

# Update of the European Strategy for Particle Physics

GDR-InF contribution to the  
French HEP community submission

6 November 2024

# Strategy set up in 2018 (updated in 2020)

From <https://cds.cern.ch/record/2720129/files/CERN-ESU-013.pdf>

## Main strategy:

- Exploit HL-LHC (also LHCb Upgrade II),
- Future: e+e- Higgs factory is the highest-priority  
→ Launched FCC feasibility studies (2021-2025),
- In parallel, support for smaller experiments (EDM, CLFV, DM & axion,...).

## But also:

- Importance of adequate support for theory,
- Importance of adequate detector software and infrastructure R&D,
- Importance to minimise environmental impact.

# Strategy update: objectives and calendar

- **Gianotti:** CERN leading role [...] will NOT survive without a flagship project, strongly motivated by physics, following the LHC within a short time (<10 years). A first-stage future collider running in the mid 2040's is crucial [...].
- **Desired timeline:** recommendation by **next ESPP ~ 2026**, approval by CERN's Council by end of the decade, start of construction early- 2030's, start of operation mid 2040's. Realistic for FCC-ee and CLIC, difficult for FCC-hh (magnet technology, cost).
  - Call for individual contributions (10 pages), to be sent by **March 2025**.
  - National HEP communities encouraged to participate. For France, IN2P3 & Irfu take charge, and rely on the GDRs to prepare a 10 page contribution. **Contribution call deadline 25/10 → 18/11, meeting Jan 20-21, 2025.**

# Timeline for the update of the European Strategy for Particle Physics

Council appointment of the members of the PPG and decision on the venue for the **Open Symposium**

**Deadline** for the submission of main input from the community

**Open - Symposium**

**Deadline** for the submission of final national input in advance of the **ESG Strategy Drafting Session**

Submission of the draft strategy document to the Council

End September 2024

31 March 2025

23-27 June 2025

14 November 2025

End January 2026



**December 2024**

Council decision on the venue for the **ESG Strategy Drafting Session**

**26 May 2025**

**Deadline** for the submission of additional national input in advance of the **Open Symposium**

**End September 2025**

Submission of the "Briefing Book" to the ESG

**1-5 December 2025**

**ESG Strategy Drafting Session**

**March and June 2026**

Discussion of the draft strategy document by the Council and **updating of the Strategy**

# Mandate for the strategy update

- The aim of the Strategy update should be to develop a **visionary and concrete plan** that greatly advances human knowledge in fundamental physics through the realisation of the next flagship project at CERN. This plan should attract and value international collaboration and should **allow Europe to continue to play a leading role in the field.**
- The Strategy update should include the **preferred option for the next collider at CERN** and **prioritised alternative options** to be pursued if the chosen preferred plan turns out not to be feasible or competitive.
- The Strategy update should also indicate **areas of priority for exploration complementary to colliders and for other experiments to be considered at CERN and at other laboratories** in Europe, as well as for participation in projects outside Europe.” It would thus be most useful if the national inputs explicitly included the preferred prioritisation for non-collider projects.

# Output “perspectives” French particle physics 2022

## The recommendations for the intensity frontier are:

1. Exploit the two large-scale facilities with a wide flavour physics program, LHCb and Belle-2, which will provide further insights into the nature of the current flavor anomalies. Support the theoretical effort required to fully exploit the data, e.g., lattice calculations for flavour factories. [[LHCb](#), [Belle 2](#)]
2. Pursue a long-term flavor physics program with possible upgrades of LHCb and/or Belle-2 experiments, and exploiting the opportunities provided by the FCC-ee running at the Z pole. The support of the theoretical effort in these endeavors is crucial. [[FCC-ee](#), [CEPC ?](#)]

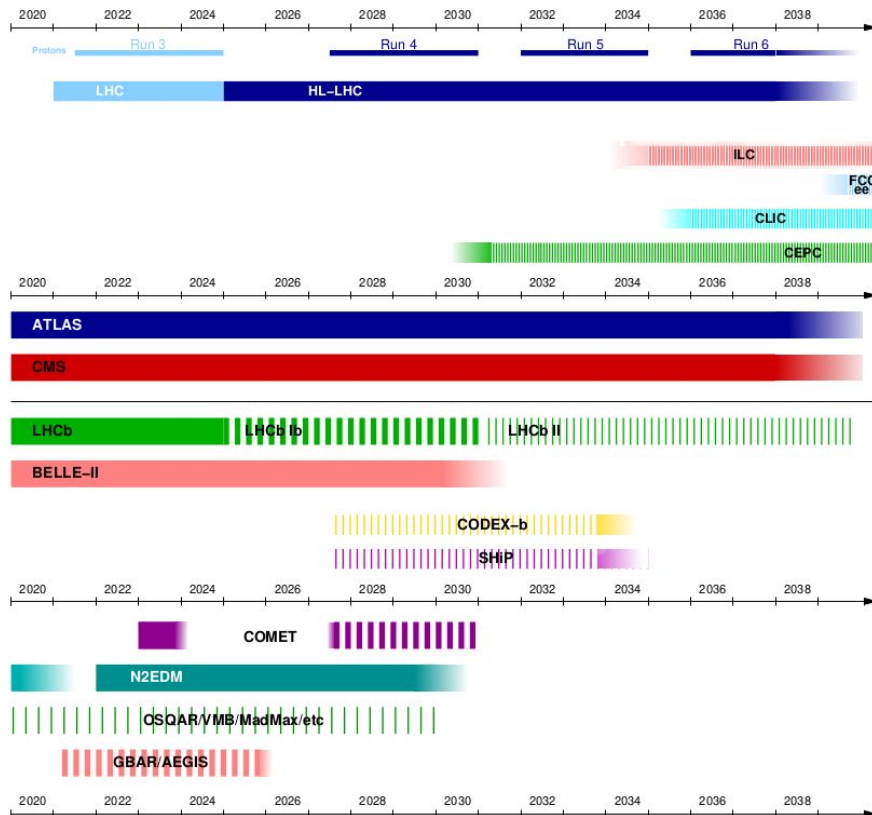
## For the dedicated experiments the group recommends to:

