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The discovery of the Higgs Bosons and how it may change the current understanding of nature

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Abstract
This paper aims to help following the future progress which is going to be made in the current understanding of the fundamental building blocks of nature. Experiments done in last few years that look backwards in time towards the big bang are covered and discussed, some understanding of what was happening in the first few fractions of a second after time itself started to exist is predicted from what has happened at the world most powerful particle collision in the Large Hadron Collider (LHC).This paper ends up with some theoretical abstract ideas, through suggestions of ideas about the mathematics that underlies the current understanding of the universe. The basic idea of the fundamental particle reality is an excitation of relativistic Quantum Field Theory (QFT), was introduced starting from Hooke's law and wave mathematics with possible modifications of wave equations. The Quantum Harmonic Oscillator (QHO) was discussed as well as zero- point energy. The basic definition of scalar and vector fields are discussed, along with the concept of relativistic field. Finally, by combining the idea of quantum mechanics with concept of relativistic field to show that the particle is the smallest possible vibration of quantum field.

Key words: *building blocks of nature, big bang, Large Hadron Collider (LHC), Quantum Field Theory (QFT), zero- point energy, Quantum Harmonic Oscillator (QHO), relativistic field, vibration of quantum field.*

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I. Introduction:

By 1869 Mendeleev for a decade had been trying to find a pattern of the elements. Whatever the order he and the chemists of his time tried to impose, there were still elements that wouldn't fit. Hence a universal theory seen was out of reach, but Mendeleev came with a new idea to rearrange these elements chemical according to there atomic weights. Previously chemists had grouped the elements according to their chemical properties or by grouping them according to their atomic weights. Mendeleev was able to combine these two methods together [1]. All the known elements then, were arranged in a grand table which relates them together. Mendeleev had revealed a deep truth of nature; that there is a numerical pattern underlying the structure of the matter. The modern picture known today rooted back in the Mendeleev discovery, is what the universe is made of, which is the periodic table of elements. This table is one of the most iconic images in all science. Here; there are hundred and twenty different elements. In the nineteenth century people thought this table constitute everything in nature, so any material can be simplified down to its component's parts, to find out all of its components parts is one of these hundred and twenty elements. From the chemical point of view this basically good as it gets, but from the physical point of view this is not the proper way to organize nature, because this is not the end of the story and not the fundamental building blocks of nature, there is something deeper than this [2] .

After J. J. Tomson discovered the electron particle 1987, the electron considered to be the fundamental element of nature. Hence Dalton statement which define the atom as a fundamental element particle which cannot be created, divided or destroyed was thus revised after this discovery to get the model of the atom structure by Rutherford fifteen years later [1]. The structure of the atom consists of the nucleus which contains the most of the mass of the atom and it is positively charged, around which goes these electrons to give all the elements of the periodic table their properties. In 1930 it was discovered that the nucleus itself is made of smaller particles called the protons and the neutrons. The neutrons are electrically neutral while the protons are not. These protons and neutrons are smaller parts of smaller particle, the atom, they are much heavier than the electron by about 200 times. In 1960 it was discovered both the protons and the neutrons are not fundamental particles, they are made of smaller things called the quarks. The proton is made of two up quarks and a down quark, while the neutron is made of two down quarks and one up quark. That basically says all of the matter, every atom and everything people know about, is made up of just three different fundamental particles, the electron, the up quark and the down quark. Everything is made of these three fundamental particles arranged in a rather peculiar way essentially. These tree fundamental particles are the first ones to enter what is called the standard model of particle physics, but some people are not happy with this name for something quite extraordinary, and really the standard model is so close to the complete description of the universe at the fundamental level. For the standard model there are two things everybody should be aware of and familiar with;

(a) The standard model does not include the gravity, but other than that it is pretty pinned down, so the standard model got these three fundamental particles that make up all the matter.

