

ECFA Detector R&D Roadmap

TF9 - Training

Symposium summary & drafting plan

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ECFA

European Committee for Future Accelerators



TF9 symposium

at a glance

Audience :

~50 instantaneous , ~110 total

Training is not by itself a final objective

Should contribute to motivate/help (young) scientists to build and operate instruments

50 % ECRS

40 % followed inst. training in past 3 years

60 % inst. trainers

→ need recognition for engagement in training

Contribution to the Detector R&D Roadmap

backbone structure

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 !

Contribution to the Detector R&D Roadmap

backbone structure

7 2 Relevance of instrumentation training

8 Particle Physics experiments demand technology well beyond the state-of-the-art, with
9 always increasing complexity. Establishing novel technologies requires decades from
10 conception to application. The detector development program of particle physics exper-
11 iments must be accompanied by a long-term training program aimed at preparing the
12 next generations of detector developers and detector operation experts required by the
13 field and by industry. A successful training concept shall be based on the following key
14 points:

- 15 • Stimulate and recognise the field of innovation.
- 16 • Attract and train outstanding talents in physics and engineering.
- 17 • Recognize the diversity of skills needed in the field.
- 18 • Find appropriate balance between specialization and breadth.

19 Detector instrumentation training spans all career levels, from University courses,
20 to (post-)graduate programs programs, to specialization courses for professionals. An
21 adequate and well structured program shall be developed, well balanced between class-
22 room, online and hands-on courses. It shall provide access to modern infrastructures,
23 also addressing geographic and human diversity.

24 Scientists pursuing a career in instrumentation should be able to count on: recognition
25 at all stages, i.e. dedicated scholarships, stipends, awards, ...; opportunity for pub-
26 lications in high-ranked journals of technology and experimental methods; guaranteed
27 career prospects. Particularly this last point is of great important for ECRs and not
28 sufficiently addressed at the current state.

29 Establishing a successful long-term training program in instrumentation has benefit to
30 particle physics, ensuring the continuity of highly qualified detector experts; and benefit
31 to society, providing a talent pool for industry and other sectors.

32 2.1 Junior ECFA survey (Sarah/Johann, 1 page)

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:
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Predrag Milenovic, University of Belgrade
Steven Schramm, University of Geneva
Mariana Shopova, Plovdiv University
/Bulgarian Academy of Sciences
Sarah Williams, University of Cambridge
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Contribution to the Detector R&D Roadmap

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3 Status of detector training in Europe

34 Detector instrumentation for high energy physics relies heavily on the expertise and
35 experience of senior scientists, a specialized technical workforce, cutting edge facilities
36 and a large number of students, postdocs and early career scientists.

37 Additionally to the main HEP instrumentation fields such as detector science, elec-
38 tronics, mechanics, materials science, programming (FPGA, DAQ), accelerator science,
39 scientists require continuous training in emerging topics: quantum computing, detector
40 at the quantum limit, condensed matter, quantum dots, cryogenic detectors, etc.

41 In order to get young people interested in the field, early recruitment has to happen
42 through detector schools and instrumentation studentships. We review first the existing
43 landscape in terms of university programs, Sec: 3.1, dedicated graduate schools for HEP
44 instrumentation in Europe and worldwide Sec: 3.2, and specific offers from the major
45 EU laboratories Sec: 3.3. The status of accelerator training is reviewed in Sec: 3.4.

46 **3.1 University programs dedicated to HEP instrumentation training**
47 **(Richard, 1 page)**

→ Input: talk from Eric Chabert

48 **3.2 Graduate schools, doctoral and post-doctoral programs dedicated**
49 **to HEP instrumentation training (Claire, 1 page)**

→ Input: talk from Aurore Savoy Navarro

50 **3.3 Contribution of major laboratories (Jeff, 1/2 page)**

→ Input: talk from Clara Nellist

51 **3.4 Status of accelerator training in Europe (Robert max 1+1/2**
52 **pages)**

→ Input: talk from Phil Burrow

Collection of lot of useful links, list of training programs, instrumentation schools, online offers
→ we would like to store this on a ECFA web page for reference

