Vacuum charges within a teleparallel weyl tensor:  
a new approach to quantum gravity

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Abstract
A comparison is given between the Newtonian and Einsteinian frames of gravitation. From this it is shown that there exist a weak connection to gravitation and electromagnetism. This connection is then studied more thoroughly with the Weyl tensor and with the electromagnetic vacuum Λ. Which dictates General Relativity should be reformulated to confer to a ‘Einstein-Cartan-Weyl’ geometry. Where it is seen that the Gravitational Constant is the inverse of the Compton wavelength shown through a Weyl gauge potential of form \[ F_{\alpha\beta} + A^\alpha_{\alpha\beta}, \beta \]. The gauge potential along with Einstein-Cartan geometry is argued to explain superluminal velocities observed within General Relativity.

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“The acceleration of motion is ever proportional to the motive force impressed; and is in the direction of the right line in which that force is impressed.”

–Newton (1687)

1 Introduction

There are currently two viable models for the gravitational field, being the classical and the relativistic gravitational field. Of course this refers to the law of universal gravitation proposed by Newton and General Relativity (GR) by Einstein. The two theories are certainly correlated and attempt to describe the same phenomena, however mathematically they are treated quite different from one another. It thus becomes natural for the sake of coherence to give a unified structure of the two theories, even if only ad hoc. What is peculiar, or even

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far more obvious is that both theories of gravitation are subtle variations of the second law of motion.

The development of this work was made possible through studying the relationship between classical and relativistic gravitational fields where a weak connection can be shown to electromagnetism. In previous works it has been shown that the cosmological constant $\Lambda$ can be represented by a covariant electromagnetic field \[1\], \[2\]. It has also been suggested that the cosmological constant can be derived from the quantum vacuum \[3\], \[4\]. Using an analog of quantum theory and electromagnetism an empirical unification with gravitation is quickly realized with the classical Kaluza-Klien (KK) theory \[5\]. From an empirical KK geometry a connection with gravitation and Newton’s second law of motion can be explained by means of the Weyl tensor within the GR formalism. The general conclusion that can be arrived from this analysis is that GR is not a complete theory of gravitation when only considering Ricci curvature of the Riemannian manifold.

The organization of this work is given rather straightforward in §1.1 the Newtonian theory for gravitation is explained through the second law of motion. In §1.2 Newton’s view of the world is briefly discussed, whereas in §1.3 Einstein’s ‘world view’ is given, where the two are related within §1.4. In §1.5 $G$ is reformulated through the second law, where a relation is shown to electrostatics in §1.6 which is shown to be a superposition field within §2. In §2.1 empirical equations of this field are given, which resembles a KK space which is discussed in §3. A gauge field is considered for gravitation in §5 which suggest a correlation to the vacuum energy explored in §6. In §6.1 the GR analog is discussed with the Weyl tensor. In §6.2 first order Lagrangians are presented, which leads to teleparallel Weyl tensor in §6.3. In §7 a relationship between vacuum energy and the gravitational constant are given. A standing wave is shown in §7.1 which gives an allusion of the classical KK space. The explanation for the Vacuum charges in the title is seen in the Appendices. Appendix A describes the relation between the gravitational constant and the Compton wavelength, as well as explaining superluminal velocities observed in astrophysics. Appendix B gives an alternative origin for mass increase, Appendix C briefly discusses other theoretical values for $G$. Finally in Appendix D there is shown a need to modify the definition of the planck length under this work.

### 1.1 Newton-Einstein Gravity

It is obvious to start such a modeling with the widely known Newton-Einstein action:

$$\frac{d^2x_{\mu}}{dt^2} = \frac{\kappa c^2}{8\pi} \frac{\partial}{\partial x_{\mu}} \int \frac{\sigma dV_0}{t} \tag{1}$$

Where the left term is defined by the second law of motion:

$$m \left\{ \frac{d^2x^\alpha}{dt^2} + \Gamma^\alpha_{\beta\gamma} \frac{dx^\beta}{dt} \frac{dx^\gamma}{dt} \right\} = F^\alpha \tag{2}$$

Here another generalization of the second law can be given with the equation $\vec{F} = m \frac{d^2\vec{r}}{dt^2}$. When taking the convection $\vec{r} = (x, y, z)$ a gravitational acceleration
is derived by:

\[ m \frac{d^2 \vec{r}}{dt^2} = -\frac{GMm}{|\vec{r} - \vec{R}|^2} \vec{e}(\vec{r}, \vec{R}) \]  

(3)

The gravitational field is then defined through \( \varphi = \frac{GM}{R} \), thus a gravitational field is produced through poisson’s equation through \( \nabla \varphi = 4\pi G \rho \). Where for simplicity sake we receive the standard deviation for Newton’s gravitational field:

\[ \vec{F}_g = G \frac{m_1 m_2}{d \vec{r}^2} \]  

(4)

It is quite clear that Newton’s formulation of gravitation is formed through his second law of motion. Which is explained as an external force mechanism which causes masses to accelerate one another.

1.2 the absolute spacetime

Newton considered space and time as separate and finite invariant dimensions. We can see this definition early on in Book I of Princpa by means of Scholium I:

“absolute, true, and mathematical time, of itself, and from its own nature flows equably without regard to anything external, and by another name is called duration: relative, apparent, and common time is some sensible and external (whether accurate or unequalable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year.”

A conclusion that is drawn from the roots of Euclidean geometry which can be expressed in the form

\[ ds = \sqrt{dx^2 + dy^2 + dz^2} \]  

(5)

where the following spatial identities arise by means of an infinitesimal rotation:

\[ F^x = F^x \cos \theta + F^y \sin \theta, \quad F^y = F^x \sin \theta + F^y \cos \theta, \quad F^z' = F^z \]  

(6)

again we see how the spatial definition directly relates to the second law of motion.

1.3 Special Relativity

With a suggestion from Minkowski Einstein transformed the cherished absolute description of space and time to a relative space-time of the form:

\[ ds^2 = c dt^2 - dx^2 - dy^2 - dz^2 \]  

(7)

with the invention of a ‘spacetime’ continuum, one can notice subtle changes with an infinitesimal rotation:

\[ ct' = \cosh \theta ct - \sinh \theta x, \quad x' = \sinh \theta ct + \cosh x, \quad y' = y, \quad z' = z \]  

(8)

With Einstein’s fundamental postulate acceleration in such a frame would be limited to the speed of light, lending the beta function:

\[ \gamma = \gamma(v) = \frac{1}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}} \]  

(9)
working backwards now we can see that kinetic energy of a body in this frame is given in the form

\[
KE = \int_0^u m\gamma^3 u du = mc^2(\gamma - 1)
\]  

(10)

Thus at this point we see that these two different formulations of space will produce very different forms of acceleration. In classical terms mass is defined as a focused point of force, while in relativistic terms it is defined as ‘stress-energy’ within an arbitrary manifold.

1.4 forces to fields

Taking a new look at Newton-Einstein gravity one may make a second order generalization of the field by:

\[
T^i_{j} \left\{ \frac{d^2 x_\mu}{dt^2} - \Gamma^i_{\beta \gamma} \frac{dx^\beta}{dt} \frac{dx^\gamma}{dt} \right\} = \frac{k c^2}{8\pi} g^i_{j} \partial_x \partial_x^\mu
\]  

(11)

Notice how this equation describes gravitation not as a force but as a manifold. Furthermore mass is no longer an intrinsic property but a local field in the geometry, i.e. the change results in going from a point particle theory (mass) to a field theory (tensors). This force is taken equivalent to a manifold of the form \( \frac{dL}{dx^\mu} = \frac{\partial}{\partial x^\mu} \), assuming a Riemannian manifold and lines of calculations one results in the Einstein-Field-Equation (EFE)

\[
R^i_{j} - \frac{1}{2} g^i_{j} R = - \frac{k c^2}{8\pi} T^i_{j}.
\]  

(12)

Thus it can naturally be seen that the roots of GR can be originated through the second law of motion. In a larger sense, the “gravitational force” is in reality a consequence of the second law of motion, expressed differently only in the terms of mathematical dimensions. Therefore one may wish to explain the gravitational force as a two dimensional acceleration of the form

\[
F'_g = \alpha(E/c^2)(E/c^2)/dx^2 = 4\pi a_\mu = \nabla \varphi.
\]

Of course for a gravitational field \( a \) is replaced by Newton’s Gravitational constant \( G \).

