The Cover

The celestial Rose formed by the interaction of galaxies may no longer be in bloom.

The light now reaching the Hubble Space Telescope has traveled 300 million years

Dedications and Acknowledgments

TO THE MEMORY OF MY MOTHER CAROL

AND MY UNCLE ROY

And my personal thanks to:

Robert and Gloria Potter

And

James J. Brennan

For Their Continued Support

FIELD FORCES FROM FIRST PRINCIPLES

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FUNDAMENTAL FORCES FROM FIRST PRINCIPLES

Introduction

Natures laws reveal an intrinsic communion between space and time. The ratio of one to the other is constant in all reference frames. In the lexicon of mathematical physics, it is given the symbol '**c**' commonly consociated with the speed of light. In reality, '**c**' is panoptic. Energy and mass are linked by $\mathbf{c^2}$ and, as developed herein, so also are gravitational and electric fields.

A self creating universe imposes restrictions upon energy and momentum–both must be net zero within the limits of the uncertainty principle. Expansion carries with it the implication of the whole in perpetual communication with its parts. What then is the universal commutator, that which insures the acceleration-mass product will be zero on the global scale? In the words of Richard Feynman: "*....it is the space, the framework into which the physics is put* ."

Empty space is not recognized by modern physics as a medium. In lieu of force, curvature has been adopted as the standard explanation of action at a distance. Without a substantive physiology, however, there is nothing upon which the geometry can act, and therefore no way for inertial fields to communicate, an essence stressed by Einstein in his later years. Although General Relativity is credited with many successful predictions, the mechanism by which mass distorts space, remains unanswered.

In his musings, Richard Feynman queried whether gravity might be a "pseudo force" (his term for inertial reaction). If this be so, the question immediately arises as to what causes the acceleration—there can be no inertial reactionary force without a primary impetus? That such a dynamic exists, is the bases for our thesis. Global expansion creates isotopic spatial acceleration stresses in the vicinity of non-expanding matter. Static space cannot be distorted by inert matter, but inertial matter can strain momentum space. In the case of gravity, the reactionary force is spread over an area, what is commonly referred to as a local '**g**' field.

The requirement that momentum and energy be zero on the global scale commands space-mass reciprocity. Conservation of momentum demands that natures laws be operatively symmetric; i.e., the force must be the same when the roles of space and matter are reversed. Just as reactive forces exerted by the cosmos upon accelerating objects are proportional to their mass, so also must the expansion field be opposed by the inertial reaction of local matter.

Long range reactive fields are two in number. In the case of gravity, reactive force is scaled to mass. For the electric field, reactance is proportional to angular momentum. Both fields being coextensive with global expansion, they diminish inversely with area.

As with all vector fields, spatial coordinates are assigned magnitudes and directions. Electric and gravitational fields are specified in terms of the reactive acceleration to be applied at each point. The coordinate values for an empty void, however, do not imply physical motion of massless space–rather they specify reactance accelerations as "*virtual fields*." These mathematical constructs are emulative of spatial action, but their sustenance depends upon the expansion of space rather than a property of space itself.

PRELUDE TO GRAVITY AS INERTIA - OPPOSITE SIDES OF THE SAME COIN

As first proposed by William McCrea in collaboration with Edward Milne (circa 1950), expanding negative pressure creates positive energy. Combined with the equilibrium negative potential of the void first elaborated by Richard Feynman, the zero energy, self mediating universe, emerges as a viable alternative to nascent matter *ex nihilo*. Obviated is the implication of fine tuned constants, cosmological evolution reckons space and mass as joint rather that severable. Synthesis of long range gravitational action follows from expansion induced dynamics.

REACTIVE DENSITY

How does space communicate opposition to changing velocity anywhere in the universe? Historically, instantaneous reaction has been the Achilles heel of Machian mechanics, and most likely the reason for Einstein's reluctance to embrace it as a perspective of General Relativity. The average density of static space is immeasurably small, offering nil resistance to kinetic change. Yet in some manner, the universe instantly induces counter forces when masses and charges are accelerated. This conveyance of electric and gravitational effects with no loss of energy, bespeaks of an omnipresent modulus-like resiliency.

Newton's 2nd law equates inertia to rate of change of momentum. For invariant mass, the non-relativistic relationship between force, mass and space can be written in terms of a pressure **P** as:

$$\frac{\mathbf{F}}{\mathbf{A}} = \left[\frac{\mathbf{M}}{\mathbf{A}}\right]\mathbf{a} = \mathbf{P} = \sigma(\mathbf{a}) \qquad \text{(X-1A)}$$

where both force and reaction have been divided by an area '**A**.' In this new cast, exposition, of gravitational action proceeds from dimensional reformulation of "*local-force-per-unit-mass*" to "*global-force-per-unit-area*."

When measurements were made to precisely define the unit of force in terms of a specific rate of acceleration, the 17th Century English were in a preferred position. One-meter-per-second-squared acting upon one **kgm** was equated to one **ntn** of force. Experimenters could not have guessed they were actually measuring cosmological properties defined by the size, shape and mass of the Hubble universe. That local effects depend from global parameters should come as no surprise to today's inquisitor, but why is inertia defined by Hubble parameters to the exclusion of what lies beyond?

While reactionary force is indifferent to the shape, area and volume of an accelerated object, gravitational fields diminish inversely with area. To assign a value to sigma in (X-1A), there is much to suggests the naturally occurring relational ratio of Hubble mass $\mathbf{M_u}$ divided by Hubble surface area $\mathbf{4\pi R^2}$. Not the least of which is the fact that reasonable guesstimates of $\mathbf{M_u}$ in the range of $\mathbf{1.5 \times 10^{53}\ kgm}$ and Hubble radius $\mathbf{R = 1.1 \times 10^{26}\ meters}$, lead to a convenient scalar density field $\boldsymbol{\sigma}_u = \mathbf{kgm/m^2}$. Pressure is then $(\boldsymbol{\sigma}_u)(\mathbf{a_n})$ where $\mathbf{a_n}$ is acceleration normal to the scalar density field which is any direction since $\boldsymbol{\sigma}_u$ is an intrinsic reactionary property of space irrespective of direction.

A dilating spherical space gives up energy as it expands. When the pressure reaches zero, there is no kinetic energy left to do work against the container. Further expansion requires work-

energy be added to system. This was McCrea's catenation of an energy creating expansion algorithm which preserves the status quo. But unmoderated negative pressure can lead to runaway growth, a condition now believed to be the current state of Hubble expansion. Whatever space is, volumetric increase appears to be proportional to existing volume, a result which follows from the natural law of geometric multiplication (a form of positive feedback). Not by coincidence, this also coincides with what is believed to be the correct interpretation of the velocity-distance law [**v = Hr**], which, for constant **H**, can be assumed to be empty accelerating space, (e.g. an expanding 2-sphere shell universe or a real universe where positive matter energy equals negative potential energy).

$$\mathbf{[dv/dt = H(dr/dt) = Hv]}. \qquad \text{(X-1B)}$$

Substituting '**c**' for '**v**' and '**c/R**' for **H**, then $\mathbf{dv/dt = c^2/R}$. Per (X-6) below, $\mathbf{c^2/R}$ also corresponds to **q = -1** de Sitter expansion, all enrolled herein as meaning isotropic acceleration $\mathbf{a_n}$ normal to ($\boldsymbol{\sigma_u}$).

The inertial affect of matter upon expanding space follows from Newton's 2nd law. The isotropic acceleration field acting upon a mass $\mathbf{M_e}$ creates counter reaction force $\mathbf{M_e(a_n)}$. If $\mathbf{M_e}$ is a spherically uniform inertial mass of radius $\mathbf{r_e}$, the counter pressure at all points of the surface $\mathbf{4\pi r_e^2}$ must equal the source pressure that produced the counter action. Specifically,

$$\frac{\mathbf{F}}{\mathbf{A}} = \frac{\mathbf{M_u}}{\mathbf{A_u}}(\mathbf{g}) = \frac{\mathbf{M_e}}{\mathbf{A_e}}(\mathbf{a_n}) = \boldsymbol{\sigma_u}\mathbf{g} \qquad \text{(X-2A)}$$

Equation (X-2A) is Newton's 2nd law in gravitational field form: "*The pressure created by the cosmological acceleration field $\boldsymbol{a_n}$ acting upon a local mass having a mass to area ratio $\boldsymbol{M_e/A_e}$ is equal to the pressure created by the '**g**' field counter acceleration acting upon the cosmological scalar density function $\boldsymbol{\sigma_u}$.*"

The intensity of the force per unit area at any point **r** beyond $\mathbf{r_e}$ is inversely proportional to the surface area $\mathbf{4\pi r^2}$ of an imaginary concentric sphere of radius **r** over which the force is distributed. Thus, for any distance '**r**' from the mass center ($\mathbf{r_e < r < R}$), reactionary counter acceleration will be proportional to the isotropic acceleration field divided by the area of the imaginary sphere $\mathbf{4\pi r^2}$. From (X2-A),

$$\mathbf{P_E} = \left(\frac{\mathbf{M_e}}{\mathbf{A_e}}\right)(\mathbf{a_n}), \text{ and } \mathbf{P_u} = \frac{\mathbf{M_u}}{\mathbf{A_u}}\mathbf{g} = (\boldsymbol{\sigma_u})\mathbf{g}$$

For the pressure $\mathbf{P_E}$ to equal $\mathbf{P_u}$ at the space−mass interface, then:

$$\mathbf{g} = \frac{\mathbf{P_E}}{\boldsymbol{\sigma_u}} = \left[\frac{\mathbf{M_e}}{\mathbf{A_e}}\right]\left[\frac{\mathbf{a_n}}{\boldsymbol{\sigma_u}}\right] = \left[\frac{\mathbf{M_e}}{\mathbf{4\pi r^2}}\right]\left[\frac{\mathbf{a_n}}{\boldsymbol{\sigma_u}}\right] = \left[\frac{\mathbf{c^2}}{\mathbf{4\pi R}\boldsymbol{\sigma_u}}\right]\left(\frac{\mathbf{M_e}}{\mathbf{r^2}}\right)$$

identifying……$\dfrac{\mathbf{c^2}}{\mathbf{4\pi R}\boldsymbol{\sigma_u}}$ **as big G**

$$\mathbf{g} = \mathbf{G}\frac{\mathbf{M_e}}{\mathbf{r^2}} \text{……(X−2B)}$$

As a check on (X-2B), we use our previous estimate for $\mathbf{R = 1.1\ x10^{26}}$ meters, in which case $[\mathbf{c^2/4\pi R\sigma_u}]$ equates to $\mathbf{6.5\ x\ 10^{-11}\ m^3/sec^2\ per\ kgm}$), well within would could be expected considering the uncertainly in both cosmic mass and radius. In summary, $\mathbf{G/4\pi}$ is simply directionally resolved Hubble expansion $[\mathbf{12\pi Rc^2/3}]$ divided by Hubble mass $[\mathbf{\rho_u(4/3)\pi R^3}]$.[1]

Although not possible to recognize in Newton's time, the mysterious attraction between masses can now be seen is a paradigm of 2nd law symmetry. In resisting expansion, each quantum of inertial matter pulls back upon the expansion field creating local negative pressure that reach a maximum at the space-mass interface. As presaged by Einstein, acceleration is relative. The Hubble sphere is an inertial frame, net force equals zero and therefor acceleration, like energy, is balanced to zero, whether in form as velocity change or gravitational attraction of mass.

If $\mathbf{M_u}$ is to be a player in forging Newton's laws of inertia and gravity from Mach's Principle, the formularising of **G** must reflect the scalar field $\mathbf{\sigma_u = M_u/4\pi R^2}$ as an instantaneous presence throughout the Hubble volume. Transformation from volume to surface density follows from the divergence theorem,

$$\iiint_{\mathbf{v}} \rho_{\mathbf{u}}\mathbf{dV} = \iint_{\mathbf{s}} \sigma(\mathbf{dA})$$

The integral of $\mathbf{dA = 4\pi R^{2}}$, the integral over the volume $\mathbf{dV= (4/3)\pi R^3}$. The scalar density field is thus related to volumetric density as:

$$\mathbf{\sigma_u = \rho_u R/3} \qquad \text{(X-3)}$$

and the pressure of the void far removed from matter in a $\mathbf{q = -1}$ universe having scalar density per (X-3) is:

$$\mathbf{(-P) = (c^2/R)(\rho_u R/3) = \rho_u c^2/3} \qquad \text{(X-4)}$$

as required to cancel positive mass energy in Einstein's field equation.[2] Isotropic $\mathbf{c^2/R}$ acceleration is thus synonymous with ($\mathbf{q = -1}$) de Sitter expansion.[3] While positive pressure is uniform in a closed container *a la* Pascal's law, expanding negative pressure creates gradients in the vicinity of non expanding matter. As per (X2-B) these gradients are the '**g**' fields of local matter.

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[1]Because local '**g**' fields are diluted by the area $\mathbf{4\pi r^2}$ over which the reactionary force is spread, the $\mathbf{4\pi}$ factor should logically be assigned to the'**g**' field instead of big **G.** The clandestine presence of $\mathbf{1/4\pi}$ as a numerical additive to the value of big **G** isn't going to go away, however, because the empirical process always involves masses acting upon another

[2]In a purely massless void, $\mathbf{\rho = 0}$, so pressure must also be zero. This was de Sitter's adaptation of Einstein's gravitational equation that reduced to $\mathbf{\Lambda}$ as exponentially expanding space. Initially regarded as an unrealistic curiosity until Howard Robertson showed that real solutions could be obtained if mass were sprinkling throughout the volume. Expansion acting upon the scattered masses creates gradients in the form of negative pressure '**g**' fields, continuous action in the form of global expansion being necessary for the sustenance thereof.

[3]Transition from a more leisurely pace to accelerated expansion thus looms as a plausibility for a universe expanding from a hot dense genesis. If the present theory of accelerating expansion is ultimately validated, there is reason to consider the transition state as that which existed when decreasing energy density was overcome by negative cosmological pressure.

To recapitulate, we imagine the Hubble density $\boldsymbol{\rho_u}$ reconfigured as a shell having surface area $\mathbf{4\pi R^2}$ and density $\boldsymbol{\sigma_u}$ = **1 kgm/m²**. Per (X-4), de-Sitter expansion of the empty interior volume equates to isotropic radial acceleration $\mathbf{c^2/R}$, and corresponding free space negative pressure $\boldsymbol{\sigma_u(c^2/R)}$. There being no real Hubble matter shell upon which acceleration can operate, negative pressure must conceptualize as isotropic momentum flow (recessional space velocity). By this means, empty space is endowed with the scalar density function $\boldsymbol{\sigma_u}$ = **kgm/m²**, the dynamic reactive field encoded in Newton's second law. The shell metaphor having served its purpose, matter is then redistributed throughout the volume, the negative pressure of locally created '**g**' fields balanced against the negative pressure created by expanding space as each individual mass bares in relation to the Hubble scalar density $\boldsymbol{\sigma_u}$ **= 1 kgm/m²**. By this artifice, Hubble density $\boldsymbol{\rho_u}$ enters as $\mathbf{1/\sigma_u}$, thus sustaining the inertial lineage of mass as the legitimate issue of its Machian progenitor.

A collateral implication of the above synopsis, sheds light on the answer to the question originally posed as to why gravity depends from Hubble parameters rather than the size and mass of the unobservable universe beyond. If the ratio $\boldsymbol{\sigma_u}$ **= 1 kgm/m²** is temporally invariant, the inertial dependence of mass is tied to the spatial dilation rate, in which case, all volumes, no matter how large, will exhibit the same scalar density field and consequently lead to the same results for big **G**. We explore these possibilities with greater detail in Part I.

