

La Strategia della Fisica delle Particelle: input INFN

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Sestri Levante
17-19 March 2025



European Strategy for Particle Physics

- The **European Strategy for Particle Physics** is a comprehensive framework **coordinated by CERN Council** to set the **priorities and future directions for particle physics research in Europe**. It aims to guide scientific, technological, and financial decisions in particle physics, in Europe, but not only: it impacts on a global scale due to the international collaboration and to the impact of CERN/Europe on the fundamental research worldwide.
- This process, typically carried out every 7-8 years, is **based on an extensive consultations with the scientific community, stakeholders, and relevant institutions** to ensure that the strategy reflects the latest scientific and technological advancements and addresses emerging challenges.

The main ESPP bodies

- **CERN Council**: Final decision-making authority, approving the strategy.
- **European Strategy Group (ESG)**: Oversees the entire strategy process, **prepares recommendations**. The **ESG** is the central coordinating body responsible for overseeing the development of the European Strategy for Particle Physics
- **Physics Preparatory Group (PPG)**: Evaluates scientific and technical input, advises the ESG. The **PPG** is an advisory group of experts that provides detailed scientific and technical evaluations of the proposals and input received from the particle physics community, A “**Briefing Book**” based on the input and discussions will then be prepared by the PPG. The Briefing Book is submitted to the ESG.
- **Strategy Secretariat** Oversees the ESPPU process and assists the PPG
 - Also:
 - **ECFA**: Advises on accelerator-based projects and future facilities
 - **SPC**: Provides scientific guidance, assessing the feasibility and impact of proposed projects
 - **National Labs & Institutions**: Provide scientific input and resources
 - **Funding Agencies & Governments**: Evaluate financial feasibility and support the strategy
 - **International Partners**: Coordinate global collaborations and shared projects

European Strategy for Particle Physics

Steps in the Update Process

ESPP Update
2024-2026

1. Mandate by the CERN Council:

- The update process begins when the CERN Council issues a **mandate to review and update the current strategy**. This mandate outlines the scope, goals, and timeline for the update. ✓

2. Community Involvement and Call for Input:

- A **public call for input is issued**, inviting contributions from the global particle physics community, including researchers, institutions, and national funding agencies. This step ensures that a wide range of perspectives and ideas are considered. ✓

3. Establishment of the Physics Preparatory Group (PPG):

- A **Physics Preparatory Group (PPG)** is formed, consisting of experts from the field. This group is responsible for collecting input, organizing discussions, and preparing a draft of the updated strategy. The PPG typically includes representatives from CERN, member states, and prominent physicists. ✓

4. Open Symposium:

- An **Open Symposium is held**, gathering scientists and stakeholders to discuss the input received and the key scientific questions that the updated strategy should address. This symposium serves as a platform for debate on the future direction of the field, including potential projects, experiments, and technologies.

Lido di Venezia
23-27 June 2025

5. Drafting the Strategy Update:

1. Based on the discussions and input, the **PPG drafts the updated strategy**. This draft, **the Briefing Book**, outlines the recommended scientific priorities, technological developments, and necessary investments for the coming years.

Monte Verità in Ascona,
1-5 December 2025

6. Submit the European Strategy Update recommendations to the CERN Council:

- The **Briefing Book is reviewed by the European Strategy Group (ESG)**, which includes representatives from CERN, member states, and observer states. Additional feedback is sought to refine and adjust the recommendations. A final document based is issued by the ESG to the CERN Council

The update process and its timeline

2024: year of preparation, establishments of committees, choice of locations for the various meetings

2025: submission of scientific inputs, Open Symposium, drafting of the strategic document

2026 discussion at Council and Strategy update (in 2027/2028 Council decides...)

Timeline for the update of the European Strategy for Particle Physics



Strategy Secretariat:

organising and running the ESPP process

Strategy Secretary (K. Jakobs.)
Paris Sphicas (ECFA Chair)
Hugh Montgomery (SPC Chair)
Dave Newbold (LDG Chair)

European Strategy

Group (ESG): Prepares the Strategy Document

Physics Preparatory Group

(PPG): collects input from the community, organises the Open Symposium, prepares the Briefing Book

Inputs from the community will be reviewed by **ESG**: careful and rigorous study of the documentation provided, i.e of the Briefing Book drafted by **PPG** with support of the **Strategy Secretariat**

Open Symposium 23-27 June 2025 - Lido di Venezia ! I do hope to see you there

ESPPU 2020 recommendations

Original version

❑ Fully exploit the **LHC potential** and lay the foundations of a new system of **future accelerators**

❑ feasibility study

❑ conceptual design

❑ infrastructure and costs for a new ring (~100 km) hosted at CERN .

- First stage FCC-ee.
- Second stage FCC-hh (same tunnel)
 - a scheme that CERN has already used with the sequential construction of LEP and LHC.

❑ R&D for New Accelerators

❑ **Muon Collider (MC)**, an innovative muon collider in the design phase characterized by great potential for both precision and discovery physics.

❑ **Plasma acceleration** (EuPraxia)

“An **electron-positron Higgs factory** is the highest-priority next collider. For the longer term, the European particle physics community has the **ambition to operate a proton-proton collider at the highest achievable energy.**”

“Europe, together with its international partners, should investigate the **technical and financial feasibility** of a future hadron collider **at CERN** with a centre-of-mass energy of at least 100 TeV and with an **electron-positron Higgs and electroweak factory as a possible first stage.**”

“Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.”

“ The European particle physics community must intensify accelerator R&D and sustain it with adequate resources.”

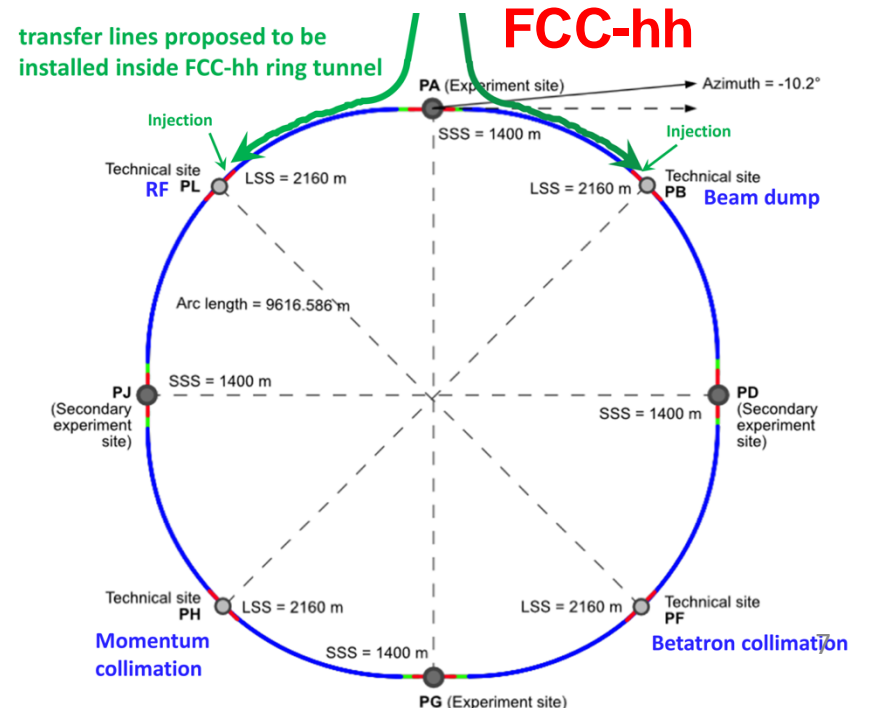
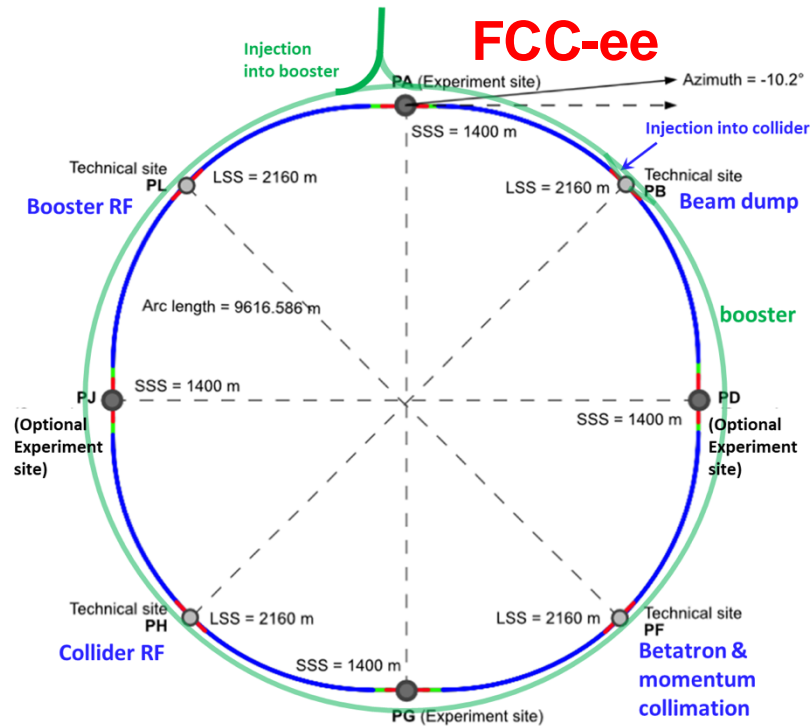
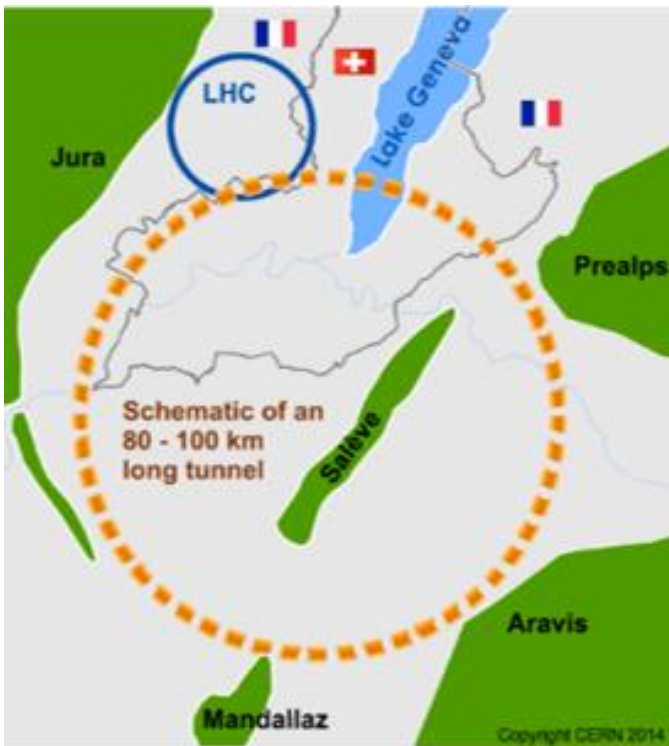
Flagship project: the integrated FCC

