
ECFA Roadmap implementation for future R&D in electronics

TWEPP 2022

Facts and Questions

- Electronics is ubiquitous in HEP experiments and strategically important for their future developments
- Technology and tools are increasingly complex and expensive
- Engineering effort is difficult to recruit and retain

- How can we remain above critical mass?
- How can we maintain accesses to Hi-end technology and tools?
- How can we bridge the gap between long detector development and upgrade cycles?

- How can we become more visible as a community, attract the necessary resources and deliver the next-generation systems?

1. ECFA Roadmap Drafting Process
2. Roadmap Content (for electronics)
3. Roadmap Implementation Proposal

EPPSU & ECFA Roadmap Process

- European Particle Physics Strategy Update



- » The European Strategy for Particle Physics is the cornerstone of Europe's *decision-making* process for the *long-term future* of the field.
- » The latest update of the Strategy was approved by the CERN Council at its June 2020 Meeting. It places *priority on the successful completion of the High-Luminosity LHC*, and begins to map out the potential landscape for research in Europe in the post LHC era.
- » The Strategy update recommends a so-called *Higgs factory* as the highest priority to follow the LHC, while pursuing a technical and financial feasibility study for a next-generation *hadron collider* in parallel, in preparation for the long-term.
- » recommended that “Organised by ECFA, a roadmap should be developed by the community to balance the *detector R&D efforts* in Europe, taking into account progress with emerging technologies in adjacent fields”.
- » Recommended that a similar process be followed for *R&D on accelerator technologies*.

<https://europeanstrategyupdate.web.cern.ch/>
<https://indico.cern.ch/e/ECFADetectorRDRoadmap>

