Vacuum Polarization, Gravitation, Charge, and the Speed of Light
(First version)

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Author Comment:
This paper and the series of papers associated with, introduce a new basic view of physics providing originating mechanisms for rest mass, gravitation, electric forces, and the velocity of light in the universe. The originating mechanism of the mass of the electron is established. The Fine Structure Constant is calculated in terms of the physical constants, within the measured experimental error bars. The relation between Gravitational constant and the fine structure is calculated accurately without fudge factors.

These ideas are not going to come into the mainstream of physics for at least many years after my life, not likely anyone will pay much attention, but I believe it is the starting point of the next revolution, and I have done the best I can to elucidate it.

Abstract

The concept of mass and particle interaction by way of force and continuous fields, has persisted since Faraday's time, and is still the prevalent theoretical mechanism in spite of the problems the infinities and the impossible energy densities. The concept of the Vacuum Polarization has also been known for almost a century and is the origin of the mechanism creating pair production for electrons, and setting the speed of light [22].

The purpose of this paper is to present a plausible alternate mechanism for the electric and gravitational forces, define an alternate mechanism for the vacuum polarization and the causation of the speed of light. This same mechanism, the presence of the probability of Feynman action path photons, creates the forces in atoms that bind electrons and atoms together.

Feynman has well illustrated that a photon going from one point to another, takes an infinite number of possible action paths. The probability of taking these paths throughout space is measurable and displayed by measurements of the Anomalous Gyromagnetic Ratio, g_A. The calculation and measurement of these path delays of electron loop probability, give a certainty that a moving photon exists not only on its classical path inside the Compton orbit, but its probability exists, and has a substantial effect throughout space. It is to be shown that this probability density creates the effect of charge, mass, and gravitation.

It is proposed that there is neither a Gravitational nor an Electric field energy density. The concept of electric and gravitational fields is useful in calculating potential energy and motion in atomic system and gravitational dynamics, but otherwise is a conceptual mistake. The change in c induced by the presence of the Feynman photon probability is shown to create the effect of both phenomena, and in fact are one in the same. (See Endnote 1)

This paper addressee primarily, time independent static electric and gravitational effects. The dynamic photon-photon interactions are better addressed by the continuity of the time dependent photon probability density expressed by the wave equation, and the photon four-momentum. The single photon wavefunction represents the time dependent continuity of the sum of the location probability, and the interaction of these wavefunctions creates a time independent Lorentz invariant standing wave solutions that represent mass particles. These are the standing waves that are the solutions to the Schrodinger equation .The dynamic interaction of photons requires the formalism of the photon wavefunction, and the attendant four-momentum that are developed in, “The Dirac Equation and the Two Photon Model of the Electron” [1]

Vacuum Polarization

It is presented here that “Vacuum Polarization” is not a field at all but the presence of the probability density flux of Feynman action path photon, generated by the internal action paths of photons residing in mass particles. The Vacuum Polarization of Dirac, Schwinger, et.al, is cast as a probability density of Planck particles, having no energy, no scatter or interaction with mass, but sets both rest mass and potential energy for the interaction of particles as the result of a change in c.

Main

Although ignored by most; if the Feynman action paths do exist, there is the probability of the presence of Feynman action path photons being elsewhere in space. It is asserted that the presence of Feynman photons generated by the internal motion of photons in mass particles, alter the speed of light, and change the energy of other mass particles mass via $E = mc^2$. The same change in the relativistic energy as a result of the change in the velocity of light generates the potential energy difference for both charge and gravitation. The spatial potential energy between mass particles is not generated by magic but by the interaction of the probability density of the Planck size photons.

Primary Postulate

The change in the speed of light moving thru a density of Feynman photons generated by mass particles is:

$$\frac{\Delta c}{c_0} = \sum_n \frac{\lambda\!\!\!^{-}{}_{PL}^2}{\lambda\!\!\!^{-}{}^2}\left(\frac{2\hbar}{mcr}\right) \qquad \frac{\text{additional hits per second of travel}}{\text{misses per second of travel}} \tag{1}$$

The ratio of the change in the velocity of light to c_o is equal the ratio of additional hit to misses of a Planck particles per second.

The first term on the right of this equation is the ratio of hit to miss on passing within the Compton radius of another photon, the second term is the probability density of the photon passing there.

Topics;

The Interaction Mechanism

The speed of light is set by the ratio of the probable hit to the probable miss per second of the Feynman photons. The Feynman photons being the Planck size photons generated from the action paths of the internal motion onside the Planck radius of mass particles.

Each, half spin boson particle generates the probability two photons and by the same concept of the action paths, there is a probability density of location outside their classic path of $\hbar / L$. The density is thus inversely proportional to the angular momentum. The probability density as a function of r is found to be:

$$\text{Spin } 1/2 \text{ boson} \qquad P = \frac{2\lambda\!\!\!^{-}}{r} = \frac{\hbar}{mcr/2} \tag{2}$$

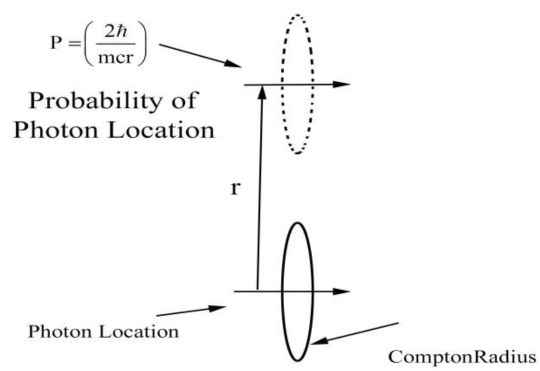

Fig. 1. The probability of a photon being at a distance from the center of its Compton radius.

