European Strategy Update

Detector R&D Panel Discussion

Panel members

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- Didier Claude Contardo
- Cinzia Da Via
- Giuliana Fiorillo
- Francesco Forti
- Lucie Linssen
- Felix Sefkow

Scope of panel discussion

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- As part of the preparation work leading up to the Open Symposium:
  - All inputs submitted to the EPPSU were reviewed.
  - EPPSU-PPG, EPPSU-ESG and ECFA initiated discussions with colleagues, communities and heads of collaborations.
  - ECFA initiated several European community surveys.

- Three topics were identified as important to further discuss:
  1. **Generic —> Guided detector R&D activities**
  2. **Coordination of detector R&D activities**
  3. **Knowledge preservation, training and career perspectives**

- Organization of today's discussion:
  - Recurring questions associated to each of the three topics will be presented.
  - Brief summary of data collected as part of the preparation work will be presented (A. Cattai)

- Goal:
  - **Make progress towards formulating constructive answers/suggestions to these questions, to bring forward to the European Strategy.**
    - Today's discussion will provide input to the writing of the "Briefing Book"

1. Generic —> Guided R&D

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- What is the appropriate relative fraction of different classes of R&D activities (generic, current/future project-guided) that our community should engage in?
- Do existing funding mechanisms support this sharing?
- How much resources should go to generic/blue sky R&D?
- What are the challenges/opportunities associated to different classes of R&D activities?
- What role and importance should technology transfer activities take in detector R&D activities?
- How to grow connections to industry?

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1. Generic —> Guided R&D

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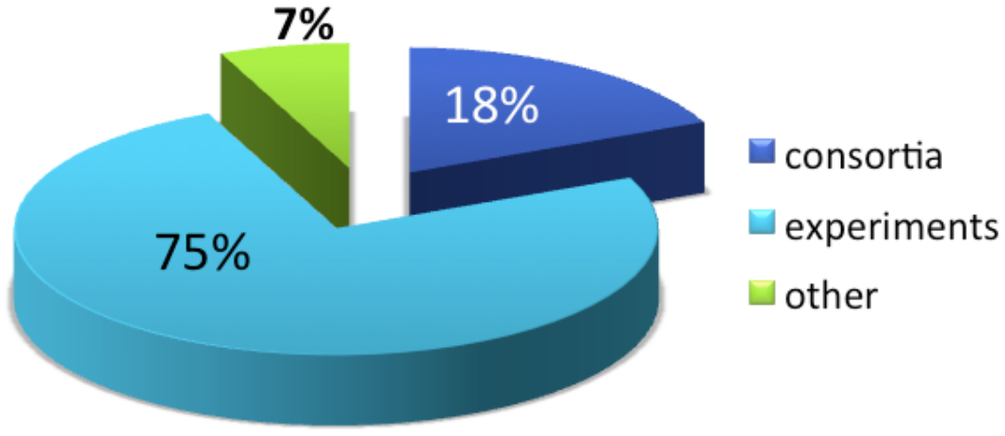
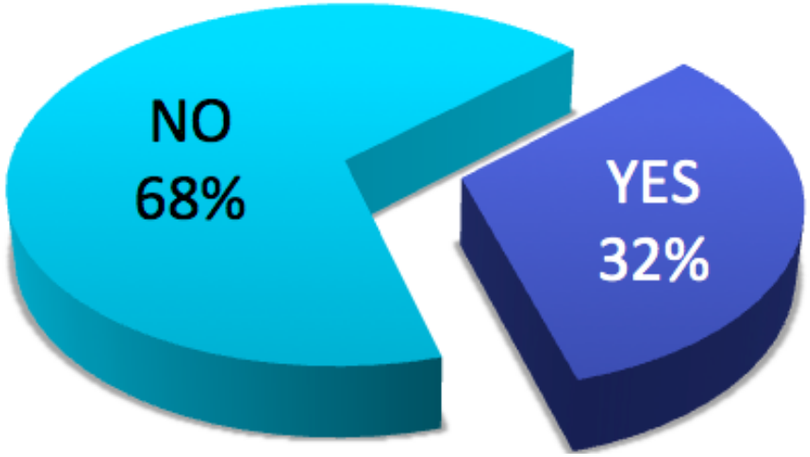
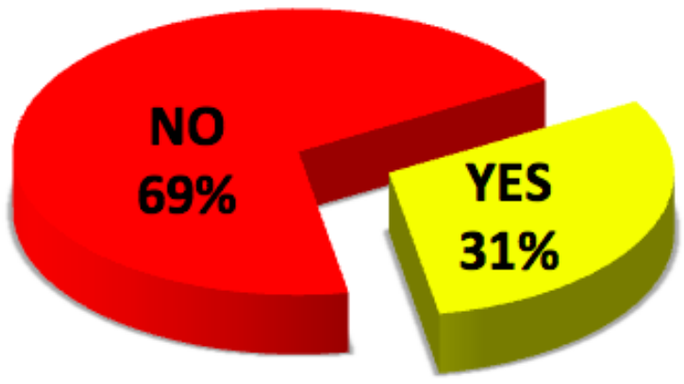
Data collected from ECFA survey, 700 respondents representing 2900 FTE

