Impressions from the FCC Week

CEPC Detector R&D

João Guimarães da Costa

CEPC Day, IHEP
Beijing, 15 June, 2026

CERN Council Decision on FCC-ee

ESPP 2026 Update · Council Resolution of 22 May 2026 · Costas Fountas (Council President)

- **The CERN Council updated the European Strategy for Particle Physics (ESPP)**
  - adopting FCC-ee as the **next flagship project at CERN** and the **FCC integrated programme (ee + hh)** as the long-term vision
  - 24 of 25 Member State communities support FCC-ee; 20 of 25 support the integrated FCC-ee/FCC-hh programme. Strong support also from Associate and Non-Member States.
- **Funding mandate to the Director-General (Mark Thomson):**
  - Initiate discussions with Member/Associate/Non-Member States and the EU to secure additional cash + in-kind contributions.
  - Build on existing pledges:
    - 860 M€ from private donors already secured.
    - 3 B€ FCC budget line in the EU Draft Multi-annual Financial Framework (MFF) 2028-2034
    - Develop a financially feasible funding plan — ~4-5 MCHF needed outside the CERN budget.
- **Governance & timeline:**
  - Informal Council retreat in Tallinn, Estonia (Feb 2027) to discuss FCC governance and financial models.
  - Annual reports on Strategy implementation; target a final Council decision on FCC-ee by 2028.

CERN Council - FCC Timeline

Draft Updated FCC Timeline

FCC Phases (assuming approval)

- 2026-2028: Reference Design Phase (previously referred to as pre-TDR Phase)
- 2029-2033: Technical Design Phase
- 2033- : Project Implementation

Proposed Council Milestones (updated from CERN/SPC/1259/RA CERN/3912/RA)

- Mar 2026: discussion of Reference Design Phase scope and deliverables
- Jun 2026: approval of Reference Design Phase following ESPP update
- Sep 2026: input from Council in requirements for project approval
- Dec 2026: decision in Council on the main features of the funding model
- Mar 2027: decision on FCC governance model (previously Dec 2026) – after possible retreat?
- Jun 2028: final review of Reference Design Phase (previously Mar 2028)
- Sep 2028: earliest decision point (previously Jun 2028)

DG - March 2026

CERN Council - the adopted FCC-ee project

- **Future Circular Collider (FCC)** — a new 91 km ring at CERN
- **Timeline**: targeting start of operations in ~2045–2048
- **Cost**: ~15 BCHF over ~15 years

I. The *next CERN flagship collider project*

i. The electron–positron Future Circular Collider (FCC-ee) is recommended as the preferred option for the next flagship collider at CERN.

ii. A descoped FCC-ee is the preferred alternative option for the next flagship collider at CERN

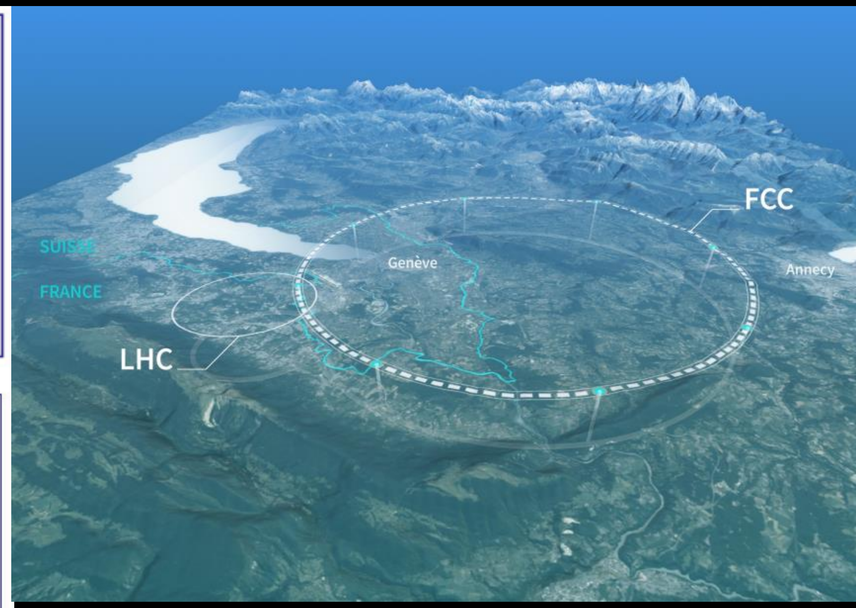
A descoped FCC-ee (to improve the financial feasibility)

- Descoping scenarios include:
  - removing the top-quark run — -1.26 BCHF
  - constructing two rather than four interaction regions and experiments — - 0.80 BCHF
  - decreasing the RF system power (50 MW → 30 MW) — - 0.35 BCHF
- These measures would reduce the construction cost by approximately 15%
- *The luminosity for the descoped FCC-ee would be (M. Benedikt, F. Zimmermann):*

  $\mathcal{L}\,(\text{FCC-ee})_{\text{descoped}} = \mathcal{L}\,(\text{FCC-ee}) \times 3/5 \times 2/4 \times 1.2 = \mathcal{L}\,(\text{FCC-ee}) \times 0.36$

- Should additional resources become available, these descoping scenarios would be reversible

K. Jakobs



CERN's Scientific Strategy & Priorities

Mark Thomson, DG CERN · FCC Week 2026 · Helsinki

Top Priority: Exploitation of LHC & HL-LHC

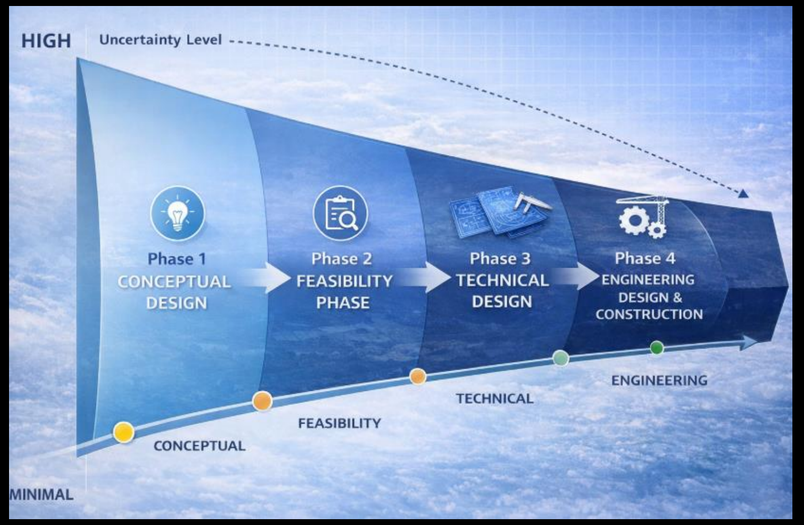
- HL-LHC and ATLAS/CMS Phase-2 upgrades are CERN's **highest priority**
- Long Shutdown 3 (LS3) begins 29 June 2026 — largest CERN project in ~20 years
- 4-year shutdown: install and commission HL-LHC, ATLAS/CMS Phase-2 upgrades
- HL-LHC operations ~2030–2041: 6× more data than LHC, new discovery potential
- Full exploitation includes ALICE and LHCb upgrades during LS4
- **Meeting the current schedule is** essential for momentum toward the next long-term project

Highest Long-Term Priority: FCC-ee

- FCC-ee is endorsed as CERN's **sole vision for the next flagship collider**
- Target: be in position for CERN Council to decide on FCC-ee from **June 2028 onwards**
- New FCC Project Office established to steer reference design and documentation
- "Options analysis" will be prepared for Member States: FCC-ee vs. descoped FCC-ee
- Non-collider physics: new roadmap for future non-collider programme by early 2027
- International partnership model needed for FCC-ee delivery

From Feasibility Study to Reference Design Phase (RDF)

