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Exploring the Foundations of Gravity Using Empirical Data

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Abstract

This exploration of spacetime and gravity emerged from two discoveries that were derived from very detailed analyses of the empirical data. These discoveries are, (i) the massless formula for gravitational acceleration g=τc2 and (ii) that the gravitational constant G is not a constant but a variable Gi dependent upon the isotopic mass of element I, therefore, the need for a gravitational theory that encompasses, cosmology, near field gravity measurement inconsistencies and gravity modification.

This paper presents one approach, that Nature is consistent everywhere, at every level of detail, and thus, spacetime is a non-null medium different from dimensions. Spacetime is the carrier of velocity and acceleration that alters the ruler of the dimensions, and therefore, the spacetime interval does not exists. Macro forces are observed when a Non Inertia (Ni) field is present and governed by g=τc2, the universal descriptor of macro forces. This, lends itself to the development of gravity modification engines. This paper provides detailed guidance on how to design and construct gravity modification engines. An example is provided. From a cosmological perspective, the galaxy rotational anomalies are due to nucleosynthesis resulting in a decreasing gravitational constant. The variable gravitational coefficient Gi for isotope i provides alternatives to both, the dark matter thesis, and the big bang thesis. This paper proposes that all blackhole masses (black stars) are composed of a new type of particle, the black particle, who mass is 26.6 times heavier than the proton, and that black stars consists of a new type of matter, the black matter.

Keywords: ***Black holes; Galaxy rotation anomaly; Conservation of mass-energy; Dark matter; Nucleosynthesis; Gravitational constant; Spacetime interval; Newton's third law of motion.***

Introduction

In 2015, the Planck Space Telescope data [1] showed that the Universe is simpler than thought and that both string and quantum theories require revisions. To add to this debate, in 2012 the Fermi Gamma-Ray Space Telescope photographs of gamma ray burst, showed [2] that quantum foam could not exist, therefore, the need to fundamentally rethink at least some of

the foundations of physics. For example, finding the answers to some unasked questions in contemporary physics; Relativity, String and Quantum (RSQ) theories.

These questions are:

(i) How does matter create gravitational fields?

(ii) How does Nature implement probabilities?

(iii) How will these answers impact our understanding of the Universe? And

(iv) Can radically new technologies be developed?

Therefore, pursuing a new approach, one can broaden the scope required of gravitational theories by requiring that new theories are consistent with:

(i) Distant cosmology,

(ii) Near field local gravity probes, and

(iii) Local gravity modification.

In 2015 using this broadened framework two new theoretical considerations [3] were proposed.

First, that gravitational fields are indeed produced by quark motion not mass, and that mass is only a proxy for amount of matter. Second, a 4th approach to forces, not related to the RSQ theories, was proposed. That a particle's velocity and acceleration is evidenced by the shift in the Center of Field CF of the local field's spatial gradient. This field could be gravitational, electromagnetic, electric, magnetic or mechanical motion.

This paper presents the main findings of 19 years of rigorous research into the foundation of forces. That gravity is a Non Inertia (Ni) field, and all macro forces, gravity, mechanical, electromagnetic, and electric forces are Ni fields and therefore obey [2]. The Center of Field approach is for a non-point sized particle, not particle exchange as in Quantum theory or spacetime structure as in General Relativity (GR). Consequently, the gravitational constant G is a variable or a coefficient, dependent upon the isotopic mass of the element and has implications to cosmology (Big Bang), astrophysics (determining stellar masses and galaxy rotation), near field gravity probe research, and gravity modification.

This paper proposes that unlike GR's spacetime (x, y, z, t), dimensions and spacetime are different manifestations.

Method

Center of field method

GR makes no overt assumptions about a particle's size, but later in this paper the authors will show that the implicit assumption is a point-sized particle, like Quantum Theory. In 2015 this broadened framework [3] provided two new theoretical considerations. First, the gravitational fields are indeed produced by quark motion not mass, and that mass is only a proxy for amount of matter (see later section). Second, a 4th approach to forces that is not related to the RSQ theories, that a particle's velocity and acceleration is evidenced by the shift in the Center of Field CF of the local field's spatial gradient. This field could be gravitational, electromagnetic, electric, magnetic or mechanical motion.

It was proposed that the deformation of this field results in the shift in the Center of Field CF, just as altering the shape of an

object would alter its Center of Mass CM. The magnitude and direction of the shift of this CF governs the strength and direction (attraction or repulsion) of the resulting motion of this field.

For example, in a gravitational field, the Newtonian Gravitational Transformations NGT (4) would induce non-linear length contraction, mass increase and time dilations across an elementary particle. The net effect on a particle's spherical shape (when external to a gravitational field) is the deformation (in a gravitational field) to an asymmetrical ovoid-like shape thereby causing the particle's center of mass to shift towards the gravitating mass, evidenced as acceleration. Using the Center of Mass concept, the Center of Field CF of a field F that ranges from lower limit L to upper limit U, is defined as:

$$C_F = \int_L^U P(x)xdx / \int_L^U P(x)dx \quad (1)$$

Where P is the property of the Field used to evaluate the Field's CF whether spatial gradient or the property itself. If the deformation of the field property is non-linear then the spatial gradient of the Field's property P or dP/dx is the parameter used to estimate the Field's CF. If there is no deformation of the field property, then the field's property P is the parameter used to estimate the Field's CF as the spatial gradient of P is zero.

The importance of this finding is that Poincaré stresses [4] no longer exists as electric field lines and therefore magnetic field lines are no longer repulsive. This non-repulsiveness would be consistent with the field behavior in the electromagnetic transverse wave.

The field effect

The discovery in 2007, of the new massless formula for gravitational acceleration (2), points to the need for major changes in gravitational theories;

$$g = \tau c^2 \quad (2)$$

where τ is the spatial gradient of the time dilation transformation or change in time dilation transformation, divided by that distance of this change. Noting that the time dilation transformation is the ratio of t_v/t_0 per Lorentz-FitzGerald Transformations (LFT) or (3), and Newtonian Gravitational Transformations (NGT) or (4).

$$\Gamma(v) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{x_0}{x_v} = \frac{t_v}{t_0} = \frac{m_v}{m_0} \quad (3)$$

$$\Gamma(a) = \frac{1}{\sqrt{1-\frac{2GM}{rc^2}}} = \frac{x_0}{x_a} = \frac{t_a}{t_0} = \frac{m_a}{m_0} \quad (4)$$

Or in the generic form, the environmental transformation Γ (e),

$$\Gamma(e) = \frac{x_0}{x_e} = \frac{t_e}{t_0} = \frac{m_e}{m_0} \quad (5)$$

Eqn. (2) provides a mathematical solution to Hooft's assertion that the "absence of matter no longer guarantees local flatness" and established [5-7] that eqn. (2) is valid for mechanical and electromagnetic forces. That is the universal mathematical descriptor of acceleration for macro forces.

