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The problem of weak and strong nuclear forces and prediction of the Higgs-Boson mass from the GEMS (Gravity electro-magnetism strong) unification theory

Abstract

The GEMS (Gravity Electro-Magnetism Strong) theory is extended to the problem of Weak and Strong Nuclear Forces and the problem of the Higgs Boson mass, as the beginning of an effort to include short range Nuclear Forces in the successful GEM unification theory. The presence of a compact 5th dimension is found to create subatomic structures upon which surface resonances and Mie scatterings occur, and these resonances can give rise quanta, called, here, mieons, that mediate nuclear forces.. In the Kaluza-Klein theory of EM and gravity, a 5th force field called the "Radion" arises as a scalar, with a signature number of the Radion interaction in the GEM theory: =42.8503. Higher order resonances off the electrostatic radii of the electron, proton and 5th dimension size form of the GEM theory, generate the quanta with masses of the pion $m_\pi = 2\, m_e / \alpha \cong 140.0$ MeV and Z boson: $m_Z = 2\sigma\, m_p = 80.4$ GeV. The η_c meson $m_\eta = 2985$ GeV is identified with the 5th dimension compactification force mediated by the Radion field. Another particle associated with is the Radion scattering quanta off the fifth dimension with a mass $\sigma m_\eta \cong 127.7$ GeV, which is the Higgs-Boson.

Keywords

GEM unification theory; Quantum electrodynamics; Weak force; Strong force; Exchange boson; Mie scattering; Higgs Boson.

INTRODUCTION

"Seek simplicity and then distrust it."
Albert Einstein

This article presents an attempt to unify gravity, EM, Weak, and Strong Forces in the context of the GEM (Gravity Electro-Magnetism) unification theory[1-6]. The search for unification is the search for simplicity, where a single underlying principle or phenomenon is sought to explain diverse and possibly baffling effects. In the case of the Strong and Weak Nuclear interactions, highly developed and complex formalisms were developed to explain each separately, however, to achieve formal unification of these interactions, one must step back and focus on creating simple descriptions that explain salient experimental realities. In particular, constraints involving mathematics of phenomena that are not directly observable must be dispensed with, in favor of prediction of observables. The GEM unification theory has had some success in unifying the two long-range forces of nature, EM and gravity, and has achieved this based on simple models, yet can predict the proton mass and Newton Gravitation constant to high accuracy without free parameters. Therefore, this GEM-inspired study of the short-range forces of nature: the Weak and Strong interactions, is carried out in the same spirit of physics, that of using simple physical models to achieve a simple calculation of observables. Such a spirit existed in the dawn of the quantum era. In that era of Planck, Bohr and Einstein, the scientific community encountered a strange new world of atomic scale phenomenon and responded with simple, but radically new, physical concepts and viewpoints. Successful early models of that type are the Bohr Model of the Hydrogen atom and Uhlenbeck and Goudsmit's model of the spinning elec-

tron, which accounted for observables with simple models, and even now, serve as a basis for more sophisticated understandings.

The GEM theory is a geometric theory, that is an alloy of the Sakharov[7] and Kaluza-Klein theory[8] 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, that the fabric of spacetime 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, 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, with out free parameters, as a result.

The 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. However, it is now recognized that the GEM theory created a doorway to understanding the 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. Therefore, the GEM theory can be extended to explain the Weak and Strong forces based on two postulates: 1. The electron and proton appear as resonances off the Kaluza-Klein 5th dimension size of the Radion or mass inducing field created when EM and Gravity separate; 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.

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[9], must exist with massless quanta. This can be understood heuristically in the context of the SU(5) theory of Georgi and Glashow[10], 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 produces 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 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. In the next section, it will be briefly shown that the masses of the mediating quanta at low energies for the Weak, Strong and Radion field– the Higgs-Boson can be generated. However, this section will be only introductory and point the way to careful study the Strong nuclear force in the GEM context.

The Weak nuclear force has already successfully unified with EM force by Glashow, Weinberg and Salam[11], leading to the successful prediction of the mass of the Z and W vector Bosons. We will therefore concentrate primarily on the relationship of the Strong force to EM, which is the long-range force most active in the subatomic scales. In the remainder of this article we will describe how an extended electrodynamics from the GEM 5th dimensional theory leads to a host of unstable particles and that these new particles lead to new force fields outside the proton, leading to the formation of nuclei, and also to color-charge electrodynamics. Finally, we will discuss the unification of both the long- and short-range forces of nature in a five dimensional universe through the resulting GEMS SU(5) symmetry group in an extension of the work of Georgi and Glashow[10]. Here, we will bring tools used in the unification of gravity with EM. First, we will begin with the GEM creation of the electron and proton as pair of particles symmetric in charge but asymmetric in structure, reflecting the asymmetry of structure of time and space.

