Higgs Boson makes it a champagne year for physics

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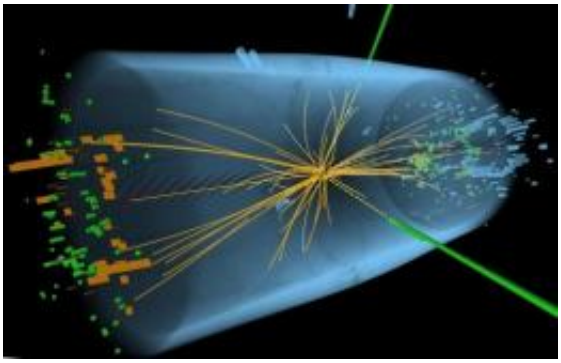

An graphic distributed on July 4 by the European Organization for Nuclear Research (CERN) in Geneva shows a representation of traces of a proton-proton collision measured in the Compact Muon Solenoid (CMS) experience in the search for the Higgs boson. 2012 will go down in history as a landmark year when physicists discovered a fundamental particle that may answer one of the greatest riddles.

2012 will go down in history as a landmark year, when physicists discovered a fundamental particle that may answer one of the greatest riddles of all.

Investigators believe their discovery to be the long-coveted Higgs Boson, an invisible particle that explains the mystery of mass.

Without the Higgs, say theorists, we and all the other joined-up atoms in

the Universe would not exist.

"The discovery is a wonderful example of the ability of the human imagination to understand the Universe to the greatest depths," said Sir Paul Nurse, a Nobel laureate who is president of Britain's Royal Society.

"As an achievement, it ranks alongside the confirmation that the Earth is round or Man's first steps on the Moon," said Pauline Gagnon at CERN, where the particle was detected in sets of rival experiments.

Theorised back in 1964, the boson carries the name of a Briton, Peter Higgs.

He was the first to suggest that a field of these particles could explain a nagging anomaly: Why do some particles have mass and why do others, such as light, have none?

That question was a gaping hole in the Standard Model, the conceptual framework for understanding the nuts-and-bolts particles and forces that constitute the cosmos.

CERN's announcement on July 4 stressed the need to confirm that the newcomer is the Higgs, a margin of uncertainty that probably prevented the discovery from gaining a Nobel this year.

And further work is needed to see exactly how the Higgs—or Higgses, if the boson exists in different flavours—interacts with other particles.

One notion is that the Higgs was born when the new Universe cooled after the Big Bang some 14 billion years ago.

Former European Organization for Nuclear Research (CERN) Director-Generals Christopher Llewelyn-Smith, CERN scientific director Lyn Evans, Herwig Schopper, Luciano Maiani and Robert Aymard react on July 4 during a seminar on the latest update in the 50-year bid to explain a riddle of fundamental matter in the search for a particle called the Higgs boson at CERN in Meyrin, near Geneva.

It exists in an invisible field that, to use a simple image, is like a comb whose teeth are coated with syrup.

Most types of particles interact with the treacly stuff, acquiring some of its mass to varying degrees, but a few slip through and do not acquire any. With mass comes gravity—and through gravitational pull, particles meet.

A Higgs-less Universe would thus be a terrifying thing.

It would be dark and utterly dead, its listless particles unable to join up to form atoms and thus matter.

"Without the Higgs, there would be no stars and ultimately no life," said Themis Bowcock of Britain's University of Liverpool. "The Higgs offers humanity, for the first time, a unique glimpse into WHY nature is the way it is."

The discovery has unfathomable potential in practical terms, said Sir Peter Knight, head of Britain's Institute of Physics.

He pointed to the discovery of hydrogen in 1766 by Henry Cavendish, who called the curious gas "inflammable air."

"Now, hydrogen is our rocket fuel," said Knight. "Who knows what purpose the Higgs will serve, but I don't think anyone in the 18th century would have predicted a line of causation from Cavendish's work to the first man on the Moon."

The hunt for the Higgs was an extraordinary tale, exemplifying some of the best things in science.

It combined open debate based on evidence; fierce but friendly rivalries; and big-bucks experiments where teams threw themselves into the quest unhampered by borders and nationalities, united by the common language of physics.

It began with a dazzling series of conceptual insights by six men, including Higgs, each building on the work of others, who published a flurry of papers within four months of each other back in 1964.

After years of cut-and-thrust debate in the community of particle physics, momentum developed for building machines that smash sub-

atomic particles together and trawl through the debris for clues.

Ultimately the crown went to the Large Hadron Collider (LHC), whose labs are enclosed in a giant circular tunnel straddling the French and Swiss borders.

The massive project was completed four years ago at a cost of 6.03 billion Swiss francs (five billion euros, $6.27 billion dollars), yet is still not even close to running at full capacity.

Many challenges lie ahead in fundamental physics, said Gagnon.

"We have enough questions to keep us happy for many decades to come," she quipped.

There is the search for the graviton, a theoretical particle that explains gravity.

Then there is dark matter, a bizarre substance which can only be perceived indirectly, though its gravitational pull, yet accounts for around 25 percent of the contents of Universe.

One explanation lies in supersymmetry, the notion that there are novel particles that are counterparts to the known actors in the Standard Model.

Supersymmetry is deemed by some to be marginal or plain weird. But then, so too was the Higgs Boson, half a century ago.