(b) There is another thing gets added to the table called the neutrino. The neutrinos are sort of invisible little ghosts, almost undetectable particle. There are trillions of them going through the matter, produced by the sun in vast quantities, they go straight through the earth and they are very rarely Interacting with matter humans are made out of, and that is why people are not aware of their existence most of the time.

The first column of the standard model consists of four particles to make up what is called the first generation of matter. For some reason which nobody understands, nature provides two additional copies of these particles, exactly the same as in the first column, except they are more massive, called the second generation and the third generation. In the second generation the particles are more massive than those in the first column and they are unstable, so the electron has a sort of heavy cousin called the muon which is about two hundred times heavier than the electron, the muon is not hanging around because; if possible to make a neutrino in high energy collision with the aid of Large Hadron Collider (LHC) the muon quickly decays into an electron plus some neutrino. In the third generation the particles are even more heavier and unstable than those in the second and first generations.

In the following figure there are (3x4) twelve matter particles, so they make up a kind of solid stuff at least from the first stable column if they were not all unstable.

u	c	T
d	s	b
e	μ	τ
ν_e	ν_μ	ν_τ

It is a big mystery people don't know why there are two more extra unstable columns in the table, exactly a bit like the periodic table in a way to have this sort of structure, seen to have these patterns without knowing what underlies this. There may be some deeper structure that could explain why this strange set of matter particles.

The last ingredients of standard model are the force particles. There are three fundamental forces in the standard model, the most familiar one is the electromagnetisms studied fairly well by Faraday, Maxwell and several others, so it the force that causes the electrons to stick to the nuclei of atoms to bind them together, it is responsible for chemistry of most of the stuff to transmit electromagnetic interactions by what is known as the photon, the particle of light, therefore light is an electromagnetic phenomenon. Also, there is another force called the gluon known as the strong nucleus force responsible for binding the quarks together inside the atomic nucleons to bind the protons and the neutrons together. The third force is the weak nuclear force, actually there are two of them $\omega^{\mp}$ and Z^0, even though they are rather weird forces they transmit the third force, they are not responsible of binding things together like what the electromagnetic force do or the strong nuclear force do, but it is responsible for causing particles to decay, for example the muon turns into an electron through this weak force interaction [2].

This is the standard model as had been studied, sorted out and observed in July 2012. Still there is one piece missed called the HIGGS, what is this Higgs is the thing which the aim of this paper is all about. For the time being Higgs boson can be defined as an elementary particle in the standard mode of particles produced by the quantum excitation of Higgs Field [3].

II. The Standard Model:

All elementary particles people aware of are put into this table;

U	C	T	γ	H
d	s	b	g	
e	μ	τ	$\omega^{\mp}$	
ν_e	ν_μ	ν_τ	z_o	

The standard model of particle physics is the theory of the four known fundamental interactions. The elementary particles taken part in these interactions, to make the visible matter in the universe. Description of the standard mode of particle physics sets out the building blocks of everything, and usually can be described in a diagram form with a grid of (4x4) as shown in table above. The top six boxes are the fermion quarks, there are the up, down, charm, strange, top and bottom quarks, they are called Fermions. The bottom six boxes are Fermion leptons, the electron, the heavier electron (the muon) and even, the heaviest one the (tau), with their associated neutrinos, the electron neutrino, the muon neutrino and the tau neutrino. Of course, all these particles have anti-particles or anti matter equivalence. The right-handed column is reserved for what is called the bosons (the guage bosons or the exchange particles), sometimes they are known as force carriers;

(1) The photon (γ) is the force carrier for the electromagnetic force.
(2) The gluon (g) is the force carrier for the strong nuclear force.
(3) The W^+, W^- and Z^0, which together form the weak nuclear force carriers.

Note that the gravity carrier (the graviton) is not included, because up to now there is no evidence if it exists or not. Another box should be added for the recently discovered Higgs boson which recently accounts for mass. The Higgs boson has slightly different function.