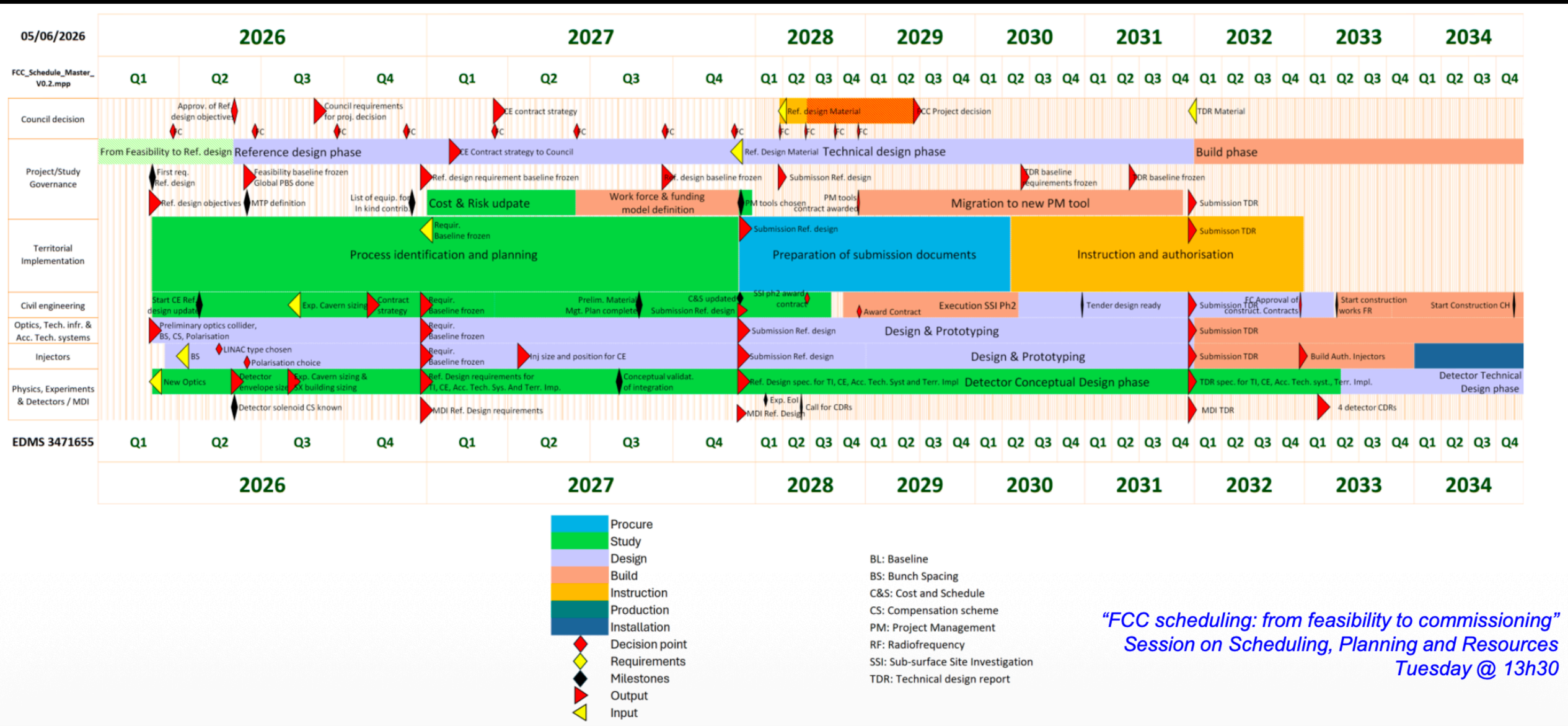
- **Now moving to Reference Design Phase (2026-2028)**
  - followed by Technical Design Phase (2029-2032), targeting project decision by Council after RDP



- **RDP Objectives (6 key areas):**
  - Increase technical design maturity & address FS review recommendations
  - Civil engineering refined for tender design readiness, environmental impact & authorisation
  - Reduce project risks via integration, prototyping, cost/performance contingency, close coordination with Host States
  - Reinforce international collaboration as basis for global project support

- **RDP Deliverables by Q1 2028:**
  - Integrated technical baseline | Resource-loaded project master schedule | Updated cost estimate with uncertainty | Project-wide risk register | Procurement strategy (incl. in-kind contributions)

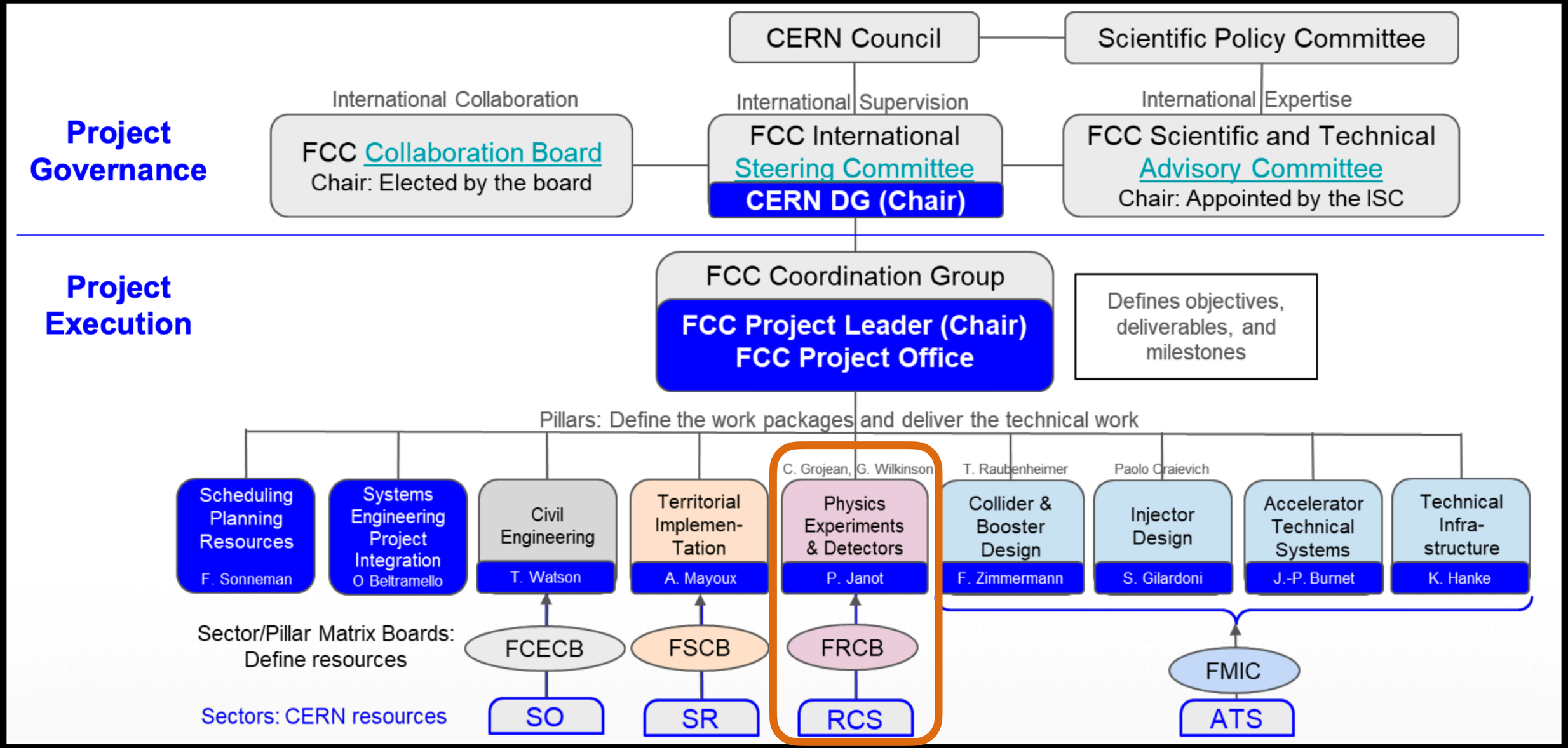
FCC Master Schedule



"FCC scheduling: from feasibility to commissioning"
Session on Scheduling, Planning and Resources
Tuesday @ 13h30

