

TF7 Symposium, Electronics

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25 March 2021

ECFA Detector R&D Roadmap

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.”

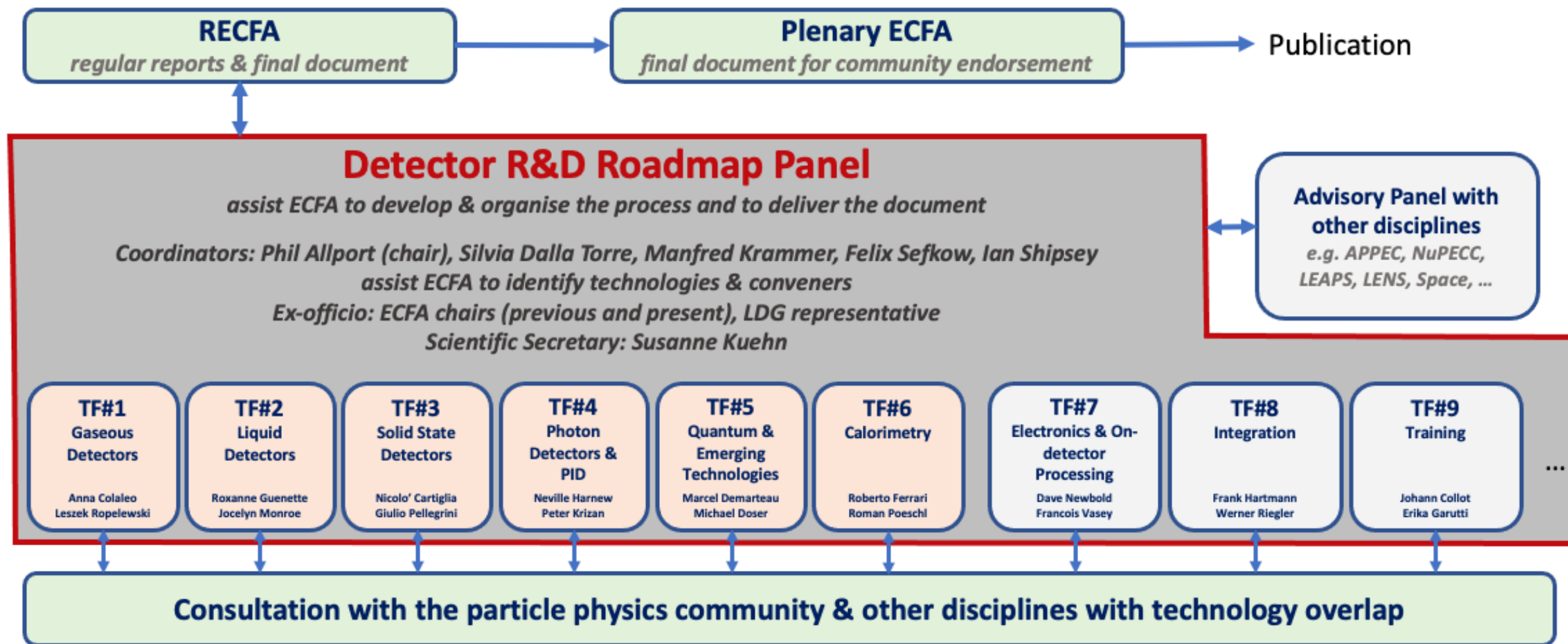
“The community should define a global detector R&D roadmap that should be used to support proposals at the European and national levels.”