Comprehensive long-term program, follows ESPPU 2020 recommendations, **maximizes** physics opportunities

- ❑ Phase 1: FCC-ee (Z, W, H, $t\bar{t}$): Higgs factory, electroweak & top factory
- ❑ Phase 2: FCC-hh (~100 TeV): natural continuation @ energy frontier, pp & AA collisions; eh option

highly synergic

- ❑ Civil engineering and common technical infrastructure, exploits CERN's existing infrastructure
- ❑ It allows for the the start-up of a new machine at CERN within a few years after the end of HL-LHC



FCC feasibility study mid-term report

Full Report

8 Chapters/Deliverables
~ 700pp document
~ 16 editors
~ 500 contributors

Executive Summary

8 Chapters/Deliverables
~ 45pp document
~ 16 editors



International review committees:

SAC: Scientific Advisory Committee ,

CRP: Cost Review Panel

CERN **SPC:** Scientific Policy Committee

CERN **FC :**Financial Committee)

assessed both the level of technical/physical studies and the cost estimate as adequate for this intermediate phase of the project.

further investigation and work towards the final report of the FCC Feasibility Study Group
March 2025

Final Report expected by end of March 2025

INFN: activities & R&D

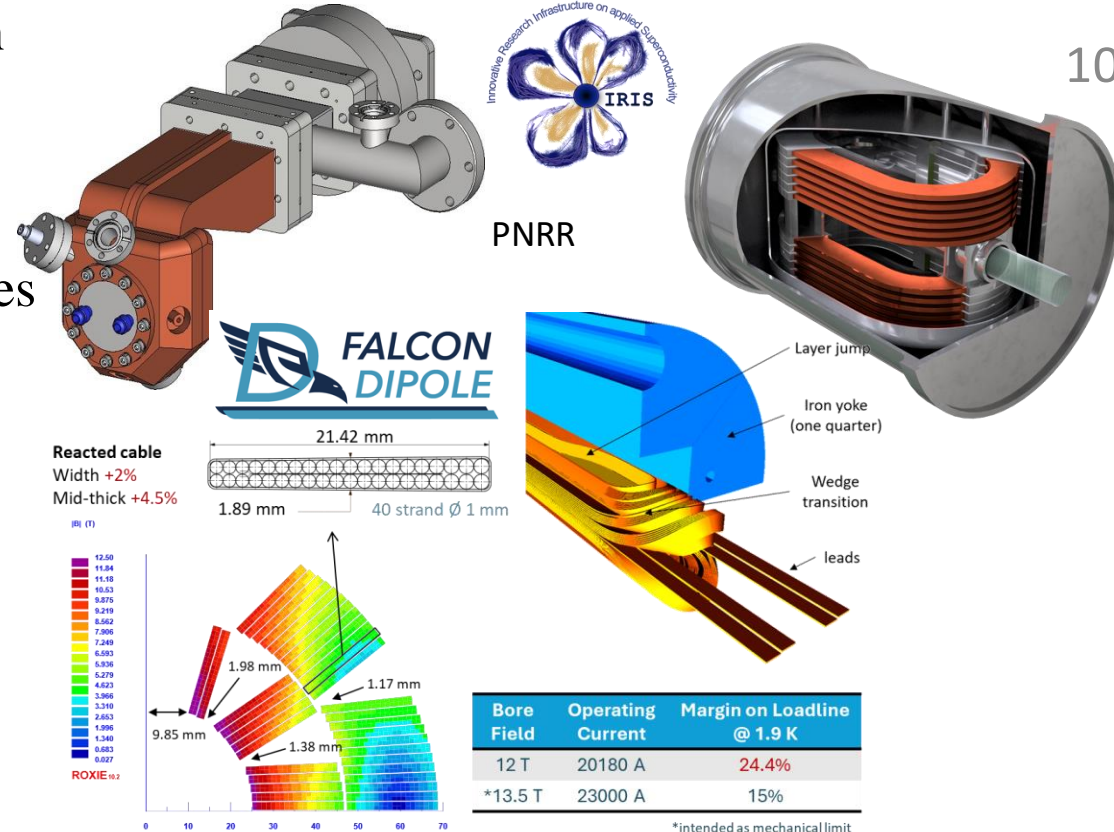
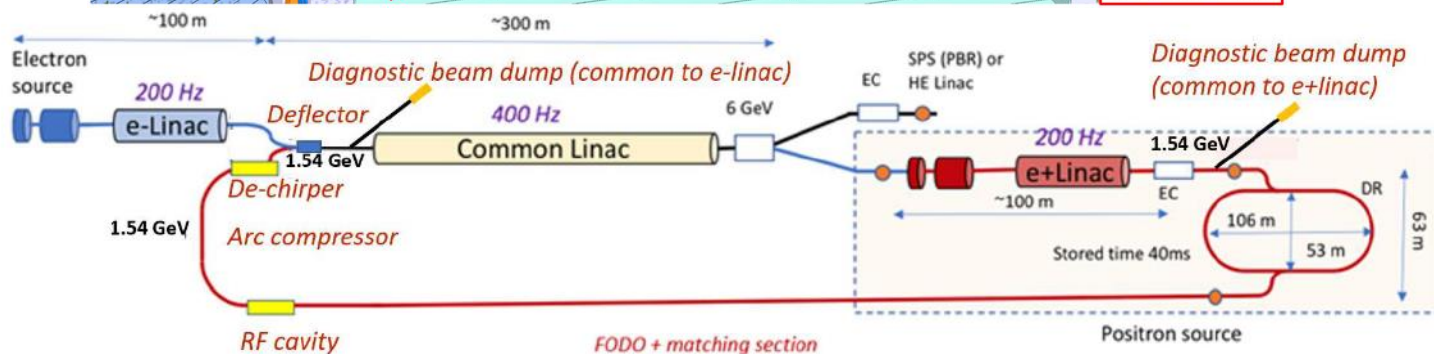
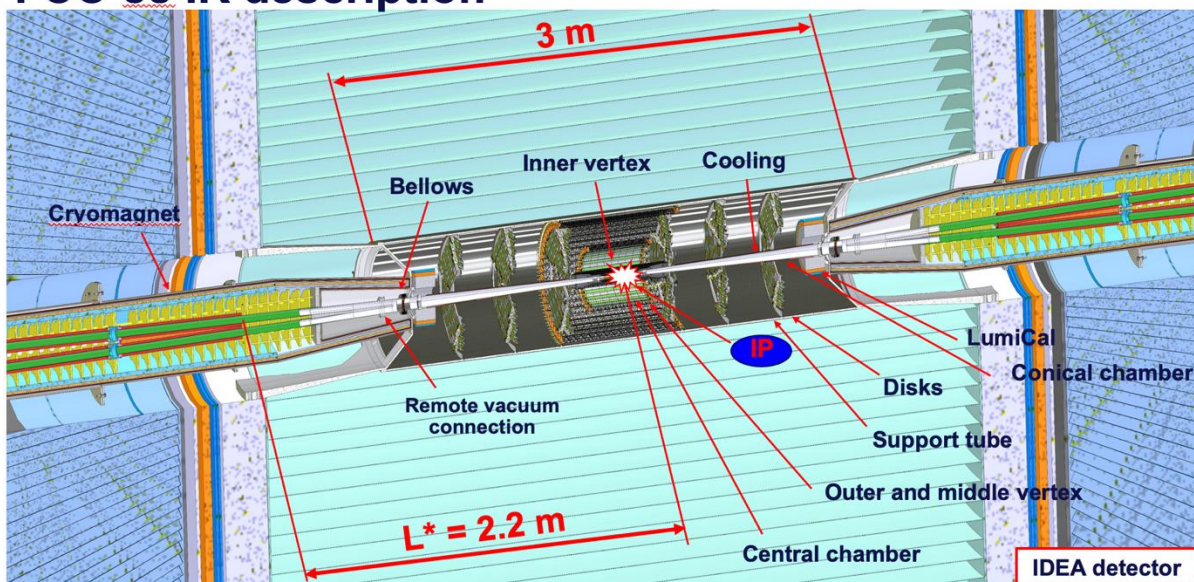
The FCC project poses many technological challenges including:

- ☐ The damping ring and the injectors
 - ☐ Radiofrequency cavities
 - ☐ High-Field Magnets: Beam dipoles and quadrupoles, Solenoids
 - ☐ Machine/detector interface
-
- INFN has promoted/financed **specific R&D** projects that can significantly contribute to the current European Strategy and the one in preparation.
 - Among these projects there is also the **Muon Collider**.

INFN community involved in the study of SRF cavities, high field magnets for the cooling cell, and in the study of the interaction region, the injector and dumping ring, and the detector

It is essential to carry out an R&D experiment that demonstrates the feasibility of a high-energy muon collider → Demonstrator

FCC-ee IR description



Progetti per Acceleratori di Particelle per prossima European Strategy

Muon Collider R&D activities

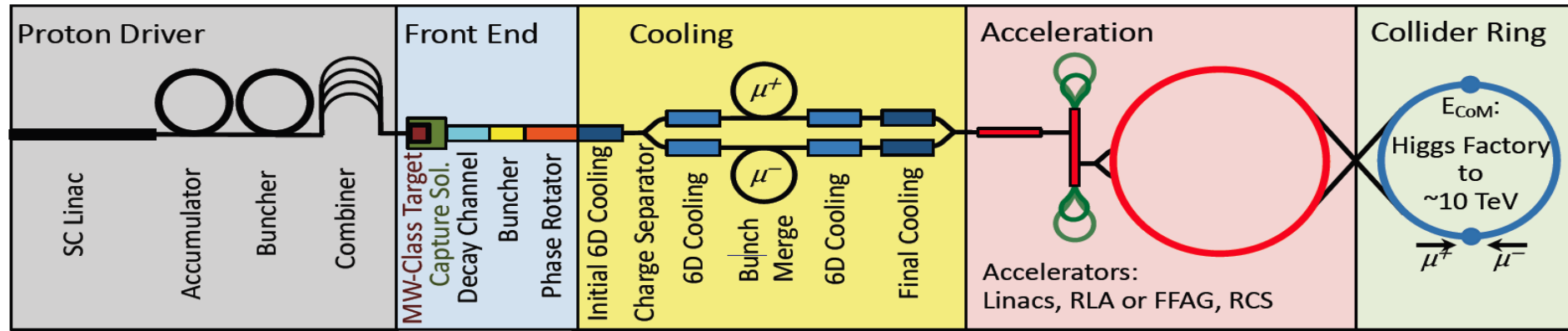
INFN Istituto Nazionale di Fisica Nucleare

