

Particle Physics Technology Advisory Panel

Paula Chadwick, Durham University – PPTAP Chair

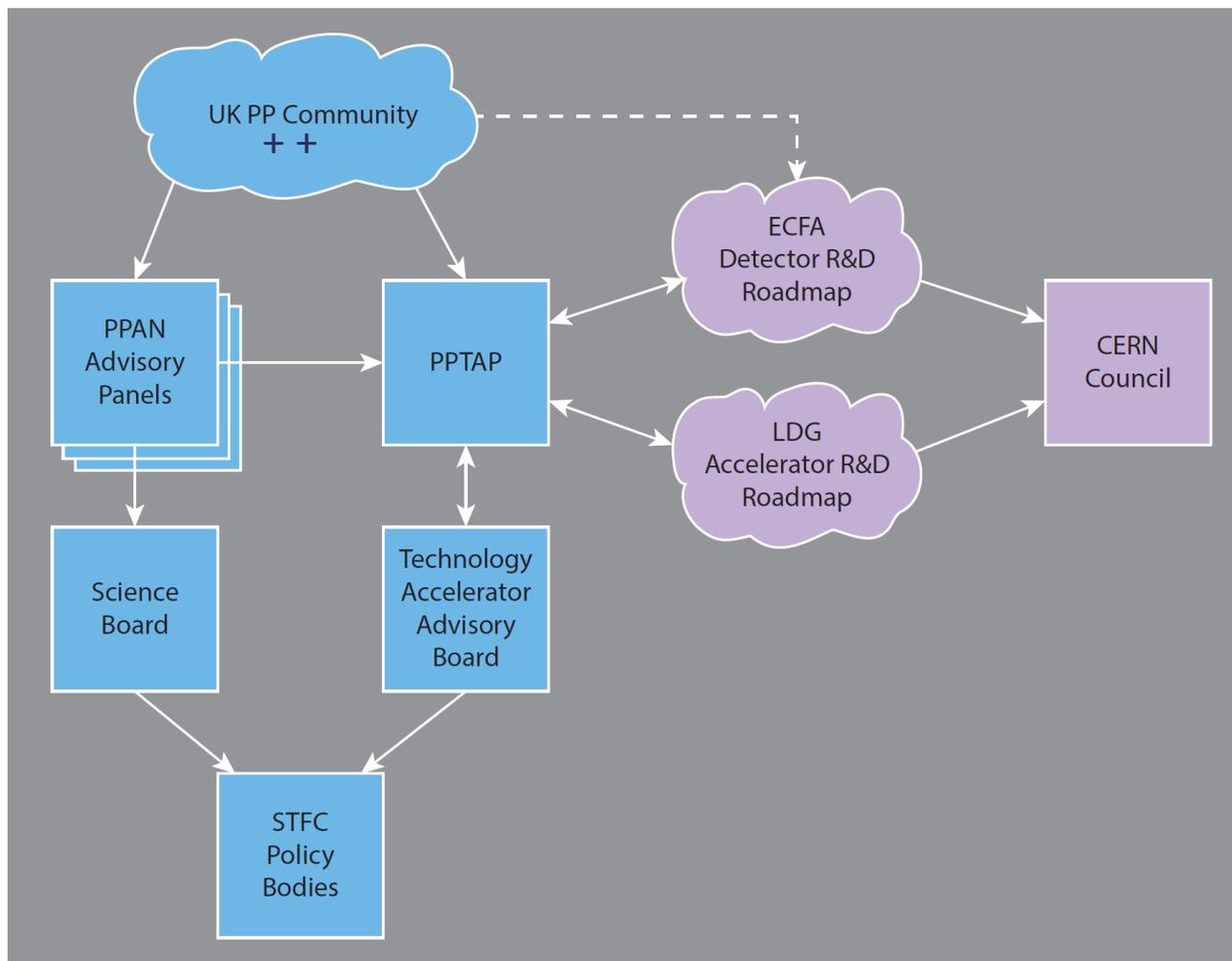
Why a PPTAP?

