News from ECFA Roadmap Implementation

Gaseous Detectors

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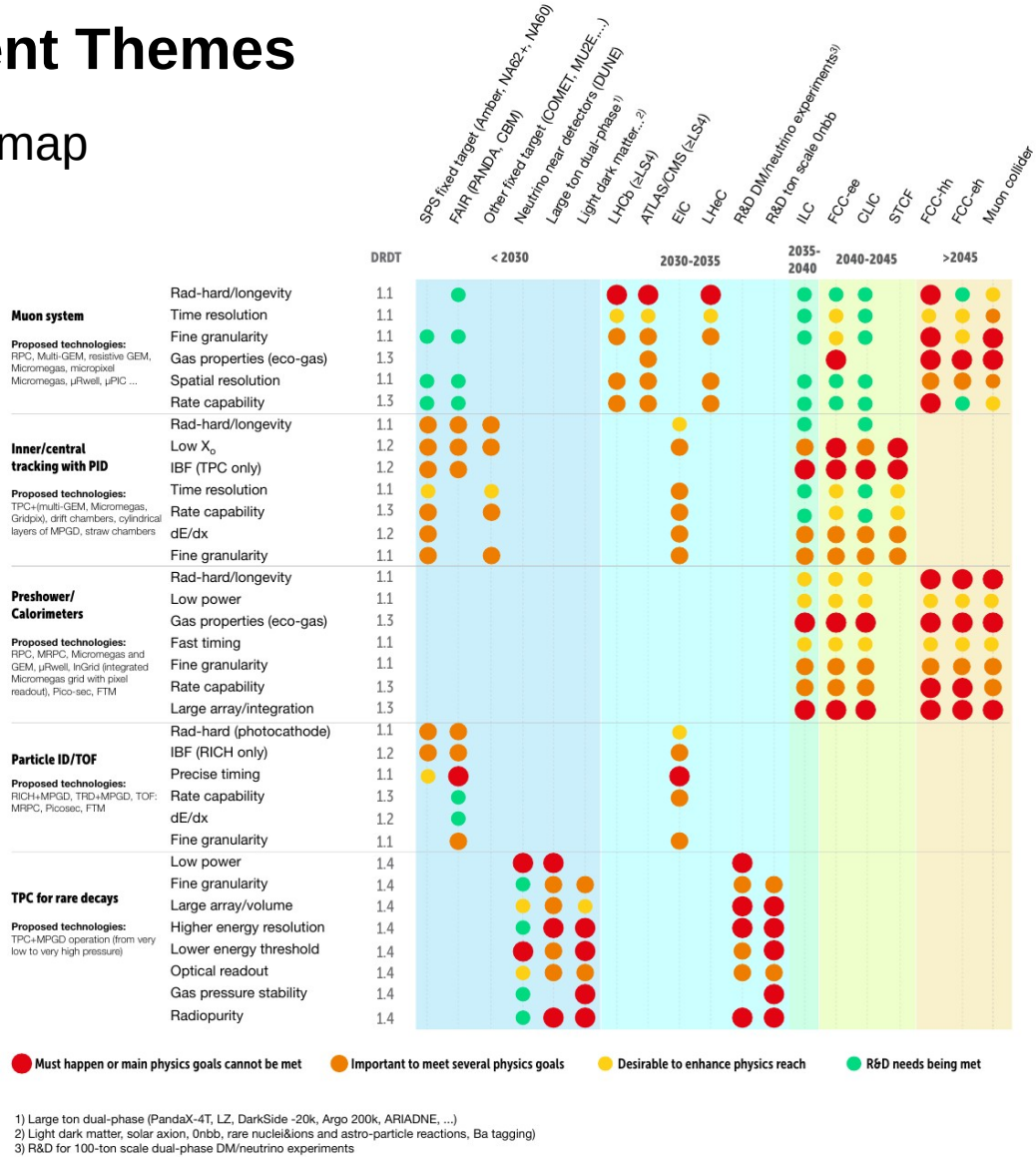
Detector Research and Development Themes

According to ECFA Detector R&D Roadmap

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

Figure 1.8: Summary of the R&D challenges for different applications.

ECFA Detector R&D Roadmap.pdf



New Collaboration is formed

RD51 will be terminated at the end of this year – DRD1 will hopefully be formed.

Timeline:

- A survey has been conducted
- March 1-3 Community Meeting at CERN
- March – June drafting DRD1 – proposal: Submission end of June
- Final decision in fall 2023

Start of DRD1: planned for 1.1.2024

German institutes (contact person) having expressed interest so far:
DESY (T. Behnke), FZJ (P. Wirtz, J. Ritman), GSI (B. Voss), LMU (J. Bortfeld), MPP Munich (H. Kroha, O. Kortner), RWTH (K. Höpfner), TUM (L. Fabbietti), U. Bonn, (K. Desch), U. Frankfurt (H. Appelshäuser), U. Freiburg (U. Landgraf), U. Heidelberg (I-M Deppner), U. Mainz (J. Gülker), U. Würzburg (R. Ströhmer)

Gasdetector consortium

So far, first meeting (1.2.) to inform about the DRD1 formation process. Discuss about a Verbundantrag for the BMBF call.

List of interested institutes (so far)

- LMU Munich (R. Hertenberger, J. Bortfeldt)
- RWTH Aachen (S. Roth, K. Höpfner)
- U. Bonn (K. Desch, B. Ketzer)
- U. Frankfurt (C. Blume)
- U. Hamburg (K. Nikolopoulos)
- U. Heidelberg (I-M. Deppner)
- U. Mainz (J. Gülker)

If you are interested in joining, please contact: kaminski@physik.uni-bonn.de

The MPP group is interested in a collaboration with the university groups.
Focus of the MPP R&D: RPCs. Analog ASICs for gaseous detectors.