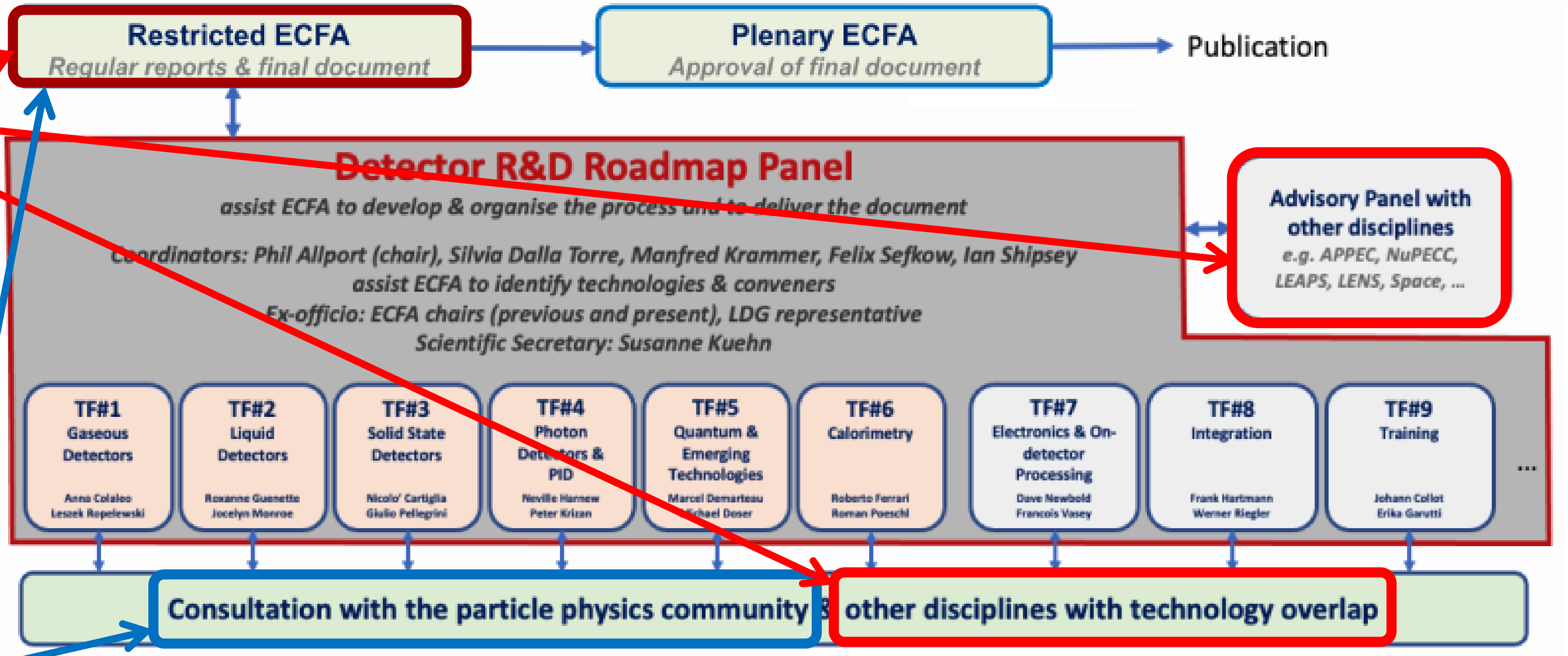
ECFA Detector R&D Roadmap
Status of Implementation Plans

Phil Allport

(University of Birmingham)

Roadmap Organisation

"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" *



"The community should define a global detector R&D roadmap that should be used to support proposals at the European and national levels" *

ECFA Detector R&D Roadmap Panel web pages at:
https://indico.cern.ch/e/ECFADetectorRDRoadmap

*** 2020 European Particle Physics Strategy Update**
https://europeanstrategyupdate.web.cern.ch/

THE 2021 ECFA DETECTOR RESEARCH AND DEVELOPMENT ROADMAP

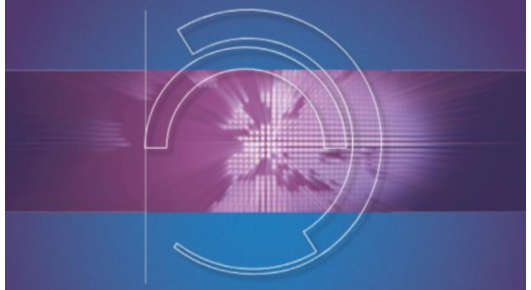
The European Committee for Future Accelerators Detector R&D Roadmap Process Group

European Strategy Update | ECFA European Committee for Future Accelerators

Contents

We ought, in every instance, to submit our reasoning to the test of experiment, and never to search for truth but by the natural road of experiment and observation.

Antoine Lavoisier
Traité élémentaire de chimie, 1789



More information:

https://europeanstrategy.cern
https://indico.cern.ch/e/ECFADetectorRDRoadmap
https://ecfa.web.cern.ch/

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European Strategy Update | ECFA European Committee for Future Accelerators

2021

Detector R&D Roadmap

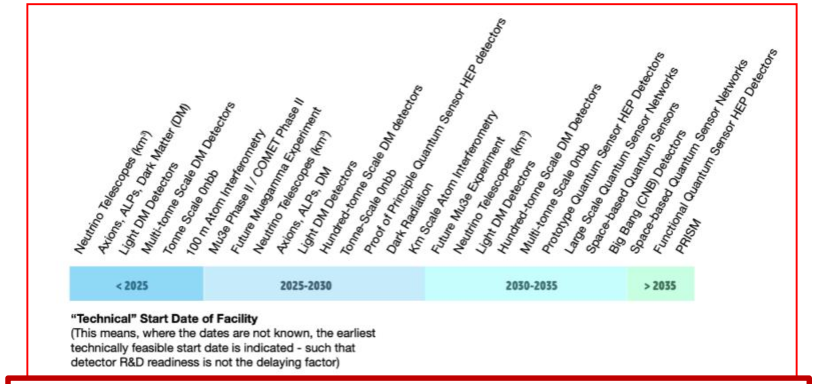
ECFA
European Committee for Future Accelerators

Roadmap process involved: 67 authors; 12 expert Input Session speakers; ECFA National Contacts; respondents to the Task Force surveys; 121 Symposia presenters; 1359 Symposia attendees as well as 44 APOD (Advisory Panel with Other Disciplines) Task Force topic specific contacts.

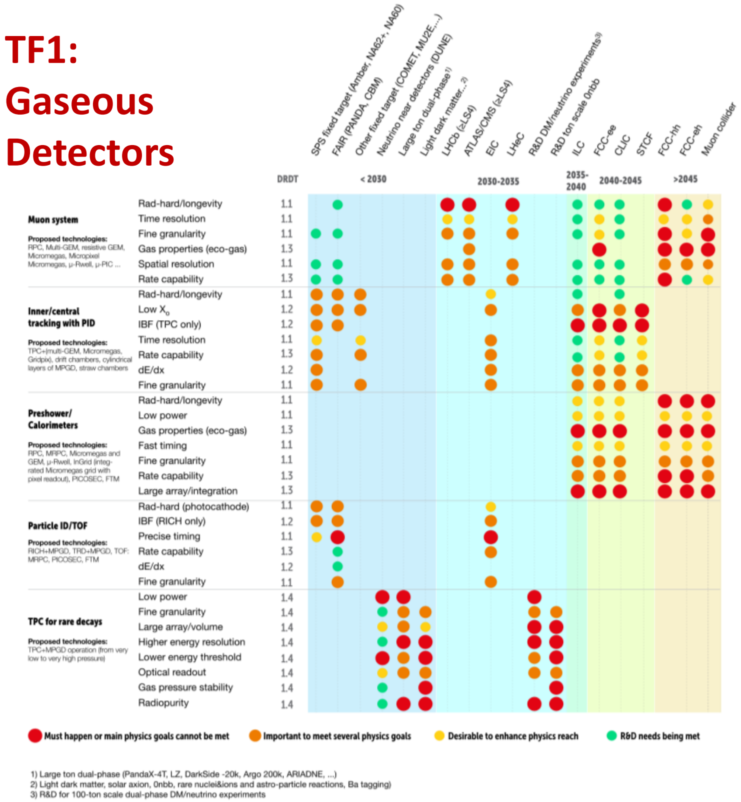
248 page report and 8 page synopsis document identifying the most urgent R&D topics or activities for meeting the EPPSU listed programme in the 9 Task Force Areas.

