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| **THE HIGGS BOSON PARTICLE** |

**Abstract**

The higgs boson particle is an important sub-atomic particle which has been under deep study since time immemorial. Commonly referred to as the “God Particle”, its research has been termed as “monumental” because it confirms the existence of Higgs field which is pivotal in the study of particle physics. I have chosen this topic because of the various experiments, studies and research conducted on it. It labels it as an indispensable part of modern physics.  The higgs boson is known to be associated with the mass of an atom and explains why some fundamental particles possess mass when in actual they were rendered massless.

Higgs boson is currently being researched in Geneva, Switzerland in a large hadron collider- one of the most complex and expensive experimental facilities till date. It has helped in answering many questions related to the particle.

The term paper is compiled to present the three phases of research of the higgs boson particle which includes early, current and future applications. It shall focus on its implementation and the aims associated with the study of this particle.

Any comments on the improvement of the paper will be highly appreciated.

**Introduction**

The Higgs Boson particle was initially detected in 1964 and has been under crucial study ever since. However its existence was only confirmed on 14th March 2013. So what is the higgs boson particle and why is it important for the universal standard model of an atom? The higgs boson is named after Peter Higgs, who in 1964 proposed the mechanism that suggested the existence of such particle.

In the Standard model of an atom, the higgs particle is a boson with no spin or electric charge. It is very unstable and decays into other particles immediately. The higgs mechanism is a mathematical model devised by three groups of researchers in 1964 that explains why and how gauge bosons could be still massive despite their governing symmetry. It showed that conditions of symmetry would be broken, if a field would exist throughout space and then particles would possess mass. This field known as the Higgs Field is a necessary kind of field which exists throughout space and triggers the Higgs mechanism, causing the gauge bosons responsible for the weak force to be massive. Detecting Higgs bosons would automatically prove that the Higgs field exists, which shows the Standard Model is essentially correct. In further studies, scientists also explained why electrons and neutrons also have mass. Discovering the higgs boson by the scientists was a very difficult job as the particle readily decayed and broke in ten-[**sextillionth**](http://en.wikipedia.org/wiki/Names_of_small_numbers) of a second. Although remarkable results were achieved, the discovery took up to 30 years with the help of particle colliders, detectors and computers.

In [**particle physics**](http://en.wikipedia.org/wiki/Particle_physics), [**elementary particles**](http://en.wikipedia.org/wiki/Elementary_particle) and forces give rise to the world around us. Nowadays, physicists explain the behavior of these particles and how they interact using the[**Standard Model**](http://en.wikipedia.org/wiki/Standard_Model)—a widely accepted and "remarkably" accurate framework based on [**gauge invariance**](http://en.wikipedia.org/wiki/Gauge_invariance) and [**symmetries**](http://en.wikipedia.org/wiki/Symmetry_%28physics%29), believed to explain almost everything in the world we see, other than [**gravity**](http://en.wikipedia.org/wiki/Gravity). [[**24]**](http://en.wikipedia.org/wiki/Higgs_boson#cite_note-31)

The Higgs Boson is a theoretical elementary, subatomic particle predicted to exist by the Standard Model of particle physics. It is the only Standard Model (SM) particle that has not yet been observed. Dubbed “the God” particle by Nobel Prize winning physicist Leon Lederman, the Higgs is thought to impart mass to all other particles in the universe. The Higgs particle is named after the British theorist Peter Higgs who along with Robert Brout and François Englert theorized its existence in 1964. The search for the Higgs remains one of the most important objectives of research in elementary particle physics today. Since the current way to test particle physics theories is experiments in particle accelerators (colliders), one of the main goals of the world’s newest and most powerful particle accelerator, the Large Hadron Collider (LHC) at CERN on the Franco-Swiss Border, is to detect the Higgs particle. At the same time, the Tevatron at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois wants to discover the Higgs first.

Finding the Higgs, though made looking for needles in haystacks seem simple. The discovery eventually came about using the largest human machine ever made “Large Hadron Collider” (LHC),  in which bunches of protons were send round a ring 27km in circumference, in opposite directions , at close to the speed of light, so that they collide head on. The faster the protons are moving, the more energy they have. When they collide, this energy is converted into other particles (famous equation of Einstein; E=mc2) which then decay into yet more particles. The scientist where fighting with this elusive mystery for decades in search of a pattern in those decay particles that shouts “Higgs!”  It was indeed a Higgs mania all around whenever they feels they are close but then the light disappears.

In order for the Standard Model to retain its symmetry, all particles would have to be massless. This is not possible since we know through experiments that the weak force carriers have mass. The Higgs mechanism was originally introduced to allow the W and Z bosons to have mass. Physicists found to their delight that this was a way to give fermions mass as well. The current Standard Model provides no explanation of how some particles come to have mass. The presence of the Higgs and its corresponding Higgs field rectifies this problem. Studying about the Higgs Boson particle is an important part of our knowledge. It is the background of how all sub-atomic particles possess mass- a basic fundamental unit in all living and non-living things. This study is essential in understanding the basic Standard Model of an atom in particle physics. This topic will help me to stimulate my interest in modern physics and learn about the most marvelous discovery of scientists- the higgs boson particle. As yet, there are no known immediate technological benefits of finding the Higgs particle. However observers in both media and science point out that when fundamental discoveries are made about our world, their practical uses can take decades to emerge, but are often world-changing when they do. A common pattern for fundamental discoveries is for practical applications to follow later, once the discovery had been explored further, at which point they become the basis for social change and new technologies. Following the paper will be consisting of experimentations, results and conclusions based on this.

**CHAPTER 2- EXPERIMENTATIONS**

The higgs boson was experimented first in 1990 and the search continued on for decades. The major research is being carried out in CERN in Geneva, Switzerland by a large group of physicists from over the world. They have achieved a major breakthrough in this field in the past one year.

Following are the various experiments performed on the Higgs Boson:

**THE LARGE HADRON COLLIDER (LHC):**

To [**produce Higgs bosons**](http://en.wikipedia.org/wiki/Higgs_boson#Production), two beams of particles are accelerated to very high energies and allowed to collide within a [**particle detector**](http://en.wikipedia.org/wiki/Particle_detector). Occasionally, although rarely, a Higgs boson will be created fleetingly as part of the collision byproducts. Because the Higgs boson [**decays**](http://en.wikipedia.org/wiki/Higgs_boson#Decay) very quickly, particle detectors cannot detect it directly. Instead the detectors register all the decay products (the *decay signature*) and from the data the decay process is reconstructed. If the observed decay products match a possible decay process (known as a *decay channel*) of a Higgs boson, this indicates that a Higgs boson may have been created. In practice, many processes may produce similar decay signatures. Fortunately, the Standard Model precisely predicts the likelihood of each of these, and each known process, occurring. So, if the detector detects more decay signatures consistently matching a Higgs boson than would otherwise be expected if Higgs bosons did not exist, then this would be strong evidence that the Higgs boson exists.

Because Higgs boson production in a particle collision is likely to be very rare (1 in 10 billion at the LHC)**[[Note 13]](http://en.wikipedia.org/wiki/Higgs_boson%22%20%5Cl%20%22cite_note-production_rate-108%22%20%5Ct%20%22_blank)** and many other possible collision events can have similar decay signatures, the data of hundreds of trillions of collisions needs to be analyzed and must "show the same picture" before a conclusion about the existence of the Higgs boson can be reached. To conclude that a new particle has been found, [**particle physicists**](http://en.wikipedia.org/wiki/Particle_physicist) require that the [**statistical analysis**](http://en.wikipedia.org/wiki/Statistical_analysis) of two independent particle detectors each indicate that there is lesser than a one-in-a-million chance that the observed decay signatures are due to just background random Standard Model events—i.e., that the observed number of events is more than 5 [**standard deviations**](http://en.wikipedia.org/wiki/Standard_deviation) (sigma) different from that expected if there was no new particle. More collision data allows better confirmation of the physical properties of any new particle observed, and allows physicists to decide whether it is indeed a Higgs boson as described by the Standard Model or some other hypothetical new particle.

To find the Higgs boson, a powerful [**particle accelerator**](http://en.wikipedia.org/wiki/Particle_accelerator) was needed, because Higgs bosons might not be seen in lower-energy experiments. The collider needed to have a high[**luminosity**](http://en.wikipedia.org/wiki/Luminosity#Scattering_theory) in order to ensure enough collisions were seen for conclusions to be drawn. Finally, advanced computing facilities were needed to process the vast amount of data produced by the collisions. For the announcement of 4 July 2012, a new collider known as the [**Large Hadron Collider**](http://en.wikipedia.org/wiki/Large_Hadron_Collider) was constructed at [**CERN**](http://en.wikipedia.org/wiki/CERN) with a planned eventual collision energy of 14 **[TeV](http://en.wikipedia.org/wiki/TeV%22%20%5Co%20%22TeV%22%20%5Ct%20%22_blank)**—over seven times any previous collider—and over 300 trillion (3×1014) LHC proton–proton collisions were analysed by the [**LHC Computing Grid**](http://en.wikipedia.org/wiki/LHC_Computing_Grid), the world's largest [**computing grid**](http://en.wikipedia.org/wiki/Computing_grid) (as of 2012), comprising over 170 computing facilities in a [**worldwide network**](http://en.wikipedia.org/wiki/Distributed_computing) across 36 countries.

The first extensive search for the Higgs boson was conducted at the [**Large Electron–Positron Collider**](http://en.wikipedia.org/wiki/Large_Electron%E2%80%93Positron_Collider) (LEP) at CERN in the 1990s. At the end of its service in 2000, LEP had found no conclusive evidence for the Higgs.[**[Note 14]**](http://en.wikipedia.org/wiki/Higgs_boson#cite_note-120) This implied that if the Higgs boson were to exist it would have to be heavier than 114.4 GeV/*c*2.

The search continued at **[Fermilab](http://en.wikipedia.org/wiki/Fermilab%22%20%5Co%20%22Fermilab%22%20%5Ct%20%22_blank)** in the United States, where the **[Tevatron](http://en.wikipedia.org/wiki/Tevatron%22%20%5Co%20%22Tevatron%22%20%5Ct%20%22_blank)**—the collider that discovered the [**top quark**](http://en.wikipedia.org/wiki/Top_quark) in 1995—had been upgraded for this purpose. There was no guarantee that the Tevatron would be able to find the Higgs, but it was the only supercollider that was operational since the [**Large Hadron Collider**](http://en.wikipedia.org/wiki/Large_Hadron_Collider) (LHC) was still under construction and the planned [**Superconducting Super Collider**](http://en.wikipedia.org/wiki/Superconducting_Super_Collider) had been cancelled in 1993 and never completed. The Tevatron was only able to exclude further ranges for the Higgs mass, and was shut down on 30 September 2011 because it no longer could keep up with the LHC. The final analysis of the data excluded the possibility of a Higgs boson with a mass between 147 GeV/*c*2and 180 GeV/*c*2. In addition, there was a small (but not significant) excess of events possibly indicating a Higgs boson with a mass between 115 GeV/*c*2–140 GeV/*c*2. [[**108]**](http://en.wikipedia.org/wiki/Higgs_boson#cite_note-122)

The [**Large Hadron Collider**](http://en.wikipedia.org/wiki/Large_Hadron_Collider) at [**CERN**](http://en.wikipedia.org/wiki/CERN) in [**Switzerland**](http://en.wikipedia.org/wiki/Switzerland), was designed specifically to be able to either confirm or exclude the existence of the Higgs boson. Built in a 27 km tunnel under the ground near [**Geneva**](http://en.wikipedia.org/wiki/Geneva) originally inhabited by LEP, it was designed to collide two beams of protons, initially at energies of 3.5 TeV per beam (7 TeV total), or almost 3.6 times that of the Tevatron, and upgradeable to 2 x 7 TeV (14 TeV total) in future. Theory suggested if the Higgs boson existed, collisions at these energy levels should be able to reveal it. As one of the [**most complicated scientific instruments**](http://en.wikipedia.org/wiki/List_of_megaprojects#Science_projects) ever built, its operational readiness was delayed for 14 months by a [**magnet quench event**](http://en.wikipedia.org/wiki/Magnet_quench) nine days after its inaugural tests, caused by a faulty electrical connection that damaged over 50 superconducting magnets and contaminated the vacuum system.

Data collection at the LHC finally commenced in March 2010. By December 2011 the two main particle detectors at the LHC, [**ATLAS**](http://en.wikipedia.org/wiki/ATLAS_experiment) and [**CMS**](http://en.wikipedia.org/wiki/Compact_Muon_Solenoid), had narrowed down the mass range where the Higgs could exist to around 116-130 GeV (ATLAS) and 115-127 GeV (CMS). There had also already been a number of promising event excesses that had "evaporated" and proven to be nothing but random fluctuations. However from around May 2011, both experiments had seen among their results, the slow emergence of a small yet consistent excess of gamma and 4-lepton decay signatures and several other particle decays, all hinting at a new particle at a mass around 125 GeV. By around November 2011, the anomalous data at 125 GeV was becoming "too large to ignore" (although still far from conclusive), and the team leaders at both ALTAS and CMS each privately suspected they might have found the Higgs. On November 28 2011, at an internal meeting of the two team leaders and the director general of CERN, the latest analyses were discussed outside their teams for the first time, suggesting both ATLAS and CMS might be converging on a possible shared result at 125 GeV, and initial preparations commenced in case of a successful finding. While this information was not known publicly at the time, the narrowing of the possible Higgs range to around 115–130 GeV and the repeated observation of small but consistent event excesses across multiple channels at both ATLAS and CMS in the 124-126 GeV region (described as "tantalizing hints" of around 2-3 sigma) were public knowledge with "a lot of interest". It was therefore widely anticipated around the end of 2011, that the LHC would provide sufficient data to either exclude or confirm the finding of a Higgs boson by the end of 2012, when their 2012 collision data (with slightly higher 8 TeV collision energy) had been examined.

**THE ATLAS EXPERIMENT –**

ATLAS (A Toroidal LHC Apparatus)**[[1]](http://en.wikipedia.org/wiki/Atlas_experiment%22%20%5Cl%20%22cite_note-1%22%20%5Ct%20%22_blank)**  is one of the seven particle detector experiments constructed at LHC - a particle accelerator at CERN in Switzerland, Geneva. The experiment is designed to take advantage of the unprecedented energy available at the LHC and observe phenomena that involve highly massive [**particles**](http://en.wikipedia.org/wiki/Elementary_particle) which were not observable using earlier lower-[**energy**](http://en.wikipedia.org/wiki/Energy) accelerators. It might shed light on new [**theories**](http://en.wikipedia.org/wiki/Theories) of [**particle physics**](http://en.wikipedia.org/wiki/Particle_physics) beyond the Standard Model.

ATLAS is 45m long, 25m in diameter and weighs about 7,000 tons. The experiment is a collaboration involving roughly 3,000 physicists at 175 institutions in 38 countries. The project was led for the first 15 years by Peter Jenni and between 2009 and 2013 was headed by **[Fabiola Gianotti](http://en.wikipedia.org/wiki/Fabiola_Gianotti%22%20%5Co%20%22Fabiola%20Gianotti%22%20%5Ct%20%22_blank)**. Since 2013 it has been headed by David Charlton. It was one of the two LHC experiments involved in the discovery of a particle consistent with the [**Higgs boson**](http://en.wikipedia.org/wiki/Higgs_boson) in July 2012.[**[4]**](http://en.wikipedia.org/wiki/Atlas_experiment#cite_note-4)

One of the most important goal of building the ATLAS was to study the Higgs Boson. The hypothesis states that higgs is responsible for imparting mass to fundamental particles while the photon ejected is massless. On July 4, 2012, ATLAS (together with CMS – its sister experiment at the LHC) reported evidence for the existence of a particle consistent with the Higgs boson at the level of five sigma, with a mass around 125 GeV or 125 times the proton mass.

The ATLAS detector consists of a series of ever-larger concentric cylinders around the [**interaction point**](http://en.wikipedia.org/wiki/Interaction_point) where the proton beams from the LHC collide. It can be divided into four major parts: the Inner Detector, the calorimeters, the Muon Spectrometer and the magnet systems.[**[13]**](http://en.wikipedia.org/wiki/Atlas_experiment#cite_note-TPoveralldetector-13)  Each of these is in turn made of multiple layers. The detectors are complementary: the Inner Detector tracks particles precisely, the calorimeters measure the energy of easily stopped particles, and the muon system makes additional measurements of highly penetrating muons. The two magnet systems bend charged particles in the Inner Detector and the Muon Spectrometer, allowing their momenta to be measured.

The only established stable particles that cannot be detected directly are neutrinos; their presence is inferred by measuring a momentum imbalance among detected particles. For this to work, the detector must be "hermetic", meaning it must detect all non-neutrinos produced, with no blind spots. Maintaining detector performance in the high radiation areas immediately surrounding the proton beams is a significant engineering challenge.

**CHAPTER 3- CONCLUSIONS OF EXPERIMENTS**

The latest research findings from the Large Hadron Collider (LHC) at CERN show that the CMS and ATLAS experiments are now reporting that the significance of their observation of the Higgs-like particle is standing close to the 7 sigma level, well beyond the 5 required for a discovery, and that the new particle's properties appear to be consistent with those of a Standard Model Higgs Boson.

The news comes in a week when the *Physics World* award for their '2012 Breakthrough of the Year' gone to the ATLAS and CMS collaborations at CERN, for their joint discovery of a Higgs-like particle at the LHC. The CMS and ATLAS results were delivered when representatives of the Large Hadron Collider (LHC) and five of its experiments presented a round-up report on the first three years of activity to the CERN Council.

The CMS and ATLAS representatives went on to report that further analysis of the data, and a probable combination of both experiments' data next year, will be required before some key properties of the new particle, such as its spin, can be determined conclusively. The focus of the analysis has now moved from discovery to measurement of the new particle in its individual decay channels.

The measurements reported by both experiments show that the new Higgs-like particle is in good health with a mass of around 125 GeV, but much further analysis is needed to reveal the full details of its identity. The next update is scheduled for the spring 2013 conferences, but for the final word before the LHC resumes running in 2015, we'll probably have to wait some time longer.

Other highlights from CERN included the LHC experiment reporting on a measurement of one of the rarest processes so far observed in particle physics, the decay of a Bs meson into two muons. Measurements of rare decays provide important tests of the Standard Model of particle physics, and are good places to look for new physics beyond the Standard Model.

Physicists hope that a "new physics" will provide a more straightforward explanation for the characteristics of the Higgs boson than that derived from the current Standard Model. This new physics is sorely needed to find solutions to a series of yet unresolved problems, as presently only the visible universe is explained, which constitutes just four percent of total matter.

The Higgs boson is important to our current fundamental theory of physics as it explains why the elementary building blocks of matter have a mass at all.

The existence of the Higgs boson was predicted in 1964 and it is named after the British physicist Peter Higgs. It is the last piece of the puzzle that has been missing from the Standard Model of physics and its function is to give other elementary particles their mass. According to the theory, the so-called Higgs field extends throughout the entire universe. The mass of individual elementary particles is determined by the extent to which they interact with the Higgs bosons.

On the one hand, the Higgs particle is the last component missing from the Standard Model of particle physics. On the other hand, physicists are struggling to understand the detected mass of the Higgs boson.

On 14 March 2013 CERN confirmed that: CMS and ATLAS have compared a number of options for the spin-parity of this particle, and these all prefer no spin and positive parity [two fundamental criteria of a Higgs boson consistent with the Standard Model]. This, coupled with the measured interactions of the new particle with other particles, strongly indicates that it is a Higgs boson."This also makes the particle the first elementary scalar particle to be discovered in nature.

**IMPLICATIONS OF THE HIGGS BOSON**

The higgs boson referred to as the “God Particle” because it is said to have caused the “Bang Bang” billions of years ago. The name has been assigned to it despite criticism by various influenced, because of the role it plays in the Standard Model of an Atom in particle physics.

Since 2008, CERN has been experimenting on the particle in a Large Hadron Collider specifically causing collisions to prove the existence of higgs boson. The discovery of the higgs boson is a pivotal element in the physics arena because it explains the Standard Model of an Atom completely. The only missing particle left to be studied was the higgs boson which is now under great scrutiny.

Confirming a Higgs boson, physicists say, will have wide-reaching implications. Here are six of the biggest consequences:

1. 1.     The origin of mass-

The Higgs boson has long been thought the key to resolving the mystery of the origin of mass. The higgs boson is associated with a field, called the Higgs field, theorized to pervade the universe. As other particles travel though this field, they acquire mass much as swimmers moving through a pool get wet, the thinking goes. Confirming the particle is a Higgs would also confirm that the Higgs mechanism for particles to acquire mass is correct.