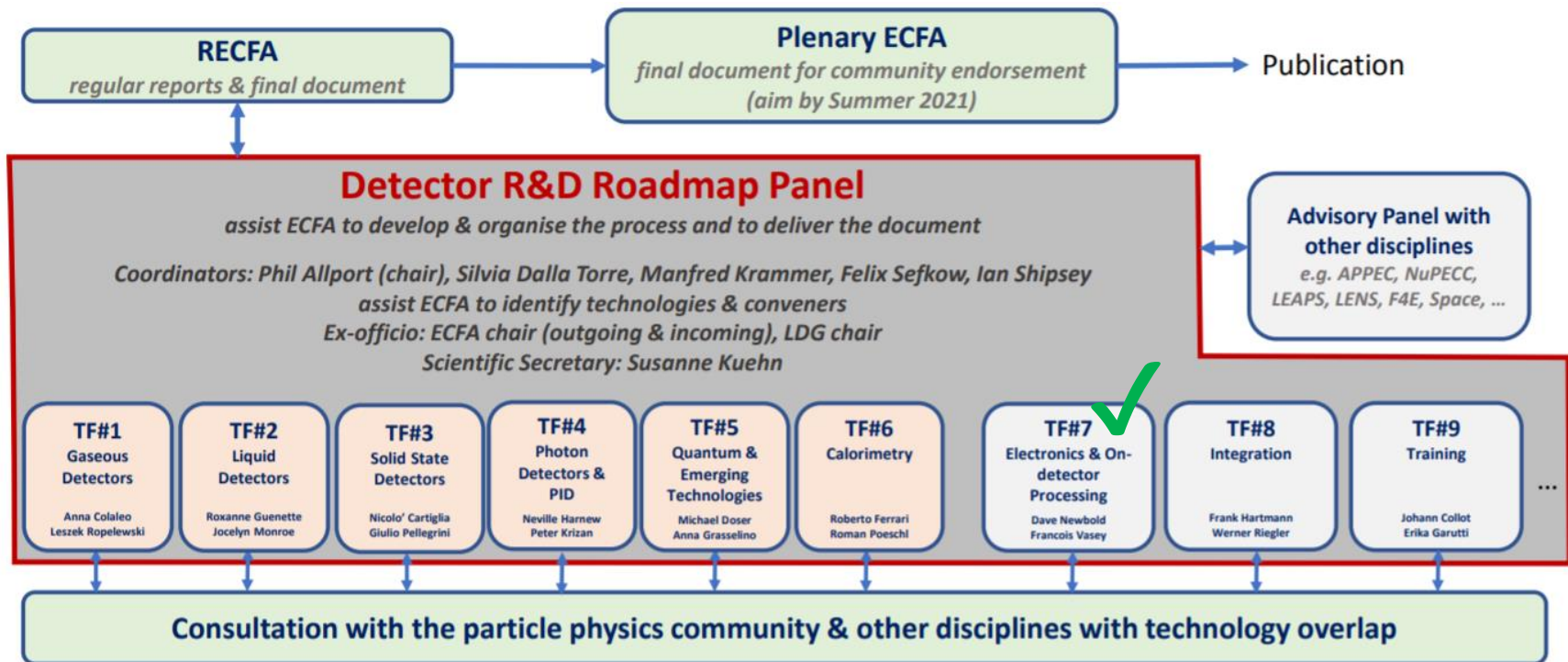
Detector R&D Taskforces

ECFA

European Committee for Future Accelerators



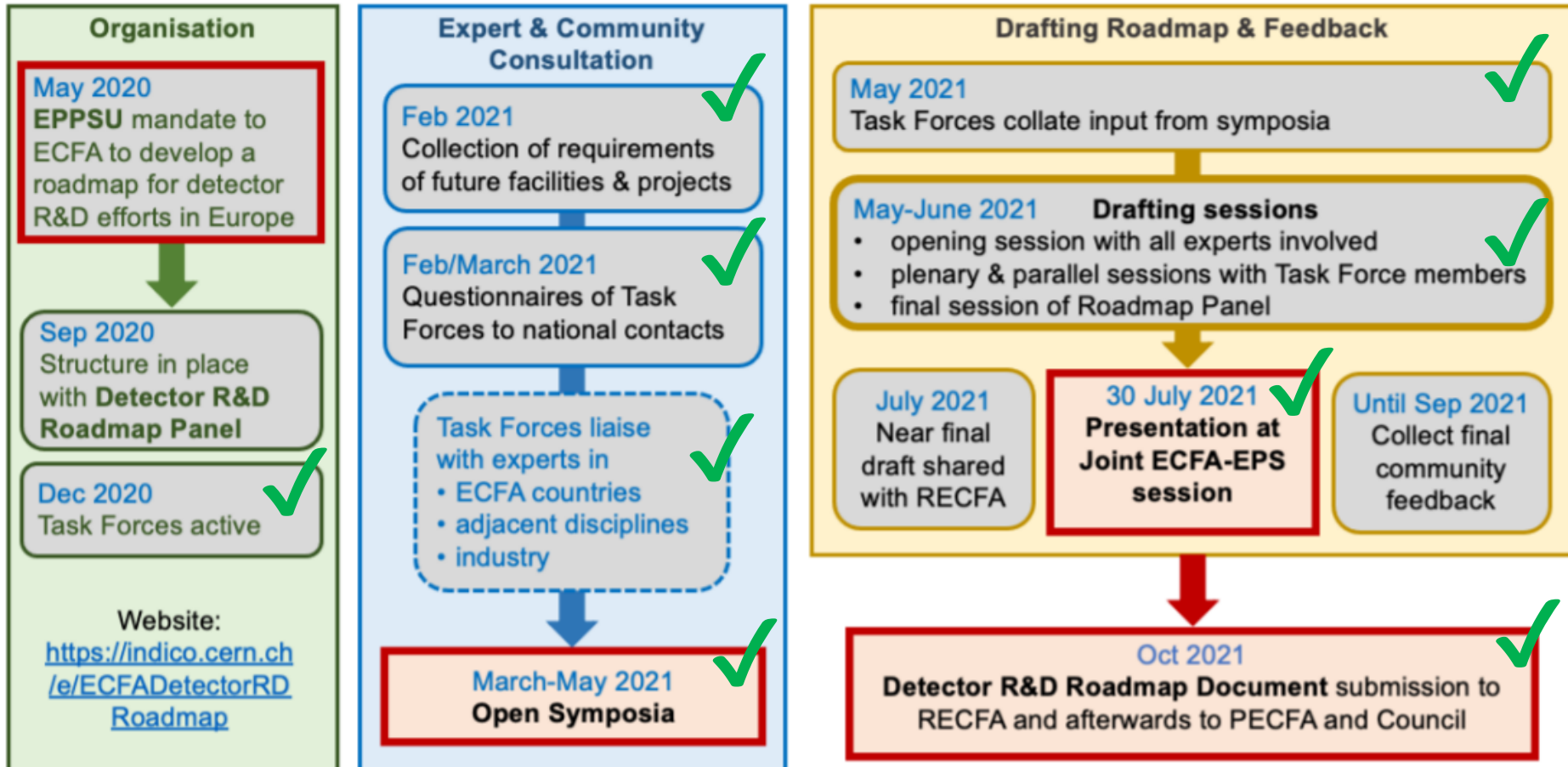
Detector R&D Roadmap



Task Force 7 Electronics: Dave Newbold³⁴, Francois Vasey² (*Conveners*)
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Roadmap Drafting Process

ECFA Detector R&D Roadmap Process



TF7 Electronics Roadmap

- Information Gathering



- Questionnaire

- Symposium on 25 March 2021

- Part A: ASICs
 - Part B: Links, powering and interconnects
 - Part C: Off detector systems

- and several follow-up discussions

- With community