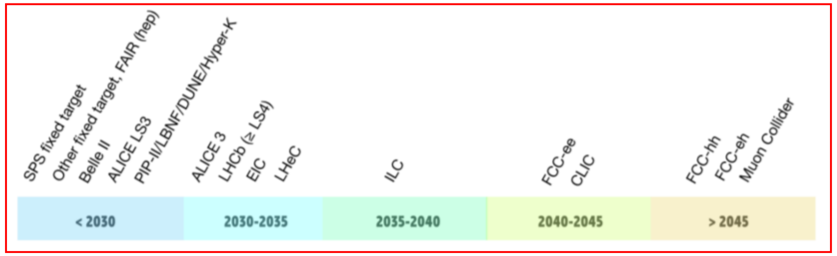
(https://cds.cern.ch/record/2784893)

Example non-accelerator dates (not complete)

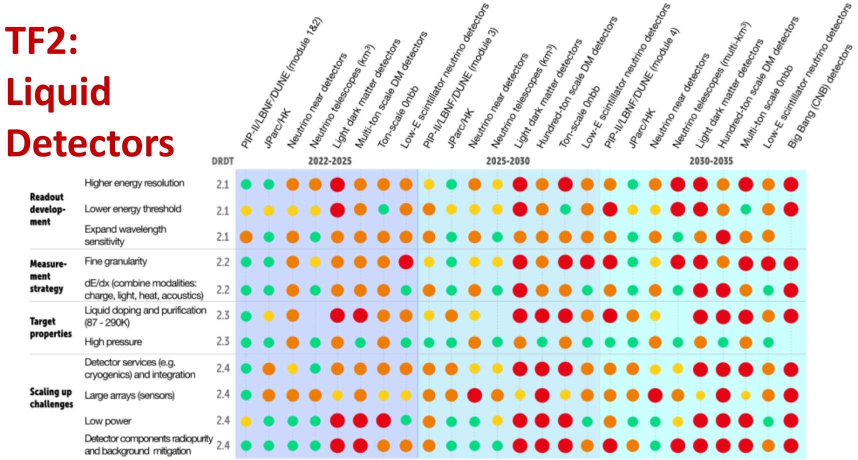


TF1: Gaseous Detectors

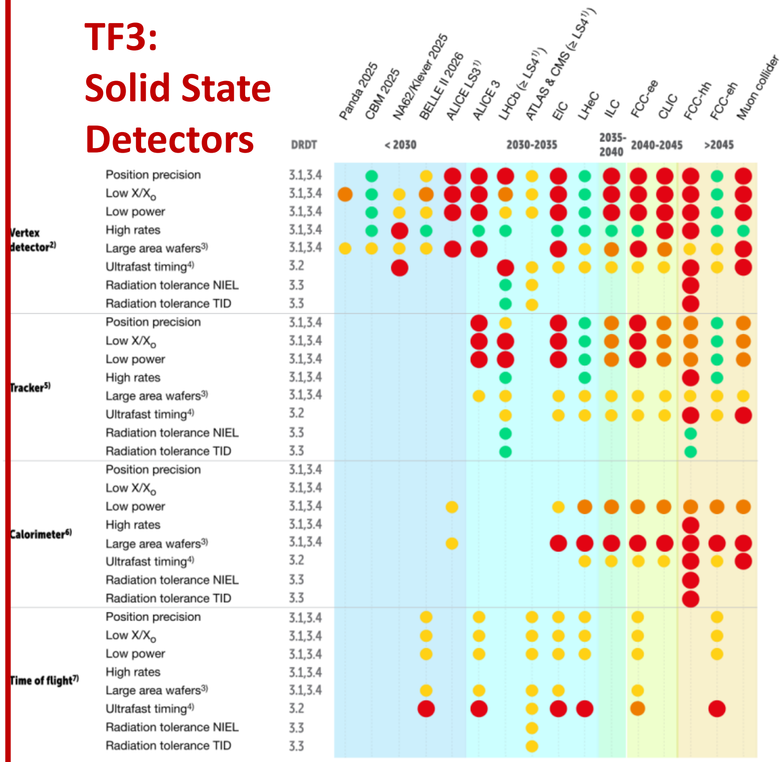




TF2: Liquid Detectors



TF3: Solid State Detectors



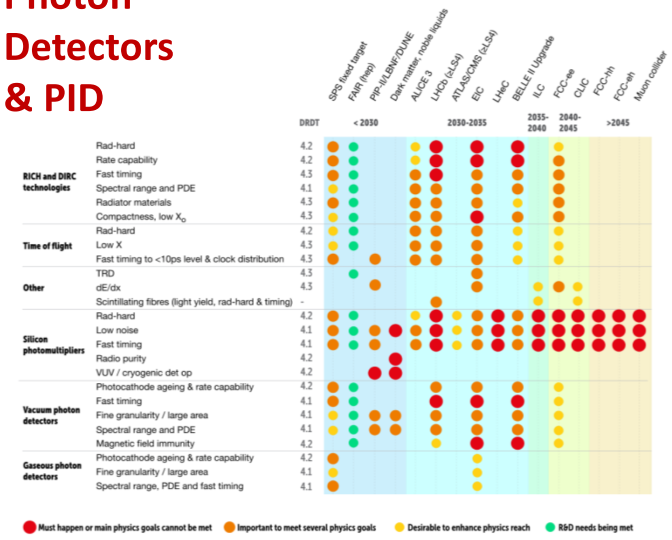
Must happen or main physics goals cannot be met — Important to meet several physics goals — Desirable to enhance physics reach — R&D needs being met

ECFA

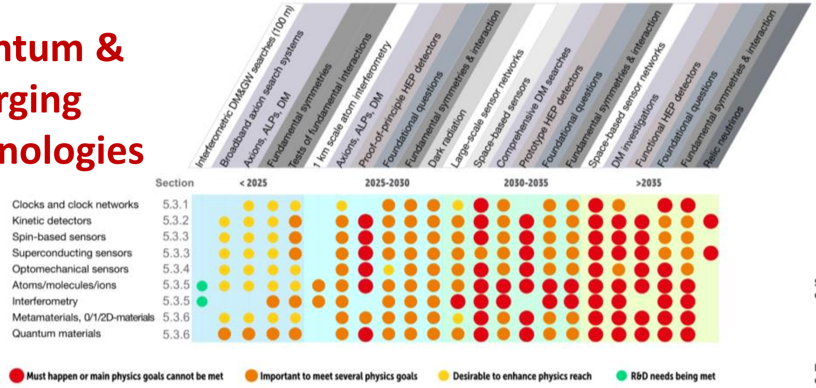
European Committee for Future Accelerators

Detector R&D Roadmap

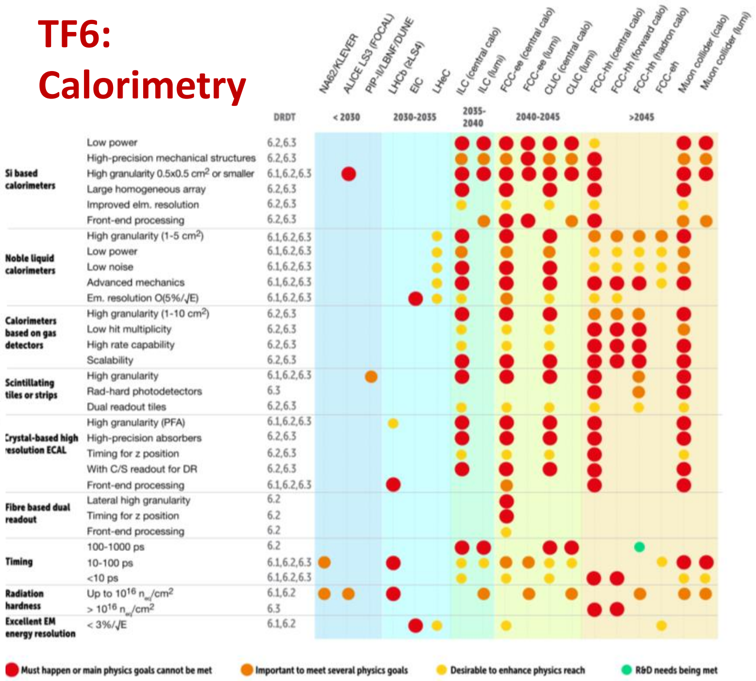
TF4: Photon Detectors & PID



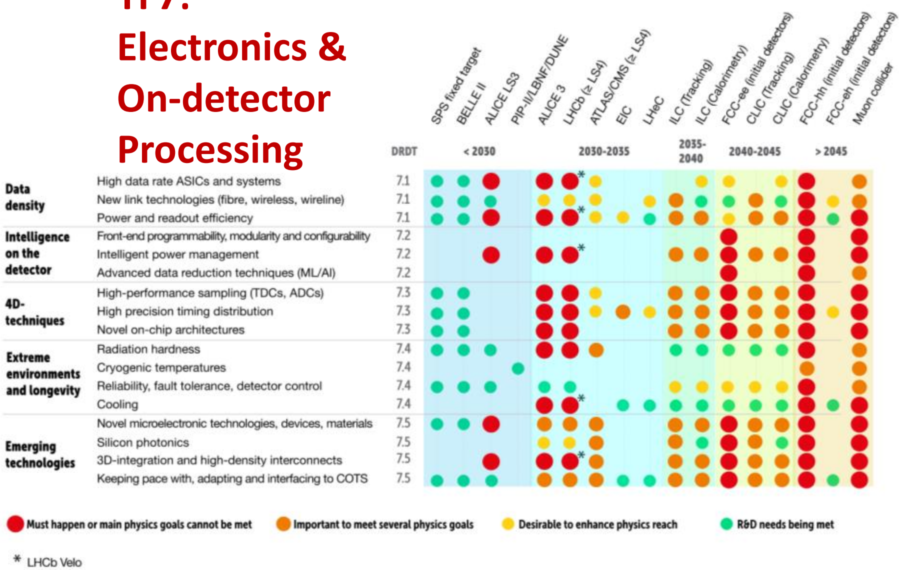
TF5: Quantum & Emerging Technologies



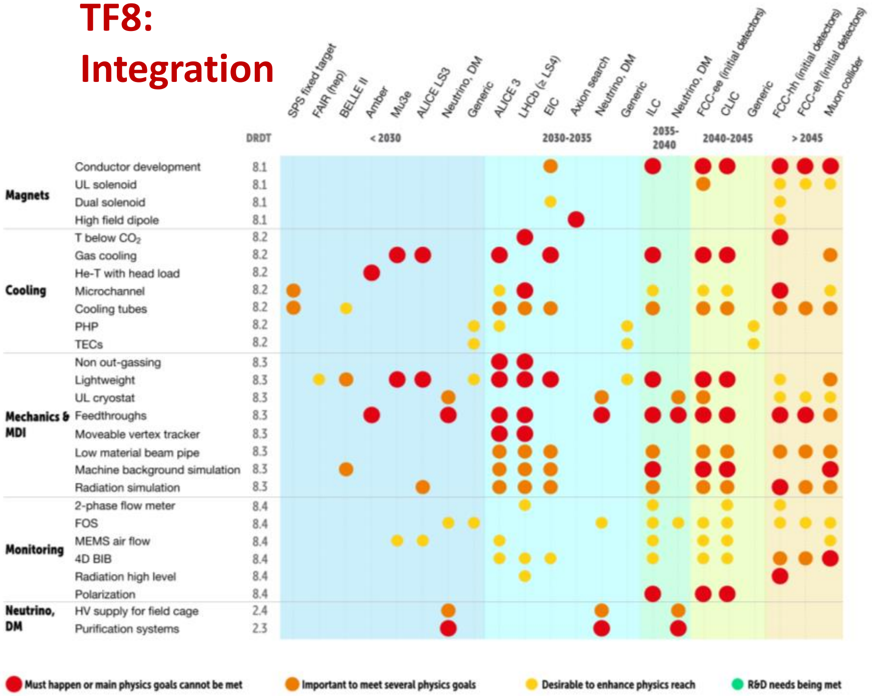
TF6: Calorimetry



TF7: Electronics & On-detector Processing



TF8: Integration



Detector R&D Roadmap

- The most urgent R&D topics in each Task Force area are identified as **Detector R&D Themes.**
- The timeframes for activities in these areas are illustrated in this figure from both the brochure and the main document.
- **Stepping stones** are shown to represent the R&D needs of **facilities intermediate in time.**
- The faded region acknowledges the typical time needed between the completion of the R&D phase and the readiness of an experiment at a given facility.

→ See "Results of the 2021 ECFA Early-Career Researcher Survey on Training in Instrumentation" ECFA ECR Panel *arXiv:2107.05739*

(https://cds.cern.ch/record/2784893)