The appearance of the Kaluza-Klein fifth dimension comes from the splitting of a compact "light-like" spacetime interval, the only spacetime interval compatible with the vacuum, and that this triggers the appearance of both the proton and electron from the vacuum ZPF and the separate appearance of the EM and gravity force.

THE GEM THEORY OF PARTICLES AND THE RADION FIELD

We begin with the quantities that characterize the vacuum: the gravitation constant *G*, the rationalized Planck's constant, $\hbar$, and the speed of light *c*, which can be combined

to yield the vacuum quantities of the Planck length, the Planck Mass and a quantity with units of charge termed the Planck or "vacuum" charge respectively:

$$\mathbf{r_P = \sqrt{\frac{G\hbar}{c^3}}} \quad \textbf{(1a)}$$

$$\mathbf{M_P = \sqrt{\frac{\hbar c}{G}}} \quad \textbf{(1b)}$$

$$\mathbf{q_v = \sqrt{\hbar c}} \quad \textbf{(1c)}$$

where M_P=2.18x10^{-8} kg and r_P =1.616x10^{-35} m.

At The Planck scale in vacuum, quantization of even the geometry of spacetime itself is accomplished, time and space are quantized in r_P, r_P/c, and mass in M_P. Thus, particles as objects of fixed geometric size are a reflection of the particulate nature of spacetime at the Planck scale.

The GEM theory describes how the full Maxwell's and Einstein equations and the non-vacuum quantities of the electron and proton charge $-e$, e, and the electron and proton mass m_e and m_p arise with the birth of the Kaluza - Klein fifth dimension, which defines what are called subatomic particles. These give rise to a new length scale, r_o which we will term the "mesoscale" because it is intermediate between the Planck and Cosmic scale and which we will consider to be the hidden dimension size and a new mass scale m_o.

The size of the particle, or 'hidden" dimension, is a constrained spacetime interval scale where the fifth dimension can mix freely with the normal 4 dimensions of spacetime. It is more of a small doorway than a hidden dimension. This can be described in two limits as a quantized radius of a small sphere r_o or a time interval t_o.

$$\mathbf{r_o^2 \le (x_o^2 + y_o^2 + z_o^2)} \quad \textbf{(2a)}$$

$$\mathbf{r_o^2 \le c^2 t_o^2} \quad \textbf{(2b)}$$

$$\mathbf{m_o = \sqrt{m_p m_e}} \quad \textbf{(3a)}$$

$$\mathbf{r_o = \frac{e^2}{m_o c^2}} \quad \textbf{(3b)}$$

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

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, space-time 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.

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

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

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

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:

$$\mathbf{q_o = -q_t = q_x + q_y + q_z} \quad \textbf{(5a)}$$

$$\mathbf{q_o^2 = q_t^2 = q_x^2 + q_y^2 + q_z^2} \quad \textbf{(5b)}$$

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 subcharges, while the electron acts like a single entity. The Strong nuclear force, we shall see, arises from the extended electrodynamics of this splitting of spacetime into a time-like and space-like piece. What is also introduced, it will become apparent, is entropy. The quantized size of the 5th dimension, in turn, creates a structure with an intrinsic charge but also subject to scattering and resonances with the surrounding ZPF fields of the vacuum. Since in quantum mechanics a wave or resonant vibration can be indentified with a particle, the scatterings lead to branching off of new particles. This process will be most active around stable particles or the fifth dimension itself. We will call these resonances-particles that are unstable quantum Mie scatterings off of more stable structures a "mieon."

The Radion field in Kaluza-Klein theory is the field that gives rise to the size of the 5th dimension[9]. Briefly, the Radion field arises automatically when one introduces a hidden 5th dimension that is larger than the Planck scale.