For a mass this density is the probability of a photon in its Compton radius will be moving in the same direction at a distance of r from the center of the Compton radius. The energy and angular momentum of the particle is quite definite, but the probability of where it is located from its center is this function of r. This is the probability density of a photon actually being on the probable action paths defined by Feynman. Feynman illustrated that the paths go in all directions and may be forward or reversed in time, but the presumption is that the probability of the action paths at a distance are parallel to the photon velocity.

The Δc per photon

The change in the velocity of light per single photon encountered per second shown in Eq.(1), is:

$$\frac{\lambda_{PL}^2}{\lambda_C^2} \tag{3}$$

This is the area ratio of the core Planck particle $\lambda_{PL}^2 = \mu\lambda$, in the photon, to the Compton area λ_e^2, or is the ratio of the hit to miss of a Planck size particle passing within the Compton radius of the photon. If n is the number density per unit area passing a point then the total change is:

$$\Delta c = \Delta c_n \, n \tag{4}$$

The mechanism of interaction of the Feynman photons with mass is not a kinetic transfer but is a change in c altering the relativistic energy relation, $\Delta\varepsilon = \Delta\left(mc^2\right)$. The differential in relativistic rest energy will be shown to provide the potential energy for both gravitational and electric interaction.

Historical Note

The concept of the nonlinear aspects of the electromagnetic field producing electron–positron pairs was first discussed by Dirac and Heisenberg in the 1930's, and the effects were calculated R. Serber and E. A. Uehling, [6], [7], [8], [9], [10], [11]. Later the values of the energy densities of the Vacuum Polarization necessary to create pair production were developed by Schwinger [12]. The history of the concept is well known in the physics community.

Units and Concept

The probability density of Feynman photons generated by a Spin ½ mass particle is equivalent to 2 photons distributed throughout space. This is easily understood for the electron which consists of only two orbiting photons. Other bosons must have the same intrinsic density that is generated by a sum of internal motion. The Feynman photons all have the same Planck size and velocity, but the density is dependent on the mass of the generating particle.

For collections of mass particles the directions of the Feynman photons are random thus leaving gravitation being the result of the sum of random photon motion throughout space. For electrons the spin angular momentum of the two internal rotating photons are polarized and align and thus the vector interaction predominates.

The most minimal change in $\Delta c / c$ is the result of a probability density of intersecting an increase in Planck particles of one per second. For a photon passing within the Compton radius of one proton generated photon per second is:

$$\frac{\lambda_{PL}^2}{\lambda_P^2} = 5.9059571E-39 \tag{5}$$

The Photon

The photon is proposed to be a Planck particle revolving at the photon frequency ω such that, the Compton radius, is equivalent to the distance from the center that light travels in one cycle. The probability of the particle location oscillates linearly back and forth as the particle rotates at is frequency. Beyond the Compton radius, the photons probability exists, but only for that of the bare Planck particle with a repetition rate equal to the frequency, but no spin nor Compton radius.

The probability of existence beyond the Compton radius is evidenced by the Anomalous Gyromagnetic Ratio and the effect on other photons. Beyond one wavelength however, the particles are so small, 10^{-66} cm^2, that the probability passes through dense mass without delay or scatter. This property is responsible for the observation that gravitational effects are not shielded. The effect, of a change in photon density is to alter the speed of light, and change the relativistic energy. For purposes here the mass of a photon is considered to be $m = p / c_0$.

Gravitation

Mass Induced Change in the Local Velocity of Light and Gravitation

From Eq.(16), a change in the value of c as the result of the local probability of Feynman photons is:

$$\frac{\Delta c}{c_0} = \left(\frac{\lambda_{PL}^2}{\lambda_C^2} \frac{2\lambda}{r} \right) = \frac{2\mu\lambda}{\lambda r} = \frac{2\mu}{r} = \frac{2Gm_1m_2}{\left(m_2c_0^2\right)r} \tag{6}$$

Noting that $\Delta c = c_0 - c$, the third relation in this can be written:

$$\frac{c}{c_0} = \left(1 - \frac{2\mu}{r} \right) \tag{7}$$

This is a known relation between the speed of light and gravitational mass. It has been measured by the Schapiro effect [16], and theorized from GR by the projection of the gravitational tensor onto Minkowski four-space by Blandford [17]. The value is thus in agreement with experiment. It can also be viewed from another perspective as providing the source of gravitational potential energy. (See Endnote 2)

Gravitational Potential Energy

The fourth term in Eq.(6), is the ratio of the specific energy, to unit mass of a test particle thus the change in c provides the source of gravitational potential energy.

With c being a function of the Feynman photon density generated by mass particles the mystery of gravitational energy potential can be better understood. It is easy to deduce the reciprocity between the relativistic mass energy and the velocity of light.

Leibniz's accusation of Newton's of introducing 'occult' forces because, gravity acts at a distance as if by magic. It is here asserted that Gravity is not a mysterious force, but a force generated by a probability density of photons produced by the mass particles existing on the Feynman action paths altering the speed of light near massive objects.

Putting a **test particle** m_2 in both sides of Eq.(6), shows the "specific energy" or energy per unit mass of the gravitational energy potential for a mass particle 2 to be:

$$m_2 c_0^2 \frac{\Delta c}{c_0} = \frac{2Gm_1 m_2}{r} \tag{8}$$

Noting that $\Delta c = c_0 - c$, Eq.(8), can be stated as a change in the relativistic energy.

$$\Delta\varepsilon = \left(m_2 c_0^2 - m_2 c_0 c\right) = \frac{2Gm_1 m_2}{r} \tag{9}$$

The right side of this expression is the relativistic energy change of m_2 and the left is the total relativistic energy change of m_2 entering the gravitational potential, thus the specific energy per unit mass, and in a conservative system it includes both the potential and kinetic energy.

$$K_e + \frac{Gm_1 m_2}{r} \tag{10}$$

It is concluded that **gravitational energy is equal to the change the relativistic rest energy** $\left(m_2 c_0 c\right)$ of a mass particle, as a result of a change in c, and Δc is the source of the observed gravitational potential energy. This casts the expression $\Delta\varepsilon$ as a Hamiltonian.