FCC Project decision already in second quarter of 2029

FCC organization for Reference Design Phase



Parameters from Feasibility Study

based on **GHC** lattice developed by K. Oide

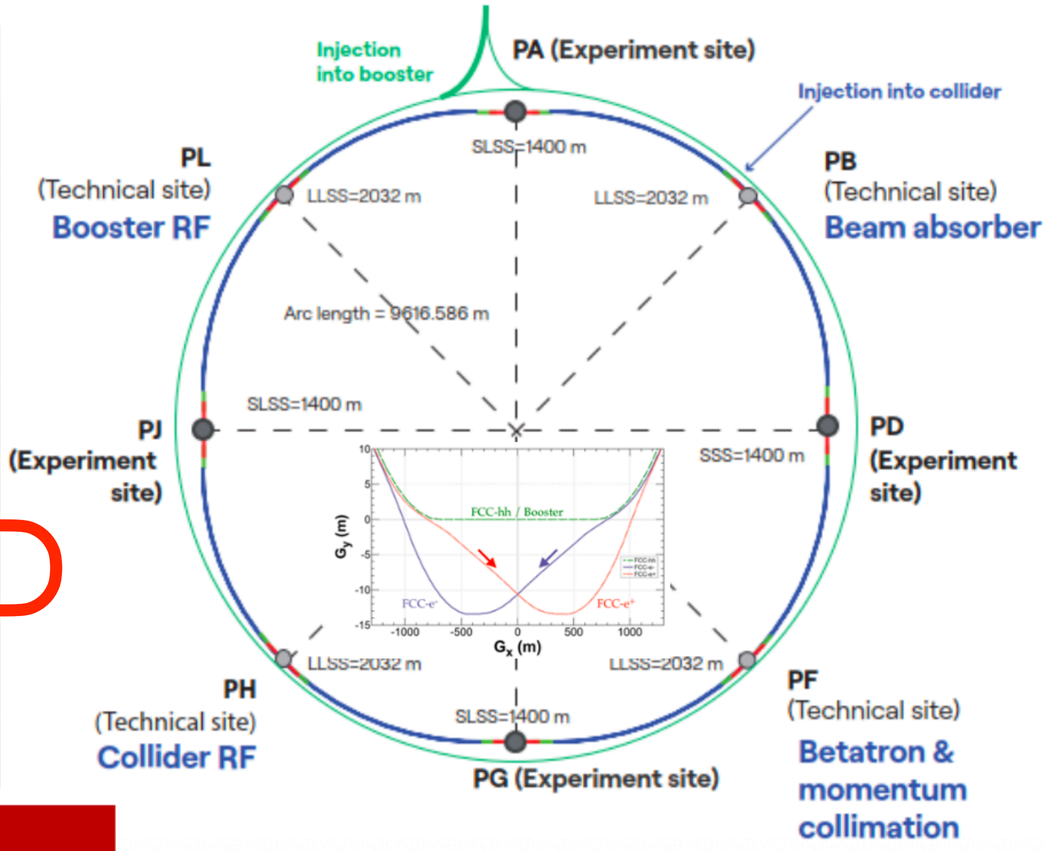
parameter	Z	WW	H (ZH)	tt̄
beam energy [GeV]	45.6	80	120	182.5
synchrotron radiation/beam [MW]	50	50	50	50
beam current [mA]	1294	135	26.8	5.1
number bunches / beam	11200	1852	300	64
total RF voltage 400/800 MHz [GV]	0.08 / 0	1.0 / 0	2.09 / 0	2.1 / 9.2
# IPs	4	4	4	4
luminosity / IP [10^{34} cm^{-2}s^{-1}]	145	20	7.5	1.4
total integrated luminosity / IP / year [ab^{-1} / yr]	17	2.4	0.9	0.17
beam lifetime [min]	21	13	9	10

4 years
6 x 10^{12} Z
LEP x 10^{5}

2 years
> 10^{8} WW
LEP x 10^{4}

3 years
> 2x10^{6} H

5 years
2 x 10^{6} tt pairs



basis for nominal FCC-ee physics programme

CEPC Operation Scenarios and the FCC

Baseline Scenario (TDR) — SR Power: 30 / 12.1 MW

Mode	√s (GeV)	SR Pwr (MW)	L/IP ($\times10^{34}$ $cm^{-2}s^{-1}$)	Run (yr)	∫L dt (ab^{-1},1IP)	Event Yields
H	240	30	5	15	10	2.0×10^{6}
Z	91	12.1	26	4	13	5.6×10^{11}
W^+W^-	155 - 170	30	16	1	1.2	1.0×10^{7}

Ultimate Scenario (Upgrade) — SR Power: 50 MW

Mode	√s (GeV)	L/IP ($\times10^{34}$ $cm^{-2}s^{-1}$)	∫L/yr (ab^{-1})	Run (yr)	∫L (ab^{-1},2IP)	Event Yields
H	240	8.3	2.2	10	21.6	4.3×10^{6}
Z	91	192	50	2	100	4.1×10^{12}
W+W-	155 - 170	26.7	6.9	1	6.9	5.5×10^{7}
ttbar	360	0.8	0.2	5	1.0	0.6×10^{6}

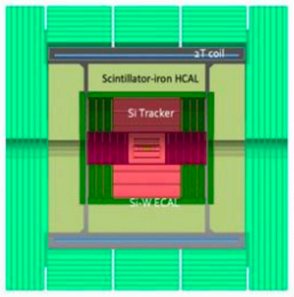
Some detector components needs further studies to guarantee optimal performance at the higher rate of upgraded CEPC or FCC plan A

Main concern: Gas tracker -- TPC, increase inner radius further (?), drift chamber (?) or other options

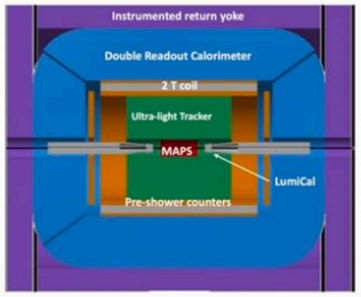
Work to be done next in collaboration with FCC community

Physics, Experiments, Detectors - objectives

- Continue developing the **international high-energy physics community**
- Consolidation of the **interaction region layout, detector integration,** and **beam-background** mitigation
- Optimised **procedures for √s calibration** & possible **monochromatic operation at √s = 125 GeV**
- Finalising common **software/analysis framework** and developing **common computing architecture**
- Realistic studies of **experimental systematic uncertainties** for some **EW precision** measurements and consolidation of the **pertaining requirements** on collider, detectors, and theory
- **Engagement of theory community** to address theory challenge and nurture the young generation
- Proposal for staging implementation and improvements of the **staged/descoped FCC-ee**
- **Prepare** to answer call for (at least 4) **documented EoI's for FCC-ee experiments end 2028**

