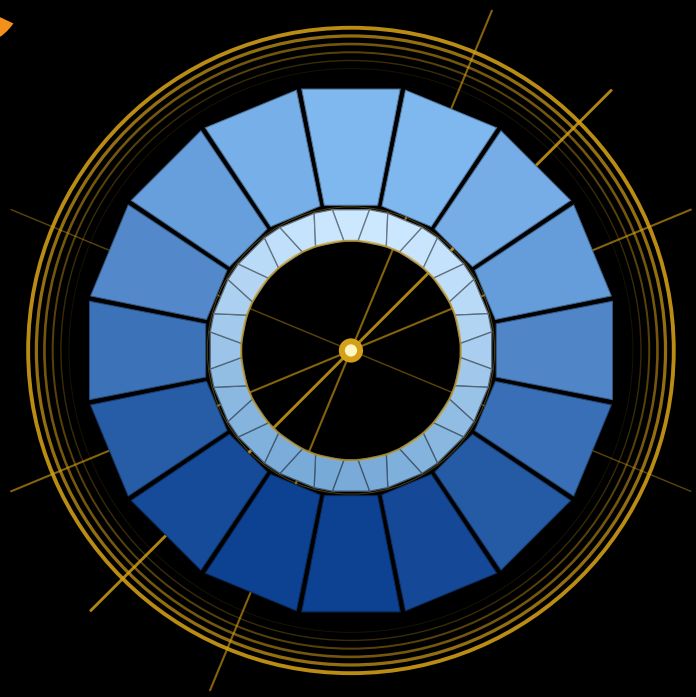
CEPC Day

AGORA at FCC-ee

Status and Integration Plan

Reference design phase. The next 12 months are decisive.



AGORA

IHEP, Beijing, 20 September 2026

FCC-ee — The Paradigm Shift

FEASIBILITY STUDY
Study what FCC-ee could achieve

→

REFERENCE DESIGN PHASE
Prepare a project that can be approved, implemented and exploited

CERN Council decision: expected **2028**
Reference Design Phase: **2026–2028**

- Goal: at least **4 documented detector EoIs by Q1/Q2 2028**
- AGORA is one of **6 detector concepts** (CLD, ILD, IDEA, ALLEGRO, ALFA, AGORA)
  - Need to prepare **AGORA** EOI ahead of time to be ready **Q1 2028**

Timeline

2026–2028	After approval	~2030	Mid-2040s
Concept studies and R&D	Documented detector EoIs	Open community process → four collaborations and LoIs	Experiments in operation

"CERN incubates and enables • ECFA catalyses • the community forms the collaborations. The composition of the collaborations and their detector choices are not prejudged."

ECFA coordinates the final choice of concepts

FCC Governance — PED Structure and AGORA's Place

PED is one of the **nine FCC pillars**. FCC Project Coordination: **M. Benedikt** (project leader), FCC Project Office

FCC PED Coordination: **C. Grojean, P. Janot, G. Wilkinson** · **6 Work Packages and 36 Working Groups**.

WP	Conveners	Relevant for AGORA
MDI	M. Boscolo, F. Palla	WG2 (Detectors/beam background), WG5 (Global integration), WG4 (Metrology), WG1 (IR Optics),
EPOL	J. Keintzel, E. Torrence, G. Wilkinson	Polarization, monochromatization
Physics Software & Computing	B. François, D. Lange	Core SW/Key4hep, geometry/simulation, MC production
Physics Studies	P. Azzi, J. de Blas, D. d'Enterria, M. McCullough, M. Selvaggi	Higgs, EW, BSM, Flavour, Precision
Detector Concepts	M. Dam, M.-A. Pleier	**AGORA**, ALFA, ALLEGRO, CLD, IDEA, ILD
ECOI	C. Adam	Education, Communication, Outreach

KEY POINT
AGORA is formally listed under **Detector Concepts**. It should be represented in **MDI, EPOL, PSC and Physics Studies** to be fully integrated.