1. 2.     The Standard Model of Atom-

The Standard Model is the reigning theory of particle physics that describes the universe's very small constituents. Every particle predicted by the Standard Model has been discovered — except one: the Higgs boson.

It's the missing piece in the Standard Model, a researcher at CERN working on the ATLAS experiment, said last year of the particle announcement.

So far, the Higgs boson seems to match up with predictions made by the Standard Model. Even so, the Standard Model itself isn't thought to be complete. It doesn't encompass gravity, for example, and leaves out the dark matter thought to make up 98 percent of all matter in the universe.

1. 3.     The Electroweak Force-

The confirmation of the Higgs also helps to explain how two of the fundamental forces of the universe — the electromagnetic force that governs interactions between charged particles, and the weak force that's responsible for radioactive decay — can be unified. Every force in nature is associated with a particle. The particle tied to electromagnetism is the photon, a tiny, massless particle. The weak force is associated with particles called the W and Z bosons, which are very massive.

1. 4.     Super symmetry-

The theory super symmetry is also affected by the Higgs discovery. This idea posits that every known particle has a "super partner" particle with slightly different characteristics.

Super symmetry is attractive because it could help unify some of the other forces of nature, and even offers a candidate for the particle that makes up dark matter. So far, though, scientists have found indications of only a Standard Model Higgs boson, without any strong hints of super symmetric particles.

1. 5.     Validation of LHC-

The Large Hadron Collider is the world’s largest particle accelerator. It was built for around $10 billion by the European Organization for Nuclear Research (CERN) to probe higher energies than had ever been reached on Earth. Finding the Higgs boson was touted as one of the machine's biggest goals. "This discovery bears on the knowledge of how mass comes about at the quantum level, and is the reason we built the LHC. It is an unparalleled achievement," Spiropulu said in a statement last year. "More than a generation of scientists has been waiting for this very moment and particle physicists, engineers, and technicians in universities and laboratories around the globe have been working for many decades to arrive at this crucial fork. This is the pivotal moment for us to pause and reflect on the gravity of the discovery, as well as a moment of tremendous intensity to continue the data collection and analyses."

The discovery of the Higgs also has major implications for scientist Peter Higgs and his colleagues who first proposed the Higgs mechanism in 1964. The finding also shines a symbolic light on the boson's namesake, the late Indian physicist and mathematician Satyendranath Bose, who along with Albert Einstein, helped to define bosons. A class of elementary particles, bosons (which include gluons and gravitons) mediate interactions between fermions (including quarks, electrons and neutrinos), the other group of fundamental building blocks of the universe.

**APPLICATIONS-**

vScientists hailed CERN's confirmation of the Higgs Boson in July of 2012, speculating that it could one day make light speed travel possible by "un-massing" objects or allow huge items to be launched into space by "switching off" the Higgs.

vCERN physicists hope that the "new physics" will provide a more straightforward explanation for the characteristics of the Higgs boson than that derived from the current Standard Model. This new physics is sorely needed to find solutions to a series of yet unresolved problems, as presently only the visible universe is explained, which constitutes just four percent of total matter.

v  It explains why matter possesses mass. The mass of individual elementary particles is determined by the extent to which they interact with the Higgs bosons.

**CHAPTER3- FUTURE RESEARCH ANDAPPLICATIONS**

The two experiments, named ATLAS and CMS, responsible for collecting data on the "God particle," still needed further confirmation before physicists could state definitively that they had found the particle, however.

Whereas the findings released in July 2012 were robust enough to confirm that a "Higgs-like" particle had been found, the newest science from the CMS refines some of the data, providing the strongest evidence yet that this is the particle predicted by the [**Standard Model**](http://www.livescience.com/13613-strange-quarks-muons-nature-tiniest-particles-dissected.html), the reigning theory governing particle physics. In coming years, the LHC will study many more of them, and that's what people will be focused on, hoping to see something unexpected," Woit said.