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The quest to derive **G** from first principles, is in one sense, historically established in the works of Alexander Friedmann (circa 1923) and later George Lemaitre (circa 1930), in that both men, working independently, were able to formulate a model for the expanding universe in terms of the Hubble parameters **G**, **c**, **R** and $\mathbf{M_u}$. Prior to GR, gravitational force was believed to emanate from within matter. While Einstein disposed of the need for separate gravitational mass *per se*, he did so at the expense of creating a new physics principle, namely that inert matter bends static space. While spacetime is affected by inertial mass, the mechanism is dynamic in origin. **G** comprehended in terms of its units (volumetric acceleration per unit mass) is described by expanding space diluted by the area over which it is spread. Taken as the inertial effect of matter upon spatial expansion dissolves the mystery with no new physics required. As example, (X-5) equates the well know relationship between the deceleration parameter **q** and density as:

$$\boldsymbol{\rho_u = (-q)(3H^2/4\pi G)} \qquad \text{(X-5)}$$

For **q = +1/2**, (X-5) predicts exponential deceleration. For de Sitter's universe, **q = -1**, expansion grows at an exponentially accelerating rate:

$$\ddot{\mathbf{R}} = (-\mathbf{q})\frac{\dot{\mathbf{R}}^{\,2}}{\mathbf{R}} = \frac{\mathbf{c}^2}{\mathbf{R}} \qquad \text{(X-6)}$$

Equation (X-5) is then: $\boldsymbol{\rho_u = (3H^2/4\pi G)}$ (X-7)

Rearranging gives: $\mathbf{G = [3H^2/4\pi(\rho_u)] = [3(c^2/R^2)]/[4\pi\rho_u]}$ (X-8)

And from (X-3), then: $\mathbf{G = c^2/4\pi R\sigma_u}$ (X-9)

The application of Newton's 2nd law to gravity follows from another familiar relationship of longstanding intrigue, namely the force acting upon a mass $\mathbf{M_E}$ at the Hubble manifold. Since Newton's gravitational equation treats the mass of a uniform sphere as concentrated at its center, then from his second law:

$$\mathbf{F = M_u a_n = GM_u M_E/R^2} \qquad \text{(X-11)}$$

where '$\mathbf{a_n}$' = $\mathbf{c^2/R}$ obtains from the definition of **q** in (X-6). Rearranging:

$$\mathbf{G = (c^2/R)(R^2/M_u) = c^2R/M_u} \qquad \text{(X-12)}$$

Which will be recognized as the mysterious ratio:

$$\frac{\mathbf{M_u G}}{\mathbf{c^2 R}} = \mathbf{1} \qquad \text{(X-13)}$$

puzzled over by cosmologists for many years. Within the limits of experimental error, why should the Hubble mass $\mathbf{M_u}$ multiplied by **G** equal the Hubble scale factor **R** multiplied by the speed of light squared ($\mathbf{c^2}$). Such notables as Robert Dicke and Carl Brans long studied the relationship in search of a Scalar-Tensor theory of gravity underwritten by Mach's Principle.[4] The numerator was deemed to represent "gravitational mass," the denominator "inertial mass." While attempts to establish the ratio on a theoretical basis have not been accepted by the regimented majority of cosmological professionals, there can be no doubt about the fact that (X-13) confirms our expansion synthesized development of **G** in that both expressions lead to the same result. Specifically, substituting [Hubble volume x Hubble density] for Hubble mass $\mathbf{M_u}$ in the (X-13) ratio gives:

$$\mathbf{G = (c^2R)[\rho_u(4/3)\pi R^3]^{-1} = 3H^2/4\pi\rho_u} \qquad \text{(X-14)}$$

And from (X-3), then:

$$\mathbf{G = c^2/4\pi R\sigma_u} \qquad \text{(X-15)}$$

as deduced from (X-2B)

[4] Carl Brans, "Varying Newton's constant: A personal history of scalar Tensor Theories, *in Einstein Online* Vol. o4 (2010), 1002.

Notes

FEYNMAN'S FOLLY

"One very important feature of pseudo forces is that they are always proportional to the masses. The same is true of gravity. The possibility exists therefore that gravity itself is a pseudo force. Is it not possible that perhaps gravitation is due simply to the fact we do not have the right coordinate system?"

Feynman - Lectures on physics

For Richard Feynman, the idea that gravity could be a delusory manifest of some known phenomena seemed to be always with him. In his Lectures on Gravity, he frames the issue thus:[1]

1) Gravitation is a new Field of its own, unlike anything else, or

2) Gravity is a consequence of something already known but incorrectly perceived.

New Physics requires strong evidence. The empirical support for a theory of gravitons congruent with the successful predictions of Einstein's geometric was then, and is today, still missing. But does static space really curve, and if not, do gravitons really exist? If neither, then what slumbers within the tiniest increments of matter to summon one mass to another. Perhaps the culprit is space itself. Indeed, some characteristics commonly attributed to the void are similar to those of solids, liquids and gases. Still, well understood descriptors such as expansion, distortion, and pressure, can be nebulous and even contrary when applied to massless volume.

Feynman referred to forces that result from acceleration as "*pseudo forces*" (instantaneous inertial opposition proportional to mass).[2] The identity of the structure undergoing acceleration, however, is not specified by Newton's second law, at least not by Newton. Symmetry of action, however, is a mandate of conservation, in the case of gravity and inertia, it is conservation of force. As Einstein foretold, inertial reaction and gravity are opposite sides of the same coin. If local '**g**' fields are negative pressure gradients, how is virtual stress stored? Dimensionally, pressure is momentum flow, and for the cosmos, momentum flow is spatial expansion.

Reversing the roles between space and matter excites new possibilities. While working out the theory of General Relativity, Einstein explored the properties the universe must posses to prevent the detection of absolute motion.[3] What followed was the principle of relative acceleration...the force felt by the crew of an accelerating rocket ship is no different than that experienced by the same crew at rest in a universe undergoing unidirectional acceleration. How might this pseudo force be distinguished? Although not recognized as such, the answer would come with the discovery of cosmological expansion. Accelerating objects feel inertial reactions as pseudo forces. Masses subjected to isotropic spatial acceleration, create counter reactions. Embellishing upon Feynman's musings, we look further into the expansion mechanism from the perspectives of the prelude.

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[1]Feynman, Lectures on Gravity, Lecture 1, §1.5

[2]Feynman, Lectures on Physics, Vol I, §12-5

[3]'Understanding Physics, Isaac Asimov, Barns and Noble 1993. Mechanism at pages 115-120:

As Einstein foretold, gravitational and inertial mass are equivalent. More correctly, the gravitational effect (a la General Relativity) is curvature of static space induced by inertial matter. But throughout the 18th and 19th centuries, the inertial property of mass was patently observable only as opposition to changing velocity. In General Relativity, mass was given a new job description–that of bending static space, a functional addition to that of opposing acceleration.

As developed herein, inertial matter at rest in expanding space feels reactive forces analogous to those measured when objects are accelerated relative to the cosmological rest frame. Because matter is composed of particles held together by electric and quantum forces, these forms of energy are not disassociated or deformed by the relatively weak expansion field. Expansion resistant masses create counter fields proportionate to their masses. To complete the formalization of gravity as a pseudo force within Feynman's denotation, a **corporal** vitality must be identified and quantified.

Mass, gravity, space, time and charge are intimately entwined. As one of two long range force fields, gravity will necessarily depend upon the content and action of the cosmos of which it is a part.[4] Commencing with a 2-dimensional template built upon reasonable estimates of Hubble mass **(1.5×10^{53} kgm)** and size **(1.1×10^{26})** meters, we previously improvised an expanding shell having surface density σ_u **= one kgm/meter^2** By this artifice, we morphed Machian mass into Hubble expansion to create a reactive surface density[5]

$$\sigma_u = (1.5 \times 10^{53}\ \text{kgm})/4\pi(1.1 \times 10^{26}\ \text{m})^2 \approx \text{one kgm/meter}^2 \qquad (1)$$

As a corollary, cosmic mass-energy can then be conveniently expressed as:

$$M_u = 4\pi R^2\ \text{kgm/meters}^2 \ = \ 4\pi R^2 \sigma_u \qquad (2)$$

Figure 1 illustrates the relationship between gravity and expansion, wherein the energy content of the Hubble sphere M_u is imagined as uniformly spread over the Hubble surface. The gravitational energy U_2 of the 2- sphere construct is [6]

$$U_2 = \frac{(M_u)^2 G}{2R} \qquad (3)$$

The implications of (2) appear to impose rigorous conditions upon the expansion state of a zero energy universe when not accelerating; As later submitted, inertial energy must increase as R^2.

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[4]When asked to summarize G.R. in one sentence Einstein Replied: *"Time, and space and gravitation have no separate existence from matter....physical objects are not in space, but these objects are spatially extended."*

[5]The 2-sphere is a make-believe **E**xpanding **R**ubber **S**heet **A**nalogy [**ERSA**] where imaginary experiments can be made and results projected to the real world of three dimensional space. A true 2-sphere universe only has two dimensions. Our analogy of an empty interior 3-sphere borrows the 2-sphere formulation of energy as σ_u. The "Toy Model" in the context herein, is a set of parameters to be played-with to test different theories.

[6]The gravitational energy depends upon how mass is distributed. The energy of a shell structure will be less that M_u by a factor of ½ (i.e., the sum of the separate masses if far removed from one another is twice of the shell model). For a uniform density three-sphere, the energy deficit is greater than the shell model by a factor of 6/5. Exact calculation is not trivial for our lumpy Hubble, as extensively studied by Arnowitt, Deser and Misner [(Physics Rev, Lett **4** (1960) 375, Rev **118**, (1960) 1100 and **120**, (1960) 313].

If empty interior is given a spatial dimension, the 2-sphere becomes a 3-sphere, permitting bits of matter to be sprinkled throughout the volume. Per Feynman, "it costs nothing to create a mass at the center of a Hubble sphere (which is anywhere)." In a zero energy universe, positive $\mathbf{Mc^2}$ energy is balanced by its negative gravitational potential. The interior can therefore be uniformly populated with chunks of matter from the shell while still retaining the notion of an inertial scalar density function $\boldsymbol{\sigma_u}$. What is not in the shell is now in the interior volume faithfully fulfilling the job of opposing expansion by pulling back upon the acceleration field created by global expansion. Each point is the center of its own Hubble sphere, it makes no difference where the shell is imaged. Transition from shell mechanics to the real world of 3-sphere homogeneity completes the ontogeny.

Transfer of the first mass $\mathbf{M_E}$ to the center of $\boldsymbol{\sigma_u}$ cost nothing in terms of energy.[7] By like reasoning, it costs nothing in energy to constellate $\mathbf{M_E}$ anywhere.[8] However, as the interior density increases, the gravitational energy deficit also increases.[9]

Because of expansion, $\boldsymbol{\sigma_U}$ and $\mathbf{M_E}$ are mutually attracted, each exerting a symmetrically balanced force upon the other.

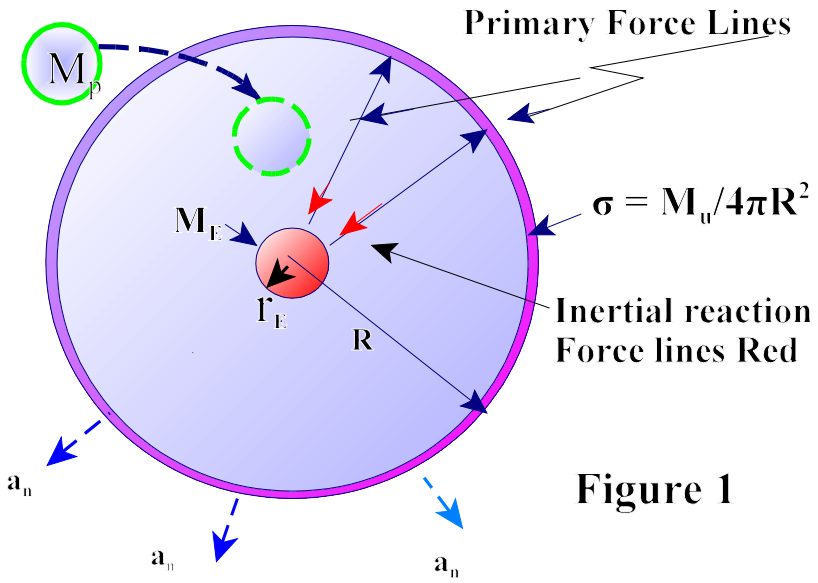

Figure 1

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[7]Throughout Part I of this treatise, capitol **M** refers to ordinary matter mass and lower case '**m**' refers to meters In Part II a subscripted lower case (e.g., $\mathbf{m_o}$) refers to a subatomic mass

[8]To quote Richard Feynman: "it cost nothing to create a mass." The idea of a net zero (energy) universe appears to have originated with him, although he did not pursue it further. (Feynman - Lectures on Gravity)

[9] When all shell matter is distributed uniformly throughout the volume, the gravitational energy will increase by a factor of 6/5. To Construct a 3-sphere universe using the same mass to create the same gravitational energy will change either **R** or **G**. However, from a dimensional aspect, **G** is determined by volumetric acceleration, its value is not directly linked to the energy involved in redistribution. But **G** is a factor that depends upon **R**

Expansion being yet undiscovered in 1916, Einstein inventively dismissed the lack of a force by postulating a new physics principle, namely: "*mass induced curvature of static space*."[10] While General Relativity correctly predicts the motion of masses along geodesics of curved space, it does so by injecting the empirical value of **G** at the critical point where functionality is wanting. By contrast, the "pseudo force" conceptualization of gravity requires no new physics. The universe takes on de Sitter persona, expansion is exponential, so **R** is constant.

The foremost question, there being no real Hubble surface to oppose spatial expansion and acceleration of objects in general, how justified is the ubiquitous scalar density function $\boldsymbol{\sigma_u}$? The answer turns upon the non severability of space and mass. Pressure is momentum flow. In de Sitter's universe, isotropic momentum flow equates to spatial expansion:

$$\mathbf{P = \rho_u c^2/3 = (c^2/3)(3\sigma_u) = \sigma_u c^2/R} \tag{4}$$

Momentum carried by recessional flow thus defines the negative pressure field. The metaphorical scalar density surface is in reality an eclat of the expansion field. Opposition to acceleration is due to the embedification of Hubble mass within the expansion dynamic.

In **Figure 1**, the black arrows illustrate isotropic spatial expansion $\mathbf{c^2/R}$, the Hubble manifold being depicted as a stretching shell having surface density $\boldsymbol{\sigma_u}$ per (2). The isotropic global acceleration field will create a counter acceleration field at the space-matter interface of any non-expanding inertial object [e.g., $\mathbf{M_E}$] as shown by red arrows]. In one of natures deceptive charades, reactionary '**g**' fields appear to magically originate internally.

Einstein saw through vale. He perceived gravity as curved space. But there was no physical law that predicted how space gets curved. Ultimately, he seized upon mass as causal.[11] Expansion was yet to be discovered, the **G** field could not then be reckoned as a natural result thereof.

When local '**g**' fields are viewed as counter actions, it is the **G** field that is rucked by inertial matter. Since '**g**' fields diminish inversely with area (same number of imaginary force lines cross each surface encompassing $\mathbf{M_E}$), the sum over an encompassing surface at distance $\mathbf{r_1 > r_E}$ is the same as any other encompassing surface at distance $\mathbf{r_2 > r_E}$ Thus:

$$\mathbf{F = [M_E(c^2/R)/\sigma_u][1/4\pi r^2]} \tag{5}$$

As developed in the Prelude, field intensity for a mass $\mathbf{M_E}$ in an expanding three dimensional universe can be expressed in terms of the area over which the force is spread. Each mass reacts to the pressure $\mathbf{\rho_u c^2/3}$ to create its own local '**g**' field proportionate thereto. Rewriting (5) as:

$$\mathbf{F = F_g = G[(M_E)/r^2]} \tag{6}$$

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[10]To complete the theory, Einstein set up a static field equation, the left side he referred to as made of fine marble. It represented the scalar Riemannian manifold which described curved spacetime. The right side he dubbed a "house of straw." It premised matter as the cause. Only after discovering the elegance of the mathematical construct, did he artfully introduce a new role for mass as the provocateur of curvature. He was confident about the marble mansion, but never quite satisfied with the "house of straw.

[11]"God hath chosen the most foolish things of the world to confound the wise." (1st Corinthians I, vs 27).

where, as in the prelude $\mathbf{c^2/4\pi R\sigma_2}$ has been replaced by the symbol **G**. If there is no spatial expansion, there can be no force between $\boldsymbol{\sigma_2}$ and $\mathbf{M_E}$. However, the universe itself can be treated as a reactionary mass $\mathbf{M_u}$ wherein spatial expansion throughout the cosmic volume will create a counter acceleration field '$\mathbf{a_n}$' as:

$$\mathbf{a_n = M_u G/R^2} \tag{7}$$

From (2), (3) and (7): $$\mathbf{G = [a_n/4\pi\sigma_u] = c^2/4\pi R\sigma_u} \tag{8}$$

which has the same scalar-vector composition as the **G** field *derived in the Prelude a la* $\boldsymbol{\sigma_u}$ and $\mathbf{a_n}$.

Adverting again to **Figure 1**, mass beyond the surface of $\mathbf{M_E}$ does not add to the '**g**' field of **E**.[12] A second particle **P** introduced into **E's** Hubble arena, defines its own Hubble coordinate center. The reaction field of both $\mathbf{M_p}$ and $\mathbf{M_E}$ will be isotropic except to the extent $\mathbf{M_E}$ and $\mathbf{M_p}$ act upon one another. Global expansion thus converts Newton's 2nd law to volumetric expansion per unit mass resulting in the acceleration gradients that cause masses to be attracted to one another.

