Higgs Boson : The God Particle

The standard model of particle physics hypothesized about Higgs Boson in 1964.
The discovery of Higgs particle was announced at CERN on 4 July 2012. The discovery has been called monumental because it appears to confirm the existence of the Higgs field, which is pivotal to the Standard Model and other theories within particle physics. As scientists are busy finding out the details of the Higgs Field, let's have a quick look at some of the most perplexing questions based on Higgs particle.

Why is the Higgs particle called the "God particle"?

The nickname is pure invention. There's nothing in the mathematical equations, in the interpretation of the physics, in any philosophy, or in any religious text or tradition that connects the Higgs particle or the Higgs field with any notion of religion or divinity. Professor and Nobel Prize Winner Leon Lederman, allowed his book on the Higgs particle to be assigned this attention-getting title, and thus the name!

Field vs Waves vs Particle

A field is normally made up of waves. An waves are made up of particles. The least-intense possible wave that a field can have is called a particle. Applying the concept in Higgs Field : Higgs particle is the smallest possible Higgs wave, and a Higgs wave is a ripple in the Higgs field.

What's so important about the Higgs particle?

Finding the Higgs particle is the first big step toward the main goal: understanding the properties of the **Higgs field** and why it has a non-zero average value.

What's so important about the Higgs field?

The Higgs field has a non-zero average value. And because it does, many elementary particles have mass. Remember that the electric field has zero average value. Discovery of Higgs field would explain why some fundamental particles have mass when the symmetries controlling their interactions should require them to be massless. It would also explain why the weak force has a much shorter range than the electromagnetic force. The discovery of a Higgs boson should allow physicists to finally validate the last untested area of the Standard Model's approach to fundamental particles and forces, guide other theories and discoveries in particle physics, and potentially lead to developments in "new" physics.

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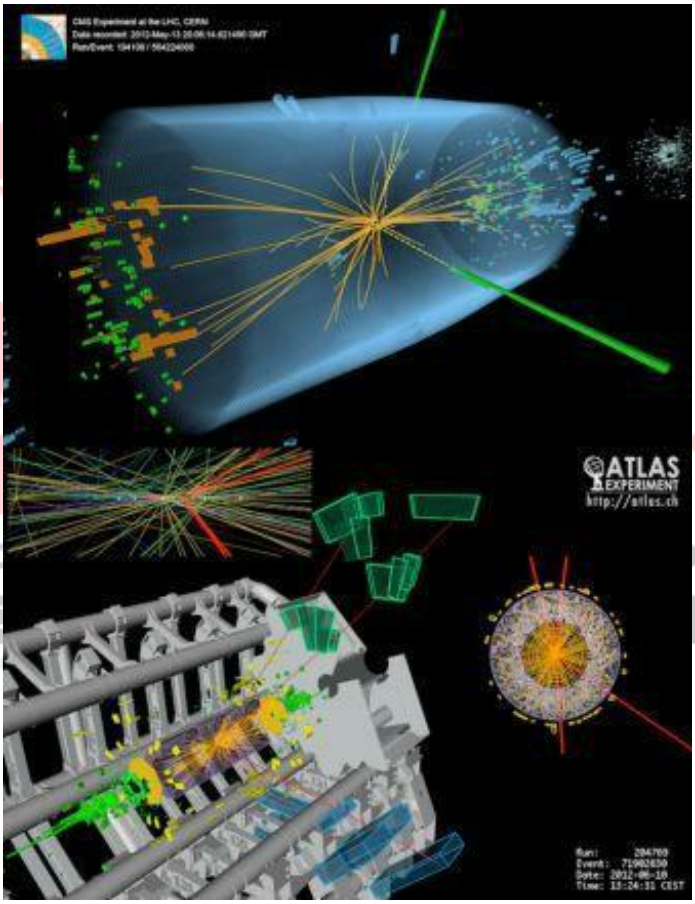
Large Hadron Collider

Large Hadron Collider (LHC) was built to figure out what the Higgs field is (or Higgs fields are), how it works (or they work), and whether it is (or they are) elementary or composite. In-fact LHC was built to do much more than discover the Higgs Boson, such as…



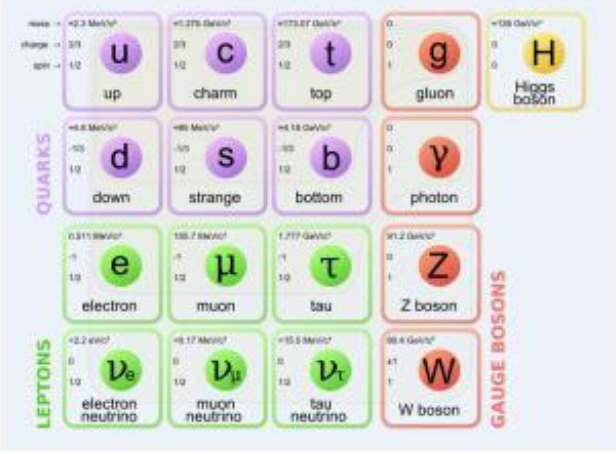
- Identify dark matter
- Search for extra dimensions of space and microscopic black holes
- Look for signs of unification of fundamental forces
- Find "evidence" for string theory
- Find the Higgs Boson
- Understand antimatter Learn
- about the fundamental forces that have shaped the universe since the beginning of time, and will determine its fate.

The Higgs field is not the universal giver of mass to things in the universe!

Ordinary matter's mass is mostly from atomic nuclei. That doesn't come entirely from the Higgs field.The Higgs field gives mass to most of the elementary particles, but not to bigger composite particles. This means even if there is no Higgs field, there would have been protons and neutrons, which of-course has mass. So Higgs field is not the universal giver of mass to things in the universe.

Higgs field is not the sole mass giver even to elementary particles!

The Higgs field is not the universal giver of mass to all elementary particles. The Higgs particle itself gets its mass, at least in part, from elsewhere, may be from dark matter.



Standard Particle Model

PS: Now it is true that the W and Z particles, the quarks, the charged leptons and the neutrinos must get their mass from a Higgs field. It's not possible for them to have masses any other way. But this is not true of the Higgs particle itself.

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NB : The mass-less particles are photons, gluons and gravitons.

Beyond the Higgs Boson

The standard model of particle physics hypothesized about Higgs Boson. In fact this hypothesis states that the Higgs Field is made up of elementary particles called Higgs Bosons. But in reality there might be more than one Higgs Field made up of particles other than Higgs Bosons too.

UPSC Question on Higgs Boson

Question: The efforts to detect the existence of Higgs boson particle have become frequent news in the recent past. What is /are the importance of discovering this particle?

1. It will enable us to understand as to why elementary particles have mass.
2. It will enables us in the near future to develop the technology to transferring matter from one point to another without traversing the physical space between them.
3. It will enable us to create better fuels for nuclear fission.

Select the correct answer using the codes given below:

1. 1 only
2. 2 and 3 only
3. 1 and 3 only
4. 1, 2 and 3

Ans : 1 (1 only)