A Ni field, is a spatial gradient of real or latent velocities that are orthogonal to the direction of the acceleration, and this acceleration, governed by eqn. (2), is in the direction of increasing orthogonal velocities. Gravity is a Ni field as one observes that a satellite's orbital velocity increases as the radius of the satellite's orbit decreases, and the gravitational acceleration increases as this radius decreases.

Does this conflict with GR? No, because this scheme can be written in terms of GR's separation vectors [8,9]. The standard z-direction (6) separation vector is a function of gravitational mass m, and gravitational constant G at a distance r from the source. Gravitational acceleration g (10) is defined by these separation vectors. This three-part schema can be described as, i) the source, a function of mass (8), ii) the field or the transformations present in spacetime (9), and iii) the field effect, acceleration (10).

$$\frac{d^2\xi^z}{dt^2} = 2\frac{Gm}{c^2r^3}\xi^z \quad (6)$$

$$\frac{d^2\xi^z}{dt^2} = \Omega\xi^z \quad (7)$$

$$\Omega = 2\frac{Gm}{c^2r^3} \quad (8)$$

$$\frac{d^2\xi^z}{dt^2} = h\left(\xi^z\right) \quad (9)$$

$$g = f\left(\frac{d^2\xi^z}{dt^2}\right) = \tau c^2 \quad (10)$$

For more complete discussion on the schema approach to gravitational fields [5,6].

Unrecognized consistencies in gravitational fields

Consistency is a fundamental requirement of physics, stated as the laws of physics are the same everywhere. Reconstituting as the Law of Consistency, the laws of the Universe are consistent everywhere and at every level of detail. There are two basic parts to this Law of Consistency.

The first, Transference Consistency (11), that any fundamental transformation present in spacetime must be identically mirrored on a particle in that local region and vice versa.

The second, Transformation Consistency (14), that all fundamental transformations are the same everywhere even though their origins are different.

With respect to Transference Consistency (11), assuming that a particle has mass and occupies a volume, it was proposed that the particle's mass-volume field deformation was due to the internal effects of the NGTs, present in the local region of the external gravitational field such that the spacetime transformations Γs (x, y, z, t) are concurrently reflected as particle transformations Γp (x, y, z, t) or,

$$\Gamma_{p(x,y,z,t)} = \Gamma_{s(x,y,z,t)} \quad \text{Transference Consistency} \quad (11)$$

The utility of eqn. (11) is that it explains why the gravitational field passes through all matter. Additionally, particles (i) are not point-like but do have a size (however small) and shape that Nature recognizes, (ii) since LFT and NGT are velocity determined space contraction transformations, non-point-sized particles contract with velocity. This modeling led to the discovery of eqn. (2).

This approach is a means to falsify (technical term) strings as they contradict LFT. Macro bodies elongate as the body falls into a gravitational field. Let's reexamine this tidal behavior with the additional requirement that this tidal gravity property be consistent with LFT or Special Theory of Relativity (STR). To be consistent with LFT, the atoms and elementary particles would contract in the direction of the fall. However, to be consistent with tidal gravity's elongation, the distances between atoms in the macro body increases at a rate consistent with the acceleration and velocities experienced by the various parts

of the macro body. That is, the atoms get flatter while the distances apart get longer. In the RSQ theories particle are point-sized and therefore the Tidal Axiom is that "objects" get longer in a gravitational field. One suspects that string theory's Tidal Axiom, that strings expand with energy, is inconsistent with LFT and NGT.

With respect to Transformation Consistency (14) in Nature, consider a body falling in a gravitational field. Falling from infinity (where t_∞ is time dilation at infinity) it has both acceleration a and velocity v. If the gravitational time dilation derived from the non-inertia NGT produces the correct instantaneous free fall velocity when plugged into the inertia LFT then these transformations are consistent in some manner.

The empirical evidence [5-11] shows that non-inertia NGT is consistent with inertia LFT as for any location point in spacetime the two transformations produce identical velocities. That is, the time dilations as a function of acceleration t (a) and time dilation as a function of velocity t (v) are equivalent or t (a) ≡ t (v). To restate, the LFT transformations of flat spacetime is observable in non-flat gravitational fields. Or (5) can be rewritten as,

$$\Gamma(e) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\frac{2GM}{rc^2}}} = \frac{x_0}{x_e} = \frac{t_e}{t_0} = \frac{m_e}{m_0} \qquad \text{When v is the escape velocity at distance r} \qquad (12)$$

However, elementary particle experiments [9] demonstrate that time measured by atomic clocks depend only on velocity and not on acceleration; but by the principle of equivalence that all effects of a uniform gravitational field are identical to the effects of a uniform acceleration of the coordinate system, one could propose that the time dilation t (a) derived from NGT and the time dilation t (v) derived from LFT should not be correlated or t (a) ≠ t (v) should in general be true. This is contrary to the empirical evidence [5-7,11].

Therefore, the derivation of time dilation from the non-inertia NGT demonstrates that in addition to the principle of equivalence, in free fall Nature requires inertia LFT relationships to be consistent with non-inertia NGT relationships; that these two transformations are not separate from or independent of each other. This consistency holds even when inertia motion is not a degenerated special case of non-inertia motion because it is verifiable for any acceleration a and velocity v (|v| « c).

One infers firstly, that the nature of transformations governs time dilation, length contraction, mass increase, velocity, and acceleration. Second, that LFT and NGT co-exist in a manner that is consistent with each other and possibly imply that other (as, yet unknown) transformations may exist consistently with these two.

There is one other unexpected consequence of this approach. Note GR does not make any statements about particle structure or size. For a non-point sized particle, the non-linear accelerating gradient of a gravitational field is not the same as a constant or linear acceleration of a macro bodies.