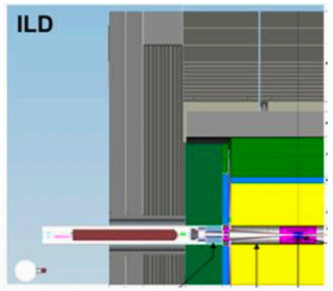


CLD



IDEA

ALLEGRO

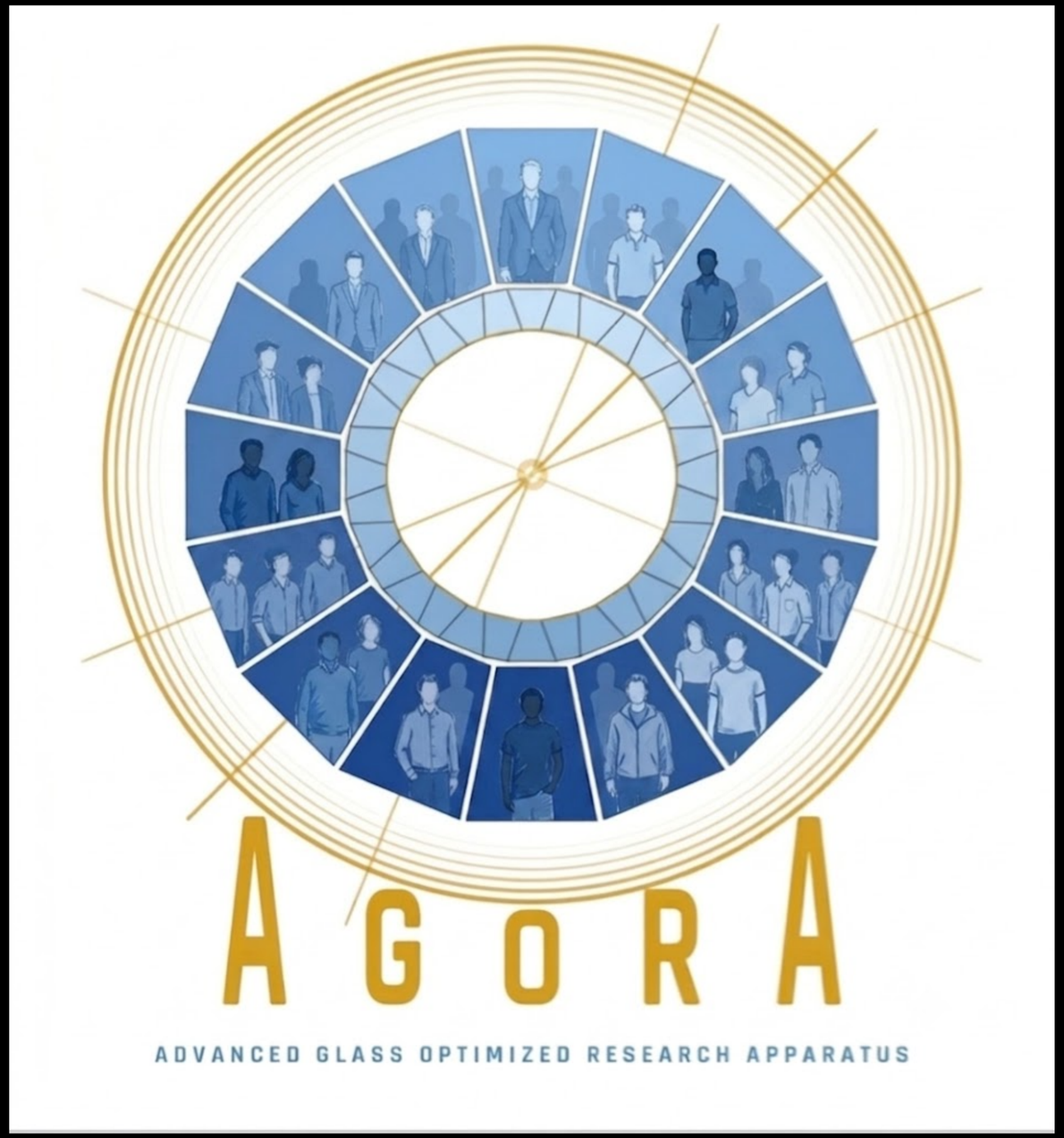


ILD

ALFA

etc.

AGORA: Advanced Glass Optimized Research Apparatus



FCC: Evolution of Detector Concepts Work Package

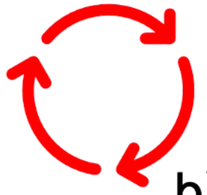
https://indico.cern.ch/event/1664041/contributions/6995583/attachments/3285322/5873191/Detector Concepts Monthly June 2026.pdf

In DRDs:

RnD / technologies

- Gaseous Detectors (DRD1)
- Liquid Detectors (DRD2)
- Semiconductor Detectors (DRD3)
- Photodetectors & PID (DRD4)
- Quantum Sensors (DRD5)
- Calorimetry (DRD6)
- Electronics (DRD7)
- Mechanics (DRD8)

US R&D Collaborations (RDCs) focus on generic (non-targeted), interdisciplinary and blue sky R&D – will collaborate where possible.



In FCC Detector concepts:

a) Generic system-level studies
(create structure as needed or organize workshops)

- Tracker (e.g. Si + straw tracker) & PID
- Calorimetry
- Muons
- TDAQ
- Luminometry
- Magnet

Full mandate for the Detector Subsystem subgroup

b) Concept-specific studies
(using specific envelopes/support structures, or physics benchmarks)

- ALFA
- Allegro
- CLD
- IDEA
- ILD
- …

Full mandate for the Detector Concept Study subgroup

Non-exclusive membership, need to preserve synergies and unity of the community!

FCC: Evolution of Detector Concepts Work Package

https://indico.cern.ch/event/1664041/contributions/6995583/attachments/3285322/5873191/Detector Concepts Monthly June 2026.pdf

- Status of Appointment of convenors for subsystem subgroups:
  - Tracker & PID: **Valentina Cairo (CERN) & George Iakovidis (BNL)**
  - TDAQ: **Thorsten Wengler (CERN) & Zeynep Demiragli (BU)**
  - Calorimetry: **Marco Lucchini (Milano-Bicocca), Lucia Masetti (Mainz), Nicolas Morange (IJCLAB), Hwidong Yoo (Yonsei University)**
  - Muons: **Riccardo Farinelli (Bologna) & Taejeong Kim (Hanyang)**
  - Luminometry: need community building; Workshop at CERN July 27th https://indico.cern.ch/event/1690381/
  - Magnet: need community building (WS July 2-3)
- Upcoming events
  - FCC week, Helsinki, June 8-12 2026, https://indico.cern.ch/e/fccweek2026
    - The call for poster abstracts is open: https://indico.cern.ch/event/1552126/abstracts/ with a special track for "Detector Subsystems and Concepts". There will be a prize for the best posters and there is an option for publication in a special edition of Springer Nature EPJ journal series; this is an opportunity to publish some recent results that didn't make it to the Feasibility Study Report.
  - DRD1 meeting on June 16 on Technologies and Applications of Gaseous Detectors at FCC
  - FCC Tracking/PID workshop: Week of November 16 @ CERN
- Next DetCon Meetings:
  - Tracking: monthly meetings on Thursdays, 16:00 - next one June 4th
  - Muons: monthly meetings on Wednesdays, 15:00 - next one: June 17th
  - TDAQ: biweekly meetings on Fridays, 15:30 - next one: June 5th
  - General Monthly:
    - Monday 6 July 2026, 16:00, https://indico.cern.ch/event/1681937/
    - Monday 31 August 2026, 16:00, https://indico.cern.ch/event/1691945/

FCC: Physics, Experiments and Detectors (PED)

https://indico.cern.ch/event/1664041/contributions/6995583/attachments/3285322/5873191/Detector Concepts Monthly June 2026.pdf

AGORA will be added to the FCC email lists and indico pages

How to get involved

Group name	Email	Signup	Indico
Calorimetry	FCC-PED-DetectorConcepts-Calorimetry@cern.ch	click	click
Luminometry	FCC-PED-DetectorConcepts-Luminometry@cern.ch	click	click
Magnet	FCC-PED-DetectorConcepts-Magnet@cern.ch	click	click
Muon	FCC-PED-DetectorConcepts-Muon@cern.ch	click	click
TDAQ	FCC-PED-DetectorConcepts-TDAQ@cern.ch	click	click
Tracker & PID	FCC-PED-DetectorConcepts-Tracker@cern.ch	click	click
ALFA	FCC-PED-DetectorConcepts-ALFA@cern.ch	click	click
ALLEGRO	FCC-PED-DetectorConcepts-ALLEGRO@cern.ch	click	click
CLD	FCC-PED-DetectorConcepts-CLD@cern.ch	click	click
IDEA	FCC-PED-DetectorConcepts-IDEA@cern.ch	click	click
ILD	FCC-PED-DetectorConcepts-ILD@cern.ch	click	click

- As a bonus, signing up to any of the above adds you to "FCC-PED-DetectorConcepts@cern.ch". For free! Not even a click!
- Indico categories have been created for Detector Subsystems and Concept Studies
- FCC-PED homepage with upcoming meetings
- Indico meeting calendar