Detector R&D Roadmap

- The most urgent R&D topics in each Task Force area are identified as **D**etector **R**&**D** **T**hemes.
- The timeframes for activities in these areas are illustrated in this figure from both the brochure and the main document.
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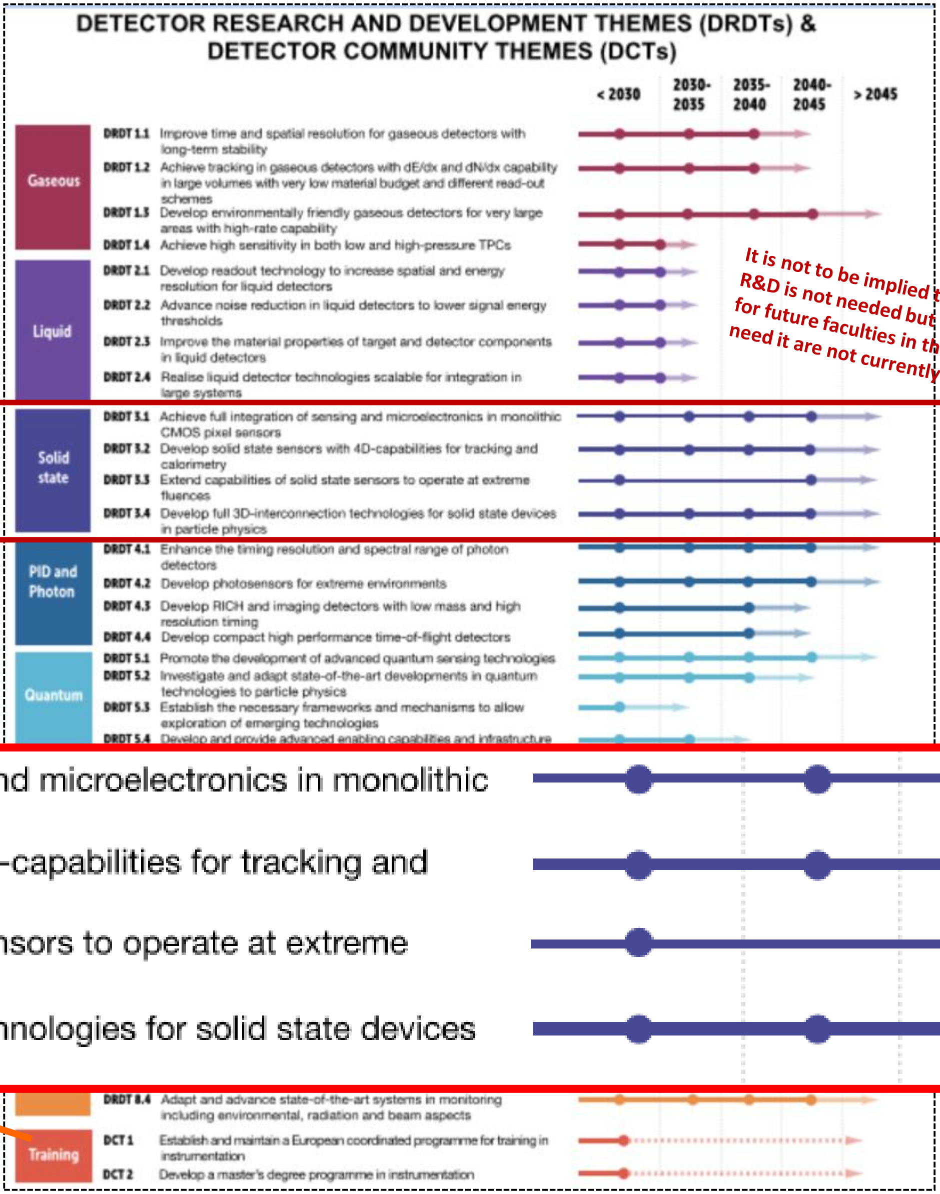
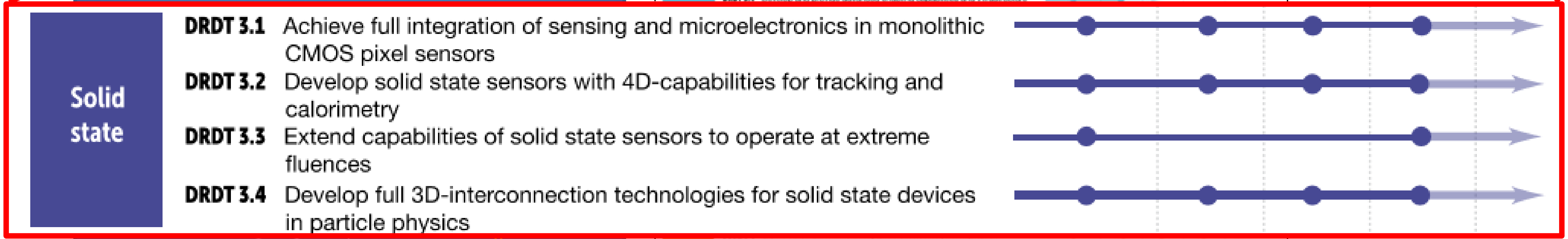
- The faded region acknowledges the

Training in Instrumentation" ECFA ECR Panel *arXiv:2107.05739*





(https://cds.cern.ch/record/2784893)

In addition to the Detector R&D Themes described above and discussed in each chapter the following General Strategic Recommendations were made under the following headings.

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

GSR 5 - Distributed R&D activities with centralised facilities

GSR 6 - Establish long-term strategic funding programmes

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

GSR 1 - Supporting R&D facilities

It is recommended that the structures to provide Europe-wide coordinated infrastructure in the areas of: test beams, large scale generic prototyping and irradiation be consolidated and enhanced to meet the needs of next generation experiments with adequate centralised investment to avoid less cost-effective, more widely distributed, solutions, and to maintain a network structure for existing distributed facilities, e.g. for irradiation

GSR 2 - Engineering support for detector R&D

In response to ever more integrated detector concepts, requiring holistic design approaches and large component counts, the R&D should be supported with adequate mechanical and electronics engineering resources, to bring in expertise in state-of-the-art microelectronics as well as advanced materials and manufacturing techniques, to tackle generic integration challenges, and to maintain scalability of production and quality control from the earliest stages.

GSR 3 - Specific software for instrumentation

Across DRDTs and through adequate capital investments, the availability to the community of state-of-the-art R&D-specific software packages must be maintained and continuously updated. The expert development of these packages - for core software frameworks, but also for commonly used simulation and reconstruction tools - should continue to be highly recognised and valued and the community effort to support these needs to be organised at a European level.

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

With a view to creating a vibrant ecosystem for R&D, connecting and involving all partners, there is a need to 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. It is also recommended to revisit and streamline the process of creating and reviewing these programmes, with an extended framework to help share the associated load and increase involvement, while enhancing the visibility of the detector R&D community and easing communication with neighbouring disciplines, for example in cooperation with the ICFA Instrumentation Panel.

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. Keeping in mind the growing complexity, the specialisation required, the learning curve and the increased cost, 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 Europe and through them also be available to help provide enhanced training opportunities.

GSR 6 - Establish long-term strategic funding programmes

Establish, additional to short-term funding programmes for the early proof of principle phase of R&D, 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. Beyond capital investments of single funding agencies, 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

It is essential that adequate resources be provided to support more speculative R&D which can be riskier in terms of immediate benefits but can bring significant and potentially transformational returns if successful both to particle physics: unlocking new physics may only be possible by unlocking novel technologies in instrumentation, and to society. Innovative instrumentation research is one of the defining characteristics of the field of particle physics. "Blue-sky" developments in particle physics have often been of broader application and had immense societal benefit. Examples include: the development of the World Wide Web, Magnetic Resonance Imaging, Positron Emission Tomography and X-ray imaging for photon science.

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

Innovation in instrumentation is essential to make progress in particle physics, and R&D experts are essential for innovation. It is recommended that ECFA, with the involvement and support of its Detector R&D Panel, continues the study of recognition with a view to consolidate the route to an adequate number of positions with a sustained career in instrumentation R&D to realise the strategic aspirations expressed in the EPPSU. It is suggested that ECFA should explore mechanisms to develop concrete proposals in this area and to find mechanisms to follow up on these in terms of their implementation. Consideration needs to be given to creating sufficiently attractive remuneration packages to retain those with key skills which typically command much higher salaries outside academic research. It should be emphasised that, in parallel, society benefits from the training particle physics provides because the knowledge and skills acquired are in high demand by industries in high-technology economies.