The Principle of Equivalence, that gravitational acceleration and acceleration in general are equivalent, is a special case and only for a point sized particle, as with a point-sized particle, the effective consideration is that a thin slice of gravity is the same as a thin slice of mechanical acceleration.

To restate it in a more structured manner, for non-point sized particles, mechanical acceleration is a first derivative of velocity whether spatial or temporal, whereas gravitational acceleration is a second derivative of velocity. This results in different

effects across the volume of a particle but has no consequence for a point sized particle. Therefore, GR's implicit axiom is that particles are point-like.

What is spacetime?

This section reviews the properties of spacetime as originally proposed by FitzGerald and later by Lorentz, confirmed by the Michelson Morley experiments and later adopted by Einstein in his paper on STR.

Let's step back for a moment. Why does length contract but time dilate? A careful examination shows that length is a quantity or number of markings on a ruler, but time in this case is the quantity between clock ticks i.e. the quantity between the ruler markings. Standardizing length to distance interval d between ruler markings gives a space and time intervals that behave (13) identically,

$$\Gamma(e) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\frac{2GM}{rc^2}}} = \frac{d_e}{d_0} = \frac{t_e}{t_0} \quad \text{when } v \text{ is the escape velocity at distance } r \tag{13}$$

Or, given ρ, the general representation for a dimension's ruler which is only a function of velocity and not the velocity gradient,

$$\Gamma(e) = \frac{\rho_e}{\rho_0} \quad \text{Transformation Consistency} \tag{14}$$

Therefore, accounting for the different rulers at different velocities, one can now prove that the spacetime interval is always zero, i.e. it does not exist. A simple test is of two particles A and B, both moving at a velocity v_1 along an axis x at a distance d apart with A behind B. Have particle C in front of B, moving along the same axis x in the opposite direction at a velocity v_2 such that $v_1 \neq v_2$. At a specific point in time both B and C will be at the same location. That is, the space between A and B and A and C is the same, since B and C coincide, but due to LFT (14), the measured distances between A and B or d1 and A and C or d_2 are different. This effect is due to the different rulers of B and C.

The inference from (14) is that the length, time and mass distortions at a velocity v are always consistent and independent of how these transformations originate, either by acceleration or some other effect. Therefore, one can propose that the dimensions are fundamental properties of Nature. The dimensions can express a zero spacetime, therefore spacetime is not dimensions but an emergent (see Appendix for more on emergence) property of the dimensions.

By the Transference Consistency (11) the modification of spacetime is evident as energy of the particle. However, the spacetime distortion, though equivalent to energy, is not energy, else gravitational fields will deplete, and these don't. Therefore, energy is an emergent property of spacetime.

The amount of modification present in spacetime can be measured by the energy of a particle. Transfer Consistency (11) goes both ways, from spacetime to particle, and from the particle to spacetime.

By Transformation Consistency (14) spacetime is the carrier of velocity and acceleration, therefore of momentum and force, not particles. Particles appear to carry forces due to Transference Consistency (11).

This paper proposes that the underlying principles for conservation of energy are the Transference (11) and Transformation (14) Consistencies.

So, what is spacetime? Occam's razor requires (i) the simplest and (ii) minimum set of factors. If spacetime was null, the dimensions could not observe multiple transformations per (14). It had been suggested [12] that spacetime needed to be rich.

As a first iteration, spacetime is a non-null medium that is the carrier of velocity and acceleration. Using the minimum set requirements, electric and magnetic fields should be expressed in terms of spacetime properties. The electric field vector would be the ideal candidate as its field lines are simpler (per Occam' simplest requirement) and the magnetic field can be expressed in terms of the electric field and velocity. Proposing that the electric field vector E is a dimension with its corresponding ruler ϵ, gives a 5-dimensional spacetime K_5 that can explain all observations. Such that,

$$K_5 = \{\Gamma(V_x), \Gamma(V_y), \Gamma(V_z), \Gamma(V_t), \Gamma(V_E)\} \quad (15)$$

And by (14) ϵ observes the same LFT and NGT transformations (16) as the other dimensions

$$\Gamma(e) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\frac{2GM}{rc^2}}} = \frac{d_e}{d_0} = \frac{t_e}{t_0} = \frac{\epsilon_e}{\epsilon_0} \quad (16)$$

Eqn. (16) conforms to Lorentzian electromagnetic field theory. Thus, spacetime (15) is the non-null medium that obeys Transference Consistency (11) and Transformation Consistency (14), therefore, the carrier of motion-based transformations, and differs from the current spacetime definition of (x, y, z, t). That is. the Newtonian dimensions are transformed by the non-null spacetime medium into the Einstein Relativistic Spacetime (ERS) or $K_{5,ERS}$.

One infers that,

(i) The dimensions are the same everywhere but our measure of them changes with velocity.

(ii) Confirming that the dimensions are different from spacetime.

(iii) That quite possibly the Universe appears to be expanding because its rulers change to make it so and this implies that the universe is a closed system. And

(iv) For a property to be a dimension it must obey four conditions,

(a) Is quantifiable.

(b) Lends itself to vectoring. Note that vectoring is a space property.

(c) Cannot be expressed in terms of the other dimensions. And

(d) Must obey LFT. Thus, mass is not a dimension even though it obeys (a) and (d) and the mass increase with velocity is due to the transformation of the dimensions.

Note, the dichotomy present in ERS, the absolute of the dimensions and the relative of the measure. Since there are many types of particles, are there many types of spacetime?

The term kenos (now shortened to keno) is Greek for vacuum. Within the limits of the 5 dimensions (x, y, z, t, E), two [3,5,13,14] kenos were proposed,

(i) As the carrier of probabilities in Nature, the Subspace Keno K_3=(x, y, z) does not exhibit the time dimension as probabilities are time invariant, and

(ii) The Variable Electric Permittivity Keno K_5, VEP=(x, y, z, t, E) is evidenced as binding energy of atomic nuclei where electric permittivity has a powerful effect, but much research is still required here.

Taking mass out of gravity

The RSQ theories' axiom is that gravitational coefficient G is a constant, however, near field gravity probe experiments are unable to determine the value of G with significant precision. What if this is not the correct axiom? Equations (2) and (10) show that acceleration can be disengaged from the gravitating mass source (8). Therefore, are there experiments that can prove that (A) it is matter and not mass that generates gravitational fields, (B) can gravity type Ni fields be produced without using mass?