Concept Studies

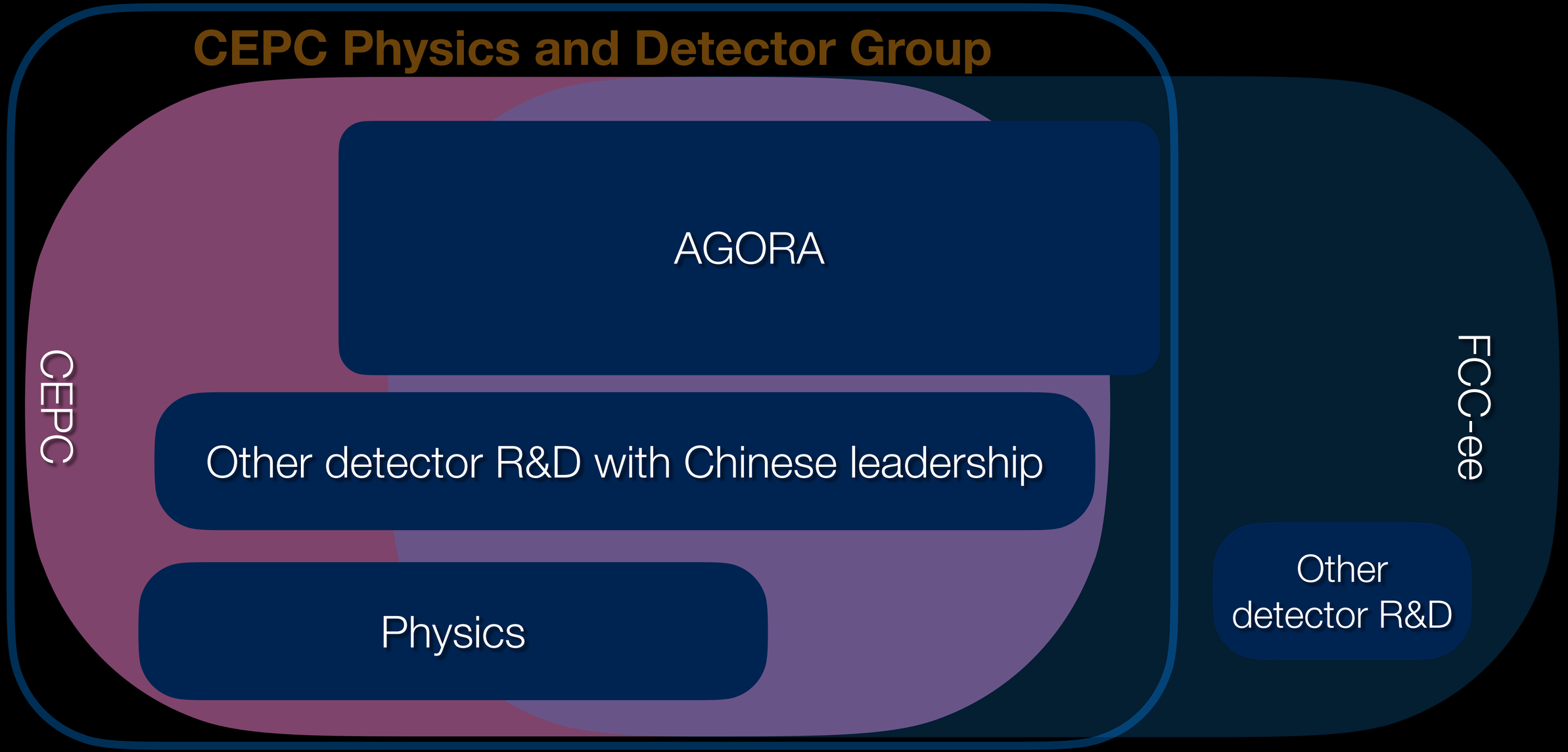
- ALFA
- ALLEGRO
- CLD
- IDEA
- ILD

Detector Subsystems

- Calorimetry
- Luminometry
- Magnet
- Muon
- TDAQ
- Tracker & PID

Sign-up for the corresponding lists!

CEPC Physics and Detector Organization



Common Aspects Across All Concepts

General-purpose design for the full FCC-ee physics programme (Z, WW, ZH, $t\bar{t}$)

- **Silicon vertex detectors:**
  - MAPS-based, 0.1–0.3% X_0 per layer, beam-pipe radius ≈10–13 mm
- **Superconducting solenoids:**
  - 2–3.5 T central field, all major subsystems within the coil
- **Highly granular calorimetry:**
  - Particle-flow or dual-readout techniques, jet energy resolution <4%
- **Muon identification:**
  - **E**mbedded in flux-return yoke, RPC or scintillator+SiPM readout
- **Software:** common Key4HEP framework (Geant4 + DD4hep + Gaudi + Marlin/LCIO)

Main Differences: Tracker & PID Technologies

Concept	Primary Tracker	PID Technique	Material Budget
AGORA	TPC (pixelated readout) + Si envelope	dN/dx (2%) + ToF (50 ps)	~1.5% X_0
IDEA	Drift chamber (112 layers, He/ iC_4H_{10})	Cluster counting (primary ionization)	1.6% X_0 (90°)
ILD	TPC + Si tracker	dE/dx → migrating to dN/dx	~2% X_0
CLD	All-silicon (pixel + strip)	None (ARC RICH under study)	~2.5% X_0
ALLEGRO	IDEA-like / straw tube / drift + Si wrap	dE/dx + timing	TBD
ALFA	All-MAPS (no gaseous detector)	ARC (Array of RICH Cells)	0.31% X_0/layer

Main Differences: Calorimetry

Concept	ECAL Technology	HCAL Technology	BMR
AGORA	BGO crystal bars (orthogonal, 24 X_0)	Glass scintillator + steel (6 λ_i)	3.87%
IDEA	Dual-readout crystal (PWO/ BGO+BSO + filters)	Dual-readout fibre (bucatini style)	~3–4%
ILD	Si/W high-granularity (30 layers, 5×5 mm^2)	Scint-steel (AHCAL) or RPC (SDHCAL)	~3.5%
CLD	Si/W high-granularity (40 layers)	Scint-steel (SiPM-on-tile)	~3.5%
ALLEGRO	Noble-liquid (LAr/LKr + Pb/steel absorbers)	TileCal-style (scintillator tiles + steel)	TBD
ALFA	GRAiNITA ($ZnWO_4$ grains in transparent resin)	Dual-readout in iron	Under eval.

Some Key Parameters Comparison

Concept	B-Field	Design Maturity	Cost Estimate	Collaboration Size
AGORA	**3 T (2 T at Z)**	**TDR complete (Oct 2025, 700+ pp)**	**333.3 MCHF (+3% install)**	**1500+ authors, 385 institutes**
IDEA	2 T (3 T studied)	Conceptual (2–3 yr to TDR)	Not available	170 authors, 47 institutes
ILD	3.5 T (2 T at Z)	Conceptual (3–4 yr, from ILC)	~390 MUSD (2012, not upd.)	~275 members, 59 institutes
CLD	2 T (3 T studied)	Conceptual (from CLICdet)	Not available	Not specified
ALLEGRO	2 T	Early conceptual (EoI submitted 2025)	Not available	170 authors, 47 institutes
ALFA	3 T	<1 year (design forming)	Not available	Starting up

AGORA: Biggest Challenges

Technical Challenges

- **CEPC → FCC-ee pivot**: MDI, final focus, background simulations must be re-optimised for FCC-ee conditions
- **Glass scintillator HCAL**: light yield only ~1500 ph/MeV (vs BGO 7500), attenuation length ~6 cm, slow decay (500 ns)
- **BGO ECAL scale-up**: 24 m^3 of crystals, 571k channels — mass production, quality control, SiPM cooling
- **TPC at Z pole**: ion back-flow from space charge; needs double-mesh Micromegas or graphene-coated cathode
- **Software migration**: CEPCSW (Gaudi) → full FCC Key4HEP; adapt digitisation and background mixing

Project & Collaboration Challenges

- **Designed for CEPC, not FCC-ee** — the largest conceptual challenge
- Different MDI interface, beam parameters, civil engineering constraints
- Electronics clock, bunch crossing rate
- Re-baselining requires some effort
- Must pivot physics goals from CEPC to FCC-ee

IDEA & ILD: Biggest Challenges

IDEA

- **Cluster counting PID at scale**: full-length prototype not built; fast FPGA peak-finding still in development
- **Dual-readout crystal ECAL**: scintillation + Cherenkov separation with optical filters — still R&D
- **Drift chamber ageing**: He/iC_4H_{10} at high rate; long drift time (~350 ns) → pile-up at high luminosity
- No cost estimate; MDI mock-up under construction at Frascati

ILD

- **Linear → circular adaptation**: designed for ILC pulsed mode (199 ms gap); must handle 23 ns bunch spacing at Z pole — 100× power dissipation increase
- **TPC space charge**: ion back-flow and field distortions in continuous mode; dN/dx software not yet available
- **Lower B-field at Z pole (2 T)**: degrades momentum resolution; needs systematic performance re-evaluation
- Forward coverage reduced by deeper final-focus intrusion vs ILC

CLD & ALLEGRO: Biggest Challenges

CLD

- **All-silicon tracker**: multiple scattering degrades low-momentum resolution vs gaseous trackers
- **ECAL cost**: 40 layers Si/W likely too expensive; studying 20–30 layers with thicker absorbers
- **Continuous cooling**: no power-pulsing possible; active cooling without adding excessive material
- No intrinsic PID; ARC addition would modify tracker length and introduce cracks

ALLEGRO

- **Noble-liquid ECAL**: cold front-end electronics, low-mass cryostat (carbon fibre), crosstalk <1%, large electrodes (1×0.6 m)
- **Bunch spacing sensitivity**: calorimeter prefers 50 ns over 5 ns; simulation of both patterns needed
- **Particle-flow software**: endcap clustering not functional; PandoraPFA + ML-PFlow under development
- No formal collaboration yet; solenoid between ECAL and HCAL (shared cryostat)