 - Across Task Forces

- Synthesis

- Technical findings and identified R&D needs

- Observations

- Organizational and structural level findings

- Recommendations:

- a) General themes defining future R&D lines
- b) Practical and organizational issues

- Top level strategic recommendations



<https://indico.cern.ch/event/1001692/>

A Roadmap and a Synopsis Brochure

Endorsed by CERN SPC and Council on 10 Dec 2021 !



8 pages for a less specialized audience



<https://indico.cern.ch/event/957057/page/23281-the-roadmap-document>

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A Roadmap for which Facilities ?

Future Facilities Timeline



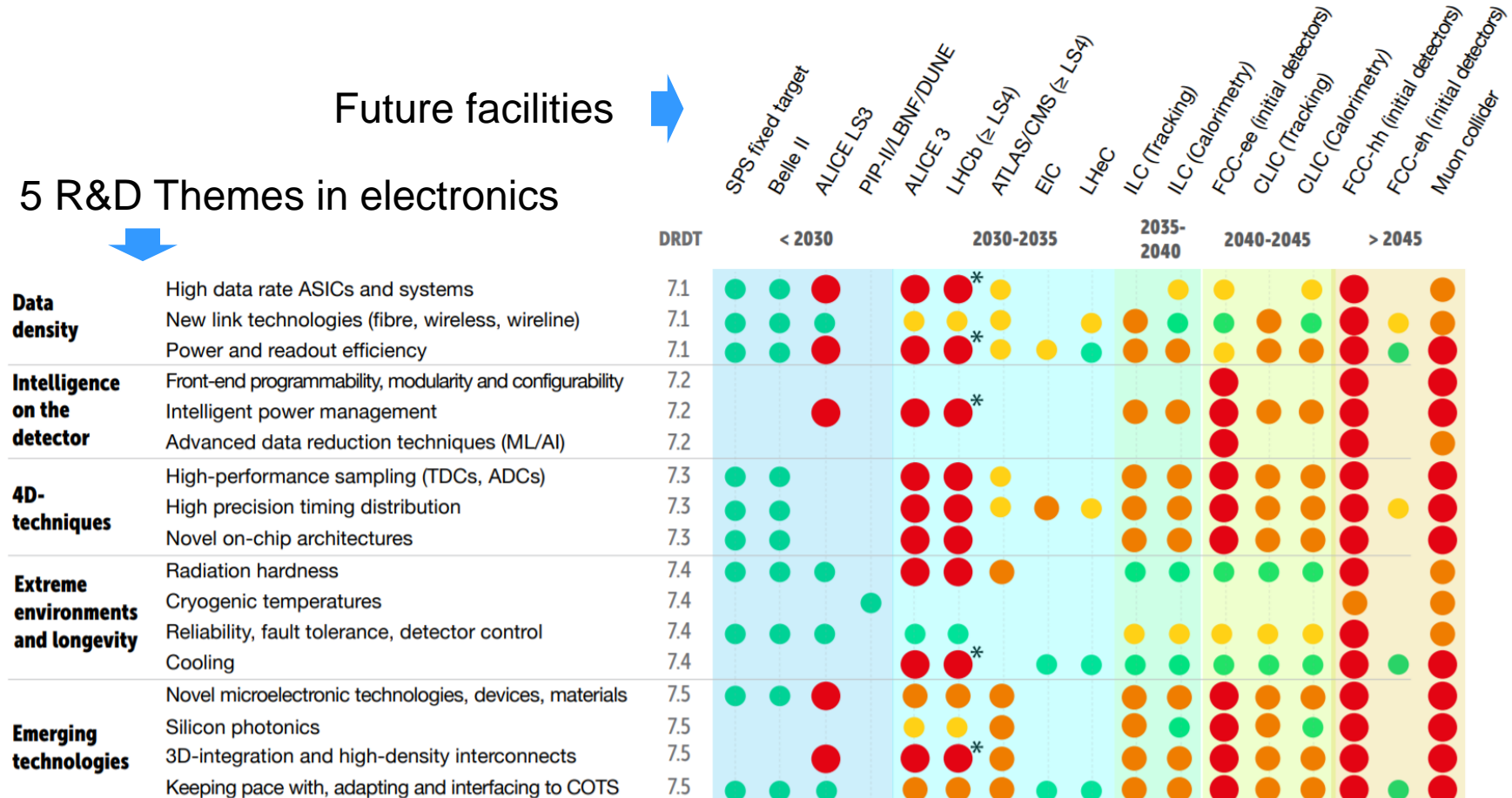
- ▶ ‘Chicken-and-egg’ problem
 - ▶ Cannot define an R&D timeline without knowing the approximate dates of future facilities
 - ▶ Cannot predict dates of future facilities without knowing R&D needs
- ▶ **Detector / accelerator roadmaps have used a common timeline**
 - ▶ Highly approximate, and not to be used out of context
 - ▶ Dates represent the ‘earliest feasible date’, driven by both technical considerations and the processes of approval
 - ▶ The goal on both sides is that R&D shall not be the rate-limiting step