How FCC Will Be Approved — The ECFA-Led Process

The LHC model as precedent

Phase	LHC (1984–1997)	FCC (2026–2030s)
Feasibility studies	Lausanne 1984; CERN prioritisation 1991	Feasibility Study Report 2025
Evian workshop	1991–1992: initial concepts; EoIs	ECFA-led "Evian-like" workshops
Community mergers	EAGLE + ASCOT = ATLAS; ALICE, LHCb formed	Open community process ~2028–2030
Approval process	Proto-collaborations → TPs → LHCC → Council	Four collaborations and LoIs ~2030

How to converge into 4 collaborations:

COMPARE
Physics performance and engineering credibility

TEST
Compatibility with collider constraints

CONNECT
Ideas, institutes, expertise and resources

CONVERGE
Complementarity, common solutions and mergers where useful

ECFA's role as catalyst / CERN's intended role

- **CERN coordinates** — without centralising; **enables convergence** — without imposing it; **preserves diversity** — and the long-term FCC potential.

IMPLICATION FOR AGORA
The Evian-like process is where AGORA will be evaluated against other concepts. We must be visible and ready to demonstrate **physics performance**, **engineering credibility** and **MDI compatibility**.

FCC-hh Cavern-Size Validation

CSEF = Comité Suisse d'Évaluation du FCC — the Swiss FCC Evaluation Committee
(meeting on 4 September 2026 at CERN)

FCC-CSEF Recommendation: validate the planned size of the two large experimental caverns against the range of FCC-hh detector requirements **to avoid costly retrofits**.

- Two **large caverns** dimensioned against reference FCC-hh detectors.
- Two **small caverns** dimensioned against specialised FCC experiments (LHCb/ALICE-like).
- Civil-engineering validation during FCC-ee RDP must **preserve this envelope**.

+60–70 cm
AGORA 2 T contingency
radial increase → increased cost

NOW
Must be validated against
the cavern envelope

IMMINENT
Discussion of cavern size
increase to present to FCC project office

IMPLICATION FOR AGORA
If AGORA's 2 T contingency requires a **radial increase**, this must be validated against the cavern envelope **now.**
Need to report back our feedback

e+e- detectors should not be the drivers of the caverns size unless they are assigned the smaller caverns

FCC Project News and Context (September 2026)

LCF380 / LEP3 - raised again

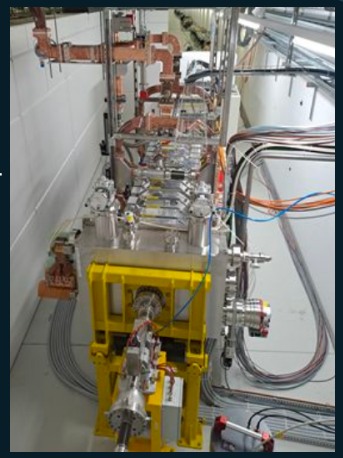
- Internal distraction consuming CERN/ATS staff time.
- DG clarification (16 Sep 2026): limited to **250 GeV**, not a new design study.
- "A substantial number of CERN/ATS staff stop working for FCC in the middle of the day … because they have to work on LEP3."

Swiss Engagement (CSEF)

- Swiss institutes want to intensify PED participation: **EPOL, Detector R&D, MDI, Theory**.
- HPC centre in **Ticino** available for ML training.

Positron Source (PSI SwissFEL)

- **First positrons seen late July 2026.**
- Positrons from e- impinging on Tungsten target



French Public Debate

- 15 cahiers d'acteurs, 3 contributions d'expertise.
  - Some positive some negative
  - One from, "Scientifiques en Rébellion" calling for canceling FCC-ee
- Christophe and Patrick submitted a positive contribution (16 Sept). Deadline: **1 October**.

First PED Coordination meeting (September 17) that i have attended

Next PED Coordination: 15 October 2026 (monthly)

FCC Detector Concepts — Status and Opportunities

- **Detector Concept coordination:**
  - two additional co-conveners being selected
  - nominations have occurred. Not easy to have representation.
- **Systems Engineering & Integration:**
  - Meetings ongoing; access for FCC-PED members under discussion. AGORA MDI team must attend.
- **Active discussion on 3 T → 2 T:**
  - from MDI coordinators (Fabrizio & Manuela)
- **Luminometry:**
  - Community building; workshop on July 27–28
  - AGORA was represented by Suen (online)

- **Detector concept study groups:**
  - Next plenary meeting on **5 October**.

