Welcome and Rules of the Game

Symposium ECFA R&D Roadmap - TF8 “Integration”

Werner & Frank

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Welcome! - Dear Audience

- **<u>We need YOUR HELP!</u>** You also have the responsibility to make sure **everything is covered**!

- Full symposium is recorded

Recording: The meeting will be recorded.

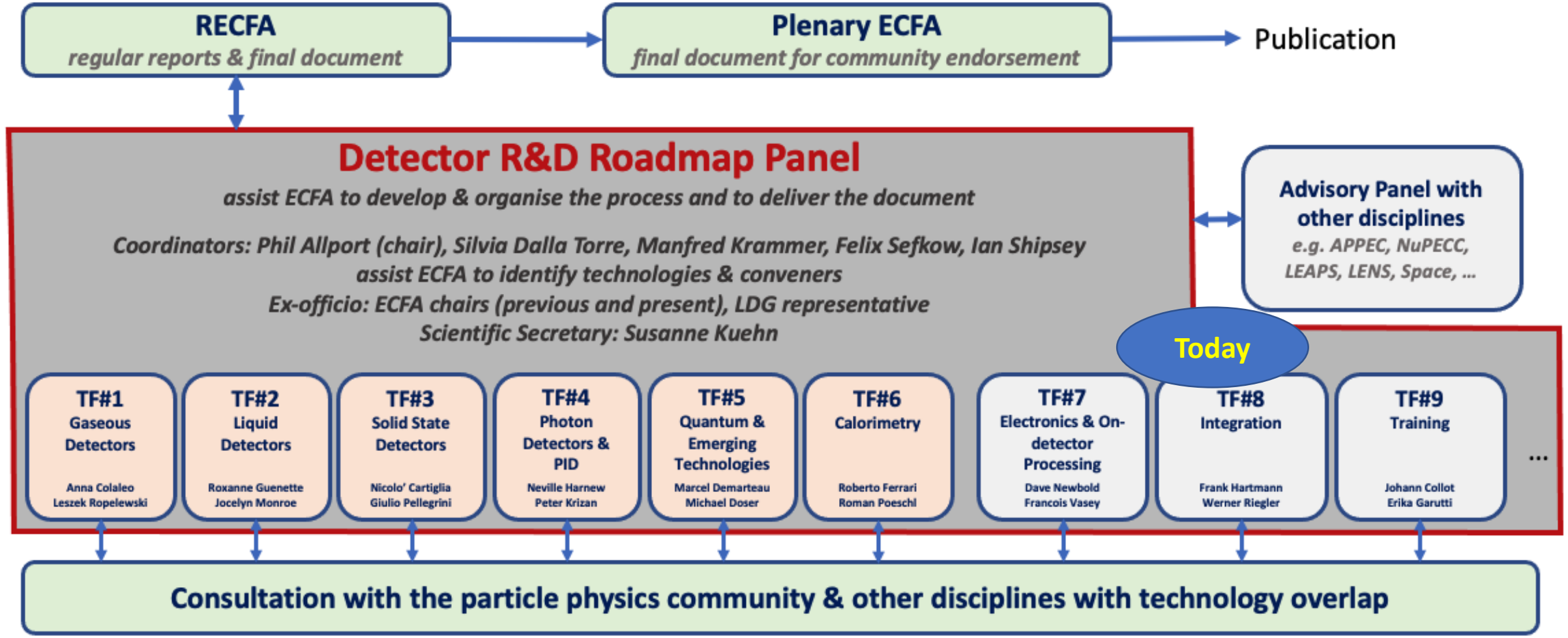
- Audience is expected to be large
  - **We have 10 minutes after each talk – please pose your questions already during the talk in the Q&A sections!**
  - People with 'raised hands' will be unmuted one-by-one!

Questions or comments: Use the "Q&A window" to raise and comment on questions. Please raise your hand to speak (as by default participants are muted).

- Today' symposium largely seeds the write-up
  - But it will further be informed by the other 8 TF symposia
- And, this symposium is not the end of the consultation of TF8
  - **Additional feedback is welcome until the last symposium on 7 May**
  - Send your comments to: *ECFA-DetectorRDRoadmap-TF8Integration-Input@cern.ch*

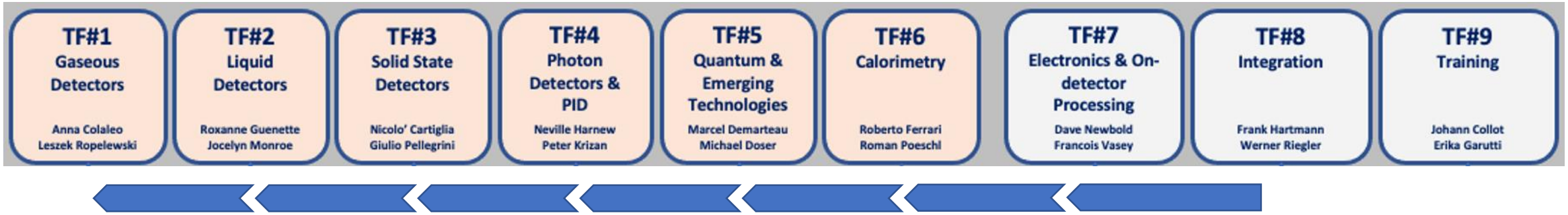
Role – Attendee: Attendees should place questions for the panelists in the "Q&A window" and they can also "chat" with the other attendees.

Organization for Consultation of Relevant Communities



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

Integration as transverse Task Force



- Every Task Force has a connection to TF8: *transverse Task Force*

- Our methodology was to group topics where applicable and spanning many facilities
  - Lightweight mechanics, local cooling, cooling systems, magnet systems, MDI. Monitoring, Robotics
- Discuss Integration challenges of specific systems
  - Calorimeter, Neutrino, Dark Matter
- **After first fact findings and the Input Symposia, the experts/speakers reached out further**

