Particle Physics from the European Region

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FCC Workshop 2018
9-13 April
Amsterdam
Particle Physics today

\[\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\psi} \mathcal{D}\psi + h.c.
+ \bar{\chi} \mathcal{Y}_{ij} \chi \phi + h.c.
+ |\mathbf{P}\mathbf{\phi}|^2 - V(\phi)\]
Particle Physics today

description ≠ understanding
Particle Physics today

description ≠ understanding

new physics
Particle Physics today

description ≠ understanding

add your own design

new physics

a simple design?
Particle Physics today

description ≠ understanding

or more elegant?

new physics
Particle Physics today

description ≠ understanding

or more exotic?

new physics
Particle Physics today

\[ \mathcal{L} = -\frac{1}{4} F_{\mu \nu} F^{\mu \nu} + i \bar{\psi} D \psi + h.c. + \gamma^i Y_i \phi \bar{Y}_i \phi + m \bar{\phi} \phi + V(\phi) \]

description ≠ understanding

connection

add your own design

new physics
Need to agree on a long-term strategy for Particle Physics

European Particle Physics Strategy (2013)

Higgs discovery (2012)

Start data taking at the LHC (2010)

Start data taking HL-LHC (2026)
Need to agree on a long-term strategy for Particle Physics

- Higgs discovery (2012)
- Start data taking at the LHC (2010)
- European Particle Physics Strategy (2013)
- European Particle Physics Strategy (2020)
- Start data taking HL-LHC (2026)
Need to agree on a long-term strategy for Particle Physics

- Start data taking at the LHC (2010)
- Higgs discovery (2012)
- European Particle Physics Strategy (2013)
- European Particle Physics Strategy (2020)
- Start data taking HL-LHC (2026)
CERN, the European Laboratory for global collaboration

European institutions are involved in Particle Physics experiments worldwide

13342 users
60% from member states
Running at 13 TeV, beyond design luminosity, goal is 300/fb by end of Run3

HL-LHC approved by Council in June 2016, goal is 3000/fb by ~2037

Accelerator and detector upgrades on schedule for timely installation
The role of the LHC

A MORE PRECISE and more COMPLETE description

connection

unique exploration of the TeV scale

new physics
With the LHC towards a more profound understanding

Picture from Flip Tanedo @ Quantum Daires
Some physics results of the LHC – scalar sector

Gauge interaction

\[ \alpha m_v^2 / v^2 \]

Yukawa interaction

\[ \alpha m_f / v \]

Self interaction

\[ \alpha m_h^2 / v^2 \]

Particle mass [GeV]

1

10

100

Ratio to SM

0

0.5

1

1.5

CMS Preliminary

35.9 fb\(^{-1}\) (13 TeV)

SM Higgs boson

[\( M, \varepsilon \)] fit

\( \pm 1\sigma \)

\( \pm 2\sigma \)
Some physics results of the LHC – Standard Model

Production Cross Section, $\sigma$ [pb]

- $\sigma_{Wn \text{ jet(s)}} \geq \sigma_{Zn \text{ jet(s)}} \geq \sigma_{\gamma W} \geq \sigma_{\gamma \gamma}$
- $\sigma_{WW} \geq \sigma_{WZ} \geq \sigma_{ZZ}$
- $\sigma_{\mu \ell, l=e, \rightarrow, Z \nu_l \rightarrow EW}$
- $\sigma_{qqW} \geq \sigma_{qqZ} \geq \sigma_{q\bar{q}W} \geq \sigma_{q\bar{q}Z}$
- $\sigma_{ttH} \geq \sigma_{ttW} \geq \sigma_{ttZ}$

CMS Preliminary

January 2018

CMS 95%CL limits at 7, 8 and 13 TeV

- 7 TeV CMS measurement ($L \leq 5.0 \text{ fb}^{-1}$)
- 8 TeV CMS measurement ($L \leq 19.6 \text{ fb}^{-1}$)
- 13 TeV CMS measurement ($L \leq 35.9 \text{ fb}^{-1}$)

Theory prediction

- CMS Preliminary

All results at: http://cern.ch/go/pNj7

the cup doesn’t break over many orders of magnitude
Some physics results of the LHC – SUSY searches

Several strategies to search phenomena of supersymmetry.

The production of a pair of stop quark pairs is searched for in several decay channels.
A broad range of ongoing SUSY searches
<table>
<thead>
<tr>
<th>Model</th>
<th>$f, g$</th>
<th>Jets†</th>
<th>$E_{\text{miss}}^\text{T}$</th>
<th>Limit</th>
<th>Reference</th>
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<tbody>
<tr>
<td>ADD $G_{\text{add}} + g/s$</td>
<td>0, $e, \mu$</td>
<td>1 − 4</td>
<td>Yes</td>
<td>35.1</td>
<td>$M_{\text{Lx}} \leq 7.75$ TeV</td>
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<td>ADD non-resonant $\gamma\gamma$</td>
<td>2 $\gamma$</td>
<td>− −</td>
<td>−</td>
<td>36.7</td>
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<tr>
<td>ADD GBH</td>
<td>2</td>
<td>1</td>
<td>37.0</td>
<td>$M_{\text{Lx}} \geq 8.9$ TeV</td>
<td></td>
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<td>ADD BH high $\Sigma_{\text{R}}$</td>
<td>2 $\Sigma_{\text{R}}$</td>
<td>2</td>
<td>32.1</td>
<td>$M_{\text{Lx}} \leq 6.2$ TeV</td>
<td>CERN-PH-EP-2017-132</td>
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<td>ADD BH multijet</td>
<td>2</td>
<td>1</td>
<td>36.7</td>
<td>$M_{\text{Lx}} \leq 9.95$ TeV</td>
<td>CERN-PH-EP-2017-132</td>
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<tr>
<td>RS1 $G_{\text{rs}} + g/s$</td>
<td>2 $\gamma$</td>
<td>− −</td>
<td>−</td>
<td>36.7</td>
<td>$M_{\text{Lx}} \leq 4.1$ TeV</td>
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<td>Bulk RS $G_{\text{bulk}} + g/s$</td>
<td>1, 2</td>
<td>1, 3</td>
<td>Yes</td>
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<td>$M_{\text{Lx}} \leq 1.75$ TeV</td>
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<tr>
<td>2UED + RRP</td>
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<td>3</td>
<td>Yes</td>
<td>13.2</td>
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<td>Extra dimensions</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SMZ + $\gamma$</td>
<td>2 $\gamma$</td>
<td>− −</td>
<td>−</td>
<td>36.1</td>
<td>$M_{\text{Lx}} \leq 2.4$ TeV</td>
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<td>SMZ + $\tau$</td>
<td>2 $\tau$</td>
<td>− −</td>
<td>−</td>
<td>36.1</td>
<td>$M_{\text{Lx}} \leq 1.5$ TeV</td>
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<tr>
<td>Lepton + $\tau$</td>
<td>2 $\tau$</td>
<td>− −</td>
<td>−</td>
<td>36.1</td>
<td>$M_{\text{Lx}} \leq 2.9$ TeV</td>
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<td>1 $\rho_{\text{V}}$</td>
<td>− −</td>
<td>−</td>
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<td>$M_{\text{Lx}} \leq 5.1$ TeV</td>
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<td>HVT V$^Q$ VV$^Q$</td>
<td>0 $\ell$</td>
<td>2</td>
<td>36.1</td>
<td>$M_{\text{Lx}} \leq 2.5$ TeV</td>
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<td>0 $\ell$</td>
<td>2</td>
<td>36.1</td>
<td>$M_{\text{Lx}} \leq 2.9$ TeV</td>
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<td>LRSM $W_{\text{Q}} + b$</td>
<td>1, 2</td>
<td>1, 0</td>
<td>1, 3</td>
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<td>$M_{\text{Lx}} \leq 1.92$ TeV</td>
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<td>2 b, 1</td>
<td>1</td>
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<td>Gauge bosons</td>
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<td></td>
<td></td>
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<tr>
<td>Cl $q_1 + q_2$</td>
<td>2 $\gamma$</td>
<td>− −</td>
<td>−</td>
<td>37.0</td>
<td>$M_{\text{Lx}} \leq 21.8$ TeV</td>
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<td>Cl $q_1 + q_2$</td>
<td>2 $\gamma$</td>
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<td>−</td>
<td>43.6 TeV</td>
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<td>2 $\gamma$</td>
<td>− −</td>
<td>−</td>
<td>37.0</td>
<td>$M_{\text{Lx}} \leq 21.8$ TeV</td>