Vacuum Polarization and Gravitational set Speed of Light in the Universe

It is asserted that the speed of light in the universe is set by the probability density of Feynman photons generated by the mass particles. This sea of probable photons generated by the particle masses provides the limit to the velocity of light.

In an empty universe the velocity of light would be near infinite, (see Endnote 3), but the probability of collision with other photons, reduces the speed to finite values.

Employing the first postulate, Eq.(1), and noting that, as more and of the mass of the universe is included the calculation, $\Delta c = (c_0 - c)/c_0 \to 0$, the ratio of c to c_0 approaches one, and Eq.(1), becomes:

$$c = c_0 \sum_n \frac{\lambda_{PL}^2}{\lambda^2}\left(\frac{2\hbar}{mcr}\right) \tag{11}$$

From estimates of the distribution and mass of the universe, the number density of Feynman photons in universe as a whole can be estimated.

Most of the mass in the universe consists of proton mass particles and the most significant density contributor of Feynman photons. By summing Eq.(11), over the entire universe, setting it equal to the velocity of light, and simplifying the expression, it becomes:

$$c = c_0\left(\frac{\lambda_{PL}^2}{\lambda_n^2}\sum_n \frac{2\lambda_n}{r_n}\right) = c_0\left(\sum_n \frac{2Gm_P}{c_0^2 r_n}\right) \tag{12}$$

From an estimate of the mass in the universe by D. Valev [13], which is the same as setting the radius of the visible universe as the Schwarzschild radius, the relation between the mass and the radius in a flat universe is:

$$R = \frac{2Gm}{c^2} \qquad \text{or} \qquad \frac{2Gnm_P}{c^2(R)} = 1 \tag{13}$$

With the radius of the universe determined to be. $R = 1.2961570E+28$ cm, [15], the number of equivalent masses is:

$$n_P = \frac{R}{2\mu_P} = 5.2176112E+79 \tag{14}$$

From the presumption that the mass in the universe is primarily made up of protons and neutrons with approximately the same mass m_P. This sum can be integrated over the universe giving:

$$c = c_0\left(\sum_n \frac{2Gm_P}{c_0^2 r_n} \right) = \int_V \sigma \frac{dv}{r} \rightarrow c_v\left(\frac{2nGm_P}{c^2 R} \right) \qquad (15)$$

Comparing Eq.(12), and Eq.(13), the value of the ratio of c/c_0 for the universe is:

$$\frac{c}{c_0} = \left(\frac{\lambda_{PL}^2}{\lambda_p^2} \times \sum_n \frac{2\lambda_P}{r_n} \right) = 1 \qquad (16)$$

The first term in this expression is just the ratio of the Planck area to the proton Compton area, and is the change in c due to the interaction with a single Feynman proton photon density $\lambda_{PL}^2 / \lambda_p^2$ .The values for the Planck particle are:

$$\lambda_{PL} = 1.61624\text{e-}33 \text{ cm} \qquad \lambda_{PL}^2 = 8.2067\text{e-}66 \text{ cm}^2 \qquad (17)$$

The reciprocal of this must be the number density of Feynman photons in the universe. n_f , can then be calculated from Eq.(16), as the reciprocal:

$$\frac{c}{c_0} = 1 = \frac{\lambda_{PL}^2}{\lambda_{Prot}{}^2} \times n_f = \frac{1}{1.6932057E+38} \times n_f \qquad (18)$$

The Feynman photon flux density n_f, in the universe is then estimated as:

$$n_f = 1.6932057E+38 \qquad (19)$$

This is the number density, n_f, of Planck particles per cm^2 sec, generated by protons passing throughout the universe.

This flux constitutes what has been known as the “Vacuum Polarization”. Because of Feynman photon cross-section of the Planck particle, E-66 cm^2 there is no extractable, detectable or measurable energy content. The photon density affects the speed of light which in turn affects particle interaction, but the photons have no ascertainable energy content. **This contrasts with the consistency issues between**

quantum electrodynamics, **and Lorentz covariance,** which that suggest energy density for the vacuum polarization electric energy to be greater than, 10^{123} ergs/cm^2 ,[14], [15]. This density of energy is obviously an absurd and undoubtedly erroneous result. (See Endnote 1)

Electric Field and Charge

The Electron Binding Density and Vacuum polarization

Described earlier is the illustration that a change in the flux density of oncoming photons alters the velocity of a moving photon. If two photons are moving in the same particle the concurrence of their densities alters their mutual speed.

For the two photon model of the electron, postulated in [1], & [4], the photon density encountered by one of the photons, in addition to the space vacuum value, includes the density provided by the other revolving photon. Although the photons in the electron are orbiting in the same direction Feynman action paths are sums over all directions and thus the photons in the Compton orbit encounters the same opposing probability density. The densities are a function of the angular momentum as noted above, and thus provide a radial gradient in the index of refraction in the electron. This Gradient in the index of refraction is not a force but induces circular orbits that bind the photons in the electron [22]. It can be compared to the force on a charge in an electric provided by the Schwinger Critical value. (See section comparing relation)

Self-Generating Index of Refraction in the Electron

It has been shown [1]. [2], that electrons are composed of two polarized photons in orbit in an electron.

From Eq.2, the probability density of a photon P_1 passing at a distance r from its center is:

$$P_1 = \frac{2\lambda\!\!\!^-_1}{r} \qquad (20)$$

If the photon is orbiting in the electron, at a frequency per revolution of ν, an interloping photon would encounter the background density in photons per second, plus the density of the internal photon at its frequency. Thus the probability density of the orbiting photon is multiplied by its rotation rate, and from Eq.(1), the change in c for the interloping photon would be:

$$\frac{\Delta c}{c_0} = \frac{\lambda_{PL}^2}{\lambda_1^2} \frac{2\lambda_1}{r} \nu_1 \tag{21}$$

The other photon in the electron is not an interloping photon, but also orbiting, and the change in c is the probability of one of the photons being in the same place as the other. This is the coincident probability or the product of the photon densities.

$$P_1 P_2 = \frac{\lambda_1}{r} \nu_1 \frac{\lambda_e}{r} \nu_1 \tag{22}$$

The change in c for each of the photons as the result of the other is:

$$\frac{\Delta c}{c_0} = \frac{\lambda_{PL}^2}{\lambda_1^2} \frac{2\lambda_1}{r_1} \nu_1 \frac{2\lambda_2}{r_2} \nu_2 \tag{23}$$

This is the coincident collision density of the interacting photons.

The frequency is the Compton frequency $\nu_1 = c / 2\pi\lambda_1$, and the energy of each of these photons composing the electron. The value of the Compton frequency of the photons are half the Compton frequency of the electron, thus Eq.(23), can be:

$$\frac{\Delta c}{c_0} = \frac{\lambda_{PL}^2 \nu_e^2}{\lambda_e^2} \left(\frac{\lambda_e}{r_1} \frac{\lambda_e}{r_2} \right) \tag{24}$$

(Previous error corrected. See Endnote 4)

From the Born's* QM, view, P would be the probability amplitude, and the coincident probability would correspond to the square or wavefunction probability density. Here, it is the probability density of the location of a coincident event, thus the probability density of the location of opposing photons.

The change in their mutual speed of light is then the probability of a hit times the change in c as a result of that probability:

The difference in this equation Eq. (24), and Eq. (6), regarding gravitation, is that this is the mutual change in the photons velocity resulting from a mutual change in the oncoming photon density whereas Eq. (6) is the effect of the ambient probability density or the effect on an interloping photon. This expression, Eq.(24), provides the mutually induced gradient in c for the photons that holds the two photons in orbit in the electron. Understanding this expression is the key to understanding how the universe works

Structure of the Electron

Reducing Eq. (24), gives:

$$\frac{\Delta c}{c_0} = \left(\frac{\lambda\!\!\!^{-}_{PL} \nu_e}{r_{12}} \right)^2 \tag{25}$$

Then the minimum value of r is:

$$\frac{\Delta c}{c_0} = \left(\frac{\lambda\!\!\!^{-}_{PL} \nu_e}{r_{12}} \right)^2 \rightarrow r_{12} = \lambda\!\!\!^{-}_{PL} \nu_e \tag{26}$$

Thus At the minimum probable value of r, $\Delta c = c_0 - c = 0$, **the photons would be stopped**. This is below the possible orbiting radius for the electron, since energy and angular momentum could not be conserved. Is the radius at which the **flux density of the two photons inside the electron increases the ambient flux density to the point that the photon mean free path becomes zero.**

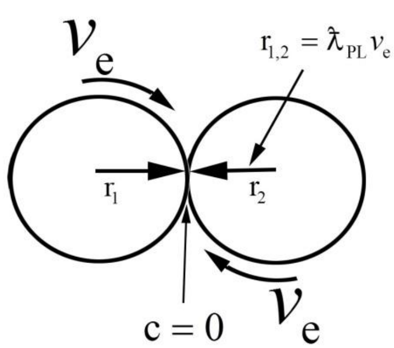

Fig. 1. The Electron Planck particles at their minimum r_{min}, distance would bring the relative velocity to $c = 0$,

The minimum orbit calculated here is related to the electron minimum orbit, but angular momentum and energy can't exist if the velocity is zero. The actual minimum occurs when the sum of the angular momentum is $\hbar / 2$, and the velocity of light is $c = c_0 / 2$

The two orbiting photons in the electron are bosons and as such have an angular momentum of $\hbar$. The in angular momentum, p is a function of c, thus when the velocity of light is 1/2, the angular momentum is $\hbar / 2$, creating a Fermion. This is also the limitation that defines the Fine Structure Constant.

Eq.(25), can be re configured as:

$$\frac{\Delta c}{c_0} = \frac{1}{2}\left[\left(\frac{\sqrt{2}\lambdabar_{PL} v_e}{\lambdabar_e}\right)\left(\frac{\lambdabar_e}{r}\right)\right]^2 \tag{27}$$

The value of $\Delta c / c_0$ Is ½ so the terms in the bracket is equal to 1

Although not intuitive the group of constants in the first parenthesis is identified as the **fine structure constant** α,

$$\alpha = \frac{\sqrt{2}\lambdabar_{PL} \nu_e}{\lambdabar_e} \qquad \text{(See Eq.(32), and appendix I)} \tag{28}$$

Eq.(27), then becomes.

$$\frac{\Delta c}{c_0} = \frac{1}{2}\left(\frac{\alpha \lambdabar_e}{r}\right)^2 \tag{29}$$

, and the minimum value of r is

$$r = \alpha \lambdabar_e = \sqrt{2}\lambdabar_{PL} \nu_e \tag{30}$$

This is the $\sqrt{2}$ larger than the stopping radius of the photons Eq.(26). It is the classical radius of the electron, and defines the fine structure constant, Eq.(28).

Atomic Energy Levels

With the parameters for the electron defined above it is a short step to defining the energy levels of an atomic system of two particles.

In the case of two attracting opposite charged mass particles, the electron and the positron, the same mechanisms as for the binding of the photons in the electron apply. The coincidence of the interaction of the two photons in the opposite particles provides the gradient in c that binds the two particles. The coincidence probabilities of angular momentum quantum levels correspond to eigenvalues of the wavefunction in the Schrodinger equation.

The Feynman photons generating the probability density for the two photons in the electron, is exactly equivalent to the interaction probabilities of the two mass particles. Noting that . $2v_{1,2} = v_e$, Eq.(24), becomes:

$$\frac{\Delta c}{c_0} = \frac{ƛ_{PL}^2}{ƛ_e^2}\left(\frac{2ƛ_e}{r_1}v_1 \frac{2ƛ_e}{r_2}v_1\right) \rightarrow \frac{ƛ_{PL}^2 v_c^2}{ƛ_e^2}\left(\frac{ƛ_e}{r_1}\frac{ƛ_e}{r_2}\right) \tag{31}$$

The difference is that for massive particles the minimum value of the separation of the particle distances is the Compton radius, $ƛ_e$. This is the radial interaction point where the opposite going photons have coincidence and have integral but opposite angular momentum. The photon probabilities can be anywhere but at this radius is the probability of the coincidence of the photons of the two particles. Max Born, et, al, identified what is referred to here, Eq.(20), as of the photon probability density as the wavefunction amplitude, and the photon coincidence probability density, Eq.(22), as the square of the wavefunction amplitude.

The major difference between Eq.(25), for the bound photons, and Eq.(31), for two mass particles is that the first is bound bosons having only a single quantum level of $\hbar / 2$ and the latter is pair of fermions can have multiple discrete values of angular momentum.

Reorganizing Eq.(31), again gives

$$\frac{\Delta c}{c_0} = \frac{1}{2}\left[\left(\frac{\sqrt{2}\,ƛ_{PL}\nu_e}{ƛ_e}\right)\frac{ƛ_e}{r_1}\right]\left[\left(\frac{\sqrt{2}\,ƛ_{PL}\nu_e}{ƛ_e}\right)\frac{ƛ_e}{r_2}\right] \tag{32}$$

After some pre-anticipated factorization the terms in parenthesis are identified as the fine structure constant Eq.(28), (Appendix I), and equation E.(32), becomes:

$$\frac{\Delta c}{c} = \frac{1}{2}\left(\frac{\alpha \lambdabar_e}{r_1}\right)\left(\frac{\alpha \lambdabar_e}{r_2}\right) \tag{33}$$

This is the change in c at an observation point at the distance, r_1, and r_2, from the center of the two particles 1 and 2.

Two Particle Energy Potential

For potential energy considerations, setting the observation point r_1 for particle 1 at the point of minimum energy $\alpha\lambdabar_e$, Eq.(30). The value of Δc is then the difference between the minimum value at the first particle, $c_0 / 2$, and the change as a function of the position of the second particle. This then provides the specific energy change per unit mass of the potential energy as a function of the distance between the particles,.

$$\frac{\Delta c}{c_0} = \frac{1}{2}\left(\frac{\alpha \hbar c}{m_e c^2 r_1}\right) = \frac{1}{2}\frac{Q^2}{mc^2 r} \tag{34}$$

This equation gives the total energy difference as being half the conventional electric potential energy as a function of the radial distance.

$$\Delta E = mc_0^2 - m_0 c_0 c = \frac{1}{2}\frac{Q^2}{r} \tag{35}$$

The value of Q^2 is $\alpha c\hbar$, and allows identification with the electric potential but it is not the product of charges, and is just the compact representation of the terms

Eq.(35), provides a potential energy difference that binds the particles together expressed as an electric equivalent.

By taking the gradient of ε, in Eq.(35), shows the force due to the gradient in the relativistic energy to be, the gradient in the total energy, not the change in the electric field.

$$f = \frac{d\varepsilon}{dr} = m_e c_0 \left(\frac{dc}{dr}\right) = -\frac{1}{2}\frac{Q^2}{r^2} = \frac{QE}{2} \tag{36}$$

This is half the electric field potential energy. The Lagrangian electric field equivalent of this expression is that the total energy difference is:

$$\phi(\varepsilon) = -\frac{1}{2}\frac{Q^2}{r} = -\frac{Q^2}{r} + \frac{1}{2}mv^2 \tag{37}$$

Atomic energy levels, A New Atom

Equation Eq.(33), gives the continuous probability densities of the Feynman photons produced by the two charged particles, and the relative energy differences at any distance. The electrons although composed bosons are fermions and can only have specific values of angular momentum:

$$\frac{\Delta c}{c} = \frac{1}{2}\left(\frac{\alpha \ \hbar}{m_e c r_1}\right)\left(\frac{\alpha \ \hbar}{m_e c r_2}\right) \tag{38}$$

This means that their Compton radii are integral values, and the angular momentum is a multiple of $\hbar$, that is: $L_1 = m_e c r_1 = n_1 \hbar$.

From an observation point at the closest approach of the two particles to each other, or at the point that their radii touch, the change in c is:

$$\frac{\Delta c}{c_0} = \frac{1}{2}\left(\frac{\alpha \ \hbar}{n_1 \hbar}\right)\left(\frac{\alpha \ \hbar}{n_2 \hbar}\right) \tag{39}$$

This, as in Eq.(8), is the specific energy change per particle, thus the change in the energy of the electron:

$$m_e c \Delta c = \frac{\alpha^2}{2}\frac{m_e c^2}{n_1 n_2} = \frac{R}{n_1 n_2} \tag{40}$$

This is the change in energy of the mass of the electron if the coincident point of the interaction photons is integral values of the Compton radius from the particle center.

Eq.(40), is the first energy levels of an atomic system, or the principle quantum number. The primary differential energy levels for a hydrogen type atomic system are then:

$$\Delta\varepsilon = R\left(\frac{1}{n^2} - \frac{1}{n^2}\right) \tag{41}$$

These are the primary energy levels of an atom.