The Standard Model describes a Cosmos where particles and both EM fields and gravity fields exist, and the only theory that derives both sets of fields from the same principle is the Kaluza-Klein theory involving a "hidden" 5th dimension. The Kaluza and Klein theory extends the Hilbert action principle, from which GR can be derived, by

adding an additional dimension that is "compactified" to small fixed length r_o so that we have an action principle for a universe full of hydrogen and gravity and EM fields:

$$W' = (16\pi G)^{-1}\int K\sqrt{-g}\,dx^5 \quad (6)$$

$$\gamma_{ab} = \begin{bmatrix} g_{\tau\upsilon} + \xi\kappa^2 A_\tau A_\upsilon & \xi\kappa A_\tau \\ \xi\kappa A_\upsilon & \xi \end{bmatrix} \quad (7)$$

$$K = R - 2\Lambda + \xi\kappa^2\left[\left[\frac{E^2 - B^2}{8\pi}\right] + \gamma_{ab}\Theta^{ab}\right] \quad (8)$$

where the energy density K can be written, in the limit of the new dimension being compactified:

Here, E and B are the electric, and magnetic field strengths, ξ is parameter of value 0 or 1 that controls the appearance of the 5th dimension, and $\kappa^2 = 16\pi G/c^4$. Where we have defined the metric tensor over dimensions 1-5 as a or b and dimensions 1-4 of conventional space-time as the Greek letters τ or υ. We note that element $\gamma_{55} = \xi$ is the element controlling the length of the line element in the fifth dimension with itself, so that for ξ=0 the fifth dimension does not exist and for ξ=1, it is fully deployed. The Radion field is the field that carries the value of ξ. It obeys a wave equation so it will have resonances where its wavelength matches the size of objects:

$$(\nabla^2 - \partial_t^2/c^2)\phi_r = 0 \quad (9)$$

Where ϕ_r is the Radion field. The Radion is a scalar field, like a pressure, and can be associated with the "scalar EM" wave field proposed by Tesla. Since, in both Quantum Mechanics and General Relativity, geometry, or radius of an object, directly transforms to mass, the Radion field gives mass to particles. This is directly correspondent to the Higgs field in the Standard Model. In the GEM theory the dynamics of the Radion field were mostly switched off and it was assumed to be constant. However, in the GEMS SU(5) theory, which deals with the subatomic scale, rather than the cosmic, we will allow the Radion field to become a fully dynamic and quantized entity like the EM field.

RESULTS AND DISCUSSION

The GEM theory of stable and unstable particles

The electron and proton are stable particles, being time invariant states as well as being invariant to movement in the spatial dimensions. In the GEM theory, these stable particles arise from the compactified 5th dimension. The electron and proton must therefore assume a special place in the GEMS theory. However, there is another time and spatial invariant quantity in the GEM theory that is the quantum ZPF (Zero Point Fluctuation) arising from Heisenberg Uncertainty. The presence of structures, such as the 5th dimension, allows resonant wave excitations to occur on the structures, creating Mie scattering, due to the presence of the ZPF. These Mie excitations, due to the wave-particle duality of quantum mechanics, must give rise themselves to quanta or particles, though we may expect that these quanta cannot exist by themselves for very long, decaying quickly once they fly away from the vicinity of the structure they were born on. Thus, when we assume a compact 5th dimension exists in the vacuum, the quantum ZPF will create quantum Mie (pronounced "me") scatterings or "mieons." The principal Mie scattering of EM waves from a conducting sphere occurs as a surface resonance with the sphere circumference corresponding to one vacuum wavelength, the condition $\lambda = 2\pi r_o$, where λ is the wavelength and r_o is the sphere radius (see Figure 1).

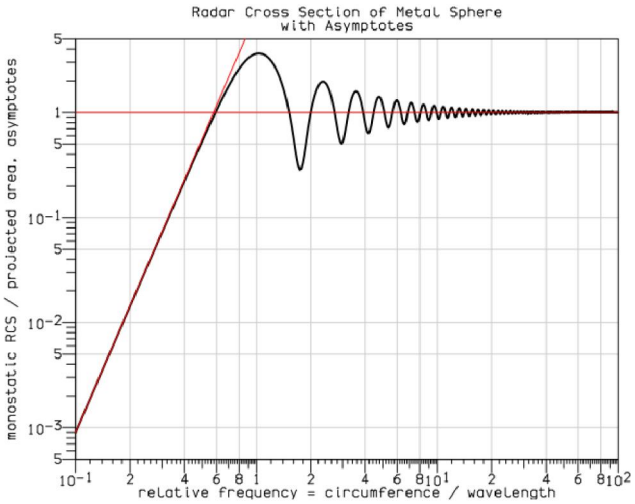

Figure 1 : The effective "radar" cross section of a metal sphere interacting with plane EM waves. Peaks correspond to peak intensity of excited surface resonances, with the largest at $\lambda = 2\pi r_o$.

Because in quantum mechanics, coherent waves are particles, these mieons will be short-lived particles (see Figure 2). Because of the quantum statistics of boson fields, which are subject to "Bose Condensation" the particles surrounded by these mieon fields will feel an attractive force due to the condensation of the these boson fields. The ZPF is not only EM waves but also Radion waves, which can be described as a sort of scalar EM wave. Thus, both EM and Radion mieons will occur around the 5th dimension, giving rise to both stable and unstable particles in a rich tapestry. Despite the fact that these mieon particles are short-lived, they create powerful effects and serve as exchange particles for short-range forces. The introduction of the fifth dimension into the quantum vacuum thus creates a "chandelier" effect, with scatterings and scatterings off of scatterings, where before was only darkness. In this way simplicity gives rise to complex diversity and also entropy. We can understand this because, from this viewpoint, first scatterings of the Radion

portion of the ZPF off the 5th dimension are the proton and electron themselves. We can see this from the fundamental concepts of the GEM theory:

$$\mathbf{m = m_o \exp(\pm\left|\frac{q}{e}\right|\phi_o)} \quad \textbf{(10)}$$

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:

$$\mathbf{m = M_P \exp(\pm\left|\frac{q_P}{e}-1\right|\ln\sigma)\exp(\pm\left|\frac{q}{e}\right|\ln\sigma)} \quad \textbf{(11)}$$

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

$$\mathbf{m_p = M_P\sigma^{-\alpha^{-1/2}} = 1.713\times10^{-24}g} \quad \textbf{(12)}$$

We can relate the electron Bohr radius r_B, to the electron Compton radius r_C, and the electron classical radius, r_e, as a succession of QED (Quantum Electro-Dynamic) interactions, leading to changes in energy and thus mass:

$$\mathbf{r_B = r_C/\alpha = r_e/\alpha^2 = \frac{e^2}{m_e c^2}\left[\frac{\hbar c}{e^2}\right]^2} \quad \textbf{(13)}$$

In likewise fashion, we can write this Eq. 12 in terms of integral powers of σ representing quantized interactions of the Radion mass-inducing field with the particle leading to changes in mass. Since $\alpha^{1/2}$ =11.706…

$$\mathbf{m_p = M_P\sigma^{-.706}\ \ \sigma^{-11} = M_P\sigma^{-.706}/\sigma/\sigma....} \quad \textbf{(14)}$$

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

$$\mathbf{m_p, m_e = m_o\ \sigma^{\pm1}} \quad \textbf{(15)}$$

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

$$\mathbf{m_\eta = m_o/\alpha = m_e\sigma/\alpha \cong 3000.6MeV} \quad \textbf{(16)}$$

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:

$$\mathbf{m_W = 2m_p\ \ \sigma \cong 80.409GeV} \quad \textbf{(17)}$$

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.

$$\mathbf{m_{\pi\pm} = 2m_e/\alpha = 140.05MeV} \quad \textbf{(18)}$$

Where the measured value is $m_{\pi\pm}$(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 $m_W/m_{\delta\pm} = \acute{a}\ \sigma^3$ =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:

$$\mathbf{m_H = m_{\eta c}\ \ \sigma \cong 127.69GeV} \quad \textbf{(19)}$$

This is then the Higgs-Boson, which is a quantum that can be associated with the Radion or mass inducing field. 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, the Z boson, and 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. In the following section we ex-

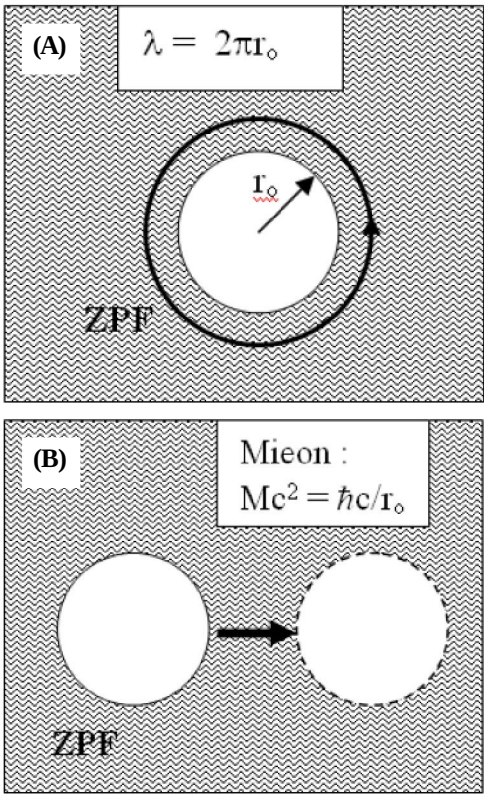

Figure 2 : (A) Excitation of a Mie scattering wave by ZPF at resonance on the classical surface of a subatomic particle where the condition $\lambda = 2\pi r_o$ occurs; (B) Emission of a quantum Mie particle, or mieon, with Compton wavelength $\lambda = 2\pi r_o$.

plore in more detail the relationship of the Strong force to the EM force.

The strong nuclear force theory outside the proton

We begin our derivation of the Strong nuclear force by looking at its residual portion outside the proton surface. In the GEMS theory both electrons and protons are the same geometric size. We will call this size the electron electrostatic radius r_c and it found from the model of the electron as a hollow, conducting, thin shell of charge such that all its mass is due to electrostatic energy. Such models are very useful in classical electrodynamics in the derivation of Thomson scattering and relativistic electrodynamics.

$$\mathbf{m_e c^2 = \tfrac{1}{2}\frac{e^2}{r_c}} \qquad \textbf{(20a)}$$

$$\mathbf{r_c = \frac{e^2}{2m_e c^2} = 1.409x10^{-13}\,cm} \qquad \textbf{(20b)}$$

This radius is ½ the usual definition of the electron classical radius $r_o = e^2/m_e c^2$. That the proton should be the approximately same radius to the nucleon defined by its nuclear volume is because of the Strong force. In the GEMS theory, this Strong force is due to the interaction of the electron as an extended object with the quantum ZPF.

The existence of the electron as an extended object, rather than a point means it can have internal excitations, induced by the ZPF. The resonant frequency of the electron because of its radius as a conducting shell is approximately $f_c = c/r_c$ this oscillation is purely radial and does not create normal EM radiation, photons, but instead creates conditions for a new quantum particle of Compton radius matching the electron radius $r_c \cong \lambda\!\!\!^{-}_{\pi}$ and with mass m_π = 264m_e corresponding to this wavelength, this particle is the neutral π meson or pion.

$$\mathbf{m_\pi c^2 = \frac{\hbar c}{\lambda\!\!\!^{-}}} \qquad \textbf{(21a)}$$

$$\mathbf{\lambda\!\!\!^{-} = \frac{\hbar c}{2m_e c^2} = 1.414x10^{-13}\,cm} \qquad \textbf{(21b)}$$

Quantum mechanics says basically that everything, including the vacuum itself vibrates and that particles have a dual existence as wave fields. The electron, being the lightest mass charged particle is the easiest particle to excite out of the vacuum and in the electric field of the proton a cloud of virtual electrons appear and their coherent internal excitations give rise to a cloud of π mesons. This cloud of mesons and the excitations it represents creates a gravity-like force inwards towards the photon, this is the model of Yukawa for the Strong nuclear force between protons and other protons and neutrons.

The internal color-charge-dynamics of the proton

The proton has inside its radius of approximately r_c, three dynamic entities, quarks, as a reflection of the space-like structure is acquires when the 5th dimension split the vacuum spacetime interval. The quarks are inseparable, and cannot be seen in isolation. In the GEMS theory this is due to the fact that the proton is a three-dimensional object and cannot be made into something of lower dimensionality, just like a rubber ball can be squashed but not reduced to infinitesimal thickness, when released from pressure it rebounds to its normal spherical shape. What also occurs in the GEMS theory is that the proton is isotropic and spherical and this means that the quarks are best modeled as chaotically mixed at all times. In the GEMS theory the proton is full of entropy.