To answer part (A) requires a theoretical foundation that proves that gravitational acceleration is independent of mass. Towards this end it was proposed that the gravitational constant G was not a constant but a coefficient Gi which changes with the mass of isotope i.

Therefore, the Earth's gravitational coefficient G_E is a composite (17) of the isotopic gravitational coefficients Gi (18) of element i in the proportion w_i found on this planet and dependent upon the isotopic mass M_i of element i,

$$G_H = \sum_i w_i G_i \quad (17)$$

$$G_i M_i = k_{iso} \quad (18)$$

Where isotope constant, kiso=2.973856 × 10^{-36} m^3s^{-2}. Thus, the gravitational acceleration gH of a heavenly body H of mass M_H and radius R_H is given by (19),

$$g_H = k_{a,R}(\sum_i w_i G_i) M_H / R_H^2 \quad (19)$$

Where, $k_{a,R}$=*2.244171x10*^{25} is the aggregation constant at radius R_H, or how matter is arranged in a body, such that,

$$k_{iso} k_{a,R} = G_E \quad \text{for planet Earth} \quad (20)$$

The gravitational coefficient G_E=6.67384 × 10-11 m3kg-1s-2. For a single atom (19) reduces to,

$$g_i = \frac{k_{a,R} G_i M_i}{R_i^2} = \frac{k_{a,R} k_{iso}}{R_i^2} = \frac{G_E}{R_i^2} \quad (21)$$

Thus, proving that it is matter and not mass that produces gravitational fields with mass being a proxy for the quantity of matter. However, this raises some concerns in astrophysics. Nucleosynthesis cause stellar nuclei to increase in mass, and thereby decrease the overall gravitational coefficient G_H of the star, and its gravitational pull g_H.

This leads to two inferences

(i) That quite possibly that the Big Bang was not an "explosion" but a disintegrating like expansion caused by nucleosynthesis, and

(ii) One needs to know the composition of a star before determining its mass.

Noting that expansion of the Universe points to an early Universe that was extremely small, and that nucleosynthesis implies that there were more particles in the early Universe that there is now, rewriting (19) in terms of the early Universe consisting of n almost massless particles of type i, with radius R_U, gives a Universe gravitational acceleration g_U,

$$g_U = \frac{k_{a,R}(\sum_i w_i G_i)(n\sum_i w_i M_i)}{R_U^2} = \frac{nk_{a,R}(\sum_i w_i G_i)(\sum_i w_i M_i)}{R_U^2} \quad (22)$$

By eqn. (17) as Mi →0, Gi →∞. However, Nature shows [15] that 0x∞ is a constant, say k_∞ or,

$$g_U = \frac{nk_{a,R}k_\infty}{R_U^2} = k_U \frac{n}{R_U^2} \quad (23)$$

Where k_U is some constant. Since n is an extremely large number and R_U is an extremely small number, the gravitational acceleration that appeared after mass formed, was extremely large. This gravitational pull would have accelerated the rate of nucleosynthesis, which in turn reduced the gravitational pull resulting in an expanding Universe. It should therefore, be possible to retrace the original R_U or $R_{U,0}$ and some of the properties of matter, in the beginning.

If one assumes that at some point in the early Universe, all existing protons and neutrons were formed and that the Universe is now a hydrogen consuming universe, with similar aggregation constant $k_{a,R}$, then the Universe's gravitational accelerations g is given by,

$$g_1 = \frac{nk_{a,R}G_1M_1}{R_1^2} \quad \text{when only Hydrogen existed} \quad (24)$$

$$g_2 = \frac{nk_{a,R}(0.8G_1M_1+0.2G_2M_2)}{R_2^2} \quad \text{when 80\% Hydrogen and 20\% Helium} \quad (25)$$

$$\frac{g_2}{g_1} = \frac{G_1M_1}{(0.8G_1M_1+0.2G_2M_2)}\frac{R_1^2}{R_2^2} \quad (26)$$

Or in general,

$$g_1R_1^2 = g_jR_j^2 = \frac{G_1M_1}{(\sum_j w_jG_jM_j)} \quad \text{for } j \text{ isotopes present in the Universe} \quad (27)$$

The expansion of the Universe is increasing as nucleosynthesis reduces the Universe's gravitational pull. This gravitational pull is inversely proportional to the radius square of the universe.

It should be noted that since the gravitational coefficient G_E is isotope dependent, this should explain why it has not been possible to precisely determine the Earth's gravitational coefficient G_E. In this light, by accounting for the "nearby" isotopic nature of the Earth, near field gravity probe experiments should be able to prove or disprove this claim.

Results and Discussion

An exploration of black holes

A blackhole can be deconstructed into two components, (i) spacetime funnel and (ii) the mass source or black star. The spacetime funnel is the distortion of the ruler (14-16) that is between the event horizon and the surface of the black star. In the absence of any known observations inside a black hole, one can propose that as a star compresses into a blackhole due to its own gravitational pull, the black star retains a "measurable" volume and is spherical in shape as it shrinks.

One cannot observe the black star primarily due to the distortion of spacetime.

Therefore, this "spherical property" necessitates that the strength of the gravitational field reduces from its surface to the center of the black star (not black hole). The spherical property is a characteristic that is independent of the composition of a

planet or star. That is, at the surface of the black star, the spacetime ruler does not approach infinity and cannot approach infinity within the black star i.e. singularity (radius=0) does not exist.

Therefore, the concept of singularity is the result of extrapolating the mathematical model, GR, beyond its operating range by not recognizing its boundary conditions. Thus, the black star has a finite radius.

What is this radius?