So far as people know, these particles included in the standard model are not made of anything else, and considered to be the basic particles of nature. According to the standard model theory these fundamental particles should be massless. The current best theory, the Higgs mechanism, explains how these particles attain their masses from the Higgs field excitation. Higgs mechanism states that there is scalar Higgs field permeates all parts of the universe. Particles with no mass, such as the photon, don't interact with Higgs field at all; maintaining their kinetic energy and passing through at the speed of light. Particles with mass such as the quarks and leptons interact with Higgs field which slows down their speed and converts some of their kinetic energy into mass. In order to prove the presence of the Higgs field, a Higgs boson must be created and detected, this however has proven to be a difficult task, as the Higgs boson is predicted to be massive particle requiring huge amount of energy to produce. The ATLAS detectors is the tool to detect Higgs bosons, situated at CERN, European Organization for Nuclear Research, in Geneva Switzerland to detect the high energy collision produced by Large Hadron Collider (LHC). In (LHC) two beams of protons are accelerated in opposite directions with speed close to the speed of light to be collided at the Centre of the ALICE. But how do massive particle such as Higgs can be created from only two small protons, this comes down to Einstein energy equation;

$$\boldsymbol{E} = \boldsymbol{m}c^2 \qquad (2.1)$$

By speeding up the protons to 99.999999% of the speed of light, they acquire additional kinetic energy total (7 tera ev), this combines with the energy of the other proton travelling in the opposite direction to produce a collision of (14 tera ev). Upon the collision this energy becomes hundreds of different kinds of particles, under these conditions, the Higgs boson could be created if it is really existing.

Finally, the Higgs boson will be a big revolution in science, and paves the way to understand the origin of mass and help in discovering other great mysteries of the universe

III. Higgs Mechanism and Particle's Mass:

The mass is the measure of the amount of matter in an object, measured in kilograms regardless of its location in the universe and the gravitational force applied to it (that is to say mass is the same where ever it is located in the universe, but differ in weight). The greatest mystery of science is how to search for the origin of mass to know what exactly the mass is, to provide much more understanding of how the universe comes into existence, and how the various particles of the standard model obtain their masses. It is proposed the mass was created by taking a lot of energy. The entire universe was born after when a lot of energy was turned into mass. The universe mass started right after the big bang. During the first moments of the universe, almost all the particles were massless travelling at the speed of light, in very extremely hot conditions. Before these particles attains any mass, the four forces this of nature started-up to split a part, then inflationary expansion took place increasing the size of the universe. At some time during this period the Higgs field turned on, permeating the universe and giving mass to the elementary particles, but most of the mass comes from somewhere else. Therefore, the Higgs boson is not responsible for matter mass, and the Higgs mechanism is not meant to account for masses of everything, it only accounts for fundamental particles masses, what means an electron derive its mass entirely from Higgs interaction, so the quarks and other building blocks that cannot be broken into smaller parts. The energy of interaction between quarks and gluon is what is what gives protons and neutrons their masses. Protons and neutrons are made out of quarks, and the quarks masses gained from Higgs bosons are so small to make up only 1% of either the proton or the neutron mass, so it is not convenient to say the protons and the neutrons have their masses entirely from the Higgs bosons, the rest of their masses comes from the energy confinement in the gluons field, and this where the mass of the nucleus came from. Hence the mass of everything virtually around us. Gluon is massless, but possesses much energy in them given by the famous concept in physics, represented mathematically by equation (2.1) above, to represent an object at rest, or rest energy of an object to indicate that mass and energy are the same thing [3], in other words mass is another form of energy.

Since the protons and neutrons are baryons; the existing technology is not able to convert four liters of gasoline into pure energy, this is forbidden by the law of conservation of baryons which states that the number of protons and neutrons remain the same, although from the theoretical point of view, by β-decay the protons can change into neutrons and vice versa [4].

