

## **FCC: The World's Largest Atom Collider in Development**

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On March 31, 2025, the European Organization for Nuclear Research (CERN) released a report assessing the feasibility of the Future Circular Collider (FCC) study. This grand-scale project proposes the construction of an atom smasher greater in both size and precision than the Large Hadron Collider (LHC), CERN's current instrument in Switzerland (Euronews, 2025).

“If approved, the FCC would become the most powerful instrument ever built to study the laws of nature at the most fundamental level,” said CERN's director-general Fabiola Gianotti (Nature, 2025).

The LHC is a 27-kilometer loop consisting of a network of magnets in which particles accelerate to collide at near the speed of light (CERN, 2019). The 91-kilometer FCC will potentially generate around 10 times more energy, providing physicists the means to gather more precise data and inform advancements in fields including but not limited to cryogenics, superconducting magnets, and vacuum technologies (Euronews, 2025). It will span underground across the French-Swiss border and below Lake Geneva, with 8 surface sites for housing technical infrastructure or conducting scientific experiments (CERN, 2019).

Indeed, as Giorgio Chiarelli, a research director at Italy's National Institute of Nuclear Physics, remarks, “[the] history of physics tells that when there is more data, the human ingenuity is able to extract more information than originally expected” (Euronews, 2025).

According to the March report, the project will cost about 15 billion Swiss Francs and entail over 12 years of construction (CERN, 2019). While a few experts have voiced concerns regarding the time required to complete the project, many of the consulted scientists agree that

the FCC will ultimately produce a positive socio-economic benefit-cost ratio, as well as create about 800,000 person-years of employment (Nature, Euronews, 2025).

In 2028, independent experts from CERN's 24 member nations will determine whether to continue the initiative (CERN, 2019).

“This set of reports represents an important milestone in the process, but a full sense of the likelihood of it being brought to fruition will only be known through careful studies by scientists, engineers, and others, including politicians who must make difficult decisions at time when uncertainty rules the day,” explained Dave Toback, a professor of physics and astronomy at Texas A&M University (Euronews, 2025).

If the project goes forward, the underground tunnel will first house the FCC-ee, an electron collider that will record precise measurements starting from the 2040s (CERN, 2019). In the 2070s, the FCC-hh will replace the existing machinery, with features that allow for experiments involving high-energy collisions (CERN, 2019).

The FCC study gained momentum upon the discovery of the Higgs boson in 2012, a particle whose properties hold monumental implications for studies in particle physics, specifically in the context of the Big Bang and the fate of the universe (Euronews, 2025). As the CERN webpage states, physicists hope that the Higgs boson can help explain concepts such as dark matter and antimatter (CERN, 2019). With FCC, they will be able to explore these questions in greater depth.

The project “provides an exciting opportunity for the particle physics community, and indeed all of physics, on the world stage,” Toback concluded (Euronews, 2025).

## References

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