75% R&D performed in present/future experiments (CMS, ATLAS, FAIR....)
18% R&D performed within a consortium (AIDA, RDx,…)
7% Generic R&D







32% of R&D activities are linked to Tech. Transfer but the large majority (70%) do not get enough support to solve: financial, manpower, technical and legal challenges.

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2. Coordination of R&D

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- **How to best coordinate detector R&D in particle physics?**
  - within Europe and abroad ?
  - across different disciplines (astroparticle, neutrino, nuclear……)?
- **How to fund different types of detector R&D programs?**
- **What kind of resources can be shared between institutions and laboratories, and how?**

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According to the ECFA survey:

- The R&D in Europe is reasonably organized centrally (50% vs 50%), but it should definitely be better coordinated (77% vs 23%) among the different communities in fundamental physics.
- Funding sources

Agency funding the R&D projects	%
International funding program	13
EU funding program	32
National funding agency	**71**
Home Institute	**52**
Other *(Mainly private or industry)*	1
	>100

3. Knowledge, training, career

- **What area(s) is(are) in danger of losing critical mass?**
- **What key area(s) of knowledge/expertise in community need(s) to be further developed?**
- **What initiatives already exist to preserve knowledge and train future generations of instrumentation experts?**
  - How effective are these initiatives?
- **What new initiatives could be considered?**

3. Knowledge, training, career

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According to the ECFA survey:

- At present there is a strong indication of major interest for R&D around semi-conductors technologies and related electronics & mechanics

Detectors technologies	% of FTE
Gaseous detectors	13
Semi-conductors	**30**
Scintillators and crystals	11
Photo-detectors	10
Cryogenic (liquid) detectors	2
Cerenkov detectors	2
Highly specialized mechanics	**7**
Detector specific electronics	**14**
Detector specific software	9
Other	2

Other (TES – RF related - bolometers, opto-mechanical sensors – MEMS, laser, photonics, magnets, quantum sensors ……..)

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3. Knowledge, training, career

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According to the ECFA survey:

Most promising areas of R&D

Most promissing future R&Ds	% respondents to ECFA survey
Precision timing	56
Precise position resolution	17
Rad Hard	8
Precise energy measurements	7
CMOS HV-MAPS monolithic	6
High granularity imaging calorimetry	6
Artificial intelligence / Machine Learning	4
Fast (tracker) triggers (online)	4
4D tracking	4
High rate capability	4
Low power consumption systems/electronics	4
Fast detectors/electronics	3
High energy resolution	3
PID TOF	3
Low mass detectors & services	3
Silicon photomultipliers	3

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3. Knowledge, training, career

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<u>ECFA inputs and recommendations</u> regarding **training**:

- Many effective schools for PhD/PostDocs exist.
- It would be profitable to enhance, already at University level the basic knowledge required for applied physics activities
- Discussion could start with academia such that PhD students in experimental physics would include in their PHD thesis the basic knowledge in detectors.
- R&D shall not be centralized exclusively in large-scale facilities or in the major labs but should be encouraged and supported in local institutions and Universities.

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3. Knowledge, training, career

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ECFA inputs and recommendations regarding

knowledge preservation and career perspective:

The success and future of our field depends:

- on our strength to attract the *most talented researchers* (physicists and engineers)
- in our ability to foster *them*, recognizing individual achievements especially within large collaborations
- in our ability to provide *them* with sufficient and adequate career opportunities

How to achieve all this?

Maybe difficult to succeed since, at present, it is resented that detector technology research is less valued than physics data analysis & interpretation (already at level of PhD)

Detector development needs to be fully recognized as a research field leading to a valuable PhD degree,