In what proceeded, $\boldsymbol{\sigma_u}$ was used to derive the negative pressure field for the shell model. While volumetric spatial acceleration is the source, it will be seen that the essence of $\boldsymbol{\sigma_u}$ is the quantity of matter contained by the Hubble sphere and its dependence upon $\mathbf{4\pi R^2}$.

Comes now an application of Hubble size as a mensuration artifice. While there appears to be no physical consequence to the observational limit **R**, the Hubble scale and the Hubble mass are nonetheless determinates of **G**, a curious state as rhetorically posed in the prelude. Both mass and space are cloaked in the form of a scalar density ratio $\boldsymbol{\sigma_u}$ and **R** is the unique distance where spatial recessional flow equals "**c**." Here we will attempt to shed light upon why the Hubble parameters determination **G**.

Volumetric growth of space $\dot{\mathbf{V}}$ within the Hubble sphere and its derivative $\ddot{\mathbf{V}}$ (volumetric acceleration) can be related to isotropic spatial flux $\dot{R}$ and its rate of change $\ddot{R}$. To find the internal production rate of space, we construct an imaginary Gaussian surface **S** of radius $\mathbf{R_S}$ to encompass the Hubble volume as shown in **Figure 2.** Accordingly, the following relations hold:

$$\mathbf{V} = \frac{\mathbf{4}}{\mathbf{3}}\pi\mathbf{R}^3 \quad \text{.....(9)}$$

$$\dot{\mathbf{V}} = (\mathbf{4}\pi\mathbf{R}^2)(\dot{\mathbf{R}})$$

$$\ddot{\mathbf{V}} = \mathbf{8}\pi\mathbf{R}(\dot{\mathbf{R}})^2 + \mathbf{4}\pi\mathbf{R}^2(\ddot{\mathbf{R}}) \quad \text{.....(10)}$$

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[12] Because the gravitational force of $\mathbf{M_E}$ is not affected by matter beyond the surface of the sphere $\mathbf{r_E}$ the **g** field of $\mathbf{M_E}$ can only be the result of spatial expansion, the two sphere shell density $\boldsymbol{\sigma_u}$ has no obvious affect upon $\mathbf{M_E}$ Nonetheless the mass $\mathbf{M_u}$ is indirectly a factor in the constellation of **G** since it is encoded in the formulation *a la* $\boldsymbol{\sigma_u}$.

Figure 2

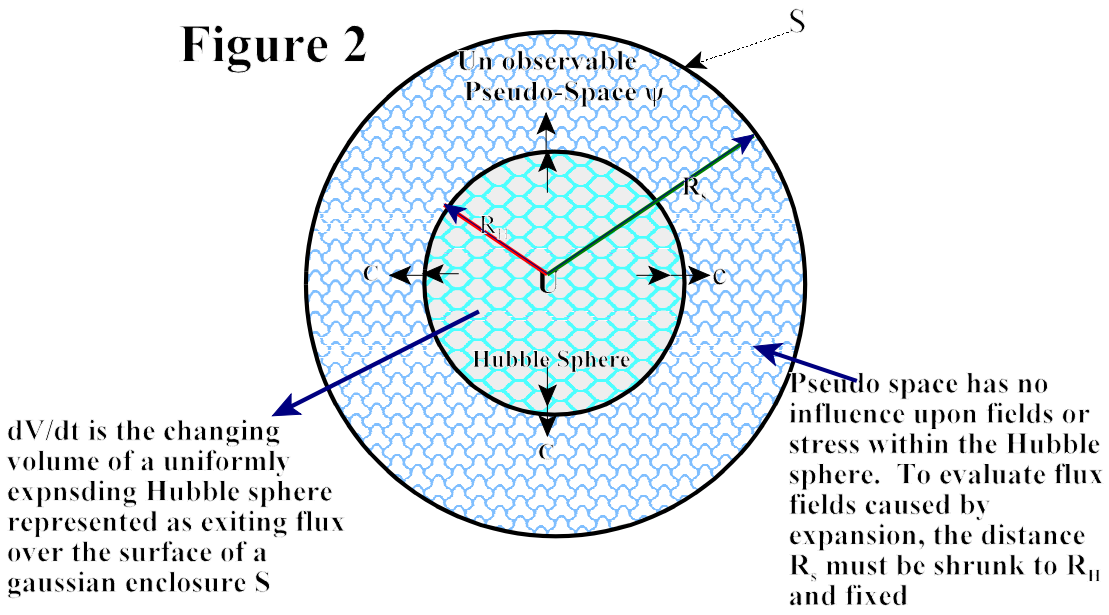

Figure 2: The radius of the expanding Hubble sphere is given a subscript R_H to distinguish it from the fixed Gaussian sphere R_S. A Hubble scale R_H has volume $V_H = (4/3)\pi(R_H)^3$. For uniform radial dilation at velocity 'c' the volumetric acceleration of the Hubble sphere is $[8\pi(R_H)(c^2)]$. R_S represents the radius of a spherical Gaussian enclosure having a fixed surface area $4\pi(R_S)^2$. For a uniformly expanding space [$\dot{R} = c$] the rate of change of spatial volume dV/dt will equal $4\pi R_H^2 c$ as indicated by the arrow dV/dt denoting spatial volume per second exiting across the fixed Gaussian surface. In a slowing universe, the observational sphere dilates at greater velocity than the recessional flow of internally expanding space; in an accelerating universe, the opposite is true. To evaluate the present state of the universe, it is necessary to know whether the acceleration is zero, positive or negative at R. When the radius of the Gaussian surface S is shrunk to $R_S = R_H$ (or conversely when the Hubble has expanded to R_S) the Gaussian surface takes a snapshot of the exiting flow as measured by the metering orifice $4\pi R_s^2$. The conceptual significance of spatial flux exiting across the Gaussian surface is that it reveals the dynamic state of the universe within the observational limit at the instant of measurement. All space beyond R_H can be ignored since only changes within the Hubble sphere contribute to acceleration. The changing radius of the observational limit has no obvious physical or functional effect in determining the value of G. The instantaneous Hubble radius does specify where to put the Gaussian gauge for measuring the internal rate of spatial growth in terms of the exit flux at the instant of coincidence. This corresponds to a closed structure wherein gravitational mass is balanced by negative gravitational energy. R is fixed during exponential expansion, and therefore no new negative energy can be created as would be required to fill an expanding negative volume, and therefore no increase in positive inertial matter energy is possible in a zero energy universe. In this sentience, the Hubble parameters determine G.

Encompassing the Hubble sphere with a Gaussian surround '**S**' concurrent with the Hubble sphere at the instant of measurement is an adaptation of a volume to surface transformation first elaborated by the 18th century mathematician, Carl Friedrich Gauss.[13] For purposes of determining volumetric acceleration, the Hubble universe is considered devoid of mass, composed only of infinitesimal volumes, each expanding uniformly in three dimensions. In this expose´ volumetric expansion of space is treated as a functional operative at the smallest limit of existence (The vector divergence field is expressed mathematically as the fractional change in volume per unit area as the area approaches zero). Fractional change in volume per unit area can thus be regarded as a dynamic modulus, a measure of the intrinsic characteristic of space as expansion. Gauss's divergence theorem relates the integral over the volume of the surface that contains the divergences to the flux exiting across the surface that contains the volume. To apply the theorem to an expanding Hubble sphere, we sum over the exiting volume of recessional space and divide by the surface area of the Gaussian surround $\mathbf{4\pi R_S^2}$. At the juncture of coincidence, $\mathbf{R_H = R_S = R}$, then from (10):

$$\frac{\ddot{\mathbf{V}}}{\mathbf{Area}} = \frac{\mathbf{8\pi R(\dot{R})^2 + 4\pi R^2(\ddot{R})^2}}{\mathbf{4\pi R^2}} = \frac{\mathbf{2\dot{R}^2}}{\mathbf{R}} + \mathbf{\ddot{R}} \tag{11}$$

When (11) is expressed in terms of the deceleration parameter "**q**" then:[14]

$$\frac{\ddot{\mathbf{V}}}{\mathbf{Area}} = \frac{\mathbf{(\dot{R})^2}}{\mathbf{R}}\mathbf{[2-q]},$$

$$\mathbf{where\ldots q} = -\frac{\mathbf{\ddot{R}R}}{\mathbf{\dot{R}^2}} \tag{12}$$

In an accelerating universe, **q = -1**, and therefore:

$$\frac{\ddot{\mathbf{V}}}{\mathbf{Area}} = \mathbf{A_H} = \frac{\mathbf{3c^2}}{\mathbf{R}} = \mathbf{3H^2R} \tag{13}$$

Equation (13) expresses the volumetric acceleration per unit area of an exponentially expanding Hubble sphere in terms of the Hubble constant. But equation (13) is also Einstein's prescription for

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[13] **Johann Carl Friedrich Gauss** (1777 — 1855) sometimes referred to as the *Princeps mathematicorum* (The Prince of Mathematicians)..

[14] After the discovery of the velocity-distance law **v = Hr** circa 1928**,** and throughout most of the 20th century, expansion was assumed to be slowing due to gravity. To express the rate of change in terms of velocity and distance, a **q** factor was concocted with a minus sign and given the name "deceleration parameter." If the rate of expansion is increasing with time, then **dv/dt** is positive and equal to **H(dr/dt)** or what is the same, $\mathbf{H^2r}$. At the Hubble distance **r = R** and **v = c**, so recessional flux exiting the Hubble sphere at any point is normal thereto. The Hubble surface is the transluminal locus of the **q = -1** universe where velocity is **c** and acceleration is ($\mathbf{c^2/R}$).

a static universe. [15] More specifically, to balance the gravitational force $\mathbf{F_G}$ tending to collapse the universe:

$$\mathbf{F_G = GM_u/R^2 = 4\pi G\rho_u R/3}. \quad (14)$$

Einstein introduced a counter force $\mathbf{\Lambda}$ that, when multiplied by **R/3**, would cancel gravity on the global scale. From the Friedmann-Lemaitre equations, this can be expressed as:

$$\mathbf{\Lambda R/3 = - 4\pi G\rho_u R/3 = -H^2 R}$$

And therefore: $$\mathbf{\Lambda = 3H^2} \quad (15)$$

Exponential spatial growth is locked to the velocity '**c**' at distance **R** where recessional space becomes transluminal, that is, where $\mathbf{c = HR}$ and $\mathbf{a_n = c^2/R}$. How is it, that $\mathbf{\Lambda}$, can at once fix Einstein's universe as static while simultaneously sourcing exponential expansion. Metamorphosis from static to dynamic follows from the physical emulation of $\mathbf{\Lambda}$ as spatial expansion. For the mathematical model (General Relativity) to be static, the physiology must be functionally dynamic. When Einstein's $\mathbf{\Lambda}$ is embodied as spatial expansion, **G** emerges as $\mathbf{\Lambda/4\pi\rho_u}$.

The physical interpretation of Einstein's cosmological constant is de Sitter's exponentially expanding void. Expanding space is the implementation of Einstein's prescription for a balanced universe. As originally envisioned, it was an independent operative purposely instituted to counter gravity. In reality the opposite is true. **G** is the manifest of global expansion—the intrinsic property of space as isotropic dilation. Recognition of $\mathbf{\Lambda}$ as the elusive root cause of **G** renders the universe comprehensible. The isotropic acceleration field $\mathbf{c^2/R = 4\pi G\sigma_u}$.

In the light of later discoveries, Einstein's inclusion of $\mathbf{\Lambda}$ in the 1916-1917 edition of the General Theory, proves to be of great value. The relevance of $\mathbf{\Lambda}$ as the source of **G** resolves several

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[15] The same relationship follows if the $\mathbf{M_E}$ is placed immediately beyond the Hubble surface. $\mathbf{M_E}$ can now be considered a point mass separated from $\mathbf{\sigma}$ by distance **R** per (6). The velocity-distance law specifies the acceleration, i.e., if the rate of spatial expansion is increasing in proportion to the amount of space in existence, then since **v = Hr,** the acceleration is:

$$\mathbf{dv/dt = H(dr/dt) = Hv = H^2 r.}$$

At the Hubble sphere, **r = R**, so the acceleration '**a**' is = $\mathbf{H^2/R}$. Equating this as the acceleration produced by the gravity field of the universe per(6) then:

$$\mathbf{M_u G/R^2 = H^2/R}$$

Substituting the cosmic density-volume product $\mathbf{\rho_u V}$ of the Hubble universe for $\mathbf{M_u}$, there results:

$$\mathbf{G = 3H^2/4\pi\rho_u}$$

This value is listed in the "Electronics World" table of constants. It obviously cannot be a constant because of the factor $\mathbf{\rho_u}$ in the denominator. Nor does it provide a physical model for **G** that can be used to rationalize the implied increase in **G** as the universe expands. [density is normally considered to diminish as $(1/R^3)$]. The derivation is not without merit however. When properly modified by a mass accretion algorithm, the above leads to the same value for **G** as the expanding two sphere model shown in **Figure 1**.

enigmas, including the puzzling question of why density appears to be miraculously balanced between run-away expansion and gravitational collapse.

Isotropic exponential expansion of space *a la* Eienstein's **Λ** field provides a convenient coordinate system for expressing gravitational effects as pseudo forces. The inertial reaction of matter in reply to cosmological acceleration masquerades as locally originated, but as Einstein correctly observed, in reality there is no gravitational mass *per se*. Inert matter in repose cannot self-create a force in static space. Inertial matter, can however, resist isotopic expansion, and in so doing, create a counter acceleration field of much greater intensity that the **G** field from which it derives. $\mathbf{M_E G}$ like all pseudo forces, is simply a Newtonian (2nd Law) reaction that must necessarily be spread over the matter-space interface upon which the isotropic expansion field acts. **G** defines **(g)** when properly scaled by local mass and surface area.

General Relativity outputs correct results, but the theory is incomplete, it does not predict the value of **G**, which can now be understood, at least in our present era, as exponential spatial expansion. Gravitational and inertial mass are equivalent because both are inertial reactions.

From an simple perspective, all spherical masses as well as the universe, can be considered shells for the purpose of quickly calculating local '**g**' fields, that is, for an object '**x**'

$$\mathbf{g_x = a_n(\sigma_x/\sigma_u)} \tag{16}$$

Λ acts upon the matter shell of a local mass to create isotropic inertial reaction, the intensity of the pseudo force field diminishes inversely with the square of the distance, while at the same time the area of the field increases with the square of the distance. The result is that total reactionary force is the same at every distance, consequently the isotropic reactionary force acting against the expansion field is the same as $\mathbf{M_u}$ exerts upon $\mathbf{M_E}$. To illustrate, we consider **E** as the earth, then $\mathbf{M_E}$ is the earth's mass, and $\mathbf{r_E}$ its radius. Next we imagine $\mathbf{M_E}$ as uniformly distributed over the earth's surface to create a surface density $\boldsymbol{\sigma_E = M_E/4\pi(r_E^2)}$. **Figure 3**, depicts the Hubble manifold as a green circle $\boldsymbol{\sigma_u}$**= kgm/m²**. For a generic cosmological acceleration factor $\mathbf{A_n}$, the local "**g**" force reduces to a ratio of surface densities $\boldsymbol{\sigma_E/\sigma_u}$ where $\boldsymbol{\sigma_u}$ is one **kgm/m²** and for de Sitter expansion, the acceleration $\mathbf{A_n}$ equals $\mathbf{a_n = c^2/R}$.

$$\frac{\mathbf{g}}{\mathbf{A_n}} = \frac{\sigma_e}{\sigma_u} = \frac{\dfrac{\mathbf{M_e}}{\mathbf{4\pi(r_e)^2}}}{\dfrac{\mathbf{M_u}}{\mathbf{4\pi(r_e)^2}}} = \frac{\dfrac{\mathbf{M_e}}{\mathbf{4\pi(r_e)^2}}}{\dfrac{\mathbf{kgm}}{\mathbf{meters^2}}} \tag{17}$$

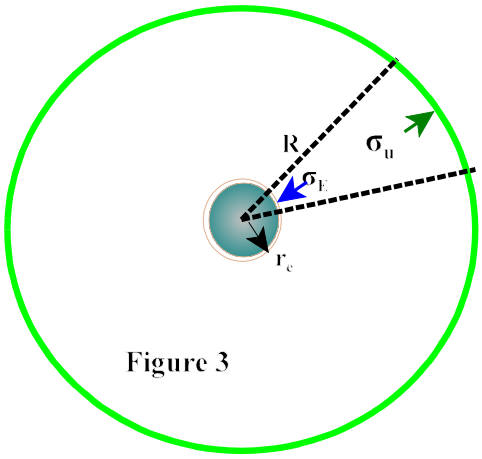

Figure 3

The earths gravity '$\mathbf{g_E}$' at its surface is from **Figure 3**:

$$\mathbf{g_E = [M_e/4\pi(r_{E)}^2](c^2/R)(meters^2/kgm)} \tag{18}$$

For earth $\mathbf{M_E = 5.98 \times 10^{24}\ kgm}$ and $\mathbf{r_E = 6.37 \times 10^6\ meters}$, so from (18) $\mathbf{g_E}$ is **9.6 m/sec²**.

