CERN approves hunt for new cosmic particles at the Large Hadron Collider

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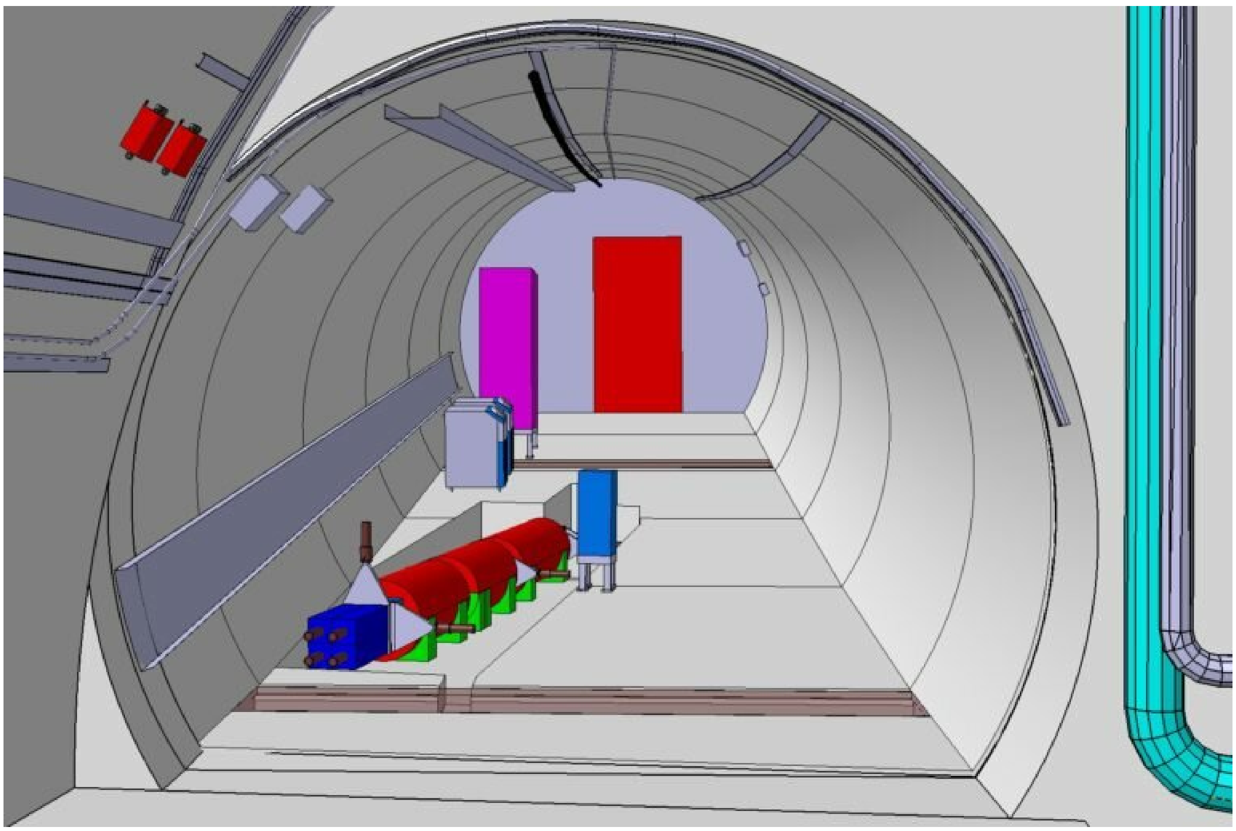

A computer drawing shows the FASER instrument in a tunnel at CERN's Large Hadron Collider in Geneva, Switzerland. The detector will be precisely aligned with the collision axis in the ATLAS instrument 480 meters away. FASER will track and measure the decay of particles produced. Credit: FASER / CERN

The CERN research board has approved the Forward Search

Experiment, giving a green light to the assembly, installation and use of an instrument that will look for new fundamental particles at the Large Hadron Collider in Geneva, Switzerland.

Initiated by physicists at the University of California, Irvine, the five-year FASER project is funded by grants of $1 million each from the Heising-Simons Foundation and the Simons Foundation – with additional support from CERN, the European Organization for Nuclear Research.

FASER's focus is to find light, extremely weakly interacting particles that have so far eluded scientists, even in the high-energy experiments conducted at the CERN-operated LHC, the largest particle accelerator in the world.

"Seven years ago, scientists discovered the Higgs boson at the Large Hadron Collider, completing one chapter in our search for the fundamental building blocks of the universe, but now we are looking for new particles," said FASER co-leader Jonathan Feng, UCI professor of physics & astronomy. "The dark matter problem shows that we don't know what most of the universe is made of, so we're sure new particles are out there."

Feng, a theoretical physicist, will be joined by CERN collaborators as well as other scientists from research institutions in Europe, China, Japan and the United States. The FASER team will consist of 30 to 40 members, relatively small compared to other groups conducting experiments at the LHC.

The FASER instrument is also compact, measuring about 1 meter in diameter and 5 meters long. It will be placed at a specific point along the 16-mile loop of the LHC, about 480 meters (1,574 feet) away from the hulking, six-story instrument used by the ATLAS Collaboration to discover the Higgs boson.

As proton beams pass through the interaction point at the ATLAS instrument, they may create new particles that will go through concrete in the LHC tunnel and then into the FASER instrument, which will track and measure the progress of their decay. FASER will collect data any time ATLAS is operating.

"One of the advantages of our design is that we've been able to borrow many of the components of FASER – silicon detectors, calorimeters and electronics – from the ATLAS and LHCb collaborations," said Jamie Boyd, CERN research scientist and co-spokesperson for the project. "That's allowing us to assemble an instrument that costs almost hundreds of times less than the largest experiments at the LHC."

Another advantage is FASER's rapid construction schedule. According to FASER experimental physicist Dave Casper, UCI associate professor of physics & astronomy, graduate students joining the team now will be able to participate in the complete life cycle of the experiment – from assembly and installation to gathering data and reporting on results – something scientists on larger LHC projects, some of which took decades to design and build, could only dream of.

The FASER detector, which will be one of only eight research instruments at the LHC, is being built and installed during the collider's current hiatus and will collect data from 2021 to 2023. The LHC will be shut down again from 2024 to 2026. During that time, the team hopes to install the larger FASER 2 detector, which will be capable of unveiling an even wider array of mysterious, hidden particles.

This area of research has strong links to past UCI efforts. Founding faculty member Frederick Reines won the Nobel Prize in 1995 for his co-discovery of neutrinos in 1956.

"In some sense, we're following that tradition by looking for extremely weakly interacting light particles, like the neutrino," Feng said. "We now know that neutrinos make up some chunk of the universe but far less than 1 percent of the dark matter. We're trying to find out what makes up the rest."

Provided by University of California, Irvine

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