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The GEM unification theory using a Feynman-Hawking path integral approach and the Higgs boson: *Did dimensional collapse trigger the Big Bang?*

Abstract

The GEM unification theory builds on the GEMS (Gravity EM Strong) Theory. to unify all four force fields of nature: Gravity, EM, Strong, and Weak using Feynman Path integral formalism. The model is rudimentary, and can be called a "Bohr Model" of unification. It is basically found that Gravity and the other forces can be understood as quantum electrodynamics. In particular the proton emerges as a fundamental particle despite being composed of quarks and is the principle interaction vertex of the Higgs boson, which is seen here as direct consequence of a hidden 5th dimension, where the Higgs mass is due to 5th dimensional compactification. A particle mass formula based on Feynman Path Integrals including paths across the hidden 5th dimension gives the proton and electron masses to high accuracy and finds the charged bosons responsible for the short range nuclear forces. The masses calculated for the particles are as follows: the charged pion $m_\pi = 2\, m_e/\alpha \cong 140.0$ MeV and W boson: $m_w = 2\sigma\, m_p = 80.4$ GeV. The η_c meson $m_\eta = 2985$ GeV is identified with the 5th dimension compactification force mediated by the Radion field. The Higgs boson associated with this mass inducing field is the most general EM+Radion scattering quanta off the hidden dimension size with a mass $m_p/\alpha \cong 127.7$ GeV. This results in a structural resonance $\lambda\!\!\!^{-}_{Higgs} = r_p$ where $\lambda\!\!\!^{-}_{Higgs}$ is the Compton radius of the Higgs boson and $\lambda\!\!\!^{-}_{Higgs} = \hbar c/m_{Higgs}c^2$ the r_p electro-dynamic length of the proton $r_p = e^2/m_pc^2$. A path integral calculation for the neutron mass assuming a second-order Higgs interaction yields the mass $m_n \cong m_p(1+1/(\alpha(4\pi)^2 5^4)) = m_p(1.00138847)$. Collapse and compactification of a 5th dimension is argued as the triggering event for the Big Bang with the Higgs acting as a short range scalar graviton. The Higgs field is also identified with the Radion scalar field of Klauza-Klien theory. Also, a derivation of the Wyler fine structure constant formula $\alpha^{-1} = (10/3\pi)(32\pi^5/15)^{3/4} = 137.036$ using Planckian physics is also shown.

Keywords

GEM unification theory; Feynman path integrals; Gravity; Electromagnetism; Weak force; Strong force; Mie scattering; Structural resonance; W boson Higgs Boson; Pion; Kaluza-Klein theory; Radion scalar gravity.

INTRODUCTION

"*everything is geometry*,"
John Archibald Wheeler

According to present understandings, the cosmos, as we know it, began with a tremendous explosion, called the Big Bang that became the expansion of the universe. This can be interpreted as the sudden appearance of charged massive particles from the vacuum, along with entropy. Such a hidden dimension can lead to the appearance of other particles and forces and proposed in the GEM (Grandis et Medianis) *"the unity of the great and middle"* theory[1-5]. The GEM theory unites the "middle" or subatomic scale of particles with "great" scales of both the Cosmos and Planck Scale. The GEM theory is combination of two concepts- the

hidden 5th dimension concept of the Kaluza-Klein[6] theory unifying gravity and electromagnetism, and the Sakharov[7] concept of an electro-dynamic vacuum spacetime-vacuum as the origin of an electro-dynamic gravity.

Kako[8] has recently conjectured that the Big Bang was due to appearance of the Higgs Boson which caused particles to acquire mass. But was this appearance of the Higgs merely another consequence of a change in physics? Here, we make a deeper, howbeit rudimentary, inquiry into the origin of mass as due to the appearance of a hidden 5th dimension, and we find that the Higgs Boson falls out as a consequence of the appearance of compactified 5th dimension, and gains its own mass from it, rather than being a direct cause of particles acquiring mass. However, the Higgs Boson is obviously associated with the mass generating mechanism of the 5th dimension and so is part of circle of cause and effect. In this GEM model, which we will refer to as a "Bohr Model" of unification, the Big Bang was triggered by a collapse or shattering of a formerly infinite 5th dimension, breaking up large scale coherence in that dimension and thus increasing entropy, by spreading action over a range of scales. The appearance of this compactified 5th dimension led to particles, including the Higgs Boson, to acquire mass and the Cosmos we experience.

Based on studies of primordial nucleo-synthesis in the early fireball, the physics of the universe has remained unchanged since the first fractions of a second of the primordial explosion. However, in order for the Big Bang to occur, physical laws must have undergone a change. It now appears possible to understand a mechanism by which the Big Bang was triggered, leading to the universe we now know. It can be postulated that a universe of 5 dimensions, all infinite, existed, and that one of the dimensions that existed then underwent a catastrophic collapse and compactified, becoming a curled up or hidden dimension[6]. The driver for this collapse was apparently an increase in entropy and lessening of action, two fundamental principles that determine dynamics in our present universe, this change also gave rise to mass and electric charge. This can be seen mathematically by a model of a universe filled with a massless quanta, that is a vacuum, with a metric tensor seen in Eq. 1.

$$\gamma_{ab} = \begin{bmatrix} g_{\tau\upsilon} + \xi\kappa^2 A_\tau A_\upsilon & \xi\kappa A_\tau \\ \xi\kappa A_\upsilon & \xi \end{bmatrix} \quad (1)$$

In Eq. 1 A is the electric 4 potential, the indices, a and b, run from 1-5, $\kappa^2 = 16\pi G/c^4$, and Greek indices are assumed to run from 1-4 for standard spacetime, and $g_{\tau\upsilon}$ is the familiar 4 metric tensor. The symbol ξ is a parameter that determines the size of the 5th dimension, with $\xi = 1$ being a compactified universe and $\xi = \xi_o$ being the primordial universe with an infinite 5th dimension. We have then a Lagrangian for a set of massless scalar quanta, with $M_P = (\hbar c/G)^{1/2}$ being the Planck mass, a mass that can arise spontaneously out of the vacuum, where using our 5th dimensional metric is used to define a Hilbert Action as in the formalism of the original Kaluza-Klein[6] article:

$$L = \frac{h^2}{M_P}\int \left(\partial_a \phi \partial_b \phi \gamma^{ab}\right)\sqrt{-\gamma}\, d^5x \quad (2)$$

The minimization of this Lagrangian leads to a simple Klein-Gordon wave equation for massless quanta in flat space[8]:

$$\partial_a \partial_b \phi \gamma^{ab} = 0 \quad (3)$$

However, if we allow the fifth dimension to become compact, we can require all dependence on the 5th dimension to be of the form:

$$\phi = \sum_n \phi_r(x^\nu)\exp(i n x_5/(2\pi r_o)) \quad (4)$$

Where n is an integer index and r_0 is the size of the hidden dimension, x_5 is a displacement in the 5th dimension, then the particles in the quantum Lagrangian acquire both mass and charge:

$$L = \frac{h^2}{M_P}\int\left(\left[(\partial_a - \frac{in}{2\pi r_o}\xi\kappa A_\upsilon)\phi\right]^2 - \left(\frac{n}{2\pi r_o}\right)^2\phi\right)\sqrt{-\gamma}\, d^5x \quad (5)$$

