



RD_FCC collaboration meeting



Franco Bedeschi

RD_FCC

December 15, 2021

Summary

- ❖ News on FCC/CEPC
- ❖ RD_FCC status
- ❖ Discussion topics



FCC (1)



❖ FCC: developments at CERN after ESU

➤ June 2021: FCC Feasibility Study approval by Council

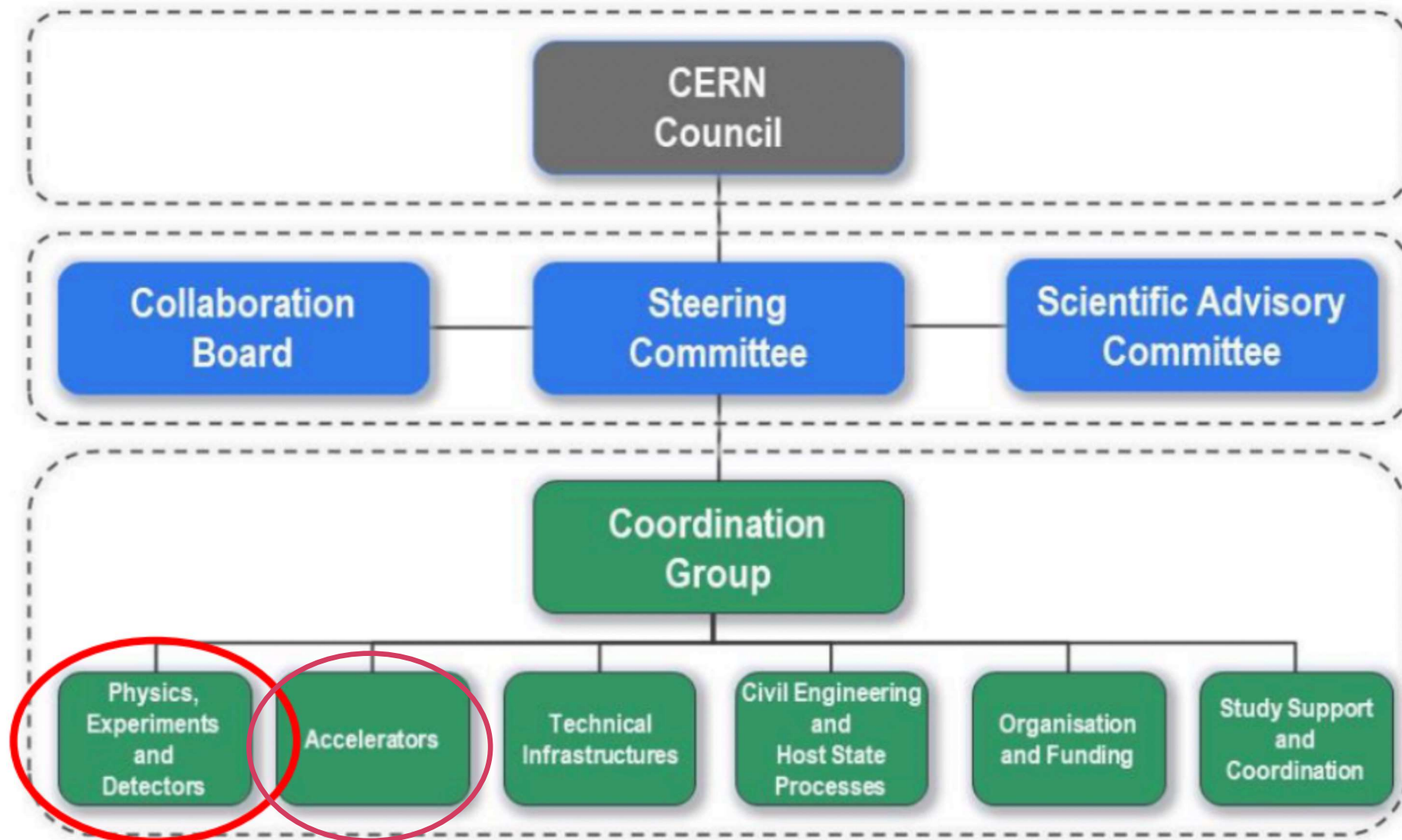
■ Organizational structure

CERN/3566/Rev.

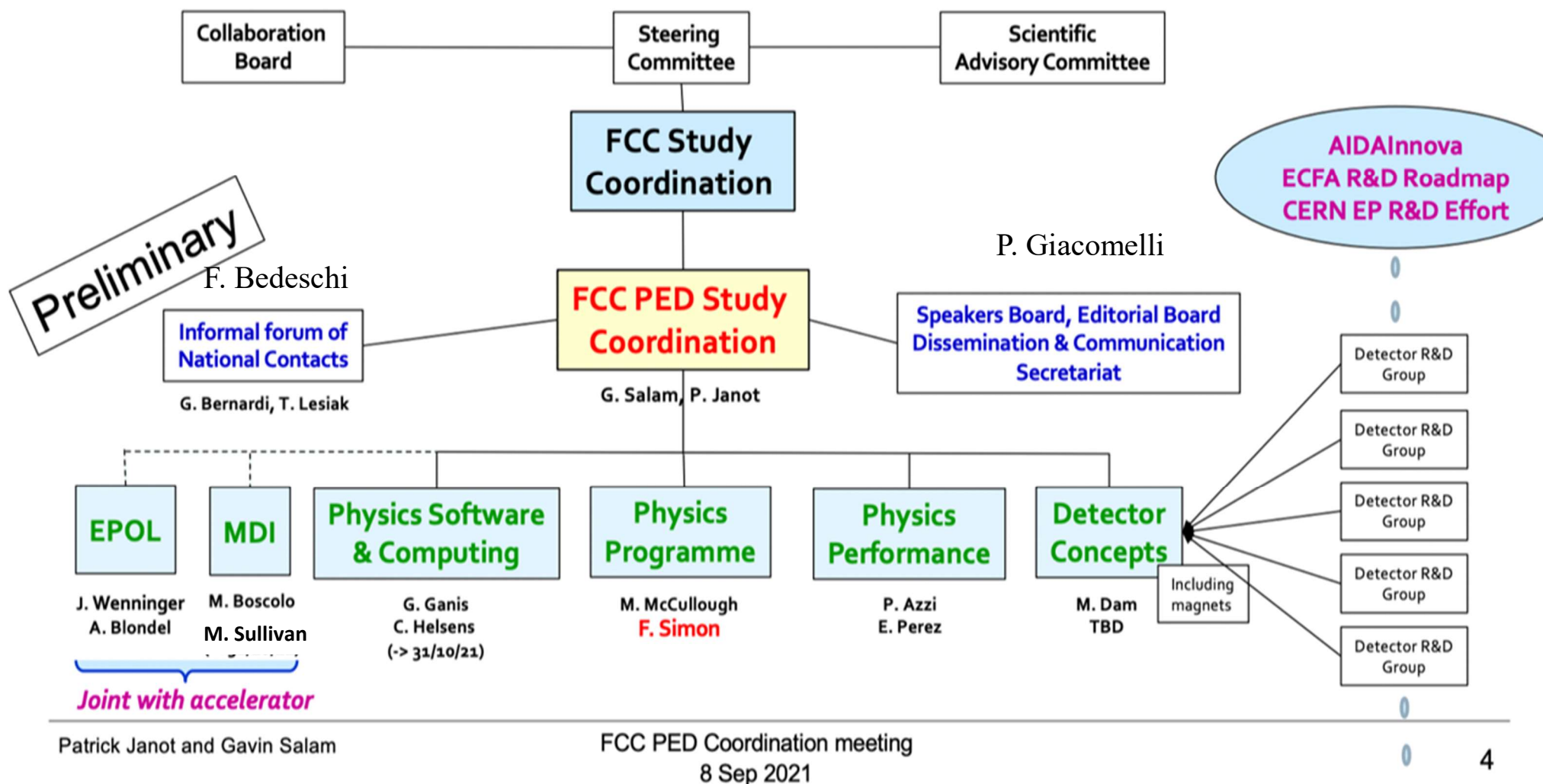
Oversight

Supervision

Execution



The PED Pillar Organisation - preliminary



❖ FCC: developments at CERN after ESU



The PED Pillar Objectives in 2025



- Mostly defined by the general (tight) timeline of the FCC project

Infrastructure and accelerator

Physics, Experiments, and Detectors

Milestone / activity	Target date	Possible timeline
First e^+e^- collisions in FCC-ee	Early 2040's	FCC-ee detector commissioning
Start machine installation	2037	Start FCC-ee detector installation
Tunnel completion	2035/36	
Start tunnel construction	2030	Start FCC-ee detector construction
Project approval	2028/29	FCC-ee Detector TDR's and approvals
Next European Strategy Update	2026/27	Next European Strategy Update (ESU)
Key prototypes (feasibility proof)	2026	FCC-ee Proto-collaborations and EoI's
FSR ^(*) (feasibility proof)	End 2025	PED FSR, includes enough common material and knowledge for FCC-ee proto-collaborations

(*) FSR = Feasibility Study Report

Adapted from schedule in M. Benedikt's presentation

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CERN/3566/Rev.

■ Deliverables

CERN/3588

- ✳ Optimisation of the placement and layout of the ring and related infrastructure
- ✳ Pursuit, together with the Host States, of the preparatory administrative processes
- ✳ Optimisation of the design of the colliders and their injector chains ...
- ✳ Devel. and documentation of the main components of the technical infrastructure
- ✳ Elaboration of a sustainable operational model for the colliders and experiments in terms of human and financial resource needs
- ✳ Development of a consolidated cost estimate
- ✳ Identification of substantial resources from outside CERN's budget
- ✳ **Consolidation of the physics case and detector concepts for both colliders.**

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■ **1st Cost review (tunnel+FCCee) 2023, 2nd 2025**



FCC (2)



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- CERN was very slow in setting up the FCC Feasibility Study organization
- Representation in Collaboration Board (e.g. France 4 members, Turkey 10)
 - Yet it elects 5 members of the steering committee!
- Concern on Italian representation in new IAC still in preparation
- Concerns by INFN management → important presence in FCC bodies
 - So far only 2 people from RD_FCC in CB (M. Boscolo also in CB Exec Board)

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❖ New CERN unit: RCS/PRJ/FC

- Non-CERN people can register as CERN users for FCC (CLIC, MuColl)

ECFA Detector R&D Roadmap Process

Organisation

May 2020
EPSSU 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/ECFADetectorRD/Roadmap>

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

25-28 May 2021 Drafting sessions

- opening session with all experts involved
- plenary & parallel sessions with Task Force members
- final session of Roadmap Panel

