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Tantalizing hints of long-sought particle

European collider finds traces of what could be the Higgs boson

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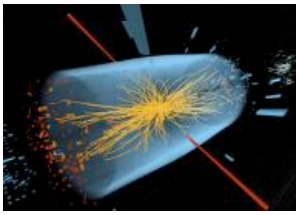

ENLARGE

HIGGS IN THE SPOTLIGHT
Colliding protons create a splash of particles streaking outward along paths (yellow) reconstructed here from data collected by the CMS detector at CERN's Large Hadron Collider. A pair of photons emerging from this smash-up (red bars) qualify this event as a potential Higgs sighting.
CERN

The world's most powerful atom smasher has given physicists a tantalizing — but inconclusive — hint that the long-sought Higgs particle actually exists.

The Higgs is the last undiscovered elementary particle predicted by the standard model, physicists' leading framework for describing the constituents of matter and transmitters of force. Its discovery would confirm the theory that matter particles acquire their mass by interacting with a pervasive Higgs field occupying all space.

Speaking in front of a packed auditorium, two competing teams at the Large Hadron Collider said they've seen showers of particles that match the debris expected when the Higgs particle breaks down.

"It's too early to tell if the success is due to the fluctuations in the background, or if it's due to something more interesting," said Fabiola Gianotti, a spokeswoman for LHC's ATLAS detector, who presented her team's work December 13 at the European laboratory CERN, the home of the LHC, near Geneva.

This subatomic detritus — seen by both the ATLAS and Compact Muon Solenoid detectors at the LHC — is suggestive of a Higgs boson with a mass of about 125 billion electron volts (the mass of a proton is about 1 billion electron volts). That number conforms nicely with requirements of the standard model.

It also corresponds with previous data from the LHC and from other colliders — including the LHC's predecessor at CERN, the Large Electron-Positron Collider — which ruled out the existence of a Higgs with a mass below about 114 billion electron volts or above about 141 billion electron volts.

"If the Higgs was there, this is more or less the kind of thing you would expect," said Lisa Randall, a theoretical physicist at Harvard University.

But like poker, particle physics is a game of odds. The chance that the ATLAS detector's sighting is simply a random fluctuation is about one in 90. For CMS, the odds are about one in 35. That's a far cry from the gold standard needed to claim discovery: about one in 3.5 million.

This lack of certainty isn't surprising. It's about what would be expected at this stage of the LHC's operations. In two years, the giant machine has rammed together 400 trillion pairs of protons in its effort to create the Higgs particle (technically, the Higgs boson). If the Higgs is produced in those collisions, the LHC's detectors could not see it directly. Instead, they look for other particles left over after the short-lived Higgs breaks down: pairs of photons and groups of electrons, muons and neutrinos.

Over the coming months, the two teams will combine their data to reduce the uncertainty in their findings. They expect to have definitely confirmed or ruled out the Higgs by the end of 2012, when the LHC will have collected four times as much data as it has to date.

If the intriguing new bump in the data ultimately disappears, scientists will have to give up on the simplest version of the Higgs boson they've been hunting, a particle born of a single Higgs field.

Alternate theories propose exotic Higgs particles that are extremely heavy or decay in strange ways. Some modifications to the standard model include more than one Higgs field and two, five or even seven distinct Higgs particles, which for the most part are more difficult to find than a single particle. Other ideas do away with the particle entirely, replacing it with new forces or other kinds of particles.

SUGGESTED READING :

R. Cowen. Large Hadron Collider. Science News, Vol. 174, July 19, 2008, p. 16. Available online:

CITATIONS & REFERENCES :

ATLAS Collaboration. Search for the Higgs boson in the H->WW(*)->lvlv decay channel in pp collisions at sqrt{s} = 7 TeV with the ATLAS detector. arXiv.org:112.2577. December 12, 2011.

CMS Results: