Keplerian restraints on general quantized theories of gravity and the emergence of anomalous electro-gravitic couplings at the Compton scale

Edward Halerewicz, Jr.
University of Illinois at Springfield*
One University Plaza, Springfield IL 62703

March 8,2006

Abstract

Anastasovki and Hamilton have argued that the shell energy structure of nuclear matter maybe be bounded to a gravitational constant with magnitude $G_{AH} = 1.49 \times 10^{29}\ Nm^2/kg^2$ at the Compton scale [7]. Expanding Anastasovki and Hamilton's arguments to an electron in an atomic ground orbital by means of Kepler's Third Law results in a "bare" gravitational constant of order $G_b = 5.35 \times 10^{26}\ m^3/kg\ s^2$ which inversely negates G_{AH} effects beyond the Bohr radius a_0 and may be responsible for the emergence of Newton's gravitational constant G_N outside the atomic regime. G_b is found to be separated from G_N by a correction of order $G_N \equiv (\alpha\ \not{h}/14\pi)G_b$, where $\not{h}$ is a dimensionless version of planck's constant and α being the fine structure constant. Energy-time uncertainties for G_b orbitals require quantum-electric corrections that transform Kepler's third law to $T = (8\pi^2\alpha/7)ka^3$. The quantum-electric Keplerian corrections which modify G_b to $G_k = 8.96 \times 10^9\ m^3/kg\ s^2$ transforms to the ordinary Coulomb constant by $k_{Col} = G_k/4\pi G_k \epsilon_0$ suggesting that electromagnetic effects may owe their origin to gravitational forces interacting at the subatomic level. An anomalous electro-gravitic force having an apparent relationship to the magnetic permeability μ_0 constant and the general relativistic curvature constant for $\kappa_k = 8\pi G_k/2c^2$ is found through several approaches further suggesting a gravitational origin for electromagnetic interactions.

A general approximate method of spacetime quantization is also argued through the relation $G_N/(16\pi\ \not{h}c^2)m_e$, where m_e is the electron mass, it is later found that a Zero-Point (ZP) modification of this approximation may allow for the spacetime quantization of all elementary particles. A highly interesting connection between ordinary electromagnetism and the ZP gravitational planck scale is also found through a Bohr-like quantization ratio between planck and electo-gravitic planck actions such that fine structure can be given as $\alpha_{ZPF} = M_{pl}l_{pl}/m_e a_0$, where the numerators represent the conventional planck mass and length. One possible ramification of the results explored in this work is that Cosmic Background Radiation (CBR) may result from ZP induced Unruh–like radiation mediated through Compton frequencies rather than from the thermal cooling of the Big Bang. Lastly in regards to conventional physics a new definition for the speed of light is found through the relation $c = (\hbar/\alpha\, m_e a_0)$ which may have direct applications for alternative interpretations of presently well established theories.

1 Introduction

A widely held contention in theoretical physics today holds that if it were possible to establish a mathematically concise method of renormalizing general relativity with established quantum field theories (QFTs) then all of the four fundamental forces known in nature could be unified into a single consist theory of force [1]. Essentially the current state of affairs in modern physics holds that theoretical physics has reached an end aside from a few loose ends in the Standard Model (SM) such as neutrino oscillations [2] and the quantization of gravity. String theories offer the *potential* to explain away present problems such as SM anomalies and the nonrenormilization problem of general relativity with a yet undiscovered suspersymmteric unification procedure which has presently manifested into so called M-theory [3]. But it is hardly critical to blindly accept M-theory as a cure all to the physical world when current string models are still having difficulties in realistically incorporating the SM [4]. Although with Kaluza-Klien (KK) unification techniques in high fashion these days alternative unifica-

*Enrolled student. E-mail: ehale02s@uis.edu, halgravity@yahoo.com

tion methods are perhaps too easily overlooked. Alternatives can even be met with scorn especially when one begins by drawing analogies between Newtonian gravity and Coulomb electric forces as is usually done by introductory textbooks [5]. Classically the sole purpose of drawing a link to electromagnetism and gravitation is simply to illustrate the apparent fundamental nature of the inverse square law whose origin is now more adequately understood in terms of modern QFT [6]. A recent example of an alternative unification procedure was put forth by Anastasovki and Hamilton (AH) whom argued for a direct link between gravity and the electric force at the atomic scale [7]. From a traditional perspective the greatest obstacle encountered by AH unification is one of scale, specifically that their derived gravitational constant exponentially explodes, a clear red flag to traditional thought. There is however an elegant solution to prevent the exponential explosion of the gravitational constant which we will becoming to later in section 3 but for matters of euclidiation and precedence we will continue down AH's nontraditional unification path.

2 a not so standard unification procedure

The underlying principle behind AH unification is rather simple, just equate the electric force between two charges to the gravitational force between an electron and a proton at the same separated distance and derive an atomic gravitational constant. The only initial constraint imposed by AH unification is that an "atomic gravity field" must be mediated by through a superposition of an electron and proton's respective Compton wavelengths $\lambda_C = h/m_0 c$ near the Bohr radius. This was done in large part as researchers have recently begun to speculate that a particles Compton frequency whose quantum energy is mediated through the Einstein-de Broglie relation $\hbar\omega_C = m_o c^2$, can be be described by $\omega_C = 2\pi v_C$, where $v_C = c/\lambda_C$ and may tie the origin of gravitation and inertia through electromagnetic Zero Point Field (ZPF) style interactions [8]. Therefore a ZPF based modification of gravity implies that the critical length at which electric and gravitational forces could equalize would lie within the range $\lambda_{Ce} \leq r_i \leq \lambda_{Cp}$, AH however went a step further and also included nuclear shells into their unification picture so that their arguments imply that ZPF description of gravity becomes relevant at $r_i = 1.2\times10^{-13}m$ [7]. Therefore in the AH world view the electric and gravitational forces can be equated when $F_{Col} = k_{Col}(e^2/r_i^2) = 1.602 \times 10^{-2}\ N \rightarrow F_g = G_{AH}(m_e m_p/r_i^2)$ and thus we arrive at the afore mentioned exploded gravitational constant:

$$G_{AH} = 1.49 \times 10^{29}\frac{Nm^2}{kg^2} \qquad (1)$$

although a more straight forward method to reach such a conclusion would appear to result from eq. 6. Classically however one looking at eq. 1 might erroneously jump to the conclusion that no such implied force has been ever observed and hence must be unphysical rubbish, but we will soon come to realize that such a conclusion is flawed one even though it is far from obvious at this point. But with these conceptual problems that we have been encountering it sure does go along way to explain the popularity of the KK approach among theorist today.

Another strong reason why not to immediately abject to AH unification is for the same reason it was accepted for publication, being that their unification apparently adequately describes one physical manifestation. Anastasovki and Hamliton described the existence of what could be termed a gravitational fine structure field surrounding the nucleus of an atom, which deflected negatively charged particles as though there was an external (negative) repulsive electric field emanating from nuclei. The "gravitational fine structure" affecting the nuclear energy states can be approximated at a first level as

$$\alpha_{AH} = \frac{4G_{AH}\ m_p}{r_k c^2} \equiv 6.583 \times 10^{-3} \qquad (2)$$

where $r_k \equiv\ r_i$ and m_p is the proton mass, for fine details see [7]. Yet another reason why not to reject the AH unification procedure is that similar results can be found when one attempts to make quantum corrections to Kepler's third law as we see in the next section.

3 first principles

Perhaps an under appreciated beauty of Kepler's third law of planetary motion $T^2 = ka^3$ is that one can derive Newton's Gravitational constant $G_N = 6.672 \times 10^{-11}$ Nm^2/kg^2 if one knows the precise orbit of a body around another body and if the masses of the system are also known to great precession. As an example of deriving G from Kepler's law can be seen by taking the average orbital period of earth T_E and its orbital radius a_E such that $G_N \approx a_E^3/(T_E^2 M_\odot) = 5.984\times10^{-12}\ m^3/kg\ s^2$, where $M_\odot$ is the Sun's mass.[1] The author has been even told that among engineers units in which a gradient can be inferred are preferred, that is an ideal approximation should be given in terms of orbital angular frequency, for earth $\omega_E = 1/2\pi T_E$ so $G_N \approx (4\pi^2\ \omega_E^2\ a_E^3)/M_\odot = 5.984 \times 10^{-12}\ m^3/kg\ s^2$ which essentially reveals that

[1] There is no real difference between Nm^2/kg^2 units and $m^3/kg\ s^2$ units, in fact in general relativity the later is preferred for obvious geometric reasons.

there are three different ways to interpret G_N at a classical level.

Imagine now that there was a twilight zone earth where the value G_N had had only recently be found and the atomic theory was far ahead of gravitational theory (yes it would be quite a limbo dimension!), for that earth atomic orbitals would be the starting point to understanding gravity and not a dead end as it appears to us. The first problem the scientists in the twilight zone earth would encounter is that their calculated atomic gravitational constant which we will call G_a for now (eq. 3) grossly violated their own Keplerian laws which were proved long ago, as such they would be forced into finding a normalizing constant for G_a (eq. 29). Before the twilight zone scientists could discover the proper normalizing constant they were also forced into introducing an unknown gravitational coupling to the distance component of the inverse-square-law in order to validate both G_a and Kepler's laws. Later through a stroke of genius on the twilight earth someone devised an experimental method to find G_N and thus finally realized that G_a was in fact a bare gravitational constant of a more fundamental origin of gravity. Thus it seems the twilight zone earth stumbled onto a non problematic description of quantum gravity for their scientists by probing for the right questions which our scientists have neglected through apparent non necessity. What we have gathered from our insightful hypothetical interdimensional travel is that a long standing problem regarding quantum gravity in our world can be solved by an alteration of Kepler's third law, but our early success in understanding macroscopic gravity found no motivating reason to alter Kepler's law.

To examine the bare G concept we must realize that for an atomic system the central mass becomes the proton mass and thus the angular frequency of an electron's orbit calculated from the first Lyman band $\lambda_{Lym} = 1.22 \times 10^{-7}\ m$ of a hydrogen atom would give the maximum gravitational force felt by an atomic system. Thus the angular gravitational frequency of a Bohr electron becomes $\omega_e = c/(2\pi\lambda_{Lym}) = 3.91 \times 10^{14}\ rad/s$, and we find that

$$G_b \approx \frac{4\pi^2(\omega_e)^2\ a_0^3}{m_p} = 5.35 \times 10^{26} \frac{m^3}{kg\ s^2} \tag{3}$$

where $a_0 = 5.292 \times 10^{-11}\ m$. It is also noted that the previous equation is suspiciously dominated by $m_p^{-1} = 5.979 \times 10^{26}\ kg^{-1}$ which may have some physical baring on the meaning of this constant (in section 6 we discover that this is the case). Conventional wisdom would tell us to reject the above value but if we did that we would miss out on the realization that eq. 3 is in fact a "bare" gravitational constant. Perhaps a better illustration of this would be to compare the ratio between the gravitational acceleration of an electron at the Bohr radius to the actual electrostatic acceleration

$$\frac{(v_e^2/a_0)}{G_N(m_e/a_0^2)} = 4.167 \times 10^{42} \tag{4}$$

where $v_e = \hbar/m_e a_0 = 2.188\times10^6\ m/s^2$, which would imply that at the atomic scale $G_N \to 2.78 \times 10^{32}\ m^3/kg^{\ 2}$, it is also noted that a value close to eq. 1 is likewise obtained by replacing m_e with m_p. Additionally there exist two other methods of obtaining an approximation of G_{AH}, first a method suggested to the author by Ian Wrightman is through an electron orbiting an atom at the ground state where

$$G_{AH} \equiv \frac{(\omega_0)^2 a_0^3}{m_p} = 1.511 \times 10^{29} \frac{m^3}{kg\ s^2} \tag{5}$$

with $\omega_0 = 4.16 \times 10^{16}\ rad/s$. A second method of obtaining G_{AH} was speculated by Todd Desiato during a conversation with the author and may be perhaps a more fitting origin than the last method, where

$$G_{AH} \equiv \frac{e^2}{4\pi\epsilon_0 m_e m_p} = 1.514 \times 10^{29}\ \frac{m^3}{kg\ s^2}\,. \tag{6}$$

The problem however is that there is no evidence of any such G_N rescaling at the classical level, thus the only other possible alternative explanation is that there might be some quantum modification of the bare gravitational constant in order to obtain G_N.

4 quantum adapting Kepler's Third Law

Now looking at things from the twilight earth perspective and assuming a connection to gravitation and the electric force, the only way to explain away the approximate magnitude differences between G_b and Coulomb's constant k_{Col} would be taking the derivative of orbital period within Kepler's law. Thus it would seem that a quantum-electric modification to Kepler's law would first require a set up where $T^2 = (\exp(Tka^3))$, and thus the full correction would become

$$2Tg_c = ka^3\ e^{(Tka^3)} \tag{7}$$

where $g_c = 7/8\pi^2\alpha$ is a coupling constant with fine structure $\alpha = 2\pi k_{Col}e^2/hc$. Those overzealous with mathematical rigor may be troubled by eq. 7's treatment of T as a variable. There is however no real problem with the treatment of T as we know from quantum mechanics when one is exactly precise about the energy condition of a quantum system as in the case of an electronic orbital level a time variance occurs through the system by means of the energy-time uncertainty $\Delta E \Delta t \geq h/2$. Now while the energy-time relationship is an important realization as why there appears to be a quantum correction to Kepler's law of course the real magic in all this is that the modified law seems to produce the magnitude of the familiar Coulomb electrical constant k_{Col}:

$$G_k \approx \frac{a_0^3}{2T_{\omega_e} m_p} \, g_c^{-1} \cdot \frac{rad}{sec} = 8.96 \times 10^9 \, \frac{m^3}{kg \; s^2} \qquad (8)$$

where $T_{\omega_e} = 4.07 \times 10^{-16} s$, units not withstanding (although a standard unit conversion is possible as seen from table 1) we have essentially demonstrated that $k_{Col} \equiv G_k \cdot \left[kg^2/C^2\right]_{norm} = 8.98 \times 10^9 \; Nm^2/C^2$! Those closely examining eq. 8 would have also noticed that rad/sec has been artificially added to maintain geometrical units rather than force units for "G" a workable justification for this fudge factor has been argued by Putnam[2], where α is interpreted as the radian measure of charge/photon interactions. Now just for comparison sake and to avoid any initial skeptical woes of any further artificial fudging of eq. 8 Kepler's standard third law along with the coupling constant gives $G_b = 4.403 \times 10^{25} \; m^3/kg \; s^2$, a result that would most certainly be rejected on classical grounds. We can also show by taking the root of ω_e and from equation eq. 3 and removing α from g_c from eq. 8 that again we arrive at an identical result

$$\mathcal{D}_\omega G_b = \frac{\omega_e \; a_0^3}{2m_p} \cdot \left(\frac{2}{7}\right) \frac{rad}{sec} = 4.95 \times 10^9 \; \frac{m^3}{kg^2 \; s^2} \; . \qquad (9)$$

Thus with relatively little effort we have arrived at a rather elegant Keplerian solution (eq. 7) in order to unify an exploded bare gravitational constant which appears to be coupled to a seemingly gravitational-like Coulomb electric constant.

Perhaps another reassuring thought is that by using Anastasovki and Hamilton's refined "atomic gravitational constant" [7] is that the formula generates a solution which only marginally deviates from eq. 3 as seen by

$$\begin{aligned} G'_{AH} &= G_N/((\alpha_{AH})^8(\lambda_{Cp}/\lambda_{Ce})^5 \cdot 10^{-3}) \\ &= 3.949 \times 10^{25} \, \tfrac{m^3}{kg \; s^2} \end{aligned} \qquad (10)$$

[2] James Putnam. "A New General Theory of Physics." Part III. URL: http://newphysicstheory.com, cited on: February 4, 2005. Putnman's angular interpretation for the existence of the fine structure constant is given as $\omega_P = \alpha/(2\pi\Delta_{tc}) = 6.58 \times 10^{15} \; Hz$, where $\Delta_{tc} \approx a_0/c$. Thus the Putman ω_P appears to give a nice and possibly physical reason as to why g_c pops into eq. 7 as $\exp(0.985)/T_{\omega_e} = \omega_P$ and provides a tool to further investigate this possible "quantum gravity" correction.

this striking first approximation correlation suggest that both approaches are in fact families of a single underlying theoretical framework. Qualitatively the above equation suggest that the electrons in the ground state of an atom feel a G of 26 orders in strength that increases to 29 orders near the nucleus, seemingly having the opposite effect of AH's theorized nuclear interactions and may give reason to believe that G_{AH} can reduce to G_N outside an atom enforcing the practicality of this non standard approach. Moreover the systemic results of eq. 8 not only yields a correspondence to electric forces but to quantum phenomena as well as evident from table 1.

A special note about table 1 is that the magnetic permeability can be writen as $\mu_0 = 4\pi(k_{Col}/c^2) = 1.257 \times 10^{-6} \; Tm/A$, and oddly enough as $\mu_0 = 4\pi(G_k/c^2)$ which is directly related to the κ_k version of the curvature constant in general relativity by halving the formula as seen from table 2 and remarkably the units still match the other G_k derived constants in table 1! At a superficial level it would appear that beneath the Bohr radius electric fields begin to behave as gravitational field and gravitational fields like electric fields. In short it appears that an anomalous electro-gravitic interactions must be taking place at the subatomic level, but we don't quite yet have an explanation for the seeming disappearance of G_b beyond the nature of eq. 7.

4.1 an interpretation of kg^2/C^2 normalization through a $4\pi G_k \epsilon_0$ factor

The most general avenue for understanding kg^2/C^2 units comes by inversing the product of Newton's gravitational constant and magnetic permitivity so that $1/(G\epsilon_0) = 1.693 \times 10^{21} \; kg^2/C^2$, the only problem is that the scale is 21 orders of magnitude too large. So a scale balance of $e/(G_N\epsilon_0) = 271.186 \; kg^2/C$ would be required for G_k to regain SI force units so that $1/(G\epsilon_0) = 1.693 \times 10^{21} \; kg^2/C^2$, the only problem is that the scale is 21 orders of magnitude too large. So a scale balance of $e/(G_N\epsilon_0) = 271.186 \; kg^2/C$ would be required for G_k to regain SI force units

$$F_{SI} = \left(\frac{[\dim_{G_k}|_{A^2m/kg}]}{271.186 \; C}\right) \frac{e}{G_N \epsilon_0} \qquad (11)$$

from a classical perspective it would require 1.693×10^{21} charged particles to balance out the G_k units, however experimental results clearly rule out this possibility. So perhaps a better method of regaining SI units would be to use the classical definition of Coulomb's constant so

$$k_{col} = \frac{1}{4\pi\epsilon_0} = \frac{G_k}{4\pi G_k \epsilon_0} \qquad (12)$$

thus conventional units would be given as

$$F^*_{SI} = [\dim_{G_k}|_{A^2m/kg}](4\pi G_k \epsilon_0) \qquad (13)$$

nomenclature	SI units	G_k units	G_k to SI units
k_{Col}	$8.988 \times 10^9\ Nm^2/C^2$	$8.96 \times 10^9\ m^3/kg\ s^2$	kg^2/C^2
a_0	$5.292 \times 10^{-11} m$	$5.308 \times 10^{-11}\ kg^2m/C^2$	C^2/kg^2
$F_{Col}\|_{a_0}$	$8.238 \times 10^{-8} N$	$8.212 \times 10^{-8}\ A^2m/kg$	kg^2/C^2
ϵ_0	$8.854 \times 10^{-12}\ C^2/Nm^2$	$8.882 \times 10^{-12}\ kg \cdot s^2/m^3$	C^2/kg^2
μ_0	$4\pi \times 10^{-7}\ Tm/A$	$1.253 \times 10^{-6}\ m/kg$	kg^2/C^2
$E_e\|_{a_0}$	$5.142 \times 10^{11}\ N/C$	$5.126 \times 10^{11}\ Am/kg\ s$	kg^2/C^2
$U_e\|_{a_0}$	$27.21\ V$	$27.126\ m^2A/kg \cdot s$	kg^2/A^2
c	$2.998 \times 10^8\ m/s$	$2.998 \times 10^8\ m/s$	self defined
α	7.298×10^{-3}	$7.275 \times 10^{-3}\ C^2/kg^2$	kg^2/C^2
$\hbar$	$1.055 \times 10^{-34}\ J \cdot s$	$1.051 \times 10^{-34}\ Am^2C/kg$	kg^2/C^2

Table 1: Displayed above are some of the relationships between the standard k derived derived physical fields along with the G_k ones, all within 0.03% of accpeted values as expected from eq. 8. All G_k values can be converted to SI Units as seen by the G_k to SI column, thus allowing for the seamless exchange between units. Special note should also be made that the G_k value for μ_0 above was evaluated by halfing the genereal relativistic constant κ as seen from table 2. Finally $\hbar = h_{eg}/\alpha$ was derived from Visser's use of electric-gravitic untis [9], specifically where $h_{eg} \sim e^2 k_{Col}/c = 7.696 \times 10^{-37}\ Js$.

and therefore a G_k force could be defined as

$$F_{G_k} = [\dim_{SI}|_N](4\pi G_k \epsilon_0) = 1\frac{A^2 m}{kg}\ . \tag{14}$$

Therefore through eq. 12 it would seem ordinary electromagnetic effects would appear to bare no direct relation to gravitation, however effects which can not be purely electromagnetically derived seem to have an apparent relationship with gravitation as seen through the magnetic permeablilty constant.

5 formulating quantum gravity in the standard high energy regime

We begin this section by drawing attention to table 2 which gives several very interesting results, let us first analyze them through the traditional planck energy scale $M_p = G_N^{-1/2} \equiv 10^{19}\ GeV/c^2$, thus the table gives rise to the following two additional energy scales $M_k = G_k^{-1/2} \equiv 10^{10}\ GeV/c^2$ and $M_b = G_b^{-1/2} \equiv 10\ GeV/c^2$.[3] Now according to conventional wisdom at the planck scale gravitational and quantum interactions become indistinguishable, one concrete example would be that the Compton wavelength and the schwarzschild radius would be of the same magnitude $\lambda_{Cpl} \approx \hbar/M_p\ c \equiv 2G_N M_p/c^2$. So the first bit of information that table 2 gives us is that

$$\lambda_{Ck} \approx \frac{\hbar}{M_p\ c} \equiv \frac{2G_k\ m_p}{c^2} \tag{15}$$

which seems to confirm the belief that M_p energy scales may unify the classical electromagnetic and gravitational forces. Another result is that there seems to exist another electro-gravity energy scale which posses fields having many magnitude jumps over the traditional electromagnetic force in terms of strength as seen by

$$\lambda_{Cb} \approx \frac{\hbar}{M_b\ c} \equiv \frac{2G_b\ m_p}{c^2} \tag{16}$$

thus appearing as a very highly contradictory result but we'll return this point after the last item. And lastly from table 2 we obtain a magnitude relationship between the general relativistic curvature constant and the G_k planck length $\kappa_N \equiv l_k$, which suggest that the reason high mass content is required to substantially warp classical spacetime may likely be the result of M_k scale interactions. Now back to the contradiction, it would seem that the planck spacetime unit lengths become unreliable with the use of more than one gravitational constant, ironically enough illustrating the need for further quantum corrections.

The apparent contradiction however can be qualitatively explained through the first principles explored in section 3 along with the comparisons drawn between tables 1 and 2 as the role of κ_k would purely seem to renormalize the bare curvature κ_b to classical spacetime curvature κ_N (although this is not entirely clear until we come to eq. 31). Further we can note that the difference between M_p and M_k is 10 GeV/c^2 also just happens to

[3] This scale at first would appear to indicate a possible resolution to the hierarchy problem of string theory, which deals with the mystery between the weak and planck scale interactions $l_W/l_{pl} \sim 10^{17}$ [2], but the energy scale is much too low!

nomenclature	standard operation	G_N value	G_k value	G_b value
κ	$(8\pi G_N)/c^2$	$1.86 \times 10^{-26}\ m/kg$	$2.505 \times 10^{-6}\ m/kg$	$1.496 \times 10^{11}\ m/kg$
l_{pl}	$(G_N \hbar/c^3)^{1/2}$	$1.616 \times 10^{-35}\ m$	$1.873 \times 10^{-25}\ m$	$4.576 \times 10^{-17}\ m$
r_{Sch}	$(2G_N m_p)/c^2$	$2.484 \times 10^{-54}\ m$	$3.335 \times 10^{-34}\ m$	$1.991 \times 10^{-17}\ m$

Table 2: Above are the rather simple conversions (from the theories which they emerge) between actual and theorized (planck) spacetime units into standard SI units of measure. The planck energy scale of M_k is interesting in that appears to give rise to general relativistic curvature if interpreted as a kind of anti-gravitating field and could give an explanation why the planck scale towers over all known interactions .

be the scale of M_b interactions which is hardly surprising since m_p has been used as a scaling mass and since the *uud* quark masses of a proton just happen to roughly yield an energy of 10 GeV/C^2. The end result of the planck energy scale comparisons is effectively that the proton mass is removed from the equations leaving the pure gravity field, meaning the planck scale data is not as contradictory as it first seemed! Furthermore the M_k interactions of eq. 15 therefore seems to suggest a reason why an energy of around 10^{10} GeV/c^2 is required for classical spacetime to probe G_b gravity. In general it seems the "gravitational constants" with the exception of G_b behave as running coupling constants because the remaining constants seem to act as a gauge of spacetime curvature.

5.1 possible interpretations of κ_k

Perhaps a theoretical explanation for the apparent relationship

$$\kappa_k = \frac{8\pi G_k}{c^2} \equiv \mu_0 \tag{17}$$

could be explained through Ivanov's usage of Weyl-Majumdar-Papapetrou (WMP) spacetime, where electro–magnetic sources may act to accelerate gravitational fields by a root action of $(G_N)^{1/2}$ [10]. Through root gravity eq. 17 can be approximated as

$$\mu_0 \approx \sqrt{\frac{G}{4\pi^2}} \equiv \frac{8\pi G_k}{2c^2} \tag{18}$$

so that the G_k system may be nothing more exotic than root gravity, i.e. electromagnetically induced gravitational acceleration [10].

Another interesting possibility is that μ_0 could be understood by inversing, replacing m_0 with m_p and multiplying $4\pi(kg/m)$ to the self constraint action of Sardin's proton quantization [11]

$$\begin{aligned} F_{\downarrow}^{-1} 4\pi(kg/m) &= \tfrac{r_p}{r_0}\tfrac{c^2}{v_c^2}\tfrac{1}{m_p c^2} 4\pi(kg/m) \\ &= 1.312 \times 10^{-6}\ \tfrac{Tm}{A} \end{aligned} \tag{19}$$

where $r_0 = e^2/m_e c^2$ and $r_p = e^2/(4\pi\epsilon_0 m_p c^2) = 1.535 \times 10^{-18}\ m$. This is because in Sardin's model the proton mass is derived through the electrons mass by

$$\left[\left(\frac{r_e}{r_p} - 1\right) - \log\left(\frac{r_e}{r_p}\right)\right] \gamma_c m_e c^2 = 1.508 \times 10^{-10}\ J \tag{20}$$

where $\gamma_c = 1 + (\alpha r_e/r_p)^{-2}$, this becomes useful in this discussion as both electron and proton masses become inverses of their respective magneton constants [11]. This quantization may be more likely than it first appears as from Haisch Rueda Puthoff (HRP) [16, see for proper reference] inertial mass is given as $m_i = \Gamma_z \hbar \omega_c^2/2\pi c^2$, if we define $\Gamma_z = T_{\omega_e}/4\pi^2$ we see that

$$m_{ip} = \frac{T_{\omega_e}\hbar}{2\pi(\lambda_{Ce})^2} = 1.16 \times 10^{-27}\ kg \tag{21}$$

which is amazingly within a hair of the actual proton mass. The problem however is that eq. 19 muddies the waters with more units to ponder, the only reason it is mentioned at this time is to give a possible explanation of why G_N becomes so highly modified through AH unification. On another note an earlier work of Sardin [12] describes neutrons as having an outer shell which only stabilizes along with another proton, in this context the nature of AH gravity in neutron rich nucleons be better understood and perhaps expanded to make further predictions.

6 formulating gravity as a low energy quantum interaction

When one computes the scale differences between G_b and G_N by mediated by a dimensionless version of Putnam's angular fine structure where $\omega_P \Delta_{tc} = \alpha/2\pi$ one finds

$$\left(\frac{\alpha}{2\pi}\right)\frac{G_b}{G_N} = 9.312 \times 10^{33} \tag{22}$$

which by magnitude resembles the inverse of the planck action h. In fact by inverting eq. 22 one finds a dimensionless version of the angular planck action

$$\hbar \equiv \left(\frac{2\pi}{\alpha}\right)\frac{G_N}{G_b} = 1.074 \times 10^{-34} \tag{23}$$

whose scale is within 1% of the accepted value. By peforming the opertion $2\pi\ /\hbar$ to the above equation its familiar non angular counterpart is also easily found

$$\not\hbar \equiv \left(\frac{4\pi^2}{\alpha}\right)\frac{G_N}{G_b} = 6.748 \times 10^{-34}\ . \tag{24}$$

From the the previous equations dimensional analysis shows that the dimensionless planck constants show up in what could be described as a electro-gravitic fine structure

$$\alpha_{eg} = \frac{e^2\ \not\hbar}{2hc\epsilon_0} = 7.696 \times 10^{-37} \tag{25}$$

of a broken gravitational symmetry which turns out to be the exact scale of dimensionless electro-gravitic planck action. The reason why this occurs can bee seen from table 1 because we we can write $\hbar = h_{eg}/\alpha$ so that $\alpha = h_{eg}/\hbar$, what is really interesting is that we can derive h_{eg} through a "planck atom", that is

$$h_{eg} = \alpha\hbar = M_{pl} v_e l_{pl} = 7.696 \times 10^{-37}\ Js \tag{26}$$

so

$$\alpha_{ZPF} = \frac{M_{pl} l_{pl}}{m_e a_0} = 7.297 \times 10^{-3} \tag{27}$$

therefore it would seem that the electromagnetic ZPF is separated from the planck scale by the fine structure constant. For illustration purposes the broken symmetry shows up when the gravitational scales are isolated

$$G_b \approx \left(\frac{7}{\alpha_{eg}}\right) G_N = 6.069 \times 10^{26}\ \frac{m^3}{kg\ s^2} \tag{28}$$

$$G_N \approx \left(\frac{\alpha_{eg}}{7}\right) G_b = 5.881 \times 10^{-11}\ \frac{m^3}{kg\ s^2} \tag{29}$$

although why this occurs at this point remains somewhat a mystery. However since Goldstone's theorem holds that whenever a continuous symmetry is spontaneously broken Nambu-Goldstone bosons will appear [6], photons in this context may be viewed as the bosons resulting from a broken gravitational symmetry. From this discussion we might conclude that the geometry of general relativity becomes quantized by

$$\frac{G_N}{2\ \not\hbar c^2} = 5.602 \times 10^5\ \frac{m}{kg} \tag{30}$$

which seems very unphysical at first, but is almost exactly as what is expected from putting κ_k and κ_b from table 2 into the same physical space (within a margin of 1.495). We can get a value which is closer to classical spacetime curvature if we quantize spacetime by m_e where

$$\left(\frac{G_N}{16\pi\ \not\hbar c^2}\right) m_e = 2.031 \times 10^{-26}\ m \tag{31}$$

and from here the bare gravitational constant may be better understood. That is a dimensionless version of G_b becomes

$$\begin{aligned} \not G_b &= \frac{G_N/(16\pi \not\hbar c^2)}{\kappa_N}\frac{m_e}{m_p} \\ &= \frac{1}{128\pi^2 \not\hbar}\frac{m_e}{m_p} = 6.506 \times 10^{26} \end{aligned} \tag{32}$$

being the ratio between spacetime quantization and curvature, where it is noted as in section 3 that the inverse proton mass dominates the ratio. From here Newton's gravitational force could be interpreted as

$$\begin{aligned} F_g &\approx \left(\frac{\alpha_{eg} G_b \not G_b m_p}{7}\right) \cdot \left[\frac{1kg}{1meter^2}\right]_{def.} \\ &= 6.422 \times 10^{-11} N \end{aligned} \tag{33}$$

so it would seem that Newton's description of gravity is only valid when protons dominate the masses of a gravitating field. An implication of the above may be that so called "quark stars" may acquire a a slightly higher value for G_N internally due the modified nuclear structure of matter.

Moving on to obtain units of energy for eq. 24 we find an exploded planck action scale

$$h_b = \left(\frac{\alpha}{2\pi}\right)\frac{G_b h}{G_N} = 6.17\ Js \tag{34}$$

which when interpreted through the traditional planck length gives

$$l_b \equiv \sqrt{\frac{G_N \hbar_b}{c^3}} = 1.559 \times 10^{-18}\ m \tag{35}$$

which is roughly the same magnitude seen in table 2. It is also worth mentioning that the h_b quantum action has the same energy scale of $M_b = (G_b)^{1/2}$ gravity as seen from section 5. Perhaps a more revealing insight is seen by realization that M_b is pretty close to the energy scale of a proton and l_b approaches the classical proton radius r_p. We can even go a bit further than this thanks to table 2, that is we find the relation

$$\frac{2G_b m_p}{c^2} \equiv 4\pi r_p = 1.929 \times 10^{-17}\ m \tag{36}$$

from this we may reason that proton masses effectively masks the G_b gravity field which exist just outside of of r_p. Also from eq. 24 an additional gravitational planck action being in exact agreement with present theory

$$h_N = \left(\frac{2\pi}{\alpha}\right)\frac{G_N h_b}{G_b} = 6.626 \times 10^{-34}\ Js \tag{37}$$

which yields the relation

$$l_b = \sqrt{\frac{G_b \hbar_N}{c^3}} = 4.576 \times 10^{-17}\ m \tag{38}$$

as explored in section 5; perhaps revealing the quantum quantum gravity correction explored earlier. From previous relations it can also be reasoned that a h_b quantum mass would be the equivalent to the traditional planck mass at a one meter wavelength $h_b/(c \cdot 1\ m) = 2.058 \times 10^{-8}\ kg$. By virtue a photon's rest mass would be $h/(c \cdot 1m) = 2.21 \times 10^{-42}\ kg$, although it is obvious that if this were the case further restraints would need to be imposed.

7 modified gravity at the Compton scale

Since AH were motivated by a Compton ZPF induced gravitational constant we explore in this section more conventional interpretations of gravitation at the Compton scale. To draw parallelisms to classical general relativity an overview of Rosquist's investigation of gravitation at the Compton scale [13] is in order which is based upon the Kerr-Newman metric

$$\begin{aligned} ds^2 &= -\tfrac{\Delta}{\rho^2}[dt - a\sin^2\theta d\phi]^2 + \tfrac{\sin^2\theta}{\rho^2}[(r^2+a^2)d\phi - \\ &\quad -adt]^2 + \tfrac{\rho^2}{\Delta}dr^2 + \rho^2 d\theta^2 \end{aligned} \tag{39}$$

with $\Delta \equiv r^2 - 2Mr + a^2 + Q^2$, $\rho \equiv r^2 + a^2\cos^2\theta$, and $a \equiv S/M$. The use of this metric becomes highly appreciated with our previous discussions as Rosquist finds a relationship to α in his formulation by

$$\alpha \equiv \frac{Q^2}{2r_{Se}(\lambda_{ce}/4\pi)} \sim \frac{Q^2}{2Ma} \tag{40}$$

where $Q = 1.38 \times 10^{-36}\ m$ and where $r_{Se} = 6.76 \times 10^{-58}\ m$ is the electron schwarzschild radius. In Rosquist's work the Compton scale (for the electron) becomes important when $r = Q^2/2M = 1.409 \times 10^{-15}\ m$, as at that point the spin nature of elementary particles dominate the behavior of gravitational fields and hence modify classical electric potentials, which may essentially be viewed as the inverse of [10]. Moving beyond Rosquist it is worth pointing out that Blaha has developed a a finite renormalizable "two-tier" quantum field theory [15] which amongst other things can resemble the quantum (spin) Kerr-Newman Coulomb potential of Rosquist [13]. Furthermore should string theory become a viable model of the physical world all of the previous Compton relationships can be dually extended to strings as pointed out by Sanchez [14].

7.1 implications for zero-point gravity

We can now modify gravity by imposing the resonance ZPF inertial mass from [16] where $m_i = \Gamma_z v_r(hv_r/c^2)$ onto eq. 31 which serves to suggest that all point masses result from external spacetime curvature and that all masses have the same zero-point curvature[4] as seen through

$$m_g = \frac{G_N \Delta_z\ \not{E}_r}{16\pi c^3 \lambda_{C0}} = 2.031 \times 10^{-26}\ m \tag{41}$$

where $\Delta_z = hv_r = constant$ which replaces Γ_z and $\not{E}_r = 1/\ \not{h}\ (v_0)$ which replaces v_r, and where the sub nots represent arbitrary particles. The previous formula is rather remarkable in that all elementary particles when "quantized" by gravity equate to the same κ value so that they share the same background as one would expect from general relativity, another remarkable feat is that if we use use geometrized units where $G = h = c = 1$ for spacetime curvature we really do indeed find equalization between inertial and gravitational mass.

Since HRP make use of Unruh radiation $T = \hbar a/(2\pi ck_B)$ in their formulation of the ZPF a deeper insight to Unruh radiation may lead to further clues to the nature of quantum gravity. Wald gives a nice explanation of how Unruh radiation appears as a bath of radiation to an observer who is boosted from Minkowski spacetime into Rindler spacetime and why inertial observers feel no such radiation [17]. Wald also reasons that why we do not see Unruh radiation under normal laboratory settings is that its thermal signature (in SI units) is $T_U = 4 \times 10^{-21}\ aK$, a novice would note that this is close to electrostatic acceleration of an electron where $a_e = v_e^2/a_0$, and without realizing that a Rindler boost does not exist here would incorrectly find the minimum temperature for an atom would be a quiet toasty $T = 366.74\ K$. However by making the the change $h \rightarrow h_{eg}$ to Unruh's formula we find a temperature which is close to the present Cosmic Background Radiation (CBR) scale

$$T_{CBR} = \frac{h_{eg} a_e}{2\pi c k_B} = 2.676\ K \tag{42}$$

from section 6 the culprit for this apparent benign relation is taken to be eq. 27. A possible ramification of the previous equation is that the ZPF may be capable of boosting particles into a pseudo planck spacetime having Rindler like boost characteristics. If eq. 42 were proven to be physically justifiable it would seem to have profound cosmological implications which would put into grave doubt the actual origin of CBR. On a more positive note such ZPF induced CBR might provide some definitive answers in regards to the long outstanding problem regarding the "choice" of a background metric(s) in association with QFTs in curved spacetime [18].

[4] This may serve as the long awaited physical manifestation behind Mach's Principle. Eq. 41 reduces to eq. 31 for m_e masses, perhaps suggesting a correlation between quantum spacetime curvature and the Dirac vacuum.

An approximate method of justifying eq. 42 can be found through the relation $h_{eg} = M_{pl} v_e l_{pl}$, thus an $\hbar$ approximation should yield an electromagnetic zero-point approximation of the planck scale gravity by

$$\hbar_{zp} = \frac{h_{eg}}{\alpha} = \frac{m_e v_e a_{zp}}{\alpha} \tag{43}$$

where $a_{zp} = 3.862 \times 10^{-13}\ m$. From here we see that a_{zp} is very close to AH's r_i giving further vindication of the unification approach of AH, and we also find another method of defining the speed of light

$$c = \frac{v_e}{\alpha} = \frac{1}{\sqrt{\mu_0 \epsilon_0}} = 2.998 \times 10^8\ \frac{m}{s} \tag{44}$$

and fine structure

$$\alpha = v_e \sqrt{\epsilon_0 \mu_0}\,. \tag{45}$$

Continuing the process we find that vacuum impedance can also be redefined, giving

$$Z = \frac{\alpha}{v_e \epsilon_0} = \sqrt{\frac{\mu_0}{\epsilon_0}} = 376.73\,\Omega\,. \tag{46}$$

With equation 44 it becomes rather trivial to define the Compton wavelength in terms of the de Broglie wavelength as for the electron this shows

$$\lambda_{Ce} = \lambda_{dBe,zp} = \frac{h\alpha}{m_e v_e} = 2.426 \times 10^{-12}\ m \tag{47}$$

this result is not too surprising as Haisch-Rueda-Dobyns found a similar result through a relativistic function $\lambda_{dB} = (c/\gamma v)\lambda_C$, where $\gamma = (1/\sqrt{1 - v^2/c^2})$ [16]. If the essential postulate of HR ZPF inertia is correct and if $h\alpha 2\pi \to \hbar_{eg}$, then it implies the inertial mass of an electron orbiting the ground state of a Bohr atom would result in the very physical effect implied by eq. 42.

8 brief comment on permeability and energy

Another method of coming to the magnetic permeability constant is by expressing the orbital period of an electron at the ground level of a Bohr atom $T_{e1} = 2\pi a_0 / v_e = 1.52 \times 10^{-16}\ s$ in terms of angular fine structure, and then to treat those units as ordinary electric charges multiplied by 4π

$$\mu_0 = \frac{\left(T_{e1} \frac{\alpha}{2\pi}\right)^2}{a_0^2 \epsilon_0} = \frac{1}{\epsilon_0}\left(\frac{\alpha}{v_e}\right)^2 = \frac{1}{\epsilon_0 c^2} \tag{48}$$

From here we can find the origin of eq. 44 by dropping 4π and inversing the previous equation

$$c = \frac{a_0}{T_{e1}(\alpha/2\pi)} = \frac{v_e}{\alpha} \tag{49}$$

and from that we can also interpret rest energy in new terminology

$$\begin{aligned} E_0 &= m_0 \left(\tfrac{v_e}{\alpha}\right)^2 = m_0 \left(\tfrac{4\pi k_{Col}}{\mu_0}\right) \\ &= m_0 \left(\tfrac{1}{\epsilon_0 \mu_0}\right) = m_0 c^2\,. \end{aligned} \tag{50}$$