GSR 9 - Industrial partnerships

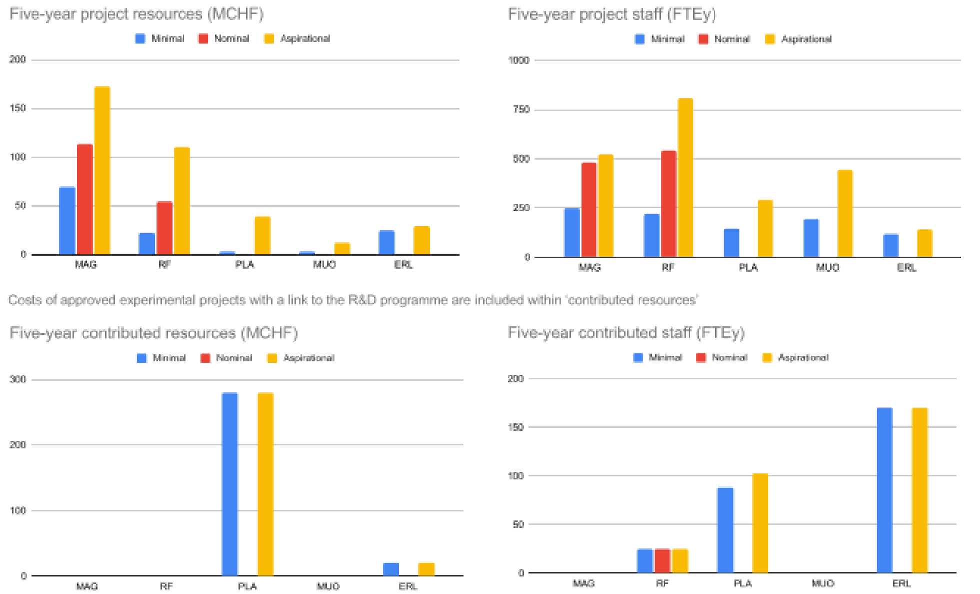
It is recommended to identify promising areas for close collaboration between academic and industrial partners, to create international frameworks for exchange on academic and industrial trends, drivers and needs, and to establish strategic and resources-loaded cooperation schemes on a European scale to intensify the collaboration with industry, in particular for developments in solid state sensors and micro-electronics.

GSR 10 – Open Science

It is recommended that the concept of Open Science be explicitly supported in the context of instrumentation, taking account of the constraints of commercial confidentiality where these apply due to partnerships with industry. Specifically, for publicly-funded research the default, wherever possible, should be open access publication of results and it is proposed that the Sponsoring Consortium for Open Access Publishing in Particle Physics ($SCOAP^3$) should explore ensuring similar access is available to instrumentation journals (including for conference proceedings) as to other particle physics publications.

Roadmap Implementation

- ECFA Detector R&D Roadmap submitted to SPC and CERN Council (6-10 December 2021) and released after submission as 10.17181/CERN.XDPL.W2EX along with the corresponding Accelerator R&D Roadmap prepared by the European Lab Director Group (LDG) at arXiv:2201.07895.
- The latter document was already submitted with a discussion of costs.
- We initially understood it would be highly urgent to prepare corresponding figures for the detector case (which we regard as much harder in our area).
- In response to the Roadmap presentations, CERN Council mandated ECFA to work out a detailed implementation plan "*in close collaboration with the SPC, the funding agencies and the relevant research organisations in Europe and beyond*".



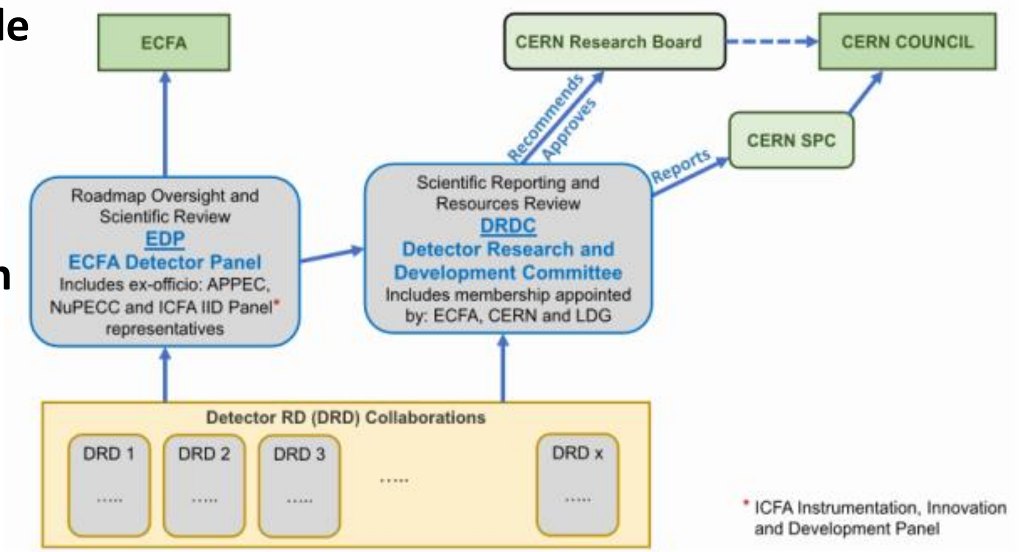
- It also mandated the LDG to work out a detailed implementation plan for the Accelerator R&D Roadmap, with both Detector and Accelerator R&D areas required to present outline plans already at the March Council Week.
- In the original planning, final proposals were to be presented during the June Council Week and, at the request of the SPC, a detailed implementation example was asked to be prepared by ECFA to illustrate how the proposed implementation plan could look in practice as a route to helping better explain the scheme being described.
- For the Detector Roadmap, the Coordination Panel (Phil Allport, Silvia Dalla Torre, Jorgen D'Hondt, Manfred Krammer, Karl Jakobs, Susanne Kuehn, Felix Sefkow, Ian Shipsey) were charged with drawing up these proposals.

Roadmap Implementation

- **The initial proposals were worked out by the Coordination group and presented and discussed first with the scientific representatives of all 28 Member countries of ECFA in the Rome RECFA meeting of (March 2022)**
- **The resulting scheme was further modified to reflect specific feedback from them and CERN management.**
- **Discussion have been going on in parallel with the leading Funding Agencies to understand what sort of new funding mechanisms and review structures might be acceptable to them.**
- **The proposed Detector and Accelerator implementation plans were presented to all Funding Agencies at the April 2022 Plenary RRB https://indico.cern.ch/event/1133070/timetable/ by ECFA and LDG Chairs (Karl Jakobs and Dave Newbold).**
- **ECFA regards the first stage, that needs the longest lead-time, as being to work out funding structures that would meet the recommendations GSR4, GSR5 and GSR6 to define a long-term framework for strategic R&D detector funding in Europe.**
- **In discussions with the many Funding Agencies with their diverse funding and costing models it was realised that the only viable model to fund future R&D Collaborations to deliver programmes to sustain the multi-decadal requirements, identified as the the DRDTs in the Roadmap, was to utilise the existing understood framework for funding long-term investments in particle physics experiments at CERN.**

Roadmap Implementation

- **This led ECFA to propose the organisation of long-term R&D efforts through newly established Detector R&D (DRD) Collaborations supported by strategic funding aimed at the DRDT topics. (This to be additional to short-term funding programmes supported at a national level for the early proof of principle "*blue-sky*" R&D and resources through other schemes which may include funding for programmes not linked to the longer term strategic goals of European particle physics.)**
- **Note, as in CERN experiments, the resources are to be awarded through the participating institutes who retain scientific and financial oversight.**
- **For approval and review of the DRDs, and specifically their progress towards meeting the goals outlined in the Roadmap, this structure has been iterated with Funding Agency representatives and CERN management as meeting a wide range of constraints.**



EDP*:
- Scrutinises the new DRD collaborations' R&D priorities;
- Produces ~annually updated, in-depth scientific progress reviews;
- Monitors how the goals and achievements reflect the vision encapsulated in the Roadmap DRDTs;
- Keeps abreast of the evolving specifications from experiment concept groups as well as proto-collaborations targeting future facilities;
- Link to neighbouring fields (APPEC, NuPECC) and ICFA.

DRDC:
- Provides overall programme strategic and financial oversight;
- Single body that interacts for approvals, reporting, etc., with the existing CERN committee structure;
- Evaluates the initial DRD collaborations' resource requests (just at the start of the project) with a focus on evaluating whether the effort required can be matched by the available effort pledged by the participating institutes;
- Decides on recommendation of approval to CERN Research Board;
- Summarises overall R&D science programme, based on input from EDP.