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<td>DM</td>
<td></td>
<td></td>
<td></td>
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<td>Axial-vector mediator (Dirac DM)</td>
<td>0 $\gamma$</td>
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<td>1 − 4</td>
<td>Yes</td>
<td>36.1</td>
<td>$M_{\text{Lx}} \geq 1.2$ TeV</td>
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<tr>
<td>VLQ L $\ell$ EFT (Dirac DM)</td>
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<td>1, 3</td>
<td>Yes</td>
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<td>$M_{\ell} \geq 700$ GeV</td>
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<td>Scalar LQ $\ell$ gen</td>
<td>0, 1</td>
<td>2, 3</td>
<td>20.3</td>
<td>$M_{\ell} \geq 1.1$ TeV</td>
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<tr>
<td>Scalar LQ $\ell$ gen</td>
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<td>2, 3</td>
<td>Yes</td>
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<td>36.1</td>
<td>$M_{T} \geq 1.2$ TeV</td>
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<tr>
<td>VLQ $T \rightarrow H + X$</td>
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<td>2, 3, 4</td>
<td>Yes</td>
<td>36.1</td>
<td>$M_{T} \geq 1.2$ TeV</td>
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<tr>
<td>VLQ $B \rightarrow H + X$</td>
<td>0, 1, 2 $\ell$</td>
<td>2, 3, 4</td>
<td>Yes</td>
<td>36.1</td>
<td>$M_{B} \geq 700$ GeV</td>
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<td>VLQ $B \rightarrow H + X$</td>
<td>0, 1, 2 $\ell$</td>
<td>2, 3, 4</td>
<td>Yes</td>
<td>36.1</td>
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<td>VLQ $Q \rightarrow W + H_{Q}$</td>
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<td>36.1</td>
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<td>Excited quark $q^* \rightarrow q_{\text{L}}$</td>
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<td>37.0</td>
<td>$M_{q^*} \geq 6.0$ TeV</td>
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<tr>
<td>Excited quark $q^* \rightarrow q_{\text{L}}$</td>
<td>1</td>
<td>37.0</td>
<td>$M_{q^*} \geq 6.0$ TeV</td>
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<tr>
<td>Excited quark $q^* \rightarrow q_{\text{L}}$</td>
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<td>37.0</td>
<td>$M_{q^*} \geq 6.0$ TeV</td>
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<td>37.0</td>
<td>$M_{b^*} \geq 2.3$ TeV</td>
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<tr>
<td>Excited lepton $\ell^*$</td>
<td>3, 4, 5</td>
<td>Yes</td>
<td>13.3</td>
<td>$M_{\ell^*} \geq 2.3$ TeV</td>
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<tr>
<td>Excited lepton $\ell^*$</td>
<td>3, 4, 5</td>
<td>Yes</td>
<td>13.3</td>
<td>$M_{\ell^*} \geq 2.3$ TeV</td>
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</tr>
<tr>
<td>LRSM Majorana</td>
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<td>20.3</td>
<td>$M_{W_{\text{L}}} \geq 2.0$ TeV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higgs triplet $H_{1}$</td>
<td>2, 3, 4</td>
<td>$\ell$</td>
<td>36.1</td>
<td>$M_{H_{1}} \geq 870$ GeV</td>
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</tr>
<tr>
<td>Higgs triplet $H_{2}$</td>
<td>2, 3, 4</td>
<td>$\ell$</td>
<td>36.1</td>
<td>$M_{H_{2}} \geq 870$ GeV</td>
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<tr>
<td>Monopole (non-rob prod)</td>
<td>2</td>
<td>20.3</td>
<td>$M_{\text{monopole mass}} \leq 657$ GeV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-charged particles</td>
<td>20.3</td>
<td>$M_{\text{monopole mass}} \leq 657$ GeV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic monopoles</td>
<td>7.0</td>
<td>$M_{\text{monopole mass}} \leq 1.34$ TeV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\sqrt{s} = 8$ TeV
$\sqrt{s} = 13$ TeV

$\mathcal{L} dt = (3.2 - 37.0) \text{ fb}^{-1}$

$\sqrt{s} = 8, 13 \text{ TeV}$

$\text{Mass scale [TeV]}$

*Only a selection of the available mass limits on new states or phenomena is shown.
†Small-radius (large-radius) jets are denoted by the letter (I).
The role of the LHC

from a BETTER description towards a more PROFOUND understanding

connection

our initial designs are not accepted by Nature

new physics
High-Luminosity LHC: 300/fb (by 2023) → 3000/fb (by 2037)

New IR-quads Nb$_3$Sn (inner triplets)

New 11 T Nb$_3$Sn (short) dipoles

Collimation upgrade

Cryogenics upgrade

Crab Cavities

Cold powering

Machine protection

Civil engineering

Formal approval by CERN Council (June 2016)

Cost to Completion: 950 MCHF (material)

Detector upgrades are well planned as well
“CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and electron-positron high-energy frontier machines. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating structures, in collaboration with national institutes, laboratories and universities worldwide.”
CLIC aims at an acceleration gradient of 100 MV/m. A drive beam is decelerated in dedicated Power Extraction and Transfer Structures (PETS), and the generated RF power is transferred to the main beam.
Higgs characterization
Precision on top quark Yukawa of ~4% and Higgs self-coupling of ~20%.

Staged approach
First period around the top quark pair threshold, thereafter increase the energy up to 3 TeV to search for new phenomena.

CLIC roadmap

2013 - 2019 Development Phase
Development of a Project Plan for a staged CLIC implementation in line with LHC results; technical developments with industry, performance studies for accelerator parts and systems, detector technology demonstrators

2020 - 2025 Preparation Phase
Finalisation of implementation parameters, preparation for industrial procurement, Drive Beam Facility and other system verifications, Technical Proposal of the experiment, site authorisation

2026 - 2034 Construction Phase
Construction of the first CLIC accelerator stage compatible with implementation of further stages; construction of the experiment; hardware commissioning

CLIC working on an implementation plan & cost reduction as input to European Particle Physics Strategy
“There is a strong scientific case for an electron-positron collider, … Europe looks forward to a proposal from Japan to discuss a possible participation.”

Waiting for a statement from the Japanese Government for their willingness to host ILC before end of 2018
International Linear Collider (ILC)

- ~1800 cryomodules of ~12m in Liquid He vessel
- ~16000 superconductive cavities of ~1m
Technology connection with the European XFEL at DESY

The 3.4 km long European XFEL generates extremely intense X-ray flashes to be used by researchers from all over the world.

Max. energy electrons = 17.5 GeV

First mass production in industry of SC radio frequency TESLA technology (from about 100 accelerator modules at the XFEL to about 2000 at ILC).

- XFEL: 80% of the cavities reach a gradient of 33 MV/m
- ILC: 90% of the cavities need a gradient of 35 MV/m

This demonstrates the goal for the ILC is potentially achievable.
Cost reduction both by scaling from 500 GeV to 250 GeV with a focus on Higgs physics, and by technological innovations on the superconducting materials (Nb) and cavity construction (surface process).

Physics Case for the 250 GeV Stage of the ILC, arXiv:1710.07621
With linear colliders one has excellent zoom-in capabilities for many terms.

<table>
<thead>
<tr>
<th></th>
<th>ILC250</th>
<th>ILC250+500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 ab⁻¹</td>
<td>full ILC</td>
</tr>
<tr>
<td>w. pol.</td>
<td></td>
<td>250+500 GeV</td>
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<tr>
<td>$g(h b b)$</td>
<td>1.1</td>
<td>0.58</td>
</tr>
<tr>
<td>$g(h c c)$</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>$g(h g g)$</td>
<td>1.7</td>
<td>0.95</td>
</tr>
<tr>
<td>$g(h W W)$</td>
<td>0.67</td>
<td>0.34</td>
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<tr>
<td>$g(h t t)$</td>
<td>1.2</td>
<td>0.74</td>
</tr>
<tr>
<td>$g(h Z Z)$</td>
<td>0.68</td>
<td>0.35</td>
</tr>
<tr>
<td>$g(h y y)$</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>$g(h ù ù)$</td>
<td>5.6</td>
<td>5.1</td>
</tr>
<tr>
<td>$g(h b b)/g(h W W)$</td>
<td>0.88</td>
<td>0.46</td>
</tr>
<tr>
<td>$g(h W W)/g(h Z Z)$</td>
<td>0.07</td>
<td>0.05</td>
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<tr>
<td>$\Gamma_h$</td>
<td>2.5</td>
<td>1.6</td>
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<tr>
<td>$BR(h \rightarrow inv)$</td>
<td>0.32</td>
<td>0.29</td>
</tr>
<tr>
<td>$BR(h \rightarrow other)$</td>
<td>1.6</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Physics Case for the 250 GeV Stage of the ILC, arXiv:1710.07621
The LCC physics & detector directorate is responsible for activities that advance the physics and detectors of the linear collider.