Where, consistent with standard Kaluza-Klein Theory, the electric charge is identified, for n = ξ = 1 as:

$$e = \frac{\kappa h c}{2\pi r_o} \quad (6a)$$

and mass is

$$m = \frac{h}{2\pi r_o c} \quad (6b)$$

with n and ξ being dimensionless. Setting n = 1 for lowest order behavior, we have for that for field free space:

$$\partial_a \partial_b \phi \gamma^{ab} + \left(\frac{mc}{h}\right)^2 \phi = 0 \quad (7)$$

So that the compactification of a 5th dimension allows both charged and massive particles to appear from a previously vacuum filled universe. These particles can move and scatter off each other freely, increasing entropy, just like the shattering of a stone obelisk into pieces increases entropy. Therefore, without going into further detail, it can be hypothesized that the universe we live in was born from the catastrophic failure of a dimension in a formerly 5 dimensional universe, leaving the formerly infinite 5th dimension as a fragment of its previous self. The values of the mass and charge

are subject to some adjustment. For instance for a value of $\xi = n = 1$ and κ being its normal vacuum value the electron charge e requires the hidden dimension size r_o to be of the order of the Planck radius, however, we will assume here that just as many physical constants are considered "running" value that we only observe as asymptotic values at low energies, so we will assume that κ, basically G, which has the Gaussian units of a charge-to-mass ratio squared, actually has a value of $\kappa \sim (e/m_o)^2$ near the hidden dimension size, where spacetime curvature changes abruptly, making gravity effectively stronger at those scales.

This is equivalent to the model of a "quartic potential", triggered by the appearance of a Higgs Boson, that particles that gives non-zero masses that are none-the-less lowest energy state, due to a gravitation-like negative self-potential. An analogous model occurs in cosmology where the proton density $n_o \cong \psi^2$, that is: a quantum probability squared, contributes to the mass-energy of the universe by an equation for energy density

$$w = \psi^2 m_p c^2 - \frac{8\pi G}{3 r_o} m_p{}^2 \psi^4 \qquad (8a)$$

where for $\Omega = 1$ the second term becomes $m_p c^2$.

This can also be viewed as an idea originating with Einstein that the charged particles could be approximated as charged spherical shells held together by gravity[1], characterized by an effective short range gravity mediated by a massive scalar particle, leading to an effective, or "running", gravitation constant at that scale as G^*:

$$\frac{G^* m_o^{\,2}}{8\pi r_o^{\,4}} = \frac{G^* e^2}{8\pi r_o^{\,4}} \rightarrow G^* \cong \frac{e^2}{m_o^{\,2}} \qquad (8b)$$

This can be considered to allow both e and r_o to be free from each other for our purposes. The problem of short range effective gravity at the scale of the classical particle radii will be discussed later. Therefore, the compactification of a 5th dimension automatically produces charged massive particles in our spacetime dimension. Since the appearance of the electron charge leads to an action $e^2/c << \hbar$ that is less than Planck's constant, i.e. the fine structure constant $\alpha = e^2/(c\hbar) = 1/137 << 1$, the compactification leading to the electric charge, is consistent with the overarching principle of minimization of action in nature. This minimum action principle underlies all physics as we understand, including everything done in this paper.

We will consider, consistent with the success of quantum electro-dynamics, that all particles are imbedded in a spacetime that is itself electro-dynamic. This means charged particles will produce "vacuum polarization" in the fabric of spacetime around themselves, over many scales of length, as if it was a conventional dielectric. This leads to observable quantities such as charge or mass "at a distance" being renormalized versions of a "bare charge" or mass measured at short distance scales. Because this process is governed by quantum uncertainty, sums over these renormalization effects lead to characteristic terms of the form $\ln(r_{in}/r_{uv})$ where r_{in} is the low energy "infrared" limit of the effects, and r_{uv} is some cutoff at the high energy "ultraviolet", which in an ordinary dilectric would be the molecular spacing of the dielectric but here in the vacuum is r_p, the Planck length. This is entirely consistent with the GEM view of the gravity as electro-dynamic, gravity being the curvature of spacetime, which is itself, is electro-dynamic. Thus the price of analyzing field unification in terms of paritcle masses and charges observed "at a distance" is to understand that quantities such as "classical radii" are actually averages or sums over vacuum electro-dynamic effects ranging down from the subatomic to to the Planck scale. Therefore, even though we will consider that charged particles exist in an electro-dynamic vacuum and have charge and mass "at a distance" that are well characterized, we will consider that such particles come into existence through process deeply removed from direct observation and operating over many deeply subatomic length scales.

We will also consider that spacetime is not just 4 dimensional, having three distinct spatial dimensions and one of time, but that an additional "compactified" 5th dimension exists as a degree of freedom. This 5th spatial dimension, whose consequence is the existence of massive particles, is restricted compared to the other dimensions, but none-the-less is a degree of freedom capable of variation.

However, it is not enough to merely create conditions for charged massive particles to exist, they must be born in a process that conserves both charge and vacuum quantum numbers. Attempts have been made to connect these processes with the Higgs mechanism for producing mass but these have been so far unsuccessful. However, in the GEM unification theory a connection has been found, and will now be discussed.

Hawking-Feynman path integral approach

Previously[1], it was found that the introduction of a compactified ("curled up") 5th dimension led to the proton and electron as the two basic particles of the cosmos and that the electrostatic structures associated with them gave rise to Mie resonances that created quanta corresponding to the charged bosons associated with the Strong and Weak forces: the charged pion and the W boson. The theoretical masses of these

particles were predicted to high accuracy. The mass of the Higgs Boson was also found to high accuracy. We are led by these results to consider the birth of particles from the vacuum, together with the force fields between them, as somehow leading to the Big Bang.

In the beginning the cosmos began with a single point, where before there was nothingness. In the next instant there was an expanding fireball of ionized hydrogen, protons and electrons with a small admixture of neutrons. By conventional theory, there was a period in the Big Bang scenario when the particles had no mass, but then the Higgs interaction- not a force between particles but a uniform field filling the vacuum itself -was "switched on" and the particles assumed their masses. Dr. Alfred Lehnen (private communication) of Madison College has commented on this scenario by pointing out that this interaction not only gave rise to the particles as we know them, but also gravity fields between particles, so no analysis of a Higgs switch-on scenario can be achieved without gravity fields appearing as well as the Higgs interaction. However, we can understand this switch-on scenario in a different way, via Kaluza-Klein theory- which contains a scalar Radion scalar field similar to the Higgs field and also contains the metric curvature of spacetime so that the Higgs interaction and gravity are coupled and can switch-on together.

