

ECFA

European Committee for Future Accelerators



ECFA Detector R&D Roadmap Summary

TF9: Training

TF9 coordinators: Johan Collot (IN2P3-LPSC), Erika Garutti (DESY and Hamburg)

Members: Rob Appleby (Manchester), Niels van Bakel (Nikhef),
Richard Brenner (Uppsala), Claire Gwenlan (Oxford), Jeff Wiener (CERN)

Adrian Bevan, on behalf of Claire Gwenlan

Most material taken from past presentations during roadmap process



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/>

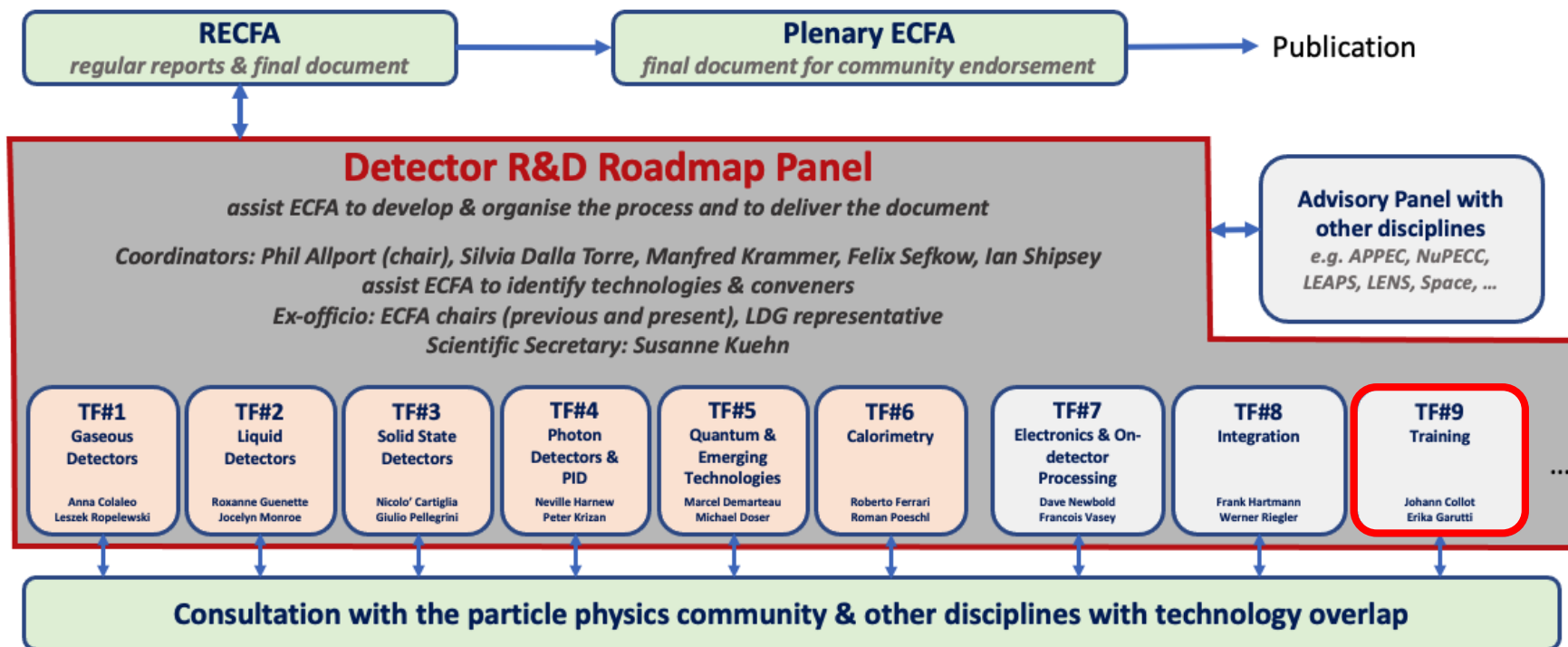
For previous presentations on the Detector R&D Roadmap see Plenary ECFA: Jorgen D'Hondt (13/7/20) & Susanne Kuehn (20/11/20) (<https://indico.cern.ch/event/933318/> & <https://indico.cern.ch/event/966397/>)

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

taken from, Phil Allport
TF9 symposium



Organization for Consultation of Relevant Communities



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

March to May 2021

taken from, Phil Allport
TF9 symposium



the importance of training...