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>

Organization for Consultation of Relevant Communities



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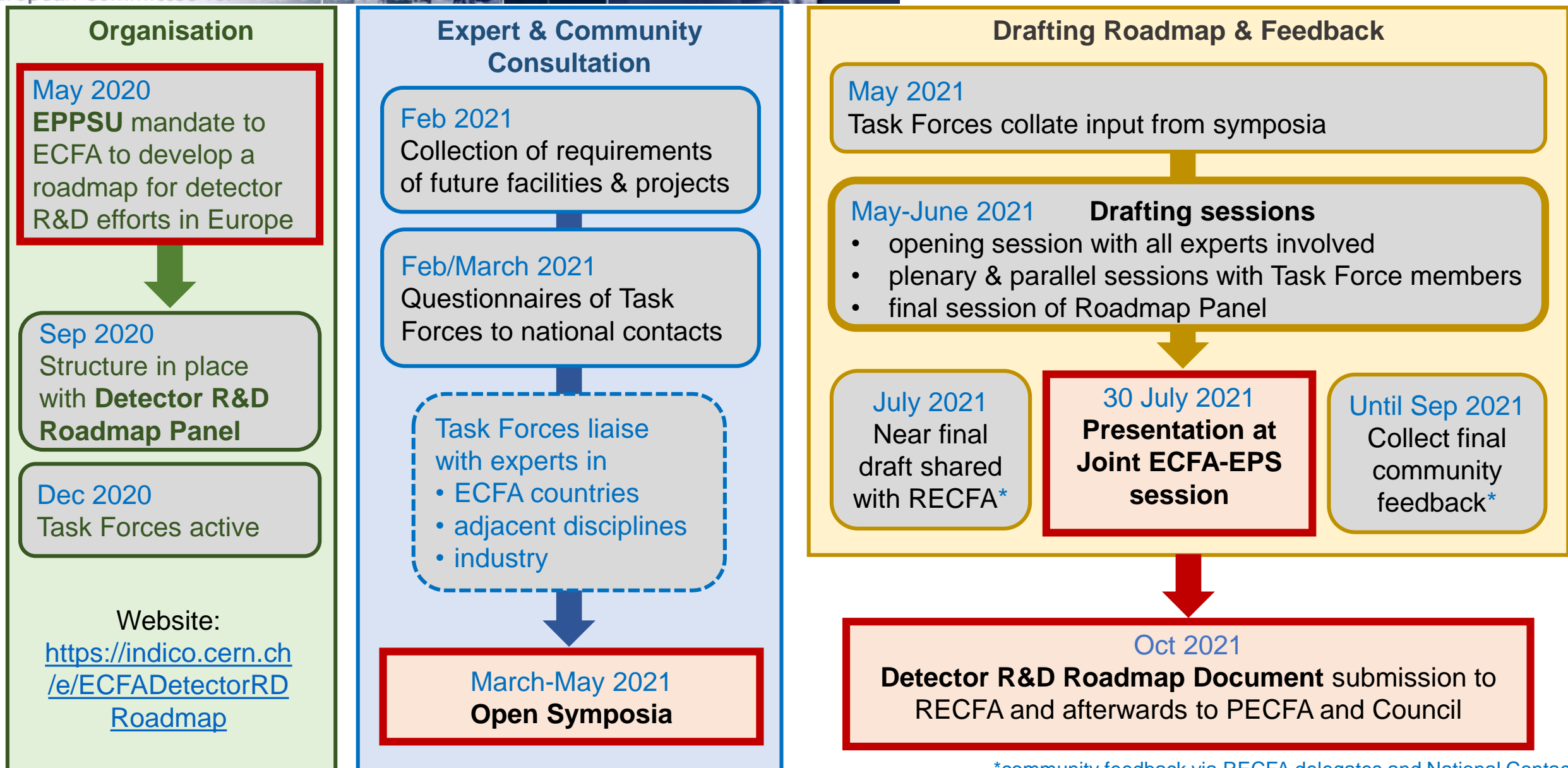
- Focus on the technical aspects of detector R&D requirements given the EPPSU deliberation document listed “*High-priority future initiatives*” and “*Other essential scientific activities for particle physics*” as input and organise material by Task Force.
- Task Forces start from the future science 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 91.2 GeV of up to $5 \times 10^{36} \text{cm}^{-2} \text{s}^{-1}$.
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 $10^{35} \text{cm}^{-2} \text{s}^{-1}$.

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



*community feedback via RECFA delegates and National Contacts



<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)

Organisation

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

25 March 2021
Open Symposia

Drafting Roadmap & Feedback

Questionnaire

- Four Topics (38 questions)
 - On-Detector ASICs
 - Links, powering and interconnects
 - Off-Detector systems
 - Collaborative issues
- One prediction (14 questions)
 - Technology evolution
- 23 replies
 - Many already grouped
 - Very relevant feedback
 - Few predictions

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25 March 2021

TF7 Symposium

Symposium

- 3 parts
 - A. ASICs
 - B. Links, powering and interconnects
 - C. Off-Detector systems
- Each part
 - Digest of questionnaire answers
 - Keynote
 - Three short topical invited
- Final open discussion
 - Synthesis of priority questions
 - Collaborative issues

Questionnaire

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• Many thanks

- To all colleagues who participated in the survey and answered the questionnaire
- To all symposium speakers who agreed to (almost) impossible assignments
- To all members of the Task Force panel

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- Electronics is ubiquitous in modern detectors
- Every Task Force has a connection to TF7: *transverse Task Force*
- TF7 has a particularly strong link with TF3 (solid state detectors)
 - Monolithic CMOS sensors
 - TF3 will handle sensor aspect of monolithic ASIC development
 - TF3 symposium on 23 April: <https://indico.cern.ch/event/999816/>
 - Monolithic ASIC development is and will remain an electronic design activity with dedicated R&D needs

- Full symposium is recorded
- Audience is expected to be large
 - May require stricter than typical management of interactions
- Topical invited talks are very short (10 minutes)
 - Talks are not all-encompassing, but rather focusing on selected topical issues
 - Please use the Q&A window to register your comments or questions
 - In each session, a 30 minutes period is foreseen at the end of the group of three topical talks for discussion
 - The Q&A window will be used to collect material and manage the discussion
 - You can prioritize relevant questions in the Q&A window by “liking” them.
- Important issues from each session will be carried forward to the late afternoon discussion for more in-depth analysis
 - We may use polls to prioritize questions
- This symposium is not the end of the consultation.
 - Additional feedback is welcome until the last symposium on 7 May
 - Send your comments to: Questionnaire-TF7-ECFA-DetRDRMap@cern.ch
- Many thanks for your participation
 - ...and understanding in case of organizational difficulty during this first event

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.

09:20 → 09:35 Part A Introduction: ASICs and front-end electronics

Covering scope and summary of inputs

Speaker: Valerio Re (Universita and INFN (IT))

 Replies_1_Question...

09:35 → 10:05 Keynote talk: Future trends, challenges and opportunities in ASICs for HEP: a birds-eye view

Speaker: Angelo Rivetti (INFN - National Institute for Nuclear Physics)

10:05 → 10:15 Topical invited talk: Moving to leading-edge technology nodes

Speaker: Federico Faccio (CERN)

10:15 → 10:25 Topical invited talk: 3D integration

Speaker: Christophe Wyon (CEA French Alternative Energies and Atomic Energy Com)

10:25 → 10:35 Topical invited talk: Perspectives on future development (TBC)

Speaker: Erik Heijne (Czech Technical University in Prague (CZ))

10:35 → 11:05 Comments and brief discussion

Identifying points to take to afternoon discussion

Speaker: Christophe De La Taille (OMEGA (FR))

11:05 → 11:20**Break**