1. Support experiments dedicated to specific measurements of fundamental observables, in particular Electric Dipole Moments and Lepton Flavour Violation. [[n2EDM](#), [COMET](#), [g-2 ?](#), [PIONEER ?](#)]
2. In complementarity with dark matter and other exotic particle searches, support the experimental searches for new long-lived particles at colliders and in dedicated experiments. [[Ship](#), [Fasler](#), [Codex-b](#), [Mathusla](#),..., [OSQAR](#), [MADMAX](#), [GrAHa](#),...]

<https://box.in2p3.fr/index.php/s/MmXJ83BxGP6NH9g>

# Output “perspectives” French particle physics 2022

Project	Science Driver		SD1	SD2	SD3	SD4	SD5	SD6
	project scale	interest in FR						
			Higgs sector	Higgs imprint	direct searches	quark flavors and CP	charged lepton flavors	cosmology
<b>Energy frontier</b>								
ATLAS&CMS@LHC/HL-LHC	€€€	★★★	***	***	***	*	*	-
ILC	€€	★★	***	***	*	-	-	*
CLIC	€€	★★	***	***	***	-	-	*
FCCee	€€	★★	***	**	*	***	***	*
CEPC	€€	★★	***	**	*	***	***	*
High-energy pp	€€€	★★	***	***	***	**	**	-
<b>Intensity frontier</b>								
Belle-II	€	★	-	-	-	***	***	-
LHCb Ia	€€	★★	-	-	-	***	***	*
LHCb Ib	€	★★	-	-	-	***	***	*
LHCb II	€€	★★	*	-	-	***	***	*
<b>Dedicated experiments</b>								
n2EDM	€	★	-	-	-	***	-	-
COMET	€	★	-	-	-	-	***	-
OSQAR/VMB	<€	★	-	-	**	-	-	*
GBAR/AEGIS	<€	☆	-	-	-	-	-	**
CODEX-b	<€	★	-	-	**	-	-	*
SHIP	€	☆	-	-	**	-	-	*



# Questions for the flavor community

Starting from the set of questions proposed in

ECFA guidelines for inputs from national  
HEP communities to the European  
Strategy for Particle Physics

<https://ecfa.web.cern.ch/ecfa-guidelines-inputs-national-hep-communities-european-strategy-particle-physics-0>

Let us discuss what flavor physics could say...



# Question 1: Which Flagship?

- What should be the next flagship at CERN from a “flavor”-point of view ?

FCC-ee at the Z pole is a clear opportunity for flavour physics (best option among proposed Higgs factory). But if we think only at flavour physics, is it the best option? (wrt LEP3, high lumi at Y(5S), ...)

- What if
- i) Japan proceeds with the ILC in a timely way?
  - ii) China proceeds with the CEPC on the announced timescale?
  - iii) the US proceeds with a muon collider?

What if NP is found somewhere else? If it is very light, or very heavy, or “different”?

Same question if the first choice is not realistic, what would be the second best flagship?

## Question 2: Why?

- How to make a flavor physics case for the flagship choice:
  - I. Physics potential
  - II. Long-term perspective
  - III. Financial and human resources: requirements and effect on other projects
  - IV. Timing
  - V. Careers and training
  - VI. Sustainability

**For us:** What is to replace the anomalies, used throughout the last report & prospectives?

What measurements will still be interesting after LHCb Upgrade II and Belle II?

What about CKM studies?

Is this program relying on specific theory/lattice advances?

## Question 3: What else?

- What other areas should be pursued, and with what relative priority?

For us: Relative weight Flagship vs small/single-measurement experiments? Sustainability?

If any, which priority to give among smaller experiments?

Are there complementary experiments that are crucial for the flagship program?

French interest for long lived particles dedicated experiments?

What about B & L violation like proton decay,  $0\nu\beta\beta$ ?

Should we also refer to non-French experiments (MEG, g-2, DM and axions,...)?

- Should CERN participate in nuclear physics, astroparticle physics or other areas of science?

For us: Do we need something there, e.g., hadronic physics and matrix elements?

# Other aspects that should appear in our contribution?

- Importance of adequate support of theory
- Sustainability and environmental impact considerations
- Detector R&D specific to intensity frontier we should push
- Challenges from big data and heterogeneous computing environment
- ...