Upcoming workshops

FCC Reconstruction Workshop
26–29 October, CERN

FCC Tracking/PID Workshop
16–20 November, CERN

CERN Courier: Detector Concepts contributions being discussed

ACTION FOR AGORA

- AGORA members should attend Detector Concept plenary meetings (5 Oct).
- Submit contributions to the Reconstruction Workshop (26–29 Oct) and the Tracking/PID Workshop (16–20 Nov).
- Volunteer for Detector Concepts working-group roles → need to attend meetings

AGORA Integration — Major Challenges

Software integration

- CEPC and FCC software need to be maintained in parallel. There are some differences between the two versions of AGORA: AGORA-CEPC and AGORA-FCC
- CEPCSW and FCCSW share the Key4hep foundation, but AGORA's custom algorithms (**e.g. crystal-bar ECAL reconstruction, CyberPFA**) are **not yet in FCCSW**.
- Without software integration, AGORA cannot produce FCC-ee simulation samples.
- **Likely a hard prerequisite for the EoI in early 2028**

MDI integration

- FCC MDI and CEPC MDI are different
  - Need to maintain studies and detectors compatible with both
- FCC likely to recommend **2 T** as working hypothesis.
  - At 2 T with optimised semi-local compensation, emittance contribution reduced to **~0.6 pm** — within the 0.5 pm budget.
  - At **3 T**, currently assessed as **unfeasible** without compromising Z-pole luminosity.
- Patrick Janot pushed back: "Keep 3 Tesla as the working hypothesis … if we face a wall, we'll face a wall."
- Conclusion: **3 T is still the current baseline, but 2 T is likely to be the end results**
- **Actually, not too different from what we had decided for the CEPC detector** (Z pole is 2 Tesla)

Hard constraints

AGORA-FCC needs to adapt FCC-MDI

- Screening solenoid cannot be closer than **1.55 m** from IP (100 mrad boundary).
- **Dipole corrector position** is the most critical parameter.
- Detector opening scenario still undecided.

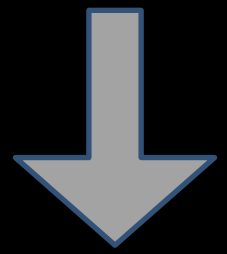
Polarization — FCC to start studies of full polarization

The electron Yukawa needs full polarized beams — and CEPC has the most advanced scheme.

WHY NOW?

- The electron Yukawa can only be probed in a dedicated run at 125 GeV.
- Monochromatization alone reaches only about 2.3 sigma.
- Longitudinal polarization yields ~4× significance gain

- FCC has now consider adopting polarized beams.
- Positron polarization is the remaining challenge.



SUGGESTION:

- CEPC's full longitudinal scheme is the most advanced for a circular collider.
- Duan Zhe joins FCC EPOL meetings regularly
- Participate in the workshop and at FCC Week 2027.

Target:

- Dedicated **1–1.5 day workshop** being organised (mid-Oct to mid-Nov) → we should participate in this
- Report to FCC management at the Spring 2027 plenary

MDI — Crossing Angle and Stay-Clear Boundary

Parameter	FCC-ee	CEPC	Source
Full crossing angle	30 mrad	33 mrad	FCC CDR / CEPC TDR
Half crossing angle	15 mrad	16.5 mrad	—
Boundary / stay-clear angle	**100 mrad**	**8.1° ≈ 141 mrad**	CEPC TDR, detector requirement
Radial space at s = 1.5 m	150 mm	**212 mm**	$R \approx s \cdot \tan\theta$
Radial space at s = 2.0 m	200 mm	**283 mm**	—
Ratio	1.00	**1.41**	—

CEPC MDI accelerator components closer to the IP:

+41%
more radial space at any given distance from the IP

141 vs 100 mrad
stay-clear cone (CEPC vs FCC-ee)

1.41
radial-space ratio (CEPC / FCC-ee)

KEY Point

The cryostat, anti-solenoid and correctors must fit inside this cone. CEPC's larger cone allows a more compact MDI.