The separation of the center of the particles, is a multiple of the Compton radius $(n_1 + n_2)\lambda_e$, and is not multiples of the Bohr orbital radii.

This is clearly not the Bohr atom. The orbits represent the coincident probability of opposite going photons with the same angular momentum, and are the contact point is location of the standing waves of the Schrodinger equation.

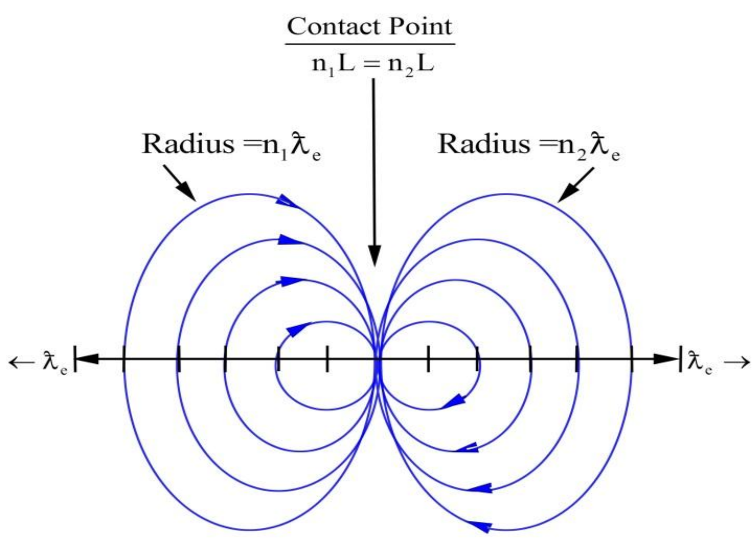

Fig. 2, The structure of the atom defined by Feynman photon considerstions

The contact point is the location where the angular momentum of the two particles is equal, and the Feynman photons are going in opposite directions. At this point the photons can have conjugate wavefunctions, and the energy of the mass of the electrons differs from rest energy, by the state energy level solutions of the Schrodinger equation. The location of the contact point does not have to move as the result of a state transition, but the angular momentum of the system is the sum of both the internal motion and the rotation of the particle around the center of mass, thus if the total is an integer:

$$L = m_e v r + n_1 \hbar = n\hbar \tag{42}$$

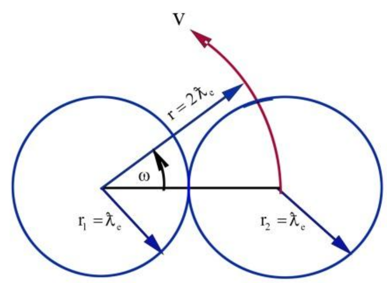

Fig. 2, Illistration of conserved anggular momentum for motion rotary motion inf the Feynman atom

The state values can be degenerate.

$$L = m_e v r = \left(n_1 - n_2\right)\hbar \tag{43}$$

The success of the Bohr atom is seen to be due to the relation between the velocity of the electron the velocity of light, and the radius of the Bohr orbits.

$$\frac{v}{c} = \alpha \qquad r_B = \frac{ƛ_e}{\alpha} \qquad L_B = m_e v r_B \rightarrow L_C = m_e c ƛ_e = n\hbar \tag{44}$$

Positron

The Positron has a different coefficient of energy as a function of r, being R/2, rather than that of an atomic system with a heavy hydrogen center. This is the result of a change in, (Δr), for two equal mass particles, also produces a move the center of mass by half that amount $\Delta r / 2$, thus reducing the energy differential by the same factor. This is the same as the orbital energy of a reduced mass system.

Attractive Repulsive Particles

This section on electric particle interaction only addressed the absolute value of an attractive charge, thus only the effect of opposite charges. Since the presented theory has no +/- signs the description of repulsive action is missing here. The repulsion of alike particles has the same but more involved causal mechanism related to spin and Lorentz properties. (See Endnote 5)

$E = mc^2$ in a Variable Speed of Light

In expressions, Eq.(9), and Eq.(37), the change in the energy $E = mc^2$ as a result of a change in c is proportional the total energy, and therefore in a conservative system includes both potential and kinetic energy.

$$\Delta\varepsilon = mc_0^2 - mc_0 c \rightarrow \quad \frac{d\varepsilon}{dr} = m_0 c_0 \frac{dc}{dr} \quad = \phi(r) \tag{45}$$

The potential is not the electrical potential, but the change in the total energy, the sum of the total change in relativistic rest and kinetic energy in a conserved system.

$$\phi(r) = \Delta m_0 c_0^2 + \frac{1}{2} mv^2 \tag{46}$$

For a particle moving into a zone of altered c the rest mass decreases and the velocity increases, For a conservative system in which the energy is constant the decrease in rest mass energy is offset with the increase in kinetic energy, thus the relativistic energy and mass remain constant.

$$m_0 c_0 c\left(1 + \frac{1}{2}\frac{v^2}{c^2}\right) = m'c^2 \quad \text{constant} \tag{47}$$

This perspective is not the normal view of relativist mass and energy. Normally the relativistic mass does not involve a change in c, and the acquired energy is by acceleration. For a conservative system, there is no acquired or lost energy in moving in or out of a zone of an increased index of refraction, thus the total relativistic energy is constant. The kinetic and rest energy have an inverse proportionality.

Eq.(45), shows a slightly changed view of the relativistic mass. It is illustrated that the square of c^2, is actually the product of two value of c, one of the observer, c_0 and one in the observed frame, c.

Relation of Schwinger Vacuum Polarization Electric Field Density and the Photon Flux Density

Energy Density E_{CR}^2 *Feynman Photon Flux Density* n_f

The purpose of his section is to show the relation between the Schwinger vacuum electric energy density, and the Feynman photon induced speed of light in the universe.

In 1951 Julian Schwinger developed the energy density associated with the Vacuum Polarization, showing the critical value of the electric energy density necessary for the commencement of Electron-Positron pair production to be the square of an intense electric field [12].

$$E_{CR} = \frac{m_e c^2}{Q \lambda\!\!\!^{-}_e} \qquad E_{CR}^2 = \frac{m_e c^2}{\alpha \lambda\!\!\!^{-}_e{}^3} = \frac{\alpha^2 m_e c^2}{\alpha^3 \lambda\!\!\!^{-}_e{}^3} \tag{48}$$

In order to compare the Schwinger electric energy density to the photon flux density concept we need to establish the ratio of the electric field energy density to the Feynman photon density. (Endnote 6)

This can be found in the electric field density of the minimum energy density of an atomic system in which the energy density is defined.

The electron consists of two orbiting photons, thus the maximum photon probability density defined in Eq.(40), is equivalent to the electric energy induced by the probability of two orbiting photons and occurs when the angular momentum of each photon is equal to $L = mcr = \hbar$. This turns out to be the Rydberg energy, and the minimum energy of the Bohr atom.

For one photon the corresponding electric energy density induced by a single photon is then half R or R/2.

Dividing the Schwinger Critical electric energy density, by the electric energy density created by a single orbiting photon value, yields the Schwinger equivalent photon number density.

$$n_{CR} = \frac{E_{CR}^2}{R/2} \tag{49}$$

The number density of Feynman photons corresponding to the Schwinger Vacuum Polarization energy density calculates to be:

$$n_{CR} = 1.7874783E+38 \tag{50}$$

This is within 5% of the value of the Feynman photon density estimated for the universe, Eq.(19),

$$n_f = 1.6932057E+38 \qquad\qquad n_{CR} = 1.7874783E+38 \tag{51}$$

The fact that these numbers are this close is probably somewhat coincidence, but being in the same ballpark addresses the credibility of the calculation.

The vacuum energy density of the universe found from the Schwinger electric energy density, (10^{123} erg/cm^3), is obviously not real, and exposes a major flaw in assigning an energy density to an electric field. The concept of charge, and electric field, is a useful mechanism for calculation the energy differentials in an atomic system, but fails outside that arena.

Conclusion

It is postulated that the Feynman (Planck) Photon probability density is the mechanism that: Sets the velocity of light; is responsible for Gravitational and Electrical interaction; creates the internal binding for the electron; and sets the energy levels in an atom.

Using the concept of, Δc, (delta c), and the probability of photon interactions instead of the concept of the electric field, removes the infinities of Quantum Electrodynamics that makes the analysis of the internal dynamics of elementary particles impossible. The concept of continuous fields containing energy, create unsolvable issues that stops the progress of understanding elementary particle structure.

It has not been the purpose to explore all the fine and hyper-fine structure of the interactions, or even the implications regarding other particles. The purpose is to illustrate the basic mechanisms of a novel theory of photon and particle interaction that can be useful in developing the structure of more complex particles.

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Appendix I

Experimental Accuracy of the Calculated Fine Structure Constant

The value of α identified in Eq.(28), is a constant arising from the structure of the electron, It the value in terms of other fundamental constants, all known to at least 11 significant digits without any arbitrary factors except the least accurate being the gravitational constant. The gravitational constant's experimental accuracy is limited to about 3 digits with considerable experimental scatter beyond that, thus there is a limit to the extent the accuracy can be tested.

The value of the Planck length, $ƛ_{PL} = \sqrt{\mu ƛ}$, contains the gravitational constant, big G, therefore solving Eq.(28), and including the anomalous gyromagnetic adjustment for $ƛ_e$ wavelength (Appendix II) for the gravitational constant gives:

$$G = \frac{\alpha^2 2\pi^2 c(ƛ_e g_A)^4}{\hbar} \tag{52}$$

If the theory is correct the value of G can be calculated to about 11 places, and compared with the experimental results. The experimental values that are in best agreement are those of BIPM and the calculated value is within the error bars of all their measurements.

Reference values of Constants and sources used in calculation (CGS units)

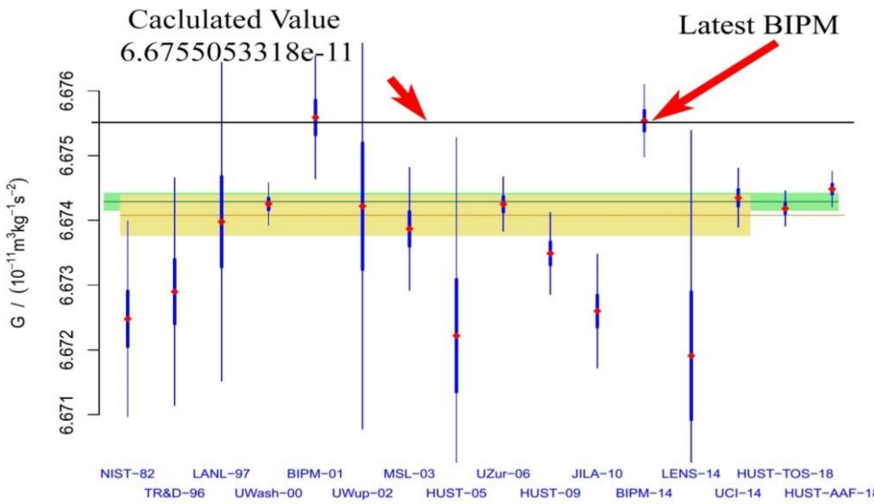
c = 2.9979245800E+10*	$g_A = g_e / 2$ = 1.00115965218
$\hbar$ = 1.054571817646E -27 *	$ƛ_e = \hbar / m_e c$ = 3.8615926794E-11
α = 1/137.035999084 †	m_e = 9.1093837015(28)E -28 ⊕

* Definition † Gabrielse et. al. [17][18] . ⊕ 2018 Codata Recommended Values

Comparing calculated value of G with BIPM* and Codata consensus values (MKS)

Calculated value	G = 6.6755052700E-11
BIPM 01-32-2001	G = 6.67559(27) x 10-11
BIPM weighted mean 2014	G = 6.67554(16) x 10-11
BIPM Sep, 2015	G = 6.67545(18)) x 10-11
Codata Consensus Value	G = 6.67430(15) x 10-11

*BIPM- Bureau of International Weights and Measurements, [19].