Three detector concepts:

- **ILD**: 71 institutions mostly from the European Region
- **SiD**: 24 institutions many from the European Region
- **CLICdp**: 29 institutions mostly from the European Region

Three detector R&D groups:

- **CALICE**: 57 institutions mostly from the European Region
- **LCTPC**: 32 institutions many from the European Region
- **FCAL**: 14 institutions mostly from the European Region
Future Circular Collider (FCC)

- **pp-collider (**FCC-hh**)**
  main emphasis, defining infrastructure requirements

- **e⁺e⁻ collider (**FCC-ee**)**
as potential first step

- **HE-LHC with FCC-hh**
technology

- **p-e collider (**FCC-he**)** option

- **µµ collider (**FCC-µµ**)** option

~16 T ⇒ 100 TeV **pp** in 100 km
Future Circular Collider (FCC) – proton collider

**Higgs production**
Compared to LHC at 14 TeV the cross section increases with a factor of about 16 at NNNLO. Together with a larger luminosity, one can expect 60-400x more events.

**Top Yukawa coupling**
Measurement to 1% precision

**Higgs self-coupling**
Measurement to 3-5% precision

**Higgs invisible decay Branching Ratio**
Sensitivity down to $3-5 \times 10^{-4}$

**Top quark production**
Cross section increases x35 compared to LHC at 14 TeV, and might collect up to $10^{12}$ top quarks

**New physics phenomena**
In general direct sensitivity to processes with mass scales up to 10-40 TeV.

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![Graph showing Higgs production cross section vs. energy](image)
Future Circular Collider (FCC) – lepton collider luminosities

- Z (91.2 GeV): $4.3 \times 10^{36}$ cm$^{-2}$s$^{-1}$
- W$^+W$ (161 GeV): $6.4 \times 10^{35}$ cm$^{-2}$s$^{-1}$
- HZ (240 GeV): $1.7 \times 10^{35}$ cm$^{-2}$s$^{-1}$
- $t\bar{t}$ (340-370 GeV): $3.8 \times 10^{34}$ cm$^{-2}$s$^{-1}$
- HZ: $1.5 \times 10^{34}$ cm$^{-2}$s$^{-1}$

LEP$\times 10^5$!
FCC – some physics objectives

ability to test our new designs or to find yet unknown elements up to 10-40 TeV

extreme zoom-in capabilities for about all terms
SC Magnet R&D – 16 T magnets would allow doubling the energy of the LHC machine (HE-LHC)

EuroCirCol WP5 (until 2019)
Feed the FCC CDR with a baseline design and a cost model for 16 T magnets

HiLumi LHC
To make space for the new HL-LHC collimators, replace a standard dipole by a pair of shorter 11 T dipoles producing the same integrated field

demonstrator short dipoles perform well
Future Circular Collider (FCC)
Accelerator R&D – Advanced Novel Accelerators (ICFA Panel)


The objective of this first ALEGRO workshop was to prepare and deliver, by the end of 2018, a document detailing the international roadmap and strategy of Advanced Novel Accelerators (ANAs) with clear priorities as input for the European Particle Physics Strategy Update.

![Graph showing beam energy versus time with various acceleration technologies](graph.png)
“Experiments studying quark flavour physics, dipole moments, charged-lepton violation and performing other precision measurements ... with neutrons, muons and antiprotons may give access to higher energy scales than direct particle production ... They can be based in national laboratories, with a moderate cost ... Experiments in Europe with unique reach should be supported, as well as participation in experiments in other regions of the world.”
Electric Dipole Moment (EDM)

Separation of particle charge along angular momentum axis. The EDM in the Standard Model is negligible (SM EDM electron $10^{-38}$ e-cm, best limit is $8.7 \times 10^{-29}$ e-cm at 90% CL), if non-zero it violates symmetries like P, T, CP.

Measure Larmor frequency shift

$\hbar \nu_+ = 2(\mu \cdot B + d \cdot E)$

$\hbar \Delta \nu = 4d \cdot E$

Variety of systems used from neutrons and electrons to atoms and molecules.
European Spallation Source

The European Spallation Source (ESS) is a multi-disciplinary research centre based on the world's most powerful neutron source. ESS will give scientists new possibilities in a broad range of research, from life science to engineering materials, from heritage conservation to magnetism. ESS is a pan-European project with Sweden and Denmark serving as host countries. The main research facility is being built in Lund, Sweden, and the Data Management and Software Centre (DMSG) is located in Copenhagen, Denmark.