2 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

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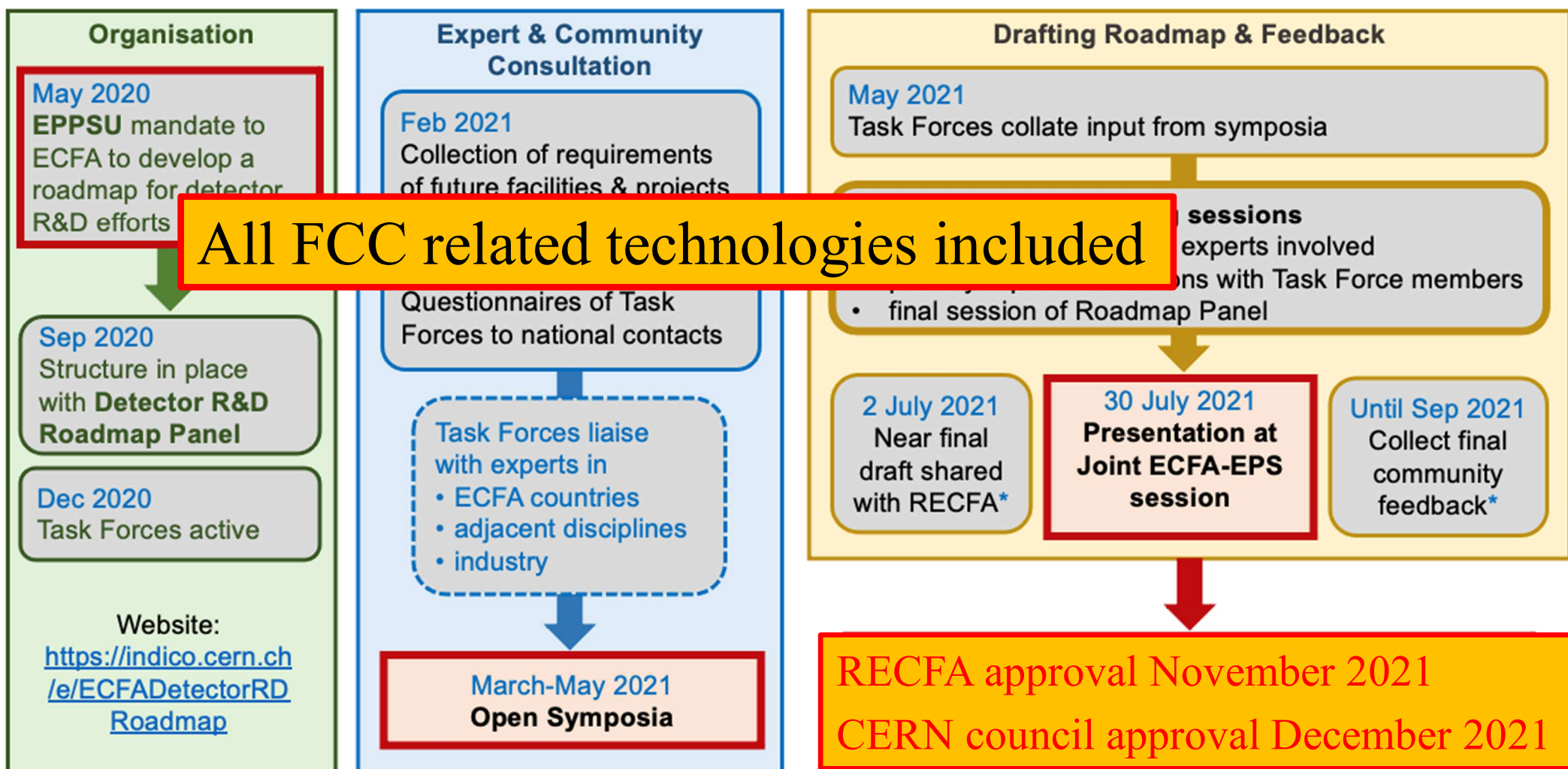
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RECFA approval November 2021
CERN council approval December 2021

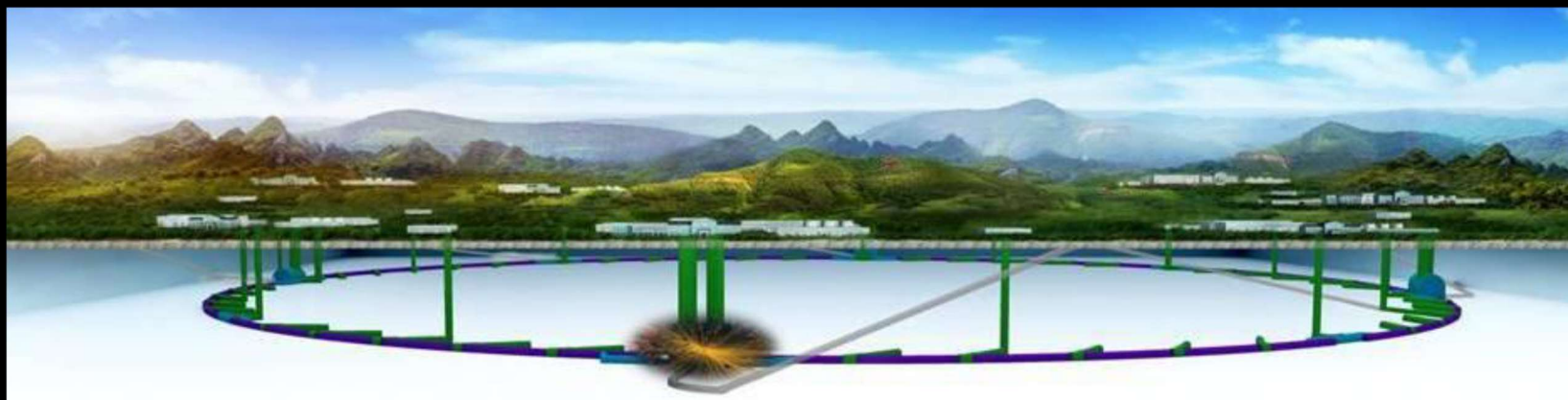
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ECFA Detector R&D Roadmap Process