R&D vs. Engineering/Prototyping

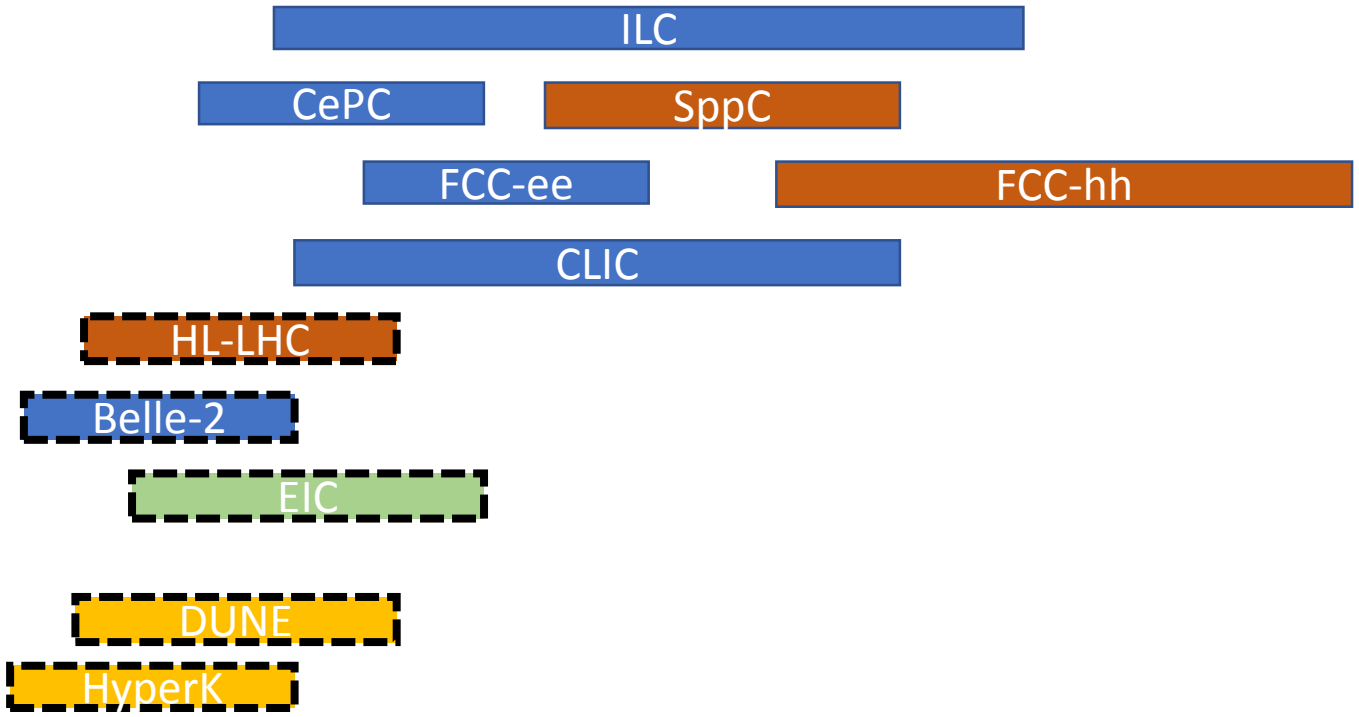
- Speakers will distinguish between **R&D** topics vs **engineering** challenges and **prototyping**.
  That's the reason why you might miss topics!
- For example, we consider the following topics not genuine R&D:
  - Dry gas supply, e.g. membrane plant from industry to provide oxygen depleted air.
  - Dewpoint measurement – sniff and measure with commercial DP meters outside volume; leak cables
  - Survey, 3D laser scanning, Virtual/Augmented reality
  - Neutron moderator
  - Cooling transfer lines (tripple-jacketed vacuum pipes, capilaries)
  - Thermal shields, thermal insulation
  - Some aspects of fibre-bragg grating (FBG), though we have have a talk to cover the remaining items
  - Alignment; we cover opening closing scenarios but not internal alignment traditionally track-based!
  - Large Movement systems for the Neutrino Near Detectors
  - Safety systems
- We do not cover R&D of the accelerators but try to address the interfaces to the detectors
- For facilities tradititionaly not in ECFA, we concentrate on synergies

And potential integration items covered in other TFs

- Gas Recuperation – TF1 Gaseous Detectors
- Cryo (largely) – TF2 Liquid Detectors
- Hybridization – TF3 Solid State Detectors
- Lightguide, WLS – TF4 Photo Detectors
- Powering & DCDC – TF7 Electronics

Timeline

- Put the R&D onto perspective!
  - There is also the corresponding accelerator R&D ongoing!
    - Detector R&D should not delay the accelerator projects
  - What can be informed by earlier ‘approved’ projects/facilities?
    - Which R&D informs the next detectors/facilities?
  - What is the lead time? What can be started much later?



