

## General News

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FC-CPPM Monthly Meeting

June 23, 2020



- 1 Update of the European Strategy on Particle Physics
- 2 FCC Innovative Study
- 3 Meetings

## Introduction



## EPPSU2020

### General Introduction

20 Strategy Statements unanimously adopted by the ESG in Jan. 2020



Two documents submitted :

1. Draft Update of the European Strategy for Particle Physics (with preamble, statements, conclusion) for feedback  
CERN/SPC/1137/RA CERN/3486/C2
2. Deliberation Document (with in addition rational behind the statements) for information  
CERN/SPC/1136/RA: CERN/3485/C

- 2 statements on **Major developments** from the 2013 Strategy
- 3 statements on **General considerations** for the 2020 update
- 2 statements on **High-priority future initiatives**
- 4 statements on **Other essential scientific activities** for particle physics
- 2 statements on **Synergies with neighbouring fields**
- 3 statements on **Organisational issues**
- 4 statements on **Environmental and societal impact**

### Derived based on

- Granada Symposium
- National Inputs
- Working Group 1: Social and career aspects for the next generation
- Working Group 2: Issues related to Global Projects hosted by CERN or funded through CERN outside Europe
- Working Group 3: Relations with other groups and organisations
- Working Group 4: Knowledge and Technology Transfer
- Working Group 5: Public engagement, Education and Communication
- Working Group 6: Sustainability and Environmental impact



## 2020 Strategy Statements

### 1. Major developments from the 2013 Strategy

2013 Strategy identified 4 high-priority, large-scale scientific activities (2 about future colliders addressed later)

- LHC → upgrade to high luminosity (10 x LHC)
- Neutrino physics → Europe to participate in long-baseline experiments in Japan and the US (Neutrino Platform)

HL-LHC will challenge the understanding of particle physics at around the TeV scale, and indirectly at multi-TeV scales.

- Development of the essential short dipole magnets with Nb<sub>3</sub>Sn superconductor ready to be tested in LHC Run3
- Upgrades of ATLAS and CMS documented in TDRs, to be commissioned in 2027; emerging new technologies for trigger systems, computing and management of big data, reconstruction algorithms and analysis methods
- Upgrades considered by LHCb (flavour physics) and ALICE (heavy ion physics)

Deliberation Document

a) 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 Nb<sub>3</sub>Sn magnets have been developed. *The successful completion of the high-luminosity upgrade of the 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.*

Strategy Statements

## CERN: Headquarter of the European Leadership



### 2020 Strategy Statements

## 2. General considerations for the 2020 update

- With the construction and efficient operation of the LHC, CERN has established itself as the world's premier particle physics laboratory
- Cooperation between the Member, Associate Member and non-Member States and the concentration of the European particle-physics effort at CERN have created a unique resource in terms of scientific accomplishments, human capital, international collaboration, technical expertise, and research infrastructure
- CERN and other accelerator-based laboratories worldwide use cutting-edge technologies (radiofrequency cavities to accelerate particles, superconducting magnets, cryogenics and high vacuum, management of large data volumes, etc.). shared throughout Europe for the benefit of the Member and Associate Member States

a) Europe, through CERN, has world leadership in accelerator-based particle physics and related technologies. The future of the field in Europe and beyond depends on the continuing ability of CERN and its community to realise compelling scientific projects. *This Strategy update should be implemented to ensure Europe's continued scientific and technological leadership.*

## The CRUCIAL choice for the Energy Frontier



### 2020 Strategy Statements

#### 3. High-priority future initiatives

**It is essential for particle physics in Europe and for CERN to be able to propose a new facility after the LHC**

- There are two clear ways to address the remaining mysteries: Higgs factory and exploration of the energy frontier
- Europe is in the privileged position to be able to propose both: CLIC or FCCee as Higgs factory, CLIC (3 TeV) or FCChh (100 TeV) for the energy frontier
- The dramatic increase in energy possible with FCChh leads to this technology being considered as the most promising for a future facility at the energy frontier.
- It is important therefore to launch a feasibility study for such a collider to be completed in time for the next Strategy update, so that a decision as to whether this project can be implemented can be taken on that timescale.

a) 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. Accomplishing these compelling goals will require innovation and cutting-edge technology:

- *the particle physics community should ramp up its R&D effort focused on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;*
- 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 timely realisation of the electron-positron International Linear Collider (ILC) in Japan would be compatible with this strategy and, in that case, the European particle physics community would wish to collaborate.