The collapse of one dimension of a 5 dimensional vacuum cosmos, with 4 infinite spatial dimensions, and one time dimension, into a compactified form, leading to a conventional 4 spacetime-dimensional cosmos with a compactified 5th dimension, can lead to particles assuming their present day masses in a cosmos full of hot plasma of plus and minus charged particles. Such an event greatly increases the entropy of the universe from the 5-vacuum state that preceded it. In one instant of time the cosmos went from being very simple and smooth to disordered and full of particles moving chaotically. Thus, the new, Big-Bang cosmos was favored thermodynamically over the old infinite 5 cosmos, because it contains more entropy. This complexity can be understood as a sum over possible histories starting with the time when no Radion field exists, indicating that the possible histories, even for an individual particle, are themselves complex. The transition of spacetime from being smooth to that a spacetime containing a hidden dimension and thus being full of dust-like regions of tightly curved spacetime, also we shall see, leads to both long range and short range forces between particles.

Force is the result of gradients in potentials. By introducing highly curved space at small radii, transitioning to uncurved space at infinity, away from the particles, gradients in spacetime curvature and thus infinite range forces are created. At short ranges, we shall also see, quantum resonances caused by preferred paths around structures or quantum Mie scattering off of structures associated with the particles and hidden dimension sizes, that create short range quantum force fields. Because the quanta created by quantum Mie scattering is of non-zero masses and thus they are confined by Heisenberg's Uncertainty principle to finite range. Thus the Klauza-Klein approach, where the birth of a collapsed dimension can trigger particle masses and also long and short range forces can unify the force fields of nature and explain particle mass as an interaction similar to the other interactions. In truth, all particle interactions with a potential, thus changing particle energy, change mass though the $E=mc^2$ relation, it is just the Higgs interaction which changes the mass most dramatically. Therefore, not-unsurprisingly, this approach can also unify the Higgs interaction with the other four particle interactions and recover the mass of its signature particle, the Higgs boson. The force of these forces vary with spatial separation in normal three-space, however, the Higgs interaction, or Radion field, varies with the separation of particles in the 5th dimension.

The search for unification is the search for the most fundamental theory of particles and fields in the cosmos. Thus, we attempt to use the most fundamental formalism of quantum mechanics, the Feynman Path[8] Integral formalism to achieve results. In Feynman path integral physics, the idea of resonance and geometry are combined, and in its extension to a 5th dimensional space, mass and spacetime geometry are connected. Here we will use formalisms proposed by Hawking to establish our basic results. A curious quantity termed "Ultra-charge" is identified as spin quanta plus charge quanta: $u_c = s + q$, and appears to represent topological information involved in some path integrals. The foundation of this new mathematical model is the results of the GEM theory.

The GEM theory is a geometric theory, that is an alloy of the Sakharov[8] and Kaluza-Klein theory[7] approaches to the unification of EM and gravity, the two long-range forces of nature. The theory is fairly primitive, being described as a "Bohr Model" of field unification at this point, by analogy to the early simple model of the quantum mechanics of the hydrogen atom. However, the GEM theory is successful in explaining the basic relationship of EM and gravity force fields. this creates the fabric of spacetime that is electromagnetic, and obtains the field equations of both with the 5th dimension of Kaluza-Klein and by linking the existence of the proton and electron. These par-

ticles are at the lowest energy end members of the Lepton and Baryon families as a pair of fields, to the existence of the force field pair of gravity and EM. The GEM theory finds the value of *G* and the mass of the proton in terms of the Planck mass, both to high accuracy, without free parameters, as a result. Here we reformulate the GEM theory in the form of Feynman Path Integrals[9]. Time and space are completely separable in the Feynman formalism, unlike other relativistic approaches where they are mixed. This means the flow of time in Feynman path integrals is forward and entropy must increase due to the sum over possible paths. This can be shown to be equivalent to the Schrodinger Wave Equation solutions in quantum mechanics. The Feynman Path Integrals method works by three basic rules:

1. The Probability for an event is given by the squared length of a complex number called the "probability amplitude".
2. The Probability Amplitude is given by adding together the contributions of all the histories in configuration space.
3. The contribution of a history to the amplitude is proportional to *exp(iS/ħ)* where *S* is the action of that history, given by the time integral of the Lagrangian L along the corresponding path between times t_2 and t_1.

$$s = \int_{t_1}^{t_2} L dt \qquad (9)$$

According to these rules, the most probable path integrals are over closed paths and result in actions that are multiples of Planck's constant:

$$h = \int_{t_1}^{t_2} L dt \qquad (10)$$

An example of this approach is defining the closed orbital paths of electrons inside a hydrogen atom, where this formalism gives the same results as the Bohr model, and hence the same predicted spectra. In general, the Feynman method can be considered as transforming the quantum evolution of a system in time with that of a statistical ensemble of possible states of a system, with more likely states dominating its evolution.

In our application of the Feynman Path Integral method to the GEM model we must include paths that lie in the 5th dimension. Since these paths are short compared to the Compton wavelength of the particles, and lie within a curled up dimension, we will assume, in keeping with the Heisenberg Uncertainty Principle that these paths involve relativistic motion at high energy and thus determine the mass of the particle itself. Thus, we identify the 5th dimensional pathways in the Feynman Path Integral with the Higgs Mechanism. The Higgs field in a conventional field theory, is a potential permeating all space that couples to the particles and gives them their masses. Since the field does not vary in ordinary space or time dimensions, we can assign it to an independent 5th dimension. Since changes in mass cannot be separated from spacetime geometry we will use the Hawking formalism[10] of Feynman's Path Integral to allow spacetime to change over the integrals, and by this obtain a formula for particle masses. This can be compared to the Einstein concept of a particle following a geodesic, or the shortest path through a curved spacetime. In the Feynman-Hawking formalism, the geodesic path is the most favored but spacetime is allowed to fluctuate around its normal smooth character. Due to the complexity of this type of theory, we will proceed quickly and semi-heuristically, and so will arrive at a mass formula. We will be guided in this by the principle that results be physically simple to interpret and will not violate Maxwell's equations and will lead to an increase of entropy in the universe, and thus be a favored process.

In order to work with spacetime curvatures, Hawking first integrates over the volume containing a particle and converts into a Gaussian-like surface integral. Following Hawking we can calculate a probability of a final field and particle configuration at time t_2 based on initial configuration at time t_1, with all possible fields ϕ and all possible spacetime metrics g, by taking a path integral I of the action between the two times:

$$< g_2, \phi_2, t_2 \mid g_1, \phi_1, t_1 >= \int D(g), D(\phi) \exp(i\, I[g, \phi] / \hbar) \qquad (11)$$

$$m c^2 = I_o = \frac{c^2}{4\pi G} \oint_{s'} \vec{g} \cdot d\vec{s} \qquad (12)$$

Where *m* is the particle mass, *G* is the Newton gravitation constant, and surface S' bounds the volume containing the particle. Hawking then uses the surface integral to calculate the mass inside it. This use of gravity to identify particle masses within a spacetime volume cannot be done without an important assumption: that is high frequency gravitons, which are allowed by the Heisenberg Uncertainty principle, and which themselves have mass, will not contribute to the mass of the space containing the particle.

