European Strategy for Particle Physics 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."***

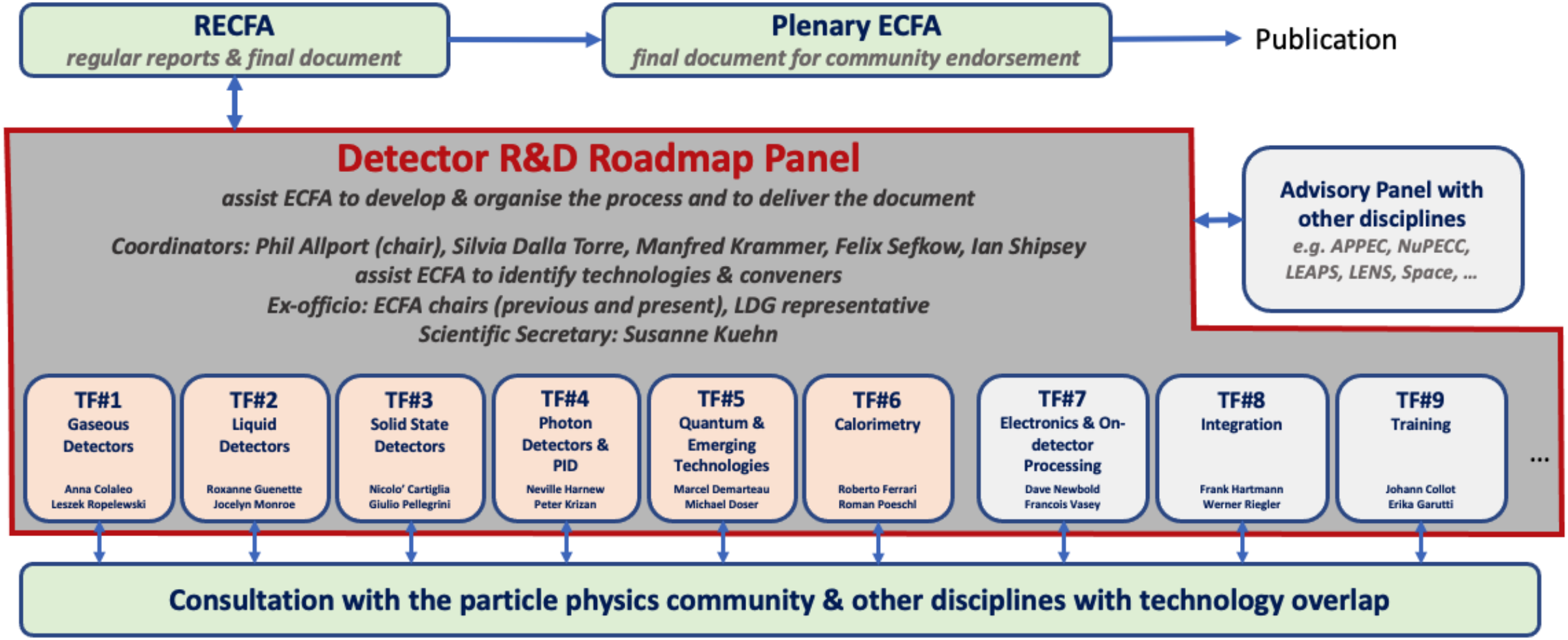
Deliberation document: ***"Detector R&D programmes and associated infrastructures should be supported at CERN, national institutes, laboratories and universities. Synergies between the needs of different scientific fields and industry should be identified and exploited to boost efficiency in the development 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 ESPPU, 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

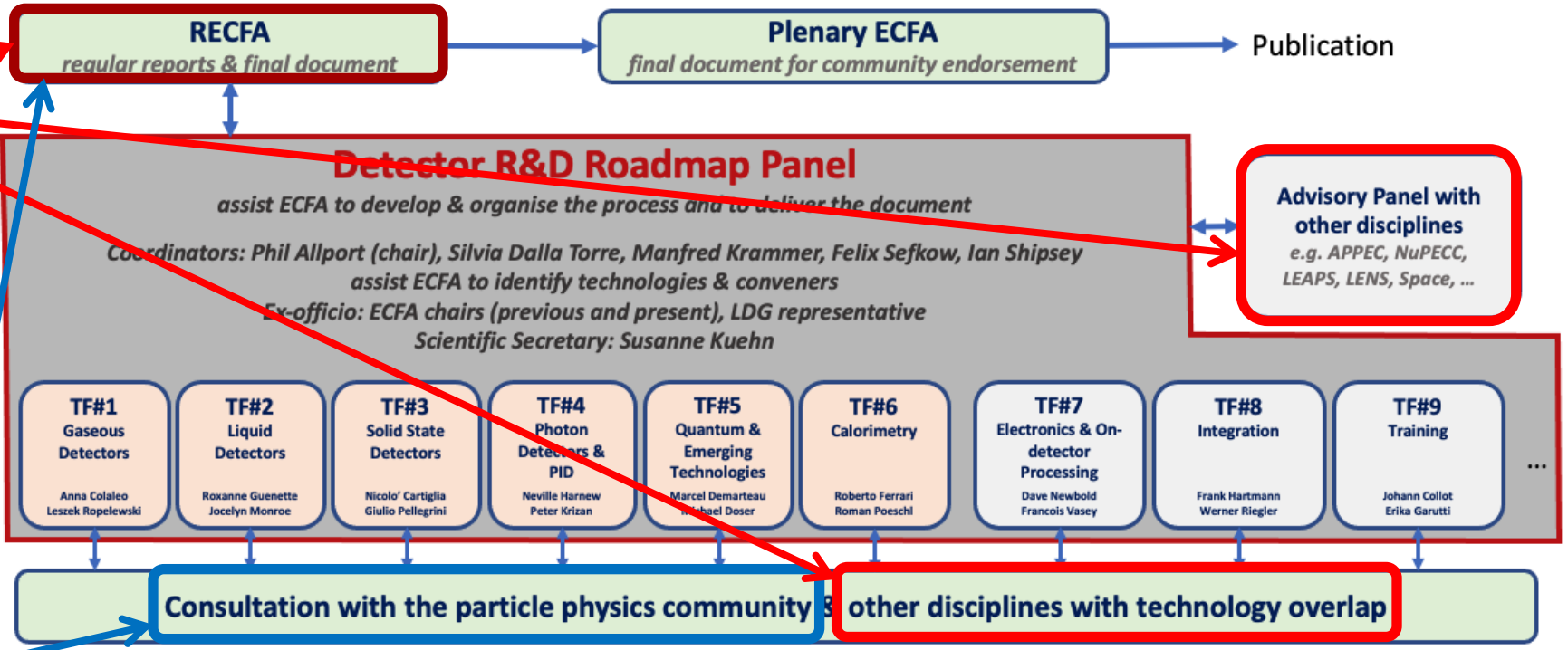


https://indico.cern.ch/e/ECFADetectorRDRoadmap

Detector R&D Roadmap

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



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

Organization for Consultation of Relevant Communities

- Focus on the technical aspects of detector R&D requirements given the ESPPU 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 programme** to identify main detector technology challenges to be met (both mandatory and highly desirable to optimise physics returns) and estimate the period over which the required detector R&D programmes may be expected to extend.
- Within each Task Force the aim is to propose a time ordered detector R&D programme in terms of **capabilities not currently achievable**.

Grouped targeted facilities/areas emerging from the ESPPU

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 $5\times10^{36}cm^{-2}s^{-1}$.**
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 $10^{35}\ cm^{-2}\ s^{-1}$.**

Grouped targeted facilities/areas emerging from the ESPPU

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 and rare decay processes, also considering 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 technological 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**

Process and Timeline

Organisation

May 2020
ESPPU 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

Until Sep 2021
Collect final community feedback*

Oct 2021
Detector R&D Roadmap Document submission to RECFA and afterwards to PECFA and Council

*community feedback via RECFA delegates and National Contacts

ECFA

European Committee for Future Accelerators

Process and Timeline

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...

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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

ECFA
European Committee for Future Accelerators

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Detector R&D requir...

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LC_DetRoadmapInp...

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ECFA_Detector_R&D...

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baudis_ecfa_feb21...

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ECFA_Lazzeroni.pdf

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Speaker: Dr Alexandre Obertelli (TU Darmstadt)
ECFA_LowEnergyFa...

Our profound thanks to all the Input Session speakers for their great presentations and invaluable material

We particularly ask you to note if there are unmet R&D needs for the ESPP identified programme that you think we have overlooked in today's material

	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
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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

Process and Timeline

Thank you to everyone who contributed to these nine highly intense full-day public meetings

We very much appreciate all the painstaking preparation work by the presenters and organisers

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. Many thanks to everyone for joining the discussions and giving feedback.

Please note our request to "modify" registration at https://indico.cern.ch/event/957057/registrations/ to accept the "Consent to ECFA Detector R&D egroup" if you would like to continue to receive ECFA detector R&D related links and materials in the future.

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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)