# RD51 ⇆ WG2 ⇆ DRD1

# Towards DRD1 Collaboration Structure: WG

*Keep RD51 structure in WGs including alignment with the scientific program of the ECFA roadmap, looking more generally to future facilities challenges and specifically to the ECFA Roadmap selected Detector RD Themes (DRDT)*

## *WG1: Technologies*

***<u>Includes exp. detector physics aspects</u>***

- MPGD
- RPC and MRPC
- Wire chambers (incl. Straws, TGC, CSC, ..)
- Large Volume Detectors (drift chambers, TPCs)
- New amplifying structures

## *WG2: Applications*

***<u>Full alignment with the ECFA detector R&D roadmap</u>***

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

## *WG3: Gas and material studies – New*

- Gas Properties (e.g. cross-section, chemical characterization, measurements); light emission in gas
- Eco-gases studies
- Gas systems, gas recuperation/recirculation systems
- Sealed detectors and systems
- Resistive electrodes
- Solid converters; PCs (novel, aging, protection)
- Novel materials (e.g. nanomaterials)
- Material properties for detector and infrastructures
- Low material budget materials; precise mechanics
- Aging, Radiation hardness, Outgassing

## *WG4: Detector physics, simulations, and software tools*

- Detector Physics (modeling and simulations)
- Detector Performance Studies (modeling and simulations)
- Software development and maintenance
- Gas Properties Databases (e.g. cross-sections) - Use and/or Maintenance; Detector design

# Towards DRD1 Collaboration Structure: WG

## *WG5: Electronics for gaseous detectors*

- Analog/Digital Electronics
- Discrete Readout Front End Electronics and ASICs
- Charge/Photon readout
- FE input protection & spark quenching
- Waveforms and Digitizer; Signal Processing
- Cluster Counting
- Specific needs: Timing, High rate, Low noise, Wide Dynamic Range,… )
- Grounding and Shielding; Calibration
- SoC based sensor readout
- General purpose DAQ, FPGA based readout/trigger and Trigger-less systems
- HV Systems and HV distribution schemes
- LV Powering, Cooling
- Laboratory instrumentation (High resolution floating ammeters, Monitoring and control systems)

## *WG8: Training and dissemination*

- Schools and trainings
- Topical workshops
- Knowledge transfer
- ( Young ) Researcher Career
- Strategies to recognize and sustain the careers of R&D experts