We can therefore model the proton, since we consider it full of chaotic EM fields as a spherical shell of radius r_c full of Planckian radiation fields, one field for each of the 3 color charge fields (see Figure 3). We will consider that the electric charge resides on the surface of the shell, which is full of neutral π mesons. We will consider the shell to be thin. We will assume an emissivity of close to one $\varepsilon \cong 1.0$ so the Black Body model will be valid. We will choose the temperature of the Planckian fields to be $kT = m_\pi c^2 =$

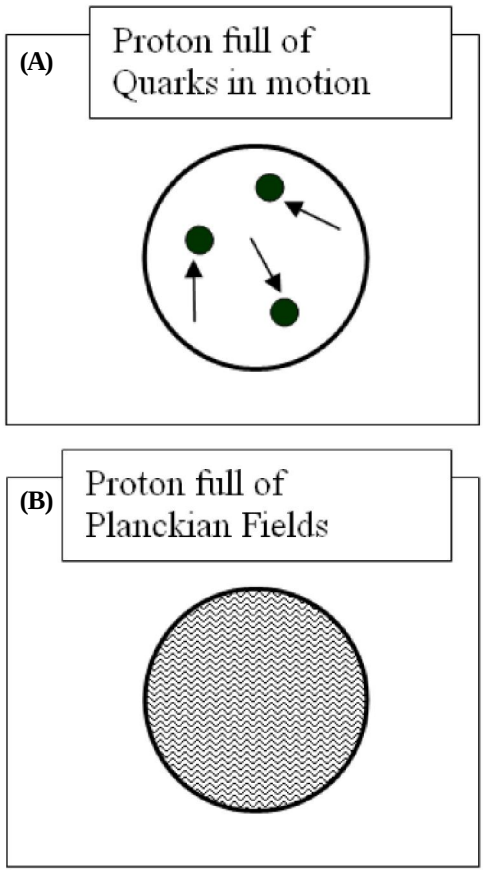

Figure 3 : (A) A model of the proton has having three rapidly and chaotically moving quarks; (B) A model of the fields in the proton as being at maximum entropy, due to quark free motion, that is: Planckian.

$264m_e c^2$, the mass of the neutral pion. Black Body modes of longer wavelength than the radius of a spherical cavity are cut off, however, the wavelength of energy maximum for a Planckian distribution is approximately 1/5 that of $\lambda = kT/(hc) = 9.183 \times 10^{-13}$ cm where h is the normal form of Planck's constant. A cutoff of wavelengths longer than that corresponding to kT thus leaves approximately 96.6% of the energy in shorter wavelength modes intact, thus such a cutoff does not violate our Planckian assumption.

Therefore, we will assume the proton is full of EM energy W in 3 Planckian modes or colors in a volume V_c of a sphere of radius r_c:

$$W = 0.966 V_c 3\left[\frac{8\pi^6}{15}\left(\frac{(kT)^4}{(hc)^3}\right)\right] \quad (22)$$

Here the Planckian modes must be considered independent, so they simply add to each other. Using the fact that $r_c (m_{\pi o} c^2/hc) = 1/(6.518)$, we obtain approximately:

$$W = 6\pi^5 0.966\left[\frac{16\pi}{45}(264.2) m_e c^2\left(\frac{r_c^3}{\lambda_{\pi o}^3}\right)\right] \quad (23a)$$

$$W = 6\pi^5 m_e c^2 (0.966)\left[\frac{16\pi}{45}\left(\frac{264.2}{276.90}\right)\right] = 6\pi^5 m_e c^2 (1.03) \quad (23b)$$

$$W \cong 6\pi^5 m_e c^2 \quad (23c)$$

Therefore, the Lenz-Wyler formula, $m_p/m_e = 6\pi^5$ which is accurate to 17 parts per million, can be derived to high accuracy from a simple model of the proton as containing 3 independent Planckian fields of temperature corresponding to the rest energy of the neutral π meson. This means that entropy exists even in the subatomic scale.

