

If CERN can come up with the requisite billions, the Future Circular Collider is a go

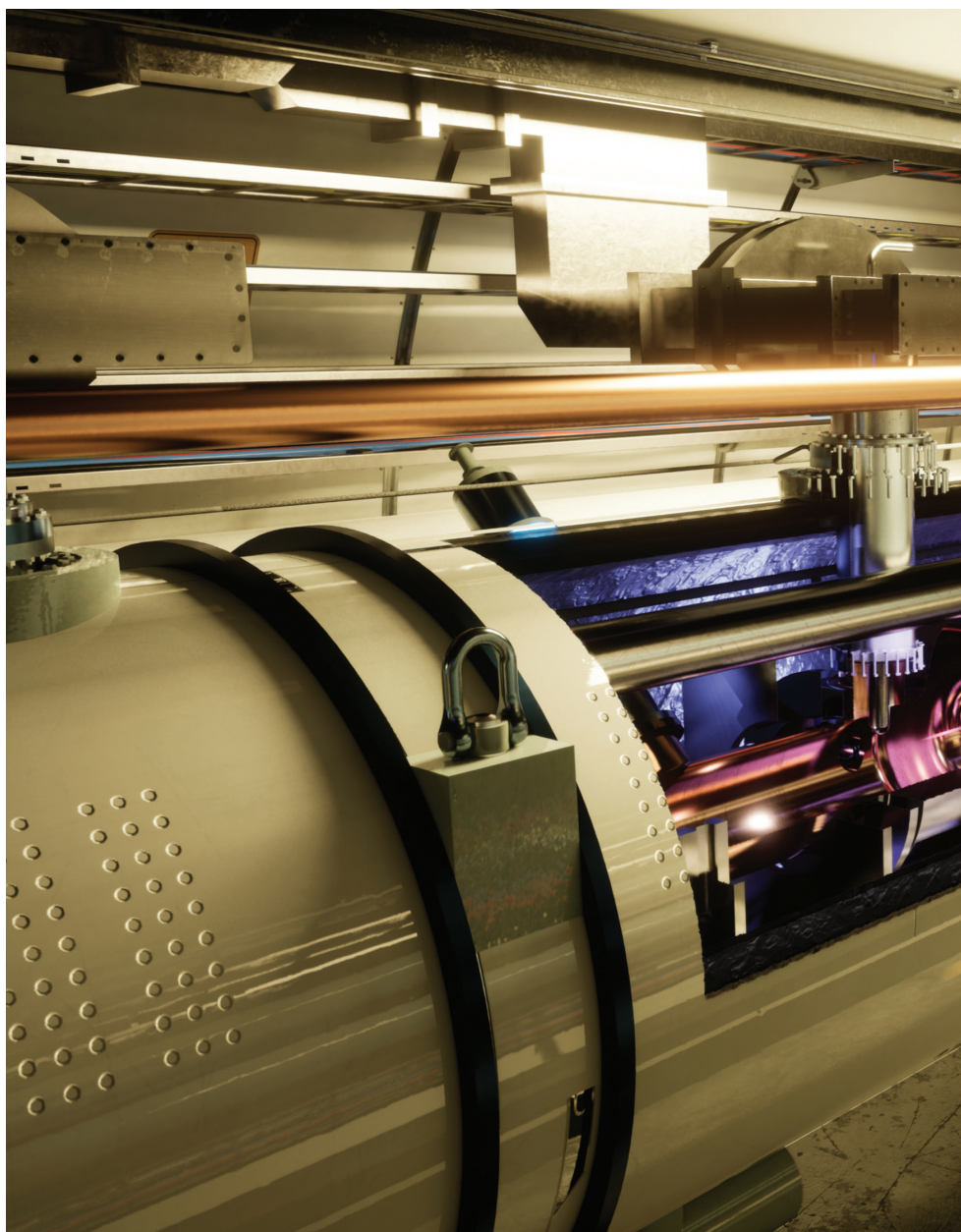
Europe's particle physicists choose a 91 km electron-positron collider as the next global flagship project.

By **Toni Feder**

The CERN Council in May agreed to move ahead with the 91-km-circumference electron-positron Future Circular Collider (FCC-ee). Now CERN has two-and-a-half years to see if it can scrape together 15.3 billion Swiss francs (about \$19 billion) to realize the project by the mid 2040s.