Highlighted Electronics R&D Themes

Future facilities



5 R&D Themes in electronics



● Must happen or main physics goals cannot be met ● Important to meet several physics goals ● Desirable to enhance physics reach ● R&D needs being met

* LHCb Velo

Highlighted practical & organizational issues

1. Collaborative Model

- Improve international collaborative model (Tier-based?)
- Prevent dispersed, uncoordinated and parallel activities
- Encourage common standards and building blocks
- Relaunch RD governance and support from large labs

2. Common Developments

- Continue technology tracking with demonstrators, even outside upgrade cycles
- Provide sustained long-term support to common projects
- Spread load, risk and expertise across community
- Acknowledge the invested effort

3. Infrastructure Needs

- Share high-end test instruments and facilities
- Invest in a coordinated way
- Support and harmonize IT-infrastructure and tools

4. Interaction with Industry

- Speak with single and coordinated voice
- Establish clean legal frameworks
- Invest long-term with few strategic industrial partners

General Strategic Recommendations

- In addition to the Task Force recommendations, the following General Strategic Recommendations (GSR) are made. They cover requirements across detector technologies and target the sustainability of an adequate environment in Europe:

GSR 1 - Supporting R&D facilities

GSR 2 - Engineering support for detector R&D

GSR 3 - Specific software for instrumentation

GSR 4 - International coordination and organisation of R&D activities

Refresh the **CERN RD programme** structure and encourage new programmes for next generation detectors, where CERN and the other national laboratories can assist as major catalysers for these.

GSR 5 - Distributed R&D activities with centralised facilities

Establish in the relevant R&D areas a distributed yet connected and supportive **tier-ed system for R&D efforts** across Europe. Consider more focused investment for those themes where leverage can be reached through **centralisation at large institutions**, while addressing the challenge that distributed resources remain accessible to researchers across.

GSR 6 - Establish long-term strategic funding programmes

Establish also **long-term strategic funding** programmes to sustain both research and development of the multi-decade DRDTs in order for the technology to mature and to be able to deliver the experimental requirements. International collaboration and support at the EU level should be established. In general, the cost for R&D has increased, which further strengthens the vital need to **make concerted investments**.

GSR 7 – “Blue-sky” R&D

GSR 8 - Attract, nurture, recognise and sustain the careers of R&D experts

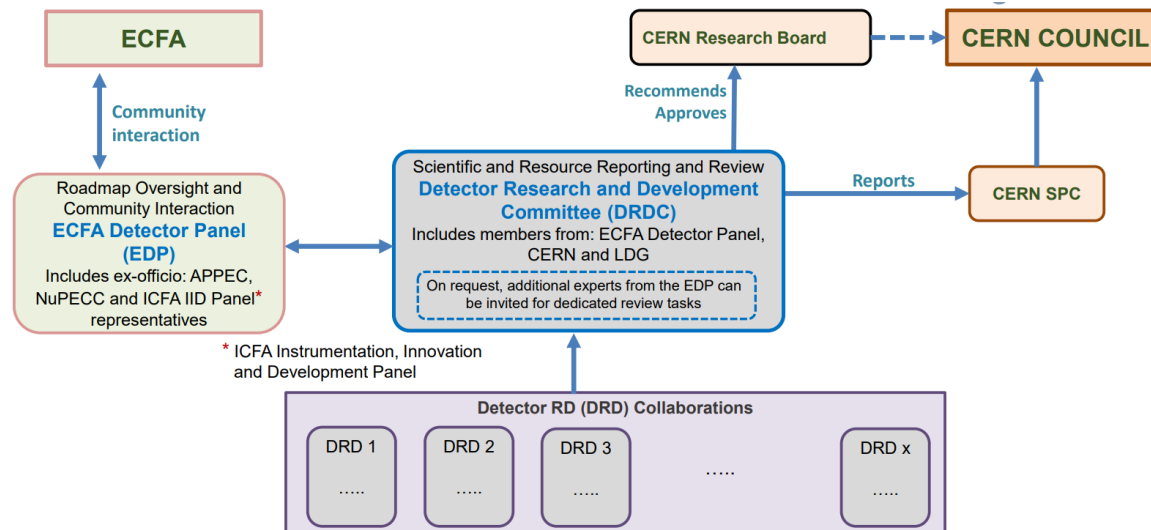
GSR 9 - Industrial partnerships

GSR 10 – Open Science

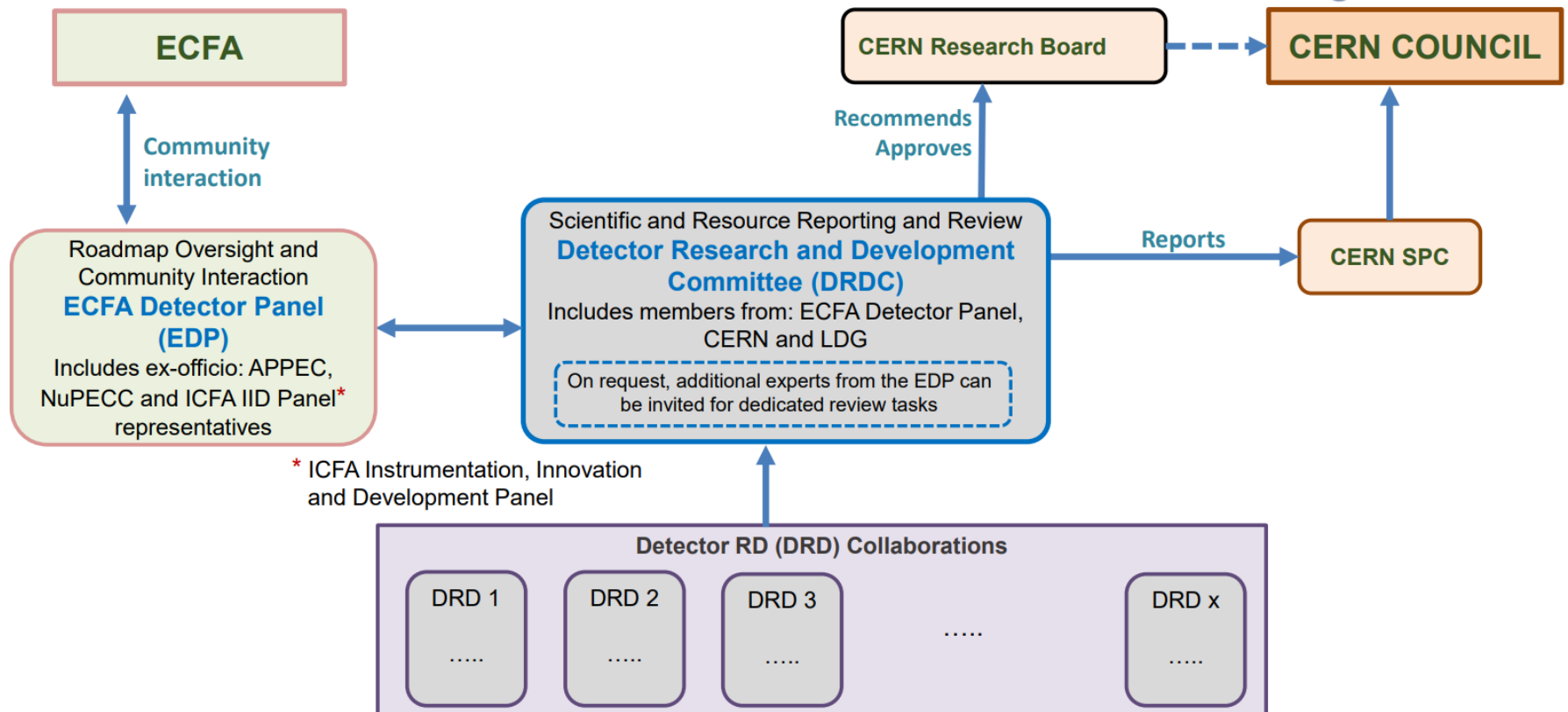
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High level implementation proposal

- CERN Council mandated ECFA in Dec 2021 to work out a detailed implementation plan
- A proposal was presented to SPC and Council in March and June 2022
 - Some discussion still ongoing, aim for final plan in September 2022
- Establish new Detector R&D (DRD) collaborations
 - Collaborations anchored at CERN
 - One per technology area (TF)
 - Community-driven approach, supported by roadmap Task Forces
 - Strategic R&D, addressing high-priority themes defined in the roadmap (DRDT)
- Reporting and Review by a new Detector R&D Committee (DRDC)