In the Mercator projection shown in **Figure 4**, the Hubble shell and Earth's surface are depicted as flat areas where the ratio $\mathbf{g/A_n = \sigma_E/\sigma_u}$. Spatial expansion $\mathbf{c^2/R}$ is then unidirectional. Both $\boldsymbol{\sigma_E}$ and $\boldsymbol{\sigma_u}$ feel the same acceleration field, but $\boldsymbol{\sigma_E >> \sigma_u}$, therefor '**g**' is proportionately greater. $\mathbf{M_u}$ does not act directly upon $\mathbf{M_E}$ since mass beyond $\mathbf{r_E}$ does not contribute to the gravitational force of **E**. However, matter and its distribution, does effect the gravitational energy deficit of the universe.[16] Lumps of matter, even though uniformly distributed, adds to the complexity, e.g., both the Moon and Sun exert tidal forces which cannot be distinguished from other forms of acceleration. Exclusive of external mass, **Figure 4** also leads to (18) for the case of unidirectional acceleration of the universe with respect to its contents, i.e., the ratio of the surface density fields ($\boldsymbol{\sigma_E/\sigma_u}$) is equal to the ratio ($\mathbf{g/A_n}$) of the acceleration fields.

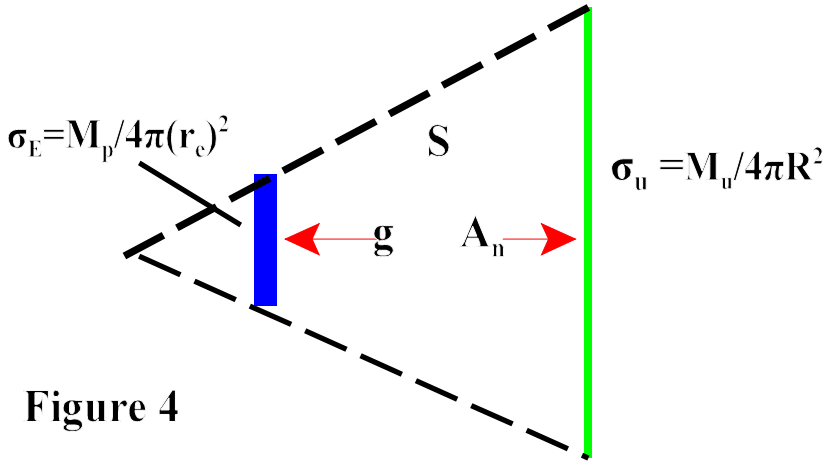

Figure 4

Dark Energy

The **R** term in the denominator of our expression for **G** raises the issue of whether **G** is currently a variable. Long term studies of planetary lunar orbits are generally interpreted as proof of gravitational invariance. Equation (16) and others derived throughout this treatise, at first glace, appear suspect. Like other variable **G** theories, the formulation presented here is consistent with Dirac's large number hypothesis. What is significant about the failed attempts to detect changes in **G** is that all such experiments only evidence the constancy of the mass-gravity product. Mass is a condition of energy. Energy is conserved, but mass converted to other forms of energy need not exhibit inertia, and when energy is in the form of mass, moving at relativistic velocity, greater inertia is observed. Mass is a state, not a conserved quantity.

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[16]The present value of the Hubble constant $\mathbf{H_o}$ is usually expressed as recessional rate in (**km/sec**) per unit of distance measured in mega parsecs (**mpc**). One **mpc = 3.09 x 10^{19}km**. For $\mathbf{H_o = 70}$, (or **2.3 x 10^{-18}/sec**) the Hubble time $\mathbf{1/H_o}$ is = **3.09/70** or **4.4 x 10^{17} sec.** One year equals **3.16 x10^7 sec**, so the Hubble age is **≈14 Gy.** The measured value of **G** (**6.67 x 10^{-11} m^3/sec^2 per kgm**) corresponds to $\mathbf{H_o}$ in the range of **70. km/sec/mpc**

All attempts to measure **G** are masked by the constancy of the **MG** product.[17] As our development predicts, an increase in space is accompanied by an increase in mass and consequently a decrease in the value of the gravitation coefficient **G,** but not a decrease in the magnitude of the negative energy defined by the negative pressure of the gravitational field. More explicitly, during non-accelerating expansion, the of the negative pressure field increases as $\mathbf{R^3}$ and **G** decreases by **1/R** so the negative energy contained within the expanding dimensions of the Hubble volume increases by $\mathbf{R^2}$. For constant $\boldsymbol{\sigma_u}$, negative energy increases at the same rate as Hubble surface area $\mathbf{4\pi R^2}$, so cosmic mass $\mathbf{M_u}$ can be written $\mathbf{4\pi R^2(\sigma_u)}$. Inasmuch as our development is based upon a present state of expansion which is believed to be accelerating, **R** is constant, and has been since the density of positive matter reached a balance with negative pressure matter, at which juncture, the inertia energy of positive matter and negative gravitational energy of space, are fixed. Exponential spatial expansion freezes the Hubble scale, and therefore **R** is constant. There is compelling correlative evidence for a long term era where inertia increased as the cosmos expanded . However, the **R** in the denominator of (16) does not require **G** to be diminishing when expansion is exponential.[18, 19, 20]

Hubble energy is balanced to zero so long as negative and positive energy increase conjointly (Positive matter created in the form of inertial enhancement equals the gravitational energy in the new volume occupied by the negative pressure field). During exponential expansion, however, **R** is constant, so newly created positive energy is no longer balanced by increased volume. In a zero energy universe, excess positive energy must be carried off by increased recessional flow, the excess energy itself being that required to increase the rate of spatial recessional flow exiting across the Gaussian surface $\mathbf{4\pi(R_S)^2}$ depicted in **Figure 2**. With greater rate of expansion comes an increase in the production of positive energy, and so on. No "*dark energy*" mystery mechanism is needed. Once the density of positive matter within the Hubble sphere exceeds the negative potential energy of the vacuum, exponential expansion becomes self sustaining.

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[17]For an orbital moon, **v** and **r** depend upon the product of the planet's mass $\mathbf{M_c}$ multiplied by **G**. The orbital parameters **v** and **r** are determined by equating $\mathbf{GM_cM^*/R^2}$ to centripetal force, $\mathbf{M^*v^2/r}$ from which:

$$\mathbf{GM_c = rc^2} \qquad (22)$$

[18]As an aside, gradually acquired inertia resolves a cosmological quandary, namely the high degree of tuning required for critical density. **G** has units of volumetric acceleration per unit mass [$\mathbf{m^3/sec^2}$ **per kgm**]. To what might these units apply other than expanding space? And if applied to expanding space, is it not conceivable that the rate of volumetric growth would change as the size of the universe changes? The stability of orbits is testament to the invariance of the **MG** product. If **G** palliates as **1/R**, the mass factor in the force equation must increase proportionately with **R**. Equation (2) can be viewed as other than a coincidental condition the present

[19]In 1937 Paul Dirac published the Large Number Hypothesis (**LNH**). Reasoning that the near equality between the electro/gravitational force ratio and Hubble/subatomic size ratio must be more than a coincidence, Dirac suggested that these large numbers maintain the same proportions at all times. This can only be true if one of the so called constants of nature changed as the universe expands. This lead to Dirac's hypothesis that **G** varies as $\propto$ **(1/R)**.

[20]There is no law of conservation of mass. The inertial resistance of masses to acceleration increases for masses traveling at high velocities relative to the fame of measurement. Nor is their bases for the idea of an explosive mass creating genesis, although much effort has been directed to justifying such scenarios. Gradually acquired inertia is as it must be, it must grow to balance the negative energy of the expanding Hubble volume.

Prior to Einstein's recognition of equivalence, inertial and gravitational mass were viewed as separate but enigmatically equal functionality(s). Unification led *to* gravity as spatial distortion. Herein, reactionary '**g**' fields supersede static distortion. With no separate existence from that which brings about their existence, they can still be understood in relation to a primary acceleration field.

As previously related in our prelude, McCrea conjured a mass creating algorithm founded upon expanding negative pressure. While tension and pressure would be uniform in an expanding negative pressure void, McCrea argued that the introduction of matter sprinkled throughout the volume would behave else-wise (unlike positive pressure space where Pascal's law applies to equalized pressure throughout the volume). McCrea reasoned that areas of high energy density (condensed energy matter) would create resistence, i.e., gradients. Together with Edward Milne, the theory was formulated from Newtonian dynamics, which reduced to Einstein's gravitational equations (24) and (25).[21] What is surprising is that G.R. and Newtonian Dynamics lead to the same equations:

$$\left[\frac{1}{R}\frac{dR}{dt}\right]^2 = \frac{8\pi G R^2 \rho_u}{3} + \frac{\Lambda R^2}{3} - \frac{kc^2}{R^2} \tag{23}$$

$$\ddot{R} = -\frac{4\pi G}{3}\left[\rho_u + \frac{3P_s}{c^2}\right]R + \frac{\Lambda R}{3} \tag{24}$$

where $\mathbf{k/R^2}$ is the curvature. In a universe where tension equals energy density, the equation of state is:

$$\mathbf{P = -\rho_u c^2} \tag{26}$$

then (24) and (25) become:

$$\mathbf{\Lambda = -8\pi G\rho_u - 3qH^2} \tag{27}$$

$$\mathbf{k/R^2 = -H^2(q+1)} \tag{28}$$

The condition $\mathbf{P = -\rho_u c^2}$ is the state equation seized upon by the detractors of Big Bang Theory. The underlying premise is that positive energy released by expansion maintains density constant, ergo, the universe need not have a beginning. This was McCrea's ingenious idea for creation of matter.[22] It provided a bases for a *constant density universe*, commonly labeled "*Steady State Theory*." In 1981, Alan Guth appropriated McCrea's recipe to develop his own mass creating algorithm, which debuted as "*Inflation*."[23]

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[21]Equations (24) and (25) were originally synthesized from General Relativity by mathematical skill and considerable labor. That Newtonian physics should lead to the same equations is still somewhat of a mystery.

[22].McCrea's concept exists in one form or another in most creation theories. In contrast to Hoyle's "*Steady State Theory*," the doctrine of gradually acquired inertia foretold herein, requires no new particle production.

[23]Like instant genesis, the supposition of rapid exponential grown during inflation results in a whole lot of up-front energy produced in a short span of time.

We touch upon these efforts to introduce another theoretical model also admitted by McCrea's work, namely the "*balanced energy universe*." If negative pressure $\mathbf{(-P) = \rho_u c^2/3}$ then (24) reduces to:

$$\ddot{\mathbf{R}} = \frac{\Lambda \mathbf{R}}{\mathbf{3}} \tag{29}$$

Equation (29) has the same solution as de Sitter's empty universe, that is, when negative pressure **(-P)** cancels positive energy density, the universe behaves as though it were empty. This condition was introduced pursuant to (4A) and (4B), to transition from shell mechanics to 3-sphere.

$$\mathbf{(\rho_u c^2/3) = (-P)} \tag{30}$$

P = ($\mathbf{a_n}$) x (surface density), then

$$\mathbf{P = -(c^2/R)\sigma = \rho_u c^2/3} \tag{31}$$

And therefore

$$\mathbf{\rho_u = 3\sigma/R} \tag{32}$$

And since

$$\mathbf{\rho_u = M_u/(4/3\pi R^3) = 3\sigma/R} \tag{33}$$

Then

$$\mathbf{M_u = 4\pi R^2 \sigma} \tag{34}$$

Energy balance between density and negative **G** field thus comports with de Sitter expansion and the dependence of positive mass-energy upon cosmic size [equation (2)]. All of which leads to the cosmological puzzle discussed in the Prelude, namely:

$$\frac{\mathbf{M_u G}}{\mathbf{c^2 R}} = \mathbf{1} \tag{35}$$

As previously shown, (35) appears to be factual statement about the Hubble universe. That it can be derived from Friedmann's equations supports that conviction?[24] From (13) and (34), we see that for our model of the universe, (35) is an identity relationship:

$$\frac{\mathbf{M_u G}}{\mathbf{c^2 R}} = \mathbf{1} \quad = \quad \frac{[(4\pi \mathbf{R}^2)\sigma_2]}{(\mathbf{c^2 R})} \mathbf{x} \frac{\mathbf{c}^2}{4\pi \mathbf{R}\sigma_2} \tag{36}$$

Equation (36) holds for any value of sigma and **R**, consequently it should apply to any era as a relational statement between mass, size and acceleration. Compare next (36) with the derivation of **G** and its dependency upon $\boldsymbol{\sigma_u}$. To reduce (8) to its simplest form, we substitute back $\mathbf{M_u/4\pi R^2}$ for $\boldsymbol{\sigma_u}$,

[24]Princeton Cosmologists Robert Dicke endeavored to find a scalar-tensor theory of gravity based upon the proposition of the numerator and denominator of (35) defined the organic connection between inertial and gravitational mass via Mach's Principle. To make merit of Dicke's theory, $\mathbf{Rc^2/G}$ must equal $\mathbf{M_u}$. The problem then reduces to that of expressing **G** in terms or **R** and $\mathbf{c^2}$. That issue is resolved by (37).

and behold:
$$\mathbf{G} = \frac{\mathbf{c}^2}{4\pi\mathbf{R}\sigma_2} = \frac{\mathbf{c}^2}{\frac{4\pi\mathbf{R}(\mathbf{M_u})}{4\pi\mathbf{R}^2}} = \frac{\mathbf{c}^2\mathbf{R}}{\mathbf{M_u}} \tag{37}$$

which is the same equation as (35). **G**, as stressed in reprise, reduces to the factuality of Hubble expansion divided by inertial content, more precisely the ratio of volumetric acceleration divided by the present inertial magnitude of its mass.

Using the values for **G** that conveniently specify the cosmic surface density we arrive at the value of **G** through the back door. Equation (35) is in reality, an alterative equation for the gravitational coefficient **G**, that is:

$$\mathbf{G} = \frac{\mathbf{c}^2\mathbf{R}}{\mathbf{M_u}} = \frac{(9\ \mathbf{x10^{16}\,m^2/sec^2})\mathbf{1.1\ x10^{26}\,m}}{\mathbf{1.5x10^{53}\,kgm}} = \mathbf{6.6\,x10^{-11}(m^3/sec^2\ )kgm^{-1}} \tag{38}$$

AFTER-THOUGHTS

A. The Reality of Accelerating Mass.

For **1a** supernova events to be a correct measure of accelerating space, the nebula must co-move with recessional flow. This requires energy, i.e., but as shown above, it need not be new or mysterious energy. So has the dark energy problem been resolved ?

Curiously, the spatial acceleration factor $\mathbf{c^2/R}$ is equal to the retarding effect of gravitational matter acting upon the presumed comoving velocity of the galaxies. That is, from the perspective of an earth observer, spatial recessional flow is isotropic, a luminous object at the Hubble limit recedes at velocity '**c**' while urged by the accelerating rate of spatial flow to accelerate at $\mathbf{c^2/R}$ to maintain its presumed state as comoving matter. Thus if cosmic mass $\mathbf{M_u}$ is $\mathbf{4\pi R^2\sigma_u}$ then the retarding effect of Hubble mass acting upon a receding galaxy of mass **M** at the Hubble limit is:

$$\mathbf{F}_G = \frac{4\pi\mathbf{R}^2\sigma_{\mathbf{u}}[\mathbf{MG}]}{\mathbf{R}^2} = \frac{4\pi\sigma_{\mathbf{u}}\mathbf{c}^2\mathbf{M}}{4\pi\mathbf{R}\sigma_{\mathbf{u}}} \tag{39}$$

and from (39) the gravitational force per unit mass $\mathbf{c^2/R}$ is opposite to the recessional acceleration field of space at the Hubble distance. Net force acting upon a mass at distance **R** zero. Since zero net force produces no acceleration, no dark energy is required by way of explanation. Massless space accelerates, but matter moves at constant velocity? If the masses are not accelerating, how might the apparent diminution of the more distance supernova events be rationalized?