LASA-MI

ESPP: WP2 IONIZATION COOLING - DESIGN AND STUDY OF A COOLING CELL

Review dei progetti di acceleratori LASA - 21 Marzo 2024

Muon Collider



Highly innovative project

- It combines precision and discovery potential
- high energy collisions with modest losses of synchrotron radiation (small rings)

Double challenge:

- Muon is unstable ($\tau = 2.2 \mu\text{s}$)
- When hadronically produced, it must be «cooled»
- Cooling, acceleration and collisions must be accomplished in a fraction of a second

US P5: The Muon Shot – The US ambition

Particle Physics Project Prioritisation Panel (P5) endorses muon collider R&D: "This is our muon shot"

Recommend joining the IMCC

Consider FNAL as a host candidate

US is already participating to the collaboration

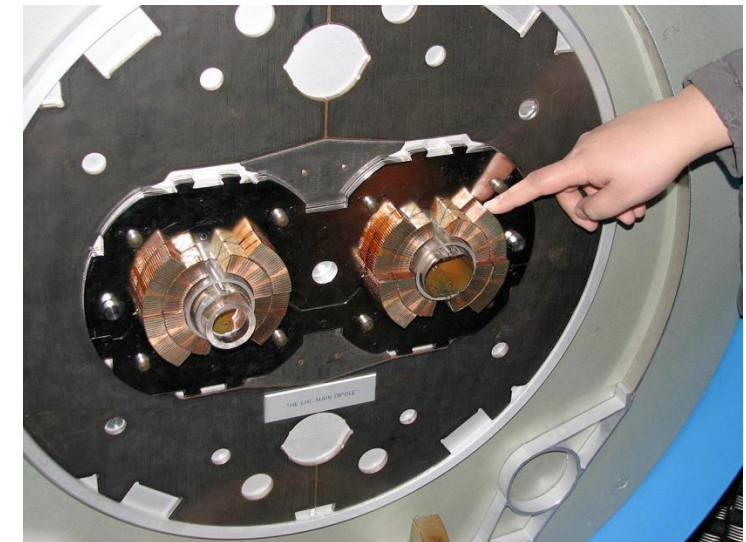
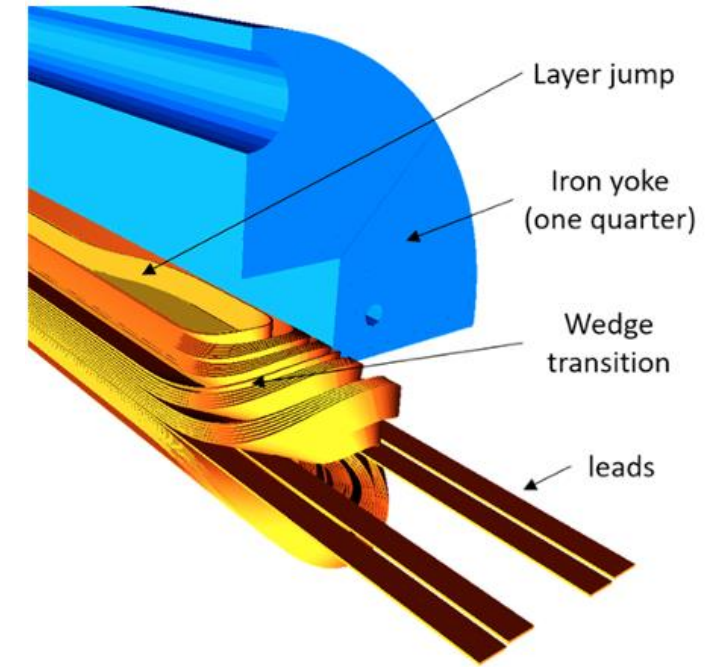
High Field Magnets



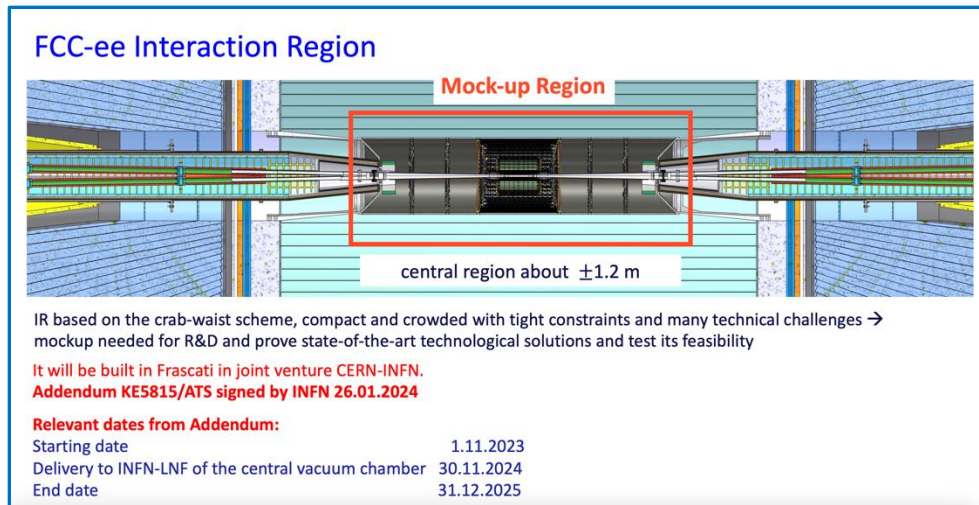
The development of high-field superconducting magnets is crucial for future hadron colliders, at energies well above those of the LHC

- ❑ INFN strongly committed to this study with the research program FALCON-D (Future Accelerator post-LHC Cos-theta Optimized Nb₃Sn Dipole.)
 - ❑ INFN/CERN agreements
 - ❑ Feasibility demonstration of 12 T field dipoles is close
 - ❑ 14-16 T dipoles need further R&D
 - ❑ INFN & CERN support this study also aimed at the realization of a double aperture dipole

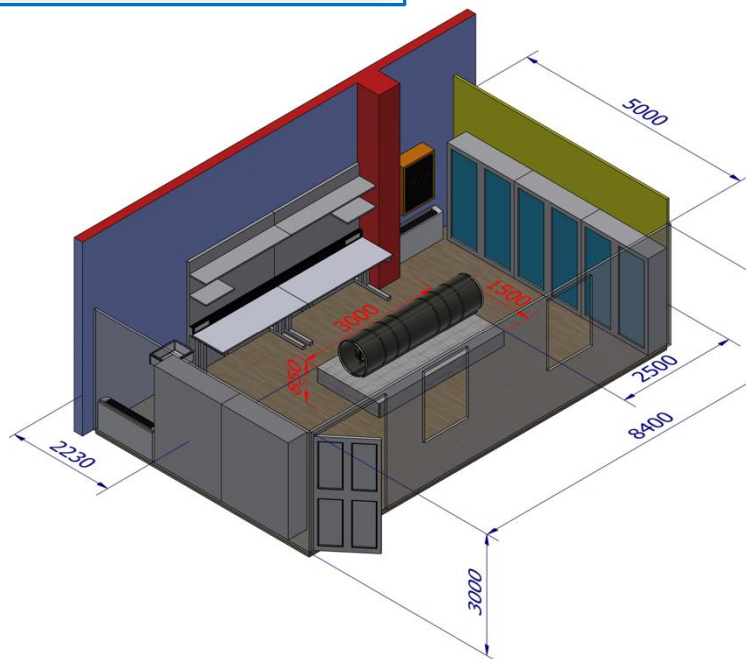
Technological challenge: high field magnets operating at “high” temperatures (HTS)



Interaction Region (MDI and IR)

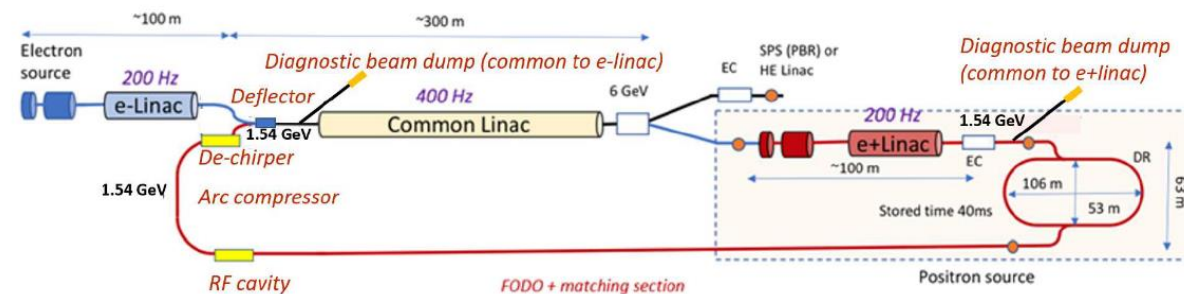


Agreements with CERN for building a **mock-up** in LNF
→
in-situ checks



Damping Ring for FCC-ee

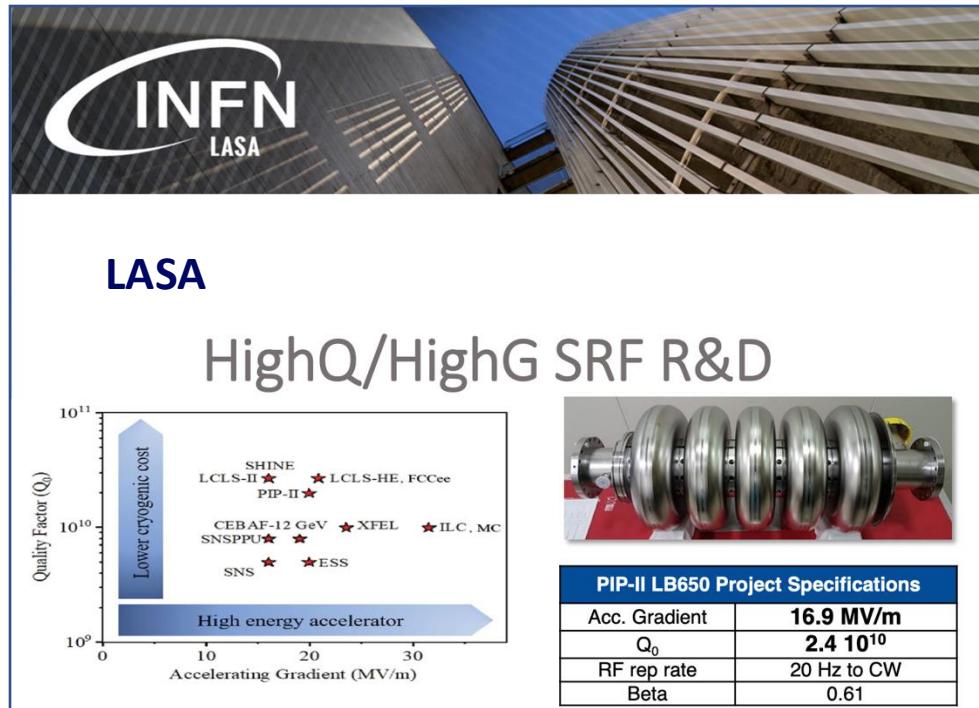
LNF



- ❑ Necessary to "compress" the positron beam originating from the source until it reaches the characteristics necessary to carry out high-frequency collisions with the electron beam in the FCC-ee ring
- ❑ Project supported by INFN and CERN