1.5 dimensional analysis of the gravitational constant

One can not deny the similarity between a classical gravitational field and the Coloumb Law \( F_{col} = kQ_1Q_2/r^2 \). Suggesting classically what Kaluza, Klein, Weyl, and others have proposed, a unification with the electromagnetic force. In GR the flat or massless gravitational field is given with \( R^i_{j} - \frac{1}{2} g^i_{j} R = 0 \). This is not entirely correct because the kappa term does not entirely vanish leading to \( R^i_{j} - \frac{1}{2} g^i_{j} R = 8\pi k_\varepsilon \ldots \). It is seen that the interpretation of a geometrical manifold neglects gravitational acceleration. If it is a property of the electromagnetic field however, the second law of motion and the vacuum field equations still hold true.

To elaborate more on the gravitational constant\(^1\) one must be familiar with

\[ G = (6.74215 \pm 0.000002) \times 10^{-11} m^3 kg^{-1} s^{-2}. \]

\(^1\)Modern values given the gravitational constant as

\[ G = \frac{(6.74215 \pm 0.000002)}{10^{-11}} m^3 kg^{-1} s^{-2}. \]
its roots, where one begins with Kepler’s third law of motion:

\[ T = 2\pi \sqrt{\frac{a^3}{M}}. \]  

(13)

In keeping with the relationship between the gravitation and the second law of motion this must be rewritten in the form \( T^2 = kr^3 \), which is analogous to pendulum motion \( T^2 = 4\pi^2 l/g \) where

\[ k \equiv \sqrt{G} = \frac{2\pi}{T} \sqrt{\frac{a^3}{M}}. \]  

(14)

Through dimensional analysis we can reduce this in a form which relates to the Coulomb law:

\[ F = m \times \frac{(2\pi r/T)^2}{r} = m \times \frac{4\pi^2 m r}{T^2} = m \times \frac{(2\pi r)^4/kr^3}{r} \]  

(15)

\[ = m \times \frac{16\pi r/k}{r} = m \times \frac{16\pi m r}{kr^3} = m \times \frac{16\pi m}{kr^2} = G. \]

Once again we see the relevance of the second law of motion, perhaps more relevantly with Kepler’s Laws. Furthermore the gravitational constant G can be represented by \( k \equiv \sqrt{kr^2} \) such that Newton’s Law of universal gravitation becomes:

\[ F = \sqrt{km_1 m_2 r} \]  

(16)

### 1.6 Electrostatics

In more simpler language the force of gravitation can be derived through the gaussian gravitational constant \( k \) of a line charge by means of a Coulomb field.

\[ \delta \oint L ds_{col} = (kQ_1 Q_2 r^7)^{1/2} \]  

(17)

Where an electric field is propagated perpendicularly by:

\[ E_\perp = \lambda s \int_{-L/2}^{+L/2} (z^2 + s^2)^{-3/2} dz = \lambda s \frac{1}{s^2} \frac{L}{(L^2 + s^2)^{1/2}} \]  

(18)

or simply

\[ E_\perp = \frac{2\lambda L}{s} (L^2 = 4s^2)^{-1/2} \]  

(19)

with poisson’s equation a general electrostatic potential is given by \( \nabla^2 \phi = -4\pi \rho(r) \) whence by the fundamental theorem of vector fields we have an inverse square relationship

\[ \phi = \int dV \frac{\rho}{R} = \frac{\rho}{R} dxdydz = \int \frac{\lambda dz}{R} \]  

(20)

for simplicity we will look at a charge configuration of the form \( E_r = \frac{\partial \phi}{\partial r} \hat{r} \). We now notice a direct relationship between an electrostatic field line and gravitational acceleration by \( \vec{g} = \frac{\partial \phi}{\partial r} \). Empirically the combination of the two fields would represent a force of the first order

\[ \vec{F}_g = \frac{\partial \phi}{\partial r} \hat{r} + \frac{\partial \phi}{\partial r} \hat{r} = \sum \frac{\partial^2 \phi^2}{\partial^2 r^2} r^2 = \int \frac{Gm_1 + m_2 r}{r^2} = \sqrt{kQ_1 Q_2(\vec{r})}. \]  

(21)
From here it can be seen that a (neutral) static charge configuration can yield gravitational acceleration.

\[ g_{ij} = -\frac{\partial^2 \phi}{\partial^2 x_{ij}} = -\phi_{ij} \]  

(22)

Such that it is now seen that relative acceleration of two particles can be given in pseudo Levi-Civita coordinates

\[ \frac{d^4 x_{ij}}{dt^4} = \Delta g_{ij} = -\phi_{ijkl} \eta^{kl}. \]  

(23)

Where a generalized pseudo Riemannian field is produced

\[ R^e_{abcd} = \frac{1}{2} g_{cd} R^{pq}_{epra} = -8\pi GT_{abcd} \]  

(24)

which reduces to directly to the Einstein Field Equation (12).

2 superposition

Equation (22) can be represented by an operator of the form \( i\hbar \) such that

\[ -\phi_{ij} = \frac{h}{i} \frac{\partial^2 \phi}{\partial^2 x_{ij}} + H\psi \]  

(25)

with Schrödinger’s equation one has

\[ i\hbar = \frac{\partial \psi}{\partial t} = -\frac{h^2}{2m} \left( \frac{\partial^2 \phi}{\partial x_{ij}} + \frac{\partial^2 \varphi}{\partial x_{ij}} \right) \]  

(26)

from the Laplacian \( \nabla^2 a \) we note this represents the original field, and which yields two gradients in spherical coordinates of the form

\[ \nabla a = \frac{\partial a}{r} + \frac{1}{r} \frac{\partial a}{\partial \theta} + \frac{1}{r \sin \theta} \frac{\partial a}{\partial \phi} \]

Which gives rise to electrostatic configurations and gravitational acceleration. Which naturally lends itself to the Schwartzschild solution when the fields are given in the first order approximation in the classical field

\[ ds^2 = (1 - 2\varphi)dt^2 - \frac{dr^2}{(1 - 2\varphi)} - r^2d\theta^2 - r^2 \sin^2 \theta d\phi^2. \]  

(27)

The gravitational and electrical fields in equation (26) can be related more clearly through superposition. This also means that the field equations (24) are really superposition fields.

A superposition of electric and gravitational fields can be given through \( \psi(x) = \psi_\phi(x_s) + \psi_\varphi(x_s) \), with Huygens principle yields:

\[ \psi(x) \sim \int_\phi \frac{\exp[2\pi i(x - x_s)/\lambda]}{|x - x_s|} \psi_\phi(x_s) dx_s + \int_\varphi \frac{\exp[2\pi i(x - x_s)/\lambda]}{|x - x_s|} \psi_\varphi(x_s) dx_s. \]  

(28)
Where through quantum mechanics an interference between the two fields arises from the probability
\[ P(x) = |\psi_\phi(x)\psi_\psi(x)|^2 = P_\phi(x) + P_\psi(x) + \psi_\phi^*(x)\psi_\psi(x) + \psi_\psi^*(x)\psi_\phi(x) \]  
(29)
thus equation [24] may be reevaluated in the form:
\[ g_i = -\frac{\partial \psi(x)}{\partial x_i} = -\psi(x)_i \]  
(30)
lending
\[ \frac{d^2 x^i}{dt^2} = -\Delta g_i = -\psi(x)_{ij} \eta^j \]  
(31)

2.1 empirical equations

From the above the empirical gravitational field that translates is
\[ R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = \frac{8\pi G}{c^4} T_{\mu\nu} + \frac{8\pi k_e a}{m^2} T_{\mu\nu}^{CC} \]  
(32)
or
\[ R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = \frac{8\pi G}{c^4} T_{\mu\nu}^{\psi} \]  
(33)

