FUTURE CIRCULAR COLLIDER

NIELS BOHR INSTITUTE
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# Detector Concepts - Plans

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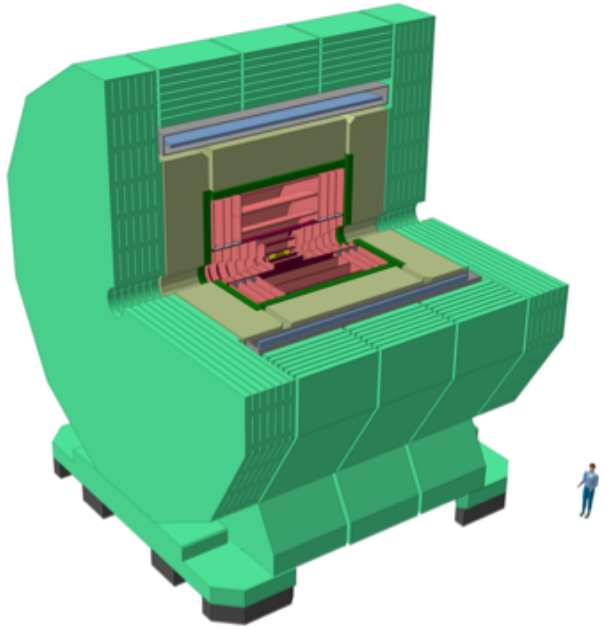
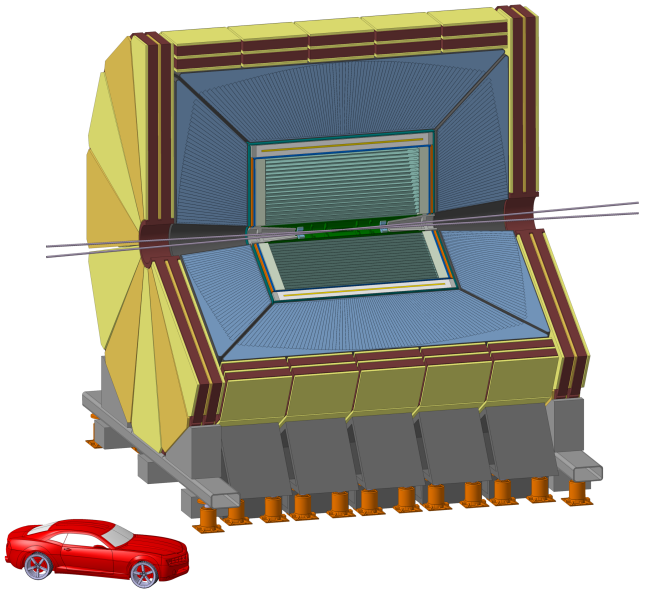
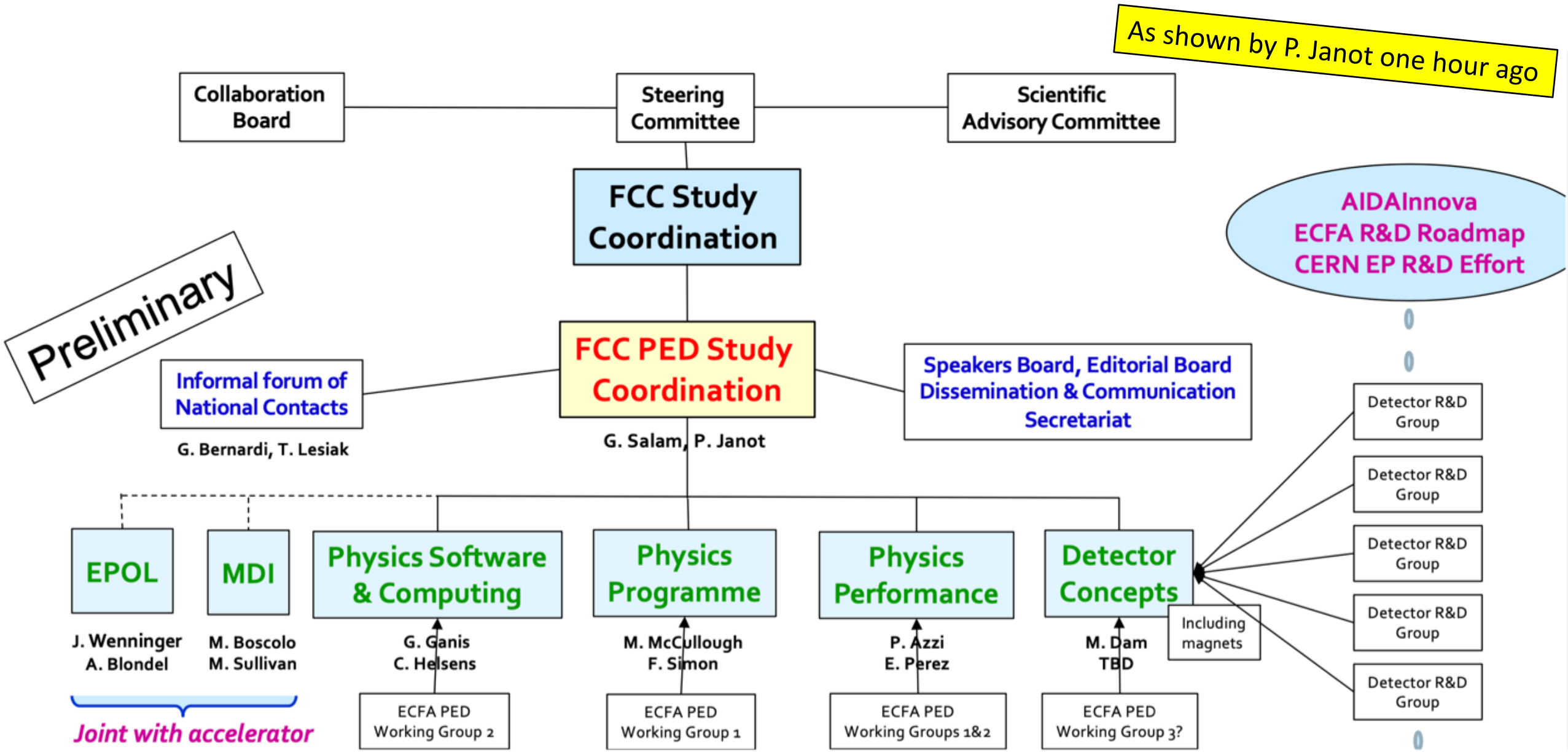