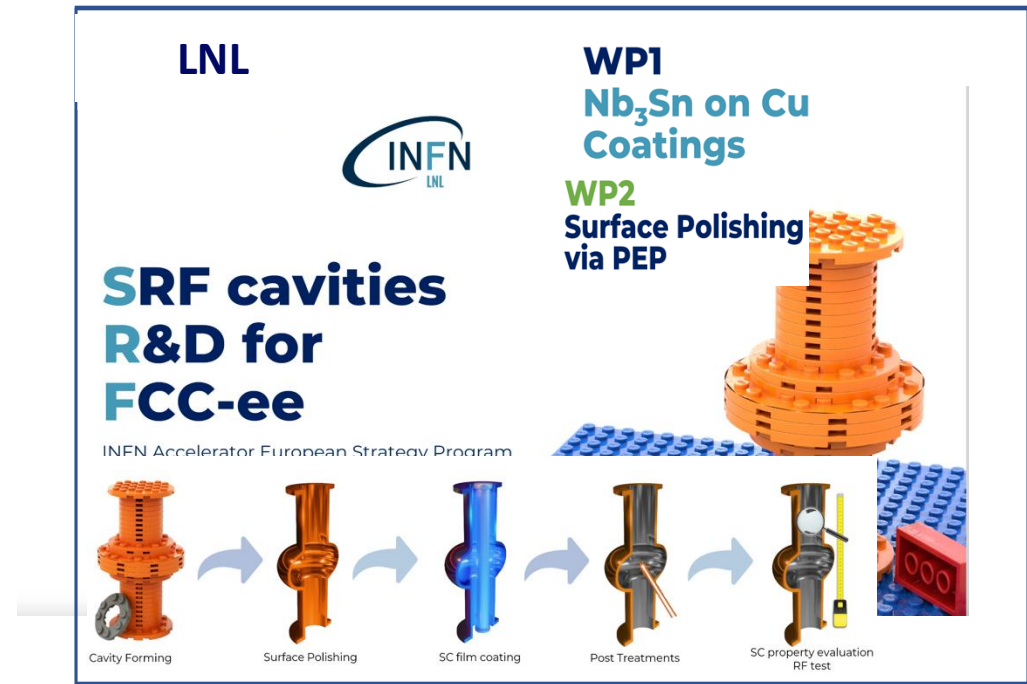
Superconducting radio frequency cavities

Niobio (Nb) SRF cavities INFN-LASA Milano



- R&D activity at LASA aimed at the production of ultra-high Q cavities for PIP-II
- experience to learn from

Nb₃Sn on Cu coatings INFN-LNL Legnaro



This solution can be used at higher temperatures than Niobium (4.5 K vs 2.0 K), with consequent important savings on the energy spent by the cryogenic system

Detector R&D for future experiments: DRD Collaborations

Fully Approved for an initial period of 3 years by CERN Research Board in December 2023



- Gaseous Detectors (DRD1) [ex RD51]
- Liquid Detectors (DRD2)
- Photodetectors & Particle ID (DRD4)
- Calorimetry (DRD6)

Reports at open session of DRDC meeting:
<https://indico.cern.ch/event/1356910>
 Full Proposals in CERN CDS

Conditionally approved



- Semiconductor Detectors (DRD3) [ex RD50, RD42,..]

Full proposals recently submitted for review



- Quantum Sensors (DRD5)
- Electronics (DRD7)

Both aim for approval in June

Letter of Intent submitted



- Integration (DRD8)

Full Proposal to be written by the end of this year

- ☐ Italian INFN colleagues in various roles of responsibility
- ☐ Waiting for MoU and Annex
- ☐ INFN financing scheme discussed with the Presidents of CSN, to be finalized
- ☐ Inter CSN review process

Streamlining the process and form of national inputs

ECFA




3. Questions to be considered by individual countries/regions in forming and furnishing a “national input” to the ESPP:

a. Which is the preferred next major/flagship collider project for CERN

b. What are the most important elements in the response to (3a)?

- ☐ **Physics potential**
- ☐ **Long-term perspective**
- ☐ **Financial and human resource requirements – and implications for other projects**
- ☐ **Timing**
- ☐ **Careers and training**
- ☐ **Sustainability**

Streamlining the process and form of national inputs

- c. **Should CERN/Europe proceed with the preferred option set out in 3a) or should alternative options be considered:**
 - i. if Japan proceeds with the ILC in a timely way?
 - ii. if China proceeds with the CEPC on the announced timescale?
 - iii. if the US proceeds with a muon collider?
 - iv. if there are major new (unexpected) results from the HL-LHC or other HEP experiments?
-  d. **Beyond the preferred option in 3a), what other accelerator R&D topics (e.g. highfield magnets, RF technology, alternative accelerators/colliders) should be pursued in parallel?**
-  e. **What is the prioritised list of alternative options if the preferred option set out in 3a) is not feasible (due to cost, timing, international developments, or for other reasons)?**
-  f. **What are the most important elements in the response to 3e)? (The set of considerations in 3b should be used).**

Streamlining the process and form of national inputs

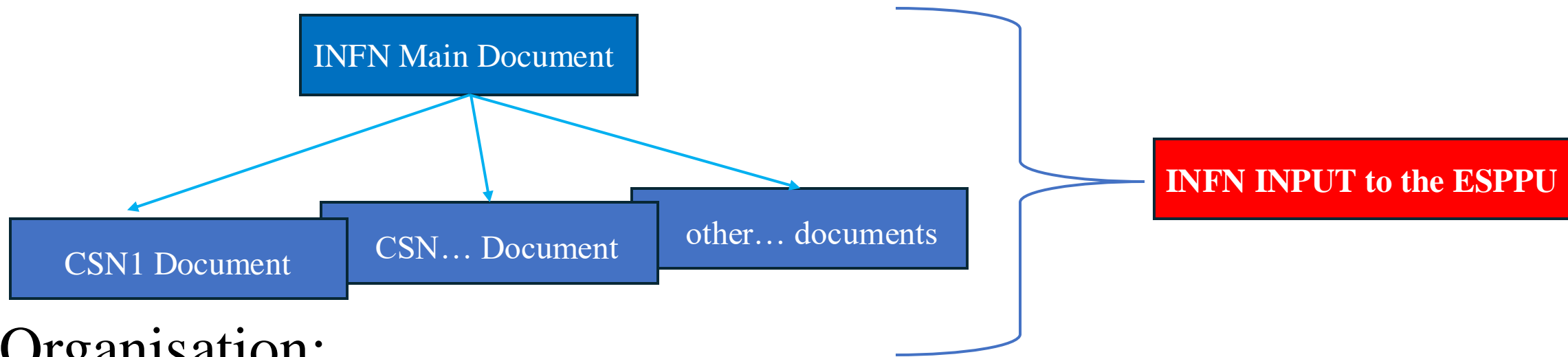
- 4) The remit given to the ESG also specifies that “The Strategy update should also indicate areas of priority for exploration complementary to colliders and for other experiments to be considered at CERN and at other laboratories in Europe, as well as for participation in projects outside Europe.” It would thus be most useful if the national inputs explicitly included the preferred prioritisation for non-collider projects. Specific questions to address:
- a) What other areas of physics should be pursued, and with what relative priority?
 - b) What are the most important elements in the response to 4a)? (The set of considerations in 3b should be used)
 - c) To what extent should CERN participate in nuclear physics, astroparticle physics or other areas of science, while keeping in mind and adhering to the CERN Convention? Please use the current level and form of activity as the baseline for comparisons.

INFN Input per la European Strategy

- The INFN has started work on the preparation of the Update of the European Strategy for Particle Physics (ESPPU) with the [workshop on May 6th and 7th in Rome](#).
 - During the discussions that took place at this meeting, the basic recommendation emerged with which INFN will contribute to the work of the *Strategy*.
- A second important event was the [INFN workshop at the University of Milano Bicocca](#). This workshop fostered broad discussion to exchange views in the scientific community before the deadline to deliver the INFN national input to the ESPP (31 March 2025).
- This approach is inspired by the model adopted by INFN during the last *European Strategy* from December 2018 to January 2020 (symposium in Granada in 2019).






