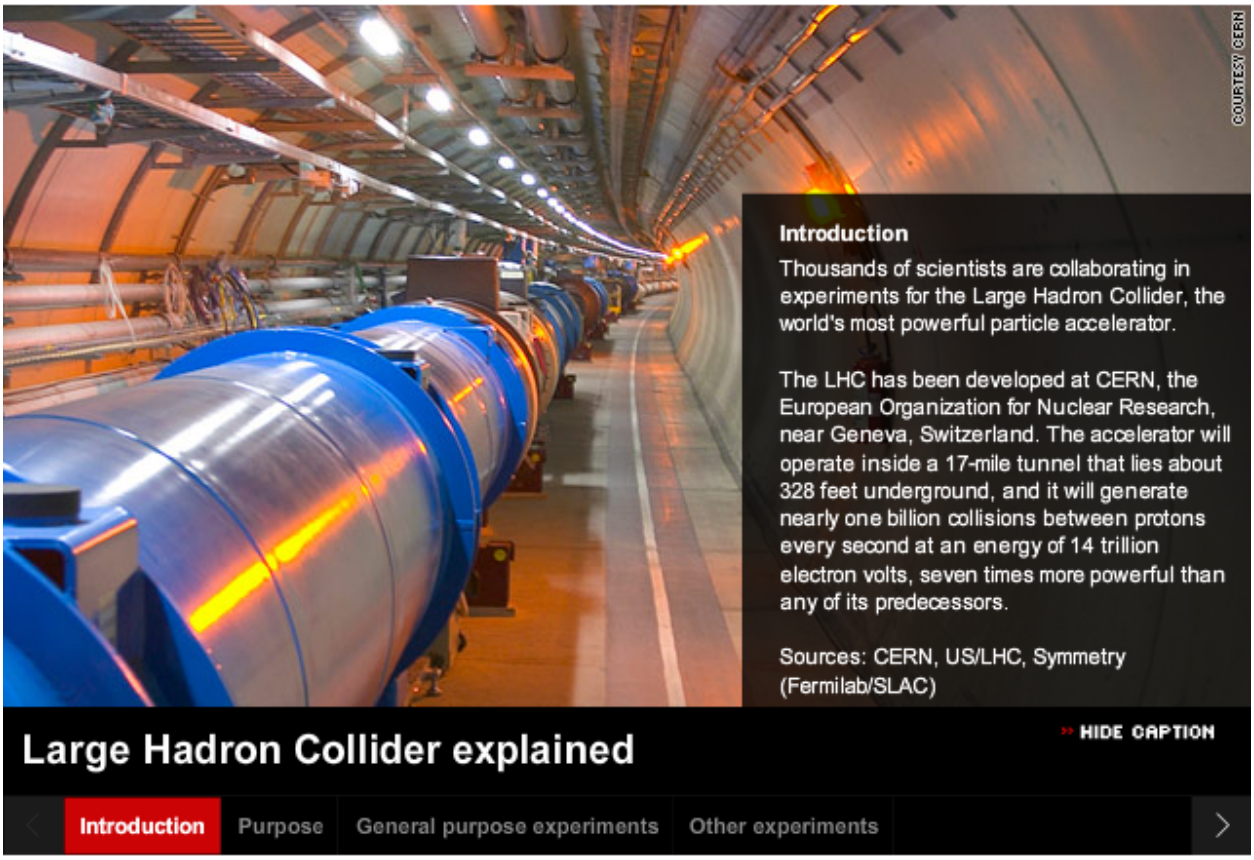
Huge $10 billion collider resumes hunt for 'God particle'

By **Elizabeth Landau**, CNN
November 11, 2009 -- Updated 1312 GMT (2112 HKT)



STORY HIGHLIGHTS

- The LHC will circulate a beam around the tunnel in November, CERN scientists say
- An electrical failure caused a major shut-down of the collider in September 2008
- The full scientific program for the LHC wil probably last more than 20 years

The LHC will look for the Higgs boson, quarks, gluons and other small particles

(CNN) -- Is the Large Hadron Collider being sabotaged from the future? Or merely by birds?

The LHC, the world's largest particle accelerator, has been under repair for more than a year because of an electrical failure in September 2008.

Now, excitement and mysticism are building again around the $10 billion machine as the European Organization for Nuclear Research (CERN) gears up to circulate a high-energy proton beam around the collider's 17-mile tunnel. The event should take place this month, said Steve Myers, CERN's Director for Accelerators and Technology.

The collider made headlines last week when a bird apparently dropped a "bit of baguette" into the accelerator, making the machine shut down. The incident was similar in effect to a standard power cut, said spokeswoman Katie Yurkewicz. Had the machine been going, there would have been no damage, but beams would have been stopped until the machine could be cooled back down to operating temperatures, she said.

CLOSE

Video: Search for 'God particle'

As it begins to run at full energy, greater than any machine of its kind, the LHC will help scientists explore important questions about the universe. The ambitious project also has attracted its share of doubters.

Some alarmists expressed fear last year that the accelerator could produce a black hole that might swallow the universe -- a theory that LHC physicists, including Myers, dismiss as science fiction.