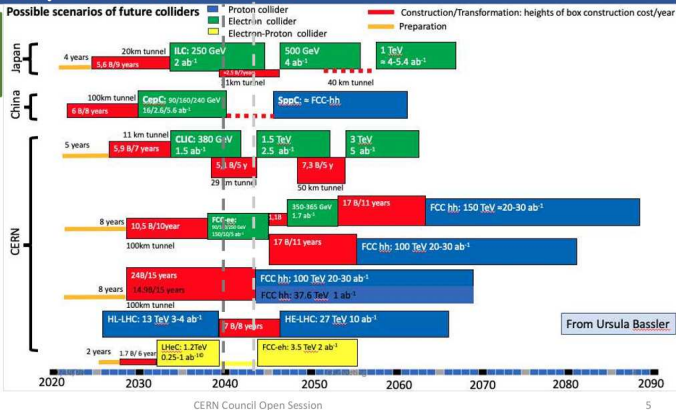
## Statements from the US



## 2020 Strategy Update

### 3. High-priority future initiatives

Map of possible future facilities submitted as input to the Strategy Update



From Ursula Bassler

## Concurrent Timelines of Facilities



### 2020 Strategy Statements

#### 4. Other essential scientific activities for particle physics

##### Diverse science at low energy: exploration of dark matter and flavour puzzle

- Change of paradigm for dark matter particles - could be as light as  $10^{-22}$  eV to as heavy as primordial black holes of  $10 \times M_{\odot}$
- Observed pattern of masses and mixings of quarks and leptons, remains a puzzle
- Physics Beyond Colliders study identified many high impact options with modest investment
- Larger scale new facilities such as the Beam Dump Facility, and later LHeC option at CERN, difficult to resource within the CERN budget, considering the other recommendations of this Strategy
- Improvements in the knowledge of the proton structure needed to fully exploit the potential of present and future hadron colliders - added value from fixed target experiments and from Electron Ion Collider (EIC) in BNL
- Given the challenges faced by CERN in preparing for the future collider, the role of the National Laboratories in advancing the exploration of the lower energy regime cannot be over-emphasised (ex. axions at DESY, rare muon decays in PSI, dark photon in Frascati)

a) The quest for dark matter and the exploration of flavour and fundamental symmetries are crucial components of the search for new physics. This search can be done in many ways, for example through precision measurements of flavour physics and electric or magnetic dipole moments, and searches for axions, dark sector candidates and feebly interacting particles. There are many options to address such physics topics including energy-frontier colliders, accelerator and non-accelerator experiments. A diverse programme that is complementary to the energy frontier is an essential part of the European particle physics Strategy. *Experiments in such diverse areas that offer potential high-impact particle physics programmes at laboratories in Europe should be supported, as well as participation in such experiments in other regions of the world.*



## Introduction

- From an H2020 call
- Goal: Carry out the technical design study for a 100 km long luminosity frontier circular collider infrastructure at CERN that will extend Europe's leadership in the domain of fundamental physics research until the end of the 21<sup>st</sup> century
- High priority topics:
  - 1 Optimisation of the particle collider design
  - 2 Implementation and public participation processes in FR and CH (environment, resources,...)
  - 3 Create a committed user community... and to engage every member of the society
  - 4 Socio-economic impact assessment
- Participants: Public + Private partnership



## FCC-IS Work Packages

- <https://indico.cern.ch/category/12545/>

Sub-tree for meetings that are specific to the FCC Innovation Study EU project.

WP1 (Management)	empty	⇒
WP2 (Collider design)	empty	⇒
WP3 (Integrate Europe)	empty	⇒
WP4 (Impact & sustainability)	empty	⇒
WP5 (Leverage & engage)	empty	⇒
FCCIS Executive Boards	empty	⇒
FCCIS International Advisory Committees	empty	⇒
FCCIS International Steering Committees	empty	⇒

- Note: in FR, only CEA and LAPP who take part in the call are eligible to get money for machine R&D

## Current Meeting Outline

10:00 → 10:20 **General News**

🕒 20m

Speaker: Dr Steve Muanza (CPPM Marseille)

10:20 → 10:30 **ILC News**

🕒 10m

Speaker: Claude Vallee (Centre de Physique des Particules de Marseille)



10:30 → 10:45 **Prospects for R&D in Mechanics for FCC**

🕒 15m

Speaker: Eric Vigeolas (CPPM)

## Next Meetings

- FCC-FR: meeting between labs representative, 29 June
- FCC-IS Kick-off Meeting, CERN, 9-11 November
- FCC Experiment & Physics Workshop, CERN, 9-13 November
- FCC-FR Workshop, Annecy, December 2020 or January 2021
- FCC General Meeting, Paris, April 2021

## Discussion

- New participants: 10% of your working time devoted to FCC studies
- FC-CPPM: autonomous group at CPPM