Contribution to the Detector R&D Roadmap

backbone structure

53 **4 The future of instrumentation training**

54 **4.1 A coordinated EU training program (???, 1 page)**

55 **4.2 The role of major laboratories (Jeff), 1 page**

56 **4.3 The role of virtual laboratories (Erika, 1/2 page)**

57 **4.4 Industry meets academia (Niels, 1/2 page)**

58 **4.5 The role of Europe in the world (Johann, 1/2 page)**

Contribution to the Detector R&D Roadmap

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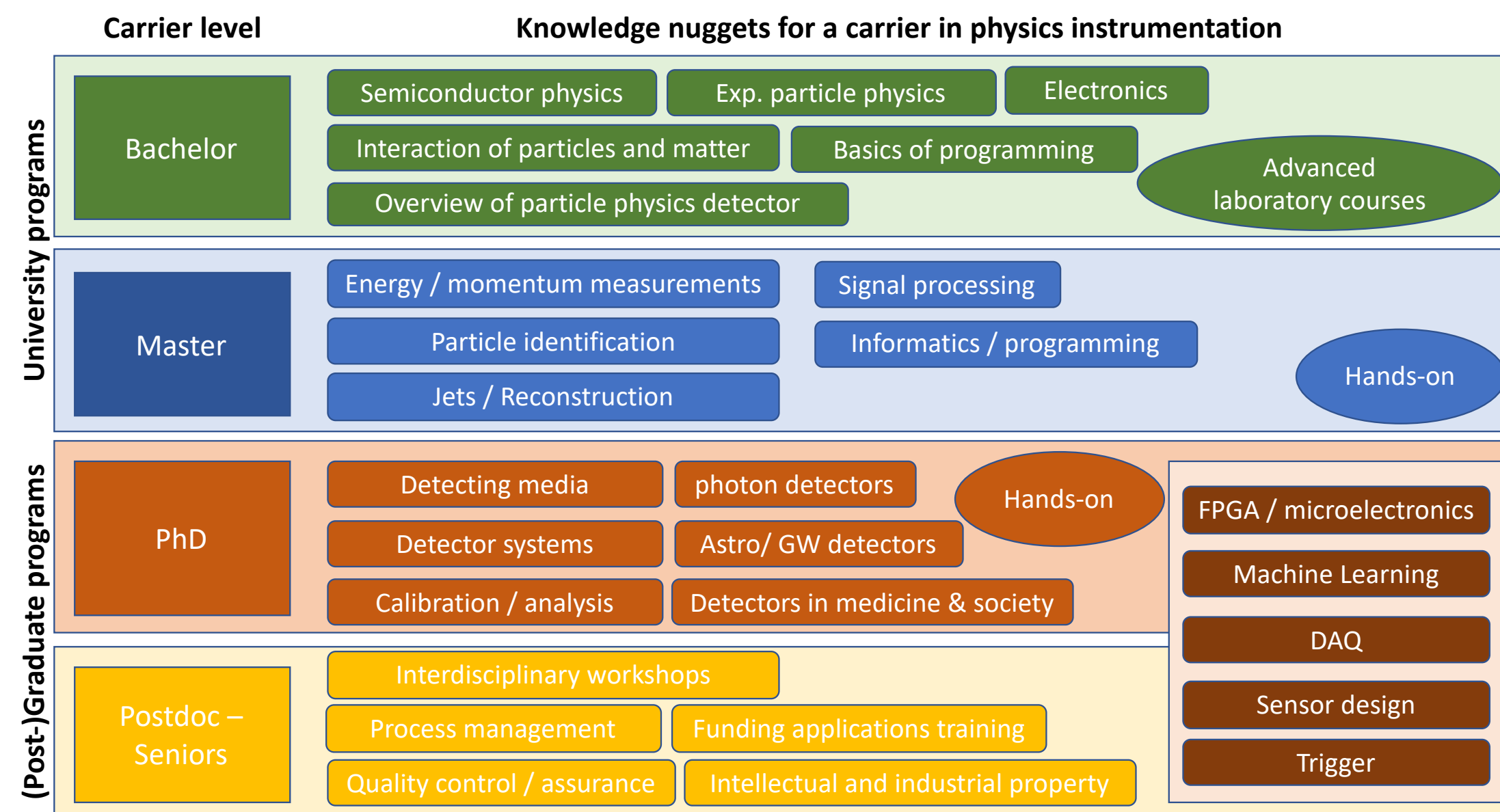
53 4 The future of instrumentation training

54 4.1 A coordinated EU training program (???, 1 page)

- The level of training varies between different countries
→ ECFA should formulate a recommendation on knowledge to be acquired at different carrier levels
+ a self test to gauge own level

- **Big challenge:** the number of students/Uni is low
→ Sharing of equipment/knowledge/expertise through EU programs:

- Develop and maintain a bank of online courses to complete / support local education
- Integrate EU instrumentation schools in master courses
- EU inter-university master degree specialised to our field



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53 4 The future of instrumentation training

54 4.1 A coordinated EU training program (???, 1 page)

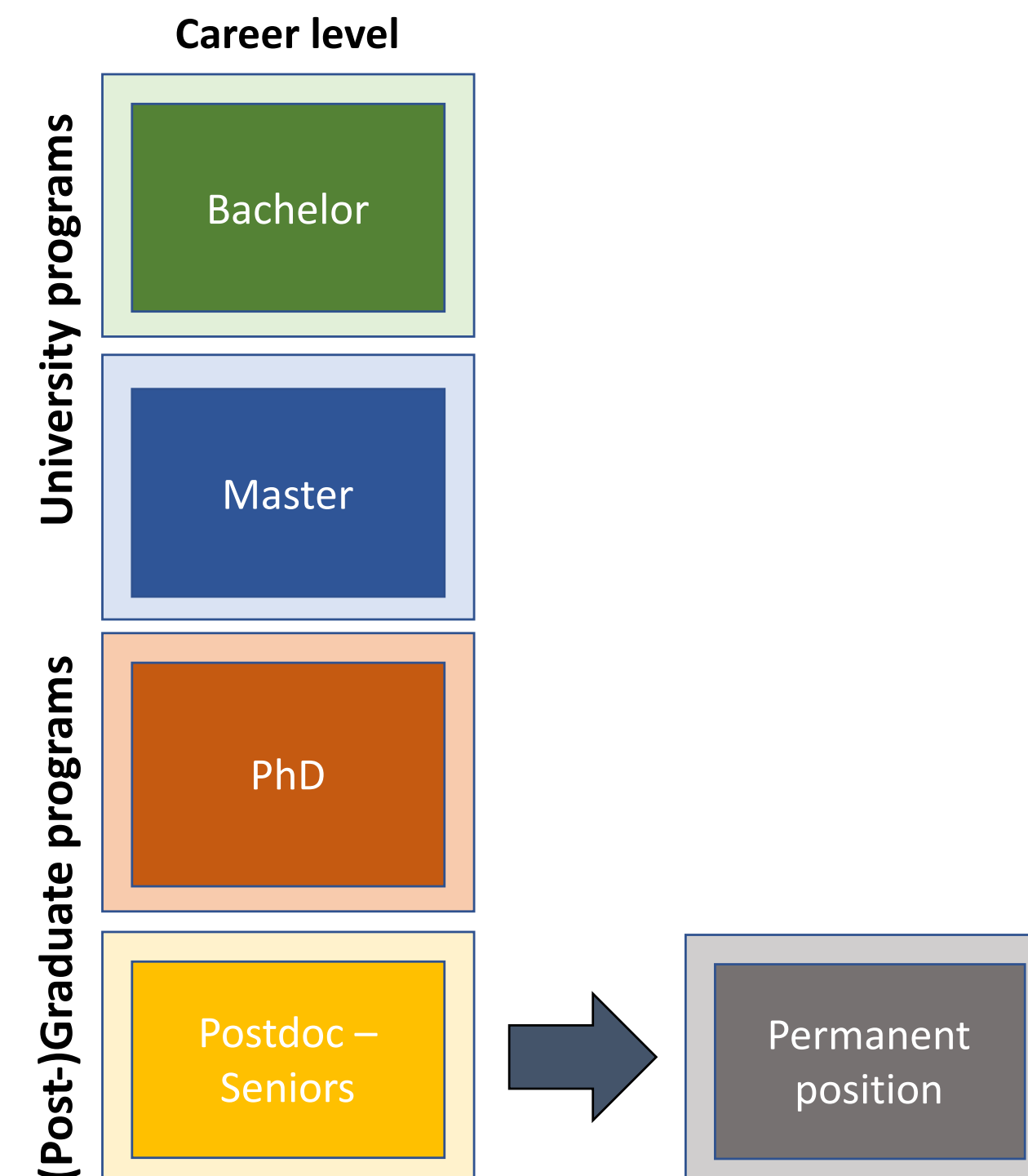
Detector instrumentation training spans **all career levels**