Since this field describes a quantum superposition, imaginary coordinates are required lending:
\[ ^* R_{abcd} - \frac{1}{4} \epsilon_{ab}^p \epsilon_{cd}^r R_{pgra} = i \left\{ \frac{8\pi G}{c^4} [T_{abcd}^{M} + T_{abcd}^{EM}(Q_1) + T_{abcd}^{EM}(Q_2)] \right\} \hbar \]  
(34)

Of course this would correspond to a complex spacetime
\[ \phi(x, y, z, t) = \int_{-\pi}^{\pi} F(x \cos \theta + y \sin \theta + i z, y + i z \sin \theta + \cos \theta, \theta) d\theta \]  
(35)

Maintaining the Minkowski metric, the background manifold \( \mathcal{M} \) one has
\[ (\omega, z^2) = \omega c t^2 - (\omega) z_1^2 - (\omega) z_2^2 - (\omega) z_3^2 \]  
(36)

Without the superposition of the mass-energy tensor, the vacuum field equation becomes:
\[ R_{\mu} - \frac{1}{2} g_{\mu} R = \frac{8\pi k_e}{c^2} T_{\mu\nu}^{EM}(Q_1) + T_{\mu\nu}^{EM}(Q_2). \]  
(37)

From equation (25) it is seen that a quantum interpretation must be given to \( G \). With electrodynamics in mind one might consider a form which pertains to the fine structure constant
\[ \alpha_e = \frac{2\pi e^2}{\hbar c} \rightarrow \alpha_g = -\frac{14\pi G m^2}{\hbar c}. \]  
(38)

This interpretation can be made when one takes the Weyl tensor, and compares it to the mechanical properties of an electromagnetic field:
\[ \frac{\partial T_{\alpha\beta}}{\partial k} - \frac{1}{2} \frac{\partial g_{\alpha\beta}}{\partial x_i} T^{\alpha\beta} = 0. \]  
(39)

As suggested in the beginning of this work the above field is implicitly implied by the second law of motion.
3 expanding KK-space

On taking Klein’s method of compactification one begins with a tensor of order 6:

\[ g^{(5)}_{IJ} = \left( g^{(4)}_{\mu\nu} + \nabla A_\mu A_\nu \right) \right) \]

From equation (36) and with an earlier work \[7\], I choose to write a Minkowski metric of form:

\[ |(\omega, z)|^2 = (\phi) c \wedge z_1 - \omega z_3^2 - \omega z_4^2 - \omega z_5^2 \]

\[ = (41) \]

which is representative of a fractal spacetime of the form 4 \( \wedge \phi^2 \). In tensorial terms leads to

\[ \hat{M} = \begin{pmatrix} i & 0 & 0 & -1 \\ 0 & -i & 1 & 0 \\ 0 & -i & i & 0 \\ -i & 0 & 0 & -i \end{pmatrix} \]

\[ \Rightarrow M = \begin{pmatrix} 1 & -1 & 1 & -1 \\ -1 & -1 & 1 & 1 \\ -1 & -1 & -1 & 1 \\ -1 & -1 & 1 & 1 \end{pmatrix} \]

such that the interpretation then transverses to:

\[ M^{diag} = \begin{pmatrix} 2 & 0 & 0 & 0 \\ 0 & -2 & 0 & 0 \\ 0 & 0 & 2i & 0 \\ 0 & 0 & 0 & -2i \end{pmatrix} \]

\[ \wedge \hat{M}^{(4)} = \begin{pmatrix} 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & -2i & 0 \\ 0 & 0 & 0 & 2i \end{pmatrix} \]

Here the time dimension is given statute through quaternion rotations in \( C^* \) space. The superposition of electromagnetism and gravitation can be seen within a relativistic frame in accordance with \( \hat{\eta}_{IK} = diag(-2, 2i, -2i) \), in the fifth coordinate this corresponds to \( \eta^{(5)}_{IK} = diag(-1, -1, -1, -1, -1) \). In essence \((44)\) is a combination of two metrics, a similar metric was inferred in Ref. \[11\] in relation to quantum gravity:

\[ d\tau^2 = \frac{a}{r} dt^2 + \frac{a}{r} dr^2 - dx_1^2 - dx_2^2 \]

Through some work made by Weyl \[8\] one can write a solution to EFE which corresponds to

\[ R^k_i - \frac{1}{2} g^k_i R = -\frac{1}{2} \nabla \psi^k_i \ldots \]

which can be reduced for convenience as \( \frac{1}{2} \nabla \psi^k_i = -T^k_i \). Furthermore this action can be represented with advanced and retarded potentials. When one conveniently exchanges the \( \psi \) term from equation \(28\), one is left with the potentials

\[ \psi^k_i(x)_- = -\int \frac{T^k_i(t - r)}{2\pi r} dV \quad \text{and} \quad \psi^k_i(x)_+ = -\int \frac{T^k_i(t + r)}{2\pi r} dV \]

Therefore meaning that the superposition of the field is made possible through an advanced wave. Thus one has the compactification of a Fourier series of form

\[ g_{IK} = \sum_n g^{(n)}_{IK}(x^\mu)e^{inx^5/\lambda_5} \]

such that the interpretation then transverses to:

\[ \hat{M} = \begin{pmatrix} i & 0 & 0 & -1 \\ 0 & -i & 1 & 0 \\ 0 & -i & i & 0 \\ -i & 0 & 0 & -i \end{pmatrix} \]

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Therefore meaning that the superposition of the field is made possible through an advanced wave. Thus one has the compactification of a Fourier series of form

\[ g_{IK} = \sum_n g^{(n)}_{IK}(x^\mu)e^{inx^5/\lambda_5} \]
Which under compactification yields
\[
\psi(x, x^5) = \frac{1}{\sqrt{L_p}} \sum_{n \in \mathbb{Z}} \psi_n(o, x)e^{inx^5/R_5}
\] (49)

where \(o\) represents quarternions. The advanced Fourier sine wave is:
\[
\psi(x, x^5) = \sqrt{\frac{2}{\pi}} \int_{0}^{\infty} f(o, x) \sin dxdt
\] (50)

which undergoes the quantum transform
\[
\Psi(o, k, t) = \frac{1}{\hbar} \Phi(o, k, t)e^{ik\omega}dk \quad \text{and,} \quad \Phi(o, k, t) = \frac{1}{\hbar} \Psi(o, k, t)e^{ik\omega}dk.
\] (51)

This action creates a cascade motion within the fifth coordinate and resulting in torsion within four-dimensional spacetime. Torsion would appear to be in form of gravitational waves through the action
\[
(D^\mu D_\mu - \frac{n^2}{R_5^2}) \psi_n = 0.
\] (52)

Thus it is seen that an observation will only occur in a quantum system if two anti-symmetric \(\eta^{(5)}_{ij}\) tensors come in contact (which one might expect from the Weyl tensor). This wave equation suggest KK-space expands into four-dimensions, resulting in self interaction. Furthermore when one compares the charge \(q_n = n(k/R_5)\) with the planck length, one sees the relation with the fine structure constant.
\[
R_5 = \frac{2}{\sqrt{\alpha}L_p}
\] (53)

From equation (53), from this it may be seen that the second law produces fine structure which in turn yields the planck length.

