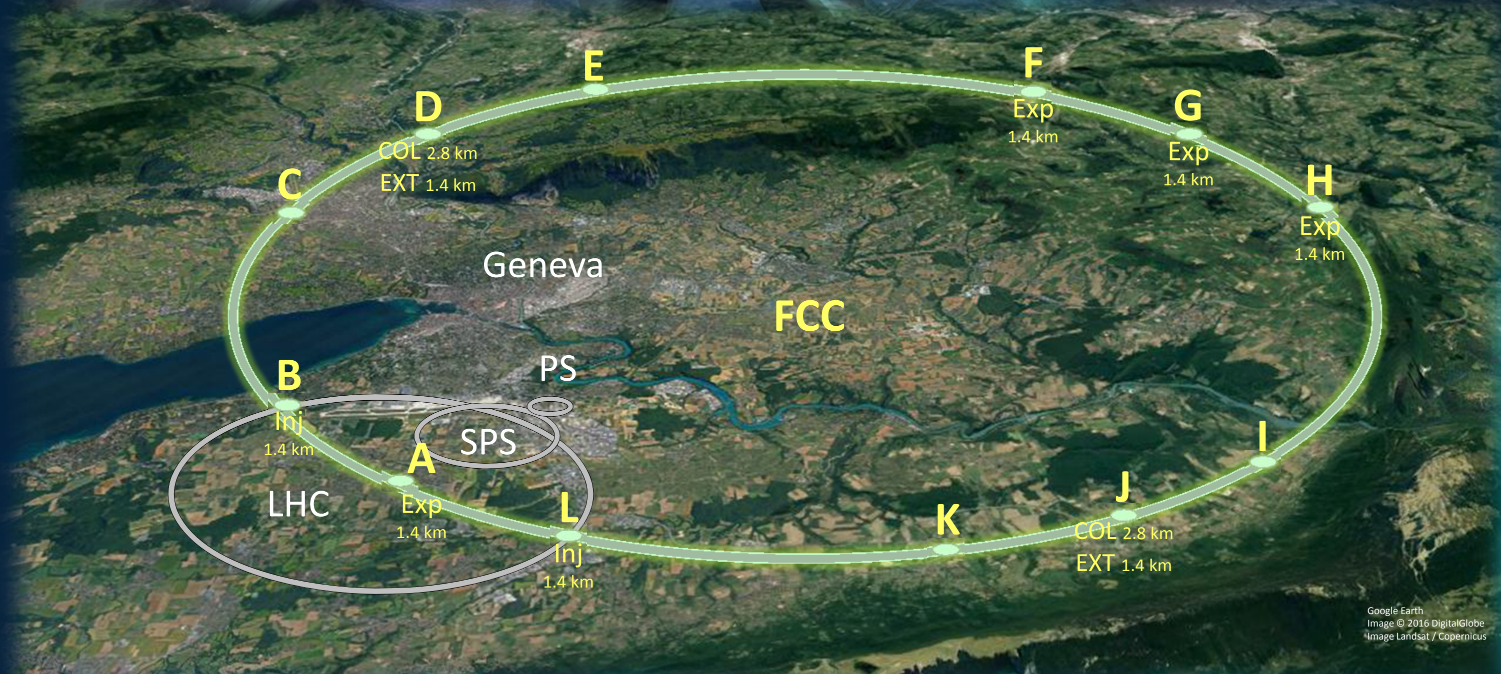
Future Circular Collider – A key to new physics

The Future Circular Collider (FCC) study is an international collaboration aimed at designing the particle accelerator that will replace the LCH once it has completed its operational lifetime. The FCC will expand the current energy and luminosity frontiers in order to help answer the most fundamental questions in science: What is dark matter? Are there extra dimensions in the universe? Are there other forces in nature?

The FCC collaboration, hosted by CERN, is open to universities, research institutes and high-tech companies. A conceptual design will be delivered before the end of 2018, in time for the next update of the European Strategy for Particle Physics.



The FCC study explores three different scenarios: a hadron-hadron collider (FCC-hh), an electron-positron collider (FCC-ee), and a hadron-lepton (FCC-he) collider. The hadron-hadron collider defines the overall infrastructure for the FCC. With a target center-of-mass energy of 100 TeV, and 16-Tesla bending magnets, such a machine will have a circumference of 100 km.

Main parameters and geometrical aspects

	LHC	FCC
Circumference [km]	26.7	100
Dipole field [T]	8.33	16
Straight sections	8 × 528 m	6 ×1400 m + 2 × 4200 m
Number of IPs	2 + 2	2 + 2
Injection energy [TeV]	0.45	3.3

FCC-hh – A discovery machine

The 100 TeV proton-proton collider (FHC-hh) will have an energy seven times higher than the LHC. Such a collider will give access to the smallest scales and the most energetic phenomena in nature.

New fundamental forces and particles can be discovered, extending the reach for searching dark matter particles, supersymmetric partners of quarks and gluons, and possible substructure inside quarks.

Billions of Higgs bosons and trillions of top quarks will be produced, creating new opportunities for the study of rare decays, flavor physics, and the mechanism of electroweak symmetry breaking.

The FCC-hh collider provides also the opportunity to push the exploration of the collective structure of matter at the most extreme density and temperature conditions to new frontiers through the study of heavy-ion collisions.

FCC-ee – A machine for precision

The second scenario of the FCC design study (FCC-ee) is a high-luminosity, high-precision electron-positron collider with center-of-mass collision energies between 90 and 400 GeV. Located in the same 100 km long tunnel as the FCC-hh it is considered a potential intermediate step towards the realization of the hadron facility, and complementary to it.

Clean experimental conditions give electron-positron colliders the capability to measure known particles with the highest precision.

FCC-ee would measure the properties of the Z, W, Higgs and top particles with unequalled accuracy, offering the potential for discovering dark matter or heavy neutrinos. The FCC-ee could enable profound investigations of electroweak symmetry breaking and open a broad indirect search for new physics over several orders of magnitude in energy.

FCC-he – New opportunities

With the huge energy provided by the 50 TeV proton beam and the potential availability of an electron beam with energies of the order of 60 GeV, new horizons open up for the physics of deep inelastic electron-proton scattering.

The FCC-he collider would be both a high-precision Higgs factory and a powerful microscope to discover new particles. It would be the most accurate tool for studying quark-gluon interactions, possible substructure of matter and unprecedented measurements of strong and electroweak interaction phenomena. The hadron-electron collider is a unique complement to the exploration of nature at high energies within the FCC complex.

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