- The European Strategy for Particle Physics [Update](#) identified an immediate need for active R&D programmes for future detectors and accelerators
- The European Committee for Future Accelerators ([ECFA](#)) called on to establish an R&D roadmap for detectors
- The European Laboratory Directors Group (ELDG) called on to establish an R&D roadmap for accelerators
- Work started in autumn 2020 and expected to report to CERN Council in December 2021
- UK input needed for these processes and to inform UK direction

PPTAP

- Aims
 - overview of the emerging R&D roadmaps
 - understand the case for investment in R&D
- Need to look at current programme and landscape
- Gather evidence
- Look for strengths and synergies
- Explore routes forward
- Output - report autumn 2021

Roadmap activities



European Particle Physics Strategy Update



“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 roadmap should identify and describe a diversified detector R&D portfolio that has the largest potential to enhance the performance of the particle physics programme in the near and long term.”

“Detector R&D activities require specialised infrastructures, tools and access to test facilities.”

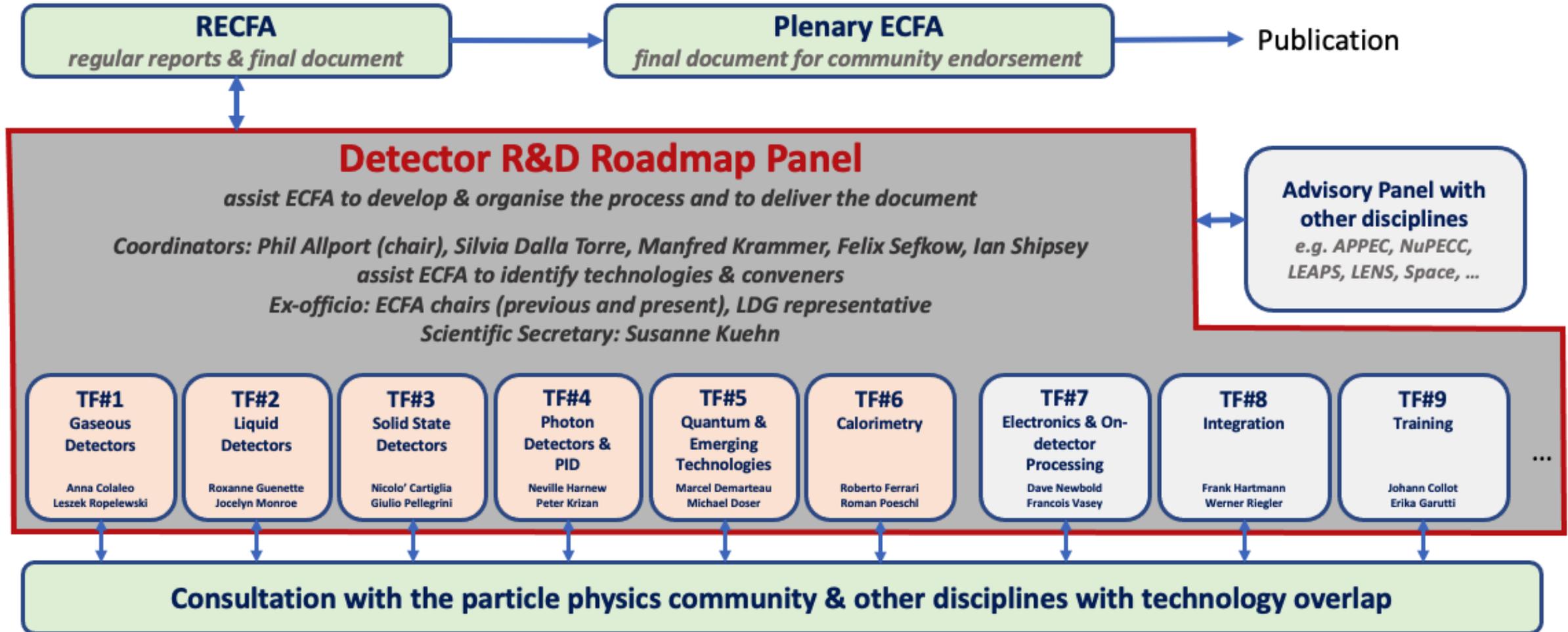
“The community should define a global detector R&D roadmap that should be used to support proposals at the European and national levels.”