4 gauge backgrounds

The gravitational force is a collection of interacting forces connected in some form by the second law (e.g., the fine structure constant). When one separates the properties of a given force from the Einstein equations, its fundamental principle break resulting in only a weak equivalence principles (which can be interpreted as a gravitational pressure). Thus lending a manifold who’s properties depend on the pressures applied to it by external factors. By the methods implied thus far it makes sense to make use of the semi-classical approach to gravitation
\[
G_{\mu\nu}(\gamma) = \langle \psi|T_{\mu\nu}(g, \phi)|\psi >.
\]

To begin let us apply a gauge field of form
\[
-k(F_{\nu}^{\mu} - \frac{1}{2}g_{\mu\nu}A_{\psi}^{\mu}F_{\psi}) \neq 0
\] (54)

which resembles a convection made seventy year ago by Einstein \cite{Einstein}:
\[
G^{\mu\nu} - F^{\mu\nu} + \Lambda_\mu^\sigma F_{\sigma\tau} \equiv 0.
\] (55)
Thus it may be viewed that the above equation is the solution for flat spacetime which implies that the canonical approach $\gamma_{\alpha \beta}(x) = \eta_{\alpha \beta} + k h_{\alpha \beta}(x)$ should be utilized. Such that the gauge field equation becomes:

$$- k (F^\mu_\nu - \frac{1}{2} F^\nu_\mu(x) + A^\mu_\alpha F^\alpha_\nu) \geq i \hbar \frac{\partial \psi}{\partial t} \left\{ \frac{8 \pi}{\sqrt{-g}} T^\mu_\nu \psi(x) \right\}$$  \hspace{1cm} (56)$$

where

$$i \hbar \frac{\partial \psi}{\partial t} = \frac{1}{2m} (\dot{p} - eA)^2 + eV \psi.$$  \hspace{1cm} (57)$$

From this it is seen that the right of the equation is governed by the laws of quantum mechanics giving a pseudo unification through means of a complex gauge field. Meaning that the fifth coordinate is false, however through complex fields, torsion becomes an integral part of both sides of the gauge inequality. The stress-energy tensor can have torsion along with electromagnetic field through the classical connection

$$T_{\mu \nu} = (Qc^2 + p)u_\mu u_\nu + pg_{\mu \nu} + \frac{1}{c^2} (F_{\mu \alpha} F^\alpha_\nu + \frac{1}{4} g_{\mu \nu} F^{\alpha \beta} F_{\alpha \beta}).$$  \hspace{1cm} (58)$$

Where torsion is given through $S_{\mu \nu \sigma} = \psi_{[\mu \nu \sigma]}$, implying the inequality has torsion in flat spacetime; where one may utilize the action principle \[10\]:

$$\delta \int \sqrt{-g} d^4x \left( \frac{R}{k} + L \right) = 0.$$  \hspace{1cm} (59)$$

Therefore a pseudo superposition can take place within flat spacetime, explaining the relationship between Newtonian gravitation and electrostatic potentials in previous sections.

### 5 vacuum energy and geodesics

From the Dirac field $i \hbar \frac{\partial \psi}{\partial t}$, matter would act as a void within the QED vacuum. This would thus cause the virtual energy $\frac{1}{2} \hbar \omega$ of the quantum vacuum, to adapt a negative energy term. This process would then act to collapse the space around it, in the presence of $n \geq 1$ ‘false vacuum’ mass acts on the fields to adopt a **negative energy requirement**, which violates the weak energy condition (WEC) $T_{\mu \nu} V^\mu V^\nu \geq 0$. Here we take this to mean a cosmological constant, such that the gauge inequality (56) becomes:

$$- k (F^\mu_\nu - \frac{1}{2} F^\nu_\mu(x) + A^\mu_\alpha F^\alpha_\nu) + \lambda \geq i \hbar \frac{\partial \psi}{\partial t} \left\{ \frac{8 \pi}{\sqrt{-g}} T^\mu_\nu \psi(x) \right\}$$  \hspace{1cm} (60)$$

The cosmological constant can be given through $\Lambda = -\frac{1}{16\pi} F^{\mu \nu} F_{\mu \nu}$, so that the inequality suggest that $\Delta x^\mu \Delta x^\nu \geq \frac{1}{2} \Lambda g^{\mu \nu}$. From this we may conclude that there exist an uncertainty within the field. This is impart because the vacuum can be described through:

$$R_{\mu \nu} - \frac{1}{2} g_{\mu \nu} R = - \Lambda g_{\mu \nu}$$  \hspace{1cm} (61)$$
we can also see that this formalism closely resembles (46), i.e. Weyl’s definition. Which suggest electrostatic energy is lost through the uncertainty which exist through the pseudo geometry and vacuum. With

\[ F^\mu\nu = \frac{\partial A^\nu}{\partial x_\mu} - \frac{\partial A^\mu}{\partial x_\nu}, \]  

(62)

the geodesic for the vacuum becomes

\[ \frac{\partial^2 A^\nu}{\partial S^2} + \Gamma^\nu_\mu_\lambda \left( \frac{\partial x_\mu}{\partial S} \right) \left( \frac{\partial x_\lambda}{\partial S} \right) = - \frac{e}{mc^2} A^\mu x^\mu, \]

(63)

we note that under this pseudo connection the Gamma term appears to be under torsion, through an action of \( \Gamma_a^b = d\Lambda_b^a + \Lambda^c_a \Lambda^b_c \). Thus (62) would appear to take the form:

\[ F^\nu_\mu = \frac{\partial A^\nu}{\partial x_\mu} - \frac{\partial A^\mu}{\partial x_\nu}, \]

(64)

such a geodesic path is remarkably similar to a sphere geodesic of an electron traveling through gravitational and magnetic fields

\[ \frac{d^2 x^\mu}{ds^2} + \Gamma_\alpha^\mu \frac{dx^\alpha}{ds} \frac{dx^\beta}{ds} = \frac{q}{mc^2} F^\alpha_\mu \frac{dx^\alpha}{ds}. \]

(65)

However, the accepted geodesic for an electromagnetic field is that of

\[ mc \left( \frac{\partial u^i}{\partial S} + \Gamma_k^i \frac{u^k}{u^l} \right) = \frac{e}{c} F^{lk} u_k, \]

(66)

From the above equation, it can be seen that at least empirically the vacuum electrostatic potential (the true vacuum) is responsible for curvature of spacetime. If one were to block the vacuum energy as in the case of the Casimir effect, it will create an inequality within the pseudo geometry resulting in a gravitational pressure. Therefore so to speak, a matter Lagrangian (false vacuum) shields (true) vacuum (zero-point-field) energy, thus resulting in negative energy, which may be interpreted through the Weyl tensor as torsion. Specifically the interaction in time produced by the pseudo Kaluza-Klien space produces the relationship between the vacuum states by \([21]\):

\[ \phi_{\text{out}}(k, \eta) = \alpha \phi^+ + \beta \phi^- \]

(67)

thus acting as the advanced and retarded Fourier series seen in section \((2.1)\). Therefore the Riemannian tensor \( R^\rho_\sigma_\nu_\mu \) contracts via the Levi-Civita connection to conserve the vacuum term, resulting in symmetric Ricci spacetime curvature, along with an antisymmetric Weyl torsion.

### 6 EM vacuum and the Weyl tensor

If one takes the coefficients of the Cosmological Constant and the Weyl tensor one has the antisymmetric field \( C^\rho_\sigma_\nu_\mu F^\mu_\nu \) (note: for simplicity the contravariant term \( F^\mu_\nu \), will be removed, it will be reinstated in \((79)\))\(^2\) Which has

\[^2\text{It is exactly from this action that we see the gauge condition envisioned by Einstein [4].}\]

appear in a more coherent form.
the following form:

\[ C_{[\rho\sigma]} F_{\mu\nu} = C_{[\rho\sigma]\mu} F_{\mu\nu} = C_{[\rho\sigma][\mu\nu]} F^{\mu\nu} F_{\mu\nu} \]  

\[ = C F_{\mu\nu} = C_{\mu}^{\rho\sigma} F_{\mu\nu} = C_{\rho\sigma}^{\mu} F^{\mu\nu} F_{\mu\nu} \]  

\[ = C_{\rho\sigma} F^{\mu\nu} F_{\mu\nu} \]  

\[ C_{[\rho\sigma\mu\nu]} = 0 \]  

(68)

(69)

(70)

(71)

from this it may be seen that the Weyl tensor is an electromagnetic version of GR.

One may now apply a Jacobi identity in order to form a pseudo Bianchi Identity of the form \( C_{\alpha\beta[\mu\nu;\lambda]} = 0 \). Which can be reduced to

\[ \nabla_\lambda C_{\alpha\beta\mu\nu} + \nabla_\nu C_{\alpha\beta\lambda\mu} + \nabla_\mu C_{\alpha\beta\lambda\nu} = 0 \]  

(72)

where we can contract with \( F_{\alpha\mu} \)

\[ \nabla_\lambda C_{\beta\nu} - \nabla_\nu C_{\beta\lambda} + \nabla_\mu C_{\beta\mu\lambda} = 0 \]  

(73)

which can be contracted further with \( F^{\beta\lambda} \)

\[ \nabla_\lambda C_{\beta\nu}^{\lambda} - \nabla_\nu C_{\beta\lambda}^{\mu} + \nabla_\mu C_{\beta\nu}^{\mu} = 0 \]  

(74)

or

\[ \nabla_\mu (C_{\mu\nu} - \frac{1}{4} F_{\mu\nu} C) = 0 \]  

(75)

From this we may conclude that a similar transformation will be made with the antisymmetric covariant term \( C_{\rho\sigma} \). When we restore the field with equation (70), we have the following field equation:

\[ C_{[\rho\sigma]} - \frac{1}{4} F_{\mu\nu} + A_{\alpha}^{\mu} C = -\Lambda g_{\mu\nu} \]  

(76)

where the gauge term is assumed to be an Ansatz \( A_{\alpha}^{\mu} = \eta_{\alpha}^{\mu\nu} \partial^\nu \ln \phi(x) \), thus equation (66) is only an approximation of the above field. To obtain field density one is left with

\[ F_{\alpha}^{\mu\nu} = -\frac{(x^2 + \rho^2)^2}{4\rho^2 \eta_{\alpha}^{\mu\nu}} \]  

(77)

which is similar to an antisymmetric gauge for a Yang-Mills field see Ref. [13]:

\[ S_{YM} = -\frac{1}{4} \int d^4 x F_{\mu\nu}^{\alpha} \star F^{\alpha\mu\nu} \]  

(78)

We recall from section (3) that an observation of a gravitational field will only occur when two antisymmetric tensor come in contact. Thus it is precisely the below field equation which bridges the gap between quantum theory and GR.

\[ \left[ C_{\alpha\beta} - \frac{1}{4} \tilde{F}_{\alpha\beta} + A_{\alpha}^{\alpha\beta} C \right]_{\beta} = 0 \]  

(79)

The gauge potential \( A_{\alpha}^{\mu} \) represents the second component of the cosmological term \( F^{\mu\nu} \) under torsion. So that with (77), we have

\[ \left[ C_{\alpha\beta} - \frac{1}{4} - \frac{4\rho^2 \eta_{\alpha\beta}}{(x^2 + \rho^2)^2} - \frac{(x^2 + \rho^2)^2}{4\rho^2 \eta_{\alpha\beta}} C \right]_{\beta} = 0 \]  

(80)
which reduces to

\[ C_{\alpha\beta} - \frac{1}{4} g_{\alpha\beta} + 2C = 0 \tag{81} \]

this solution is parallel to the Einstein field equation, when considering antisymmetric scalar curvatures.

Thus it is seen that the cosmological constant is the source of torsion in the antisymmetric Weyl tensor. In essence the false electromagnetic vacuum is responsible for gravitation within the Weyl-tensor. Our new variable action is a Weyl-Hilbert action:

\[ S_{WH} = \delta \int \sqrt{-g} d^4x \left( \frac{(R + 2\Lambda)}{16\pi G} + \mathcal{L}_M + \mathcal{L}_{YM} \right) = 0 \tag{82} \]

resulting in an uncertainty of the form \( \Delta x^\mu \Delta x^\nu = \frac{1}{2} |\theta^{\mu\nu}| \) (note: such an empirical uncertainty was given in section 5). Which suggest that the Weyl tensor should be given within a complex gauge field. Such that the Weyl-Hilbert action transforms to a Complex-Hilbert action of form:

\[ S_{CH} = \sqrt{-g} d^4x \left( \frac{(C + 2\Lambda)}{8\pi G} + \mathcal{L}_M \right) + i \sqrt{-g} d^4x \left( \frac{(\mathcal{L}_{YM} + 2\Lambda)}{8\pi G} + \mathcal{L}_M \right) \neq 0 \tag{83} \]

This was suggested in section 2.1, meaning within a quantum frame the electromagnetic and gravitational properties of the Weyl tensor may interact through a weak superposition. However, we also note from section 4 a complex solution is only empirical, thus (83) is only a pseudo action.

**6.1 gravitational Lagrangians**

Let us form a Lagrangian for the vacuum solution \(-\Lambda g_{\mu\nu}\). In order to describe such an action principle we will start with the GR Lagrangian for matter in the form:

\[ S_M = \int \sqrt{-g} d^4x (g^{\mu\nu} \partial_\mu \phi \partial_\nu \phi + ...) \tag{84} \]

from our approach thus far we would like to consider perturbations from the vacuum such that:

\[ \delta_{\text{metric}}S_{EM} = -\int \sqrt{-g} d^4x \Lambda g_{\alpha\beta} \delta F^{\alpha\beta} \tag{85} \]

which can simply be given by

\[ \Lambda g_{\alpha\beta} := \frac{1}{\sqrt{g}} \frac{\delta}{\delta F^{\alpha\beta}} S_{EM}. \tag{86} \]

From section 3 we now make the modification

\[ \Lambda g_{\alpha\beta} := \frac{1}{\sqrt{-g}} \frac{\delta \mathcal{L}_{EH}}{\delta F^{\alpha\beta}} S_{WH} = ([C_{\rho\sigma} - \frac{1}{4} g_{\alpha\beta} + 2C]_{\rho\sigma}). \tag{87} \]

It is seen from this Lagrangian that the cosmological constant in the EFE, is in fact an electromagnetic Weyl tensor.
On taking the conditions $T_{\mu\nu}(x) = 0 \Rightarrow R_{\mu\nu\rho\sigma} = C_{\mu\nu\rho\sigma}(x)$, in the absence of a matter Lagrangian torsion is carried by the symmetric Weyl tensor or generated from the electromagnetic vacuum $-\Lambda_{G\mu\nu}$. Resulting in an uncertainty of the form $\Delta x^\mu \Delta x^\nu = \frac{1}{2} \left| g^{\mu\nu} h^a_{\mu} \partial_{\nu} h^a_\mu \right|$. With this one has torsion resulting in a teleparallel description of gravitation in flat spacetime. Thus the cosmological constant is a perturbation within the curvature connection made possible through virtual particles (i.e. the false vacuum).

6.2 teleparallel geometry

The Cartan torsion connection is given by:

$$T^\sigma_{\mu\nu} = \Gamma^\sigma_{\nu\mu} - \Gamma^\sigma_{\mu\nu},$$

with tetrad form

$$\Gamma^\rho_{\mu\nu} = h_a^\rho \partial_\nu h_a^{\mu}$$

Thus the vacuum-energy tensor has torsion of the order

$$- \Lambda G_\alpha^\beta = h_a^\beta \left( \frac{1}{\sqrt{-g}} \frac{\delta L_{EH}}{\delta h_a^\alpha} \right)$$

Hence the gravitational field equation from Weyl torsion is seen through

$$\left[ C_{\alpha\beta} - \frac{1}{4} g_{\alpha\beta} + 2C \right]_{,\beta} = -\Lambda G_\alpha^\beta$$

Thus the Weyl torsion tensor within GR can be given through the metric

$$g_{\alpha} = \eta_{\alpha\beta} + \lambda G_\alpha^\beta$$

such that within the EFE the Cosmological Constant takes the form

$$R_{\alpha\beta} - \frac{1}{2} g_{\alpha\beta} R = -8\pi G T_{\alpha\beta} + \lambda g_{\alpha}$$

It is known that the electromagnetic field and the stress-energy tensor can feel torsion through the action

$$T_{\mu\nu} = -\frac{2}{\sqrt{-g}} \frac{\delta L_{EM}}{\delta g^{\mu\nu}} = \frac{1}{4} \left[ F_\mu^\rho F_{\mu\rho} - \frac{1}{4} g_{\mu\rho} F_{\rho\sigma} F^{\rho\sigma} \right]$$

Therefore the torsion of $G_{\alpha}$ can be carried not only through the stress energy tensor but onto $G$ itself.