FCC's tighter cone forces the cryostat to start further from the IP, but in a smaller cone

MDI — Longitudinal Layout

Parameter	FCC-ee	CEPC
L*	2.2 m	1.9 m
MDI region extent	~20 m	±7 m
Screening solenoid/anti-solenoid start	≥ 1.55 m (at 100 mrad)	~1.13 m
Cryostat start	~1.4 m from IP	~1.05 m from IP
Beam pipe separation	Remote vacuum connection, two independent beam pipes	Double-ring, shared interaction region

~350 mm
CEPC's cryostat can start closer to the IP

±7 m vs ~20 m
MDI region: CEPC vs FCC-ee

KEY Point:
For AGORA at FCC: the detector must be designed around a **larger cryostat envelope** that starts further from the IP. This is a fundamental geometric constraint — **it cannot be overcome by detector optimisation alone.**

MDI — Emittance Budgets

FCC-ee vertical emittance budget: $\varepsilon_y \leq$ **0.5 pm** (solenoid-induced contribution).

FCC results (Boscolo & Palla, 17 Sept 2026)

Configuration	ε_y (pm)	Status
2 T (unoptimised)	1.78	3.5× over budget
2 T (optimised)	**0.6**	**Within budget**
2.5 T (optimised)	1.6	3× over budget
3 T (optimised)	4.0	8× over budget

CEPC results (CEPC TDR)

Energy	ε_y (pm)	Coupling	Source
Higgs (3 T)	0.14	0.01%	CEPC TDR
W (3 T)	0.47	0.09%	CEPC TDR
Z (3 T)	**2.9**	1.7%	CEPC TDR
Z (2 T)	**0.2**	0.12%	CEPC TDR

0.5 pm

FCC budget — met only by the optimised 2 T configuration

CRITICAL OBSERVATION

CEPC has already implemented the dual-field strategy that FCC is now being forced into.

For AGORA: 2 T Z-pole operation is **not a fallback at CEPC — it is the baseline design**.
AGORA's tracking system has been optimised for dual-field operation, in principle giving it an advantage over concepts designed for a single field strength → but still need to investigate effect at Higgs energies and ttbar

Likely that FCC will come to the same conclusion as we did

MDI Coherence — Same Team, Two Projects

The problem — CEPC MDI team (**Haoyu Shi, Sha Bai, Ivanka Bozovic**) must now engage with FCC-ee MDI.
Same team, two projects. Risk of divergence.

FCC MDI design is evolving independently

FCC MDI active work items

- Optics baseline: LCC vs GHC.
- Small cavern dimensions (25 m → 30 m under discussion).
- Non-local compensation studies.
- IR magnet cryostat radial layout (SLAC/BNL cantilever cryostats).
- Cryostat front-end components and correctors.
- Beam pipe and SR masks.

Preliminary IR magnet and cryostat design: end 2026.
Consolidated design: mid-2027.

Existing framework: ECFA-DRD8 — DRD8 WP1 explicitly lists "Collaboration on Mechanics & Integration (FCC-ee, CEPC)".
IHEP is a participating institute. Natural home for CEPC–FCC MDI coherence, however FCC MDI meetings also exist

Suggest attendance of FCC activities

Role	Person
CEPC/AGORA MDI Detector	**Haoyu Shi**
CEPC MDI Accelerator	**Sha Bai**
Luminosity	**Ivanka Bozovic**

KEY MESSAGE
Our attendance at **FCC MDI meetings** is **not optional** — it is the mechanism by which CEPC protects its design and influences FCC decisions.