3rd FCC-France Workshop
30 Nov. - 2 Dec., 2021



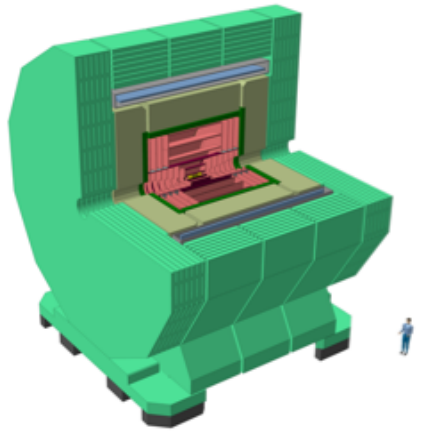
# FCC PED Organisation

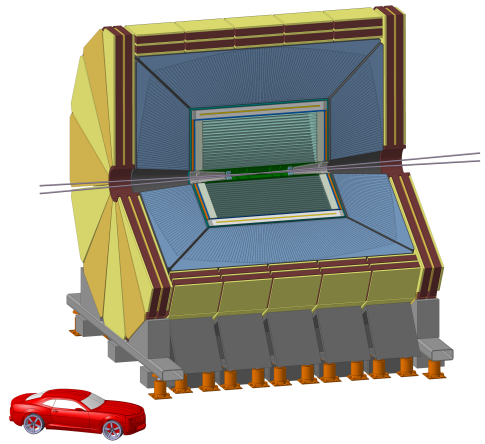
As shown by P. Janot one hour ago



# Detector Concept – what it includes

- Assembly of sub-detectors
  - Vertex detector
  - Tracking
  - Particle Identification
  - Calorimetry
  - Muon system
  - Luminosity monitor
- Magnet system
  - Technology + Placement: in-front of / within / behind calorimeter system
- Systems for data acquisition and processing
  - Global trigger system vs. free streaming self-triggered sub-detectors ⇒ impact on detector technology choice
- Overview of services, consumables, power consumption, ecological impact
- Evaluation of construction and operation costs
- Properly defined and versioned simulation model of detector