Experimental values used for statistical calculation of Codata consensus value of G, [20]

The calculated value is within 2 ten-thousands of the Codata consensus value, and within the experimental error value of the BIPM measurements.

Appendix II

Compton Radius Adjustment

The Electron developed in [4] is a composition of two orbiting photons bound by their mutually generated change in the radial index of refraction. The most probable orbit is at the Compton radius and the energy of each photon is $\frac{1}{2} m_e c_0^2$, and m_e is the rest mass of the electron.

In accurate calculations involving the Compton radius or the frequency, the Compton radius, $\lambda\!\!\!^{-}_e$ calculated from the electron rest mass needs a correction. Due to the delay in completing the orbits by the Feynman external path loops it is slightly larger than that calculated from the rest mass. The delay is responsible for creating the Anomalous Gyromagnetic Ratio, and creating the extremal probability density of the Feynman photons, and for accuracy must be included in, $\lambda\!\!\!^{-}_e = \hbar / m_e c$, thus the radius is:

$$\lambda\!\!\!^{-}_e \rightarrow \lambda\!\!\!^{-}_e g_A = \lambda\!\!\!^{-}_e \times 1.00115965218073 \tag{53}$$

Endnotes:

1
The energy in the electric field is arbitrarily assigned based on the electric potential energy of a charge at the classical electron radius, $\alpha\lambda_e$. The potential being equal to the rest mass energy of the electron at that radius. It is then integrated over all space and then assigned an electric field energy density. The arbitrary assignment of an energy density to a continuously differentiable electric field creates an impediment to understanding the mechanics of quantum physics. The concept of electric charge and electric fields only has merit down to the Compton radius and should not be ascribed to having energy density. As Einstein pointed out there are clearly photons in a dynamic electric field, but the same is not true of an infinitely divisible static field, the assignment of an energy density is quite arbitrary, and the idea of charge and electric field energy is a useful and intuitive concept, but it has fatal theoretical flaws.

2
The velocity change in the speed of light by gravitation Eq.(7), has been known for some time, but what seems to have been overlooked is that a change in c causes a change in the energy of mass particles via $E = mc^2$. The change in c thus is shown as the source of gravitational potential energy as well as electrical potential.

Eq.(7), is the interaction effect of one mass on the other, and is not reciprocal. For large differences in mass this is correct, however for large close masses interactive effects may have to be considered. The total interactive expression needs the product of the interaction as is developed for the electron Eq.(23).

3

Speed of light in an empty universe

It was noted that the speed of light is proportional the number of Planck particle hit to misses per second as the photon moves at c, or:

$$\frac{c}{c_0} = \frac{n \times \text{Area of PlanckPaeticle}}{1\ \text{cm}^2}$$

From Eq.(19), the number of protons photon per square cm per second n_f times the Planck particle gives the ratio to be $3.9881E-26$. With this, the current value, and the vacuum value of c can be found noting that the current value of c and the change in c is the result of the photon number

$$\frac{c_{00} - c_0}{c_{00}} = \left(1 - \frac{\lambda_{PL}^2 n_f}{1\text{cm}^2}\right) = \left(1 - 3.988E - 26\right)$$

Where, c_0 is the current velocity of light, and c_{00} is the value in an empty universe.

$$c_{00} = 7.5171e35\ \text{cm/sec}$$

This is about 60 million times across the universe in a second. The current value is:

$$c_0 = c_{00} 3.9881388E - 26 \ = \ 2.9979245800E\ 10\ \text{cm/sec}$$

The value of c is proportional to the mass and the radius of the universe, both related to c, thus the value of c, may be quite complicated.
The velocity of light is dependent on the cross section of the opposing Planck particles which are independent of the frequency, thus the lack of frequency dependence on the speed of light in vacuo is apparent.

4
Previous papers of the author have erred in putting in the Compton frequency of the electron in this expression, leading to an error in the potential. The frequency should be the Compton frequency of the two orbiting photons in the electron which is ½ of the electron frequency. The error leads to the derived potential being equal to the electric potential, which is not the total energy due to the change in c. Putting the proper frequency of the photons yields the potential being that of the total energy change due to Δc .

5
This paper has only addressed the concept of attractive charges or the absolute magnitude of the interactions. Since the concept of presented here does not have a +/-, Q_1, Q_2 , the repulsion of alike particles does not have a similar mechanism. The mechanism equivalent to charge is inherent in the nature of the Lorentz interaction of photons and the spin associated with the Electron and the Positron. The photon interactions presented here are for photons moving in opposite directions creating attractive forces, whereas photon encounters moving in the same direction do not interact. This can be better presented in terms of photon wavefunctions and Geometrical Algebra first defined by Dirac. (See "The Dirac Equation and the two Photon Model of the Electron. [1].).The charge sign alternative mechanism will be presented in a subsequent paper.

6
There is a correspondence between the gradient in the index of refraction and the force holding a photon in orbit [21], and for comparison, it can be notices that the Schwinger critical force on charge is equal to the centrifugal force on a photon rotating at the Compton radius:

$$f = QE_{CR} = \frac{pc}{r} = \frac{m_e c^2}{\bar{\lambda}_e} \tag{54}$$