Particle physicists have been trying to make Higgs bosons at various colliders for a long time, two decades in fact. But until now, the best they've been able to do is better define what they were looking for -- a particle that weighs about 125 gigaelectronvolts (GeV) and that, if they could create it, would decay almost instantaneously.That means that to find it, researchers have to look not for the fleeting Higgs boson itself, but rather, the particles it leaves behind in its wake. That's what Heuer was referring to when he explained Atlas and CMS's "convergent" conclusions of a year ago.Since then, the teams have been firing up the 27 km collider and smashing protons together at 99.99998 percent of the speed of light over and over again. Although the number of collisions it took to create the boson was not announced, the researchers had previously said they expected it would take on the order of one billion collision to make just 10 of them. But of course, now that one gigantic piece of the science has been done, a new era beckons: that of inevitable distortion and misappropriation of scientific ideas as they make their way into the mainstream.

The potential discovery of the Higgs boson is a gateway to a new era that could see humanity unlock some of the universe’s great mysteries, including dark matter and light-speed travel, scientists have claimed.

“**We have reason to believe that there are many particles waiting to be discovered, and the Higgs could be the portal that connects us to this invisible world.”**The higgs boson has opened doors to many more researches of the Standard Model which are yet to be discovered.

**CONCLUSION**

Human mind always tries to penetrate every dimension in search of his so many “Why’s?” and so many “What’s behind?” type questions .History events recede in importance with every passing decade and this importance became an enigma when we talk about events 12.5 billion years ago . Politics and elections can be seen and analyzed. Even the horrors of war acquire a patina of unreality. The laws of physics, though, are eternal and universal. Elucidating them is one of the triumphs of mankind.

July 4 2012, another step of mankind towards finding answers to never ending questions. Physicist working in Geneva at CERN, the world’s biggest particle-physics laboratory announced that they found the Higgs boson.

Finding the Higgs, though made looking for needles in haystacks seem simple. The discovery eventually came about using the largest human machine ever made “Large Hadron Collider” (LHC),  in which bunches of protons were send round a ring 27km in circumference, in opposite directions , at close to the speed of light, so that they collide head on. The faster the protons are moving, the more energy they have. When they collide, this energy is converted into other particles (famous equation of Einstein; E=mc2) which then decay into yet more particles. The scientist who were fighting with this elusive mystery for decades in search of a pattern in those decay particles that shouts “Higgs!”  It was indeed a Higgs mania all around whenever they feel they are close but then the light disappears. Remember!! How suddenly the news flashing of a particle travelling faster than light and your friends talking about the old physics books to be thrown out. Woo, Indeed it was a mania for the greatest minds in universe working in a close area together for knowing God more closely with his particle “Gods Particle”.  It was a quest of dreams. Peter Higgs, a British Physicist and four other scientists were actually the ones who, in 1964 , plucked what has come to be known (unfairly in some eyes) as Higgs boson or Gods particle from formulae they were working on to fix a niggle in quantum theory.

Now the discovery puts the finishing flourish on the standard model, the best explanation to date for how theuniverse works- except the domain of gravity which is governed by general theory of relativity.

Scientists believe that world starts with a big bang 12.5 billion years ago from a smallest and the densest particle which we can’t imagine. But the story doesn’t end here, it was just the answer in the box of questions. How do galaxies form? How do we have mass? What is dark matter? Lot many …

Higgs boson is supposed to be actually the mass provider to every particle. The interaction with higgs determine how massive is the particle. Imagine to cure any disease because we know how to make the brain tumors massless.

Anyways it is just the beginning of another dimensions of nature where by each passing day we feels that we were so ignorant. But till now the hunt for physics’ most elusive quarry is over and scientists across the globe can crack open a bottle of champagne but the reality lies within and again I believe the one answer is going to reveal millions of ‘whys’ for the science lovers like us to keep pondering and working on the creator most fascinating invention - our beautiful Universe.

The Higgs Boson is a breakthrough in the field of physics. It has revolutionized modern physics by explaining many unanswered questions. It has a bright future and is going to be under strict study by many physicists for decades to come.

The particle is responsible for the mass of an atom commonly referred to as “God Particle” even though it was criticized by many scientists.

Detecting a boson is a difficult and time consuming process as it takes around 1 trillion proton-proton collisions for observing a boson. Many revelations are yet to be discovered and answered by performing experiments in LHC.

The topic has been widely discussed and hope to cover all areas of work if possible. Thus concluding-

*“****It could give mathematical consistency to the standard model- the theory that describes the interactions of fundamental particles. The search for the elusive particle will require new accelerators***” – Martinus J. G. Veltman

                                                    **REFERENCES**

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