B. The Faint Supernova Studies

Spontaneous creation has been a recurrent theme throughout scientific history. But an abrupt beginning of spatial expansion need not include the entire mass of the universe in a single event. The sudden appearance of mass-energy out of nothing is discrepant with all that is known about evolutionary process. Nonetheless, the general sentient of the twentieth Century had the more distant galaxies receiving a greater initial boost and therefore traveling farther since the beginning. The model was fortified by the belief recessional velocities were slowed by gravity, and for mainstream cosmology, exponential deceleration was the defacto standard for many years. The all at once matter myth requires expansion velocity to be fine tuned to avoid a quick crash or runaway expansion.

The 1998 supernova studies were based upon the proposition that SN bursts could be used as standard candles–the exclamation of identical energies, and therefore of equal brightness and duration. To the investigators's surprise, the intensity of the more distant events were fainter than what would be expected for a slowing universe. Either the universe was accelerating or something else was in play in the distant past.

The gravitational pressure needed to trigger a supernova was derived in 1932 by the Indian physicist, Subrahmanyan Chandrasekhar, for which he later received the Nobel prize.[25] The critical energy $\mathbf{M_{limit}}$ (approximately 1.4 solar masses) depends upon the factor **(hc/4πG)**. If **G** diminished inversely with **R**, the invariance of the **MG** product speaks directly to the question of whether supernova events were less energetic in the past. If that be so, the evidence for exponential expansion vanishes, and so also does the search for dark matter.[26] A larger **G** factor in the past requires less inertia to create the same force. [27] Since electron degeneracy pressure is constant, the inertial factor is less (Because **G** is greater in the past, less inertial matter is required to trigger a **1a** supernova event in the early universe). If intensity diminution is the result of less mass rather than greater distance, the theory of accelerating expansion needs to be re-thought. In this thesis, exponential cosmological expansion is the auspicate of declining **G** and its corollary, the gradual acquisition of inertia.

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[25]A white dwarf star is kept stable by two opposing forces: 1) the electron degeneracy pressure created by nuclear fusion in the heart of the star (making lighter elements into heavier ones) pushing outwards from the core, and 2) gravity pulling inwards. When a white dwarf is locked in an orbit with a companion star, it sucks off matter over time. This increases the gravitational pressure until it overcomes the electron degeneracy pressure. The amount of mass in the core has a special significance called the Chandrasekhar Limit. When the core acquires a mass of approximately 1.4 solar masses, the electron degeneracy pressure is overcome by the pressure of gravity acting upon the core.

[26]As a side note, efforts to explain the present value of **G** in terms of **q = ½** led to much frustration for the author. The discovery of Cosmological Acceleration provided a good fit to the empirical value of **G** based upon standard model consensus $\mathbf{H_o = 71}$. The perception of uniformly expanding **3-D** space as 'time' can be appreciated as a consequence of a changing $\mathbf{4^{th}}$ dimensionality.

[27]Because the **MG** product is constant, the weight of the mass required to overcome the degeneracy pressure is the same at all eras. When the weight overcomes the electron degeneracy pressure, the white dwarf star collapses with a violent luminous display. Since the electron degeneracy pressure does not change with time, the **MG** pressure required to trigger a supernova event will also be invariant irrespective of the individual contributions of **G** and **M.** A robust **G** during an earlier era translates to smaller **M**, and consequently less energetic events. For the present value of **G**, Chandrasekhar's equation predicts 1.4 solar mass as the critical value.

C. The Faint Sun Syndrom

Geophysical and climatological data show the earths temperature during the past four billion years has not changed appreciably. However, numerical models based upon the Sun's interior indicate the Solar output would have been approximately 25% less than its present value. Various theories have arisen to justify the warm conditions that prevailed for the young earth. Of significance for this treatise, is the variable **G** theory.

The Sun's luminosity $\mathbf{L}_\odot$ is highly sensitive to **G** and **M**, being roughly proportional to $\mathbf{G^7M^5}$. The invariance of the **MG** product thus provides the mechanism and explanation for a temperate beginning. A 25% reduction in solar output based upon the Sun's condition and status as a main sequence star would be roughly balanced by a robust **G** and a smaller inertial mass **M**. In a recent publication, the variable **G** theory was studied and compared to alternatives founded upon atmospheric changes, most notably suppositions based upon unsupported levels of green house gases in the atmosphere of the young earth.[28] The authors avoided consideration of changes of size proposed by Dirac' in his Large Number hypothesis ($\mathbf{G \propto t^{-1}}$). Consequently, they were able to explain their conclusions in terms of small changes. However, as developed herein, decreasing **G** is accompanied by increasing inertial mass, the effect upon luminosity $\mathbf{L}_\odot$ due to changes in **G** is reduced from 10^7 to 10^2 when the 10^5 effect of increased mass is factored into the equation.

D. Relativistic Conformance.

Both the Special and General Theory of Relativity are integrally tied to the space/time ratio '**c**'. Although rarely expressed in terms of energy transformations, real time dilations always involve reference frames with energy differences. For special Relativity, the energy difference is kinetic, the relative rate of time depends upon velocity difference. In what initially appears to be a contrast between the Special and General Theory, the latter relates time dilation to gravitational potential. But upon closer examination, it will be understood that gravitational time dilation also depends from kinetic energy differences, specifically, the velocity required to escape the gravitational well:

$$\mathbf{\Delta t^* = \Delta t(1 - 2GM/rc^2)^{1/2}} \tag{40}$$

where $\mathbf{2GM/rc^2}$ is the escape velocity needed overcome the gravitational field of **M**, or viewed alternatively, the velocity acquired by an object falling from ∞ to the surface of a uniform spherical mass **M** of radius **r**. That this factor has a familiar complexion [(35)], suggests probative implications if applied to our development of **G** based upon $\mathbf{M_u}$ and **R**, that is, from (8) and (34):

$$\Delta t^* = \Delta t\left[1 - 2\frac{4\pi R^2\sigma_u c^2}{4\pi R\sigma_u (Rc^2)}\right]^{1/2} = \Delta t\left[-1\right]^{1/2} = i\Delta t \tag{41}$$

Consistent with uniform cosmological time, (41) reduces to one unit of temporal distance defined along the"**i**" axis ⊥ to three dimensional space.

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[28]Can A Variable Gravitational Constant Resolve The Faint Young Sun Paradox?; International Journal of Modern Physics D. Varun Sahini, Yuri Shtanov, Nov 2014.

. E. Reconstructing Newton's Second Law

In the prelude to gravity, Newton's second law was adapted to the gravitational field by diluting the force over the active surface area (For the isotropic global acceleration field $\mathbf{c^2/R}$, the appropriate area is the Hubble sphere $\mathbf{4\pi R^2}$ and the appropriate mass is $\mathbf{M_u}$, for the reactionary force, it is the surface mass density of a local object). When it is a local object subjected to unidirectional acceleration, the reactance is determined by scalar field $\boldsymbol{\sigma_u}$ encoded in the global expansion field. The object must be mathematically transformed to mass per unit area, then Newton's 2nd law becomes:

$$\mathbf{F/m^2 = (M/m^2)a}$$

From $\mathbf{kgm/m^2 = \sigma_u}$ then

$$\mathbf{F/kgm = (M/m^2)(a/\sigma_u)}$$

F. From Newton's 2nd Law—No Dark Energy Required

Newton's 2nd law for a zero energy universe tells us that no extra energy is needed to power accelerating expansion. Specifically since $\int \mathbf{F \cdot ds}$ must equal zero, then

$$\mathbf{F = d/dt(Mv) = M(dv/dt) + v(dM/dt) = 0}$$

wherefore since:

$$\mathbf{M_u = \rho_u(4/3)\pi R^3} \text{ then } \mathbf{dM/dt = \rho_u(4\pi R^2)(dR/dt)}$$

From which

$$\mathbf{F = (\rho_u)(4/3)\pi R^3)(dv/dt) + (v)\rho_u(4\pi R^2)(dR/dt) = 0}$$

and since $\mathbf{v = c}$ at the hubble limit $\mathbf{R}$, then $\mathbf{dR/dt = c}$. For a net zero energy, $\boldsymbol{\rho_u}$ cancels ∴

$$\frac{\mathbf{dv}}{\mathbf{dt}} = \mathbf{a_n} = -\frac{\mathbf{v^2}(\mathbf{4\pi R^2})\rho_u}{\frac{\mathbf{4}}{\mathbf{3}}(\mathbf{\pi R^3})\rho_\mathbf{u}} = -\frac{3c^2}{R}$$

For a zero energy universe, the radially divergent rate of global volumetric acceleration is $\mathbf{3c^2/R}$. If we interpret this to mean $\mathbf{3c^2/R}$ is the acceleration factor consistent with exponential expansion of space in a negative pressure zero energy universe, then the negative energy created by accelerating expansion must be consistent with the energy required to power the acceleration, a result previously surmised. Pressure is $\boldsymbol{\sigma_u}$ multiplied by $\mathbf{c^2/R}$, that is:

$$\mathbf{-P = (c^2/R)\,\sigma_u = \rho_u c^2/3}$$

which projects a spatial state which must expand exponentially in order that negative pressure remain in balance with diminishing density.

Conclusions:

The evolution of the universe will be guided by exponential expansion when negative pressure (**$-P = \rho_u c^2/3$**). Whether this condition has always been a factor in the evolution of the universe, or whether it occurred at some later time, cannot be determined with certainty. Based upon super nova studies, a Hubble time in the range of ½ its present age (**$1/H_o$**) would conform to much of what has been deduced from experimental analysis.

The theme here is to correlate the *'present'* **G** force with the '*now'* rate of "spatial expansion" The dimensionality of **G** sets the stage for the application of Newton's second law; global isotropic acceleration multiplied by local mass becomes a local '**g**' field when distributed over the surface of the mass defined thereby. In this sense, the center of a uniform spherical mass can be considered the origin of its coordinate system, gravity, as queried by Feynman, being decrypted as a pseudo force, the inertial reaction field of local mass counteracting isotropic global acceleration.

What affect does this have upon General Relativity? Actually very little, save for the fact that spatial distortion of static space is replaced by dynamic distortion of expanding space. Mass acts upon momentum. Although originally envisioned by Max Born as a reciprocal theory of General Relativity that could open a gateway to unification with quantum physics, the construct as presented, without more, compliments the General Theory in that the missing analytical element in Einstein's theory can now be expressed in terms of Hubble parameters. Dynamic distortion of the **G** field is an inertial reaction, and like all inertial reactions, instantaneous. The inertial field of a mass is not separate from the mass, it is the mass by virtue of the omnipresent global expansion field that encodes the scalar density function **σ_u**.

Holistic connectivity casts light on certain aspects of Einstein's Theory. Einstein, like Newton, believed gravity involved continuous action, but in 1686 and still in 1916, expansion was unknown. Einstein solved the problem by postulating a new job description for mass, that of curving static space. Born reciprocity was developed as a direct result of the observational similarity between distortions of momentum space and regular space.

What space is, and how it can be curved and what it is that is curved, is generally described in terms of Riemann surfaces. Pieced together from patches of the complex plane, they can define a topological manifold of great utility. But it will be of little use unless the hypothesized distortion of static space is true. Given the reality of expansion, a global acceleration field distorted by local matter is a natural result of the symmetry encoded in Newton's 2nd law. The issue of deformation rests upon which theory predicts the gravitational constant. It is the dynamic source **Λ** that is distorted by inertial reaction of local mass. The General Theory did not attempt to derive or explain **G**. Rather, it tied the metrical properties of the cosmic container to its contents. The revelation of **G** as an adjunct of **Λ** should not be viewed as a detraction of Einstein's gravitational theory, but rather more in the nature of an in the light of what has been discovered since.

We begin our expose' with a quote from Richard Feynman. It is fitting we close it likewise:

"No machinery has every been invented that explains gravity without also predicting some other phenomena that does not exist."

Readers are invited to email comments to:
cosmodynamics@yahoo.com

Notes

Prelude to Charge

Creation theories focus upon Space, Time and Mass. The electromagnetic entity gets no mention, neither in Big Bang beginnings, nor steady state theories, indeed, not even in religious folklore. Yet the precepts of physics are replete with evidence of an underlying communion between the two long range force fields. Despite centuries of thought, neither has been derived, one from the other, nor has a common root been found from which they might be synthesized.

The challenge is a seductive one, luring many of the great minds to its intrigue. More than a half century before Einstein took up his theoretical quest, Michael Faraday sought enlightenment in the laboratory. In 1849 he scribbled these words in his notebook:[1]

> *"Gravity: Surely this force must be capable of an experimental relation to electricity, magnetism, and the other forces, so as to bind it up with them, in reciprocal action and equivalent effect."*

After many unsuccessful experiments he concluded:

> *"Here end my trials for the present. The results are negative. They do not shake my strong feeling of the existence of a relationship between gravity and electricity, though they give me no proof that such a relationship exists."*

The great advantage of today's inquisitor, is that he has a new physics principle in his arsenal. In the quest for a gravitational field, we seized upon accelerating spatial expansion as impetus, the notion of space as a functional dynamic being demonstrated in the process. To extend this to the action of electrical charges interacting with one another at a distance requires an acceleration field $\mathbf{10^{42}}$ magnitudes greater (the ratio of the electric force between two electrons in comparison to their gravitational force of attraction). In the case of gravity, the acceleration field is weak because the Hubble sphere is large, but as the formulation indicates, **G** could have been much greater in the past. For an electron sized universe, the gravitational parameter **G** would be $\mathbf{c^2/4\pi R_e}$ which is about $\mathbf{10^{26}/10^{-14} = 10^{40}}$ magnitudes. As Newton professed two plus centuries past, forces are accelerations. To find large accelerations in a big universe requires a new model of the small universe.

The **G** field depends upon the Hubble scale. This can only be guesstimated and therefore the expansion theory of gravity can never be proved precisely by measurements. While the derivation of the electric charge from the size and mass of the electron also appears to be an approximate proposition, there is a critical difference in that subatomic properties are quantized. This leads to an exact formulation of the fine structure constant "*alpha*" based upon the expansion model of space as virtual rotation. Dimensional-less constants generally result in lost information in that they hide that which is combined to cause cancellation of dimensionality. Just as source code cannot be re-constructed from machine code, there are elements of *alpha* that can be understood only with the aid of the correct physical emulative.

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[1]Encyclopedia Britannica, 1971, pp. 670, 673

Notes

PART II - ELECTRIC CHARGE

"*....we described how in quantum mechanics the angular momentum of a thing does not have an arbitrary direction, but its component along a given axis can take on only certain equally spaced, discrete values. It is a shocking and peculiar thing ...There isn't any descriptive way of making it intelligible that isn't so subtle and advanced in its own form that it is more complicated than the thing you were trying to explain....Understanding these matters comes very slowly, if at all...the most shocking and disturbing thing about quantum mechanics is that if you take the angular momentum along any particular axis you find that it is always an integer or half integer times* $\boldsymbol{h/2\pi}$*."*

Richard Feynman, Lectures On Physics

In Part I, we maturated Richard Feynman's "*pseudo force*" musings into an expansion resistant inertial force and called it gravity. Could the cosmological acceleration field also demystify the electric charge and its phenomenological peculiarities? Like gravity, the interaction between electric particles requires some form of continuous action. The template for our study will be the electron, properly it could be called " fundamental" as it prescribes the strength and polarity of the electric force as an extension of itself. Taking mass, angular momentum and expansion as the basic operatives, we formulaize a circulatory proto-particle and calculate the reaction.

Herein electron and positron mass is designated as $\mathbf{m_o}$ ($\mathbf{9.1 \times 10^{-31}\,kgm}$), one electron unit of charge as **q** ($\mathbf{1.6 \times 10^{-19}}$ **coulombs**). Angular momentum $\mathbf{h/4\pi}$ = ($\mathbf{5.3 \times 10^{-35}\ kgm\ m^2/sec}$) in any direction of measurement. To explain the long range electric field in terms of these properties, the paradigm must account for attractive and repulsive forces $\mathbf{10^{42}g}$. The ultimate question is whether charge is a elemental property of nature, in and of itself, or like gravity, a flawed perception of something already known.

Our model of the electron takes form as a spherical mass of radius '$\mathbf{r_o}$' (**1.41** x $\mathbf{10^{-15}}$ **meters**). More particularly, '$\mathbf{r_o}$' is determined by equating the energy $\mathbf{m_oc^2}$ to that required to assemble a charge $\mathbf{q^2}$ over the surface of a sphere. All electrons are alike, the quantized value of each factor uniquely jig-sawed to complete the electron structure. The challenge is that of fitting the pieces **q**, $\mathbf{r_o}$, $\mathbf{m_o}$ and $\mathbf{h/4\pi}$ together to replicate the measured force between charged particles.[1] At the outset, a formulation of charge based solely upon the dimension parameters of electrons and positrons would seem to be in trouble. How can such a theory account for charged particles such as protons and with different dimensional characteristics? Spin-less particles exhibiting charge and massless spin particles without charge present additional hurdles. At this early stage, we adopt a cavalier approach, addressing in the end the internal cancelling factors of compound particles as well as the effects of different energies in different sized particles. Finally, we see that the muon in its bound state fulfills the requirements of charge without compromising the development of a theory premised solely upon electron parameters.