***As currently constituted, the EDP provides independent reviews to R&D Collaborations (such as CALICE) which although largely centred in Europe are not linked solely to future projects focussed at CERN. (Note, the EDP is external to CERN structures and its administration is not an additional burden on CERN).**

Roadmap Implementation

- Detector technology areas: larger DRD collaborations should be considered, given: concerns about the review and administrative overheads with too many entities covering too fine-grained topics, the synergies that can be better exploited by larger organisations and the advantages of scale in terms of dealing with external bodies.
- It is proposed that DRD Collaborations should be anchored at CERN → CERN recognition; DRD label.
- The new DRDs should take full account of existing, well-managed and successful ongoing R&D collaborations and other existing activities (current RDs, CERN EP R&D programme, EU-funded initiatives, collaborations exploring particular technology areas for future colliders, …).
- The formation of the new DRD collaborations should clearly adopt a community-driven approach;
  - propose this could be supported by existing ECFA Detector R&D Roadmap Task Forces;
  - aim to initiate this year, with full process established over the coming year, leading to creation of new structures by early 2024 to be able to bid for resources with ramp up to full funding for strategic R&D is to be achieved for 2026.
- Research topics, budget, milestones, etc., would have to be adapted as rolling grants for long-term R&D lines with flexibility for adapting to the changing international landscape and new R&D opportunities (for example coming from "*blue-sky*" R&D funded through resources outside those awarded for DRDT-specific strategic R&D).
- Many details are still under discussion, but it has been strongly recommended that the setting up of this proposed organisational structure proceeds immediately to enable it to produce concrete R&D plans to be presented during the 2022 September Council Week for final approval at the December Council Week.

Conclusions

- **The ECFA Detector R&D Roadmap was prepared by a large team of internationally recognised leaders in this area with access to a much wider pool of other instrumentation experts.**
- **It was the product of wide community consultation with very broad participation.**
- **It was endorsed by RECFA and has been presented to the CERN Scientific Policy Committee and Council and been very well received, with the SPC congratulating the Roadmap Panel and endorsing the recommendations, creating significant support and momentum for following up on its key recommendations.**
- **ECFA has been mandated to propose mechanisms for implementing the Roadmap recommendations.**
- **A process of consultation with Funding Agencies, national scientific contacts (via RECFA), CERN committees and management around the aspects requiring the longest lead-times (those linked to new funding lines and structures linking in particular to the General Strategic Recommendations GSR4, GSR5 and GSR6) has been initiated.**
- **An overall framework needs to be agreed to secure longer-term R&D resources that also anticipates post-LHC and supports non-LHC programmes in a way that takes better advantage of the multiple synergies that exist across the many particle physics (and neighbouring discipline) detector development programmes – otherwise a substantial community of experts and funding to support their activities will be lost to our community.**
- ***We need your help to pull the community together through the coming year to converge on the structures and proposals which can secure the resources that will become freed-up as the major HL-LHC deliverables begin to be completed and final integration gets underway in 2026.***

Back-up

European Particle Physics Strategy Update

"**Main report**: ***"Recent initiatives with a view towards strategic R&D on detectors are being taken by CERN's EP department and by the ECFA detector R&D panel, supported by EU-funded programmes such as AIDA and ATTRACT. Coordination of R&D activities is critical to maximise the scientific outcomes of these activities and to make the most efficient use of resources; as such, there is a clear need to strengthen existing R&D collaborative structures, and to create new ones, to address future experimental challenges of the field beyond the HL-LHC. 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."***

Deliberation document: ***"Detector R&D programmes and associated infrastructures should be supported at CERN, national institutes, laboratories and universities. Synergies between the needs of different scientific fields and industry should be identified and exploited to boost efficiency in the development process and increase opportunities for more technology transfer benefiting society at large. Collaborative platforms and consortia must be adequately supported to provide coherence in these R&D activities. The community should define a global detector R&D roadmap that should be used to support proposals at the European and national levels."***

Extracted from the documents of 2020 EPPSU, https://europeanstrategyupdate.web.cern.ch/

More roadmap process details at: https://indico.cern.ch/e/ECFADetectorRDRoadmap

Process and Timeline

Organisation

May 2020
EPPSU mandate to ECFA to develop a roadmap for detector R&D efforts in Europe

Sep 2020
Structure in place with **Detector R&D Roadmap Panel**

Dec 2020
Task Forces active

Website:
https://indico.cern.ch/e/ECFADetectorRDRoadmap

Expert & Community Consultation

Feb 2021
Collection of requirements of future facilities & projects

Feb/March 2021
Questionnaires of Task Forces to national contacts

Task Forces liaise with experts in
- ECFA countries
- adjacent disciplines
- industry

March-May 2021
Open Symposia

Drafting Roadmap & Feedback

May 2021
Task Forces collate input from symposia

25-28 May 2021 **Drafting sessions**
- opening session with all experts involved
- plenary & parallel sessions with Task Force members
- final session of Roadmap Panel

July 2021
Near final draft shared with RECFA*

30 July 2021
Presentation at Joint ECFA-EPS session

August 2021
Collect final community feedback*

October-December 2021
Detector R&D Roadmap Document circulated for approval to ECFA in Nov 2021 and presentation to Council in Dec 2021

Detector R&D Roadmap Process Group

Task Force convenors, Task Force expert members and Panel members of the ECFA Detector R&D Roadmap Process Group

Task Force 1 Gaseous Detectors: Anna Colaleo[1], Leszek Ropelewski[2] *(Conveners)*
Klaus Dehmelt[3], Barbara Liberti[4], Maxim Titov[5], Joao Veloso[6] *(Expert Members)*

Task Force 2 Liquid Detectors: Roxanne Guenette[7], Jocelyn Monroe[8] *(Conveners)*
Auke-Pieter Colijn[9,10], Antonio Ereditato[11,12,28], Inés Gil Botella[13],
Manfred Lindner[14] *(Expert Members)*

Task Force 3 Solid State Detectors: Nicolo Cartiglia[15], Giulio Pellegrini[16] *(Conveners)*
Daniela Bortoletto[17], Didier Contardo[18], Ingrid-Maria Gregor[19,20] Gregor Kramberger[21],
Heinz Pernegger[2] *(Expert Members)*

Task Force 4 Particle Identification and Photon Detectors: Neville Harnew[17],
Peter Krizan[21] *(Conveners)*
Ichiro Adachi[22], Eugenio Nappi[1] Christian Joram[2],
Hans-Christian Schultz-Coulon[23] *(Expert Members)*

Task Force 5 Quantum and Emerging Technologies: Marcel Demarteau[24],
Michael Doser[2] *(Conveners)*
Caterina Braggio[25], Andy Geraci[26], Peter Graham[27], Anna Grasselino[28],
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Task Force 6 Calorimetry: Roberto Ferrari[30], Roman Pöschl[31] *(Conveners)*
Martin Aleksa[2], Dave Barney[2], Frank Simon[32],
Tommaso Tabarelli de Fatis[33] *(Expert Members)*

Task Force 7 Electronics: Dave Newbold[34], Francois Vasey[2] *(Conveners)*
Niko Neufeld[2], Valerio Re[30] Christophe de la Taille[35], Marc Weber[36] *(Expert Members)*

Task Force 8 Integration: Frank Hartmann[36], Werner Riegler[2] *(Conveners)*
Corrado Gargiulo[2], Filippo Resnati[2], Herman Ten Kate[37], Bart Verlaat[2],
Marcel Vos[38] *(Expert Members)*

Task Force 9 Training: Johann Collot[39], Erika Garutti[40] *(Conveners)*
Richard Brenner[41], Niels van Bakel[9] Claire Gwenlan[17], Jeff Wiener[2], Robert Appleby[42]
(Expert Members)

The Task Force Convenors join those listed below to compose the Detector R&D Roadmap Panel.