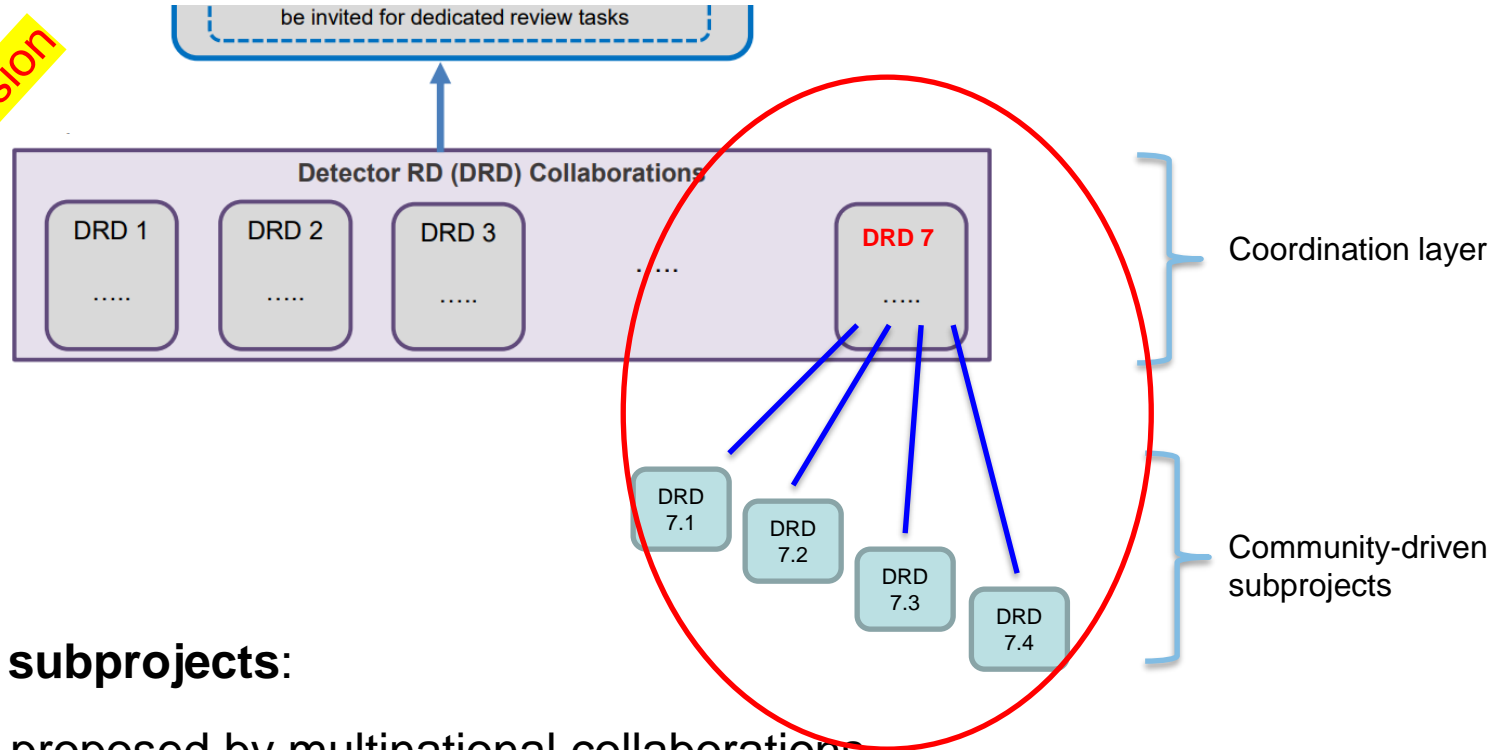


Structure for roadmap implementation



A vision being discussed for DRD7 (electronics)