Therefore, in order to avoid unphysical instability of spacetime to forming black holes, we make the fundamental GEM Assumption that high frequency gravitons are unstable to decay into EM photons and thus high frequency gravitons, with wavelengths of the order of classical particle radii and below, are suppressed by EM-gravity unification and can make no contribu-

tion other than small perturbations. With this primary assumption made, and following Hawking's formula in a simplified form, we obtain, in the limit of vacuum fields: g_o and ϕ_o, for both electromagnetic and gravity fields, with corrections due to excited fields of first: $g_\sim$ and $\phi_\sim$ and second order: $g_{\tilde{}}$ and $\phi_{\tilde{}}$:

$$mc\ell \cong \int_{t_1}^{t_2} L(g_o,\phi_o)dt + \int_{t_1}^{t_2} L(g_\sim,\phi_\sim)dt + \int_{t_1}^{t_2} L(g_{\tilde{}},\phi_{\tilde{}})dt..... \quad (13)$$

Where ℓ is some physically relevant length derived from the volume of integration for the surface integral. Here we now invoke the Kaluza-Klein 5th dimension and identify the rest mass of the particle as the path integral over a 5th dimensional path. Following the formalism of compactified dimensions proposed by Klein we will write the Lagrangian as:

$$L(g_o,\phi_o) = M_{Planck}\, c \exp(-\ln\sigma(q/e)) \quad (14)$$

where σ is identified as the proton-electron mass splitting parameter, and we use the GEM identification of the 5th dimension as electric charge, and so normalized path length is identified as q over e, where e is the electronic charge. This can be identified with Radion, or dilation factor of the new hidden dimension[11].

We obtain then, in Hawking's expansion around vacuum or near vacuum fields, the first order term:

$$mc^2 \cong \frac{c}{\ell}\int_{t_1}^{t_2} L(g_o,\phi_o)\,dt = M_{Planck}\, c^2 \exp(-\ln\sigma(q/e)) \quad (15)$$

Particles from the vacuum: The GEMS approach

We have the vacuum quantities associated with the Planck scale:

$$r_P = \sqrt{\frac{G\hbar}{c^3}} \quad (16a)$$

$$M_P = \sqrt{\frac{\hbar c}{G}} \quad (16b)$$

$$q_v = \sqrt{\hbar c} \quad (16c)$$

The simplest result then would use the vacuum derived Planck charge q_v as the length of the path in the 5th dimension. Using this we could obtain the proton mass as the simplest result.

We must now consider other constraints to such a theory. Nothing, especially the cosmos itself, is by definition simple. In particular, the appearance of one particle does not increase entropy in the universe, and entropy requires complexity. Also, we must consider that a charged particle cannot simply pop out of the vacuum without violating the electromagnetic constraint of charge neutrality. So the same simple process of a path integral allowing the appearance of a proton must also allow the appearance of an electron to balance it and to maximize entropy. Therefore, we must have the proton appear as part of a system that includes the electron, so that hydrogen results:

$$q_p = -q_e \quad (17a)$$

$$q_p = e, \qquad -e = q_e \quad (17b)$$

Another constraint occurs because the path length in the vacuum that cannot be simply a distance, but must be a spacetime interval. In the vacuum state all particles must be masses and move at the speed of light and have a spacetime interval of zero:

$$r_o^2 = (x_o^{\,2} + y_o^{\,2} + z_o^{\,2}) \quad (18a)$$

$$r_o^2 - c^2 t_o^2 = 0 \quad (18b)$$

It is seen that the appearance of the new hidden dimension occurs in a form analogous to the splitting of a canceling charge pair of particles from the vacuum, by splitting of a quantized light-like, or vacuum, spacetime interval of length zero. In the GEM theory the hidden dimension size, where the hidden dimension can mix with the non-hidden dimensions, is the quantized particle size. The hidden dimension quantities are thus able to mix with the normal spacetime quantities because they are similar at smaller scales. This will lead to, as we experience them, two particle types. One is associated with the time-like portion of the constrained interval, leading to a one-dimensional character, an electron, and another of equal size with a space-like character having three constrained sub-dimensions, a proton. The gravitation constant G, functions in the vacuum as the "interpreter" of charge into either mass or distance. Thus, ironically, charge and mass, the source terms for EM and gravity, are unified already in the vacuum quantity G, which has units of charge to mass ratio squared in the esu system used here.

$$q\sqrt{G/c^4} = r \quad (19a)$$

$$r_o^2 = (G/c^4)(q_x^{\,2} + q_y^{\,2} + q_z^{\,2}) \quad (19b)$$

$$r_o^2 = c^2 t_o^2 = (G/c^4) q_t^{\,2} \quad (19c)$$

Therefore, the quantized vacuum scale length, the Planck length, gives birth to a quantized larger scale hidden dimension. Because the quantized hidden dimension is an image of macroscopic space-time in a light-like interval, and its structure is part of a split "lightlike" spacetime where charge q is analogous to macroscopic dimensions as a length, we have charge conservation and interval conservation. We obtain from these conditions the following constraints on the charges of the particles:

$$q_o = -q_t = q_x + q_y + q_z \quad (20a)$$

$$q_o^2 = q_t^2 = q_x^2 + q_y^2 + q_z^2 \quad (20b)$$

where the subscripts denote the corresponding time or space dimensions in the unconstrained Cosmos. Thus, the space-like portion of the split interval, the proton, has three sub-dimensions that we interpret as quarks or sub-charges, while the electron acts like a single entity.

Therefore, with the constraints of charge neutrality and spacetime interval being conserved, we go forward and see the formation of the electron-proton system from the vacuum. Based on the concept of an expansion in orders from Eq. due to path integrals in the presence of vacuum, and then first-order and higher-orders of field and spacetime excitations, we can understand electron and proton appear as opposing path integrals off a main path integral over q_{Planck}. One path yields more mass and gives positive charge and the other opposing path takes away mass and gives negative charge.

We can then see from this the fundamental concepts of the GEM theory:

$$m = m_o \exp(\pm\left|\frac{q}{e}\right|\phi_o) \tag{21}$$

Where the angle $\phi_o = ln\ \sigma$ where σ= 42.8503... = $(m_p/m_e)^{1/2}$. Extension of this mass model in Eq. 10 can be achieved (Brandenburg 2011) to include a definition of m_o in terms of the Planck mass, and where we use the normalized Planck charge $q_P/e = \alpha^{1/2}$ gives us the expression:

$$m = M_P \exp(\pm\left|\frac{q_P}{e} - 1\right|\ln\sigma)\exp(\pm\left|\frac{q_p}{e}\right|\ln\sigma) \tag{22}$$

So the simplest result:

$$\boldsymbol{m = M_P \exp(-\frac{q_P}{e}\ln\sigma)} \tag{23}$$

This leads to a simple expression for the proton mass in terms of the Planck mass:

$$m_p = M_P\sigma^{-\alpha^{-1/2}} = 1.713 \quad x10^{-24}\,g \tag{24}$$

This model also leads to the fundamental relations:

$$\ln\left(\frac{r_o}{r_P}\right) = \left(m_p/m_e\right)^{1/2} = 42.8503 \tag{25a}$$

$$m_p = M_P\left[\ln\left(\frac{r_o}{r_P}\right)\right]^{-\alpha^{-1/2}} = 1.713 \quad x10^{-27}\,kg \tag{25b}$$

Which can be inverted to yield the formula for the Newton Gravitation constant:

$$G = \frac{e^2}{m_p m_e}\alpha\exp\left(-2\left(m_p/m_e\right)^{1/2}\right) = 6.668x10^{-8}\,dynes - cm^2/g^2 \tag{26}$$

Hawking presents a formalism that an expansion of the integral can be made so that the first terms are associated with the vacuum fields and the next terms are due to excitations of higher-order. In the GEMS theory then we can associate the first order excitations with paths in ordinary space and the 5th dimension on surfaces defined by the vacuum fields. These surfaces are defined by the vacuum fields around the particles defined as thin shells with mass charge and spin. Thus, except for the infinitesimal thickness of the shell, the fields are those of a vacuum. These are then spheres of the classical radii of the particles. The first sphere has a radius of the hidden dimension and is determined by the electron charge and the mesoscale mass:

$$m_o = \sqrt{m_p m_e} \tag{27a}$$

$$r_o = \frac{e^2}{m_o c^2} \tag{27b}$$

where m_o= 3.904 x10^{-29}kg and r_o = 6.58x10^{-17}m.

GEM theory linked the appearance of the electronic charge and classical particle radius, as a hidden dimension size, r_o, to the appearance of the mass scale of the subatomic particles, the electron and protons. We can interpret the adding of mass and reducing of mass as fundamental events involving pathways in the 5th dimension. However, for this to be true the path integral in the 5th dimension must have a different normalization than in normal 4 spacetime.

RESULTS AND DISCUSSION

These orders of perturbation on spacetime and fields result in separate particles within the same Gaussian surface, and thus add to the mass in increments, for the mass of an electron or proton we have:

$$I = \frac{c}{e^2}\int_0^{r_o} m c^2 e^{\pm q/e\ln\sigma}\frac{dr_c}{c} = \frac{c}{e^2} m c^2 e^{\pm q/e\ln\sigma}$$

$$\frac{r_o}{c} = m c^2\frac{r_o}{e^2}e^{\pm q/e\ln\sigma} = \frac{m}{m_o}e^{\pm q/e\ln\sigma} = 1 \tag{28a}$$

$$m = \sigma m_o \qquad +q, or, \qquad m = m_o/\sigma \tag{28b}$$

These path integrals, leading to quantum excitations with canceling changes in charge and spin have by our change in $UC = \Delta Q = \Delta q\text{-}\Delta s$ so $\Delta Q = 0$.

A conventional path integral, with normalization h exists, this one on a curved path around a classical radii we can write this as for a path around an electron radius, if we assume the resulting quantized excitation will be charged but have no spin then we have a change in $UC = \Delta Q = \Delta s$ so $\Delta Q = 1$ so a factor of ½ must be attached to the classical radius r_c

$$I = \frac{2\pi}{h}\int_0^{r_o} m c^2\frac{dr_c}{c} = \frac{2\pi}{h} m c^2\frac{r_c}{c} = \frac{2\pi}{h} m c^2\frac{e^2}{2m_e c^2} = \frac{\alpha m}{2m_e} = 1 \tag{29a}$$

$$m = 2m_e / \alpha \quad (29b)$$

We can also make a path in ordinary 4 space but with a 5th dimension normalization, across the classical radius of the proton. Once again, if we assume the resulting quantized excitation will be charged but have no spin then we once again have a change in $UC = \Delta Q = \Delta s$ so $\Delta Q = 1$ so a factor of ½ must be attached to the classical radius r_c

$$I = \frac{c}{e^2}\int_0^{r_o} mc^2 e^{+q/e\ln\sigma}\frac{dr_c}{c} = \frac{c}{e^2}mc^2 e^{+q/e\ln\sigma}\frac{r_c}{c}$$
$$= mc^2\frac{r_c}{e^2}e^{+q/e\ln\sigma} = \frac{m}{2m_p}e^{+q/e\ln\sigma} = 1 \quad (30a)$$

$$m = 2\sigma m_p \quad (30b)$$

This is the W boson, carrier of the Weak force[12]. This means that the ratio of masses of the W boson and the charged pion, both UC changing excitations, will be a pure number involving only σ, and α:

$$\frac{M_W}{m_{\pi\pm}} = \sigma^3\alpha = 574.3 \quad (31)$$

$$I = \frac{2\pi}{h}\int_0^{r_o} mc^2\frac{dr_o}{c} = \frac{2\pi}{h}mc^2\frac{r_o}{c} = \frac{2\pi}{h}mc^2\frac{e^2}{m_o c^2} = \frac{\alpha m}{m_o} = 1 \quad (32a)$$

$$m_1 = m_o / \alpha \quad (32b)$$

Finally we can do a second order integral, a path integral across the radii associated first-order excitation, such a second-order excitation could be expected to be unstable and more short lived than the first order excitation path integral quantum.

Like many two-step processes, a second path is apparent, but this path reverses the change in UC that resulted in the proton so ΔQ =-1 so that it takes away both spin and charge and thus involves only a "neutral" classical radii of the proton so the factor of 2 disappears.

$$I = \frac{2\pi}{h}\int_0^{r_o} mc^2\frac{dr_c}{c} = \frac{2\pi}{h}mc^2\frac{r_{po}}{c} = \frac{2\pi}{h}mc^2\frac{e^2}{m_p c^2} = \frac{\alpha m}{m_p} = 1 \quad (33a)$$

$$m = m_p / \alpha = \sigma m_o / \alpha \quad (33b)$$

This is the Higgs boson, which can be interpreted as a second order quantized excitation of the hidden dimension with zero change in UC so ΔQ = 0. Therefore, the Higgs boson in this theory occurs as a second order ΔQ = 0 excitation of the hidden dimension, The Higgs Boson can be interpreted as the first particle which displays the Radion quantum in a "bare" state. This particle is unique in that it represents the Radion field that creates the hidden 5th dimension everywhere is spacetime. However, it is not a "God particle", it is merely a particle representing the hidden 5th dimension and carrying an important force, like pion or photon, which, like gravity or EM, shapes the cosmos.

Accordingly, the proton and electron can be considered as 1st order Radion interactions with the particle that exists at the hidden 5th dimension.

$$m_p, m_e = m_o\sigma^{\pm 1} \quad (34)$$

These particles are stable however, the first order QED interaction or mion of the hidden dimension size $r_o = r_e/\sigma$ is the lowest lying charmonium state η_c of mass:

$$m_\eta = m_o / \alpha = m_e\,\sigma / \alpha \cong 3000.6MeV \quad (35)$$

where the measured mass is m_η = 2985MeV, or with .7%. It is this scalar meson which appears to provide the pressure to hold together the hidden 5th dimension and carry the 5th force. It will be found that both the proton and electron, being stable charged particles, have a zero frequency electrostatic radius of ½ their classical radii, and that both of these give rise to short lived quantum mieon particles due to either Radion or QED interactions, from the proton we have the mieon of mass:

$$m_W = 2m_p\,\sigma \cong 80.409GeV \quad (36)$$

Whereas the measured value is m_W(meas.) = 80.398GeV or with 1.3 parts per ten thousand. This is the lightest of the W Weak force bosons that carries the weak force. The QED first order mieon off the electron is the π meson, carrier of the strong force. This will be discussed in the next section in more detail.

$$m_{\pi\pm} = 2m_e / \alpha = 140.05MeV \quad (37)$$

Where the measured value is m_π(meas.) = 139.60MeV or within 0.3%. This suggests electron may be affected by the Strong Force. If so, this would manifest itself in anomalous energy shifts in *K* shell spectra in heavy atoms. Thus, the ratio of the two boson masses should be $m_W / m_{\pi\pm} = \alpha\,\sigma^3$ =574.3 versus the measured value of 574.2.

The η_c (eta-c) meson is an important particle despite being unstable outside the neighborhood of the 5th dimension and so it is reasonable that it would have its own mieon. The next order mieon type particle associated with the 5th dimension would then be second-order mieon, corresponding:

$$m_H = m_{\eta c}\,\sigma \cong 127.69GeV \quad (38)$$

This is then the Higgs-Boson, which is a quantum that can be associated with the Radion or mass inducing field. It can also be considered as the "most general" excitation of hidden dimension size r_o, involving both 4-dimensional paths and the 5th dimsnion at the same time. Thus, the 1st order interactions off the 5th dimension are the electron, proton, and eta-c meson, the 2nd order interactions off the 5th dimension are the π-

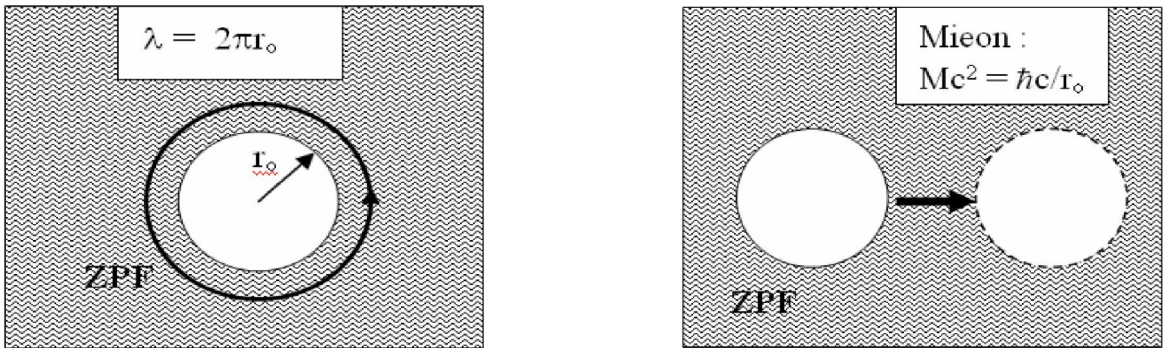
meson, and the Z boson. The most generalized excitation, involving both "long way around" and "short-cut" in the 5th dimension is the Higgs-Boson. The pion and Z boson mediate the strong and weak force, and the Higgs-Boson may serve as the carrier of the Radion field in energy range near the 5th dimension.

This means the ratio of charged mieon bosons should be:

$$\frac{M_W}{m_{\pi\pm}} = \sigma^3\alpha = 574.3 \quad (39)$$

Where the measured value of this ratio of masses is 574.2, thus, the mieon model is highly accurate. Therefore, based on simple quantum models, we can derive the Strong and Weak nuclear force from concepts flowing from the GEM theory. However, much complexity has been neglected.

This particle could be expected to be charge-neutral like the mesoscale mass. However, it is now recognized that the GEM theory created a doorway to understanding with two short-range forces of nature the Weak and Strong nuclear forces, because in unifying gravity and EM in a geometric theory, it produced a geometric scale regime for nuclear particles and the regime for their interactions. The GEM theory produced the picture of EM forces not only between charged objects but also between uncharged structures that can be extended to include short-range nuclear forces.



(A) (B)

Figure 1 : (A) Excitation of a Mie scattering wave by ZPF at resonance, represented her by a closed pathway on the classical surface of a subatomic particle where the condition $\lambda = 2\pi r_o$ occurs; (B) Emission of a quantum Mie particle, or mieon, with Compton wavelength $\lambda = 2\pi r_o$.

Entropy, renormalization, matter, and the fine structure constant

Hawking emphasizes in his article of Feynman path integrals and gravity that a single particle possess entropy because it creates gravity, and gravity is associated with thermal EM fields. The concept that a single particle can create entropy can be applied to the problem of a single electron interacting with the ZPF field. We can interpret the fine structure constant as the probability of an electron absorption and emission of a photon during an electron EM interaction time, which is classically the time it takes an EM wave to cross an electron diameter. In a complete picture of an electro-dynamic vacuum this EM interaction time is better understood as the sum of effects over many layers of vacuum polarization charge surrounding the lectron or other charged particle.

The electron moving at the speed of light undergoes multiple scattering events by the ZPF each Compton length, thus the ratio of the light transit time of the electron classical radius $r_o = e^2/m_e c^2$, which is the electron interaction time, to the Compton radius, gives the probability of photon absorption and radiation by an electron, which is the fine structure constant:

$$\alpha^{-1} = \frac{r_C}{r_e} = \frac{\lambda_C}{2\pi r_e} = \frac{\hbar c}{e^2} = 137.036 \quad (40)$$

We can compare the model of the electron compared to a perfect absorber, which must absorb a photon and reradiate it in every direction. The electron we model two ways as a perfectly absorbing sphere and a cube or similar shape of the same volume and approximately the same surface area. The perfect absorber must have a Planckian distribution of photons inside with number density:

$$n = \lambda^{-3}\left(\frac{2\pi^5}{15}\right)^{3/4} \quad (41)$$

The box of the same volume absorbing a single must have a single photon, must then fill each direction with photons going each way, and with both polarizations so we have a photon density in any direction:

$$n = \lambda^{-3}/32 \quad (42)$$

The uniform radiator sends and receives a photon and then sends it out over 4π radians whereas the cube can receive it over 3 faces but only send it out over 5 faces, since it cannot merely reflect it, so this gives us combi-

natorial ratio of 3/5 for a direction probability. So the ratio of probability of photons being radiated from each object, is the ratio of rates of radiation is:

$$\alpha^{-1} = \frac{1}{4\pi}\left(\frac{2\pi^5}{15}\right)^{3/4} 64\left[\frac{5}{3}\right] = 137.036 \quad (43)$$

$$\alpha^{-1} = \frac{10}{3\pi}\left(\frac{32\pi^5}{15}\right)^{3/4} = 137.036 \quad (44)$$

This formula was originally found by Wyler[11], who found it from ratios of volumes in higher dimensional spaces.