Panel coordinators: Phil Allport[42] *(Chair)*, Silvia Dalla Torre[43], Manfred Krammer[2],
Felix Sefkow[18], Ian Shipsey[16]

Ex-officio Panel members: Karl Jakobs[44] *(Current ECFA Chair)*,
Jorgen D'Hondt[45] *(Previous ECFA Chair)*, Lenny Rivkin[46] *(LDG Representative)*

Scientific Secretary: Susanne Kuehn[2]

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[2] CERN, Geneva, Switzerland
[3] Stony Brook University, New York, US
[4] INFN Roma, Rome, Italy
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[6] Universidade de Aveiro, Aveiro, Portugal
[7] Harvard University, Cambridge, US
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[22] KEK, Tsukuba, Japan
[23] Heidelberg University, Heidelberg, Germany
[24] ORNL, Oak Ridge, US
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[33] University of Milano-Bicocca and INFN Milano-Bicocca, Milano, Italy
[34] RAL, Didcot, UK
[35] CNRS/IN2P3-OMEGA, Palaiseau, France
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[37] University of Twente, Twente, Netherlands
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[46] IIHE, Vrije Universiteit Brussel, Brussels, Belgium
[47] ETH Lausanne and PSI, Villigen, Switzerland

Restricted ECFA Composition

https://ecfa.web.cern.ch/restricted-ecfa

Chair	Prof. Dr Karl Jakobs	Appointed Jan. 2021
Secretary	Prof. Patricia Conde Muino	Appointed July 2021

Members		
Austria	Dr Manfred Jeitler	Appointed Jan. 2018
Belgium	Prof. Nick van Remortel	Appointed July 2018
Bulgaria	Prof. Plamen laydjiev	Appointed Jan. 2016
Croatia	Prof. Mirko Planinic	Appointed July 2020
Cyprus	Prof. Panos Razis	Appointed Oct. 2017
Czech Republic	Dr Marek Tasevsky	Appointed Jan. 2019
Denmark	Prof. Mogens Dam	Appointed Jan. 2018
Finland	Dr Kati Lassila-Perini	Appointed Jan. 2018
France	Dr Jean-Claude Brient	Appointed Jan. 2020
Germany	Prof. Heiko Lacker	Appointed July 2021
Greece	Prof. Paris Sphicas	Appointed July 2018
Hungary	Dr Ferenc Siklér	Appointed Jan. 2021
Italy	Prof. Chiara Meroni	Appointed July 2020
Israel	Prof. Eilam Gross	Appointed Jan. 2018
Netherlands	Prof. Stan Bentvelsen	Appointed Jan. 2015
Norway	Prof. Alexander Read	Appointed Jan. 2018
Poland	Prof. Justyna Łagoda	Appointed Jan. 2021
Portugal	Prof. Patricia Condes Muino	Appointed July 2020
Romania	Dr Alexandru-Mario Bragadireanu	Appointed Jan. 2019
Serbia	Prof. Peter Adžic	Appointed July 2012
Slovakia	Dr Pavol Stríženec	Appointed May 2016
Slovenia	Prof. Marko Mikuž	Appointed July 2018
Spain	Prof. Celso Martinez	Appointed Jan. 2021
Sweden	Prof. David Milstead	Appointed Jan. 2018
Switzerland	Dr Mike Seidel	Appointed Jan. 2019
Turkey	Prof. Mehmet Zeyrek	Appointed July 2018
United-Kingdom	Prof. Max Klein	Appointed Jan. 2021
Ukraine	Prof. Mykola Shul'ga	Appointed July 2018
CERN	Dr Roger Forty	Appointed Sept. 2015
Ex-Officio Members		
CERN	Dr Fabiola Gianotti Prof. Joachim Mnich	Appointed Jan. 2016 Appointed Jan. 2021
LDG	Prof. Dave Newbold	Appointed Jan. 2021
Observers		
EPS-HEPP Board Chair	Prof. Thomas Gehrmann	Appointed Sept. 2019
ApPEC Chair	Dr Andreas Haungs	Appointed Jan. 2021
NuPECC Chair	Prof. Marek Lewitowicz	Appointed March 2018
Russian Federation	Prof. Victor Matveev	Appointed Jan. 2007
Early Career Researchers (ECR)	Lydia Brenner	Appointed Feb. 2021

Two Days of Input Sessions

Input session of Future Facilities I
Friday 19 Feb 2021, 13:00 → 18:00 Europe/Zurich

13:00 → 13:30 Detector R&D requirements for HL-LHC
Speaker: Chris Parkes (University of Manchester (GB))
ECFA_RD_Parkes_1...

13:30 → 14:00 Detector R&D requirements for strong interaction experiments at future colliders
Speaker: Luciano Musa (CERN)
MUSA_ECFA_IS_20...

14:00 → 14:30 Detector R&D requirements for strong interaction experiments at future fixed target facilities
Speaker: Johannes Bernhard (CERN)
Detector R&D requir...

14:30 → 14:45 Coffee-Tea Break

14:45 → 15:15 Detector R&D requirements for future linear high energy e+e- machines
Speaker: Frank Simon (Max-Planck-Institut fuer Physik)
LC_DetRoadmapinp...

15:15 → 15:45 Detector R&D requirements for future circular high energy e+e- machines
Speaker: Mogens Dam (University of Copenhagen (DK))
ECFA_Detector_R&D...

15:45 → 16:15 Detector R&D requirements for future high-energy hadron colliders
Speaker: Martin Aleksa (CERN)
20210219-ECFA-Det...

16:15 → 16:35 Detector R&D requirements for muon colliders
Speaker: Nadia Pastrone (Universita e INFN Torino (IT))
MuonColliders_Dete...

Input session of Future Facilities II
Monday 22 Feb 2021, 14:00 → 18:00 Europe/Zurich

14:00 → 14:30 Detector R&D requirements for future short and long baseline neutrino experiments
Speaker: Marzio Nessi (CERN)
21-02-22-ECFA-Neut... 21-02-22-ECFA-Neut...

14:30 → 15:00 Detector R&D requirements for future astro-particle neutrino experiments
Speaker: Maarten De Jong (Nikhef National institute for subatomic physics (NL))
ECFA - Maarten de ... ECFA - Maarten de ...

15:00 → 15:30 Detector R&D requirements for future dark matter experiments
Speaker: Laura Baudis (University of Zurich)
baudis_ecfa_feb21...

15:30 → 15:40 Coffee-Tea Break

15:40 → 16:10 Detector R&D requirements for future rare decay processes experiments
Speakers: Cristina Lazzeroni (University of Birmingham (GB)), Cristina Lazzeroni (University of Birmingham (GB))
ECFA_Lazzeroni.pdf

16:10 → 16:40 Detector R&D requirements for future low energy experiments
Speaker: Dr Alexandre Obertelli (TU Darmstadt)
ECFA_LowEnergyFa...

Input Session speakers provided detailed specifications and continued giving support for the process

… particularly for checking if there were any unmet detector R&D needs for the ESPP identified programme which may have been overlooked in the symposia programmes.