The four liters of gasoline releases $132x10^6$ Jules of energy which is enough to make 14 Nanogram of mass. But the loss of 14 Nanogram from 3 kilograms of gasoline is indetectable with any scale. Therefore, forces of electrons recombination in fossil fuels creates unnoticeable force compared to the strong nuclear force (g) from the nuclear processes. The weak force (W^+ ,W^- ,Z^0) and the electromagnetic force (γ) working together inside the nucleus to create stable configuration of protons and neutrons that means the release of energy from nuclear reaction creates enough of mass difference to be measured, especially small amounts of masses can be turned to into energy from fusion or fission of the atoms nuclei. The sun gives off $3.86X10^{26}$ watts of power loosing $4.2X10^6$ tones of mass per second due to nuclear fusion of hydrogen atom [5].

According to Quantum Field Theory (QFT) an electron shouldn't have any mass, but that is not true, it does have mass, to prove that; it has finite quantum states evolve over time, and it does not travel with the speed of light. Because of the unusual interaction involving parity violation it has got a mass. The parity violation results from an electron being a fermion- (Fermion is a particle that obeys Fermi Dirac statistics)- has intrinsic spin property whose value (either +1/2 or -1/2) which is completely different from the classical notion of spin. The electron has another property, called chirality, which is either right- handed if It spins in the direction of motion, or left- handed if it spins in the opposite direction of motion. Chirality actually matters for weak interactions, because it the only force out of the four forces that cares about a particle spin. Therefore, the weak force is the only force that exhibits the phenomenon which leads to parity violation. Due to the weak force interaction, the left-handed electron has got an additional property called weak hypercharge, however what is unusual is that it doesn't have weak hypercharge with right-handed chirality [6]. As the spin of an electron keeps oscillating, the quantum states of the electron keep evolving over time, between the two possible spin values (+1/2, -1/2). This evolution can be described by Schrodinger Equation. In between these oscillations, an electron either gains week hypercharge or looses it when an electron chirality switches. This charge comes and goes due to the Higgs field which has none zero value everywhere in the space, unlike other fields of the quantum field theory. The Higgs field can be considered as this unlimited supply of weak hypercharge, the electron takes and gives this charge whenever it's chirality switches. This interaction with Higgs field is the reason why an electron has got mass [7].

IV. Quantum Field Theory:

Trying to give an over view of the big question in science, what are the fundamental building blocks of nature are constructed from, and where does their heft and mass come from? Here comes the idea of Higgs field where the building blocks of nature are not particles, but something more nebulous and abstract. They are fluid like substances, which spread over the entire universe, and ripple in a very strange way, that is the fundamental reality of the world, given the name (fields).

The fundamental Higgs field is of crucial importance to particle physics theory. The excitation of this Higgs field results in a fundamental particle in the standard model called the Higgs boson. This Higgs boson is first suspected to exist in 1960. When a particle like an electronic a quark is trying to move through space it should have to push through the Higgs field and experience a resistance due to it's interaction with the surrounding Higgs field to be its mass without experiencing some friction against the Higgs field as it travels through empty space. This drag force only manifests itself when the particle is trying to speed up or slow down, and that is why it is not brought to rest. The idea of the space filled Higgs field is a kind of wild idea when it was put forward in the table for the first time. Most of the scientists didn't believe this idea is correct, unless it is vertified by an experiment. One of the possibilities the experiment has been done by taking particles and making them to go around the LHC close to the speed of light to slam into each other to bang into space where the sparked space is filled with Higgs field, this Higgs field jiggle in way to flick off a tiny speck of Higgs field, and that tiny speck would be the Higgs boson. It is very hard to find these particles, calculations showed that roughly one in trillion of these sparking of space due to collision of particles could actually flick off one of the Higgs bosons. But now there is a very strong evidence that the Higgs particle has been found to prove that the idea of Higgs field is correct.