Have Fun,

discuss lively
and ask questions

Backup

TF 8 Matrix of topics vs. Facilities

ID	Future Facilities	Detector component	Technology to develop
1	HL-LHC	Movable vertex tracker	Ultrathin forming, Aluminum-beryllium alloy (AlBenMet,..), bending/mechanics
		Vertex	Cooling air, convection, light-weight (ALICE ITS3)
			Low T cooling (define T to define technology), e.g. CO2, LKr, LN (LHCb VELO3), cryo*
			Cooling contacts, bridges, micro-channel cooling, TEC (for SiPM)
			Ultra-light mechanics (also not out-gassing and stabiility against air flow), 3D printing
		General	Environmental monitoring, e.g. FBG (T (down to mK), RH, deformatiion, oscillation, flow, pressure - dynamic - standardization)
			Beam monitoriing, radiation monitoring
			Opening methods (ALARA), opening closing sensors, maintenance
2	Neutrino Long Baseline	Liquid Calo	Feedthrough (compact ratio)
			Survey robots, cameras (working in cryo)
		General	Purifiers, filter, radiopure materials, water
3	EW-Higgs-Top Factories (ee)	Vertex, Tracker	Cooling air, convection, light-weight
			Cooling contacts, bridges
			Ultra-light mechanics (also not out-gassing and stabiility against air flow), 3D printing
		LAr calo	Lightweight Cryotank
			Feedthrough (compact ratio)
		General	Environmental monitoring, e.g. FBG (T (down to mK), RH, deformatiion, oscillation, flow, pressure - dynamic - standardization)
			Opening, closing methods & sensors
			Beam monitoring
		Magnet FCC-ee IDEA	Ultra-light solenoid cold mass; ultra light-radiation transparent cryostat; High yield strength Al stabilized NbTi conductors
		Magnet	BLIMP/drone - B-field mappng
4	High-energy hadron collider	Calorimeter (high granularity, rad hard)	Low T cooling (define T to define technology), e.g. CO2, LKr, LN; TEC on SiPMs
			Feedthrough (compact ratio)
		TOF (SiPM)	Low T cooling (define T to define technology), e.g. CO2, LKr, LN; TEC on SiPMs
		Tracker	Micro-fluidic interconnection
			Low T cooling (define T to define technology), e.g. CO2, LKr, LN, cryo*
			Cooling contacts, micro-channel cooling, TEC
			Ultra-light support structures, 3D printing
		General	Environmental monitoring, e.g. FBG (T (down to mK), RH, deformatiion, oscillation, flow, pressure - dynamic - standardization)
			Beam monitoring, radiation monitoring
			Opening methods (ALARA), opening closing sensors, maintenance, design choice, e.g. connectors
		Magnet - FCC-hh	Dual solenoid & 4T 10m bore magnet; Large size Al stabilized NbTi coonductors
		Magnet	BLIMP/drone - B-field mappng
5	Muon collider	see 3 (ee)	beam monitoring, especially BIB
6	Storage rings & fixed target		
7	Lepton-hadron collider	Magnet - EiC	Dual solenoid
		Magnet - EiC	MDI - integration with IP dipole, focussing and detector magnets
		see 3 (ee)	
8	Non-accelerator based experiments	DM	Purifiers, cryo*, 3D printing
		Magnet	Long and wide bore magnets for large volume (IAXO-like) or for high field (MadMAX-like 9T)
		Magnet	Large size ReBCO based spectrometer magnets at 50K (like for AMS100), conductor, cold mass, quench protection
9	Evaluation and test facilities	Magnet	5T class wide bore magnet for testing detector components
		General	Common fluence/dose measurement
10	Development facilities like gas systems, cooling		
11	Collaboration structures		

https://docs.google.com/spreadsheets/d/1-b4sKdtpCD-7rqV4WnoHvozpr6Jxns8pbxtOLfhNnZ8/edit#gid=944048056

Details and guidelines for the ZOOM meetings of the ECFA Detector R&D Symposia

Because of the large number of people already registered, the first symposium will need to be run in webinar mode. The speakers will be set as “panelists” and all other participants will have the role of “attendees”.

Role - Panelist: Speakers and session chairs can share screen and video to present their slides.

Role – Attendee: Attendees should place questions for the panelists in the “Q&A window” and they can also “chat” with the other attendees.

Recording: The meeting will be recorded.

Questions or comments: Use the “Q&A window” to raise and comment on questions. Please raise your hand to speak (as by default participants are muted).

Polls: Everybody is invited to vote in the pop-up window when a poll is run.

Reactions: Use “reactions” to give your opinion without interrupting the meeting. It will be displayed for 5 seconds.

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

Broad Topic Areas

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

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

May-June 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

Links for Roadmap Process

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

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

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)

http://aida2020.web.cern.ch/aida2020/ (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)