Credit: Johan Jarnestad / ESS
ESS is working with 15 nations, nearly 40 European in-kind partner institutions, and more than 130 collaborating institutions worldwide.
Important as well for the European Part. Phys. Strategy

Applications in society are as well important to motivate large scale experiments.

- Since 2011 CERN signed more than 250 licenses and other kind of agreements with industry and other partners
- Ever year several tens of new technology disclosures (91 in 2016)
- 18 new start-ups are using CERN technologies since 2012

for more information: kt.cern
European Particle Physics and Particle Therapy

European Network for Light Ion Therapy (ENLIGHT) since 2002

Particle therapy centres in Europe - 2002

Particle therapy centres in Europe - 2015

Source: PTCOG, October 2015

Information from Manjit Dosanjh, “From Particle Physics to Medical Applications”, IOP Publishing 2017, Bristol, UK
European Particle Physics and Particle Therapy

European Network for Light Ion Therapy (ENLIGHT) since 2002

Particle therapy facilities in operation

- P centres
- C-ion centres

Source: PTCOG, October 2015

Information from Manjit Dosanjh, “From Particle Physics to Medical Applications”, IOP Publishing 2017, Bristol, UK
The European Particle Physics community is ready to initiate its Strategy Update

- Higgs discovery (2012)
- Start data taking at the LHC (2010)
- European Particle Physics Strategy (2013)
- European Particle Physics Strategy (2020)
- Start data taking HL-LHC (2026)

Future
Key objectives set by CERN Council

- Deliver by May 2020 an update of the European Particle Physics Strategy in a global context

- This strategy or vision will thereafter be a roadmap for funding agencies and laboratories to define concrete research programmes
CERN Council approved the Strategy Secretariat

Council appointment, September 2017:

• H. Abramowicz (Chairperson)
• J. D’Hondt (ECFA Chairperson, ECFA: European Committee for Future Accelerators)
• K. Ellis (SPC Chairperson, SPC: Science Policy Committee @ CERN)
• L. Rivkin (European LDG Chairperson, LDG: Lab Directors Group)

• Contact: EPPSU-Strategy-Secretariat@cern.ch

Responsible for the organisation of the process.
European Particle Physics Strategy Update

2017

Jan. 2018
Call for proposals for venues for Open Symposium and Strategy Drafting Session (deadline May 15, 2018)

2018

Feb. 2018
Call for scientific input

March 2018
Call for nominations of PPG & ESG members

June 2018
Council decision on venues and dates

Sept. 2018
Council to launch the Strategy Update process & establish the PPG and ESG

2019

Dec. 2018
Closing submission community input (deadline Dec 18, 2018)

2nd half of May 2019
Open Symposium

Sept. 2019
Physics Briefing Book available

March 2020
Strategy Update submitted to Council

May 2020
Council to approve Strategy Update

2nd half of Jan. 2020
Strategy Update Drafting Session

one week

4 days

consultation & consensus building

Physics results appearing after May 2019 will be taken into account in the process
General considerations by the Strategy Secretariat:

• The Strategy Update process follows a bottom-up approach
• To facilitate the bottom-up approach an Open Call for input reaching out to all members of the particle physics community is issued; including research groups, research networks or collaborations, laboratories, universities, (inter)national institutions and/or organisations.
• The aim is to gather all relevant input, e.g. on scientific projects, position papers, national roadmaps, etc.
• The concrete scientific input will be considered by the Physics Preparatory Group (PPG) towards the organisation of the Open Symposium and to deliver the Physics Briefing Book.
• Other inputs will be consider by the European Strategy Group (ESG) to draft the Strategy Update.
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- Other inputs will be consider by the European Strategy Group (ESG) to draft the Strategy Update.

Pragmatically, general guidelines are provided to facilitate both the collection of the input and its use by the PPG and the ESG; i.e. be brief, comprehensive and self-contained.
The CERN Council has set itself the objective of updating the European Strategy for Particle Physics by May 2020. To achieve this, it has established a Strategy Secretariat to which it has assigned the task of organising the update process.