V. Mathematical Analysis:

Looking classically to the harmonic oscillator as a spring. The system exciting simple harmonic motion. In simple harmonic motion, the force acting on the system at any instant of time, is directly proportional to the displacement from a fixed point. The linear restoring force is (-Kx). Where K is the force constant. An oscillator in the quantum world is known as quantum harmonic oscillator. The difference between the simple harmonic oscillator and the quantum harmonic oscillator the energy levels are quantized in quantum harmonic oscillator and its smallest energy is E_0 followed by a quantum jump to the next level E_1 and so on. Then classically starting from Hooks law;

$$F = Kx = ma \qquad (5.1)$$

Oscillation is according to sine or cosine wave with a frequency ω, where;

$$\omega = \sqrt{\left(\frac{K}{m}\right)} \qquad (5.2)$$

$$K = \omega^2 m \qquad (5.3)$$

To apply the above equation in quantum mechanics, Classical energy;

$$E = K.E + P.E \qquad (5.4)$$

$$\boldsymbol{E} = \frac{1}{2}\boldsymbol{m}v^2 + \frac{1}{2}\boldsymbol{K}x^2 \qquad (5.5)$$

$$\boldsymbol{E} = \frac{1}{2m}P^2 + \frac{1}{2}\boldsymbol{m}x^2\omega^2 \qquad (5.6)$$

Set the mass (m) to unity, so as to remove it out of the way, then energy E can be written as a Hamiltonian, because the Hamiltonian is energy, the only difference is that P and x become operators;

$$\boldsymbol{H'} = \frac{1}{2}P'^2 + \frac{1}{2}x'^2\omega^2 \qquad (5.7)$$

x-operator just give the position,

$$x' Ix\rangle = x\, Ix\rangle$$

Then, x'^2 can be replaced by x^2

$$\boldsymbol{H'} = \frac{1}{2}P'^2 + \frac{1}{2}x^2\omega^2$$

The p-operator,

$$P' = \left[-i\hbar\frac{\partial}{\partial x}\right] \Longrightarrow P'^2 = -\hbar^2\frac{\partial^2}{\partial x^2}$$

For simplicity, set (ħ=1), at the end it can be restored back where it should be, then;

$$\boldsymbol{H} = -\frac{1}{2}\frac{\partial^2}{\partial x^2} + \frac{1}{2}x^2\omega^2 \qquad (5.8)$$

Let (H) acts on the wave function (I ψ >)

$$H\, I\psi \geq = -\frac{1}{2}\frac{\partial^2}{\partial x^2}\, I\psi > + \frac{1}{2}x^2\omega^2\, I\psi > \qquad (5.9)$$

To solve the quantum harmonic oscillator if the wave function as well as the corresponding energy are known, hence a solution for the wave function $\boldsymbol{I\,\psi} >$ is needed, by trial and error the solution is supposed to be;

$$I\psi \geq\, = e^{-\omega x^2/2} \qquad (5.10)$$

$$\left[\frac{\partial\, I\psi >}{\partial x} = -\frac{\omega}{2}\{2x.\, e^{-\omega x^2/2}\}\right]$$

Using the chain rule to differentiate the product,

$$\frac{\partial^2 I\psi >}{\partial x^2} = -\,\omega\, I\psi > \; + x^2\omega^2 I\psi > \qquad (5.11)$$

Plug equation (5.11) in the Hamiltonian equation (6.9), then;

$$H\, I\,\psi > = \frac{\omega}{2}\, I\,\psi > = \, E\, I\,\psi \; > \qquad (5.12)$$

Schrodinger equation is an eigen value equation, where the energy operator is the Hamiltonian on the left and its eigen value, the energy, on the right, the factors here are constants and don't change the nature of the potential.

$$E = \frac{\omega}{2} \qquad (5.13)$$

Since, $= hf$, then ħ can be restored back;

$$E = \frac{\hbar\omega}{2} \qquad (5.14)$$

Now the ground state of the Harmonic Oscillator is established

Recall equation (5.7),

$$\boldsymbol{H'} = \frac{1}{2}P'^2 + \frac{1}{2}x^2\omega^2$$

$$\boldsymbol{H'} = \frac{1}{2}P'^2 + \frac{1}{2}x^2\omega^2 = \frac{1}{2}\,(P'^2 + x^2\omega^2) \qquad (5.15)$$