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- ❖ Snowmass work restarted in summer 2021
- ❖ Many EoI's submitted on FCCee. Full list at:
 - <https://indico.cern.ch/event/951830/>
- ❖ Many EoI on IDEA and INFN R&D
 - IDEA general
 - Micro-Rwell
 - Drift chamber
 - Dual Readout
 - Infrastructure software Key4HEP
- ❖ Contributions to white papers:
 - General FCC physics/detectors – Editors S.Eno, D. Denisov
 - DR calorimetry – Editor S. Eno



❖ R&D work in progress both on machine & detectors

- CEPC not included in 5Yr plan 2020, but
- Large SRF facility established near Beijing
- Consortium of 70+ industries working on related R&D
- Much work on site selection with local governments
 - Potential funding scheme with most funds from local communities
- Updated schedule shown at Int. CEPC Workshop in Oct. 2021

CEPC Roadmap and Schedule (ideal)

- 2013-2025: Key technology R&D, from CDR to TDR, Site selection, Intl. Collab. etc.
- Ideal situation: Approval in the 15th Five-Year Plan, and start construction (~8 years)

CEPC Project Timeline



The CEPC accelerator roadmap (ideal)

2016-2021 MOST phase-1 accelerator R&D
 2018-2023 MOST phase-2 accelerator R&D
 2023-2028 MOST phase-3 accelerator R&D
 2022-2023 Accelerator TDR completed
 2023-2025 Site selection, engineering design, prototyping and industrialization
 2026-2034 Construction and Installation

The CEPC detector roadmap (ideal)

2016-2021 MOST phase-1 detector R&D
 2018-2023 MOST phase-2 detector R&D
 2023-2028 MOST phase-3 detector R&D
 Present-2024 Seek intl. collab., detector R&D
 2025-2026 Prepare for intl. collab.
 2027-2028 Detector TDR completed
 2028-2034 Detector construction
 2033-2034 Installation

HTS Magnet R&D Progr

❖ Synergic funding besides INFN/CSN1:

➤ **EU**: Cremlin+, AidaInnova, FCC-IS, FEST, **CSN5**:ARCADIA, HiDRa2

Sezione	FTE FCC	FTE altro	FTE tot	R/T total
BA	1.85	0.15	2.00	11
BO	2.05	0.95	3.00	14
CT.DTZ	1.20	0.00	1.20	2
FE.DTZ	0.50	0.30	0.80	6
FI.DTZ	0.20	0.00	0.20	3
LE.DTZ	0.80	0.30	1.10	6
LNF	0.60	2.55	3.15	12
MI	2.20	1.00	3.20	5
PD.DTZ	0.80	0.10	0.90	6
PI	2.45	0.00	2.45	24
PV.DTZ	1.10	0.30	1.40	8
RM1.DTZ	0.20	0.00	0.20	1
RM3.DTZ	0.30	0.20	0.50	4
TO.DTZ	0.80	1.05	1.85	8
UD.DTZ	0.30	0.00	0.30	3
Totali	15.35	6.90	22.25	113

❖ Year	People	FTE
2020	73	13.9
2021	91	17.5
2022	113	22.3

❖ Organization and participation (SPC e conveners):

➤ Past:

- International Workshop on the High Energy Circular Electron Positron Collider – Shanghai, October 26-28, 2020
 - 9 INFN/RD_FCC talks
- FCC week, 9-13 November 2020
 - FCCIS kickoff meeting → 3 INFN/RD_FCC talks on MDI
 - 4th FCC Physics and Experiments Workshop → 12 INFN/RD_FCC talks
- IAS program on HEP – Hong Kong – 14-21 Gen. 2021
 - 7 INFN /RD_FCC talks
- FCC week, June 28 - July 2, 2021 – 8 INFN /RD_FCC talks
- ECFA workshops on e+e- Higgs/EW/Top , June 18, 2021 – 2 session conveners
- International Workshop on High Energy CEPC, Nanjing, China, Nov. 8-12, 2021
 - 5 session conveners, 12 talks by INFN/RD_FCC
- FCCIS WP2 Workshop – Nov 29 – Dec. 10, CERN – 6 INFN/RD_FCC talks

➤ Future:

- 5° Phys., Exp. and Detector Workshop, Liverpool, UK, Feb. 7-11, 2022

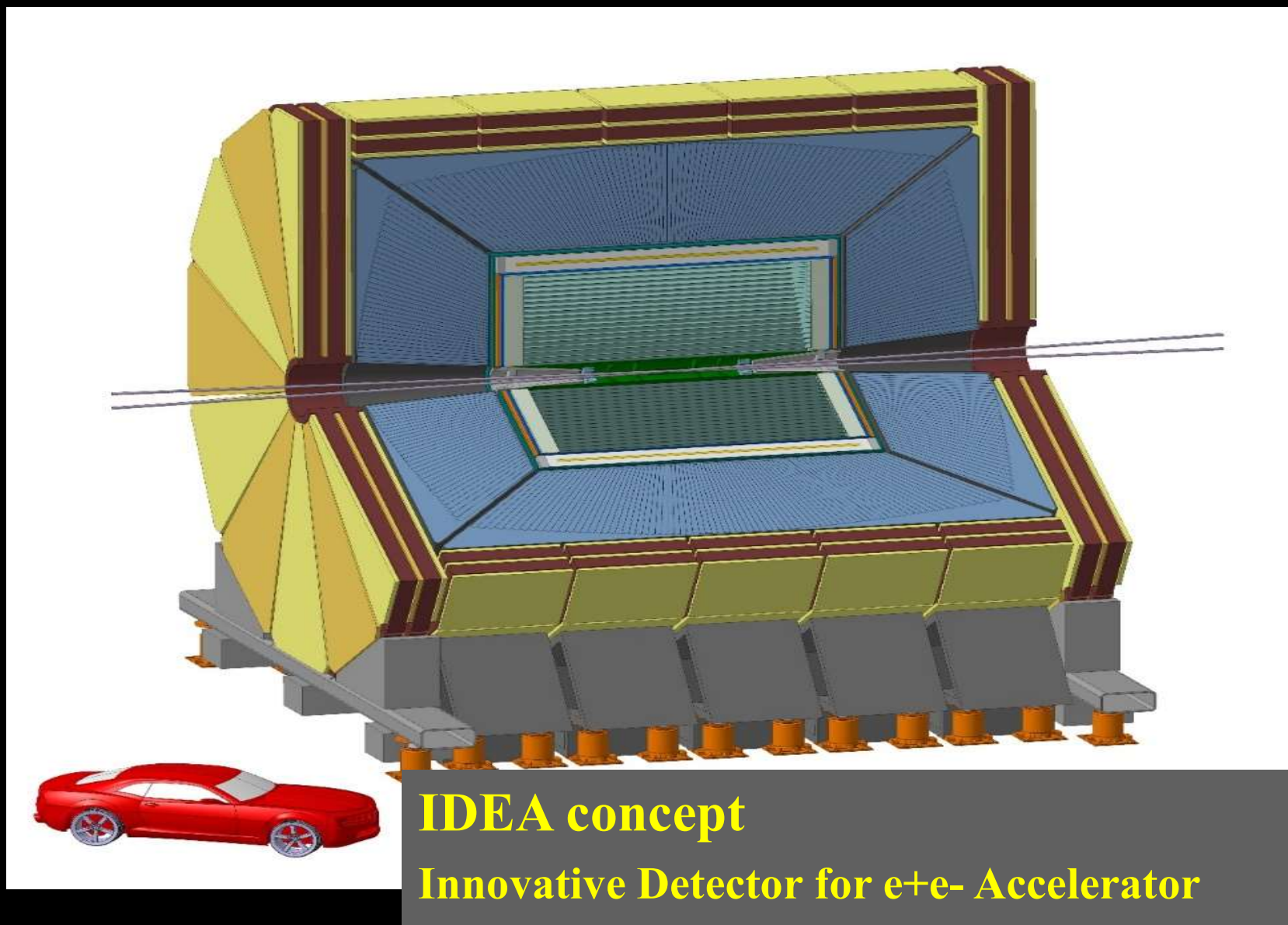
1. **P. Azzi**, L. Gouskos, M. Selvaggi, and F. Simon, “Higgs and top physics reconstruction challenges...” EPJ+ special issue, Focus on FCC-ee, arXiv:2107.05003[hep-ex]
2. **P. Azzurri**, “The W mass and width measurement challenge at FCC-ee” EPJ+ special issue, Focus on FCC-ee, arXiv:107.04444 [hep-ex]
3. **P. Azzurri**, G. Bernardi, **S. Braibant**, D. d’Enterria, J. Eysermans, P. Janot, A. Li, E. Perez, “A special Higgs challenge: Measuring the mass and production cross section” EPJ+ special issue, Focus on FCC-ee, arXiv:2106.15438 [hep-ex]
4. **P. Azzi** and E. Perez, “Exploring requirements and detector solutions for FCC-ee in” EPJ+ special issue, Focus on FCC-ee, arXiv:2107.04509 [hep-ex]
5. M. Aleksa, **F. Bedeschi**, **R. Ferrari**, F. Sefkow, and C. G. Tully, “Calorimetry at FCC-ee” EPJ+ special issue, Focus on FCC-ee, arXiv:2109.00391 [hep-ex]
6. **M. Boscolo**, H. Burkhardt, K. Oide and M.K. Sullivan, “IR challenges and the machine detector interface at FCC-ee”, EPJ+ special issue, Focus on FCC-ee,
7. **N. Bacchetta**, P. Collins, and P. Riedler, “Tracking and vertex detectors at FCC-ee” to be published on EPJ+ special issue, Focus on FCC-ee
8. **P. Giacomelli** and **S. Braibant**, “Muon detection at FCC-ee” to be published on EPJ+ special issue, Focus on FCC-ee.
9. **M. Boscolo** et al., IPAC 2021 e-print: 2105.09698
10. **M. Boscolo**, H. Burkhardt, G. Ganis, C. Helsens, EPJ+ (2021) (Essay in Part IV) ArXiv:2111.09870