The neutron mass

In among the unstable particles found in nature, none is more stable than the neutron. In isolation a neutron has a half-life of 15 minutes, longer than many radioactive isotopes. The neutron can viewed, in first approximation, as a highly compressed form of hydrogen, since it decays into an electron and a proton, plus a neutrino. The neutrino can be considered as representing part of the binding potential of the system. However studies have revealed no electron running around with the quarks inside the neutron, instead, it is as if the electron was only present in a ghostlike state. The energy contribution of the electron to the neutron mass will not be electrostatic but only due to Heisenberg uncertainty, due to it being compressed into a space much smaller than its quantum Compton radius.

We can adopt a heuristic model that the neutron represents a bound state of an electron inside a proton but with the electron only partly present in ordinary space and spending the rest of the time like a "nomad" moving over a surface in high dimensional space so that it is present in our space only as spectrum of photons. The author is indebted to Morgan Boardman for this 'inter-dimensional nomad' particle concept. Since we have already, in a previous article, modeled the proton as being a container of the size of an electron classical radius full of 3 Planckian radiation fields representing the quarks, we can include the electron contribution as that of additional component of EM photons attached to each quark. We associate this with an EM field energy density similar to its electrostatic energy density at its classical surface but with an effective charge of Planck's constant, due to quantum uncertainty being its dominant energy. The radius of confinement of the electron spectrum would be diminished by the ratio of the electron lack of residence time due to its moving on a surface of a sphere 5 times larger due to five-dimensional uncertainty. Thus the electron contributes an EM energy density over the same volume like the three quarks, and mixed with each of them, so it is "colorless" reduced by the factor of $4\pi(5)^2$ as if spread over the surface of a sphere 5 times larger. Integrated over the same volume, V, the electron term becomes:

$$\frac{e^2}{2\pi r_n^4}\left(\frac{h}{e^2}\right)V = \frac{e^2}{2\pi r_n^4}\left(\frac{h}{2\pi e^2}\right)V = m_p\left(1/(\alpha(4\pi)^2(5)^4)\right) \quad (44)$$

This leads to the expression for the neutron mass:

$$m_n = m_p\left(1 + 1/(\alpha(4\pi)^2(5)^4)\right) = m_p(1.0013885) = 939.5656\,GeV \quad (45)$$

This formula agrees with the measured value of m_p (1.001388434) to within a part per 10 million. We can confirm our conceptual model of the electron being an inter-dimensional "nomad" inside the proton by using expressions for the fine structure constant and proton mass based on Planckian, thermal EM models. Using our highly accurate expression for the proton-electron mass ratio, $m_p = 6\pi^5 m_e$, and our expression for the fine structure constant in Eq. 44, we can write our expression for the neutron mass in terms of the proton and electron mass and obtain:

$$m_n = m_p + \frac{\pi^2}{4}\left(\frac{32}{3}\left(\frac{\pi}{5}\right)^5\right)^{3/4} m_e = m_p + 2.532\,m_e \quad (45)$$

The neutron mass can therefore be written approximately as:

$$m_n \cong m_p + \frac{5}{2}m_e \quad (46)$$

Therefore, the neutron mass is approximately that of a proton plus a contribution due to an electronic component spread out over 5 dimensions with ½ m_e per degree of freedom. The neutron can be thus modeled approximately as a proton with an electron thermal distribution inside it but moving in a 5 space, with the electron being thus only partly present in the 3-space volume.

Therefore, these highly accurate expression for both the fine structure constant and the neutron mass are consistent with our conceptual model of Planckian physics extended over 5 dimensions.

CONCLUSIONS

Therefore, the process of unification of the fields, whose most recent progress was the unification of the Weak and EM forces by Glashow, Weinberg and Salam[12], has been continued. An attempt to unify the Strong Weak and EM forces has been made, but failed because it rested on the supposed non-fundamental

character of the proton, being composed of quarks, and predicted its instability[13]. However, this instability has not been observed, lending support to the GEM theory viewpoint: that the proton must be treated paradoxically as both an ensemble of quarks and also as a fundamental entity, like the electron.

In the GEM theory, the Higgs Boson, exists as a consequence of the existence of the 5th dimension of spacetime and draws its own mass from this length scale. The Higgs is the "most general " excitation of the hidden dimension size, being a scattering on all degrees of freedom simultaneously, both normal spacetime and the 5th dimension, giving a mass prediction of M higgs = $\sigma m_o/\alpha$ = 128 GeV, a mass prediction with 1.5% of the measured value of 126 GeV[8]. This leads also to the important relation of $\lambda\!\!\!^{-}_{Higgs} = r_p$, indicating the connection of the Higgs to the proton, the particle making up the known mass of the universe.

The classical radius of the proton, r_p, is the radius it would have if its mass was generated purely by its charge and determines its interaction time for EM photons much below its rest mass energy. It must be considered a renormalized quantity representing a sum over a range of subatomic length scales. The effective radius of the proton for strong interactions in the nucleus is approximately the Compton radius of the pion or classical electron radius, but we will consider here that the radius r_p is an effective radius for EM scattering related to electro-dynamic gravity and thus only appears if "far field" radiation dominates its interaction. Thus the radius appears only in calculation of much larger scale. This is consistent with gravity being a statistical electro-dynamic force that arises as a consequence of charged particles interacting in large numbers with the quantum zero point fluctuation.

It can be argued that the quarks are confined by an EM force that ensures only integer multiples of the electron charge appear, making the Strong force also electro-dynamic. Thus. $r_p = e^2/m_pc^2$ is a relationship of mass and charge measured "at a distance" and usually only has physical relevance in far-field EM radiation calculations, but none-the-less is a physical parameter. Therefore, the $\lambda\!\!\!^{-}_{Higgs} = r_p$ relationship is a seemly counter- intuitive, but is consistent with a Higgs field that is part of an electro-dynamic vacuum-space-time whose curvature generates an electro-dynamic force-gravity. We will see shortly that it occurs due to combination of compactification, where potentials follow an $\exp(r_5/r_0)$ relationship and the electro-dynamic character of the vacuum which requires all effective lengths to be the result of renormalization so $r_o = k \ln(r_G/r_p)$. The Zittergewewung motion of the Higgs within its Compton radius thus is resonant with EM ZPF interacting resonantly with the proton.

This relation indicates that the Higgs Boson exists primarily to give mass to the proton in the cosmos, which is the only abundant, massive, stable particle known. This again is counterintuitive. The proton is considered to be made of quarks, one would think that the Higgs would only interact with them singly, but actually it cannot, the quarks have little mass singly, but are bound as a massive ensemble, the proton. Thus the relationship of the Higgs to the proton is consistent with the rest of the GEM theory, which treats the proton as a fundamental and indivisible particle-yet with a three-sub-dimensional structure that cannot be reduced. Thus the quarks appear in the GEM theory as sub-dimensions of the 5th dimension which cannot be seen in isolation.