Another fringe theory holds that the LHC will never function properly because it is under "influence from the future," according to physicists Holger Bech Nielsen and Masao Ninomiya. They suggest in recent papers that no supercolliders that could produce the Higgs boson, an as-yet-unseen particle that would help answer fundamental questions about matter in the universe, will work because something in the future stops them.

This also explains the "negative miracle" of Congress canceling the Superconducting Supercollider project in Texas in 1993, Nielsen wrote in a paper on arXiv.org, a site where math and science scholars post academic papers.

"One could even almost say that we have a model for God," one who "hates the Higgs particles," Nielsen wrote.

But bizarre ideas about the LHC -- and in particular the debunked black hole theory -- have gotten more people interested in the whole project, said Joseph Incandela, professor at the University of California, Santa Barbara. He will be in the position of deputy spokesperson for the CMS experiment, one of the two general-purpose experiments at the LHC, as of January.

Although physicists such as Incandela have been working on the same questions and building accelerator experiments for decades, no one has paid much attention before now, he said. There were people who followed the topic, but not the broad audience that emerged in the past year or two, he said.

"Maybe it's just captured people's imaginations," he said. "It's really a wonder of science and technology to build such a large accelerator, a 27km-long machine that works at the precision of a fraction of the diameter of your hair," he said.

The results of the LHC experiments may help resolve fundamental problems such as the disconnect between Albert Einstein's theory of relativity, which describes the world on a large scale, and quantum mechanics, the laws of matter on a scale too small to see.

The LHC, located underground on the border of Switzerland and France, passed a proton beam halfway around the circular tunnel Saturday, undeterred by the bird incident earlier in the week. The full-circle beam event scheduled to happen this month also took place last year on September 10 amid much celebration.

But just nine days later, the operation was set back when one of the 25,000 joints that connect magnets in the LHC came loose, and the resulting current melted or burned some important components of the machine, Myers said. The faulty joint has a cross-section of a mere two-thirds of an inch by two-thirds of an inch.

"There was certainly frustration and almost sorrow when we had the accident," he said. Now, "people are feeling a lot better because we know we've done so much work in the last year."

Even physicists who are not on the ground at CERN, awaiting for news from the LHC abroad, haven't given up.

When push comes to shove, the name of the game is 'what is nature,' and we're not going to know until our experimental colleagues tell us,"

--Mark Wise, professor of physics at Caltech

RELATED TOPICS

- **Large Hadron Collider**
- **Physics**
- **Atomic and Molecular Physics**

Mark Wise, professor of physics at the California Institute of Technology, said he's just as excited about the results that will come out of the LHC as he was last year, and views the September 2008 accident as a delay rather than a devastating event.

Wise noted that Tevatron, the collider at the Fermi National Accelerator Laboratory in Illinois, has also had its share of failures, but is generally considered to work just fine.

"It's a horribly complicated piece of equipment, it's not like there's not going to be problems along the way," he said. "They will surmount those problems."

LHC personnel have done a lot of testing of electrical connections to make sure the incident is not repeated under the same conditions, and it developed a new magnet protection system, Myers said. They have also put 900 pressure relief valves all around the machine so that if a similar problem does occur, the same kind of pressure build-up will not take place.

Myers hopes to have particle beam collisions before Christmas, and then prepare the machine for higher-energy particle-smashing.

The full scientific program for the LHC will probably last more than 20 years, he said.

But it won't be that long before scientists could potentially discover new properties of nature. The Higgs boson, also called "the God particle" in popular parlance, could emerge within two or three years, Myers said. Evidence of supersymmetry -- the idea that every particle has a "super partner" with similar properties in a quantum dimension (according to some physics theories, there are hidden dimensions in the universe) -- could crop up as early as 2010.

For some theoretical physicists such as Wise, finding the Higgs boson and verifying every prediction of the Standard Model of physics would be the worst outcome. He wants the LHC to deliver surprises, even if that means no Higgs.

"When push comes to shove, the name of the game is 'what is nature,' and we're not going to know until our experimental colleagues tell us," Wise said.

ATLAS and CMS are the general-purpose experiments designed to find the Higgs boson and other rare particles that have never been detected before.

ALICE, another experiment, will explore the matter that existed some 10 microseconds after the Big Bang, said John Harris, professor of physics at Yale University and national coordinator of ALICE-USA.

At that time, there was a "hot soup" of particles called quarks and gluons at a temperature of around 2 trillion degrees above absolute zero, he said. Although they have never been directly seen, these particles are theoretically the building blocks of the bigger particles -- protons, neutrons and electrons -- that form the universe as we know it.

The "soup" is actually liquid that flows extremely fast, but will only be around for about 10^{-21} microseconds before it cools down and is itself miniscule, he said.

Not everyone who works on LHC physics intended on becoming a scientist. Incandela thought he was going to be an artist, and studied chemistry because he was interested in glass sculpture. It happened that he was also good at math and physics and ended up going into that.

Despite obvious differences, art and science -- even LHC-related physics -- do have some commonalities, Incandela said.

"Both of them enrich the human existence beyond just the maintaining of health, wealth and welfare," he said. "They both have an idealism also associated with them, a timelessness."