- DRD1 Management
- DRDC

This will not be a part of any public documents, proposals, etc.

In the proposal we show summary tables

Summary resource tables

WP	Description	Material (2024)	Material (2025)	Material (2026)	FTE (2024)	FTE (2025)	FTE (2026)
WP1	Trackers & Hodoscopes (Large Area Muon Systems, Inner Tracking/Vertexing)	#	#	#	#	#	#
WP2	Inner and Central Tracking with Particle Identification Capability (Drift)	#	#	#	#	#	#
WP3	Inner and Central Tracking with Particle Identification Capability(Straw)	#	#	#	#	#	#
WP4	Inner and Central Tracking with Particle Identification (TPC)	#	#	#	#	#	#
WP5	Calorimetry	#	#	#	#	#	#
WP6	Photo-Detectors (PID)	#	#	#	#	#	#
WP7	Timing Detectors (PID and Trigger)	#	#	#	#	#	#
WP8	TPCs as Reaction and Decay Chambers (Rare Events, Neutrino Physics, Nuclear Physics)	#	#	#	#	#	#

Table 1: DRD1 Workpackages, cumulative resources (Material[kCHF] and FTE) available in existing funding lines covering the ECFA strategic R&D for the years 2024, 2025, 2026

Summary resource tables

WP	Description	Material (2024)	Material (2025)	Material (2026)	FTE (2024)	FTE (2025)	FTE (2026)
WP1	Trackers & Hodoscopes (Large Area Muon Systems, Inner Tracking/Vertexing)	#	#	#	#	#	#
WP2	Inner and Central Tracking with Particle Identification Capability (Drift)	#	#	#	#	#	#
WP3	Inner and Central Tracking with Particle Identification Capability(Straw)	#	#	#	#	#	#
WP4	Inner and Central Tracking with Particle Identification (TPC)	#	#	#	#	#	#
WP5	Calorimetry	#	#	#	#	#	#
WP6	Photo-Detectors (PID)	#	#	#	#	#	#
WP7	Timing Detectors (PID and Trigger)	#	#	#	#	#	#
WP8	TPCs as Reaction and Decay Chambers (Rare Events, Neutrino Physics, Nuclear Physics)	#	#	#	#	#	#

Table 2: DRD1 Workpackages, additional (not existing) funding request to cover the ECFA strategic R&D for the years 2024, 2025, 2026

Summary resource tables

WP	Description	Material (2027-2029)	Material (≥2030)	FTE (2027-2029)	FTE (≥2030)
WP1	Trackers & Hodoscopes (Large Area Muon Systems, Inner Tracking/Vertexing)	#	#	#	#
WP2	Inner and Central Tracking with Particle Identification Capability (Drift)	#	#	#	#
WP3	Inner and Central Tracking with Particle Identification Capability(Straw)	#	#	#	#
WP4	Inner and Central Tracking with Particle Identification (TPC)	#	#	#	#
WP5	Calorimetry	#	#	#	#
WP6	Photo-Detectors (PID)	#	#	#	#
WP7	Timing Detectors (PID and Trigger)	#	#	#	#
WP8	TPCs as Reaction and Decay Chambers (Rare Events, Neutrino Physics, Nuclear Physics)	#	#	#	#

Table 3: DRD1 Workpackages, resources projections for the years 2027-2029, ≥2030.

Timeline

- WP projects are defined
- First draft of the extended WP tables (incl. resources) is being iterated with the interested institutes
- New institutes are welcome to join!
- The WP8 extended tables and resource tables for the proposal **deadline**:
  - **18.09.2023 → end of September 2023.**

- DRD1 Collaboration acceptance by December/January (if positively evaluated)
- MoU signing could start in January/February
- Annexes signing after acceptance of the WPs by the Resource Board of the new collaboration