ALFA: Biggest Challenges

- **Very young project (<1 year)** — design not consolidated, community building just starting
- **All-MAPS outer tracker:** stave mechanics (foam, Opteon™ SF10 cooling), serial powering, Al interconnects, Si photonics readout — all unproven at scale
- **ARC (RICH) for PID:** first design of mechanics and electronics; SiPM cooling; integration with tracker
- **GRAiNITA ECAL:** scaling to 200 tonnes of $ZnWO_4$ crystals; replacing heavy liquid with transparent resin; full-size demonstrator (17×17×40 cm^3) needed
- **Hadron energy measurement:** improvement via pulse-shape analysis and longitudinal segmentation
- Luminometer not finalised (MAPS vs Si strips); endcap tracker geometry moving from stave to 'Dee'
- Many details unsorted

AGORA: Major Advantages

Strengths that set AGORA apart from competing concepts

- **TDR completeness** — only detector with a full Technical Design Report, engineering details, and full cost estimate (333.3 MCHF)
- **Advanced TPC with cluster counting (dN/dx)**: K/π separation >3σ up to 20 GeV/c; resolution ~2% (vs traditional dE/dx at 4–5%)
  - Combined with OTK ToF (50 ps) → PID coverage from 0.5 to 20 GeV/c
- **Crystal ECAL performance**: EM resolution $1.14\%/\sqrt{E} \oplus 0.44\%$; BMR = 3.87%; Higgs mass precision 4 MeV
  - Competitive Higgs physics reach demonstrated via full simulation

Other Concepts: Key Advantages

IDEA

- **Superior PID in principle:** cluster counting is Poisson-limited — factor ~2 improvement over dE/dx
- **Ultra-low material tracker:** only 1.6% X_0 (90°) — excellent low-p tracking
- **Dual-readout calorimetry:** best EM + hadronic combination available (~30%/√E)
- **Most active test-beam programme:** 6–7 beams/year; combined ECAL+HCAL tests scheduled June 2026
- **Experienced team:** builds on KLOE and MEG2 drift chamber heritage

ILD

- **Particle-flow leadership:** PandoraPFA with 15 years of full simulation and reconstruction development
- **Large community:** ~275 scientists from 59 institutes; deep sub-detector experience
- **Proven TPC performance:** extensive test-beam validation; dN/dx can improve PID by 30–40%
- **Flexible hadronic calorimetry:** accepts both AHCAL and SDHCAL options

CLD, ALLEGRO & ALFA: Key Advantages

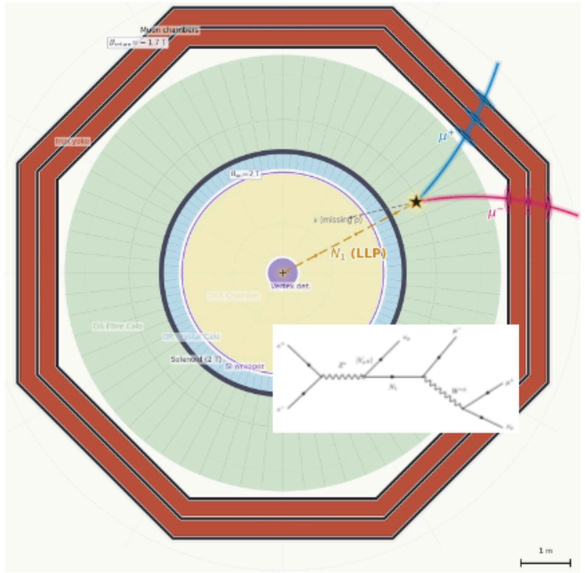
Distinctive strengths of the three concepts outside the first tier

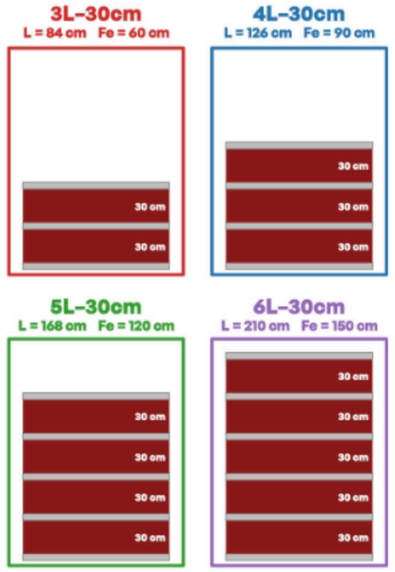
- **CLD:** all-silicon tracker — radiation-hard, excellent forward coverage, no gas system complexity; mature Key4HEP reconstruction; rapid adaptation from CLICdet (over-designed for FCC-ee backgrounds)
- **ALLEGRO:** noble-liquid ECAL — stable, linear, uniform (ATLAS LAr heritage); open design allows innovation across all sub-detectors; modular integration accepts various tracker/PID/HCAL options
- **ALFA:** clean-slate design optimised purely for performance and cost; all-MAPS tracker — 0.31% X_0/layer target, ~5 µm spatial resolution; GRAiNITA ECAL — cost-effective (<2% stochastic, <1% constant from prototype); ARC RICH PID — compact (20 cm radial, 10% X_0) with dual radiators

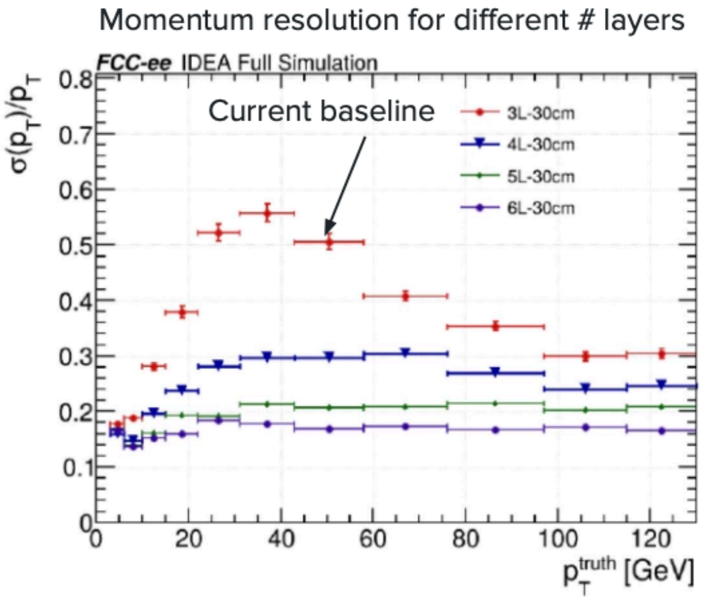
Muon System Optimization for Displaced Signature

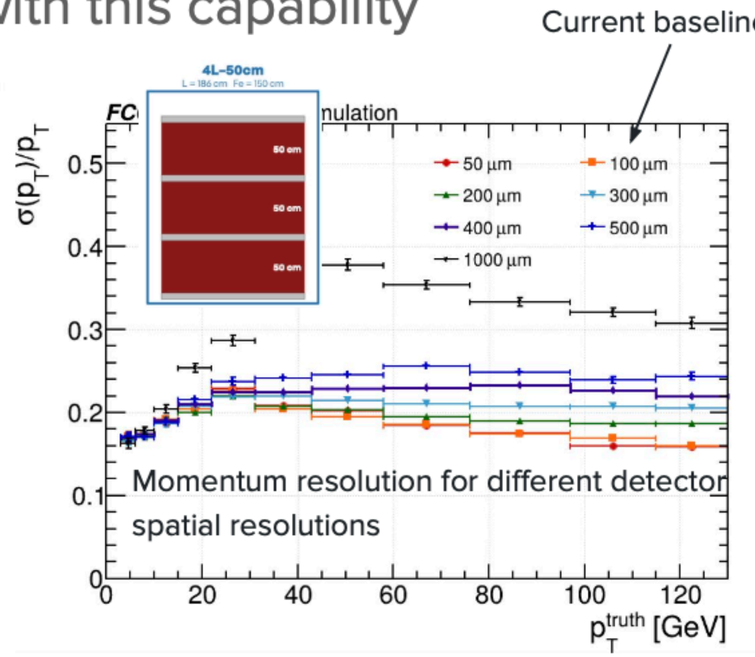
Physics studies, Detectors, Physics software and computing · Brieuc Francois (CERN)