Quarks and the subdimensions of the 5th dimension and the GEM-strong theory

Quarks in three colors appear naturally in the GEM theory. As was previously discussed the Kaluza-Klein fifth dimension can be considered to be a new dimension which can replace either time or space in a light-like interval, as was seen in Eq. 5a, b. The fifth-dimension then becomes a constrained image of either the time or space portion of spacetime and thus has four sub-dimensions. The electron corresponds to a "time-like" or scalar entity while the proton corresponds to a space-like component, having three sub-dimensions. We can minimize the volume of this three-space, given the two constraints of charge conservation and the conservation of mesoscale radius, defined in Eq. 5a,b, which is a constraint on the sum of the quark charges, and sum of the squares of quark charges. We have then the constrained relaxation of the system, in the form a Lagrange multiplier system:

$$q_1 q_2 q_3 + \lambda_1(q_1^2 + q_2^2 + q_3^2) + \lambda_2(q_1 + q_2 + q_3) \quad (24)$$

Where we minimize the three-volume formed by the quark charges: $q_1 q_2 q_3$, subject to the constraints that their total charge is that of the electron (in electron units)

$$q_1 + q_2 + q_3 = 1 \quad (25)$$

And the sum of their squares is also unitary, so the classical radius of the compound particle is that of an electron:

$$q_1^2 + q_2^2 + q_3^2 = 1 \quad (26)$$

We have then, upon varying the values of q_1, q_2, q_3 respectively, the three equations:

$$q_1 q_2 + 2\lambda_1 q_3 + \lambda_2 = 0 \quad (27)$$

$$q_1 q_3 + 2\lambda_1 q_2 + \lambda_2 = 0 \quad (28)$$

$$q_3 q_2 + 2\lambda_1 q_1 + \lambda_2 = 0 \quad (29)$$

which have the solutions:

$$\lambda_1 = \frac{1}{3} \quad \lambda_2 = -\frac{2}{9} \quad (30)$$

$$q_1 = -\frac{1}{3}, q_2 = q_3 = \frac{2}{3} \quad (31)$$

This corresponds to the standard quark model, and the second solution is that of an electron with $q_1 = -1$ and q_2 and $q_3 = 0$. Thus in solving the problem of the structure of a 5th dimension, one finds that its 3-volume, upon being minimized, with constraints, yields the charges of the quark system. Thus, the GEM theory is actually compatible with the standard model.

In the GEM theory, the splitting apart of the proton and electron is correlated to the splitting apart of the gravity and EM forces. In the Standard Model context, this means that baryon and lepton number: B and L respectively, are not conserved but their difference (B-L) is conserved and the non-conservation of B and L separately occurs at the Planck scale, where gravity and EM unify. The appearance of charge and mass at the subatomic scale occurs with the appearance and deployment of the 5th dimension, which slightly smaller than the EM cross-section of the electron. This means that, instead of subatomic particles being considered points, they must be treated as objects of definite size similar to the 5th dimension radius. This means that in the presence of the vacuum ZPF the structural sizes of the particles support resonances, and these resonances in-turn take on a quantum existence of their own.

In quantum electrodynamics, it is found that the sizes of various quantum objects can be understood as being created through orders of EM interaction. The Bohr radius of the hydrogen atom, and the Compton radius of the electron, for instance, can be found as the electron classical radius $r_e = e^2/m_e c^2$ for instance, can be found as the $1/\alpha^2$, and $1/\alpha$ respectively times the electron classical radius. However, the electrostatic radius for the electron is ½ the electron classical radius. This factor of ½ can be

understood as the difference between monopole or "scalar" EM interactions, which cannot propagate farther than r_e and dipole "vector" EM waves which can propagate. This means the ratio of charged mieon bosons should be:

$$\frac{M_W}{m_{\pi\pm}} = \sigma^3\alpha = 574.3 \quad (32)$$

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.

Towards a GEMS SU(5) unification model

In 1974 it was proposed by Howard Georgi and Sheldon Glashow that the electroweak theory could be unified with the Strong force in a SU(5) model signifying a five dimensional model. In such a model the SU(5) stands for the group of rotations around five different axes, each axis standing for a dimension. This theory was called a GUT (Grand Unified Theory) and had as a major prediction that the proton could decay into a positron and neutrinos. This was due to the GUT unification energy, where *B* and *L* conservation was violated, being somewhat lower than the Planck scale. In the Georgi-Glashow model, as in the GEM model, the quantity *B-L* is conserved, even when B and *L* are not. This theory however, can be modified into a GEMS (GEM + Strong) SU(5) theory, if the GUT unification energy is raised to the Planck scale, where EM and gravity unify. Thus, in a GEMS SU(5) proton decay does not occur. In the Standard model the 5 symmetry axes correspond to conserved charge quantities, however, in GEMS the conserved charges correspond through the 5th dimension with physical dimensions. The Georgi-Glashow Model also contains a scalar mass inducing field similar to the Higgs field, and thus corresponds directly with the Radion field. Like the GEM Theory, the Georgi-Glashow Model also does not conserve the baryon and lepton numbers, but instead considers them as canceling, so that the must appear or disappear together. Accordingly, the Georgi-Glashow Model appears to mesh well with the GEMS theory.