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From *Mandate for the FCC Detector Concepts Working Group*

# DC Working Group Tasks

- Develop, study and evaluate DCs: Make sure DCs are capable of delivering the detector requirements
  - Main tool: Detailed simulation studies
- Optimize compatibility of DCs with operation at FCC-ee:
  - MDI layout; timing and background conditions
- Identify and encourage necessary R&D in the direction of the requirements for FCC-ee
- Gather and engage a wide community around the DC effort; foster collaboration towards the common goal of developing FCC-ee DCs
- Function as a forum, where progress, ideas and results from individual R&D efforts and test-beam activities are presented, discussed and reviewed in view of FCC-ee detector requirements and physics.
  - Follow technological developments that could lead to new physics opportunities
- Revisit FCC-hh detector concepts

DC = Detector Concept

From *Mandate for the FCC Detector Concepts Working Group*

# Way towards fulfilling tasks

- Promote the use of the common FCCSW software platform & tools (key4hep based)
  - Development of sub-detector geometrical description, simulation, and local reconstruction
- Integrate sub-detectors into DCs
  - Plug-and-play technology offered by the key4hep software framework
- In collaboration with *Physics Performance*, simulate and evaluate DC performance
  - Including test-beam simulation and analysis
- Establish links to R&D groups and encourage work towards the the common goal of developing FCC-ee DCs
  - Give necessary input to R&D groups
  - Follow up on technology progress
- Identify common areas where specific engineering efforts (not covered by sub-detector developments) are required
- Arrange regular group meetings
- Organize topical and general DC workshops

From *Mandate for the FCC Detector Concepts Working Group*

# FCC Physics and Detectors

## Group boundaries and interactions

**MDI** (in Accelerator part)

- machine interface
- experimental hall infrastructure

Slide edited ”on the fly” by Felix Sefkow during a series of discussions between FS and MD

**Physics Programs**

- Models, links to theory
- Theory precision
- Generators
- Global Fits
- running scenarios
- combination with LHC, FCChh

Bench-marks

**Physics Performance (analysis forum)**

- benchmark analyses, analysis framework
- common high-level tools (jet algorithms, LH, BDT based tags)
- physics case studies for different detector concept variants (bigger/smaller, gaseous / silicon, DR vs PFlow)
  - link between physics performance (BR, M,…) and high-level detector performance (colourless object (dijet) mass, c tag, …)
- comparisons between different detector concepts (IDEA, CLD, …)

Figures of merit
Detector variants

**Detector concepts**

- overall model
  - **global** engineering (services, supports), magnet model
  - **full** (and realistic) simulations
- technology options (“plug & play”)
  - calorimeter centric concepts
- high-level performance figures of merit
  - link to low-level parameters (global and local (granularity, sampling fraction, noise, material, alignment / calibration,…)
  - low-level reco (clusters, tracks)
- link DELFES & full sim
- variations of global parameters (R, B, …),
- cost optimisation

guidance, priorities, requirements, constraints, performance impact

feasibility, validation
low level parameters, test beam, prototype, validation of design/performance / simulation, cost drivers

**R&D Groups**

- calo, tracking, vertex, PID, magnet technology (cables…)
- technologies (sensors, electronics)
  - limitations (pixel size, material, speed…)
  - scalability
- demonstrators and prototypes
- test bench, test beam
- low-level performance (pint resolution, X0, sigE)
- low-level simulations, digitisation

Concepts and independent groups

Concepts and Neighbours

**Software**

- Generator interfaces, analysis framework, detector geometry, high-level reconstruction, low-level reco, low-level simulation

# Detector Concept Short term Plans

- Establishment of Detector Concepts Group and it's structure
  - Appointment of converner(s)
    - TBD ⇒ Names of one or two real persons
  - Formation of International Advisory Committee
    - Several names already in sight
  - Formation of sub-working-groups

- Settling on agenda for the Liverpool meeting parallel sessions
  - Kick-off event for Detector Concepts activity (?)

- Plans for mid-way review mid-2023

# Conclusion & Outlook

- Detector Concepts Working Group is having a rather slow birth
- Foresee to get up to speed in early 2022 (Liverpool and onwards)
  - Regular working meetings
  - Dedicated workshops
    - e.g. luminosity monitoring, TDAQ and data processing, …
  - …