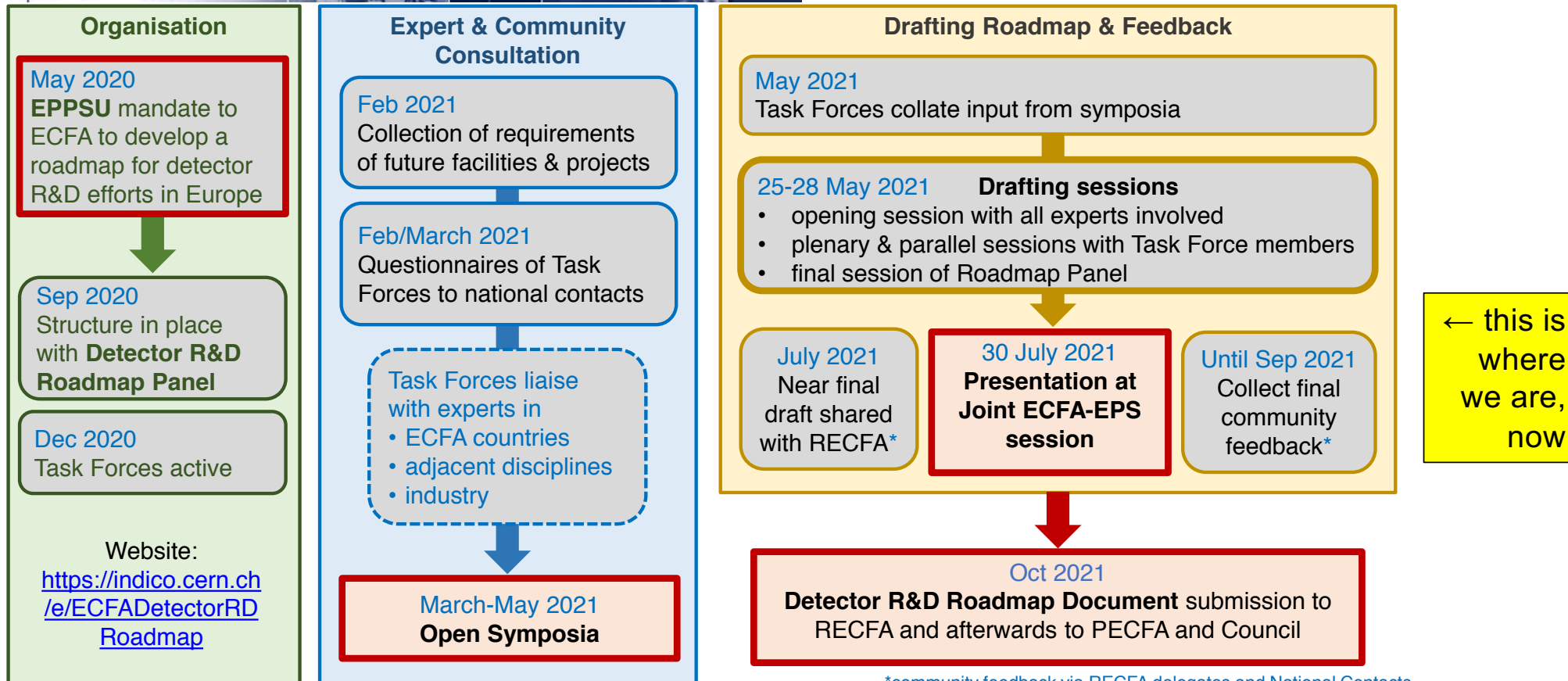
None of these plans will come to anything without the dedicated effort of highly talented enthusiastic scientists and engineers.

Our long term ambitions rely on a new generation of inspired and inspiring leaders to take the helm on these new projects.

There is an incredible intellectual resource available within our community and its vibrancy is evinced by the great R&D work going on at the moment.

“The time to repair the roof is when the sun is shining.” – John F. Kennedy.

Process and Timeline



*community feedback via RECFA delegates and National Contacts

March to May 2021

ECFA Detector R&D Roadmap

taken from, Phil Allport
TF9 symposium

TF9: questions sent to community

<https://indico.cern.ch/event/957057/page/21912-questionnaires>

Questions sent to ECFA national contacts prior to open symposia:

- **Questions of TF9 Training:**

- areas of particular national strength or of minimal significant activity within the topics covered by TF9
- current national plans for strategic investment relevant to TF9
- significant opportunities for seeking future resources, particularly (though not only) through European schemes (also in synergy with other science areas) that should be considered when highlighting training priorities
- to the best of your knowledge the list of university programs in your country dedicated to HEP instrumentation training
- to the best of your knowledge the list of international schools that are regularly held in your country in this field
- any other personal views you would like to add to this important subject?