The mass M_F of a fundamental [3,10] particle P_F (see definitions of fundamental, composite and compound particles) can be determined by it radius R_F (the radius of the particle is its RMS charged radius),

$$M_F = k_Q \left(\frac{1}{R_F}\right)^2 \tag{28}$$

Where k_Q=*4.837804891x10*$^{-34}$ *MeVm*^{2}. That there is no limit to the mass of a fundamental particle or its radius. The determining factor is the spacetime keno in which it exists; and that conservation of mass is dependent on conservation of particle radii, that the sum of masses M_{Fi} of fundamental particles *i* is a function of the radii R_{Fi} of particle *i*,

$$\sum_i M_{Fi} = k_Q \sum_i \left(\frac{1}{R_{Fi}}\right)^2 \tag{29}$$

As a first iteration, assuming Newtonian physics is still valid, and due to nucleosynthesis for which there is no reason this process should terminate, when the spacetime funnel's event horizon forms, that all matter has converted into n >0 special type of black star particle P_B (or black particle) of mass M_B, and radius R_B, given a blackhole mass of M_{BH}. (29) can be rewritten in terms of *n* black particles,

$$M_{BH} = nM_B = nk_Q \left(\frac{1}{R_B}\right)^2 \tag{30}$$

That is, the radius of the black star is dependent upon the mass and quantity of the black particle. As there is no limit to the mass of a fundamental particle, it is conceivable that this black star consists of either a single black particle P_B, or of multiple *n* black particles. In either case, given a black particle's gravitational coefficient G_B, with a blackhole gravitational acceleration g_{BH}, and at a radius (event horizon) R_{BH} from the center of the blackhole (i.e. the spacetime distortion inside and outside the event horizon obeys Transformation Consistency, but one cannot observe anything inside the event horizon). By (18), (19) reduces to,

$$g_{BH} = k_{a,R} G_B n M_B / R_{BH}^2 \tag{31}$$

$$g_{BH} R_{BH}^2 = n k_{iso} \tag{32}$$

And similarly, for the black star itself of radius R_{BS} and gravitational acceleration g_{BS} at its surface,

$$g_{BS} R_{BS}^2 = n k_{iso} \tag{33}$$

That is, both the black hole's and black star's radii are dependent upon the number of P_B particles within this star. Or,

$$g_{BH} = k_{a,R} G_B n k_Q \left(\frac{1}{R_B R_{BH}}\right)^2 = n k_B \left(\frac{1}{R_B R_{BH}}\right)^2 \tag{34}$$

$$k_B = k_{a,R} G_B k_Q \tag{35}$$

Where k_B is the black hole constant. Or, the black star's surface radius can be determined from the black hole's event horizon parameters, and from (34) its mass as,

$$R_B^2 = \frac{nk_B}{g_{BH}}\left(\frac{1}{R_{BH}}\right)^2 \quad (36)$$

The next iteration requires resolution with respect to Transformation Consistency. Since matter is the source of the gravitational fields, and the gravitational field exists outside the event horizon, the gravitational field inside the event horizon must be the same field.

Therefore, Transformation Consistency requires that the same transformations are present inside and outside the event horizon, an implicit axiom of gravitational theories. That, however, raises the question, does motion exceed the velocity of light inside the event horizon?

It was proposed [10] that mass is derived from bound photons (note, this is still work in progress) and that the number of bound photons n_p present in a particle of mass m is determined by the particle's velocity v (37).

$$n_p = \frac{c}{v} \quad (37)$$

Eqn. 37 shows that as a mass-based particle approach the velocity of light it turns into a single photon since the number of bound photons approaches *1*.

$$n \to 1 \; as \; v \to c \quad (38)$$

And at the event horizon, mass-based particles falling towards the black star, turn into photons, and gravitationally blue shift.

Is it possible to determine the mass and radius of the black particle? TABLE 1 presents the results of this analysis. Using (33) to determine the number of black particles n in a black hole, double checking that it gives the correct gravitational acceleration g_{BH}, the mass M_B, and radius R_B of the black particle.

TABLE 1. **Properties of the black particle.**

Black hole name	Mass (Sun)	Mass (kg)	Schwarzschild radius calculated	At Event horizon		n	M_B (kg)
				Schwarzschild g	Black particle g_{BH}		
Messier-87	6.20E+09	1.23E+40	1.83E+13	2.45E+03	2.45E+03	2.77E+65	4.45583E-26
NGC-205 Andromeda	90000	1.79E+35	2.66E+08	1.69E+08	1.69E+08	4.02E+60	4.45583E-26
Messier-33 Triangulum	50000	9.95E+34	1.48E+08	3.04E+08	3.04E+08	2.23E+60	4.45583E-26
Milky Way SgrA*	30,00,000	5.97E+36	8.86E+09	5.07E+06	5.07E+06	1.34E+62	4.45583E-26
Messier-31 Andromeda	4,50,00,000	8.95E+37	1.33E+11	3.38E+05	3.38E+05	2.01E+63	4.45583E-26
NGC-1023 Canes Venatici	4,40,00,000	8.75E+37	1.30E+11	3.46E+05	3.46E+05	1.96E+63	4.45583E-26
Messier-81 Ursa Major	6,80,00,000	1.35E+38	2.01E+11	2.24E+05	2.24E+05	3.04E+63	4.45583E-26
NGC-3608 Leo	19,00,00,000	3.78E+38	5.61E+11	8.01E+04	8.01E+04	8.48E+63	4.45583E-26
NGC-4261 Virgo	52,00,00,000	1.03E+39	1.54E+12	2.93E+04	2.93E+04	2.32E+64	4.45583E-26

This paper proposes that black holes, due to continued nucleosynthesis, are composed of black particles P_B with mass M_B=4.4558291 × 10^{-26} kg (25030.6200705 MeV or 26.6397870 × proton mass) and radius R_B=1.3902355 × 10^{-19} m which is much smaller than that of an electron (R_e=3.061992 × 10-17m 11).

Several inferences are evident:

1. Outer Event Horizon: Due to the spherical property, the gravitational field strength is greatest on the surface of the star. Since, the star is collapsing to form a blackhole, the event horizon first emerges on the surface of the star, while this star, now a black star, continues to collapse. Therefore, this event horizon is a historical record of the size of the star just before this event horizon formed, and a means to determining the properties of the star just before it became a black hole.