The number-one priority of Europe's particle-physics community is the high-luminosity upgrade of the Large Hadron Collider (HL-LHC); the vast amount of data it will produce will allow scientists to seek new particles and carry out precision studies of the Higgs boson. Next is the FCC-ee, which would study the Higgs boson, the electroweak sector, top-quark physics, flavor observables, and precision quantum chromodynamics. (See *PT*'s August 2025 story "Europe's particle-physics community weighs its next collider," by Matt von Hippel.)

The community also says that experiments and theoretical work should continue in other areas of particle physics and that particle-physics laboratories across Europe should strengthen ties with CERN. Those and other recommendations are spelled out in a European Strategy for Particle Physics 2026 update that was adopted in May by the CERN Council.



The LHC shuts down in late June for the high-luminosity upgrade. It's slated to reopen in 2030 and to run through 2041. Florencia Canelli is a professor at the University of Zurich and is the Swiss scientific delegate to the CERN Council. She notes that to stay at the frontier of science after the HL-LHC shutters for good, "the field needs ambition." It's also important, she says, for students to see

particle physics as "a thriving field with a clear vision."

With that in mind, the HL-LHC schedule determines the FCC-ee timeline: To avoid a prolonged gap in activity, CERN is giving itself through 2028 to rustle up commitments for funds and to decide whether to proceed. If approved, construction would start in the early 2030s and data collection could begin around 2045.

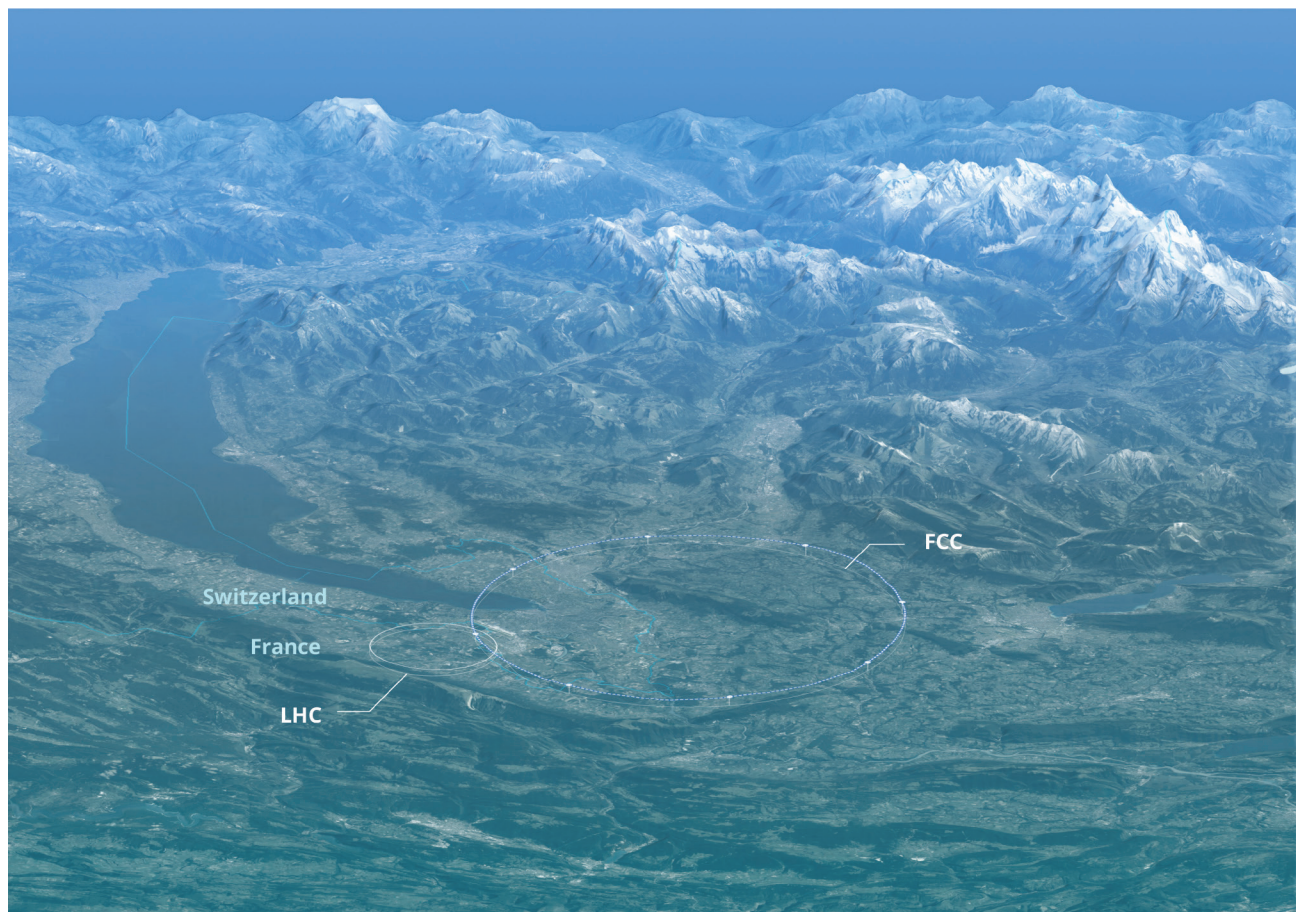
The price tag exceeds what CERN can pay out of its budget, says Karl Jakobs, strategy secretary and a professor at the University of Freiburg in Germany. To go ahead with the project, he says, additional funding to the tune of several billion Swiss francs would need to be found.