Energy can also be quantized through a particles Compton frequency

$$E_0 = hf = h\frac{v_e}{\alpha \lambda_C} = \left(\frac{\hbar}{\alpha\, m_e a_0}\right)^2 m_0 \tag{51}$$

which vindicates Sardin's method [of proton] mass quantization mediated through electrons [11] as well as the spacetime quantization method of eq. 31. Finally Coloumb's constant can also be revaluated such that

$$k_{Col} = \frac{1}{4\pi\epsilon_0}\left(\frac{\alpha c}{v_e}\right)^2 = \frac{1}{4\pi}\,\mu_0 c^2 = \frac{1}{4\pi\epsilon_0}\,. \tag{52}$$

9 discussion of results

While our review of alternative and perhaps highly controversial interpretations of quantum gravity has taken us down several winding roads we are left with what seems very little fact, but then again that can be said about present conventional attempts to quantize gravity as well. It surely would have been more reassuring and confronting to have obtained a weak approximation of general relativity dealing with at least the quantized spacetime method implied by eq. 41, but such a task would seem to require drastic reformulations of classical spacetime curvature. While eq. 41 at first sight appears it may have some coupling to the linearized equations of general relativity a quick and crude representation of stress-energy equations however conceptually take the form, $T^{ab} X^a_\sigma X^b_\rho < t_{ab} >$, which most certainly seems an unlikely order by nature. On the other hand we have gained several conceptual insights into the nature of quantum gravity while far from complete can give a qualitative description of gravitational modifications at the Compton scale.

The first picture that we are left with is that at the atomic level electromagnetism and gravitation appear to be tied in manner such that the electromagnetic force emerges from the gravitational force. The electron feels a planck style gravitational force which has been labeled as the bare electron gravitational force G_b, which happens to be at the weak end of AH gravity [7]. Newtonian gravity then results from an apparent inverse cancellation of the G_{AH} field by the bare gravitational field, in light of AH gravity the electron and proton may likely vary the polarization of spacetime at the planck scale, although the process is not entirely symmetrical yielding G_N. From which it seems that strength of gravity approaches the planck scale when $r = 10^{-13}\ m$ within atomic systems. Therefore the ZPF concept in the continuum limit would likely give natural rise to the metric description classical general relativity as first suggested by Schrödinger [19] due to natural behavior of macroscopic bodies. Borrowing membrane terminology from string theory this would imply that G_k may play the role of deflecting bulk gravity fields from our 4D SM brane thus acting as a brane confinement field. From which it would seem that the planck scale is just the classical energy required to nullify the G_k gravity, so that only the repulsive proton polarization remains. With the repulsive planck polarization field dominating it would then act as a local mechanism to eject local bodies into the bulk in a manner analogous to DGP branes [20].

Acknowledgments

I would like to thank Ian Wrightman whose interesting discussions led me to reexamine the nature of G_N. I would also like to thank Hei-Chi Chan; and Todd Desiatio for their valuable insights and suggestions among my early drafts.

References

[1] Polchinski J. String Theory Volume I: An Introduction to the Bosonic String. Cambridge University Press, 1998.

[2] Ramond P. Journeys Beyond The Standard Model. Perseus Books, 1999.

[3] Kaku M. Strings, Conformal Fields, and M-Theory. edition: 2. Springer, 2000.

[4] Munõz C. Desperately Seeking the Standard Model. arXiv: hep-ph/0312091

[5] Giancoli. D. Physics for Scientists & Engineers with Modern Physics. Princeton Hall, 2000.

[6] Zee A. Quantum Field Theory in a Nutshell. Princeton University Press, 2003.

[7] Anastasovki P. and Hamilton D. Spacetime Curvature Around Nucleons. *J. Chem. Phys., Nonlinear Optics.* (2001), cited on: March 28, 2003. [US Department of Energy] http://www.ott.doe.gov

[8] Haisch B, et al. Update on Electromagnetic Basis for Inertia, Gravitation, the Principle of Equivalence, Spin and Particle Mass Ratios. AIP Conference Proceedings of the Space Technology and Applications International Forum, Feb 2-6 (2003), arXiv: gr-qc/0209016

[9] Visser. M. Loretnzian Wormholes: from Einstein to Hawking. AIP Press, 1996.

[10] Ivanov B. On the gravitational field induced by static electromagnetic sources. arXiv: gr-qc/0502047

[11] Sardin. G. Nature and Quantization of the Proton Mass: An Electromagnetic Model. arXiv: physics/0512108

[12] Sardin G. Fundamentals of the Orbital Conception of Elementary Particles and of their Applications to the Neutron and Nuclear Structure. *Phys. Essays.* **12**, no 2. (1999), arXiv: hep-ph/0102268

[13] Rosquist K. Gravitationally Induced Electromagnetism At The Compton Scale. arXiv : gr-qc/0412064

[14] Sanchez N. Conceptual unification of elementary particles, black holes, quantum de Sitter and Anti de Sitter string states. *Int. J. Mod. Phys.* a**19** (2004), pp 4173-4200, arXiv: hep-th/0312018

[15] Blaha S. A Finite Unified Quantum Field Theory of the Standard Model & Quantum Gravity. Pingree-Hill Publishing, 2003

[16] Haisch B., Rueda A., and Dobyns Y. Inertial mass and the quantum vacuum fields. *Annalen Phys.* **10**, (2001), pp 393–414, arXiv: gr-qc/0009036

[17] Wald R. General Relativity. University of Chicago Press, 1984.

[18] Birrel N.D. and Davies. P.C.W. Quantum fields in curved space. Editors: Landshoof P, McCrea W., Sciama D., Weinberg S. Cambridge University Press, 1982.

[19] Schrödinger E. Space-Time Structure. Cambridge University Press, 1963.

[20] Kolanović M. DGP Brane as a Gravity Conductor. *Phys. Rev.* D**65** (2002) 124005, arXiv: hep-th/0203236