2. Inner Event Horizon: By the spherical property, with the formation of the outer event horizon, it is proposed that a second inner event horizon forms inside the black star, as the gravitational field strength must form a maximum on the surface, approach zero at the center of the black star. This leads to the possibility that under thermal influence, the black star hollows out to the inner event horizon forming a black shell. Assuming, that the black shell has not formed, the gravitational acceleration gr inside the black star at a distance r from the center, and by Transformation Consistency, the change in the photon frequency from ν_0 at the center of the black star to ν_r at a radial distance r from the center, is determined by the internal gravitational acceleration g_r,

$$\nu_r = \nu_0 \left(1 - \frac{g_r r}{c^2}\right) \tag{39}$$

For the inner event horizon R_I to form, the photon frequency at this inner horizon is zero, or

$$r = R_I = \frac{c^2}{g_r} \tag{40}$$

The gravitational acceleration g_r inside the black star at a distance r from the center, is given by the surface gravitational acceleration g_{BS},

$$g_r = g_{BS} \frac{r}{R_{BS}} \tag{41}$$

Or,

$$R_I^2 = \frac{R_{BS}}{g_{BS}} c^2 \tag{42}$$

From eqns. (40), (41) and (42), the inner event horizon R_I can be determined from the black hole parameters,

$$R_I^2 = \frac{1}{g_{BH}} \frac{R_{BS}^3}{R_{BH}^2} c^2 \tag{43}$$

Therefore, for the inner event horizon to form,

$$R_I < R_{BS} \tag{44}$$

Or, upper bounded by

$$\frac{R_I^2}{R_{BS}^3} \leq 1 \; or \; \frac{1}{g_{BH}} \frac{1}{R_{BH}^2} c^2 \leq 1 \tag{45}$$

$$g_{BH} R_{BH}^2 \geq c^2 \;\; or \; g_{BH} \geq \frac{c^2}{R_{BH}^2} \tag{46}$$

Or by (32),

$$nk_{iso} \geq c^2 \quad (47)$$

$$n \geq \frac{c^2}{k_{iso}} = 3.0221880x10^{52} \quad (48)$$

The inner event horizon can be determined by the black hole parameters and is present for the black holes presented in TABLE 1. The inner event horizon will not form if,

$$g_{BH}R_{BH}^2 \leq c^2 \; or \; g_{BH} \leq \frac{c^2}{R_{BH}^2} \quad (49)$$

3. Stray Gamma Rays: As mass-based particle pass the event horizon, and now a massless photon traversing the black hole, and provided it does not collide with the black star, energy gained from a gravitational blue shift is lost through the gravitational red shit. However, the pre-event-horizon mass particle is now a photon. This suggests that one should be able to detect some photons (expected in the x-ray and gamma ray spectrum) exiting the event horizon in a manner that does not concur with either the jet stream or the accretion disc.

4. Mass Upper Bound: Even though (36) suggest that particle mass is not upper bounded, the black particle's mass suggests that, stable (in their environment), fundamental particles are upper bounded by M_B.

Given the proposed black particles, is there a 6th form (plasma, gas, liquids, solids and condensed matter) of matter, black matter? By Transformation Consistency, particles are incompressible unless altered by the spacetime keno, the analysis of nuclear empirical packing density ηi, E across 798 isotopes, defines ηi, E as,

$$\eta_{i,E} = \left(N_{i,P}R_P^3 + N_{i,N}R_N^3\right)/R_{i,C}^3 \quad (50)$$

Where N_i, P and N_i, N are the number of protons and neutrons, respectively, in the nucleus of isotope i with RMS charge radius R_i, C and proton RMS charge radius RP=8.7910 × 10-16m and the equivalent neutron radius R_N=8.8031 × 10-16m.
It was determined that the Up Quark RMS charge radius R_i, U=3.242296 × 10-16m and a Down Quark RMS charge radius R_i, D=1.621148 × 10-16m. Using this quark information, nuclear empirical packing density η_i, E across 798 isotopes is given by (regression R2 > 99.9999%),

$$\eta_{i,E} = k_{P,E}M_i/R_{i,C}^3 \quad (51)$$

Where empirical packing density constant k_P, E=7.253246 × 10-49, for isotope i of mass M_i (MeV).
Therefore, if black matter is of the same as nuclear matter it should obey (51). TABLE 2 shows that it does not as its empirical packing density is significantly above 1. Therefore, it is proposed that black matter is a new form of matter, composed of black particles that are smaller than electrons (R_e=3.061992 × 10-17m 11) and heavier M_B=25,030.6200705 MeV than protons.

Note that TABLE 2, presents the black star's radius lower bound (η_i, E=1) and a reasonable upper bound [3] (η_i,

E=0.77963557) for the black particle radius R_B=1.3902355 × 10-19 m.

TABLE 2**. Black star properties.**

			Black star radius (m)		
Blackhole name	**Mass (kg)**	**n**	$\eta_{i,E}=1$	$\eta_{i,E}=0.77963557$	$\eta_{i,E}$ **(51)**
Messier-87	1.23E+40	2.77E+65	905.99	1,162.06	6.75677E+12
NGC-205 Andromeda	1.79E+35	4.02E+60	22.1	28.35	6.75677E+12
Messier-33 Triangulum	9.95E+34	2.23E+60	18.17	23.3	6.75677E+12
Milky Way SgrA*	5.97E+36	1.34E+62	71.13	91.23	6.75677E+12
Messier-31 Andromeda	8.95E+37	2.01E+63	175.41	224.99	6.75677E+12
NGC-1023 Canes Venatici	8.75E+37	1.96E+63	174.1	223.31	6.75677E+12
Messier-81 Ursa Major	1.35E+38	3.04E+63	201.29	258.19	6.75677E+12
NGC-3608 Leo	3.78E+38	8.48E+63	283.51	363.65	6.75677E+12
NGC-4261 Virgo	1.03E+39	2.32E+64	396.57	508.67	6.75677E+12

Galaxy rotation anomaly

None of the RSQ theories can explain the galaxy rotational anomalies. Brown and Moffat [16] published an extensive list of the know galaxy rotation anomalies. The constant rotation of a galaxy's outer stars could be due to the galaxy's composite gravitational coefficient G_C decreasing outwards as the later and weaker gravitation field strength take time to reach the outer stars. That as a star and it galactic center, ages its G_0 decreases, causing its galactic orbital velocity to reduce while moving the star outwards.

This implies a radial age gradient with older stars (later in their life-cycle) further away from the center of the galaxy and younger stars (earlier in their life-cycle) closer to the center.

Brownstein and Moffat [16] had proposed that the gravitational coefficient could be modified as,

$$G_\infty = G_0\left(1+\sqrt{M_0/M}\right) \quad (52)$$

Where G_∞ is the effective gravitational coefficient at infinity, G_0 the "bare" Newton's gravitational coefficient, M the mass of the galaxy and M_0 a coupling constant. This is interesting as it modifies the gravitational coefficient at infinity from the matter source.

