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# ‘Ghost Particles‘ Detected at Large Hadron Collider in Breakthrough

Neutrinos are a fundamental yet elusive part of our reality. Now, physicists have detected them in a particle collider for the first time.

By Audrey Carleton

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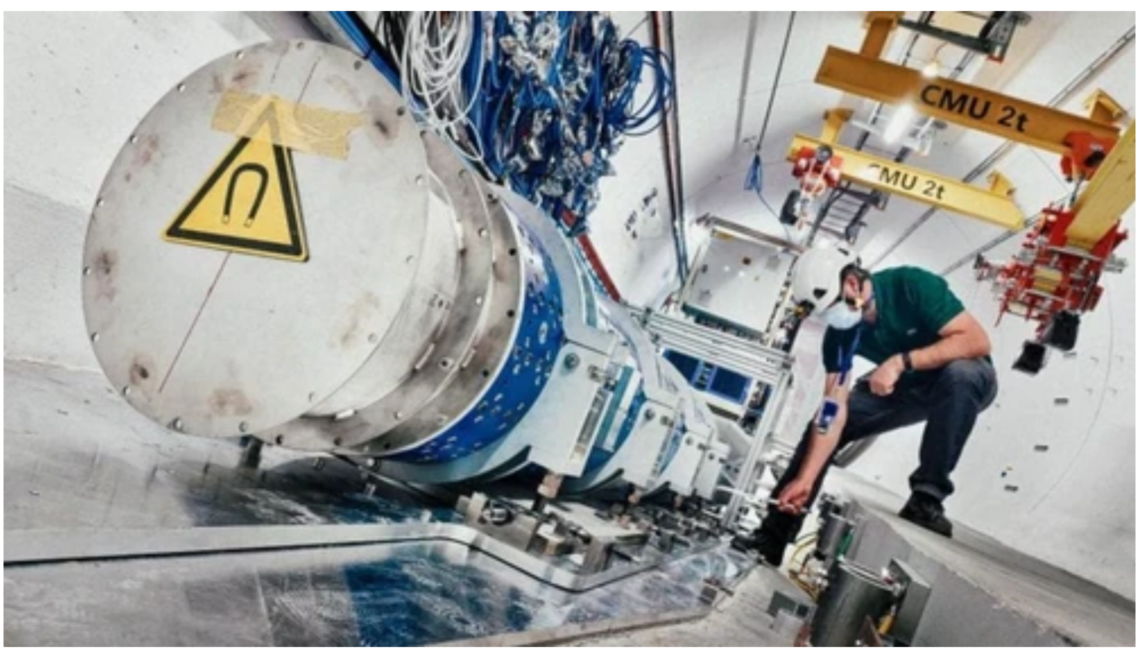


IMAGE: LARGE

In a major physics breakthrough, scientists at the Large Hadron Collider have detected highly energetic "ghost particles," or neutrinos.



A team of 78 physicists at the University of Geneva, and the University of California, Irvine—among 19 other institutions worldwide—first spotted telltale signs of the particles (so-called "neutrino interactions") in 2018. As described in a paper published last week in the peer-reviewed journal *Physical Review D*, the team used a pilot device at the Large Hadron Collider (LHC), a massive particle accelerator in Geneva designed specifically to investigate fundamental physics. The device, located 480 meters from a key interaction point in the LHC, comprised layers of lead and tungsten layered with emulsion. When neutrinos pass through the setup, they leave telltale marks on the emulsion layers.



Neutrinos are particles that carry no electrical charge and have nearly no mass, so they move through the universe at nearly the speed of light after being accelerated by extremely energetic objects. Despite being an essential part of reality (approximately 100-billion neutrinos pass through each square centimeter of the human body at any given moment), they remain mysterious to physicists, because they don't bond to anything, they move too quickly to be spotted easily, and they're too light in mass to interact much with gravity. Detecting them is hugely important, because studying them can teach us about the universe on the hugely important, because studying them can teach us about the universe on the most basic level.

The only way to locate neutrinos is by tracking their interactions with other matter—which is exactly what the scientists behind last week's paper did.

"This significant breakthrough is a step toward developing a deeper understanding of these elusive particles and the role they play in the universe," Jonathan Feng, co-author on the paper and professor of physics and astronomy at UC Irvine, said in a press release.

Interactions from neutrinos originating in outer space have been detected in large underground facilities designed just for this purpose, such as IceCube in

Antarctica. But this is the first time that neutrinos have been located in a particle collider, Feng noted. The study's key contributions to science are thus two-fold: The researchers not only located neutrinos in a particle accelerator, but confirmed that the LHC in particular is a useful object for studying them.

The successful detection of neutrino interaction candidates at LHC is just the beginning. The team is now installing a more developed device at the point where the neutrino interactions were detected at the facility. The pilot device weighed 64 pounds, but the new one, called FASERnu, will weigh 2,400 pounds.

"Given the power of our new detector and its prime location at [the facility in Geneva], we expect to be able to record more than 10,000 neutrino interactions in the next run of the LHC, beginning in 2022," study co-author David Casper, associate professor of physics & astronomy at UC Irvine, said in the press release. "We will detect the highest-energy neutrinos that have ever been produced from a human-made source."