	Speaker	Presentation Topic
1	Chris Parkes	Detector R&D requirements for HL-LHC
2	Luciano Musa	Detector R&D requirements for strong interaction experiments at future colliders
3	Johannes Bernhard	Detector R&D requirements for strong interaction experiments at future colliders
4	Frank Simon	Detector R&D requirements for future linear high energy e+e- machines
5	Mogens Dam	Detector R&D requirements for future circular high energy e+e- machines
6	Martin Aleksa	Detector R&D requirements for future high-energy hadron colliders
7	Nadia Pastrone	Detector R&D requirements for muon colliders
8	Marzio Nessi	Detector R&D requirements for future short and long baseline neutrino experiments
9	Maarten De Jong	Detector R&D requirements for future astro-particle neutrino experiments
10	Laura Baudis	Detector R&D requirements for future dark matter experiments
11	Cristina Lazzeroni	Detector R&D requirements for future rare decay processes experiments
12	Alexandre Obertelli	Detector R&D requirements for future low energy experiments

Many thanks to all these key experts for their time and help with this process

Full-day Public Symposia

Two days of Input Sessions covered all the future facilities and topic areas identified in the EPPSU (see back-up).
Following these were nine technology focussed full-day public symposia as the main fora to collect community input.

Task Force	TF7	TF8	TF2	TF5	TF3	TF1	TF9	TF4	TF6
Dates	25/3/21	31/3/21	9/4/21	12/4/21	23/4/21	29/4/21	30/4/21	6/5/21	7/5/21
Unique users	369 + 123 (webcast)	154 + 17 (webcast)	197 + 5 (webcast)	220	504	339	105	207	201
Max. number of concurrent viewers	230 + 123 (webcast)	76 + 17 (webcast)	130 + 5 (webcast)	100	275	191	59	110	115

Common registration for the symposia had logged 1359 participants by the end of the last one.

Received extensive feedback during symposia and after by email.

Surveys were also employed to receive direct inputs from individuals and via RECFA delegates or their National Contacts.

APOD appointed experts consulted where needed by Task Force convenors for advice on developments in their disciplines.

May 2021

- 07 May ECFA Detector R&D Roadmap Symposium of Task Force 6 Calorimetry
- 06 May ECFA Detector R&D Roadmap Symposium of Task Force 4 Photon Detectors and Particle Identification Detectors

April 2021

- 30 Apr ECFA Detector R&D Roadmap Symposium of Task Force 9 Training
- 29 Apr ECFA Detector R&D Roadmap Symposium of Task Force 1 Gaseous Detectors
- 23 Apr ECFA Detector R&D Roadmap Symposium of Task Force 3 Solid State Detectors
- 12 Apr ECFA Detector R&D Roadmap Symposium of Task Force 5 Quantum and Emerging Technologies
- 09 Apr ECFA Detector R&D Roadmap Symposium of Task Force 2 Liquid Detectors

March 2021

- 31 Mar ECFA Detector R&D Roadmap Symposium of Task Force 8 Integration
- 25 Mar ECFA Detector R&D Roadmap Symposium of Task Force 7 Electronics and On-detector Processing

Materials from past Symposia, Input Sessions and other components of the ECFA Detector R&D Roadmap Process can be found at https://indico.cern.ch/e/ECFADetectorRDRoadmap

Many thanks to the 121 presenters, the 1359 attendees and all who provided feedback

ECFA
European Committee for Future Accelerators

Advisory Panel with Other Disciplines

Organisation name	Contact name
APPEC	Andreas Haungs (Chair)
NuPECC	Marek Lewitowicz (Chair)
LEAPS	Caterina Biscari (Chair)
LENS	Helmut Schober (Chair)
ESA	Guenther Hasinger (Director of Science) Franco Ongaro (Director of Technology, Engineering and Quality)

APPEC: Astro-Particle Physics European Consortium
ESA: European Space Agency
LEAPS: League of European Accelerator-based Photon Sources
LENS: League of advanced European Neutron Sources
NuPECC: Nuclear Physics European Collaboration Committee

Named expert contacts		
APPEC	TF1	Jennifer L Raaf (Fermilab)
	TF2	Manfred Lindner (MPI Heidelberg)
	TF3	Fabrice Retiere (TRIUMF)
	TF4	Tina Pollmann (Nikhef)
	TF5	Harald Lück (Hannover)
	TF6	Federica Petricca (MPI Munich)
	TF7	Marc Weber (KIT)
	TF8	Aldo Ianni (LNGS)
	TF9	Katrin Link (APPEC)
NuPECC	TF1	Laura Fabbietti (TUM Munich)
		Bernhard Ketzer
	TF2	
	TF3	Luciano Musa (CERN)
		Michael Deveaux
	TF4	Eugenio Nappi (INFN Bari)
		Jochen Schwiening
	TF5	: Christian Enss (Heidelberg),
	TF6	Thomas Peitzmann (Utrecht)
		Ulrike Thoma (Bonn)
	TF7	David Silvermyr (Lund)
		Christian J. Schmidt
	TF8	Werner Riegler (CERN)
		Lars Schmitt
	TF9	Michael Deveaux,
LEAPS	Bernd Schmitt (PSI)	
	Fabienne Orsini	
	Steve Aplin (European	
	Heinz Graafsma (DESY)	

Named contacts for each TF where appropriate

Many thanks to these experts for their advice and availability

LENS	TF1	Bruno Guerard (ILL)
	TF2	Manfred Lindner (MPI Heidelberg)
	TF3	
	TF4	
	TF5	Helmut Schober (ILL)
	TF6	
	TF7	Bruno Guerard (ILL)
	TF8	
	TF9	
ESA	TF1	Nick Nelms
	TF2	
	TF3	Brian Shortt
		Nick Nelms
		Giovanni Santin
		Alessandra Constantino Mucio
	TF4	Brian Shortt
		Peter Verhoeve
		Sarah Wittig
		Nick Nelms
		Giovanni Santin
	TF5	Peter Verhoeve
		Sarah Wittig
		Nick Nelms
	TF6	Nick Nelms
	TF7	Joerg Ter Haar
		Christophe Honvault
		Nick Nelms
		Alessandra Constantino Mucio
	TF8	Massimo Braghin
	TF9	Christophe Honvault

Detailed ECFA Timeline

- Draft circulated to RECFA, National Contacts and ECR on 2nd July with deadline for comments on 16th July
- Comments received from many of the RECFA members, observers and appointed National Contacts for the ECFA Detector R&D Roadmap process.
- Overwhelmingly positive and a number of countries had also organised a careful reading of the full draft with many detailed comments to each section - which were very helpful and have been implemented.
- A number of more general comments were discussed in greater detail on 21st July with a special sub-panel composed of RECFA members with reports back to RECFA and also to Plenary ECFA on 22nd July.
- The main messages contained here were presented to the particle physics community on 30th July at the ECFA Plenary Session of the EPS-HEP2021 Conference.
- **The document will need formal approval from ECFA on 19th November and will be presented as printed copies to CERN Council on 10th December.**
- **In parallel we have prepared an 8 page "synopsis" to accompany this, summarising the main conclusions which has been prepared with CERN IR-ECO in a more accessible language and style.**
- **Currently the 8 page document is printed and will be made available with the main document as both paper copies and pdf versions.**
- **The first print run of the main document is also completed but materials can only be made public once they have first been presented to CERN Council.**

Links for Roadmap Process

(https://indico.cern.ch/e/ECFADetectorRDRoadmap)

https://indico.cern.ch/event/957057/page/21633-mandate (Panel Mandate document)

https://indico.cern.ch/event/957057/page/21653-relevant-documents

https://home.cern/resources/brochure/cern/european-strategy-particle-physics

https://arxiv.org/abs/1910.11775 (Briefing Book)

https://science.osti.gov/-/media/hep/pdf/Reports/2020/DOE_Basic_Research_Needs_Study_on_High_Energy_Physics.pdf

https://ep-dep.web.cern.ch/rd-experimental-technologies (CERN EP R&D)

https://aidainnova.web.cern.ch (linking research infrastructures in detector development and testing)

https://attract-eu.com/ (ATTRACT: linking to industry on detection and imaging technologies)

https://ecfa-dp.desy.de/public_documents/ (Some useful documents from the ECFA Detector Panel)