## *WG6: Detector production*

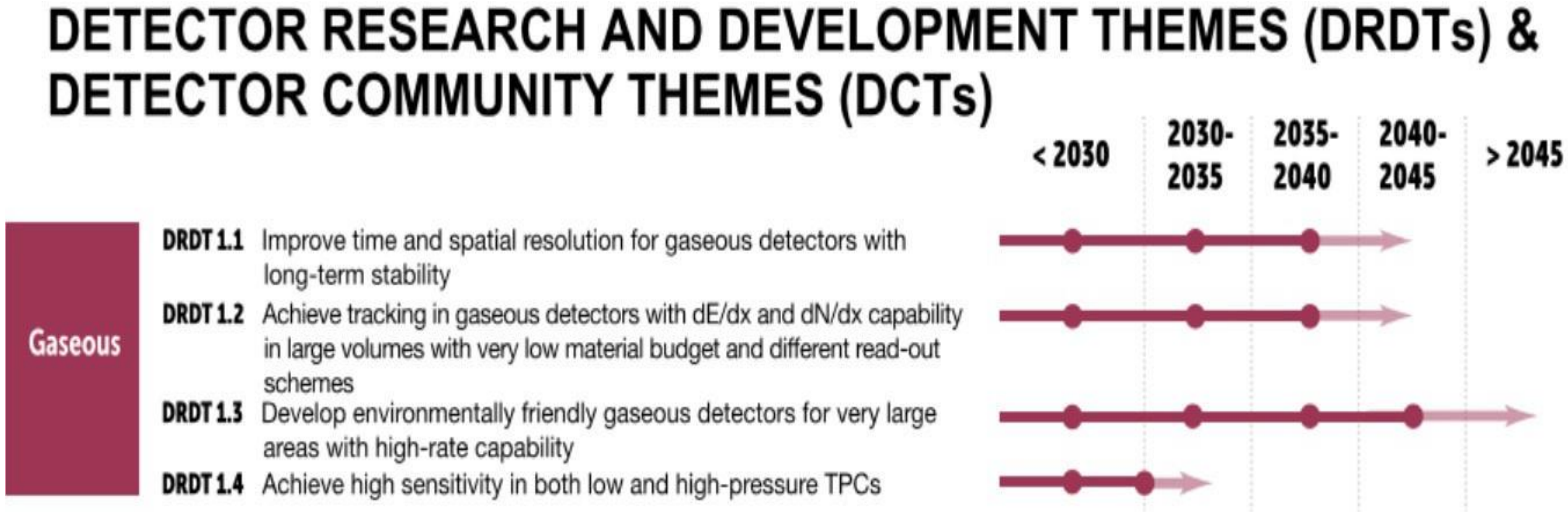
- CERN EP-DT Micro Pattern Technology (MPT) Workshop
- Saclay MPGD workshop
- RPC/MRPC workshop
- Wire chambers workshop
- Novel detector production methods
- CERN EP Thin Film & Glass service (photocathodes, coatings, ceramic)
- Technology and knowledge transfer (to industry and within the collaboration)
- Relationship with Industry

## *WG7: Common test facilities*

***Includes development of common detector characterization standards:***

- General purpose detector development labs
- Ageing Study Facility
- Gas studies facility
- Irradiation facility
- Test beam facility
- Chemistry and material laboratory
- Clean Room
- Instrumentation for common detector characterization (e.g. gas, DAQ, HV systems)

# DRD Themes


DETECTOR RESEARCH AND DEVELOPMENT THEMES (DRDTs) &
DETECTOR COMMUNITY THEMES (DCTs)
< 2030
2030-2035
2035-2040
2040-2045
> 2045
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