- Thorough detector **optimization** for **standalone muon** reconstruction based on **IDEA Full Sim**
  - **HNL's as a benchmark**, valid for any displaced charged signatures
- Varies number of muon layers, spatial resolution, yoke thickness, lever arm and B field
- Highlights: **3 layers (baseline) is not enough, lever arm is very important, spatial resolution can be relaxed (multiple scattering), return field should be kept high (~ 1.5 T)**
- Side personal note: as of today **IDEA** is the **only concept with standalone muon** capabilities
  → if we want muon standalone, **we'd better have two concepts** with this capability





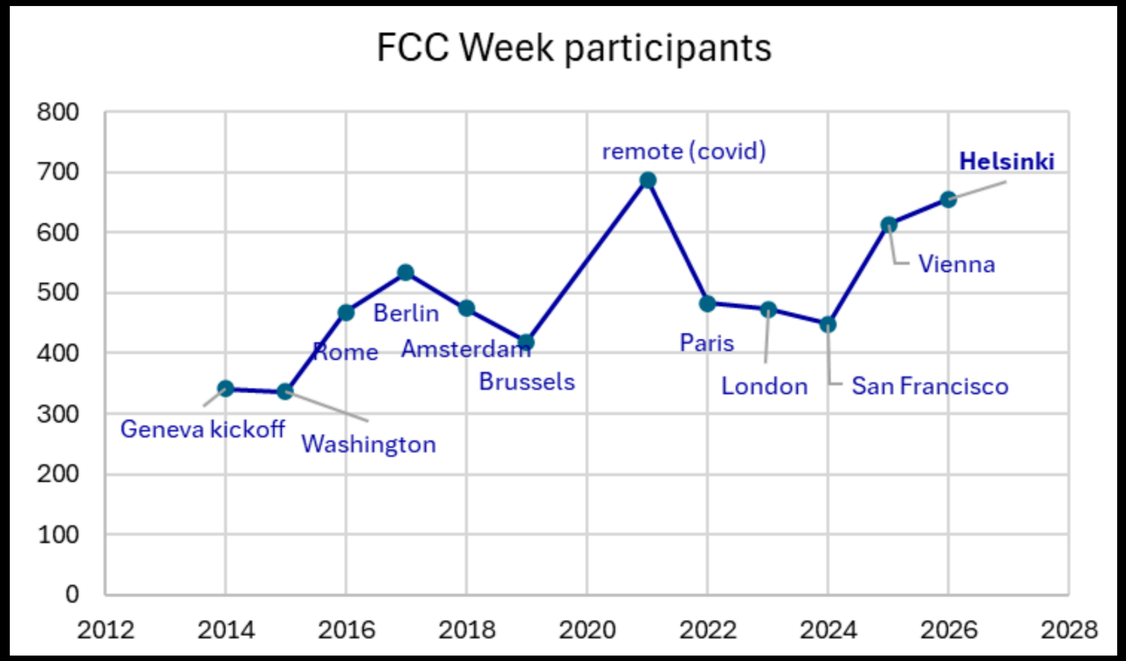


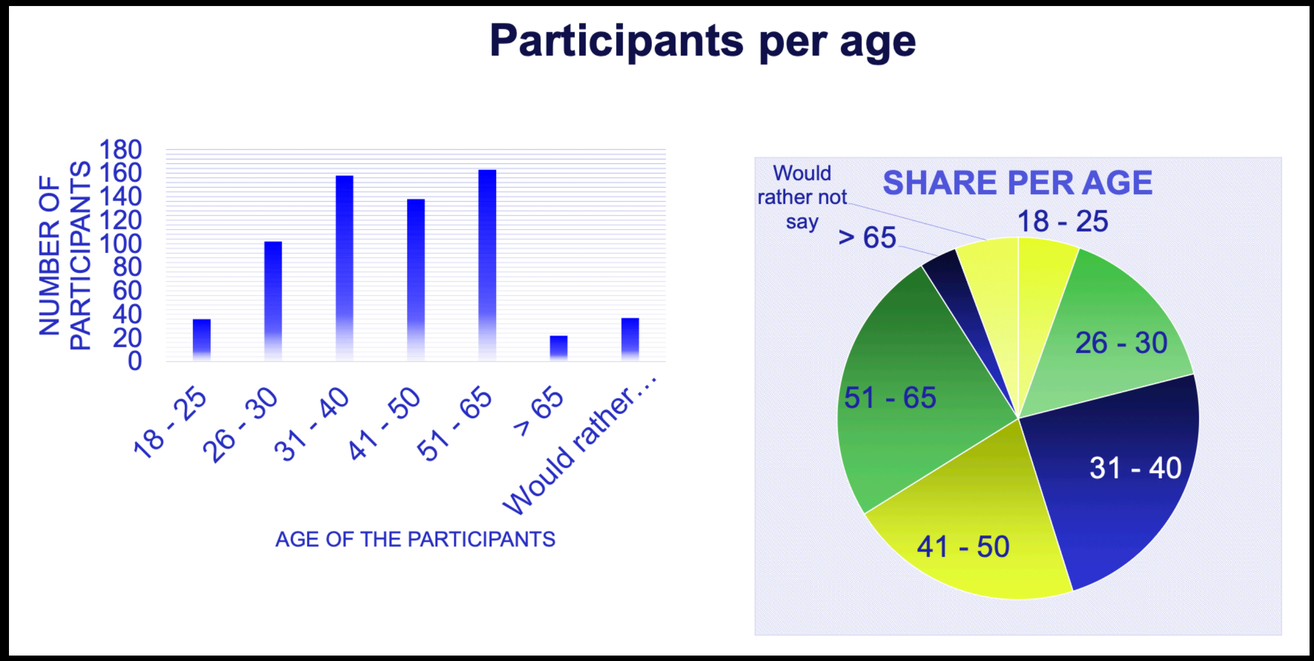


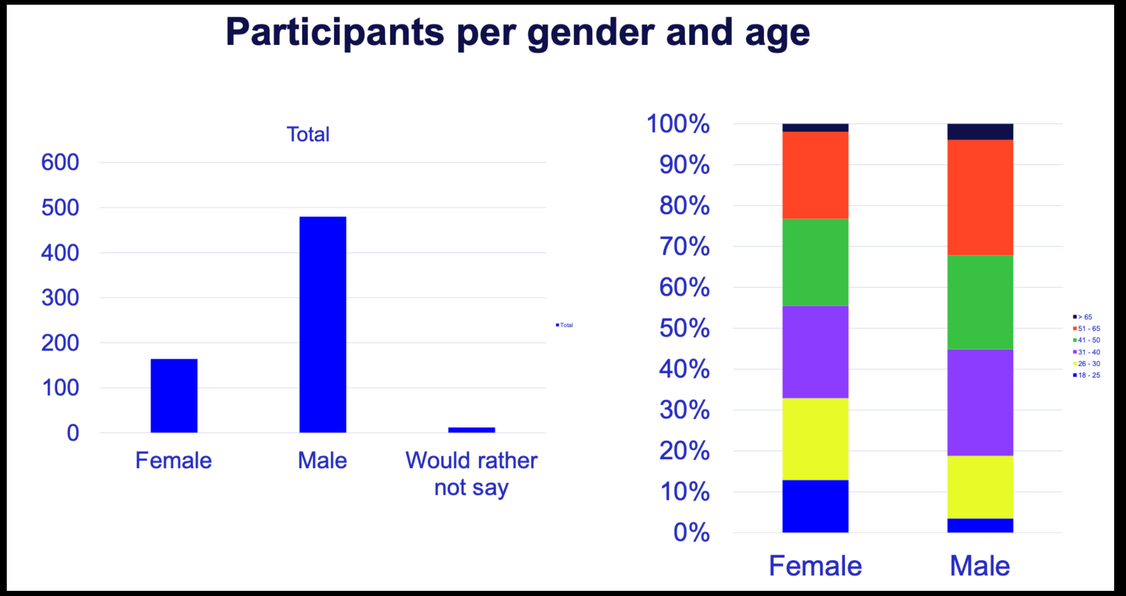
Ranking by Scientific Reach & Expected Performance (from AI)