Factorize classically equation (6.15) above,

$$\boldsymbol{H'} = \frac{1}{2}\,(P' + i\omega x)(P' - i\omega x)$$

$$\boldsymbol{H'} = \frac{1}{2}\{P'^2 + x^2\omega^2 \;+\; i\omega[p'x' - x'p']\}$$

Classically the commutator $[x', p']$ equal zero, but quantum wise, this commutator is not equal to iħ, remember that (ħ=1), hence a correction factor is needed. To write the Hamiltonian in this form, then;

$$\boldsymbol{H'} = \frac{1}{2}\{P'^2 + x^2\omega^2 \;+\; \omega\} \qquad (5.16)$$

To commutate $[(P' + i\omega x), (P' - i\omega x)]$, results in (+2iω [x, p]), where [x, p] is equal to (iħ), (ħ=1) finally it is equal to (-2ω). From this result two operators can be created according to the following definitions,

$$a^+ = \frac{p + i\omega}{\sqrt{2\omega}} \qquad (5.17)$$

$$a^- = \frac{p - i\omega}{\sqrt{2\omega}} \qquad (5.18)$$

Therefore, their commutator equals (-1),

$$[a^+, a^-] = -1 \qquad (5.19)$$

Therefore;

$$(p + i\omega) = \sqrt{2\omega}\, a^+ \qquad (5.20)$$

$$(p - i\omega) = \sqrt{2\omega}\, a^- \qquad (5.21)$$

The new form of the Hamiltonian is going to be

$$H' = \omega(a^+a^-\,) + \frac{\omega}{2} \qquad (5.22)$$

The effect of a^- on the wave function (I ψ>), let;

$$I\psi > = e^{-\frac{1}{2}\omega x^2}$$

Then;

$$a^- I\psi > = \frac{p - i\omega}{\sqrt{2\omega}}\, e^{-\frac{1}{2}\omega x^2}$$

But,

$$p = \left[\frac{-i\partial}{\partial x}\right]$$

So,

$$a^- I\psi > = \frac{-i}{\sqrt{2\omega}}\left(\frac{\partial}{\partial x} + \omega x\right) e^{-\frac{1}{2}\omega x^2} = 0$$

Therefore, the effect of (a^-) acts on the wave function in a way to destroy it, so it is an *annihilation* operator.

The effect of a^+ on the wave function (I ψ>), let;

$$a^+ I\psi > = \; a^+ e^{-\frac{1}{2}\omega x^2}$$

The eigen value of the Hamiltonian gives the energy, then;

$$H\, a^+ I\psi > = \lambda\;\, a^+ I\psi > = \; E\, a^+ I\psi >$$

From equation (5.22) substitute the new form of the Hamiltonian;

$$\left[\omega(a^+a^-\,) + \frac{\omega}{2}\right]\;\, a^+ I\psi > = \lambda\;\, a^+ I\psi > = \; E\, a^+ I\psi >$$

$$[\omega(a^+[a^-\; a^+])\, I\psi > + \frac{\omega}{2} a^+ I\psi > \; = \; E\, a^+ I\psi > \qquad (5.23)$$

From equation 5.19.

$$[a^+, a^-] = -1$$

Therefore;

$$(a^-\; a^+) = (a^+a^- \,+ 1) \qquad (5.24)$$

Substitute equation (5.24) into (5.23), then;

$$E = \frac{3}{2}\omega$$

Now restore ħ back,

$$E = \frac{3}{2}\hbar\omega \qquad (5.25)$$

Remember that the basic energy level started with $\frac{1}{2}\hbar\omega$, so the effect of (a^{+}) acts on the wave increases the energy by (ħω) in a quantized manner, and get the energy into new state or level. So, a^{+} is a *creation* operator. Therefore, the energy levels of the Harmonic Oscillator increased in units of (ħω) and has to go up in steps when operated on the wave function by (a^{+}). (a^{+}) takes the basic level of the Harmonic Oscillator and increase the energy one step up, if done again it takes the energy another step, by contrast (a^{-}) takes the basic level to zero state where there is no energy (the vacuum).