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

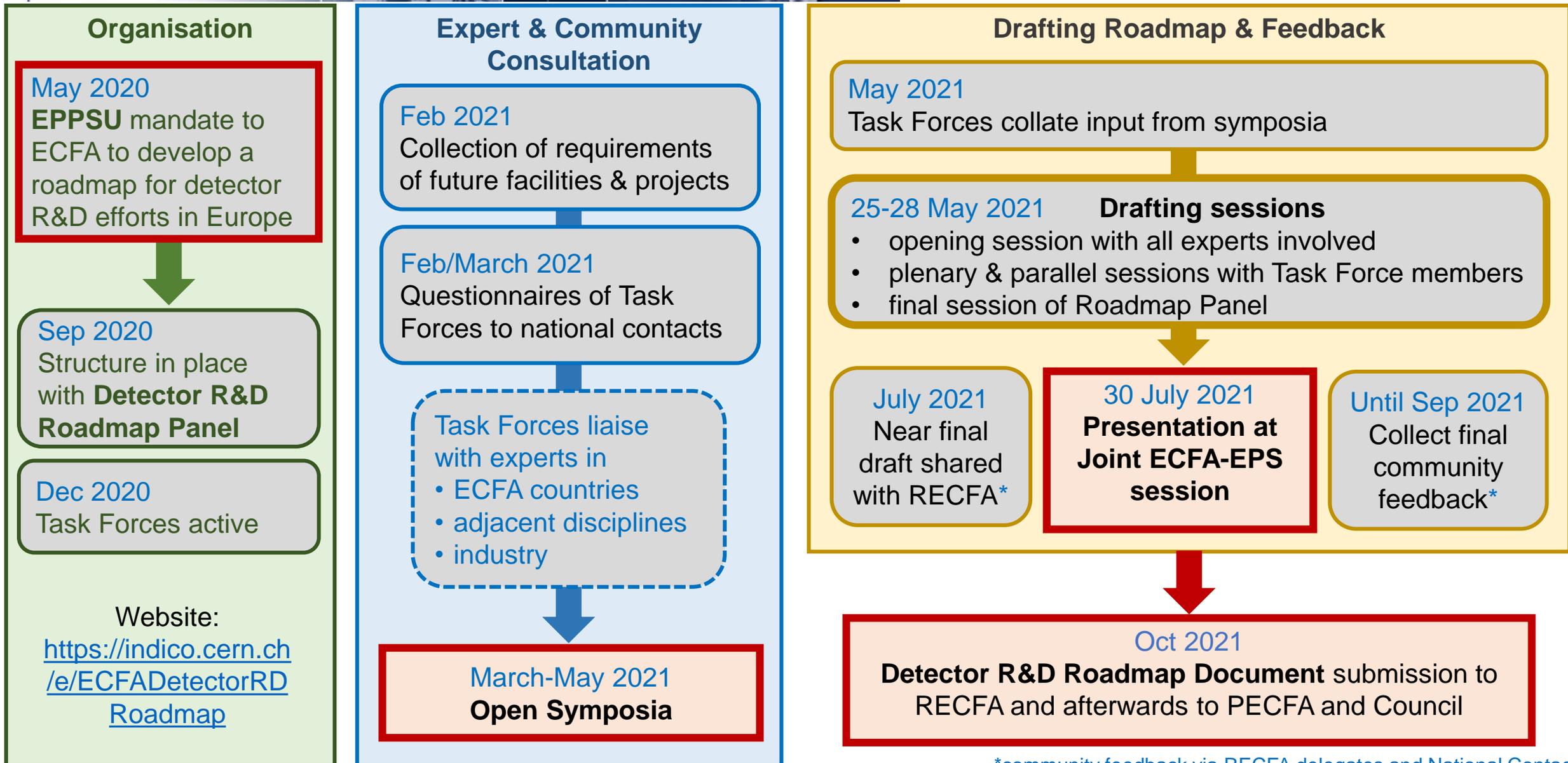
For previous presentations on the Detector R&D Roadmap see Plenary ECFA: Jorgen D’Hondt (13/7/20) & Susanne Kuehn (20/11/20) (<https://indico.cern.ch/event/933318/> & <https://indico.cern.ch/event/966397/>)

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

Organization for Consultation of Relevant Communities



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



*community feedback via RECFA delegates and National Contacts

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...

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

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>

LDG Roadmap Requirements

Provide an agreed structure for a coordinated and intensified programme of particle accelerator R&D, including into new technologies, to be coordinated across national laboratories

Be compatible and commensurate with corresponding roadmaps in detectors, computing and other developments, with a compatible timeline and deliverables

Be based on the goals of the European Strategy, but defined in its implementation through consultation with the community and, where appropriate, through the work of expert panels

Take into account, and coordinate with, international activities and work being carried out in other related scientific fields, including development of new large-scale facilities

Specify a series of concrete deliverables, including demonstrators, over the next decade

Be designed to inform, through its outcomes, subsequent updates to the European Strategy.