TF9 symposium

<https://indico.cern.ch/event/1001747/>

May 2021

- 25 May [ECFA Detector R&D Roadmap: Plenary meeting of drafting sessions](#)
- 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 Detector R&D Roadmap Symposium of Task Force 9 Training

Friday 30 Apr 2021, 09:00 → 18:00 Europe/Zurich

Erika Garutti (University of Hamburg), Johann Collot (University Grenoble Alpes (FR))

Description Details about the ECFA Detector R&D Roadmap can be found on: <https://indico.cern.ch/e/ECFADetectorRDRoadmap>

The agenda is still being finalized.


You are invited to register for the symposium on: [Registration Link](#)

We kindly request that you write your questions/comments in the google doc document: <https://docs.google.com/document/d/1owPyPu7cYjH4p0EDnwHkoOPgXFe9aJQTI66QSPgqCQ/edit#>

or via email to: ECFA-DetectorRDRoadmap-TF9-Input@cern.ch

Comments received until 07.05.2021 will be considered in the preparation of the ECFA detector R&D document.



Videoconference Rooms  ECFA Detector R&D Roadmap Symposium Meeting [Join](#)

Audience: 105 unique users (max. number of concurrent views: 59)

50% ECRs

40% had followed instrumentation training in past 3 years

60% instrumentation trainers → need recognition for engagement in training

Training by itself not a final objective – should contribute to motivate and help (young) scientists to build and operate instruments

Feedback from the community is still possible, up to 4 June: ECFA-DetectorRDRoadmap-TF9-Input@cern.ch

TF9 contribution to the Detector R&D Roadmap

TF9 - Instrumentation training

1. Executive Summary

2. Relevance of instrumentation training

3. Status of instrumentation training in Europe

4. The future of instrumentation training

5. Recommendations

Structure of the symposium

Junior ECFA Opinion

Speaker: Sarah Louise Williams (University of Cambridge (GB))

Selected University Instrumentation programs

Speaker: Dr Eric Chabert (Centre National de la Recherche Scientifique (FR))

Instrumentation schools in Europe and in the world

Speaker: Aurore Savoy Navarro (Université Paris-Saclay (FR))

Requirements and offers from major facilities

Speaker: Clara Nellist (Radboud University Nijmegen and NIKHEF (NL))

Training in accelerator physics

Speaker: Philip Nicholas Burrows (University of Oxford (GB))

Virtual Reality: a new way to enter a lab

Speaker: Prof. Christian Bressler (Universität Hamburg)

Industry meets academia events

Speaker: Markus Nordberg (CERN)

A big thank you to all speakers !

Relevance of instrumentation training for the community

recipe for success

- Stimulate and **recognise** the field of innovation
- **Attract** and train outstanding talents in physics and engineering
- Recognize the **diversity** of skills needed in the field: Detector science, electronics, mechanics, materials science, programming (FPGA, DAQ), accelerator science
- **Balance** between specialisation and breadth

Establishing a successful long-term **training program in instrumentation** has

Benefit to particle physics: ensuring the continuity of highly qualified detector experts

Benefit to society: providing a talent pool for industry and other sectors

Junior ECFA input

Sarah Williams for J-ECFA

[Link to survey review](#)

J-ECFA initiated a survey widely distributed around ECR networks → 473 responses

32% said they had not expressed an interest in instrumentation training,

38% had been able to access it,

30% had expressed an interest in instrumentation training but had not been able to access it...

There is a lot of interest and enthusiasm for instrumentation work within the ECR community

BUT

- There are concerns about **support** (financial, but also logistical/practical and/or lack of encouragement)
- ECRs would benefit from **more networking** opportunities for those involved in instrumentation work
- **Recognition is a concern**: some feel instrumentation work will not help them secure a future career in particle physics:
 - Irrespective of whether this is true, how instrumentation work is recognised should be revisited
 - This should be done in parallel to developing additional training opportunities.