By comparison equation (17) modifies the composite gravitational coefficient G_C of local matter in local spacetime. After structuring the data [16], and defining each galaxy rotation into Inner Start Field (ISF) and Outer Star Field (OSF), and by classifying their respective velocity gradients into gentle-intermediate-steep and negative-flat-positive, respectively, it was shown that for outward expansion, a star's rotational radius R_B before 1H:4He nucleosynthesis and after R_A with rotational velocity V_B before 1H:4He nucleosynthesis and after V_A is given by,

$$R_A > R_B \quad (53)$$

$$V_A^2 < (G_A/G_B)V_B^2 = k_{H:He}V_B^2 \quad (54)$$

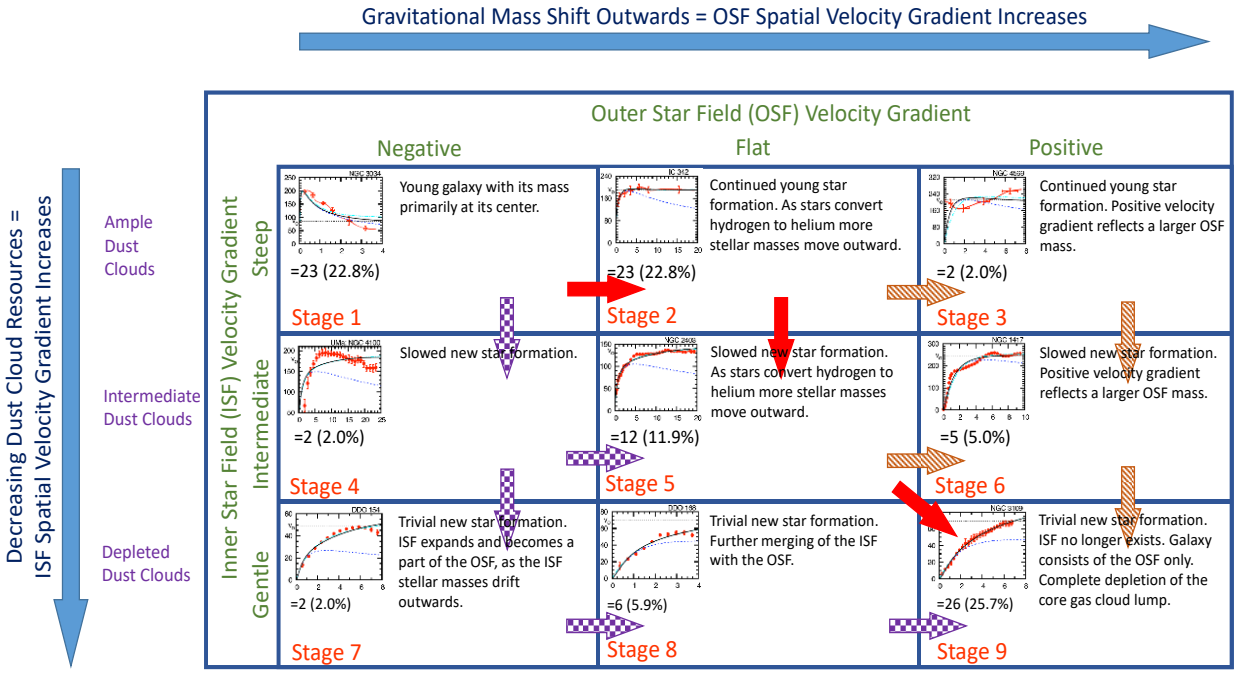

FIG. 1. **Galactic Sequence with Main Galaxy Sequence identified by solid red arrows (Source [3]).**

Where G_B and G_A are the composite gravitational coefficients before and after the 1H:4He conversion, respectively. By conservation of energy, for a star of mass m, and central galactic mass M, the total kinetic and potential energy, before T_B and after T_A must be the same,

$$T_B = mV_B^2/2 + G_B Mm/R_B \quad (55)$$

$$T_A = mV_A^2/2 + G_A Mm/R_A \quad (56)$$

Using equation (31),

$$T_A = mk_{H:He}V_B^2/2 + k_{H:He}G_B Mm/R_A \quad (57)$$

Therefore,

$$T_A < T_B \quad (58)$$

And by Conservation of Mass and Energy, there is a missing energy component $f\,(G_A)$ and this isotopic gravitational coefficient thesis could be an alternative to the dark matter thesis.

$$T_B = T_A + f(G_A) \quad (59)$$

Expanding on this work, galaxy evolution sequences [13] shown in FIG. 1, is derived from this galaxy rotation analysis. Visual inspection of this data showed that only 35 of the 101 rotation curves provided good spatial velocity gradient data. These 35 were then regression ($74.7\% < R^2 < 99.1\%$) fitted to determine a 'best' type of relationship, given the logic that if there were a consistent galactic process:

(1) This consistent galactic process would be revealed as a consistent type of equation, linear, exponential, logarithmic, power or polynomial. The polynomial is the least desired as most fundamental physics are not polynomials.

(2) Variations in this consistent galactic process would be evident as variations in the coefficients of this equation.

Assuming constant galaxy mass M and substituting centripetal acceleration into equation (19) and dividing outer and inner star equations gives equation (60) for both ISF and OSF, while M cancels out. For ease of usage let's name the LHS as the gravitational ratio function.

$$\frac{k_{a,O}(\sum_i w_i G_{i,O})}{k_{a,I}(\sum_i w_i G_{i,I})} = \frac{V_O^2 R_O}{V_I^2 R_I} \tag{60}$$

Where $k_{a,O}$ and $k_{a,I}$ are the aggregation constants, $G_{i,O}$ and $G_{i,I}$ the isotopic gravitational coefficients, and R_O and R_I the galactic radii of the OSF and ISF, respectively. The best fit for the RHS, the galactic radii ratio, of equation (60), are shown in FIG. 2, FIG. 3 and FIG. 4. This analysis shows that there are only two types of gravitational ratio functions and therefore, processes, at work. The exponential process,

$$\frac{k_{a,O}(\sum_i w_i G_{i,O})}{k_{a,I}(\sum_i w_i G_{i,I})} = pe^{q\frac{(R_O - R_I)}{R_O}} \tag{61}$$

