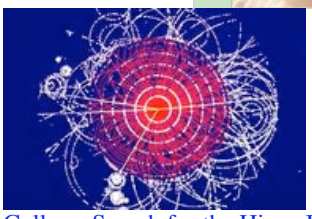
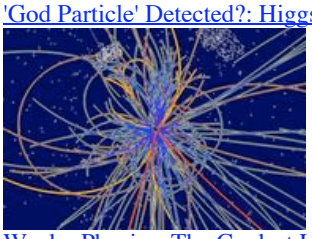

Gallery: Search for the Higgs Boson


'God Particle' Detected?: Higgs Boson Experiment Bearing Fruit


Wacky Physics: The Coolest Little Particles in Nature

Article:

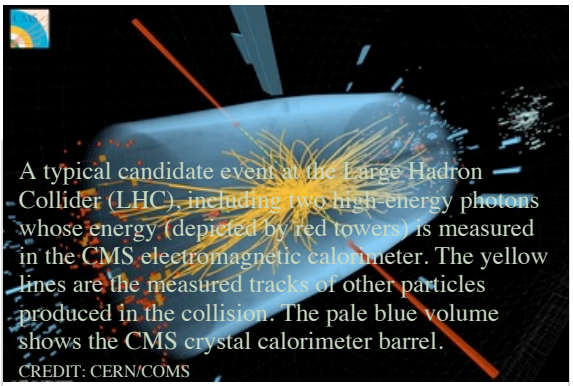
Long-Sought Higgs Particle Cornered, Scientists Say

Clara Moskowitz, LiveScience Senior Writer FOLLOW US
Date: 13 December 2011 Time: 08:52 AM ET

This story was updated at 9:55 a.m. EST.

Physicists are closer than ever to hunting down the elusive Higgs boson particle, the missing piece of the governing theory of the universe's tiniest building blocks.

Scientists at the world's largest particle accelerator, the Large Hadron Collider at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland, announced today (Dec. 13) that they'd narrowed down the list of possible hiding spots for the Higgs, (sometimes called the God particle) and even see some indications that they're hot on its trail



A typical candidate event at the Large Hadron Collider (LHC), including two high-energy photons whose energy (depicted by red towers) is measured in the CMS electromagnetic calorimeter. The yellow lines are the measured tracks of other particles produced in the collision. The pale blue volume shows the CMS crystal calorimeter barrel.
CREDIT: CERN/COMS
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"I think we are getting very close," said Vivek Sharma, a physicist at the University of California, San Diego, and the leader of the Higgs search at LHC's CMS experiment. "We may be getting the first tantalizing hints, but it's a whiff, it's a smell, it's not quite the whole thing."

Today's announcement was highly anticipated by both the physics community and the public, with speculation running rampant in the days leading up to it that the elusive particle may have finally been found. Though the news is not the final answer some were hoping for, the progress is a significant, exciting step, physicists say. [Top 5 Implications of Finding the Higgs Boson]

"It's something really extraordinary and I think we can be all proud of this," said CERN physicist Fabiola Gianotti, spokesperson for the LHC's ATLAS experiment, during a public seminar announcing the results today.

Experts outside the LHC collaborations agreed.

"These are really tough experiments, and it's just really impressive what they're doing," Harvard University theoretical physicist Lisa Randall told LiveScience.

Physicists at the CERN laboratory in Geneva, Switzerland view a presentation of the data collected so far in the search for the Higgs boson particle at the Large Hadron Collider's ATLAS experiment.
CREDIT: CERN
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Origin of mass

The Higgs boson is thought to be tied to a field (the Higgs field) that is responsible for giving all other particles their mass. Ironically, physicists don't have a specific prediction for the mass of the Higgs boson itself, so they must search a wide range of possible masses for signs of the particle.

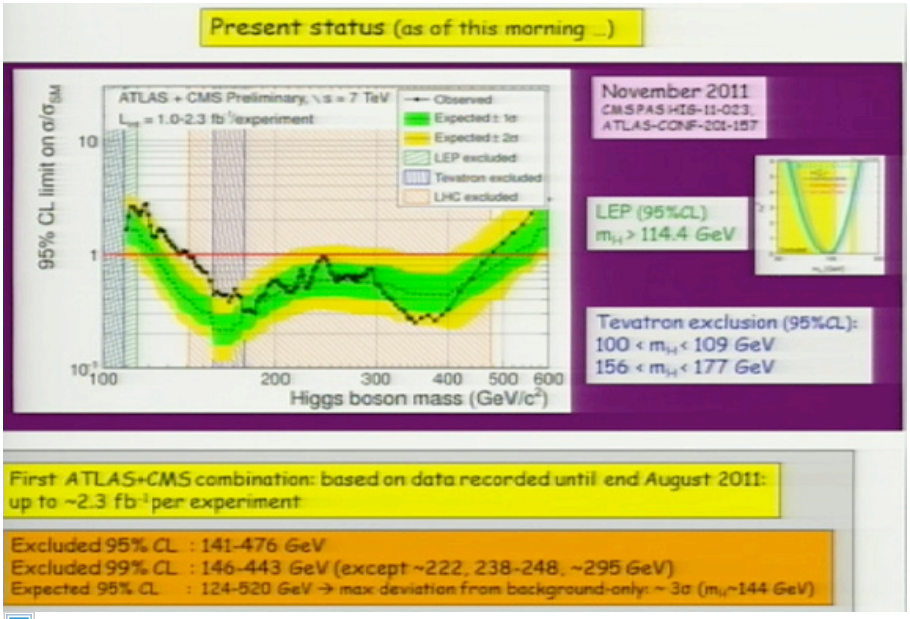
Based on data collected at LHC's CMS and ATLAS experiments, researchers said they are now able to narrow down the Higgs' mass to a small range, and exclude a wide swath of possibilities.

"With the data from this year we've ruled out a lot of masses, and now we're just left with this tiny window, in this region that is probably the most interesting," said Jonas Strandberg, a researcher at CERN working on the ATLAS experiment.

The researchers have now cornered the Higgs mass in the range between 115 and 130 gigaelectronvolts (GeV).For comparison, a proton weighs 1 GeV Outside that range, the scientists are more than 95 percent confident that the Higgs cannot exist.

Within that range, the ATLAS findings show some indications of a possible signal from the Higgs boson around 125 GeV, though the data are not strong enough for scientists to make a claim with the level of confidence they require for a true discovery.

The CMS experiment also showed preliminary indications of a signal around that spot.



This plot shows the data collected so far by the Large Hadron Collider's ATLAS experiment in the search for the Higgs boson particle.
CREDIT: CERN/ATLAS
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"The excess is most compatible with a Standard Model Higgs in the vicinity of 124 GeV and below, but the statistical significance is not large enough t say anything conclusive," CMS experiment spokesperson Guido Tonelli said in a statement. "As of today what we see is consistent either with a background fluctuation or with the presence of the boson. Refined analyses and additional data delivered in 2012 by this magnificent machine will definitely give an answer."

Proceed with caution

Ultimately, scientists said they were excited by the LHC's findings so far, but that it's too soon to celebrate.

"Please be prudent," said CERN director general Rolf-Dieter Heuer. "We have not found it yet, we have not excluded it yet. Stay tuned."

The fact that the independent studies conducted by ATLAS and CMS appear to be pointing in the same direction is particularly promising, experts said.

"Based on the predicted size of the signal, the experiments may have their first glimpse of a positive signal," University of Chicago physicist Jim Pilche wrote in an email to LiveScience. "It is especially important to compare the results of two independent experiments to help reduce statistical fluctuation and experimental biases."

But it shouldn't be much longer before scientists can be sure if the Higgs exists, and if so, how much mass it has.

"We know we must be getting close," Strandberg told LiveScience. "All we need is a little bit more data. I think the data we take in 2012 should be able to really give a definitive answer if the Higgs boson exists."

Underground explosions

The Large Hadron Collider is a 17-mile (27-kilometer) loop buried underneath France and Switzerland, run by CERN, based in Geneva.

Inside this loop, protons traveling near the speed of light collide head-on, and release huge amounts of energy in powerful explosions.

This energy then coalesces into new particles, some of which are exotic, hard-to-find species like the Higgs. The Higgs quickly decays into other particle products, which are then sensed by the detectors inside ATLAS and CMS. [6 Exotic Particles Explained]

The new results are based on data accumulated over 500 trillion proton-proton collisions inside the LHC.

Big payoff

The Higgs boson and its related Higgs field were predicted in 1964 by physicist Peter Higgs and his colleagues. Though the Higgs mechanism is the best explanation for why particles have mass, it can't be trusted until its major prediction — the Higgs boson — is found. [Infographic: The Higgs Boson]

"It would be a major discovery, absolutely," said Randall, who is the author of a recent book covering the Higgs and other particle mysteries called "Knocking on Heaven's Door: How Physics and Scientific Thinking Illuminate the Universe and the Modern World" (Ecco, 2011). "We've known abou the Higgs mechanism for years, but we don't know if it's right."

The discovery of the Higgs would offer final credence to the idea and its originators.

"If it is found there are several people who are going to get a Nobel prize," said Vivek Sharma, a physicist at the University of California, San Diego, and the leader of the Higgs search at LHC's CMS experiment.

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