❖ AIDAInnova – P. Giacomelli elected unanimously new Scientific Coordinator

- WP 5 – Pixel MAPS – tasks: 5.2.1/ 5.2.2
 - ARCADIA/Belle2
- WP 7 – Gas Detectors – tasks: 7.3.2/ 7.4.1
 - μ Rwell chambers/drift chamber readout
- WP 8 – Calorimetry – tasks: 8.4.2
 - Dual readout calorimeter
- WP 10 – Cooling for VTX – tasks: 10.2
 - Cooling substrates/microcooling
- WP 11 – Microelectronics – tasks: 11.3
 - ASICS for μ Rwell chambers
- WP 12 – Software – tasks: 12.2.1 /12.4.2/ 12.5.2
 - Key4HEP/MPGD simulation/Particle flow for Dual readout cal.

❖ Other ongoing grants:

- EU: Cremlin+, FCC-IS, FEST (extension granted ends dec. 2025)
- INFN/CSN5: ARCADIA, HiDRa2 recently approved





RD_FCC Work Packages



- ❖ **Physics & SW – Coordinators: P. Azzi (PD), P. Azzurri (PI)**
 - IDEA fast and GEANT simulation toward Key4HEP
 - FCCee physics studies
- ❖ **MDI – Coordinators: M. Boscolo (LNF), N. Bacchetta (PD)**
 - INFN: LNF, RM1 tasks 2.3 “IR and MDI design” of FCC-IS
 - Major work on IR and machine backgrounds
- ❖ **Silicon det. - Coordinators: M. Caccia (MI), A. Andreazza (MI)**
 - ARCADIA: DMAPS development for vertex detectors
 - Silicon tracker staves with ATLASpix3
- ❖ **DCH – Coordinator: F. Grancagnolo (LE)**
 - New DCH technologies and cluster counting
- ❖ **DR calorimetry – Coordinator: R. Ferrari (PV)**
 - SiPM based DR fiber calorimeter
 - Crystal DR calorimeters
- ❖ **Muon – Coordinator: P. Giacomelli (BO)**
 - uRwell technology for pre-shower and muon systems

❖ Accelerator:

- Can we expand the scope of the INFN contribution on accelerators?
- Can we identify areas where INFN expertise could be important?
- Is there a manpower issue or interference with the Muon Collider work?

❖ Detectors:

- How do we expand the current R&D collaborations both in Italy and internationally?
- What is the path toward forming proto detector collaborations?

❖ Physics & Software

- How to increase participation and speed up the work in this area?
- How to increase international collaboration?