# DRD1 Work Packages

*From the draft template*

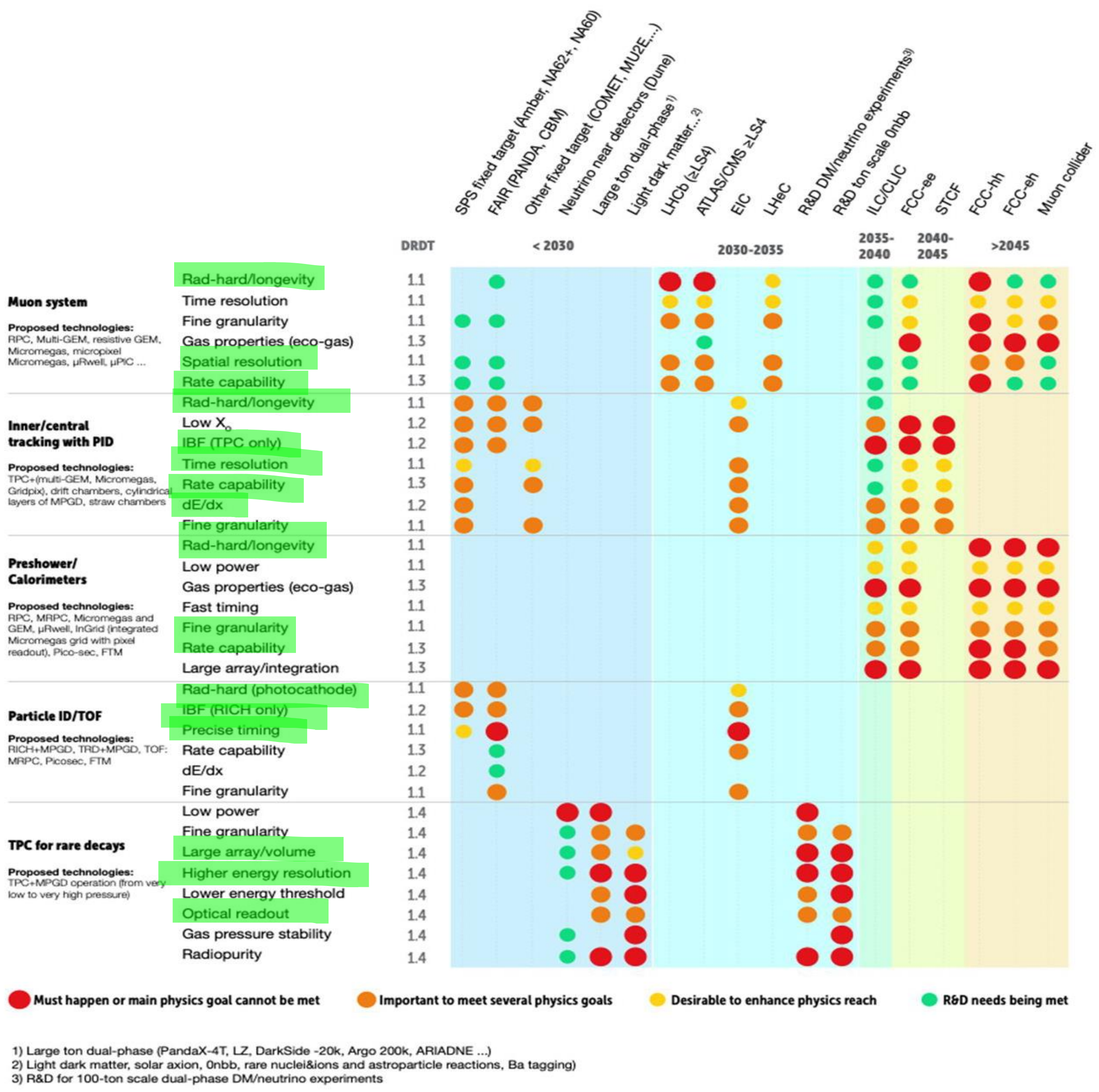
- The purpose of a WP in DRD1 is to offer formal and recognized activities to members of DRD1 to facilitate their funding requests
- All funding and resources should stay in the end of the groups creating and joining the WP
- The format of the WP should be flexible to be adapted by the various team to the funding agency requests

**WP proposal:**

- Scope of WP
  - Activities
  - Infrastructures, services, tools
- Milestones and Deliverables
- Cost Estimates and Resources
- Groups Participation and Contributions