Intuitively, a five dimensional universe requires five forces, one force purely existing to compactify the hidden 5th dimension. So this 5th force, or Radion force, may in fact be the force associated with the eta-c meson or Higgs particle or a similar field, and be responsible for the existence of massive subatomic particles as we experience them. However, it must also be understood that some particles, the photon and gravition, for example, are massless and do not acquire mass at all from anything, and cannot in any theory that describes the real universe. Thus, the statement that some particle, the Higgs, "gives all particles mass" cannot be accurate. However, this investigation has only begun and much further work on the Strong Force and its cousin short-range force, the Weak force, must yet be achieved.

It is not possible to journey in the land of quantum field theory without the companionship of paradox and abstraction. This occurs because the subatomic realm is so far removed from our everyday experience. This leads to the tensions between the schools of thought represented by Einstein and Schrodinger on the one hand, who argued that quantum physics should be an extension of classical mechanics, and the school of thought from Bohr and Heisenberg, who argued that observables should be the sole focus of theory and that all physical intuition and conception should be abandoned. History has judged that both schools have merit, however, physical models have largely triumphed over pure abstraction, even in quantum mechanics, so we still imagine atoms and subatomic particles and their dynamics, rather than a universe of mysterious black boxes. Therefore, the conclusion of this preliminary study is that subatomic particles appear linked to the existence of finite sized hidden dimensions and therefore, are not mathematical points, but this should not be a surprise.

In the early development of quantum mechanics, all particles were considered points until experiments proved otherwise. The debate over renormalization, was actually ended only by cutting off electron-mass calculations with a finite but Planck-length sized radius. Now, with the reality of Planck scale physics becoming more accepted, the idea of any particle being a mathematical point is fading. With the concept of hidden dimensions being larger than the Planck length, and the structural size of such dimensions being considered detectable, the whole question of structural resonances of such hidden dimensions must be revisited.

CONCLUSIONS

Obviously, a small hidden dimension would appear experimentally as a particle in certain interactions, and any particle with finite size should exhibit quantum resonant scattering behavior for certain force fields. In this study, the quantum resonant scattering of Radion and EM fields of the structures of subatomic particles give rise to the quanta that mediate the Strong and Weak forces between subatomic particles. This is similar to the appearance of Van der Walls forces between molecules on much larger scales.

The basis for applying a quantum description of matter and fields can be found in the quantum character of lengths,

masses, and charge-action in the vacuum. The two long-range forces EM and gravity, can be related in terms of their relative coupling strengths and length scale. This is by using a model of the emergence of quantum particles and their fields from the vacuum with the birth of a hidden dimension. They all separate from each other at the Planck scale with the birth of a new dimension, which carries with it an inherent quantum scale length that is the signature of matter in the Cosmos. This process gives rise to the only two massive stable particles known in the universe, the electron and proton. The electron was associated with the EM field and the proton with the gravity field. We have now found that the existence of the electron and proton in the quantum vacuum, as finite sized objects, excites quantum Mie scatterings at resonances that become the exchange bosons for two short-range fields, one associated with the electron and the Strong force, and another associated with the proton, and the Weak force. The scale length of the fifth dimension also excites the presence of a fifth force boson, the η_c meson, and its higher mass state, the Higgs-Boson. It is also that the presence of three freely moving quarks in the proton means that entropy is found at the subatomic scale, and this can be used to find the proton mass to high accuracy. The GEMS theory arises naturally from this picture because the proton must be space-like and thus have 3 subdimensions, quarks. The dynamics of electron, not only as a quantum particle, but as an object given a finite size due to the 5th dimension, naturally gives rise the π meson as a structural resonance, and thus to the Strong nuclear force. This picture continued into the proton, gives rise to Planckian radiation fields in three colors and provides a good approximation to the proton mass. Thus GEMS SU(5) theory is off to good start and now proceeds to SU(5) unification.

The Radion field, mediated by massless quanta, is responsible for rest mass in the GEMS theory. This means the possibility of controlling mass may be possible with future technology that has implications of advanced propulsion systems to reach the stars.

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