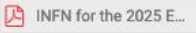
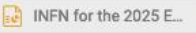


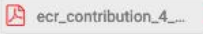


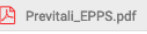

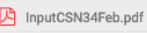
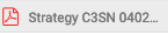

INFN Input for the European Strategy



- Organisation:

- **Steering Group** (C. Borca, M. Ciuchini, S. Malvezzi, A. Nisati, R. Tenchini)
- **Gruppo di Lavoro**, composed by:
 - ⑩ Presidenti delle cinque Commissioni Scientifiche
 - ⑩ Direttori dei Laboratori Nazionali
 - ⑩ Chair del Machine Advisory Committee dell' INFN (MAC)
 - ⑩ Rappresentante attività Calcolo (CNC)
 - ⑩ Rappresentanti dell' Ufficio Comunicazione dell' INFN

Agenda of the Milano INFN Workshop

9:55 AM → 10:00 AM	Introduzione	5m
Speakers: Aleandro Nisati (Istituto Nazionale di Fisica Nucleare), Sandra Malvezzi (Istituto Nazionale di Fisica Nucleare), Tommaso Tabarelli De Fatis (Istituto Nazionale di Fisica Nucleare)		
		
10:00 AM → 11:10 AM	Fisica sperimentale con acceleratori - R&D Acceleratori	1h 10m
Convener: David Alesini, Tommaso Tabarelli		
<ul style="list-style-type: none"> Commissione Scientifica Nazionale 1 – Roberto Tenchini (30') R&D INFN Acceleratori di particelle – Giovanni Bisoffi (25') Strategia dei Laboratori Nazionali di Frascati – Paola Gianotti (15') 		
Speakers: Giovanni Bisoffi (Istituto Nazionale di Fisica Nucleare), Paola Gianotti (LNF), Roberto Tenchini (Istituto Nazionale di Fisica Nucleare)		
    		
11:10 AM → 11:30 AM	Break (Galleria della Scienza)	20m
11:30 AM → 11:45 AM	Fisica teorica	15m
Convener: Stefania De Curtis		
<ul style="list-style-type: none"> Commissione Scientifica Nazionale 4 		
Speaker: Fulvio Piccinini (Istituto Nazionale di Fisica Nucleare)		
		
11:45 AM → 12:45 PM	Dibattito	1h
<ul style="list-style-type: none"> Argomenti: CSN1, CSN4, Acceleratori, e LNF 		
12:45 PM → 1:20 PM	Early Career Researchers	35m
Convener: Matteo Giovannetti		
<ul style="list-style-type: none"> Relazione (20') e dibattito 		
Speaker: Cecilia Borca (Istituto Nazionale di Fisica Nucleare)		
 		
2:40 PM → 3:13 PM	Fisica senza acceleratori, astroparticelle	33m
Convener: Aldo Ianni		
<ul style="list-style-type: none"> Commissione Scientifica Nazionale 2 – Oliviero Cremonesi (18') Laboratori Nazionali del Gran Sasso – Ezio Previtali (15') 		
Speaker: Oliviero Cremonesi (Istituto Nazionale di Fisica Nucleare)		
 		
3:13 PM → 3:33 PM	Dibattito	20m
<ul style="list-style-type: none"> Argomenti: CSN2 e LNGS 		
3:33 PM → 4:25 PM	Fisica nucleare, applicazioni interdisciplinari e nuove tecnologie	52m
Convener: Andrea Dainese, Nadia Pastrone		
<ul style="list-style-type: none"> Commissione Scientifica Nazionale 3 – Paolo Giubellino (18') Commissione Scientifica Nazionale 5 – Alberto Quaranta (18') Comitato di Steering Coordinamento Nazionale Calcolo – Gianpaolo Carlino (15') 		
Speakers: Alberto Quaranta (TIFPA - University of Trento), Alberto Quaranta (TIFPA), Gianpaolo Carlino (Istituto Nazionale di Fisica Nucleare), Paolo Giubellino (Istituto Nazionale di Fisica Nucleare)		
  		
4:25 PM → 4:45 PM	Dibattito	20m
<ul style="list-style-type: none"> Argomenti: CSN3, CSN5 e C3SN 		
4:45 PM → 5:05 PM	Break (Galleria della Scienza)	20m
5:05 PM → 5:15 PM	Comunicazione	10m
Convener: Francesca Scianitti		
<ul style="list-style-type: none"> Ufficio Comunicazione 		
Speaker: Antonella Varaschin (Istituto Nazionale di Fisica Nucleare)		
		
5:15 PM → 5:45 PM	INFN National Input to the European Strategy	30m
Convener:		
5:45 PM → 6:30 PM	Conclusioni	45m
<ul style="list-style-type: none"> Dibattito e considerazioni finali 		

INFN Input Supporting Documents

- *Document by CSN1 community*
- *Document by CSN2 community*
- *Document by CSN3 community*
- *Document by CSN4 community*
- *Document by Accelerator community*
- *Document by LNF*
- *Document by LNGS*
- *Document by C3SN Community*
- *Document by CSN1 Community*
- *Document by Ufficio Comunicazione*

INFN National Input (under finalisation)

key points

- Continuity with the recommendations of the previous ESPP Update (2019-2020)
 - Physics-programme completion @ HL-LHC
 - Physics case for a future particle collider at CERN, after HL-LHC
- The FCC project and its feasibility study (invited by the CERN Council in 2020)
- R&D support for innovative particle colliders
- Enhance collaboration between CERN, with a new frontier accelerator facility, at the forefront of global research, and European physics laboratories
- Connections with research areas complementary to particle physics with accelerators: astroparticle physics
- Strong involvement of Early Careers Researchers

INFN National Input (under finalisation)

- **We recommend FCC-integrated (FCC-ee, followed by FCC-hh) as the next major flagship collider project for Europe, and for CERN in particular.**
 - Motivations: exceptional physics potential, unique opportunity for Europe^(*) to reaffirm its leadership in fundamental physics. Also: technological advancement and significant economic benefits in Europe
 - long-term perspective for high-energy physics research, opportunity to train new generations of researchers in particle physics, ensuring the preservation and transmission of this knowledge to future generations.

(*) Draghi's report

INFN National Input (under finalisation)

- While taking into account international scenarios regarding potential future projects in high-energy physics worldwide, **Europe must remain firmly committed to the integrated FCC project.**
 - enables significant advancements in our understanding of fundamental physics and ensures the consolidation and further enhancement of our continent's leadership and competitiveness in frontier research.
- Before releasing a firm statement on this point, INFN would like to access the input on the updates on the financial assessment of FCC, as well as from the other proposed projects. This might imply for INFN to submit an addendum to the National Document, well before the Open Symposium will take place.

- **It is also important for CERN to actively engage on cutting edge of technological innovation**
 - for example: Artificial Intelligence, Quantum Technologies and Computing, infrastructure for Gravitational Wave Observatories

However, it remains essential that **CERN continues to uphold its leadership of advancing fundamental physics through particle accelerators.**

- This mission is the foundation upon which the laboratory was established, cementing its position as the foremost institution in Europe and one of the few most significant in the world which have driven the advancement of elementary particle physics on an international scale.

Conclusions

- **A new accelerator at CERN, is essential to push the energy frontier beyond the LHC, enabling discoveries that could reshape our understanding of fundamental physics.**
- The proposed FCC-integrated program (FCC-ee followed by FCC-hh) offers an unparalleled opportunity to explore the Higgs boson, electroweak interactions, and new physics at unprecedented energy scales.
- Advancements in superconducting magnets, accelerator technology, and new generation detector innovations will have broad applications, driving economic and industrial benefits as well.
- **Investing in a leading new accelerator will ensure a long-term research vision, attracting and training the next generation of physicists and engineers in cutting-edge scientific challenges.**
- A next-generation collider at CERN will secure Europe's leadership in high-energy physics, fostering global collaboration in an era where science has proven its natural ability to unite. This is of immense importance at a time when division and human fragmentation are being encouraged or imposed with arrogance.
- **INFN is playing a fundamental role in shaping this strategy, leading advanced R&D efforts in accelerator, detector, electronics, computing, and software technologies.**

Conclusions

- **A new accelerator at CERN, is essential to push the energy frontier beyond the LHC, enabling discoveries that could reshape our understanding of fundamental physics.**
- The proposed FCC-integrated program (FCC-ee followed by FCC-hh) offers an unparalleled opportunity to explore the Higgs boson, electroweak interactions, and new physics at unprecedented energy scales.

2026 UPDATE

OPEN SYMPOSIUM
**European Strategy
for Particle Physics**

23-27 JUNE 2025

CERN

INFN
Istituto Nazionale di Fisica Nucleare

European Strategy
for Particle Physics

Open Symposium on the European Strategy for Particle Physics

- **INFN is playing a fundamental role in shaping this strategy, leading advanced R&D efforts in accelerator, detector, electronics, computing, and software technologies.**

backup

Mario Draghi's Report to EU

- Available at this [link](#)
- FCC/CERN cited in page 236:

The Large Hadron Collider has propelled CERN to global leadership in particle physics – a mantle that has shifted from the US to Europe – and it stands as CERN's flagship facility. One of CERN's most promising current projects, with significant scientific potential, is the construction of the Future Circular Collider (FCC): a 90-km ring designed initially for an electron collider and later for a hadron collider. Chinese authorities are also considering constructing a similar accelerator in China, recognising its scientific potential and its role in advancing cutting-edge technologies. If China were to win this race and its circular collider were to start working before CERN's, Europe would risk losing its leadership in particle physics, potentially jeopardising CERN's future.

and in page 252 as well:

the future of CERN is at risk due to China's progress in emulating one of CERN's most promising current projects, the Future Circular Collider (FCC). Refinancing CERN and ensuring its continued global leadership in frontier research should be regarded as a top EU priority, given the objective of maintaining European prominence in this critical area of fundamental research, which is expected to generate significant business spillovers in the coming years.

CERN Council Mandate to the European Strategy Group (ESG)

From CERN/SPC/1239/Rev.2

The ESG should take into consideration:

- the input of the particle physics community;
- the status of implementation of the 2020 Strategy update;
- the accomplishments over recent years, including the results from the LHC and other
- **experiments and facilities worldwide**, the progress in the construction of the **High-Luminosity LHC**, the outcome of the **Future Circular Collider Feasibility Study**, and **recent technological developments in accelerator, detector and computing**;
- the international landscape of the field.

The Strategy Secretariat and European Strategy Group (ESG)

Strategy Secretariat:

Karl Jakobs (Strategy Secretary, Chair)

Hugh Montgomery (SPC Chair)

Dave Newbold (LDG Chair) (→ will be replaced by Mike Seidel (PSI, as new LDG Chair) on 1st Jan. 2025)

Paris Sphicas (ECFA Chair)

Organising and running the ESPP process

(bi-weekly meetings over the past two months to ramp up the process)

European Strategy Group (ESG)

Preparation of the Strategy Document

(kick-off meeting held on 18th September)

- The Strategy Secretary (acting as Chair)
- **One representative appointed by each CERN Member State**
- **One representative appointed by each of the laboratories represented in the Large Particle Physics Laboratory Directors Group (LDG), including its Chair**
- **The CERN Director-General**
- **The CERN Director-General elect**
- The SPC Chair
- The ECFA Chair
- Invitees: President of CERN Council, one representative from each of the Associate Member and Observer States, one representative from the European Commission, the Chairs of APPEC, NuPECC and ESFRI, the members of the Physics Preparatory Group.



- Strategy Secretary (acting as Chair),
- four members appointed by the Council on the recommendation of the SPC,
- four members appointed by the Council on the recommendation of ECFA,
- SPC Chair,
- ECFA Chair,
- Chair of the European Laboratory Directors Group ,
- one representative appointed by CERN,
- two representatives from Asia appointed by the respective regional representatives in ICFA,
- two representatives from the Americas appointed by the respective regional representatives in ICFA.