A big thank you to

ECFA-ECR Detector R+D working group:

Jan-Hendrik Arling, DESY
Liron Barak, Tel Aviv University
Katie Dunne, Stockholm University
Armin Fehr, University of Bern
Adrián Irlés, IFIC CSIC/UV
Magdalena Kuich, University of Warsaw
Predrag Milenovic, University of Belgrade
Steven Schramm, University of Geneva
Mariana Shopova, Plovdiv University
/Bulgarian Academy of Sciences
Sarah Williams, University of Cambridge
ecfa-ecr-detector@cern.ch

taken from, Erika Garutti
ECFA R&D drafting session

Contribution to the Detector R&D Roadmap

backbone structure

3 Status of instrumentation training in Europe

The design and delivery of detector instrumentation and accelerator projects in high energy physics relies heavily on the expertise and experience of senior scientists, a specialized technical workforce, cutting edge facilities and a large number of students, post-doctoral researchers and early career scientists.

In addition to the main HEP instrumentation fields, such as detector science, electronics, mechanics, materials science, programming (FPGA, DAQ) and accelerators, scientists require continuous training in emerging topics, for example, quantum computing, detector at the quantum limit, condensed matter, quantum dots, novel methods of acceleration and cryogenic detectors.

In order to attract young people to the field, early recruitment has to happen, starting with programs designed for high schools, and then through instrumentation studentships and detector schools, or through graduate training and dedicated schools in the case of accelerators. In this section, we review the existing landscape of instrumentation and accelerators in terms of university programs (Sec: 3.1), dedicated graduate schools for HEP instrumentation in Europe and worldwide (Sec: 3.2), and specific offers from the major EU laboratories (Sec: 3.3). The status of accelerator training is reviewed in Sec: 3.4.

- 3.1 University programs dedicated to HEP instrumentation training
- 3.2 Graduate schools, doctoral and post-doctoral programs dedicated to HEP instrumentation training
- 3.3 Contribution of major laboratories
- 3.4 Status of accelerator training in Europe

Via this process, collected lots of useful links, list of training programs, instrumentation schools, online offers ...

TF9 google doc document:

<https://docs.google.com/document/d/1owPyPu7cYjH4p0EDnwHkoOPgGXFe9aJQTI66QSPggCQ/edit#>

Is your University program in this list?

<https://docs.google.com/spreadsheets/d/1L3F68aRaKiUq7UcVY81EtPSHF4TWeR3vN0oNiySc/edit#gid=0>

Is your Instrumentation School in this list?

<https://syncandshare.desy.de/index.php/s/t6TGb6W7x2ER4Qe>

→ plan to store this information on maintained web page for reference

Block	School	Target audience	Focus
a	ESIPAP	Master/PhD/ECR	Instrumentation for Particle and Astroparticle Physics
	ESI	PhD/PD phys./eng.	Basic principles of instrumentation
	EDIT	PhD/1 st year PD	Detector and Instrumentation Technologies
b	INFIERI	Master/PhD/ECR phys./eng.	Advanced technologies in the fields of semiconductors, very deep sub-micron and 3D technologies, nanotechnology, interconnects, data transmission, big data, HPC, AI, quantum technology
	ISOTDAQ	Master/PhD/PD phys./eng./comp.	Triggering and acquiring data
	CRYOCOURSE	PhD/PD phys./eng.	Cryogenics, microwave measurements and low temperature engineering for quantum technology
c	International School of Nuclear Physics, Erice	PhD/PD/ECR phys.	Networking school and seminars between young scientists and highly recognized experts in nuclear, particle and astroparticle phys.
	ISAPP	PhD/PD/ECR phys.	Networking school and seminars between young scientists and highly recognized experts in nuclear, particle and astroparticle phys.

Table 1: List of exemplary international instrumentation-related schools. Only schools which have a significant EU contribution, are open to students world-wide, and are considered to be an ongoing series (have been repeated at least two times, most recently within the last three years), are included. Block a) are instrumentation specific schools ordered by increasing complexity. Block b) are examples of highly specialized schools on a given topic in the instrumentation field. Block c) are broader schools of particle physics and neighbouring fields which sometime include dedicated instrumentation programs.

School	Target audience	Focus
The CERN accelerator school (CAS)	MSc/PhD/ECR/Staff	A range of schools offered, from introductory to more specialist topics.
The Joint Universities Accelerator School (JUAS)	MSc/PhD/ECR	An intensive school for the fundamentals of accelerator physics and engineering.
The Linear Collider School	MSc/PhD/ECR/Staff	A dedicated school for the physics and engineering of the International Linear Collider
The US Particle Accelerator School (USPAS)	MSc/PhD/ECR	Education in Beam Physics and Accelerator technology

Table 2: List of international accelerator schools. Only schools which have a significant EU contribution, are open to students world-wide, and are considered to be an ongoing series (have been repeated at least two times, most recently within the last three years), are included.