Covariant Maxwell’s potentials can be given through torsion by

$$F^* := -\omega_\nu \wedge \theta^\nu = A_\nu^\mu \wedge \omega_\mu \wedge \omega^\mu$$

with current potentials

$$J^* := dF^* = d\theta^\mu \wedge \omega_\mu - \theta^\mu \wedge d\omega_\mu$$

The Weyl tensor can represent such a current through

$$\nabla^\mu C_{\mu\nu\rho\sigma} = J_{\nu\rho\sigma}$$
with

\[ J_{\nu\sigma} = k \frac{n-3}{n-2} \left[ \nabla_\rho T_{\nu\sigma} - \nabla_\sigma T_{\nu\rho} - \frac{1}{n-1} \left[ \nabla_\rho T^\lambda_{\nu\sigma} - \nabla_\sigma T^\lambda_{\nu\rho} \right] \right] \]  

(98)

Thus it is seen that the uncertainty by the relation \( \Delta x^\mu \Delta x^\nu \geq \frac{1}{2} |\theta^{\mu\nu}| \) causes the Weyl tensor to carry a cosmological charge current. Thereby the final form of the Weyl gravitational field is

\[ [C_{\alpha\beta} - \frac{1}{4} g_{\alpha\beta} + 2C]_{;\beta} = -J_\beta \Lambda^\alpha \]  

(99)

The right side of the above equation can be written in the form \( -J_\beta \Lambda^\alpha \). From our pseudo Weyl Curvature (75), the relationship between charges is given by:

\[
\nabla^\mu C_{\mu\nu} + [\nabla_\rho T_{\nu\sigma} - \nabla_\sigma T_{\nu\rho} \ldots] \equiv J_{\nu[\rho\sigma]} \rightarrow \\
\nabla^\mu F_{\mu\nu[\rho\sigma]} = J_\nu - [\nabla_\rho T_{\nu\sigma} - \nabla_\sigma T_{\nu\rho} \ldots] 
\]

(100)

(101)

This approximation can be given through:

\[
F_{\mu\nu} = \frac{\partial \Phi_\nu}{\partial x^\mu} - \frac{\partial \Phi_\mu}{\partial x^\nu} + C_{\mu\nu}^\alpha \Phi_\alpha \Phi_\beta
\]

(102)

which is made possible through a Ricci symmetric tensor of form

\[
\frac{\partial \Lambda^\nu_\mu}{\partial x^{\nu'}} = \eta_{\nu\nu'} \Phi_\nu \Lambda^\sigma_\mu
\]

(103)

which in a constant field is given by \( R_{\mu\nu} = \Lambda^\sigma_\mu F_{\sigma\nu} \), such a field can transpose to the relation

\[
F_{\mu\nu} = \partial_\mu \Phi_\nu - \partial_\nu \Phi_\mu
\]

(104)

such a field describes two opposed electromagnetic fields through the connection \( \Gamma_{\mu\nu} = \Lambda^\sigma_\mu \Phi_\nu \). Which has the geodesic relation

\[
\frac{d^2 x^\mu}{ds^2} + \left( \Phi_\sigma \frac{dx^\sigma}{ds} \right) \Lambda^\mu_\nu \frac{dx^\nu}{ds} = 0
\]

(105)

the above geodesic also has the form

\[
\Phi_\sigma \frac{\partial \Lambda^\nu_\mu}{\partial x^{\nu'}} = C_{\nu\nu'}^\alpha \Phi_\alpha \Phi_\beta \Lambda^\sigma_\mu
\]

(106)

this term is thus antisymmetric and yields

\[
R_{\mu\nu} = \left( \frac{\partial \Phi_\nu}{\partial x^\sigma} - \frac{\partial \Phi_\sigma}{\partial x^\nu} + C_{\nu\nu'}^\alpha \Phi_\alpha \Phi_\beta \right) \Lambda^\sigma_\mu = F_{\sigma\nu} \Lambda^\sigma_\mu
\]

(107)

One should also note that a four vector line element under this prescription is given by

\[
u_q = \frac{\Phi_{\sigma}}{\sqrt{\Phi_\sigma \Phi_\tau}}
\]

(108)

Finally a likewise connection is given through

\[
C_{\rho\sigma\mu\nu} = R_{\rho\sigma\mu\nu} - \left( \frac{2}{(n-2)} g_{\rho[\mu} R_{\nu]\sigma} - g_{\sigma[\mu} R_{\nu]\rho} \right) + \frac{2}{(n-1)(n-2)} R g_{\rho[\mu} g_{\nu]\sigma}
\]

(109)
Thus allowing a metric to remain conformally invariant through the rescaling operation $g_{\mu\nu}(x) \rightarrow e^{f(x)}g_{\mu\nu}(x)$. This would make the torsion term appear to disappear within classical GR by means of Ricci curvature, or through the Einstein-Hilbert action $S = \int \sqrt{g}dx^4 R$. However, the cosmological charge current term would still remain connected to the stress-energy tensor. This result may be obtained through the Tucker-Wang action

$$S = \int \lambda^2 R \star 1$$

(110)

where $R \star 1 = R^a_b \wedge (e^a \wedge e^b)$, is a scalar torsion corresponding to $T^a = de^a \Lambda^{a}_b \wedge e^b$. With this one can have an action principle which resembles a Brans-Dicke space by:

$$S = \delta \int \lambda^2 \left( \frac{R \star 1}{16\pi G} + \mathcal{L}_M \right) = 0$$

(111)

Thus we have a action corresponding to a Cosmological Constant, without $\Lambda$. This is made possible because we have been considering a Weyl action, empirically given by:

$$S_W = -\alpha \int C_{\lambda\mu\nu} C^{\lambda\mu\nu} \sqrt{-g}dx^4.$$ 

(112)

Since the Cosmological coefficient is included in the Weyl tensor we have been considering, it vanishes under a Cosmological model. Therefore the action for Weyl gravitation is not governed by the pseudo action (111), but by (111).

7 The vacuum and the meaning of $G$

An alternative interpretation of mass was assumed by de Broglie by the Einstein-de Broglie equation:

$$\hbar \omega_C = m_0 c^2.$$ 

(113)

This formalism has been restated recently by Haisch and Rueda [14] as a possible explanation for the origin of inertial mass. Where C is given by the Compton wavelength $\lambda_C = \hbar/mc$, thereby asserting the origin of inertia through the Compton wavelength. If we take the equivalence principle by heart then, one must assume that gravitational inertial would arise through a similar action. From Einstein-Cartan geometry we can assume that this field would be given through torsion. Specifically we will assume an equivalence of order $\Lambda = 2\pi G^{-1}$ (see [A] for details), this is validated by the quantization $\lambda_C/2\pi$. From this we see that $G$ is the inverse charge of an electron’s Compton wavelength.

In terms of EFE we have

$$R_{\alpha\beta} - \frac{1}{2}g_{\alpha\beta}R = -\frac{8\pi \langle G_Q \rangle}{c^2} T_{\alpha\beta} + \langle \lambda_Q \rangle \mathcal{G}_\alpha$$

(114)

in essence it appears that this is simply a post Einsteinian semi-classical correction to the field equations (with teleparallel Weyl torsion acting as a gauge background).