PPG MEMBERS	
Strategy Secretariat	
Scientific Secretary (Chair)	Prof. Karl Jakobs (DE)
SPC Chair	Dr Hugh Montgomery (USA)
ECFA Chair	Prof. Pareskevas Sphicas(GR)
LDG Chair	Prof. Dave Newbold (UK)
SPC	
Prof. Pilar Hernandez (ES)	
Prof. Gino Isidori (CH)	
Prof. Fabio Maltoni (BE/IT)	
Prof. Jocelyn Monroe (UK	

The 2025 PPG members

ECFA	
Dr Tommaso Boccali (IT)	
Dr Thomas Bergauer (AT)	
Dr Cristinel Diaconu (FR)	
Prof. Monica Dunford (DE)	
CERN	
Dr Gianluigi Arduini (CERN)	
ASIA/AMERICAS	
Dr Anadi Canepa (USA)	
Prof. Xinchou Lou (China)	
Prof. Rogerio Rosenfeld (Brazil)	
Prof. Yuji Yamazaki (Japan)	

Organisation of the work in PPG

- The Strategy Secretariat proposes **nine working groups** to cover the full range of physics topics as well as the technology areas of accelerators, detector technologies and computing.

Working Group		
	Co-convener (PPG member)	Co-convener
Electroweak physics	Monica Dunford (DE, exp)	Jorge de Blas (ES, theory)
Strong interaction	Cristinel Diaconu (FR, exp)	Andrea Dainese (IT, exp, HI)
Flavour physics	Gino Isidori (CH, theory)	Marie-Hélène Schune (FR, exp)
BSM physics	Fabio Maltoni (BE/IT, theory)	Rebeca Gonzalez-Suarez (SE, exp)
Neutrino physics and cosmic messengers	Pilar Hernandez (ES, theory)	Sara Bolognesi (FR, exp)
Dark matter and dark sector	Jocelyn Monroe (UK, exp)	Matthew McCullough (CERN, theory)
Accelerator science and technology	Gianluigi Arduini (CERN, acc)	Phil Burrows (UK, exp, acc)
Detector instrumentation	Thomas Bergauer (AT, exp)	Ulrich Husemann (DE, exp)
Computing	Tommaso Boccali (IT, exp, comp)	Borut Kersevan (SL, exp, comp)

To **increase the engagement by the broader particle physics community** in the current update, the Strategy Secretariat proposes additional co-conveners

(from SPC and ECFA nominations)

- Early Career Researchers (ECR) (one for each of the nine working groups) are proposed to act as Scientific Secretaries



Detectors : ECFA detector roadmap

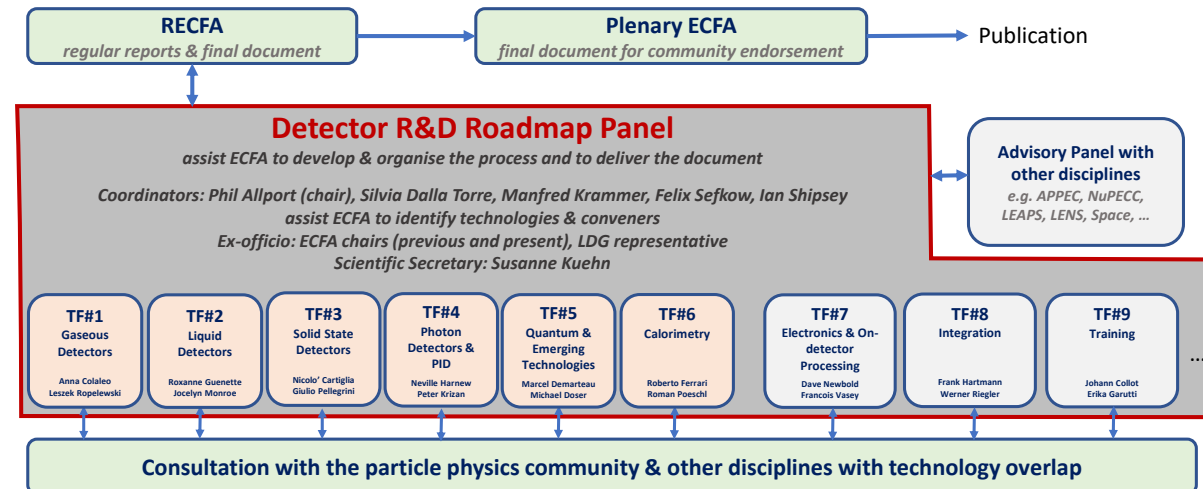
Strategic recommendations:

- ❑ R&D facilities
 - Test beam, large-scale prototyping, irradiation
- ❑ Engineering support for detector R&D
- ❑ Development of specific software for instrumentation
- ❑ International coordination and organization of R&D activities:

❑ DRD collaborations

- long-term strategic financing program
- blue-sky R&D

ESPPU 2020 : *The success of particle physics experiments relies on innovative instrumentation and state-of-the-art infrastructures. To prepare and realise future experimental research programmes, the community must **maintain a strong focus on instrumentation. Detector R&D programmes and associated infrastructures should be supported at CERN, national institutes, laboratories and universities.** ...*



Attract, cultivate and support the careers of young R&D experts

Detector R&D Collaborations

by Thomas Bergauer

Fully Approved

- Gaseous Detectors (DRD1) [ex RD51]
- Liquid Detectors (DRD2)
- Photodetectors & Particle ID (DRD4)
- Calorimetry (DRD6)

Conditionally approved

- Semiconductor Detectors (DRD3) [ex RD50, RD42,..]

Full proposals submitted
last week for review

- Quantum Sensors (DRD5)
- Electronics (DRD7)

Letter of Intent submitted

- Integration (DRD8)

Timeline

September 2024 Council

Council appointment of the members of the PPG

December 2024 Council

Council decision on the **venues for the Open Symposium** and the **Strategy Drafting Session**

Call for proposals to host these events have gone out;
Dates of both events have been fixed

31 March 2025

Deadline for the submission of input from the community

23 – 27 June 2025

Open Symposium

End of September 2025

Submission of the “Briefing Book” to the ESG

01 – 05 December 2025

Strategy Drafting Session

End January 2026

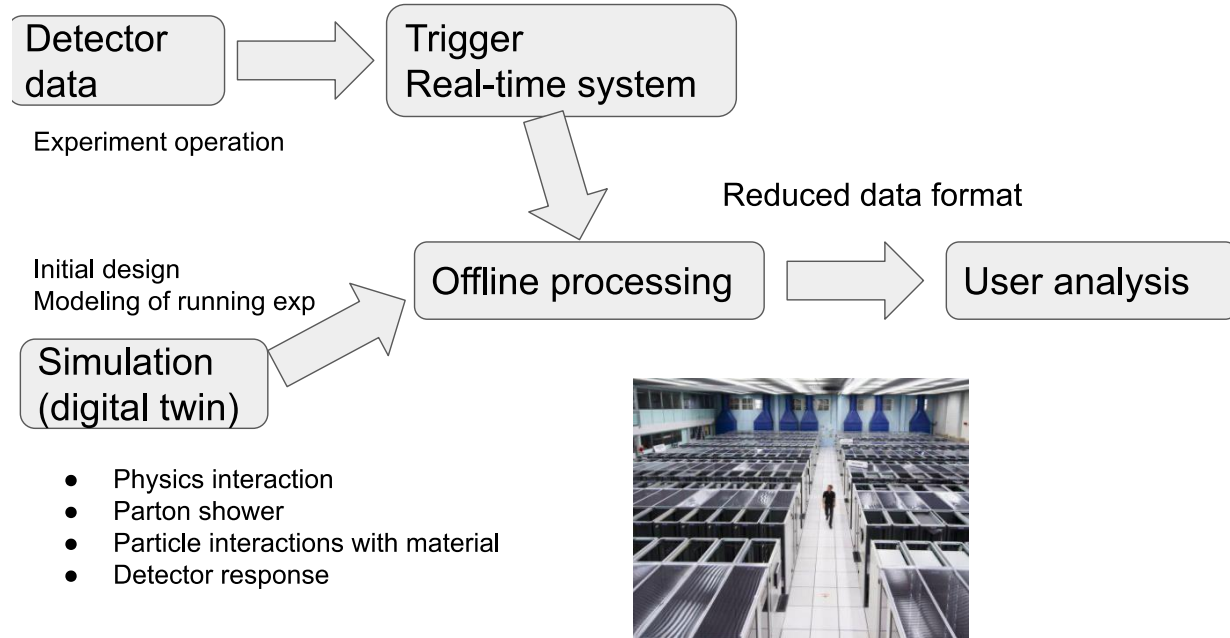
Submission of the Draft Strategy Document to the Council for feedback

March-June 2026 Council Sessions

Discussion of the Draft Strategy Document by the Council followed by the updating of the Strategy by the Council.



Software & Computing



Role of AI: accelerator control, data acquisition, event triggering, anomaly detection, new physics scouting, event reconstruction, event generation, detector simulation, LHC grid control, analytics, signal extraction, likelihood free inference, background rejection, new physics searches, etc..

....Quantum Computing

Community is Growing

challenge/opportunity:
detector optimization with
artificial intelligence?



Machine-learning Optimized
Design of Experiments



an European initiative for advancing the use of Artificial Intelligence (AI) in Fundamental Physics. Members are working on particle physics, astrophysics, gravitational wave physics, cosmology, theoretical physics as well as simulation and computational infrastructure.



EUROPEAN AI FOR
FUNDAMENTAL PHYSICS
CONFERENCE
EuCAIFCon 2024

Welcome

The European Strategy for Particle Physics is the cornerstone of Europe's strategy-setting process for the long-term future of the field. Mandated by the CERN Council, the Strategy takes into account results from the LHC and other facilities in the world, the international physics landscape and developments in related fields with the aim to maximise scientific returns.

In March 2024, the CERN Council launched the process for the third update of the Strategy. [The European Strategy Group](#) (ESG) and the [Strategy Secretariat](#) for this update were established in June 2024 to organise the full process. The [remit](#) of the European Strategy Group was also approved in June 2024.

The Strategy update process is expected to converge by January 2026, when a draft Strategy document will be submitted to the Council. The community at large will be involved during the full [process](#) and is asked to provide input at several stages.