| Muon System | Inner and Central tracking | Calorimetry | Photon detection | TOF | Rare decays |
|---|---|---|---|---|---|
| ● Radiation hardness and stability of large area up to integrated charges of hundreds of C/cm2:<br>- aging issues and discharges;<br>● Operation in a stable and efficient manner with incident particle flows up to ~10 MHz/cm2:<br>- miniaturisation of readout elements needed to keep occupancy low<br>● Manufacturing, on an industrial scale, large detectors at low cost, by means of a process of technological transfer to the industry and identifies processes transferable to industries<br>● Identification of eco-friendly gas mixture and mitigation of the issue related to the operation with high WGP gas mixture:<br>- gas tightness;gas recuperation system;accessibility for repairing<br>● Study of resistive materials (RPC and MPGD):<br>- higher gain in a single multiplication layer, with a remarkable advantage for assembly, mass production and cost<br>- new material and production techniques for resistive layers for increasing the rate capability<br>● Thinner layers and mechanical precision over large area | **Drift chambers**<br>● High rate, unique volume, high granularity, low mass<br>● Hydrocarbon-free mixture for long-term and high-rate operation<br>● Prove the cluster counting principle with the related electronics<br>● Mechanics: new wiring procedure, new wire materials<br>● Integration: accessibility for repairing<br><br>**TPC**<br>● R&D on detector sensors to suppress the IBF ratio<br>● Optimize IBF together with energy resolution<br>● Gain optimization: IBF, discharge stability<br>● Uniformity of the response of the sensors<br>● Gas mixture: stability, drift velocity, ion mobility, aging<br>● Influence of Magnetic field on IBF<br>● High spatial resolution<br>● Very low material budget (few %)<br>● Mechanics: thickness minimization but robust for precise electrical properties for stable drift velocity<br>● Integration: cooling of electronics<br><br>**Straw chambers**<br>● Ultra-long and thin film tubes<br>● "Smart" designs: self-stabilized straw module, compensating relaxation<br>● Small diameter for faster timing, less occupancy, high rate capability<br>● Reduced drift time, hit leading times and trailing time resolutions, with dedicated R&D on the electronics<br>● PID by dE/dx with "standard" time readout and time-over-threshold<br>● 4D-measurement: 3D-space and (offline) track time<br>● Over-pressurized tubes in vacuum: control the leakage rate to maintain the shape | ● Uniformity of the response of the large area and dynamic energy range<br>● Optimization of weights for different thresholds in digital calorimeters<br>● Rate capability in detectors based on resistive materials: resistivity uniformity, discharge issue at high rate and in large area detector<br>● R&D on sub-ns in active elements: resolution stables over wide range of fluxes<br>● Gas homogeneity and stable over time<br>● Eco-friendly gas mixture for RPC<br>● Stability of the gas gain: fast monitoring of gas mixture and environmental conditions<br>● Mechanics:<br>- large area needed to avoid dead zone: limitation on size and planarity of PCB is an issue<br>- multi-gap with ultra-thin modules: very thin layer of glass and HPL electrodes, gas gap thickness uniformity few micron | ● Preserve the photocathode efficiency by IBF and more robust photoconverters<br>● Gas radiator: alternative to CF4<br>● Gas tightness<br>● Very low noise when coupling large capacitance<br>● Large dynamic range of the FEE<br>● Separate the TR radiation and the ionization process<br>● In TRD use of cluster counting technique and improve it by means of a InGrid | ● Uniform rate capability and time resolution over large detector area<br>● New material for high rate (low resistivity, radiation hardness)<br>- uniform gas distribution<br>- thinner structures: mechanical stability and uniformity<br>● Eco-gas mixture<br>● Electronics: Low noise, fast rise time, sensitive to small charge<br>● Possibly optical readout<br>● Precise clock distribution and synchronization over large area | ● Radio-purity of the materials<br>● Low background<br>● High granularity<br>● For large volume detectors: transparency over large distance<br>● Pressure stability and control<br>● Electronics with large dynamic range and flexible configuration.<br>● Self-trigger capability<br>● Low noise electronics<br>● Fast electronics<br>● Optical readout |

Hard to make a clear cut between RD51 WG1 and WG2




Hard to make a clear cut between RD51 WG1 and WG2

# Ongoing and future R&D – way to cluster together?

- **High-rate trackers**
  - Discharge suppression
  - Resistive materials
  - New structures
- **TPCs**
  - CEPC: hybrid, IBF minimisation
  - ILC: 3GEM / Encapsulated res-anode MMG / GridPix
  - Optical readout
  - dN/dy
  - DLC layers for cryo operation
  - Negative ion TPCs
- **Photons**
  - Single photon detectors
  - New photocathodes, visible light!
  - IBF minimization, discharge protection
  - TRD with cluster counting?
- **Timing**
  - PICOSEC
  - Resistive materials (e.g. DLC based RPC)

Hard to make a clear cut between RD51 WG1 and WG2

+ FEE, Simulations, Gas studies, Production sites, Common infrastructure

# Ideas welcome…discussion should start now