Requires:

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

Scientists pursuing a career in instrumentation should be able to count on:

- recognition at all stages, i.e. **dedicated scholarships, stipends, awards, ...**
- publications in high-ranked journals of technology and exp. methods
- **guaranteed career prospects**



Contribution to the Detector R&D Roadmap

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4 The future of instrumentation training

4.1 A coordinated EU training program (???, 1 page)

4.2 The role of virtual laboratories (Erika, 1/2 page)

- Examples of VR in our field mainly for PR
- The crucial next step is to implement the exact physics of the experiments and their instruments into the VR world
 - Use VR labs for training
 - Requires tight cooperation between physicists and informatics experts.
- VR provides continuous access to large-scale facilities for a much broader audience than possible in person.
- VR experiments can help to overcome geographical and economical diversity of training in EU (and worldwide).

→ It is recommended that large-scale facilities, with the support of Universities, invest in creating and coordinating an available VR platform for training.

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4 The future of instrumentation training

4.1 A coordinated EU training program (???, 1 page)

4.2 The role of virtual laboratories (Erika, 1/2 page)

4.3 The role of major laboratories (Jeff), 1 page

- Major lab should remain an essential component in instrumentation training
- Coordinate & develop the Virtual laboratory experiments network:
 - Online (hands-on) schools
 - VR experiments
 - Remote control rooms for test beam experiments (virtual beam lines for schools)
- Expand the hand-on programs with more table-top instrumentation tools in laboratories
- Continue and expand Beam Lines for Schools
- Training opportunities for junior scientists interested to join instrumentation later in their careers
- **Improve the community view of instrumentation work and value these skills in scientists.**

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57 4.4 Industry meets academia (Niels, 1/2 page)

Important opportunity for network building

Goals and benefits of collaboration between academia and industry

- Students get trained to work with industry: Advanced technologies are only available in/through high-tech industry.
- Gain skills in project management and system engineering required for building a detector system
- Attract engineers to have a career in Big Science
- Enlarge the career perspectives & network for HEP PhD and PD

Training around instrumentation, organised with industry:

- Make novel technologies available to HEP at an early-stage
- Organise hands-on events like IdeaSquare @ CERN where physicists and engineers from academia and industry work together on early-stage detector Research, Development & Innovation initiatives.
- Exchange of technology, products, lab space between industry and academia as part of a training program.

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- Europe has a prominent role for HEP in the world due to the LHC
- America and Asia have strong programs in high-energy nuclear physics (EIC), neutrino physics and adjacent fields (astroparticle, cosmology, gravitational waves ...)
- Coordination / collaboration in training worldwide should be intensified
- Europe is in the natural (geographical and historical) position to reach out to Africa for training offers

New proposals

outcome of the symposium

- Yearly symposium on training
To better coordinate & develop training / education in Europe: detectors & accelerators, adjacent fields ...
 - Common portal site
To announce/promote all training actions and offers
 - Real / remote / VR labs network
Platform to collect and link offers by national labs and international facilities
 - Create a co-built academy-industry school
50% academic - 50% industry
Adapted format, massively Hands-on
Challenges ? - Hackathon ?
- Develop a coordinated EU project on training (apply for EU funds)
To implement these proposals evolving from the existing ones