From our supposed relation, one would have an identity of form $\lambda G = I$. Therefore the above relation transverses to

$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R + \lambda - G = -8\pi IT_{\mu\nu}$$

(115)
Let us now suppose that the identity is equivalent to the de Broglie wavelength $I = \hbar/p$. Thus:

$$\langle G_Q \rangle \equiv \frac{\hbar}{p} = \frac{\lambda_d}{\lambda_C}$$

(116)

where $\lambda_d$ is the de Broglie wavelength given by $\lambda_d = \hbar/p$. From Compton scattering we may assume that gravitational waves can pass through particles as though they were a wave. When we view the geodesic (166), one may rewrite the identity in eq. (117), such that $I = 1/\sqrt{g_{kk}}$. This results from a geodesic of order [17]:

$$\frac{1}{\sqrt{g_{kk}}} \left[ \frac{\partial^2 u^i}{\partial S^2} + \Gamma_{kl}^i \left( \frac{\partial x^k}{\partial S} \right) \left( \frac{\partial x^l}{\partial S} \right) \right] = \frac{e}{mc^2} F^{ik}$$

(117)

thus it is viewed from this that the term $e/mc^2$ is nearly a classical approximation of the Compton wavelength $\lambda_C = h/mc$. We see this when we compare the energy sources to that of the classical fine structure constant

$$\sigma_{\text{rad}} \sim Z^2 \left( \frac{e^2}{m_0 c^2} \right)^2 \text{cm}^2/\text{nucules}$$

(118)

which is given by an electron's radius $r = e^2/m_0 c^2 = 2.818 \times 10^{-13}\text{cm}$. Where through the quantum correction one has $2\pi e^2/hc = \frac{1}{137}$. Further the inversion by the Cosmological Constant [3] yields the Gravitational Constant through the identity $1/\sqrt{g_{kk}}$, or specifically through the geodesic coordinate $u_k = \partial S/\partial x^k$.

Thus it is seen that the gravitational constant, fine structure, and the second law of motion appear to arrive from quantum charges!

7.1 standing waves and the fifth coordinate

We note that a superposition of a sinusoidal wave yields a standing wave of the form $p = 2a \sin(2\pi x/\lambda) \cos(2\pi vt/\lambda)$. With this the standing wave of the gravitational constant would be given through:

$$p_G - \lambda_0 = 2a \cos(2\pi vt/\lambda_d) \sin(2\pi x/\lambda_C) = \cot \frac{a vt \lambda_d}{x \lambda_C}$$

Thus G is the inverse ratio between the superposition of de Broglie and Compton wavelengths. This standing wave can be seen as potential barrier, which results in the interaction of advanced and retarded potentials. This action results in the violation of the WEC, i.e. results in a false vacuum and Weyl gravitation.

3 This prescription of the Cosmological Constant as the Compton wavelength $\lambda_C$, may have bearing on modern cosmological theories. For example it has been proposed by recent observations from type IA supernova, there may be something causing the universe to accelerate its expansion. Under this scenario, the Universe would be coasting from the initial 'big bang,' however through a cosmological Compton scattering this effect would appear to increase, thus giving the allusion of an 'accelerating' universe.

4 The idea of a quantum connection to the Gravitational Constant and the Cosmological constant is not new idea, and neither is a superposition relation see Ref. [2].

5 An alternative to this interpretation arises through Quantum Mechanics, from SR an electromagnetic field at k reading locally as electric may read as a magnetic field in the frame k'. Through the action of the Weyl tensor the electric and magnetic terms may become superimposed, thus initially one has a superposition of form $\psi(x) = E(x) + H(x)$, which doesn’t take on its SR form until the wave function has been canceled.
From this we understand that a gravitational constant is an inverse charge of a particle's Compton wavelength. Meaning that each particle has its own local isotropic gravitational field, which is induced by mass and acceleration. This also leads to a startling corollary under relativistic velocities the charge of spacetime $Q$ would be altered. In such a situation the Compton charge would be altered by

$$\mathcal{L} = mc^2 \sqrt{1 - \frac{v^2}{c^2}} - m\Phi - q\Phi E + q\vec{v}\vec{A},$$

causing an inverse relation in the $G$ (the consequences of such an effect is briefly mentioned in [3]). Since the electromagnetic force has an inverse relationship squared to infinity, thus is the gravitational field. Forces such as the Yang-Mills field are confined within the Coloumb barrier, thus allowing the gravitational field at a first approximation to adopt the Newton's Gravitational constant $G_N$. When compared to classical gravitation one has the field $\nabla \varphi = 4\pi[2a_{\lambda\lambda}^{\mu\nu}]$, from this a four-vector is required, thus gravitation is a charge in spacetime!

Through Ref. [15] we see our prior assumed equivalence with the Compton wavelength pops up again through the five-dimensional action:

$$\Psi(x^\mu, x^5) = \exp \left[ ik \frac{2\pi}{\lambda^C} x^5 \right] \psi(x^\mu)$$

where it is interpreted that the gravitational force arises through torsion. While electromagnetism is derived through the fifth gauge-component of the torsion tensor (which has been shown to be false in previous sections). This is a pseudo complex interpretation produced by [19] and [67], thereby giving the allusion to a ‘fifth-coordinate,’ through a superposition mechanism.

8 discussion

This analysis of a gravitational background space reveals the following subtle quantum aspects of the gravitational field. The dual interpretation of a causal trajectory in the Feynman school, is responsible for the appearance of a pseudo ‘fifth coordinate.’ Thus causing true vacuum energy to translate into false vacuum energy converting the potential virtual energy into kinetic energy. This results in torsion within the background space, which acts to conserve the negative energy created by the false vacuum. Torsion then acts to produce a gravitational metric by means of a quantum charge, where by the equivalence principle the second law becomes valid for a classical body. Secondly torsion alters the de Brogлиe wavelength which causes electrostatic potentials to lower, acting as a relativistic gravitational field.

This analysis showed the importance of the often neglected Weyl component of Riemannian geometry. It is the antisymmetric Weyl tensor acting along with an Einstein-Cartan geometry that is responsible for the gravitational constant. Specifically pertaining to an electron's Compton wavelength for long range gravitation. However, for field of varying charge one would expect the gravitational constant and the cosmological constants to accept different values, thus gravitation in its true form would carry more than the background electromagnetic vacuum, and gravitation would be expected to have ranges limited to there local fields.[6]

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6For example, nuclear fields do not correspond to the inverse square relationship $1/r^2$, thus
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A The Compton wavelength and ‘superluminal’ shifts

The relationship between the gravitational constant $G$, and the Compton wavelength can be seen, when we except the value of $G$ to be of order \[ (122) \]

\[
G = (6.74215 \pm 0.000092) \times 10^{-11} m^3 kg^{-1} s^{-2}.
\]

We can now compare that to the Compton wavelength of an electron given by $\lambda_C = h/m_e c = 2.426 \times 10^{-12} m$. However from field density relationship shown in (80), we are left with the crude relation $\lambda_C = 2\pi G^{-1}$, we must consider the quantized wave form:

\[
\frac{h \cdot \lambda_C}{2\pi} = 386.1592642(28) \times 10^{-15} m \quad (123)
\]

Thus the inverse of $G$ is that of

\[
2\pi G^{-1} = 0.02361 = \lambda_C \times 10^{-1} \quad (124)
\]

Such that it is seen that $2\pi G$ is the inverse of the Compton wavelength. Acceleration will altered the ‘charge’ or Compton wavelength such that gravitational constant(s) would be altered upon relativistic velocities. This could very well explain the propagation of observed superluminal jets emanating from Active Galactic Nuclei (AGN).

Since classically electromagnetic waves propagate via the relation $C = \lambda \nu$, we expect a gravitational shift from

\[
\Delta v \approx v_i(G_o M) \left( \frac{1}{r_i} + \frac{1}{r_f} \right) \quad (125)
\]

thus when viewed parallel to the direction of travel one is left with a blue shift by

\[
C_0 \left( 1 + \frac{\Phi_g}{c^2} \right) = \lambda_0 \left( \nu_0 \left( 1 + \frac{\Phi_g}{c^2} \right) \right) \quad (126)
\]

Where

\[
\Phi_g = -\frac{G Q m_0}{\sqrt{x^2 + (y^2 + z^2)(1 - v^2/c^2)}} \quad (127)
\]

the wavelength would appear to be altered by

\[
\mathcal{L}_\lambda = \lambda' \sqrt{1 - \frac{v^2}{c^2}} \quad (128)
\]

gravitation would be expected to behave fundamentally different here. Since the gravitational force is one of a collective nature, all vacuum field sources should be included within such a potential formalism.

\[ Data on the Compton wavelength comes from [8].]
this is because (126), makes it appear that the wavelength $\lambda$ is increasing while it is really of function of $C_0$ and $\nu_0$. This would appear to yield superluminal travel, such a result is in accordance with [19]. This effect does not seem to be limited to AGN either, a superluminal source was also detected near SN1987A, see [20].