The GEM theory, because it treats space-time and thus gravity as electro-dynamic must treat the proton as the fundamental particle because the mass of proton is collective, the quarks being essentially massless. The Higgs boson, which here is seen as a consequence of a hidden dimension of space-time, and the Higgs potential it represents, must be seen as essentially gravitational, interacting with mass regardless of its structure. This means the length scale for a statistical electro-dynamic gravity model with the Higgs giving mass to the proton as a whole operates on a wavelength r_{GEM}:

$$r_{GEM} = \frac{\lambda\!\!\!^{-}_{p}}{\alpha} = \frac{r_p}{\alpha^2} \tag{47}$$

This wavelength is analogous the Bohr radius for an electron and reflects the fact that in the GEM theory gravity is the result of particles doing 2nd -order scattering in the EM ZPF field making up spacetime in order to sample its curvature. An analogous length is seen for the Higgs boson itself

$$r_{GEM-Higgs} = \frac{\lambda\!\!\!^{-}_{Higgs}}{\alpha} = \lambda\!\!\!^{-}_{p} \tag{48}$$

Where we have a renormalized quantity r*, formed by summing over many scales in an electro-dynamic vacuum

$$\frac{r^*}{\lambda\!\!\!^{-}_{Higgs}} = \ln\left[\frac{r_{GEM-Higgs}}{r_P}\right] = \alpha^{-1/2}\ln\sigma \tag{49}$$

Thus, we can write for the proton mass as a Higgs interaction via a Yukawa-like potential in the 5th dimension over a renormalized length.

$$m_pc^2 = \frac{e^2}{r_p} = \frac{\hbar c}{r_P}\exp(r^*/\lambda\!\!\!^{-}_{Higgs}) \tag{50}$$

Thus, the GEM theory, which formerly concerned itself with only the two long range forces of nature

and the two stable charged massive particles making up hydrogen, can be extended to explain the Weak and Strong forces based on two postulates in a new conceptual structure of path integrals. We must begin with the GEM Assumption, that spacetime is fundamentally electromagnetic, and then the Kaluza-Klein Assumption of a hidden 5th dimension, we then proceed with Feynman-Hawking path-integral formulation with these two assumptions, this tried and true formulation says that everything that exists is the result of a summation of possible histories or pathways through spacetime from one instant to another. We then obtain the following results: 1. The electron and proton appear as resonances or favored paths off the Kaluza-Klein 5th dimension size of the Radion or mass inducing field created when EM and Gravity separate, and the proton is in structural resonance with the Higgs Boson, as would seem reasonable if the proton made up most of the mass of the universe. 2. Second order quantum Mie scatterings off the EM structures of the electron and proton and the 5th dimension itself create boson fields associated with Strong Weak and Mass inducing fields, with the Higgs Boson being the "most general" excitation of the hidden dimension size.

We have explained the stable and unstable-but favored particles in terms of resonances occurring as highly favored pathways in a Feynman-Hawking action path-integral formulation. This formulation cannot give physical results without the GEM Assumption that high frequency gravity waves are unstable to generate photon formation, which makes perturbation around fields and space-times determined by General Relativity and Maxwell's equations possible. Without this assumption of an electro-dynamic spacetime, subatomic black-holes would fill spacetime, making calculation impossible and also grossly unphysical. This GEM assumption, which says that the fabric of spacetime is fundamentally electro-magnetic, is also consistent with the result that favored paths in spacetime occur across and around so called "hidden dimensions" or classical particle radii, of the stable charged particles, which are determined by equating "mass at-a-distance" for particles with their "charge at-a-distance" depend thus on renormalized quantities. Thus, even though the path integral, in simplest form, appears to be lying only around a classical circumference of a particle, it is actually the average result of all possible paths in all spacetime around the charged particle. The pathways across the hidden 5th dimension, connecting a Planckian vacuum to a vacuum field around a proton or electron, then yields the mass of the stable particles. Thus, the protons and electrons making up the hydrogen which filled the very early universe, result form a favored path integral from a Planckian vacuum. The fact that such a favored path existed, was due to the appearance of a hidden 5th dimension.

The hidden 5th dimension itself appears to have been the end result of a collapse or shattering of a formerly infinite dimension. This is consistent with the 2nd Law of Thermodynamics since such a shattering will lead to an increase in entropy and decrease in action, in the form of the appearance of electric charge. The converse event: the spontaneous appearance of such a compactified 5th dimension from the vacuum actually would decrease entropy- it must represent a "shattering" of a formerly infinite dimension. Likewise the appearance of charge from the vacuum would increase local action- so it must be the remnant of a previous state of larger action. So a collapse scenario is more consistent with a continuity of physical law, that of increasing entropy and lessening action, between an old orderly vacuum universe and a newer, entropy and matter filled, present universe. Thus, the Big Bang may have been triggered, not by the appearance of the Higgs Boson- as in Kako's conjecture, but by the collapse and shattering of an entire infinite dimension, to result in a new universe full of disorder and massive particles.

In the Kaluza-Klein 5th dimensional theory, upon which the GEM theory is based, a 5th force field, a scalar field called the R-field or "Radion" field[14], must exist with massless quanta. This can be understood heuristically in the context of the SU(5) theory of Georgi and Glashow[14], with SU(5) standing for a special unitary 5 dimensional group, where each dimension can be associated with a symmetry and a force field, with the R field and its quanta being associated with the 5th dimension. However, like all force fields, the R-field must have an interaction energy with particles that must change their mass via $E=mc^2$. Moreover, in the case of the Radion field it controls all the rest-mass, rather than a small increment. It is found in this perspective that the Strong and Weak Forces, which are short-range are mediated with first-order "branchings" or quantum Mie scatterings of the R-field and quantum EM field off the geometric structures associated with the electron and proton respectively. A charmed meson lowest mass state is associated with the size of the 5th dimension itself and a branching off of this meson to produce a "most genral" excitation produces a quanta of the mass in the range predicted for the Higgs-Boson. Thus, the Higgs-Boson occurs in the extended GEM theory, and as in the Standard model is associated with the field that creates mass. The Higgs Boson exists and has its own mass as a consequence of the existence of the hidden 5th dimen-

sion. It is the direct evidence of the existence of the 5th dimension whose existence underlies the whole visible mechanism of the Cosmos.

With this understanding, that the visible Cosmos owes its existence to a hidden geometric structure in spacetime, a rudimentary schema exists for unifying all the forces. This is the schema of Wheeler, who felt everything could be understood as "geometry." It appears that existence of the compactified 5th dimension is most likely a remnant of a formerly infinite spatial dimension which "shattered" in some primal catastrophe- the Big Bang and our present Cosmos being the result.

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