The Strategy update process will include two major events: an “Open Symposium” and a “Strategy Drafting Session”.

At the Open Symposium, to be held in the second half of May 2019, the community will be invited to debate the scientific input into the Strategy update, which will take the form of a “Briefing Book”. This will be prepared over the summer of 2019 by a Physics Preparatory Group (PPG) and submitted to the European Strategy Group (ESG) for consideration before and during its Strategy Drafting Session to be held in the second half of January 2020.

To prepare the Open Symposium, the Strategy Secretariat hereby calls upon the particle physics community in universities, laboratories, national institutes and institutions to submit written input following the enclosed guidelines.

The deadline for input is **18 December 2018.**

Input should be submitted via a portal that will be created on the Strategy update website, which will be available from the beginning of October 2018, once the Strategy update has been formally launched by the CERN Council. The link to this website will appear on the CERN Council’s web pages - [https://council.web.cern.ch/en](https://council.web.cern.ch/en) - and be widely communicated through the appropriate channels.

The Strategy Secretariat
Update of the European Strategy for Particle Physics
EPPSU-Strategy-Secretariat@cern.ch
Guidelines for submitting input

Cover page (1 page)
Each document submitted should carry a single cover page containing no more than the title, the contact person(s) and an abstract.

Comprehensive overview (maximum 10 pages)
This core part of the document must be no more than 10 pages long (excluding the cover page) and must provide a comprehensive and self-contained overview of the proposed input.

Addendum
A separate addendum is to be provided addressing the following topics (where relevant):
- interested community,
- timeline,
- construction and operational costs (if applicable),
- computing requirements.

The mandatory addendum has no strict page limit, but should be comprehensive and self-contained.
Guidelines for submitting input

Cover page (1 page)
Each document submitted should carry a single cover page containing no more than the title, the contact person(s) and an abstract.

Comprehensive overview (maximum 10 pages)
This core part of the document must be no more than 10 pages long (excluding the cover page) and must provide a comprehensive and self-contained overview of the proposed input. It should address:

- scientific context,
- objectives,
- methodology,
- readiness and expected challenges.

Addendum
A separate addendum is to be provided addressing the following topics (where relevant):

- interested community,
- timeline,
- construction and operational costs (if applicable),
- computing requirements.

For the sub-structure of the 10-pages “comprehensive overview” we provide additional guidance that might be useful especially for scientific projects.

The mandatory addendum has no strict page limit, but should be comprehensive and self-contained.
Thank you for your attention
Practical instructions for submitting input

Format and deadline for submission
The cover page and the comprehensive overview are to be submitted as a single file, the “main document”, in portable document format (pdf) by 18 December 2018. The addendum is to be submitted as a separate file by the same deadline. A dedicated submission portal will be available on the EPPSU website as of October 2018, once the Strategy update has been formally launched by the Council at its September 2018 Session. The link to the EPPSU website will appear on the CERN Council’s web pages - https://council.web.cern.ch/en - and be widely communicated through the appropriate channels.

Distribution
Both documents submitted (main and addendum) will be passed on to the Physics Preparatory Group (PPG) and the European Strategy Group (ESG). Unless explicitly requested otherwise, they will also be made public. The option not to make either document public will be available upon submission via the dedicated portal.
Physics Preparatory Group (PPG) composition, adopted by Council, December 2013:
- The Strategy Secretary (acting as Chairperson),
- four members appointed by the Council on the recommendation of the SPC,
- four members appointed by the Council on the recommendation of ECFA,
- the SPC Chairperson,
- the ECFA Chairperson,
- the Chairperson of the European Laboratory Directors’ meeting,
- 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.

Responsible to organise the Open Symposium and to deliver to the European Strategy Group (ESG) a Physics Briefing book.
European Strategy Group (ESG) composition, adopted by Council, December 2013:

- the Strategy Secretary (acting as Chairperson),
- one representative appointed by each CERN Member State,
- one representative for each of the Laboratories participating in the major European Laboratory Directors’ meeting, including its Chairperson,
- the CERN Director-General,
- the SPC Chairperson,
- the ECFA Chairperson.

Invited:

- the President of the CERN Council,
- one representative from each of the Associate Member States,
- one representative from each Observer State,
- one representative from the European Commission,
- the Chairpersons of ApPEC, FALC, ESFRI and NuPECC,
- the members of the Physics Preparatory Group.

Responsible to deliver a draft Strategy Update to Council.