B origin for inertia and mass increase?

From the previous section we have seen that the gravitational constant could be considered as the inverse of the Compton wavelength. From (126), we now may consider an inverse of the quantum energy $E = h\nu$ and the classical wavelength $C = \lambda\nu$:

$$\lambda_d = \frac{E}{C_0 \left(1 + \frac{\Phi_g}{c^2}\right)} = \frac{h\nu_0}{\lambda \left(\nu_0 \left(1 + \frac{\Phi_g}{c^2}\right)\right)} \rightarrow \frac{h}{\lambda \left(\nu_g \left(1 + \frac{\Phi_g}{c^2}\right)\right)} \equiv I$$ (129)

such that acceleration yields a mass increase through the de Borglie relation

$$p_0 \left(1 + \frac{\Phi_g}{c^2}\right) = m\nu_0 = \lambda_C \left(\nu_0 \left(1 + \frac{\Phi_g}{c^2}\right)\right)$$ (130)

thus mass increase is governed by the action seen in (128). This is thus a verification of the equivalence principle, i.e. inertial and gravitational masses are equivalent! From (128) we can now consider a Lagrangian of form:

$$\lambda' = m_0c^2 - q\Phi' + \frac{E}{C_0 \left(1 + \frac{\Phi_g}{c^2}\right)}$$

$$= m_0c^2 - q \frac{\Phi - \frac{E}{C_0 \left(1 + \frac{\Phi_g}{c^2}\right)} - v \cdot A/c}{\sqrt{1 - \frac{v^2}{c^2}}}$$ (131)

this interpretation runs parallel with [12]. However, this work diverges with equation (128), thus it is $\lambda$ which creates observable gravitational effects and not $\nu$. With this in mind one can have an action of

$$\Delta S = \frac{m_0c^2}{h} \sqrt{1 - \frac{v^2}{c^2}} + \frac{\lambda_C}{h} \int \Phi_g dt,$$ (132)

therefore the appearance of inertia only appears for particles with a corresponding Compton wavelength through the action

$$\Delta S = \frac{\lambda_C}{h} \int (\Phi_g - v \cdot A/c).$$ (133)

C gravitation within the QED vacuum

It is known that particles such as the proton have a value of $\lambda_c = h/m_pc = 1.321 \ldots \times 10^{-15} m$, for the Compton wavelength. Meaning that Gravitation is not a force directed by one term, but all terms of vacuum. Thus it maybe seen
that gravitation within an nucleus behaves quite differently than the Newtonian prescription. We assume from elementary data that a ‘nuclear’ gravitational field would be confined to the nucleus, not manifesting its effects in the global sense. However, for the early universe, one may have a spacetime with quite different cosmological constant(s) than the ones observed today, possibly giving new justification for inflation theory. Lastly in comparison to Appendix A, a beam of protons being accelerated from an AGN source would result in another prediction. The proton/electron ‘acceleration’ rates, and for any particle in general is directly proportional to their Compton wavelengths.

D implications for the planck length

It is believed that the planck length $l_p = (G\hbar/c^3)^{1/2}$, is the fundamental cut off point for the gravitational field. Two problems arise with this work 1) the planck length is determined by the Compton wavelength of the mass in question. 2) the gravitational constant and thus the planck length are altered upon acceleration. The first problem is not a problem it is simply a modification required by the theory, and for the large scale universe this result is negligible under a first approximation. The second problem is still a problem, however in an earlier work [7], I modified the planck length with disconcern. However, with that work in mind problem two is easily solved and is given by

$$l_p = (G_C \hbar/m_{p_0} c^3)^{1/2} \cdot \psi.$$  \hspace{1cm} (134)

Where $G_C$ is the gravitational constant given by the Compton wavelength, for an electron this becomes Newton’s gravitational constant $G_N$. And $m_{p_0}$ is the rest momentum of the mass in question, which is given by

$$m_{p_0} = \pm(pc/c^2).$$  \hspace{1cm} (135)

This definition is given by the relativistic wave equation $E = \pm(pc + m_0c^2)$. From (134) the gravitational constant can also be considered in the form

$$G_C = \frac{2\pi c^3}{\hbar} = 2\pi c^3(G_C^2 \hbar/m_{p_0} c^6)^{1/2} = 2\pi \frac{G_C \hbar c^3}{m_{p_0} c^3} = 2\pi \frac{G_C \hbar}{m_{p_0}}$$  \hspace{1cm} (136)

With this we see a gravitational uncertainty through $\Delta x \Delta p \geq \frac{1}{2}G\hbar$. Finally after quantization of (136) we have a pure quantum charge, i.e $G_C \hbar$, thus gravitation carries the uncertainty of the Compton wavelength.

References

[1] Pitts J. and Schieve W. Slightly Bimetric Gravitation Preprint gr-qc/0101058

[2] Moffat J. Lagrangian Formulation of a Solution to the Cosmological Constant Problem Preprint astro-ph/9608202

[3] Carrol S. The Cosmological Constant Preprint astro-ph/0004075

[4] Roberts M. Vacuum Energy. Preprint hep-th/0012062
[5] Gundlach J. and Merkowitz M. Measurement of Newton’s Constant Using a Torsion Balance with Angular Acceleration Feedback Phys. Rev. Lett. 85 (2000) 2869–72 Preprint gr-qc/0006043

[6] O’Raifeartaigh L. Early History of Gauge Theories and Kaluza-Klein Theories, with a Glance at Recent Developments Preprint hep-ph/9810524

[7] Halerewicz E. The quantum vacuum, fractal geometry, and the quest for a new theory of gravity Preprint physics/0008094

[8] Weyl H. Space-Time-Matter. 1952 (New York: Dover)

[9] Einstein A. Unified Field Theory based on Riemannian Metrics and distant Parallelism. Math. Annal. 102 (1930)

[10] Hammond R. Class. Quantum Grav. 13 (1996) L73–79

[11] Bell S, Cullerne J, and Diaz B. A new approach to Quantum Gravity Preprint gr-qc/0010106

[12] Krough K. Gravitation Without Curved Space-time Preprint astro-ph/9910325

[13] Moffat J. Noncommutative Quantum Gravity. Phys. Lett. B491 (2000) 345–52 Preprint hep-th/0007181

[14] Haisch B. and Rueda A. On the relation between a zero-point-field-induced inertial effect and the Einstein-de Broglie formula. Phys. Lett. A268 (2000) 224–27 Preprint gr-qc/9906084

[15] Andrade V, Guillen L, and Pereira J. Teleparallel Equivalent of the Kaluza-Klein Theory. Phys. Rev. D 61 (2000) 084031 Preprint gr-qc/9909004

[16] Unzicker A. Teleparallel Space-Time with Defects yields Geometrization of Electrodynamics with quantized Charges Preprint gr-qc/9612061

[17] Loup F. The Alcubierre Warp Drive: Hyperspace travel within an electromagnetic version of general relativity (to appear in gr-qc)

[18] Mohr P and Taylor N. CODATA Recommended Values of the Fundamental Physical Constant: 1998. J. Phys. Chem. No. 6 28 (1999), and Rev. Mod. Phys. No. 2 72 (2000). available online http://physics.nist.gov/constants

[19] Yuan M, et al. The Physics of Blazar Optical Emission Regions II: Magnetic Field Orientation, Viewing Angle and Beaming. Preprint astro-ph/0010215

[20] Nisenson P. A Second Bright Source Detected Near SN1987A. Preprint astro-ph/9904109

[21] Sahni V. The Case for a Positive Cosmological A-term. Int. J. Mod. Phys. D9 (2000) 373–444 Preprint astro-ph/9904368