RELATED WEBSITES

- ▶ [The European Strategy for Particle Physics](#)
- ▶ [CERN Council](#)
- ▶ [European Committee for Future Accelerators \(ECFA\)](#)
- ▶ [European Strategy Forum on Research Infrastructures \(ESFRI\)](#)

contact: epps2024@cern.ch



La home page della prossima Strategy si trova a questo link:

<https://europeanstrategyupdate.web.cern.ch/welcome>

High-Luminosity LHC European Strategy 2019-2020

CERN-ESU-014

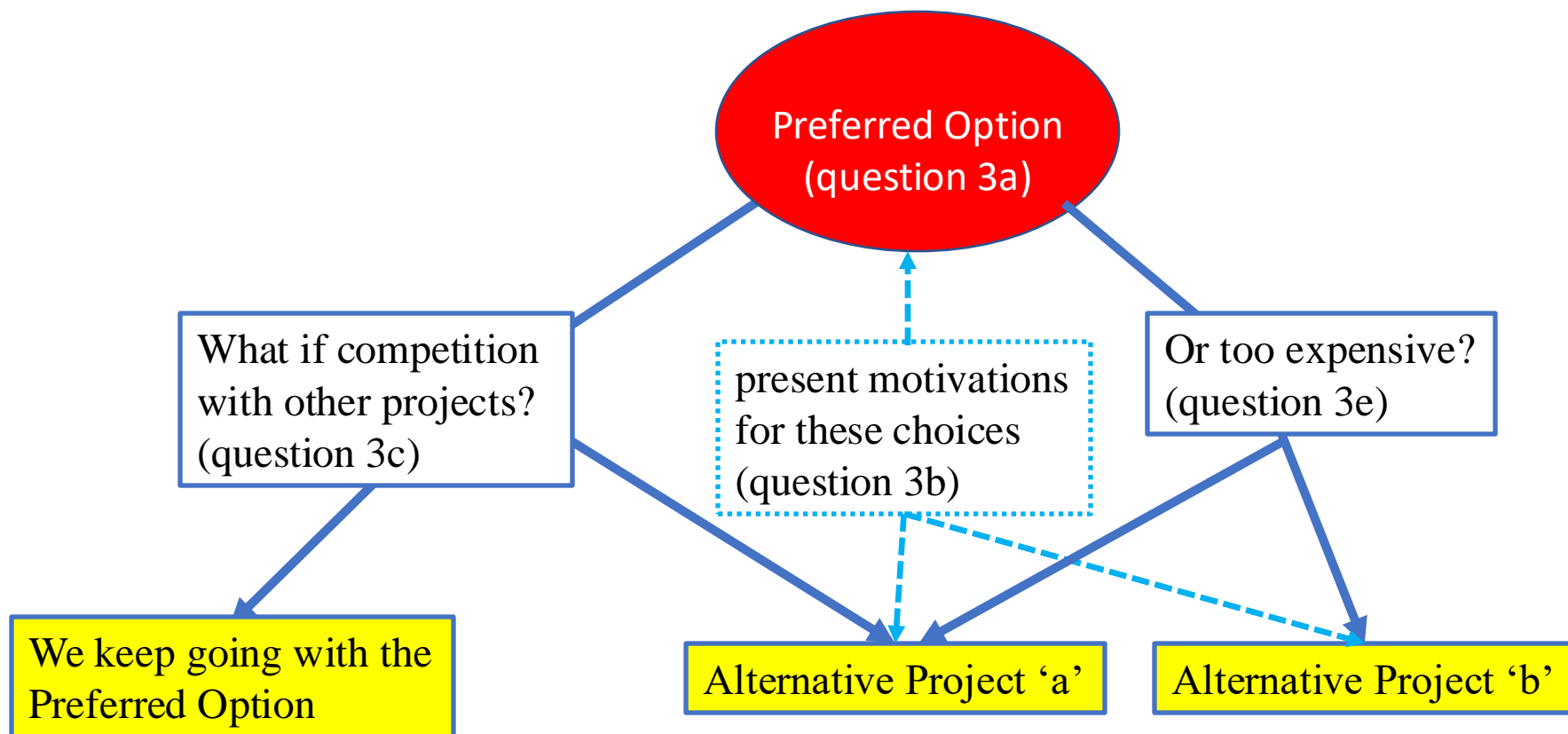
Since the recommendation in the 2013 Strategy to proceed with the programme of upgrading the luminosity of the LHC, the HL-LHC project was approved by the CERN Council in June 2016 and is proceeding according to plan. In parallel, the LHC has reached a centre-of-mass energy of 13 TeV, exceeded the design luminosity, and produced a wealth of remarkable physics results. Based on this performance, coupled with the innovative experimental techniques developed at the LHC experiments and their planned detector upgrades, a significantly enhanced physics potential is expected with the HL-LHC. The required high-field superconducting Nb₃Sn magnets have been developed.

- *The successful completion of the high-luminosity upgrade of the [LHC] machine and detectors should remain the focal point of European particle physics, together with continued innovation in experimental techniques. The full physics potential of the LHC and the HL-LHC, including the study of flavour physics and the quark-gluon plasma, should be exploited.*

The 'logic' of what asked

Karl's reminder:

Current baseline – justified by 2020 Strategy: FCC integrated programme (FCC-ee followed by a hadron collider of at least 100 TeV)



Considerazioni importanti, baseline e possibili scenari alternativi

41

by Karl Jakobs

ECFA meeting – CERN 15 Nov 2024

Baseline and possible alternative scenarios

Current baseline – justified by 2020 Strategy – :

FCC integrated programme (FCC-ee followed by a hadron collider of at least 100 TeV)

Possible alternative scenarios (for next collider, following the HL-LHC)

- Realisation of a lower-energy hadron collider (50 – 80 TeV) on an earlier timescale (2050 – 2055)
- Linear Collider at CERN (CLIC, ...)
- Muon Collider at CERN
- Further exploitation of the LHC physics programme, eventually with the addition of e-h collisions
- ...

Non-exhaustive list, other scenarios may come up and be proposed by the community

Come procediamo noi?

- Il risultato del [workshop INFN](#) del 6 e 7 Maggio è consistente con quanto presentato e discusso da Segretariato ESPP e ECFA al meeting di LNF.
 - Dobbiamo fare del lavoro ulteriore per elaborare le opzioni sui progetti alternativi
- La preparazione dei documenti che si pensa di utilizzare come Input alla prossima ESPP è in linea con quanto richiesto o suggerito
- Ulteriori affinamenti del documento di *Input* principale terranno conto delle discussioni che stanno avendo luogo o che presto avranno luogo presso i Laboratori Nazionali, le Sezioni e le Commissioni Scientifiche (e della sintesi che arriverà da questo GdL)
- Sottometteremo entro il 31 Marzo 2025 i nostri documenti di Input. Il documento principale lo vorremmo sottomettere insieme a tutti gli altri. Il Management INFN valuterà se sarà necessario un aggiornamento da parte nostra, da sottomettere prima del Simposio a Lido di Venezia, oppure dopo il Briefing Book e prima della Drafting Session.
- Riunioni svolte e previste dello Steering con il GdL (20.6.24; 22.7.24; 25.9.24, 3.12.24), workshop conclusivo il 4 Febbraio 2025 a Milano Bicocca
 - Possibili ulteriori riunioni del GdL anche dopo il 31.03.2024 e prima di della riunione dell' ESG a Monte Verità

How do we proceed?

- Fortunately, anticipating an acceleration in the process related to the next Strategy, INFN moved in time
- The outcome of the INFN workshop on May 6th and 7th is consistent with what was presented and discussed by the ESPP Secretariat and ECFA at the July LNF meeting.
 - We need to do further work to develop options for alternative projects

Future Accelerator options for CERN

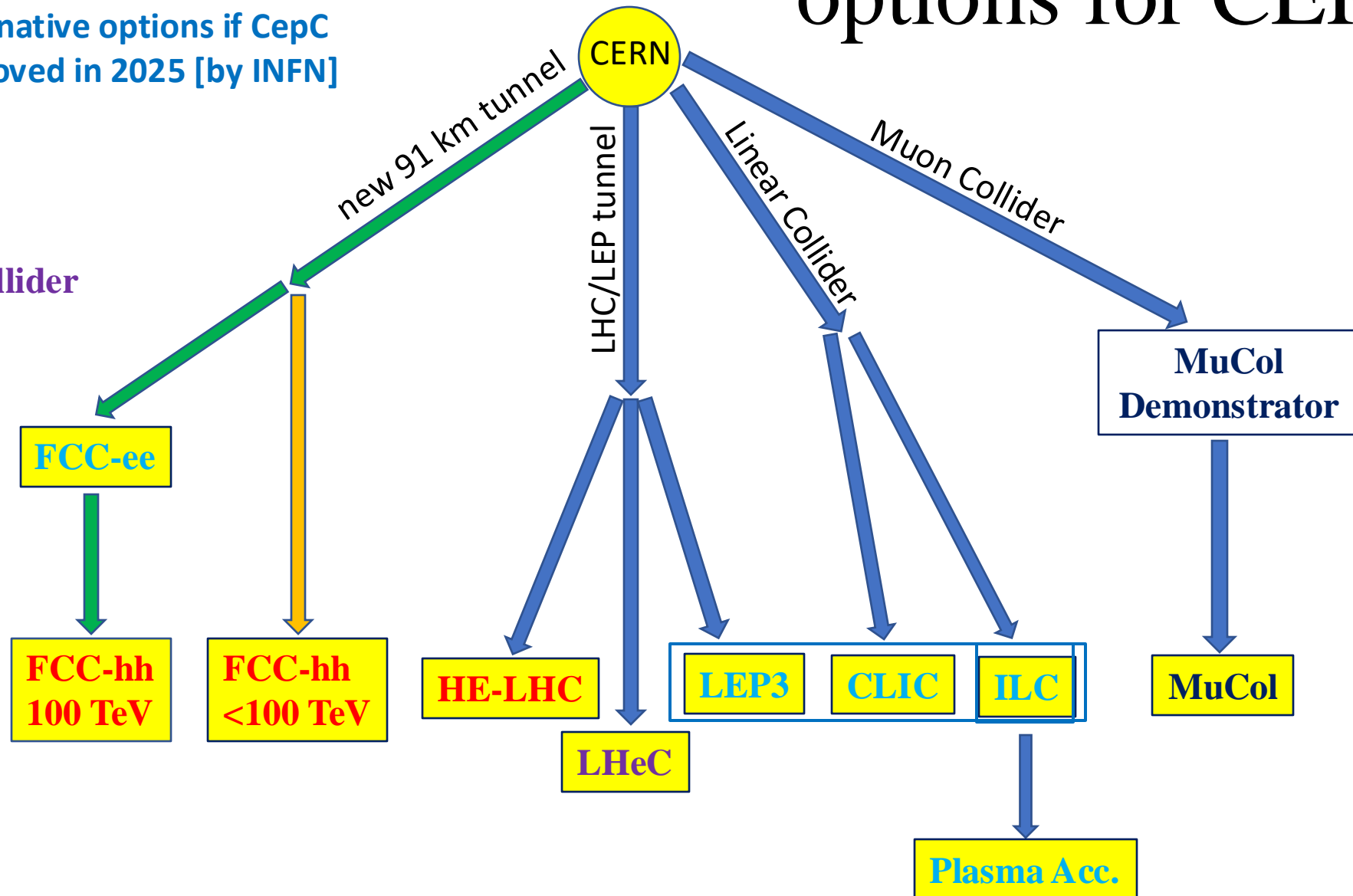
- █ ESPP 2020 recommendation
- █ Alternative options
- █ Alternative options if CepC approved in 2025 [by INFN]

e+e- collider

hadron collider

electron-hadron collider

$\mu+\mu-$ collider



Articolo su prossimo DG CERN

Repubblica 28 Ottobre 2024

- The position emerged from the Rome INFN workshop of 6 and 7 May appeared quite clearly. It is now officially announced.