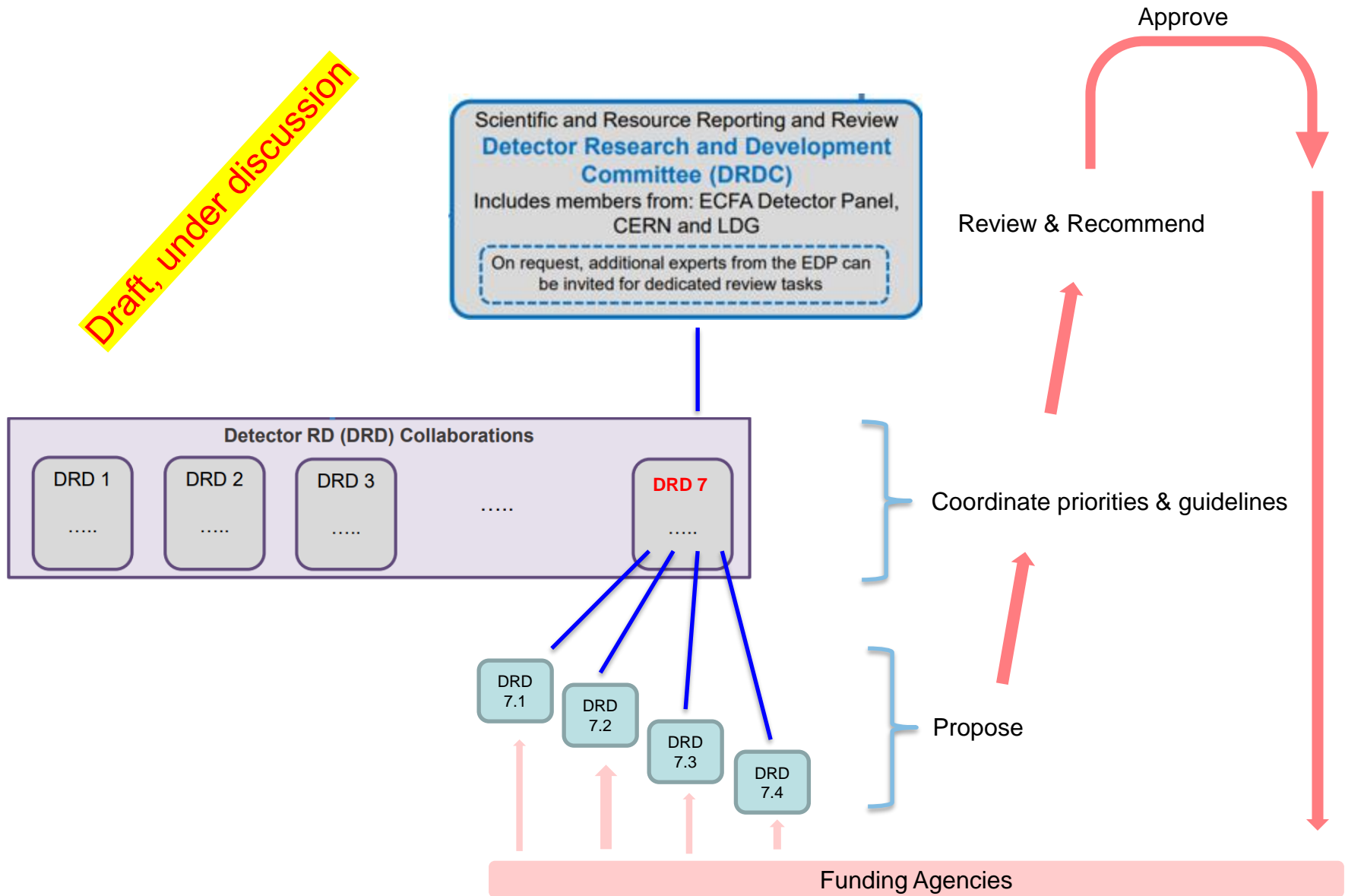
Draft, under discussion



- **Priority subprojects:**

- Are proposed by multinational collaborations
 - Prevent dispersed, uncoordinated activities
- Fit within the five priority R&D themes highlighted in the TF7 roadmap
 - Data density, on-detector intelligence, 4D, extreme environments, emerging technologies
- Embrace a collaborative model, as encouraged by TF7 recommendations
 - Balanced structure (large-small labs), coordinated effort, sustained long-term support
- Enable common developments across the community
 - No duplication, common building blocks, shared high end infrastructure, coordinated investment ...
- Report at (annual?) symposia

DRD7: A collaboration for electronics R&D



Implementation Sequence and timeline

- Completion of the HL-LHC upgrade programme is the top priority
 - Detector R&D (DRD) effort and timeline should not conflict with HL-LHC deliverables
 - Organization, preparation and ramp up of DRDs will take time
- Meanwhile, establish the scope and scale of an electronics DRD7 collaboration
 - Preliminary brainstorm discussions have started in small group
 - Community involvement will increase as vision develops
 - Open workshop in Q1-2023 will confirm R&D priorities and plans, and will propose a collaborative structure: DRD7
 - DRD7 kick-off with a Letter of Intent by mid-2023
- Detailed proposals for R&D subprojects in DRD7, and institutes sign-in expected from end-2023 – early 2024
 - Will also take into consideration needs from other DRDs
- Ramp-up of DRD7 collaboration and subprojects
 - 2024 - 2025
- Stable operation
 - 2026

- With the new EPPS strategy recommendations and ECFA detector roadmap in place, the context is right for reorganizing collaborative R&D.
- A framework is being discussed to implement the ECFA Detector R&D roadmap for electronics
- A DRD7 collaboration is proposed to:
 - Prioritize and coordinate strategic R&D
 - Keep long-term R&D teams above critical mass
 - Encourage resource sharing and merging of effort
 - Maintain access to critical technologies and tools
 - Give visibility to electronics in the HEP field
- Workshop to take place in Q1-2023, collaboration to start forming mid-2023, subprojects definition and ramp-up 2024-25