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[1]One fermi = $\mathbf{10^{-15}}$ meters. The electron radius $\mathbf{r_o}$ is therefore 1.41 fermi (½ the classical electron radius $\mathbf{r_e}$ = 2.8 fermi) To build the charge shell **q**, increments of infinitesimal charge are brought together from infinity. Since each new increment **dq** will experience a repulsive force $\mathbf{\int F(ds)}$ as it is brought from infinity to join the charge already assembled, the total work energy $\mathbf{E = m_o = K_eq^2/2r_o}$ and the resulting repulsive force F_e will be $\mathbf{K_eq^2/2(r_o)^2}$

The inability of classical mechanics to explain quantum angular momentum in terms of rotating matter, like other peculiarities of subatomic physics, calls for an extension of the global acceleration epitome from force produced gravitational reactance to spatially expanding angular momentum. To extemporize an electron as circulatory space, we ideate a spherical central HUB of radius $\mathbf{r_o}$, implicate mass $\mathbf{m_o}$ and espouse the space/time ratio '**c**' as the expansion driven operative.

Figure II-1A shows a vortical velocity profile for circulatory space wherein the velocity $\mathbf{V_r}$ decreases inversely with distance '**d**' as would a physical fluid attracted by a central source. **Figure II-1B** shows virtual spatial flux having velocity '**c**' at all radii. That the two boil down to one-in-the-same from an angular momentum perspective, will be underscored herein-below. As was the case with gravity, we begin by extending Newton's second law to relative acceleration. Taking relative circulatory velocity as '**c**' between space and HUB corresponds to isotropic divergent space $\mathbf{c^2/r_o}$. As with gravity, the action of global spatial expansion upon the rotational interface at $\mathbf{r_o}$ creates a counter acceleration field that, when multiplied $\mathbf{m_o}$ quantifies both the electrical reactive force $\mathbf{m_oc^2/r_o}$ and a yet to be explained local angular momentum field as $\mathbf{m_ocr_o}$. The actual form of $\mathbf{m_o}$ is at this adjunct of our development depicted as a central sphere of unspecified radius. From another perspective, conservation of angular momentum during expansion requires $\mathbf{(d/dt)[(m_o)(v)(r)] = 0,}$ then:

$$\mathbf{[(m_o)v[dr/dt] + (m_o)r[dv/dt] + vr[d(m_o)/dt)].} \qquad (2.1A)$$

Since $\mathbf{m_o}$ is constant for present purposes, then $\mathbf{dr/dt = c}$ at $\mathbf{r_o}$ and therefore:

$$\mathbf{dv/dt = a = (-\ c^2/r_o)} \qquad (2.1B)$$

FIGURE II-1A

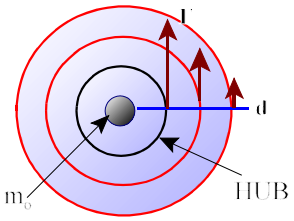


FIGURE II-1B

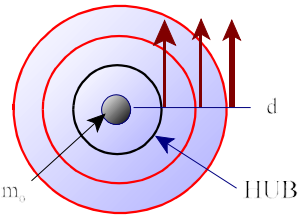


Figure II-1A illustrates the velocity profile for a free vortex (v·• r = constant). Fluid velocity increases as the radius diminishes reaching a maximum 'c' at radius $\mathbf{r_o}$. In Figure II-1B, all spatial velocities are virtual and all have the same velocity 'c.' Circulatory force at d is $\mathbf{c^2/d}$.

As with gravity, we look to the inertial dynamics of virtual motion to find a space-mass role reversing coordinate frame. Conceptually, the spatial circulatory field of electrons provides an ideal polar coordinate playing field. Centered upon the particle, and imposed with the communication condition that circulation at any distance transforms to the particle surface as $\mathbf{c^2/d \dashrightarrow v^2/r_o}$, we debut our electron as pictured in **II-1B**. The circulatory velocity at any distance '**d**' is '**c**.' Each streamtube of circulation at distance '**d**' is inversely coupled (**1/d**) to the spherical energy core $\mathbf{m_o}$ of radius r_o. (what will later be identified as the effective radius of reflexed circulatory energy of the field.

Symbolically, '**c**' defines the iconic space/time relationship as dimensional units of velocity, but in the context of massless space, nothing moves. Here, as with gravity, we inculcate an inertial reactive field rationalized from second law symmetry.

The spatial circulation field of the electron is of the same form as the Hubble expansion field. Reactionary centripetal acceleration diminishes inversely with distance '**d**.' The acceleration at $\mathbf{r_o}$ will be $\mathbf{c^2/r_o}$, and $\mathbf{c^2/R}$ at the Hubble limit. Virtual centripetal force $\mathbf{m_o c^2/r_o}$ at the HUB thus corresponds to a local angular momentum $\mathbf{m_o c r_o}$ and the angular momentum of the circulatory spatial field corresponds to $\mathbf{h/4\pi}$. As discussed below, the properties of a free vortex are concentrated at its rotational center, and for circulatory space, the effect upon angular momentum diminishes in the same ratio as vortical velocity in a material vortex. Circulatory space is mathematically analogous to frictionless flow along a streamtube i.e., $\mathbf{(dv/v + dr/r) = 0}$, from whence $\mathbf{v \bullet r}$ = Constant. However, in the case of the electron, 'r' cannot be zero, hence the velocity-distance product is constant, and therefore: the circulation is the same at all distances '**d**' greater than $\mathbf{r_o}$:

$$\mathbf{(v)\ x\ (d) = [c]\ x\ [r_o]} \tag{2.1C}$$

The HUB mass $\mathbf{m_o}$ now becomes a critical factor in coupling the inertial reaction of $\mathbf{m_o}$ concurrently to all virtual circulations of different radii and in different rotational planes? The HUB cannot be condensed matter in the traditional sense, nor can it be envisioned as simultaneous rotation about more than one axis. In **Figures II-1A** and **II-1B**, $\mathbf{m_o}$ is depicted as a sphere coincident with the systemic center. The influence of spatial circulation upon $\mathbf{m_o}$ at greater distances is thus reduced in accordance with (2.1C).[2] The effective centripetal force $\mathbf{F_d}$ at the HUB interface will be $\mathbf{(m_o)v^2/r_o}$ and the isotropic acceleration force $\mathbf{F_d}$ between $\mathbf{m_o}$ and space at any distance '**d**' is then:

$$\mathbf{F_d} = \mathbf{m_o}\left[\frac{\mathbf{v^2}}{\mathbf{r_o}}\right] = \left[\frac{\mathbf{m_o}}{\mathbf{r_o}}\right]\left[\frac{\mathbf{r_o c}}{\mathbf{d}}\right]^2 = \frac{\mathbf{m_o r_o c^2}}{\mathbf{d^2}} \tag{2.2}$$

Per (2.2), our proto-electron takes form as a virtual circulatory field having reactive mass $\mathbf{m_o}$. Intensity falls off inverse square. The same follows from a theorem due to Stokes:[3]

$$\int_{\mathbf{r}} \mathbf{v} \cdot \mathbf{dl} = \int\int_{\mathbf{S}} \mathbf{n} \cdot \mathbf{curl}\ (\mathbf{v})\ \mathbf{dS} \tag{2.3}$$

For $\mathbf{v = c}$, and $\mathbf{\int dl = 2\pi d}$, the Curl **C** for a closed path of integration including the center is the line integral/Area **:**

$$\mathbf{2\pi cd/\pi d^2 = 2c/d}\ \{\text{for one rotational plane}\} \tag{2.4}$$

---

[2] A vortex made of nothing is the analog of divergent expansion of nothing. Both are virtual in the sense that the descriptions are mathematical, the universe behaves in a way that allows $\mathbf{c^2/d}$ vectors to be assigned to each point **P** of the field which correspond to the centripetal acceleration if local space where circulating about the HUB.

[3] Stokes Theorem declares the line integral of the velocity vector around a closed contour to be equal to the integral of the curl over the surface bounded by the contour

In a two dimensional plane surface, the integral around any closed curve that includes the center is **2πC** The Curl {**∇ x F**} at a point **P** is the limit of the circulation per unit area (**ΔS**) at point **P** as the area **ΔS** shrinks to zero, expressed symbolically as:

$$\mathbf{n} \cdot (\nabla \times \mathbf{r}) = \lim_{\Delta S \to 0} \frac{\oint_C \mathbf{f} \cdot \mathbf{dr}}{\Delta S} \qquad (2.5)$$

where **n** is the unit normal vector and **ΔS** is the area bounded by the contour over which the line integral is taken. If a closed path of integration does not include the center, Curl is zero. The rotational properties of a mathematic vortex are reflexive to its center, a dimension-less point **P** where velocity is infinite. **Figure II-1C** shows the constant '**c**' circulatory spatial field of an electron and **II-1D** shows how the affect of spatial circulation diminishes with distance. The simulative treats the flux element of every streamtube at any distance '**d**' as having the same length **dl** (the distance traveled by an imaginary spatial element at velocity '**c**' for a time increment **Δt**. Red Flux sweeps out a greater angle **dθ** than the brown, and the brown a greater angle than the green.

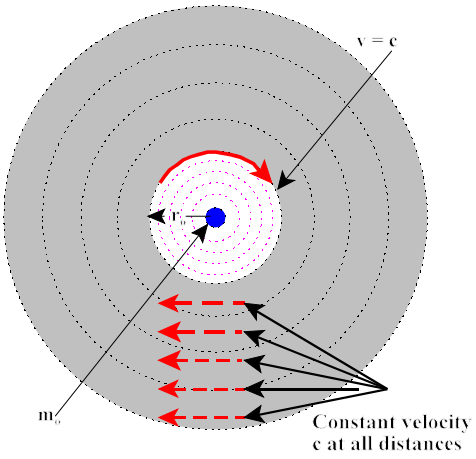


Figure II-1C

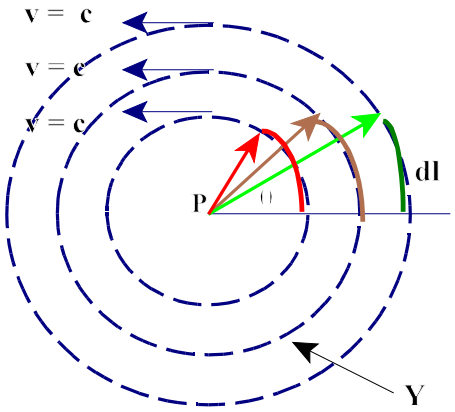


Figure II-1D

Figure II-1E. The red, green and brown radial markers illustrate the diminishing influence of circulatory spatial flux upon angular change dθ/dt = ω. Taking the path of integration over a spherical surface of radius 'd,' two orthogonal rotational planes will be contributing to centripetal force at each point on the surface of integration of area $4\pi d^2$. The effect of the two Curls (4c/d) upon the angular momentum about any axis is therefore c/d.

From the global perspective, local matter is viewed as distortion of the primary field, specifically the cosmological acceleration field which is imagined as radially convergent in the case of gravity or circulatory where particle angular momentum is driven by expansion. Although all mechanisms are speculative, the argument opined here is that local influences create directional forces by partially suppressing the expansion function ($\mathbf{3c^2/R}$) in some directions and not others.

Comparison of the gravitational and electrical formulations in terms of inertial matter reveals similarities. The intensity of both diminishes inverse square. For gravity wrt distance from the reactive center The 'g' field of a uniform 3-sphere mass **M** of radius $\mathbf{r_s}$ at **d** is:

$$E_g = \frac{\mathbf{Mc^2}}{\mathbf{R}}\left[\frac{1}{\mathbf{4\pi d^2}}\right]\left(\frac{1}{\sigma}\right) = \frac{\mathbf{Mc^2}}{\mathbf{4\pi R(d^2)}\ \sigma} \qquad (2.6A)$$

whereas for an electron, the force $\mathbf{m_o c^2/r_o}$ spread over a spherical surface of area $\mathbf{4\pi d^2}$ falls off in accordance with $\mathbf{4\pi r_o^2/4\pi d^2}$

$$F_e = \frac{\mathbf{m_o c^2}}{\mathbf{r_o}}\left[\frac{\mathbf{4\pi r_o^2}}{\mathbf{4\pi d^2}}\right] = \frac{\mathbf{c^2 r_o m_o}}{\mathbf{d^2}} \qquad (2.6B)$$

Both specify force in terms of mass energy ($\mathbf{mc^2}$) divided by distance squared.

From the standpoint of action-reaction, the mechanical model must take into account three planes of spatial rotation. However, to calculate the effect of the field at a particular point it is only necessary to consider two spin planes, that is, as between two points separated in space, only two planes can intersect both points. If the mechanical model is to merit further study, it should now be tested by comparing the predicted normal force $\mathbf{F_n}$ at $\mathbf{r_o}$ (equation 2.4) against the self repulsive coulomb force created by charge **q** distributed over a spherical surface of radius $\mathbf{r_o}$. The electrical force is $\mathbf{F_e}$ obtains by merging two charges together unto the shell and dividing by **2**, that is:

$$\mathbf{F_e} = \frac{\mathbf{k_e (q_e)^2}}{\mathbf{2(r_o)^2}} = \frac{(\mathbf{9x10^9\ kgm\cdot m^2/coul^2})(\mathbf{1.6x10^{-9}\ coul})^2}{\mathbf{2r_o^2}} \cdot = \frac{\mathbf{11.52\ x10^{-29}\ ntn\cdot m^2}}{\mathbf{r_o^2}} \qquad (2.6C)$$

For the mechanical model:

$$\mathbf{F_n} = \frac{\mathbf{m_o r_o c^2}}{\mathbf{r_o^2}} = \frac{\left(\mathbf{9.1x10^{-31}\ kgm}\right)\left(\mathbf{1.4x10^{-15}\ m}\right)\left(\mathbf{3x10^8\ m/sec}\right)^2}{\mathbf{r_o^2}} = \frac{\mathbf{11.46x10^{-29}\ ntn\ m^2}}{\mathbf{r_o^2}} \qquad (2..6D)$$

Within the accuracy of the factors used for the comparison, the two expressions define the same entity. All electrons are alike because there is only one combination of matter, momentum and magnitude that can exist as a stable configuration. As later shown (2-15 and 2-16), the mass energy of the electric field must correspond to the HUB energy which determines the HUB radius which in turn defines the maximum value of the electric field in terms of $\mathbf{c^2}$. And also as to be later shown, it is the electric field that determines the spatial angular momentum field, or more properly, they are one in the same.

Figure II-2 shows two identical particle systems $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ each comprising a mass $\mathbf{m_o}$ and spatial angular momentum $\mathbf{L_s}$ characterized as circulatory virtual flow in accordance with (2.2) in two dimensional **X-Y** space—it being understood that in the absence of an aligning field, the angular momentum spin axis may assume any and all angles with respect to an arbitrary coordinate system[4] Both particles are assigned clockwise rotations in two dimensional space. The separation distance $\mathbf{d >> r_o}$. The two parallel lines $\mathbf{Y_1}$-$\mathbf{Y_1}$ and $\mathbf{Y_2}$-$\mathbf{Y_2}$ are drawn through the centers of the particles so as to divide the **X-Y** space into three parts. In the absence of influence by the other, the spin field of each system will be spherically symmetrical with respect to mass $\mathbf{m_o}$. In the presence of the other particle, each field is unbalanced. The spin field of $\boldsymbol{\beta_2}$ is opposite to the spin field of $\boldsymbol{\beta_1}$ between $\mathbf{Y_1}$ and $\mathbf{Y_2}$ and additive in the region above $\mathbf{Y_1}$. Similarly, the spin field of $\boldsymbol{\beta_1}$ counteracts the spin field of $\boldsymbol{\beta_2}$ between $\mathbf{Y_1}$ and $\mathbf{Y_2}$ and augments it in the region below $\mathbf{Y_2}$. This superposition of spins carries a consequence: When the fields are additive, centripetal force acting between $\mathbf{m_o}$ and space will be greater than that due to its own circular field. When the field of the other opposes the circulation, net centripetal force is decreased. As a result, the central mass $\mathbf{m_o}$ of each particle system will be subjected to greater force in one direction than the other. The net force upon the masses $\mathbf{m_o}$ of $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ will be oppositely directed. Like charges repel!

13. The superposition of simultaneous spatial vortices that define a spherical surface does not create a problem in a massless medium—there being no traffic congestion in the crossing paths of such a fluid. In actuality, the particles are three dimensional and the rotation about any axis is quantized. In a "*field free*" environment, the precepts of quantum mechanics certify that the spin plane of each vortex will remain undefined until its orientation is determined by the presence of the other particle, in which case the rotations will orient to be repulsive per **Figure 11.**

FIGURE II-2

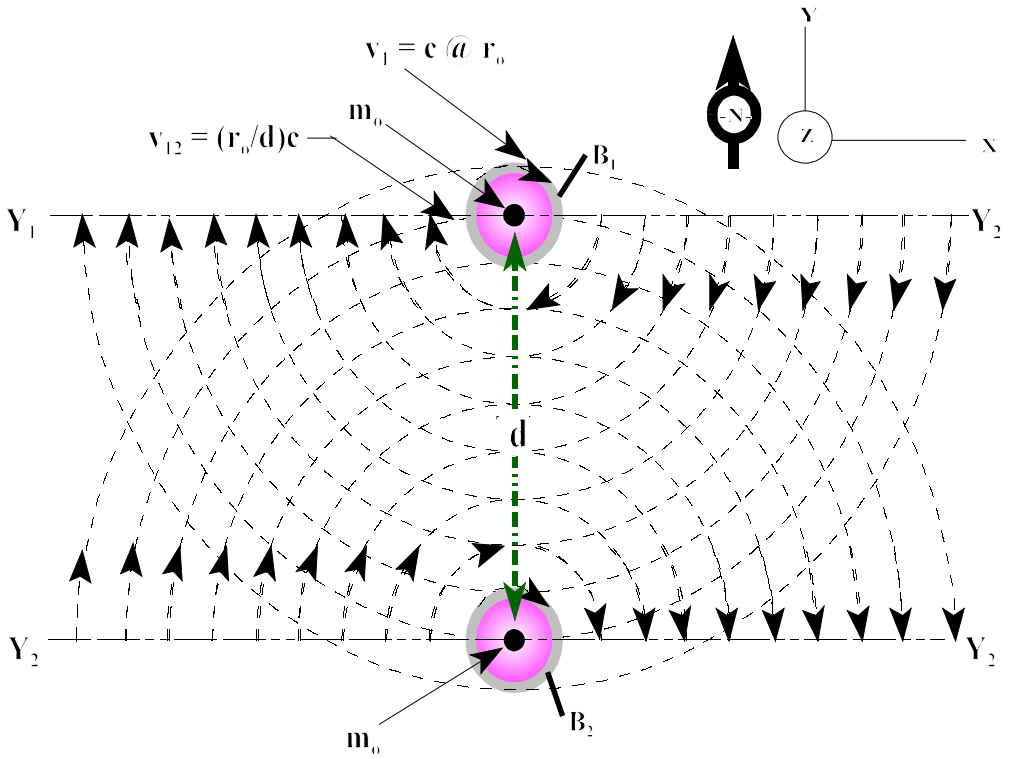


Figure II-2. The coupling between circulatory fields is shown as being simultaneously both additive and subtractive. The two virtual spatial rotations in the x-y plane each have peripheral spin velocity "c" at radius r_o, and each encompasses an identical symbolic mass m_o. Both circulations are clockwise in the X/Y plane which is divided into three areas by the two parallel east-west lines Y_1-Y_1 and Y_2-Y_2. In the hinter region between these lines the vortical field of each particle counteracts the local angular momentum of the other. In the space north of Y_1-Y_1 the field of β_2 is depicted as augmenting the vortical strength of β_1 and in the area south of Y_2-Y_2 the field of β_1 is depicted as bolstering the strength of β_2.[5] Superposition of the two fields results in an unbalance in the force exerted upon each of the masses m_o. The net force upon β_2 will be southward, and that upon B_1 will be northward. Like charges repel.

[5]The influence of $\boldsymbol{\beta_2}$ on $\boldsymbol{\beta_1}$ in the area North of $\mathbf{y_1}$-$\mathbf{y_1}$ and $\boldsymbol{\beta_1}$ on $\boldsymbol{\beta_2}$ in the area south of $\mathbf{y_2}$-$\mathbf{y_2}$ would appear to be limited to the velocity of light **c**. Since the velocity at the radius ro is '**c**' even in the absence of the other particle, the effectiveness of the velocity boosting component of each field may be a nullity. In that case the total force per rotational plane is half that calculated in (2.11). However, there are always two equally effective orthogonal circulations affecting the force acting upon the masses $\mathbf{m_o}$ of each system.

The Force Between Charges

Current **QED** theory purports to explain electrical phenomena in terms of virtual photons supposedly brought into existence by the intensity of the very fields sought to be explained. The theory itself does not predict the Coulomb force from the known properties of electrons and photons, rather, it owes its endorsement to an extremely accurate prediction of the anomalous *Gyromagnetic* spin ratio.[6] **QED** takes into account the wave nature of the electron, together with the premise that particles only transmit force in increments—the coupling between physical entities being adjusted along the way to correspond to the probability of certain occurrences identified with the strength of the perturbation. The predicted results, however, relate only to a second order effect, and not to a quantitative expression for the force.[7] What we seek here is a physical theory which explains the strength of the electron charge and how it arises. To calculate the repulsion between electrons in terms of first principles, we must take the path not taken by Richard Feynman.

Figure II-3 shows a vortical particle system $\boldsymbol{\beta_1}$ within the influence of a counterclockwise rotational field of like origin (particle $\boldsymbol{\beta_2}$ not shown). The distance **d** separating $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ is large in comparison with $\mathbf{r_o}$ which permits representation of the $(\mathbf{v_{12}})$ field produced by $\boldsymbol{\beta_2}$ as equally spaced straight lines orthogonal to the line of action drawn between the radial centers of the two particles $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$. What is desired is an expression for the combined velocity field at all points of superposition on the surface defined by the radius $\mathbf{r_o}$. From this, we will calculate the centripetal force exerted by the effective velocity at all points. The sum of the components of these forces resolved along the line connecting the particle centers is the objective.

For the particle $\boldsymbol{\beta_1}$, the force produced by the superposition of the two velocity fields in the northern (top) hemisphere is given by the square of the sum of the $\boldsymbol{\beta_1}$ field $(\mathbf{v_1})$ plus the component of the $\boldsymbol{\beta_2}$ field $(\mathbf{v_{12}})$ which is parallel to the $(\mathbf{v_1})$ field, that is:

$$(\mathbf{M_o/r})(\mathbf{v_1 + v_{12} \sin \theta})^2 \qquad (2.7)$$

and in the southern hemisphere, the force is given by the square of the difference between $(\mathbf{v_1})$ and the $(\mathbf{v_{12}})$ component parallel to $(\mathbf{v_1})$ i.e.,

$$(\mathbf{M_o/r})(\mathbf{v_1 - v_{12} \sin \theta})^2 \qquad (2\text{-}8)$$

where $\boldsymbol{\theta}$ is the angle measured from the east-west line $\mathbf{Y_1}$-$\mathbf{Y_2}$ which bisects $\boldsymbol{\beta_1}$.

Net radial force $\mathbf{F_r}$ exerted by the superposition of the velocity fields at any two points

---

[6] In **Q**uantum-**E**lectro-**D**ynamical calculations, electrons are described by wavefunctions that exists throughout space. To find the force between two such particles, one must calculate all the probabilities represented by the squared amplitudes of the waves at each point, and then add up the results. Since the wavefunctions overlap at certain places, there will be some locations where the force contributions are infinite. These infinities are disposed by a mathematical contrivance dubbed re-normalization—after which **QED** gives the right values for the anomalous magnetogyric ratio.

[7] **QED** should be applauded for what it is and what it does predict, but it is not a proper theory for explaining the origin of the Coulomb force, which it does not do.

intersected by the north-south meridian line **X** is equal to the difference between the squares of the

$$\mathbf{F_r} = \left(\frac{\mathbf{m_o}}{\mathbf{r_o}}\right)\left[\left(\mathbf{v_1} + \mathbf{v_{12}}\sin\theta\right)^2 - \left(\mathbf{v_1} - \mathbf{v_{12}}\sin\theta\right)^2\right]$$ velocities, i.e.,

$$= \left(\frac{\mathbf{m_o}}{\mathbf{r_o}}\right)\left(4\mathbf{v_1}\right)\left(\mathbf{v_{12}}\sin\theta\right) \tag{2.9}$$

The component $\mathbf{F_x}$ of the radial force $\mathbf{F_r}$ along the line of action joining the two particles is:

$$\mathbf{F_x} = \left(\frac{\mathbf{m_o}}{\mathbf{r_o}}\right)\left(4\mathbf{v_1}\right)\left(\mathbf{v_{12}}\sin\theta\right)\left(\sin\theta\right) \tag{2-10}$$

The average value $\mathbf{F_A}$ of the north-south component of the unbalancing force as the angle $\boldsymbol{\theta}$ varies from zero to $\boldsymbol{\pi}$ is:

$$\mathbf{F_A} = \frac{4\mathbf{m_o v_1 v_{12}}}{\pi\,\mathbf{r_o}} \int_0^{\pi} \sin^2\theta \; d\theta$$

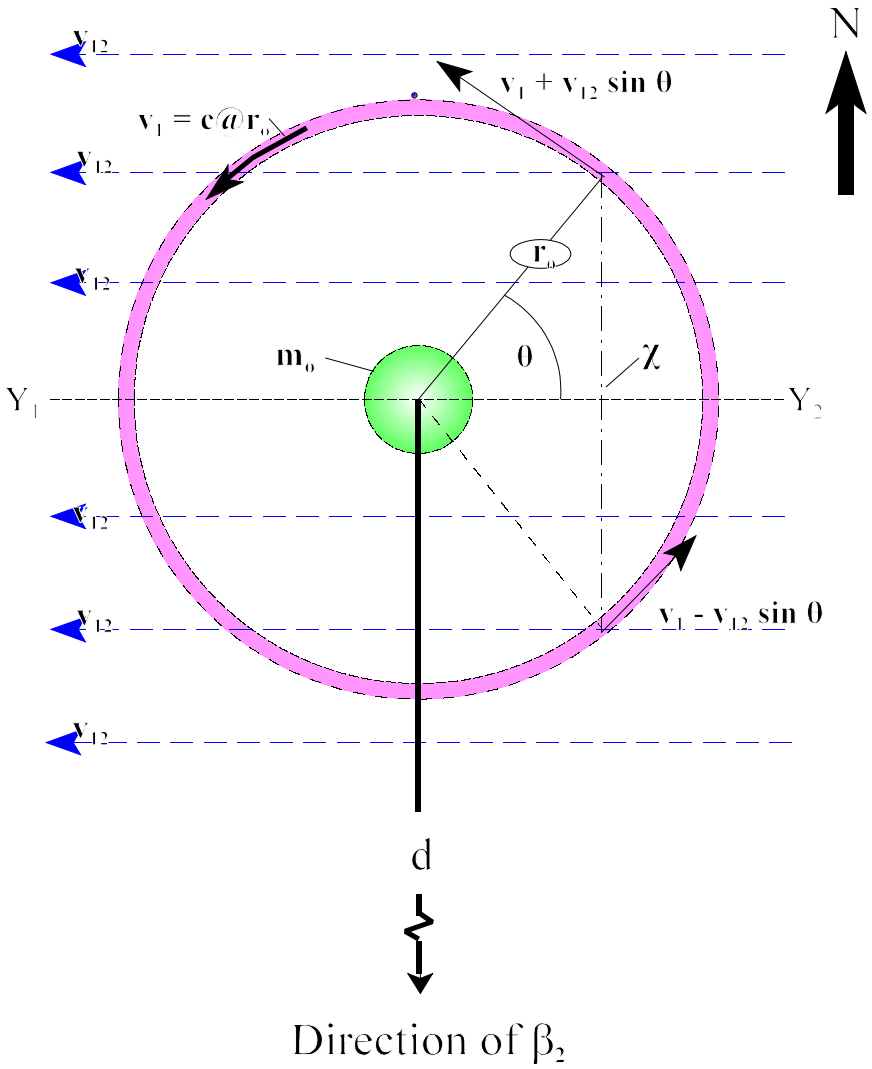
$$= \frac{4\mathbf{m_o v_1 v_{12}}}{\pi\,\mathbf{r_o}} \left[\frac{\theta}{2} - \frac{\sin 2\theta}{4}\right]_0^{\pi}$$

$$= \left(2\mathbf{m_o}/\mathbf{r_o}\right)\left(\mathbf{v_1 v_{12}}\right) \tag{2-11}$$

Comparison of equations (2-4) and (2-11) suggests we have arrived at the correct force for the operative action in both planes. If **c** is the peripheral velocity $\mathbf{v_1}$ at $\mathbf{r_o}$ and $\mathbf{c(r_o/d)^2}$ is the velocity field $\mathbf{v_{12}}$ at distance **d**, then the correct force **F** would be double (2.12).

$$\mathbf{F} = \frac{2\mathbf{m_o c^2 r_o}}{\mathbf{d^2}} \tag{2-12}$$

Figure II-3. A two dimensional particle system β_1 having counterclockwise rotation is separated from an identical particle β_2 (not shown) by a distance 'd' which is large in comparison with the nominal radius r_o. The local velocity field of β_2 can therefore be approximated as uniformly spaced straight lines v_{12} from east to west. The components of v_{12} that are to be added or subtracted from the velocity v_1 is given by the sin of the angle θ between v_1 and v_{12}. Each point at an angle θ in the northern hemisphere corresponds to a point at an angle $-\theta$ in the southern hemisphere. These complimentary locations are conjugate, the velocity v_{12} being additive in the northern hemisphere and subtractive in the southern.[8] Note shown are the interacting spatial circulations in the plane normal to the page which also passes through the centers of β_1 and β_2.



[8] If (v_{12}+ v_1) exceeds "**c**" the analysis must be modified as per pages 62-64 infra.

We have arrived at the correct numerical result without considering circulatory interaction in the orthogonal plane. Three dimensional spatial circulation reduces to interaction in the two orthogonal planes that pass through the centers of both particles. No component of rotation in a third plane perpendicular to the two orthogonal planes that pass through the electron centers can effect a force upon the electrons. Since (2-12) correctly predicts the Coulomb force as vortical interaction between two rotational fields, we conclude that superposition of one rotational field upon the other is only effective to reduce the field of the other, i.e., circulatory velocity cannot be augmented to exceed '**c**' for any region of space. With this correction (based upon **c** velocity at all distances) we accept (2-12) as correct in that it overstates the force in one plane by 50% but fails to account for interaction in the orthogonal plane which contributes ½ of the composite force.

If either one of the circulations is reversed, the direction of force will be likewise reversed. Suffice it to say, the force on $\boldsymbol{\beta_2}$ will always be equal and opposite to that of $\boldsymbol{\beta_1}$ since each produces an identical influence upon the field of the other, a commandment of Newton's 3rd law. [9]

Coulomb's Law vs Spatial Vortex

$$\mathbf{F_e = k_e \frac{q_e^{\,2}}{d^2}} \qquad\qquad F_A = \frac{2m_o c^2 (r_o)}{d^2}$$

$$\mathbf{= \frac{2.3x10^{-28}\, ntn \cdot m^2}{d^2}} \qquad\qquad = \frac{2.3x10^{-28}\, ntn \cdot m^2}{d^2}$$

Minimization of energy during interaction is a systemic stipulation of interacting fields, whether it be moving space or moving mass. Since less energy is required to imbalance the near field rather than reinforce the far field, the spin planes orient so that two of the three will occupy a state of opposition, consequently, the effective velocity field in the hinter region between the particles is diminished. Lower effective velocity decreases overall energy of the two particle system. The total energy of the field coupled structure is minimized when the in-between velocity field is minimized. The specification of electrical charge in terms of first principles is thus:

$$\mathbf{E_e = \frac{k_e (q_e)^2}{2r_o}} \tag{2.13}$$

And since $\mathbf{E_e = m_o c^2}$, then:

$$\mathbf{k_e q_e^{\,2} = 2m_o c^2 (r_o)} \tag{2.14}$$

Equation (2-14) is the electro-mechanical transform between the two divisions of classical physics. To shift from one to the other, substitute for ($\mathbf{k_e q_e^{\,2}}$) in Coulomb's law, or ($\mathbf{2m_o c^2 r_o}$) in the mechanical formulation. From (2.17) below, the energy in the electric field is ($\mathbf{- m_o c^2}$).

---

[9] **For $q_e = 1.6 \times 10^{-19}$ coul, $r_o = 1.4 \times 10^{-15}$ meters, $m_o = 9.1 \times 10^{-31}$ kgm, and $k_e = 9x10^9$ kgm m^2/coul^2**

The ultimate question of charge as a fundamental property of nature must be rethought. In its common form as an electron, spatial extent is defined by Newtonian reaction. If the formulation is correct, the virtual circulatory field summed over the volume of the Hubble sphere must correspond to the angular momentum quantum $\mathbf{h/4\pi}$.

Conservation of angular momentum is not overruled by expansion. As per (2.14) the dilation of an angular momentum space will be accompanied by an inwardly directed reactive force, that which gives rise to the electric energy field. To express the energy contained in an expanding volume of empty space, we revert to the electrical formalism. Comparison of the kinetic energy of circulatory space contained in the expanding Hubble volume to the positive energy of the non-expanding hub of radius $\mathbf{r_o}$, shows that the two are equal and opposite.[10] The energy of the electric charge is the integral over the energy density:

$$\frac{\varepsilon_o}{2}\int_V \mathbf{E}\cdot\mathbf{E}(\mathbf{dV}) = \int_{r=0}^{R}\frac{q^2}{32\pi^2\varepsilon_o r^4} = -\frac{q^2}{8\pi\varepsilon_o}\frac{1}{r} \tag{2.15}$$

Using the electrical relationship $\mathbf{4\pi\varepsilon_o = 1/k_e}$ then from (2-14):

$$\mathbf{Energy = 2m_oc^2(r_o)/2r}\big|^{r=R} \mathbf{- 2m_oc^2(r_o)/2r}\big|_{r=0} \tag{2.16}$$

which straightaway revives the age-old problem of particles as points. Clearly, there is no difficulty with the limit $\mathbf{r = R}$, but for $\mathbf{r}$ = zero, the field energy per (2.16) is infinite. The difficulty evaporates, however, if the lower limit $\mathbf{r = r_o}$ which comports with our objective in that (2.16) reduces to:

$$\mathbf{Energy = (-\ m_oc^2)} \tag{2.17}$$

As initially prefaced, the electrical and mechanical formalisms (2.14) are based upon empirical quantities. Accordingly, electron mass-energy for present purposes is a quantified constant uniquely interdependent upon $\mathbf{r_o}$. Total energy in the circulatory prescription is also $\mathbf{m_oc^2}$ per (2.17), $\mathbf{r_o}$ being correspondingly fixed and quantified consequent thereto.

In the Inertial-Gravity confluence related in Part I, negative gravitational energy and positive mass energy were axiomatically balanced. For the electron, negative circulatory energy is reflected to the HUB in form as positive energy $\mathbf{m_o}$. When virtual circulatory flow is treated as uniform (constant velocity $\mathbf{c}$ at all distances), the contribution of the flow to angular momentum (at any distance '$\mathbf{d}$' from the rotational center) is distributed over the spatial length $\mathbf{2\pi d}$. As previously belabored, the effect of circulation diminishes inversely with '$\mathbf{d}$,' per (2.4), the centripetal force also diminishes as '$\mathbf{1/d}$' per (2.1A), and the field force diminishes as $\mathbf{1/d^2}$ per (2.2).

[10]Equal and opposite circulations are presumed to arise during the initial instant of expansion when stress intensity was maximum. There is never net energy due to the consequent **G** field and never a net global angular momentum since the number of positrons locked up in protons will be always equal to the number of electrons .

So while circulatory space properly predicts repulsive and attractive forces between like and unlike charges, respectively, it also explains Feynman's enigma, the irreconcilable isotropic angular momentum quantum $\mathbf{h/4\pi}$. The electron angular momentum $\mathbf{h/4\pi}$ cannot be local rotational mass- but it can be 3-D virtual circulatory flux reflexed to the hub.[11]

Since the orientation of circulatory spatial flux is not limited to a single plane, when measured as a property of the particle, it will exhibit no directional preference. The challenge is that of showing the electric field to be the alter-identity of the spatial angular momentum field $\mathbf{h/4\pi}$.

To complete the model, we will tie the electric field to the spatial angular momentum field and claim the sum total of the energy in the spatial rotational field is $\mathbf{m_o c^2}$ and that the sum of all spatial circulations corresponds to an angular momentum $\mathbf{h/4\pi}$.

The circulation at distance '**d**' from the rotational center of a plane passing through the rotational center is from (2.1), $\mathbf{cr_o/d}$. Just as there are two orthogonal planes of spatial rotation contributing to the electric force, there are only two orthogonal rotational planes that can intersect both the center of rotation and an arbitrary point in space. They add vectorially as $\sqrt{2}$. Spatial angular momentum is therefore the square root of the sum of the squares of two orthogonal circulations multiplied by the central mass $\mathbf{m_o}$. The sum of the moment of momentum $\mathbf{LC_T}$ of two intersecting orthogonal circulation fields is:

$$\begin{aligned}
&\mathbf{LC_T} = \sqrt{2}(\mathbf{m_o})\int_{r_o}^{R}\frac{\mathbf{cr_o}}{\mathbf{r}}(\mathbf{dr}) = \sqrt{(2)}\mathbf{cr_o}(\mathbf{lnR} - \mathbf{lnr_o})(\mathbf{m_o}) \\
&\approx \sqrt{2}(\mathbf{cr_o})(\mathbf{ln10^{26}} - \mathbf{ln10^{-15}})(\mathbf{m_o}) \\
&\approx (\mathbf{1.414})(\mathbf{3x10^{8}})(\mathbf{1.4x10^{-15}})(\mathbf{60} - [\mathbf{-35}])(\mathbf{9.1x10^{-31}}) \\
&\approx \mathbf{5.1x10^{-35}\,meters^2 kgm\cdot sec^{-1}} \approx \mathbf{h}/\mathbf{4\pi}
\end{aligned} \tag{2.18}$$

This completes our composition of the electron (or positron) as virtual circulatory space, to be understood as the multiplicatus angular momentum function $\mathbf{h/4\pi}$ of every subatomic particle which, although not always measurable because of cancelling counter oriented spins, or measured in some multiple of $\mathbf{h/4\pi}$ in those particles composed of more fundamental entities. Postulation is superseded by virtual circulation, the electron now exposed as a charade where expanding spatial angular momentum poses as the electric field. No part of the electron complex is independent. Taken together with the space/time operative '**c**,' the quantified values of mass $\mathbf{m_o}$, angular momentum $\mathbf{\hbar/2}$ and radius $\mathbf{r_o}$ form a fundament called the electric unit of charge **q**.

[11]For circulatory flow, the integral around any closed path which includes the rotational center is $\mathbf{2\pi rv}$, the circulation **C** will be $\mathbf{2\pi C}$ for all paths which include the center and zero for all contours which exclude the center.

ALPHA

The ratio of the electron velocity in the first Bohr orbit to the speed of light is symbolized by the first letter of the Greek alphabet, **α**. Also known as the Sommerfield fine structure constant, "*alpha*" comes into play whenever waves interact with particles.[12] Its symbolic value $\mathbf{k_e q^2/\hbar c}$ (approximately 1/137) has always been a mystery (why should these apparently unrelated constants, combine to create a dimension-less number [approx (1/137)]?

The "mechanical formulation" of the electron provides a Rosetta Stone. When expressed in terms of mass and size,"*alpha*" demystifies as the ratio of two angular momentums, namely the Hub angular momentum $\mathbf{m_o cr}$ divided by the angular momentum of the virtual circulatory field $\mathbf{h/4\pi}$. Specifically, from (2.14), we recognize $\mathbf{k_e q^2}$ as $\mathbf{2m_o c^2 r_o}$. Rewriting alpha as $[\mathbf{k_e q^2/c}]/\hbar$, then

$$\alpha = \mathbf{k_e q^2/\hbar c} = [\mathbf{k_e q^2/c}]/\hbar = \mathbf{2m_o c^2 r_o/(ch/2\pi)} \tag{2.19}$$

which reduces to:

$$\alpha = \frac{\mathbf{m_o c r_o}}{\dfrac{\mathbf{h}}{\mathbf{4\pi}}} \tag{2.20}$$

Expressed in terms of its mechanical pedigree, alpha reveals the action of the whole in terms of its parts. Negative field energy (2.15) reflexed to the HUB ghosts as the positive rotational mass energy $\mathbf{m_o c^2}$ that defines the virtual angular momentum $\mathbf{m_o c r_o}$. The expansion generated centripetal force $\mathbf{m_o c^2/d}$ thus comports with the acceleration at distance '**d**' multiplied by $\mathbf{m_o}$. Specifically, if $\mathbf{m_o c^2/r_o}$ is the force at the Hub, then:

$$\mathbf{F_{HUB}} = (\mathbf{m_o c^2/r_o})(\mathbf{r_o/r_o}) \tag{2.21}$$

is also the force at the Hub, which can be written as:

$$\mathbf{F_{HUB}} = \mathbf{m_o c^2 r_o/(r_o)^2} \tag{2.22}$$

Ergo, for any other distance '**d**' the force due to the rotational interaction will be:

$$\mathbf{F_d} = \mathbf{m_o c^2 r_o/(d)^2} \tag{2.23}$$

which expresses the continuity of the electron state as one in the same with (2.2). In words, the inverse dependance of centripetal force upon distance assures the continuity of '**c**' circulatory formalism at all distances)**.** And since HUB angular momentum is simply '**c**' velocity rotation of the electric field energy $\mathbf{m_o}$ reflexed thereto, the whole can now be understood as a self maintaining composition.

---

[12]The constant **α** plays a crucial role in **QED** theory in that it relates the electrostatic quantities $\mathbf{k_e}$ and **q** to the **h** and **c**

The rhetorical question as to the fundamental nature of electric charge has been reduced to an expression between two mechanical circulations. This account raises two issues, 1) that of why some spin particles exhibit no electric field and 2) that of why some spin-less particles manifest the same electric intensity as electrons.

The first issue is exemplified by neutrinos and photons. Both are fundamental entities. Based upon the combination of factors used to construct the mechanical model of the electron, neutrinos should be neutral, as is the case, since they have no ponderable mass upon which acceleration fields can act. The same is true of photons, moreover, photon angular momentum is coaxial and therefore does not create 3-D circulatory fields, photons should not manifest electric charge, as is also the case. Neutrons and protons are complex particles, and like all complex structures, net charge will depend upon the ingredients.. [13]

The existence of spin-less electric particles with large masses, however, would seem to discredit any theory of charge based upon spin angular momentum. The deciphering of "alpha" suggests a rationale. For the electron, the mass and size is insufficient to explain the magnitude of its directionally resolved angular momentum $\mathbf{h/4\pi}$. Local angular momentum is limited to the reflexed mass-energy $\mathbf{m_o}$, the maximum possible HUB angular momentum is therefore $\mathbf{m_o c r_o}$. For a heavy electron (symbolized as $\boldsymbol{\mu}^-$ and called the muon minus meson), the mass factor is $\mathbf{(206.78)m_o}$. The reason why particles such as $\boldsymbol{\pi}+$ and $\boldsymbol{\pi}^-$ mesons exhibit zero angular momentum is because charged pions are complex entities composed of one neutrino and one muon, the latter determining pion polarity.[14] Analogously formulated using the muonic dimensional factors $\mathbf{m_u}$ and $\mathbf{r_u}$ in place of $\mathbf{m_o}$ and $\mathbf{r_o}$, local angular momentum $\mathbf{m_u c r_u}$ will cancel neutrino angular momentum when local angular momentum equals the circulatory electric field angular momentum $\mathbf{h/4\pi}$, that is:[15]

$$\mathbf{F_u} = \frac{\mathbf{m_u c^2 r_u} \alpha}{\mathbf{d^2}}$$

where (2.24)

$$\mathbf{r_u} = \frac{\mathbf{h}}{\mathbf{4\pi c m_u}} = \mathbf{0.95\ x\ (10)^{-15}\ meters}$$

---

[13] In the "standard theory" the constituents of protons and neutrons called quarks are hypothesized as fractional charges (**1/3q**, **2/3q**), but physically separated fractional spin entities have yet to be directly observed. While cancellation of spins in one or two dimensions of a 3-space circulation may be interpreted as fractionally charged separate particles, they can also be considered as parts of the whole. Indeed some theorists prefer the name partons as more representative of the physiology. The "standard model" is intended primarily as a mathematical artifice for predicting behavior rather than as a physical emulative.

[14] There is also a Tau particle with mass in the neighborhood of 3000 $\mathbf{m_o}$ also considered a fundamental, but like the muon, a neutrino (the tau neutrino) is released during decay. Our speculations regarding the true nature of the muon also apply the tau.

[15] The analogy here is that of two counter rotating wheels on the same shaft, one inside the other, each having the same angular momentum - net angular momentum is zero, but the larger wheel is capable of exerting an influence upon its surroundings at a greater distance.

If charged $\boldsymbol{\pi}$ mesons are a door to understanding quantum structure in terms of classical mechanics, then alpha is the key. There are then two formulations for **q**, one based upon the electron's radius and mass as determined by the circulatory field energy $\mathbf{m_o}$, the other based upon the properties of the muon. The ratio of angular momentum derived from the reflected rotational field energy to the angular momentum field is *alpha*. In the muonic formulation, increased mass is reflected in smaller radius determined within the containment structure. Muon mass being sufficient to cancel angular momentum locally, results in a condition of local angular momentum equal to global angular momentum, $\mathbf{m_u c r_u = h/4\pi}$. Upon escape from the internal force constrains imposed by the bound state of a muon as part of a complex particle, the muon decays into an electron and two hypothesized particles from the neutrino family needed to balance energy and angular momentum continuity. That charged pions decay to a muon of the same charge plus one neutrino is consistent with the existence of algebraically subtractive local spins. The sequence of events from pi-plus to mu-plus to positron is shown in **Figure II-4**.[16]

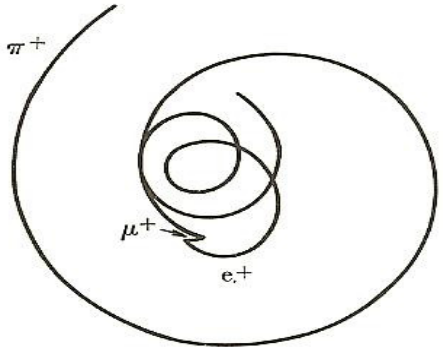


Figure II-4 shows the decay of a (pi-plus) to (mu-plus) and neutrino (the latter theorized, but not observed). (mu-plus) then decays to a positron with the emission of a neutrino and anti neutrino (both theorized but not observed). [From liquid hydrogen bubble chamber, Brookhaven National Laboratory]

The existence of rival particles manifesting the same quantum of charge as electrons whose properties formulaize as a unitized quantum **q**, is initially bothersome. But if the electron is viewed as the free state of a mu minus, the unyoked charge simply expands to its dimensional maximum, namely, the radius $\mathbf{r_o}$ corresponding approximately to the electrical energy $\mathbf{m_o}$ contained in the electric field of the muon prior to transition, i.e., the circulatory energy of the muon spatial angular momentum $\mathbf{h/4\pi}$, aka its electric field. While the tau and muon are regarded as fundamental particles, they come into free existence as an altered state of what soon disintegrates into an electron neutrino and anti-neutrino. That muons and taus can be internally stressed forms of matter that counter balance spatial angular momentum in a bound state as charged pi meson is consistent with what zero net annular momentum. Additional mass corresponds to the binding energy of two neutrinos, a smaller size and greater internal stress in the bound form.[17] While the muon is considered a fundamental particle having no place in the standard model, it is never alone–being either internally locked with other subatomic entities or a temporarily state defined by neutrinos.

[16]In approximately 1% of mu-minus decays, the pion transforms directly to an electron and anti neutrino

[17]In standard theory, the muon has been neglected entirely - there seems to be no place for it to fit

In classical physics, the idea of force per unit area, is paramount. In quantum mechanics, energy and momentum are the basic descriptors. The present study reverts to the ascription of spatial dimensions to subatomic entities. Most of these lengths can only be determined inferentially by observing other characteristics consistent therewith. What is significant from the perspective of the electron is that its local properties are determined by the extent of its global circulatory field. From a naive perspective, one might imagine an electron as a muon freed of its compactification and binding energies, thereupon expanding to the maximum radius $\mathbf{r_o}$ permitted by the left over energy $\mathbf{m_o c^2}$. In this ending, we are reminded of an idea long cherished by John Wheeler:

"*Perhaps a different theory would reveal how all matter could be made from electrons*."

Interested readers are invited to send comments to "Cosmodynamics@yahoo.com"

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