MDI — What This Means for AGORA

FCC MDI decision	AGORA consequence
2 T working hypothesis	Tracking radius **+400 mm**; HCAL depth **+220–330 mm**; total **+60–70 cm**
Screening solenoid ≥ 1.55 m	Larger cryostat envelope; different anti-solenoid layout
Dipole correctors ≥ 1.7 m	Corrector technology choice affects detector integration
30 mrad crossing angle	Detector acceptance and background levels differ from CEPC
MDI region ~20 m	Longer interaction region; detector redesign
Cavern size 25 m → 30 m	AGORA's larger size must be validated against the cavern envelope **NOW**

ACTION FOR AGORA

- Need to evaluate tracking performance for Higgs run at **both 2 T and 3 T.**
- Feed the AGORA size assessment into **FCC's cavern discussion immediately.**

Size Driver — Combined Radial Increase

- Driver 1 (tracking) pushes the **ECAL inner radius** outward by ~400 mm.
- Driver 2 (HCAL depth) increases the **HCAL thickness** by ~200 mm (to restore 6 λ_I)
- They are **additive in terms of total detector outer radius**.

Component	Baseline	With increases	Delta
ECAL inner radius	1830 mm	1830 + 400 = **2230 mm**	+400 mm
ECAL outer / HCAL inner	2140 mm	2230 + 310 = **2540 mm**	+400 mm
HCAL outer radius (6 λ_I)	3455 mm	2540 + 1515 = **4055 mm**	+600 mm
Solenoid + cryostat	~3600 mm	~4200–4300 mm	**+600 mm**

+600 mm
total radial increase

~4.2–4.3 m
new detector outer radius

Total increase is 600 mm for an HCAL with 6 interaction lengths

Proposed Integration Plan — Three Phases

PHASE 1
Technical Alignment
Now – Q1 2027

- Software integration prototype (one sub-detector in FCCSW).
- MDI compatibility study (joint AGORA–MDI working group).
- Cavern size assessment.
- Polarization leadership actions (Duan Zhe to EPOL).
- FCC Week 2027 preparation (sessions by 15 Oct; talks by 15 Nov).

PHASE 2
Collaborative R&D and Prototyping
Q1 2027 – Q1 2028

- Joint R&D via DRD collaborations (DRD3, DRD1, DRD6).
- Common simulation campaigns.
- Polarization R&D synergies.

PHASE 3
EoI Preparation and Formalisation
Q3 2027 – Q1 2028

- AGORA EoI for FCC-ee.

Immediate Actions and Deadlines

Date	Action	Owner
27 Sept 2026	Send SPC suggestions to Christophe	CEPC/AGORA leadership
1 Oct 2026	Converge on Organising Committee	Christophe
5 Oct 2026	DetCon plenary — attend	AGORA team
15 Oct 2026	FCC Week session proposals	CEPC/AGORA
26–29 Oct 2026	FCC Reconstruction Workshop — present AGORA software	Software team
15 Nov 2026	FCC Week talk proposals	CEPC/AGORA
16–20 Nov 2026	FCC Tracking/PID Workshop — present performance	AGORA tracking team
15 Dec 2026	Speaker invitations	Christophe
Mid-Oct – mid-Nov 2026	Polarization workshop — CEPC participation	Duan Zhe
Spring 2027	Report to FCC management on polarization	CEPC/EPOL
12–16 Apr 2027	FCC Week, Madrid	All

27 Sept
first deadline:
SPC suggestions

5 Oct
DetCon plenary —
confirm attendance

Critical immediate action:

Submit contributions to the Reconstruction Workshop (26–29 Oct) and the Tracking/PID Workshop (16–20 Nov).

Summary and Key Messages

1. **AGORA** — one of 6 detector concepts for FCC-ee.
2. **Challenges** — software integration, MDI constraints, newcomer status.
3. **Polarization** — CEPC leading R&D should made visible in FCC discussions → Duan Zhe to EPOL.
4. **MDI** — team must interact with FCC; attend FCC MDI meetings; use DRD8.
5. **Size sensitivity** — 3 T baseline, 2 T contingency with +60 cm radial increase.
6. **Software** — AGORA must coordinate directly with FCC computing and software (Key4hep/FCCSW). ILD is an example of another concept doing this now. Reconstruction Workshop (26–29 Oct)
7. **FCC Week 2027** — Miao He is part of SPC already. Can propose additional members and sessions.
8. **ECFA-led Evian-like process** — where AGORA will be evaluated. We must be visible.
9. **Cavern size validation** — must preserve the FCC-hh envelope. AGORA's 2 T contingency... any change?

Next 12 months are decisive. AGORA must be **visible, engaged, and proactive**.

The end