If energy level is in vacuum state, the (a^{+}) takes it to basic state (the lowest energy level) and converted it to oscillation, by contrast (a^{-}) takes the upper energy level down by one step, but if the energy level is at the bottom energy level it will take it to the vacuum.

Unfortunately, the application of the operators directly on the wave function states will not take the energy up or down one step, unless one of the factors $\sqrt{n+1}\ or \sqrt{n}$ is switched on, because in direct application, the commutator will not be satisfied to give an answer equal to minus one, as can be seen by the following examples;

$$a^{+}In > \Longrightarrow In+1 >$$
$$a^{-}In > \Longrightarrow In-1 >$$
$$a^{+}I0 > \Longrightarrow I1 >$$
$$a^{-}I1 > \Longrightarrow I0 >$$

From these relations the commutator $[a^{+}, a^{-}] = 0$.

For the commutator $[a^{+}, a^{-}] = -1$, the following relations hold and give the correct answers;

$$a^{+}In > \Longrightarrow \sqrt{n+1}\ In+1 >$$
$$a^{-}In > \Longrightarrow \sqrt{n}\ In-1 >$$

The operators derived above are generalized notion of creation and annihilation operators to act on states of various types of particles, often act on electron states as in quantum chemistry, refer specifically to ladder operators for quantum harmonic oscillators.

Creation and annihilation operators $[a^{+} and\ a^{-}]$ of quantum states in Quantum Field Theory change the eigenvalues of the number operator, such as (n) to represent the quantum number to label the single particle states of the system.

The second quantization referred to as occupation number representation in quantum field theory is known as canonical quantization, in which fields are thought of as field operators (typically as the wave function of matter). The key ideas of this method were introduced in 1927 by Paul Dirac [5], and developed later by others.

To link what has been done to Higgs field so as to use these quantum concepts to show how to build these operators in the quantum field theory in order to create particles. Every particle has got its own associated field, but nobody knows how these fields looks like. On assumption that these waves are regular, whatever the wave looks like, they have wave length and pass by a number of cycles per second. Whatever the shape of that wave during that wave length, it will be repeated in the next forthcoming cycles, and they should be subjected to two rules:

(a) The start point should be the same end point.

(b) The wave must be continuous and has a single value for any given position.

From Fourier analysis, Fourier series for approximation, position varying function ψ(x) can be written, the position function must be defined over one full period (one cycle) of one wave length, represented by combination of plain sine and cosine waves represented by e^{ikx} . In general, an exponential period signal includes a phase shift at (t = 0). Thus, the most general expression for this periodic function which is going to be our field is;

$$\psi(x) = \sum_{k=0}^{k} \alpha(k)e^{ikx} \qquad (5.26)$$

Where α is the varying amplitude of the waves associated with the wave length λ., K = 2π/λ, therefore k is an indicator of the wave length λ.

The complex conjugate of ψ(x) is;

$$\psi^{*}(x) = \sum_{k=0}^{k} \alpha^{*}(k)e^{-ikx} \qquad (5.27)$$

The conjugate can be converted into quantum field theory, hence $\psi^*(x)$ becomes a Hermitian conjugate $\psi^+(x)$ and α becomes a^+ the creation operator for each value of k. Then;

$$\psi^+(x) = \sum_{k=0}^{k} a^+(k)e^{-ikx} \qquad (5.28)$$

This is the field operator which creates particles with wave length k. But k is the proxy of the momentum (P) since;

$$P = \hbar k$$

Therefore, the particle will be created with momentum P related to k.
Similarly, the other terms (the annihilation operator) is,

$$\psi^-(x) = \sum_{k=0}^{k} a^-(k)e^{ikx} \qquad (5.29)$$

The effect of the operators will be as follows;