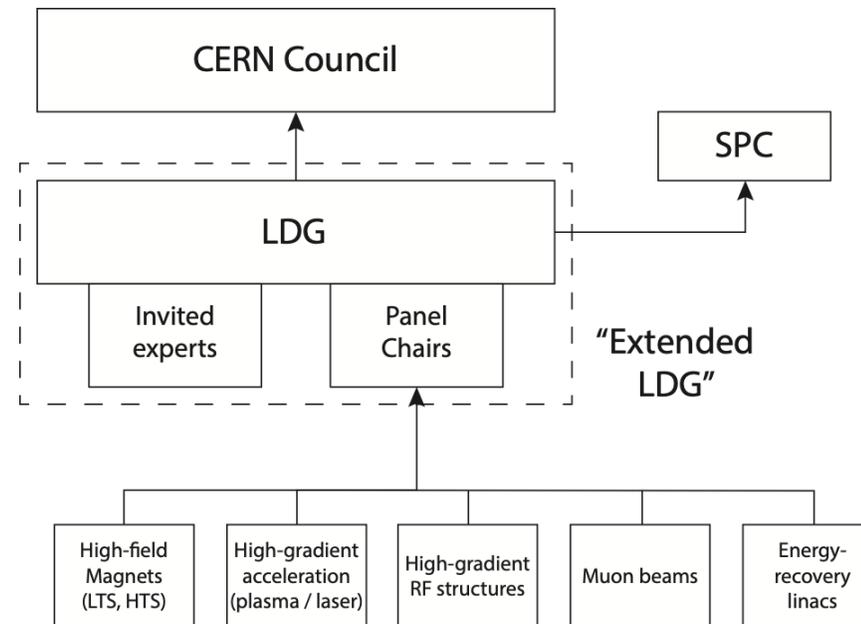
LDG Roadmap Process

Five expert panels appointed:

- High-field magnets, including use of high-temperature superconductors
- High-gradient acceleration (plasma / laser)
- High-gradient RF structures and systems
- Bright muon beams and muon colliders
- Energy-recovery linacs

Panel chairs

- Magnets: P. Vedin (IRFU)
- Plasma: R. Assmann (DESY)
- RF: S. Bousson (IJCLab)
- Muons: D. Schulte (CERN)
- ERL: M. Klein (Liverpool)
- Diverse and international set of panel members now in place and starting work



Status, Timeline and Outcome

Process is really now starting in earnest

- Panels are now fully populated, initial meetings have taken place
- List of workshops and input sessions being populated:
 - <https://indico.cern.ch/category/13700/>
- Key questions and issues being identified

Timeline

- March: Council confirmation of roadmap scope and process
 - Emphasis on 'inclusivity across the community'
- June: SPC update
- June: proposed public workshop for HEP community (NEW)
- July: Presentation of progress at EPS-HEP conference for feedback
- September: Present interim findings to SPC / Council (facts, not priorities or plan)
- December: Council approval of final report, definition of next steps

Outcome

- Yellow report summarising work of the panels and synthetic conclusions
 - We may wish to include additional thoughts / material on 'cross-cutting' issues, e.g. training
 - Clear that 'preparatory documents' may be of publishable quality
- SPC / Council recommendations on priorities and next steps

PPTAP Membership

Accelerators

Prof Deepa Angal-Kalinin, ASTeC STFC
Prof Robert Appleby, Manchester
Dr Chris Rogers, ISIS STFC
Ben Shepherd, ASTeC STFC
Prof Matthew Wing, UCL

Computing

Dr Neil Chue Hong, Edinburgh
Dr Tim Scanlon, UCL

Observers

Prof Phil Burrows, JAI
Prof Jim Clarke, ASTeC STFC
Charlotte Jamieson, PD, STFC

Detectors

Prof Adrian Bevan, Queen Mary
Prof Kai Bongs, Birmingham
Rob Halsall, Technology STFC
Dr Kimberley Palladino, Oxford
Dr Angela Romano, Birmingham
Dr Craig Sawyer
Dr Eva Vilella-Figueras, Liverpool
Prof Iacopo Vivarelli, Sussex

Prof Max Klein, Liverpool, RECFA
Prof Dave Newbold, PPD, STFC
Prof Peter Ratoff, CI

PPTAP

- [Webpage](#)
- Meetings: monthly since December
- Gathering information
 - Community survey closed 12th March
 - Circulated via PPAP, PAAP and other professional networks
 - Circulating ECFA and ELG questionnaires
 - Subject area community meetings/workshops

Community Survey

Text at the top of this page reads:

When answering the questions, responses should not be constrained by known funding pressures, but should reflect affordable propositions.

2	Focussing on the field in which you work, but also considering the broader accelerator, detector and computing ecosystem, what do you see as the UK's main strengths and weaknesses in technology R&D? (200 words)	Text	Max 250 words
3	Focussing on the field in which you work, and thinking about technology and R&D needs, what do you view as the major technical challenges in your field at the moment? (200 words)	Text	Max 250 words
4	What do you see as the biggest barrier to achieving the aims of your field in the next 10-20 years? (200 words)	Text	Max 250 words
5	What problems do you foresee in achieving the aims of your field from 2040? (200 words)	Text	
6	What will be the impact of not addressing these problems outlined in question 5? (200 words)		

21 questions in total – included the option for respondents to agree to further contact – we had 63 detailed responses

Community Workshops/Meetings

- Envisaged over the couple of months
- Focus on specific sub-areas e.g. accelerators, calorimetry etc.
- Some sub-areas have already held preliminary meetings
- These aim to fill in any gaps, provide context to questionnaire responses etc.

Community Meetings (so far)

- Accelerators
 - Preliminary meeting on March 31st
 - Further meetings in due course
- Computing
 - Specific community survey next month
 - Workshop in June
- Detectors
 - Likely a preliminary meeting soon, workshop in June
- Particle Astrophysics
 - Series of short, informal meetings (mostly) next week – DM, GWs, neutrino astrophysics, gamma-ray astrophysics



Science and
Technology
Facilities Council

Thank you

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Twitter: @STFC_matters

YouTube: Science and
Technology Facilities Council

Backup slides

Organization for Consultation of Relevant Communities

- Focus on the technical aspects of detector R&D requirements given the EPPSU deliberation document listed “*High-priority future initiatives*” and “*Other essential scientific activities for particle physics*” as input and organise material by Task Force.
- Task Forces start from the future science programmes to identify main detector technology challenges to be met (both mandatory and highly desirable to optimise physics returns) to estimate the period over which the required detector R&D programmes may be expected to extend.
- Within each Task Force create a time-ordered technology requirements driven R&D roadmap in terms of capabilities not currently achievable.

Grouped targeted facilities/areas emerging from the EPPSU

1. **Detector requirements for full exploitation of the HL-LHC (R&D still needed for LS3 upgrades and for experiment upgrades beyond then) including studies of flavour physics and quark-gluon plasma (where the latter topic also interfaces with nuclear physics).**
2. **R&D for long baseline neutrino physics detectors (including aspects targeting astro-particle physics measurements) and supporting experiments such as those at the CERN Neutrino Platform.**
3. **Technology developments needed for detectors at e^+e^- EW-Higgs-Top factories in all possible accelerator manifestations including instantaneous luminosities at 91.2GeV of up to $5 \times 10^{36} \text{cm}^{-2} \text{s}^{-1}$.**
4. **The long-term R&D programme for detectors at a future 100 TeV hadron collider with integrated luminosities targeted up to 30ab^{-1} and 1000 pile-up for 25ns BCO.**
5. **Specific long-term detector technology R&D requirements of a muon collider operating at 10 TeV and with a luminosity of the order of $10^{35} \text{cm}^{-2} \text{s}^{-1}$.**

Grouped targeted facilities/areas emerging from the EPPSU

6. Detector developments for accelerator-based studies of rare processes, DM candidates and high precision measurements (including strong interaction physics) at both storage rings and fixed target facilities, interfacing also with atomic and nuclear physics.
7. R&D for optimal exploitation of dedicated collider experiments studying the partonic structure of the proton and nuclei as well as interface areas with nuclear physics.
8. The very broad detector R&D areas for non-accelerator-based experiments, including dark matter searches (including axion searches), reactor neutrino experiments, rare decay processes, neutrino observatories and other interface areas with astro-particle physics.
9. Facilities needed for detector evaluation, including test-beams and different types of irradiation sources, along with the advanced instrumentation required for these.
10. Infrastructures facilitating detector developments, including technological workshops and laboratories, as well as tools for the development of software and electronics.
11. Networking structures in order to ensure collaborative environments, to help in the education and training, for cross-fertilization between different technologically communities, and in view of relations with industry.
12. Overlaps with neighbouring fields and key specifications required for exploitation in other application areas
13. Opportunities for industrial partnership and technical developments needed for potential commercialisation