Major accelerator & detector schools selected examples to appear in TF9 contribution

based on slide from Johan Collot,
ECFA R&D drafting session

Contribution to the Detector R&D Roadmap

backbone structure

4 The future of instrumentation training

The future of our field depends on the availability of well-trained experts for research and development, construction and operation of detectors for the next generation of HEP facilities.

In the next years it is essential that the relevance of instrumentation work receives broader recognition and acceptance by the HEP community. Career prospects for excellent detector physicists and engineers should be guaranteed.

The following sections elaborate on the key aspects we have identified, which are needed to implement a successful instrumentation training. Existing and additional training opportunities need to be developed and strategically coordinated on a European level, including virtual reality as a novel tool for remote training. In addition, seek possible world-wide cooperation, and develop training offers dedicated to underprivileged countries. Exchange and synergy with industry shall be expanded and intensified.

4.1 A coordinated EU training program

4.2 The role of virtual laboratories

4.3 The role of major laboratories

4.4 Industry meets academia

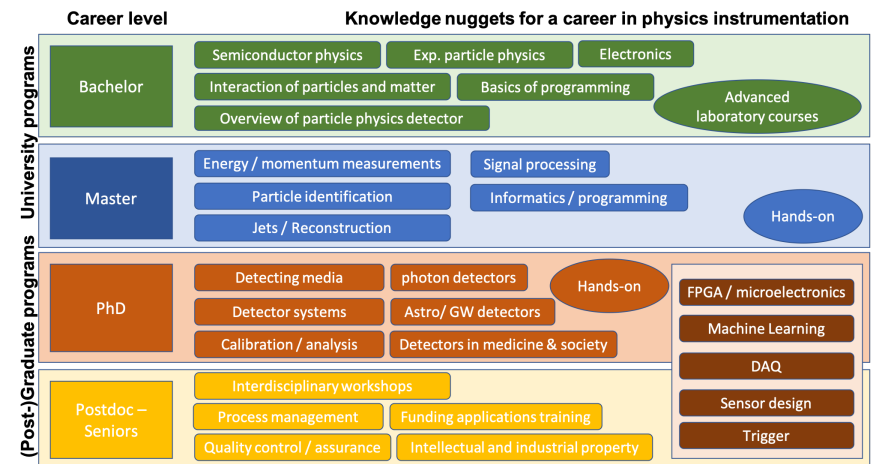


Figure 1: Possible structure of a training plan recommendation from ECFA. The knowledge expected at different levels for an career in HEP instrumentation are shown.

Detector instrumentation and accelerator training spans all career levels

REQUIRES: adequate and well structured program; balance between classroom, online and hands-on courses; access to modern infrastructure; addressing geographic and human diversity

SCIENTISTS PURSUING CAREERS IN INSTRUMENTATION should be able to count on: recognition at all stages (*dedicated scholarships, stipends, awards, ...*); publications in high-ranked journals; *guaranteed career prospects*

Contribution to the Detector R&D Roadmap

backbone structure

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Examples of VR in our field mainly for PR

NEXT STEP: implement exact physics of experiments and their instruments into VR world – use VR labs for training; VR provides continuous access to large-scale facilities to much broader audience; can

help address geographical and economic diversity of training

RECOMMEND that large scale facilities, with support of universities, invest in creating and coordinating a VR platform for training

Major labs should remain essential component in instrumentation training

Coordinate and develop virtual lab experiments (VR experiments, remote participation in beam tests, ...); expand hands-on programs (table-top exps, ...); continue and expand Beamline 4 Schools; other training opportunities for junior scientists wanting to join instrumentation later

Improve community view of instrumentation work and value these skills

Goals and benefits: students trained to work with industry; gain skills (project management, system engineering); attract engineers to have career in Bg Science; enlarge career perspectives and network for HEP students and postdocs

Training around instrumentation organized with industry: novel technologies available to HEP at early stage; organize hands-on events (e.g. IdeaSquare@CERN); exchange of technology, products, lab space as part of training program

ECFA

European Committee for Future Accelerators



Recommendations under discussion – broad themes:

Improve the recognition of the instrumentation field

European instrumentation training program

Overcome the geographical, economical limitations
and inclusion issues

Extras



<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)