$$a^+(k)\ I0> = Ik>$$
$$a^-(k)\ I1> \Longrightarrow I0>$$

Adding the dimension of time to equations (6.27, 6.28), the relations change from the standing waves state to the travelling waves;

$$\psi^+(x,t) = \sum_{k=0}^{k} a^+(k)e^{-i(kx-\omega t)} \qquad (5.30)$$

$$\psi^-(x,t) = \sum_{k=0}^{k} a^-(k)e^{i(kx-\omega t)} \qquad (5.31)$$

Differentiate equation (5.31) with respect to time t,

$$\frac{d}{dt}\psi^-(x,t) = \sum_{k=0}^{k} a^-(k)(-i\omega)e^{i(kx-\omega t)} \ (5.32)$$

Differentiate equation (5.31) twice with respect to position x,

$$\frac{d^2}{dt^2}\psi^-(x,t) = \sum_{k=0}^{k} a^-(k)(ik)^2 e^{i(kx-\omega t)} \qquad (5.33)$$

By equating the common terms in equation (5.32, 5.33), leads directly to the time dependent Schrodinger equation getting back to the first quantization, with which the concept of the second quantization of QFT has been started.

VI. Conclusions and observations:

What is so remarkable in Mendeleev periodic table it reveals all the relationships between each and every element in order. Mendeleev combine the atomic weights and the elements properties into one universal understanding of all elements. After the discovery of the electron, the atom is no longer considered to be a fundamental particle and the atomic model was revised till the arrival to a point to know that all of matter, every atom and everything is made up of just three different fundamental particles, (up quark, down quarks and the electron) arranged in a rather peculiar way, essentially in what is called standard mode of particle physics. This standard model is taken as the theory of three out of the four known fundamental interactions, and the fundamental particles that take part in these interactions to make up all the visible matter in the universe. All the high energy physics experiments carried out since mid the nineteenth century, has eventually yielded findings consistent with standard model. Still the standard model falls short of being complete theory of fundamental interactions, because gravity is not included in the model and so the dark matter energy. Also, the standard model is not able to give complete description of the lepton either, because it does not describe nonzero neutrinos masses.

Researchers thought that gravity may gave got an exchange particle suggested to be called the graviton guage boson, but so far there is no evident for that to be included in the standard model, and it is supposed to be the next challenge to get a unified model encompasses everything. The mass of the guage boson determines the range of the force, the lighter the guage boson the greater the range of the force, for example the photon has no mass, therefore the range of the electromagnetic forces is infinite, where W^+,W^- ,and Z^0 bosons of the weak nuclear force are very heavy and consequently the weak interaction force has got Avery short range of force.

These twelve fundamental particles of the standard model seem not to be enough, because every one of them has an anti-particle. A ti-matter can rarely be seen except in the laboratory, because it cannot survive for more than a fraction of a second before colliding with ordinary matter and annihilating it to produce energy that is where the universe is created with equal amounts of matter and anti-matter. The matter and anti-matter and together and annihilating leaving small residue of matter which is the substance constituents of the universe.

There are some theories suggesting that there might be more than one Higgs boson, there might be heavier Higgs, but that is to be discovered. Now another box should be added, since there is an evident for recently discovered Higgs boson which accounts for the fundamental particle mass.

Note that the first column of the standard model consists of four particles (up quark, down quark, the electron and the electron neutrino)making up what is called the first generation of matter, and for some reason nobody knows or understand why nature has chosen to provide two ore copies of these particles as a second and third generations. The second generation is (the strange quark, the charm quark, the muon and the muon neutrino). The third generation is (top quark, the bottom quark, the tau and the tau neutrino). All these particles of the second and third generations are exactly the same as in the first generation except that they are unstable, they quickly decay into an electron and some neutrinos, so the electron has a sort of heavy cousin the muon about 200 times more massive than the electron. The third generation even heavier. Up to now no one understands what underlies this phenomenon.

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