Member states may be too squeezed to contribute more than they already pay toward CERN's budget, says Jakobs, especially with many of them upping their investments into defense because of the war in Ukraine. Nonmember states are hoped-for sources of additional funds. Participation by China, Japan, the US, the European Union, and other major particle-physics communities could be crucial to realizing the FCC-ee, says Daniela Bortoletto, a professor of particle physics at Oxford University.

Notably, China's particle-physics community has expressed interest in participating in the FCC-ee. China has its own concept for a similar machine, the Circular Electron Positron Collider. (See *PT*'s 2018 story "China plans a Higgs factory.") But the CEPC is not in China's 2026–30 financial plan. Yifang Wang, who leads the CEPC project, says that for now, "we will try our best to gain support from



◀ An artistic representation of the Future Circular Collider. Some 102 cryomodules, several of which are shown, would contain a total of 408 RF cavities and accelerate the electrons and positrons to center-of-mass energies ranging from 88 GeV to 365 GeV. (Image created by the CERN audiovisual team, courtesy of CERN.)



▲ The Future Circular Collider would require digging a 200-m-deep tunnel with a 91 km circumference straddling France and Switzerland. The location of the Large Hadron Collider is also indicated. (Image adapted with permission from CERN.)

the Chinese government to join the FCC. Our community is united to support this position.” But if the FCC-ee doesn’t get the green light by 2029, he says, China’s particle-physics community will try again to get the CEPC approved.

Last year, the Breakthrough Prize Foundation, the Eric and Wendy Schmidt Fund for Strategic Innovation, and others pledged a combined \$1 billion toward the FCC-ee. The gifts are the first-ever private donations to a major CERN project.

If money for the FCC-ee can’t be raised, the European particle-physics community’s second choice would be a descope version of the machine. Savings of about 15%

could be had by building two particle interaction sites rather than four, lowering the RF system power by 40%, and scrapping the top-quark program. But there’s not a lot of room for trimming, explains Jakobs, because slightly more than a third of the total project cost is for the excavation of the 200-m-deep, 91 km tunnel that would house the collider.

Only if money falls short even for a descope FCC-ee, Jakobs says, would the community consider other collider options. The alternatives—linear colliders and circular ones that would use the existing LHC tunnel—are inferior. The FCC-ee would have a larger physics reach, be technically more advanced, and

pave the way for a transition to a 100 TeV hadron collider, the FCC-hh. A technical feasibility study completed last November found no technical barriers to building the FCC-ee.

CERN has begun engaging with local communities in Switzerland and France; the machine would straddle the border. The collider’s placement was chosen carefully to minimize dirt, noise, and traffic while the tunnel is being built, says Ursula Bassler, CERN’s director of stakeholder relations. The lab is also evaluating water and energy use to minimize the impact on the environment, she says: “We have to make a big effort to minimize nuisance to the population.” **PT**