Il timore dei fisici che vorrebbero Fcc è che l'alleanza tra Londra e Berlino nasca proprio dalla volontà di rallentare l'avvio dell'impresa. Ma ci sono altri Paesi fondatori del Cern che invece Fcc lo vogliono. A cominciare dall'Italia (9,8% del budget). «Per noi il Future circular collider è una priorità», conferma Antonio Zoccoli, presidente dell'Istituto nazionale di fisica nucleare. La pensano così anche Francia (13% del budget) e Svizzera (3,7%). I loro voti convergeranno sugli altri candidati, favorevoli a Fcc?

Iniziative INFN programmate

- **3 Luglio 2024:** 1° meeting comunità ECR
<https://agenda.infn.it/event/42205/>
- **30 Settembre 2024:** 2° meeting comunità ECR
<https://agenda.infn.it/event/42691/>
- **1 Ottobre 2024: Incontro INFN su Collider Adronici (LNF)**
<https://agenda.infn.it/event/42594/timetable/>
- **22-24 Gennaio 2025: Incontro INFN su Collider Leptonici (LNF)**
- **Workshop INFN finalizzazione Input alla European Strategy 4 Febbraio 2025**

Convention for the Establishment of a European Organization for Nuclear Research

CONVENTION FOR THE ESTABLISHMENT OF A EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Paris, 1st July, 1953
as amended on 17 January 1971

ARTICLE II : Purposes

1. The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto. The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available.
2. The Organization shall, in the collaboration referred to in paragraph 1 above, confine its activities to the following:
 1. the construction and operation of one or more international laboratories (hereinafter referred to as "the Laboratories ") for research on high-energy particles, including work in the field of cosmic rays; each Laboratory shall include:
 - i. one or more particle accelerators;
 - ii. the necessary ancillary apparatus for use in the research programmes carried out by means of the machines referred to in (i) above;
 - iii. the necessary buildings to contain the equipment referred to in (i) and (ii) above and for the administration of the Organization and the fulfilment of its other functions;

Community Involvement (cont.)

(ii) Open Symposium 23 – 27 June 2025

In addition to plenary (and parallel) presentations, this Symposium should be organised such that there is room for discussions

(iii) Based on the collected input (March 2025) and Briefing Book (Sept. 2025) **further input from the national communities is welcome**

A proposal on how to collect and structure this input is presented by ECFA

→ see talk by Paris Sphicas this afternoon

Summary on Community Input

31 March 2025

Deadline for the submission of input from the community

Further input from national communities

23 – 27 June 2025

Open Symposium

Lido di Venezia

End of September 2025

Submission of the “Briefing Book”

Further input from national communities, deadline 14 Nov 2025

01 – 05 December 2025

Strategy Drafting Session

How do we proceed?

- **The Chairs of the CSNs**, in addition to organizing internal events, will invite their Coordinators to initiate **discussions and debates at the INFN Divisions**, in agreement with their respective Directors. The conclusions that emerge from these meetings will be shared with the same Presidents.
- **The Directors of the Laboratories** will initiate a discussion within the scientific community of their respective Laboratories, focusing especially on the **contributions they can offer based on the research infrastructures available at the Laboratories themselves**.
- **The Chairs of the CSNs and the Directors of the Laboratories must produce a document to be sent to the INFN Steering Group**; this document will summarize the results of the process within the CSNs and Laboratories and may potentially be submitted as input to the Strategy.
- **The MAC Coordinator** will oversee the preparation of a document that homogeneously compiles the **studies on accelerators conducted by the INFN** and financed by the Executive Committee with dedicated funds to contribute to the development of the European Strategy 2020 recommendations.
- The Computing Representative will oversee the preparation of a document that homogeneously compiles the **studies on aspects related to computing for future projects**

Streamlining the process and form of national inputs

1) Organization of national and/or regional meetings

- a) It is suggested that two national ("town-hall" or similar) meetings be organised (clearly, each country/region remains at liberty to decide on the number):
 - i. one meeting between the end of March 2025 and the Open Symposium at the end of June, with a deadline for comments by 26 May, and
 - ii. a second one after the release of the Briefing Book around the end of September 2025, with a deadline of 14 November 2025.
- i. The meeting(s) could/should be co-organised by the Restricted ECFA delegate and the country's representative on the ESG (for some countries this is the same person).
- ii. The meeting(s) should be guided by a set of "standard questions" to be considered.
- iii. Potentially, and if deemed useful, the November 2024 Plenary ECFA meeting could be used to further guide and assist with this process.

Work / topics covered and shared among PPG and ESG

PPG:

Physics + Technology working groups

- Electroweak physics (including Higgs physics)
- Strong interaction
- Flavour physics
- Beyond the Standard Model physics
- Neutrino physics and cosmic messengers
- Dark matter and dark sector
- Accelerator science and technology
- Detector instrumentation
- Computing

→ **Physics Briefing Book**

ESG: Overarching topics

- **National input / roadmaps (→ strategic)**
- **Projects (FCC, LC/C³, LE-FCC-hh, MC, ..)**
(timeline, costs, (physics → PPG))
- Comparisons across proposed projects
- Relations with other fields of physics
- Implementation of the Strategy
(role of CERN and National Labs, coordination of European participation in projects sited outside Europe, ...)
- Knowledge and Technology transfer
- Sustainability, environmental impact
- Public engagement, education, communication
- ...

→ *ESG working groups to be set up, in preparation*



DRD1 Organization & Management



UN ESEMPIO di DRDT Management:

COLLABORATION BOARD

RESOURCE BOARD

MANAGEMENT BOARD

Management

SPOKESPERSONS

SCIENTIFIC
COORDINATION BOARD

(Working Groups, Work Packages,
DRDs Liaisons, Common Projects)

Scientific Coordination

Highlights & Milestones:

- ✓ **Dec. 2023:** Approval of the DRD1 Collaboration Organizational Structure
- ✓ **Dec. 2023:** Elections of the Spokespersons, CB Chair / Deputy
- ✓ **Dec. 2023:** Mandate of the ECFA TF1 Implementation Team extended until June 2024
- ✓ **Jun. 2024:** All management positions are filled and approved by CB
- ✓ **Nov. 2024:** MoU with completed Annexes (151 pages) sent to CERN Management for final comments & approval

Prompt signature of the DRD1 MoU is crucial to advance interactions with FA and ramp-up DRD1 work program

4.2 Persons Currently Holding Positions of Specific Responsibilities Within the Collaboration

Function	Name	Institute	Country
Collaboration Board Chairperson	Anna Colaleo	IT-INFN.BA	Italy
Collaboration Board Deputy Chairperson	Leszek Ropelewski	CH-CERN	Switzerland
Collaboration Board Secretary	Margherita Primavera	IT-INFN.LE	Italy
CB Chair Advisory Group	Markus Ball	DE-HISKP-UNI-BONN	Germany
	Alberto Blanco	PT-COIMBRA-LIP	Portugal
	Alan Bross	US-FERMILAB	USA
	Mary Cruz Fouz	ES-CIEMAT	Spain
	Jianbei Liu	CN-USTC	China
	Esther Ferrer Ribas	FR-IRFU-CEA	France
Spokespersons	Eraldo Oliveri	CH-CERN	Switzerland
	Maxim Titov	FR-IRFU-CEA	France
Management Board Elected Members	Marcello Abbrescia	IT-INFN.BA	Italy
	Amos Breskin	IL-WIS	Israel
	Gabriel Charles	FR-CNRS-IN2P3/IJCLab	France
	Paul Colas	FR-IRFU-CEA	France
	Nicola De Filippis	IT-INFN.BA	Italy
	Diego Gonzalez Diaz	ES-USC/IGFAE	Spain
	Giuseppe Iaselli	IT-INFN.BA	Italy
	Mauro Iodice	IT-INFN.RM3	Italy
	Joehen Kaminski	DE-UNI-BONN	Germany
	Thorsten Lux	ES-IFAE	Spain
	Michael Tytgat	BE-VUB	Belgium
	Peter Wintz	DE-FZJ-GSI-UBOCHUM	Germany
Management Board Members nominated by SPs	Kondo Gnanvo	US-TJNAF-JLAB	USA
	Natsuki Tomida	JP-KYOTO-U	Japan
	Andy White	US-UTA	USA
Management Board Secretary	Gabriella Pugliese	IT-INFN.BA	Italy
Resource Coordinator	Fulvio Tassarotto	IT-INFN.TS	Italy
Deputy Resource Coordinator	Hans Taureg	DE-UNI-BONN	Germany
Technical Coordinator	Florian Brunbauer	CH-CERN	Switzerland
EXSO (4.1.21)	Yorgos Tsipolitis	GR-GSRLNTUA	Greece
Working Groups Coordinator	Beatrice Mandelli	CH-CERN	Switzerland
Work Package Coordinators	Piotr Gasik	DE-GSI	Germany
Liaison Person with DRD2	Diego Gonzalez Diaz	ES-USC/IGFAE	Spain
Liaison Persn with DRD4	Fulvio Tassarotto	IT-INFN.TS	Italy
Liaison Person with DRD5	Florian Maximilian Brunbauer	CH-CERN	Switzerland
Liaison Person with DRD6	Imad Laktineh	FR-IP2I	France
Liaison Person with DRD7	Marco Bregant	BR-IFUSP	Brazil
	Sorin Matoiu	RO-IFIN-HH	Romania

Persons Currently Holding Positions as Work Package Leaders, Work Package Project Leaders are listed in Annex 7. Persons Currently Holding Positions as Working Group Conveners are listed in Annex 8.