Rank	Concept	Maturity	PID	Calorimetry	Scientific Reach
1	**AGORA**	**✓ TDR (highest)**	**Excellent (dN/dx + ToF)**	**BMR 3.87%**	**Excellent**
2	**IDEA**	**Conceptual**	**Superior (cluster counting)***	**Very good (dual-readout)**	**Excellent***
3	ILD	Conceptual	Very good (dE/dx → dN/dx)	Very good (PFA)	Very good
4	CLD	Conceptual	None (under study)	Good (PFA)	Good
5	ALLEGRO	Early conceptual	Minimal	Good (PFA)	Good
6	ALFA	Very early	Good (ARC RICH)	Under evaluation	Unknown

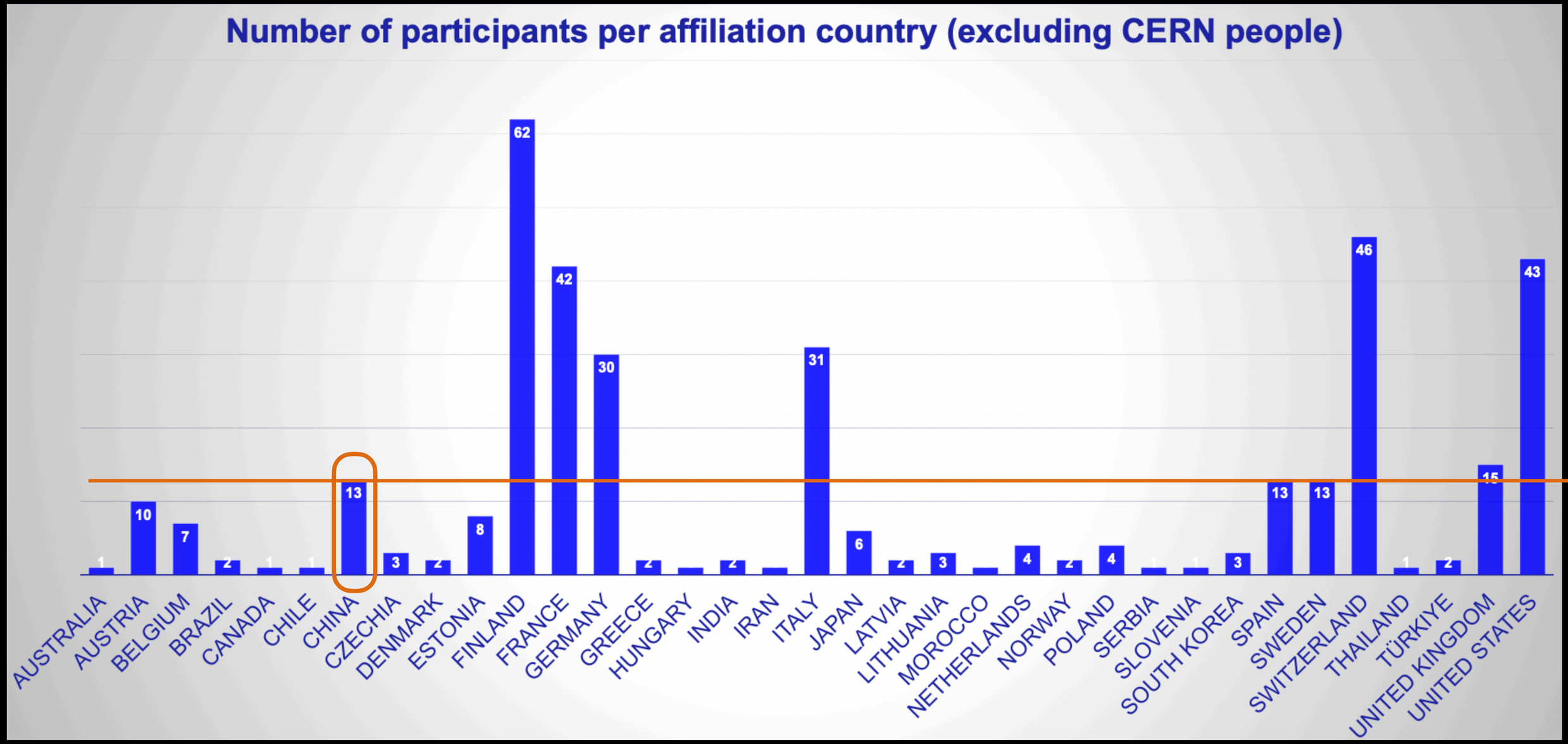
FCC Week Participation







FCC Week Participation



Final remarks

AGORA: Advanced Glass Optimized Research Apparatus

Proposed at FCC-ee Week and will be incorporated into the project

Focus will be into consolidating the designs, integrating within FCC framework

Need to join FCC-ee email lists

Create further conditions for international cooperation

Accelerator Design & Technical Infrastructure Progress

Collider Optics & Infrastructure

- **New LCC collider optics (P. Raimondi)**: endorsed by external review Jan 2026 — 10% reduction in SR power (45 MW), larger dynamic aperture, reduced sextupole circuits (cost/availability), modular insertions enable individual optics optimisation
- **Arc cell 3-D integration**: coherent mechanical model complete — basis for detailed design and precise cost estimates. Lead shielding around SR absorbers, dipole busbars, vacuum chamber support all integrated.
- **Technical infrastructure**: updated 3D model of electrical substation (~2800 m2) based on real equipment sizes. Electrical distribution, cooling, ventilation, cryogenics, safety/access, transport/logistics all advancing.
- **Arc Half Cell Mock-up**: ~30m x 5.5m installed — all services mounted, machine lines being installed. Key input for optimising 80km arc sections (installation, integration, transport, robotics).

Injector Complex & Positron Source

- **Injector complex design**: finalisation of damping ring and polarisation schemes underway. Placement, civil engineering, surface integration, infrastructure needs being defined.
- **P3 positron production experiment @ PSI**: demonstrator of e+ source and capture system using SwissFEL 6 GeV e-beam. Beamline commissioning completed, HTS solenoid for adiabatic capture installed, RF conditioning started, first e+ production in summer 2026.
- **Electron source test facility @ PSI**: proof of principle for top-up injection: charge modulation, 1-2 bunches, 0-5 nC at 100 Hz using SwissFEL photocathode RF gun. First e-beam: H2 2027.
- **Parameters from FS (baseline)**: Z: 6x10^12 events/4yr, WW: >10^8/2yr, ZH: >2x10^6 H/3yr, ttbar: 2x10^6 pairs/5yr — all at 4 IPs with 50 MW SR/beam.

Civil Engineering, Territorial Implementation & Global Collaboration

M. Benedikt & F. Zimmermann · FCC Week 2026 · Site, authorisation, and community status

Civil Engineering & Site Investigations

- **Site investigations SSI-1**: 27 drillings (1 land + 3 lake remaining), >80 km seismic surveys completed by end 2026. Tunnel expected to remain largely within molasse rock. Updated geological model Q1 2027 enables tunnel elevation/tilt adjustment.
- **Medium/longer-term planning**: excavation material disposal/ re-use plans, SSI-2 (~100 drillings, experiment sites) contract signed, injector complex designs advancing, TBM drive location strategy, construction contract procurement models.
- **Territorial implementation**: dedicated project pillar — bilateral/tripartite coordination with Host States, regulatory procedure sequencing, land/underground volume identification, cross-border environmental impact assessment framework.
- **Public participation**: France: CNDP-led public debate (2 Jun - 1 Oct 2026), Switzerland: strategic consultation framework (18 May - 2 Oct 2026). 20+ events: public meetings, workshops, site visits, exploratory walks. Prior to any project decision.

Global Collaboration & Physics Planning

- **FCC Global Collaboration**: 187 institutes from 40 countries + CERN. Plan for in-kind contributions, new MoU & Addendum for Technical Design Phase in preparation.
- **Physics/Experiments goals**: consolidate IR layout & detector integration, beam-background mitigation, optimised sqrt(s) calibration & monochromatic 125 GeV operation, common software/computing architecture, systematic uncertainty studies for EW precision, theory community engagement.
- **Expression of Interest**: call for at least 4 documented EoIs for FCC-ee experiments by end 2028.
- **FCC Organisation for RDP**: new project governance structure with Project Execution and Project Governance pillars. Simplified master schedule 2026-2034 presented — construction start target 2032/33.
- **Bottom line**: overarching goal = enable informed Council decision on FCC-ee in 2028. All activities aligned with construction start by 2032/33, following HL-LHC operations.