Where p and q are constants such that,

i) For all ISF gradients, (FIG. 2)

$$4.268893x10^{-6} < p < 1.050642x10^{-3} \tag{62}$$

$$13.934100 < q < 19.019377 \tag{63}$$

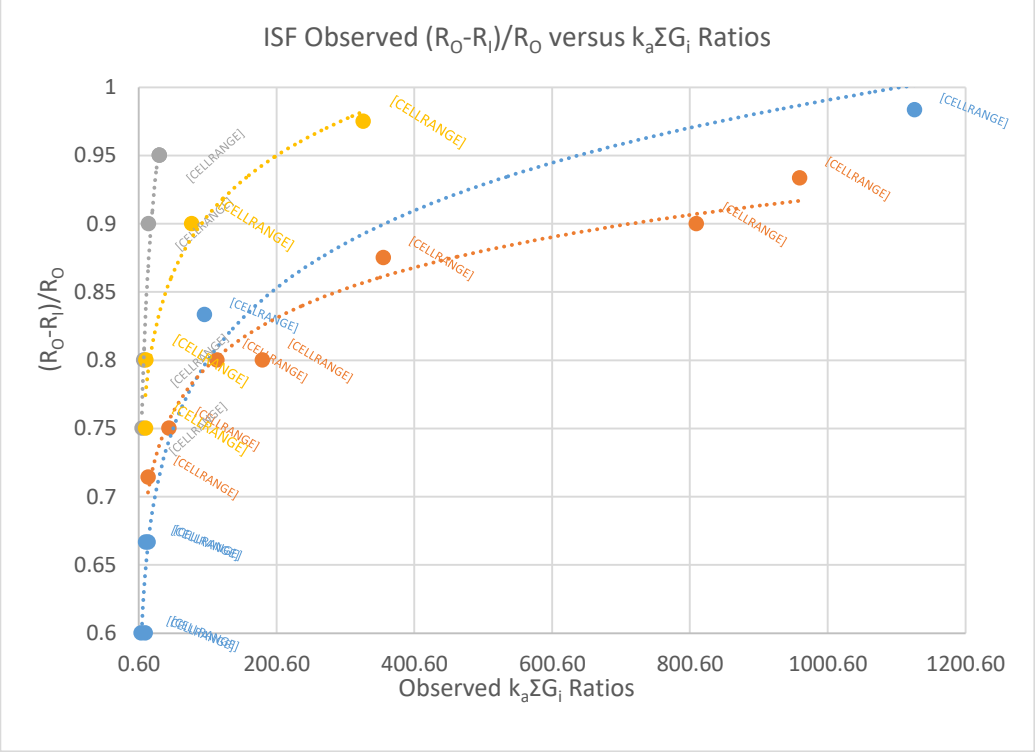

FIG. 2. **ISF kaΣGi ratios as a function of galactic radii ratios.**

ii) For OSF *positive* and *flat* gradients (FIG. 3),

$$0.262448 < p < 0.600561 \quad (64)$$

$$3.048703 < q < 3.878342 \quad (65)$$

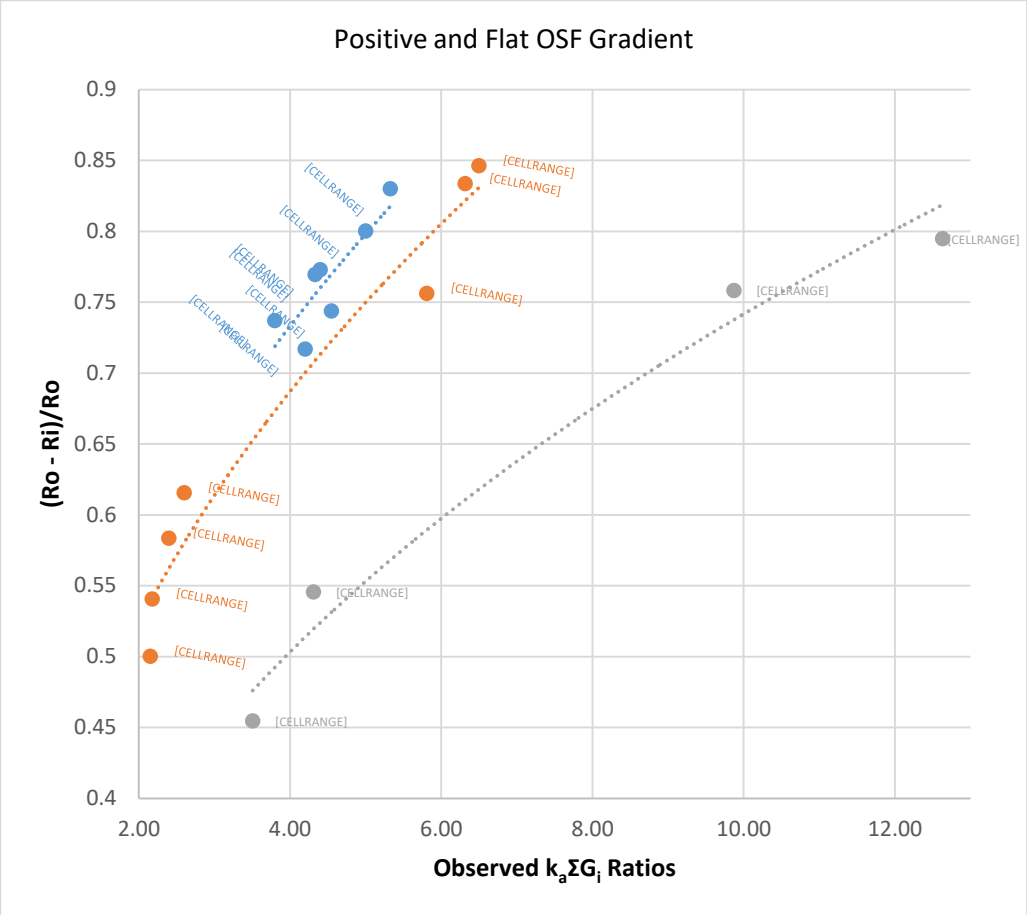

FIG. 3. **Positive and Flat OSF kaΣG_i Ratios as a Function of Galactic Radii Ratios.**

iii) However, the OSF *negative* spatial velocity gradient ratio function is a linear function (FIG. 3), not exponential,

$$\frac{k_{a,O}(\sum_i w_i G_{i,O})}{k_{a,I}(\sum_i w_i G_{i,I})} = p\left(\frac{V_O}{V_I}\right) + q \quad (66)$$

Where,

$$3.913963 < p < 17.199780 \quad (67)$$

$$-9.930104 < q < -1.256407 \quad (68)$$

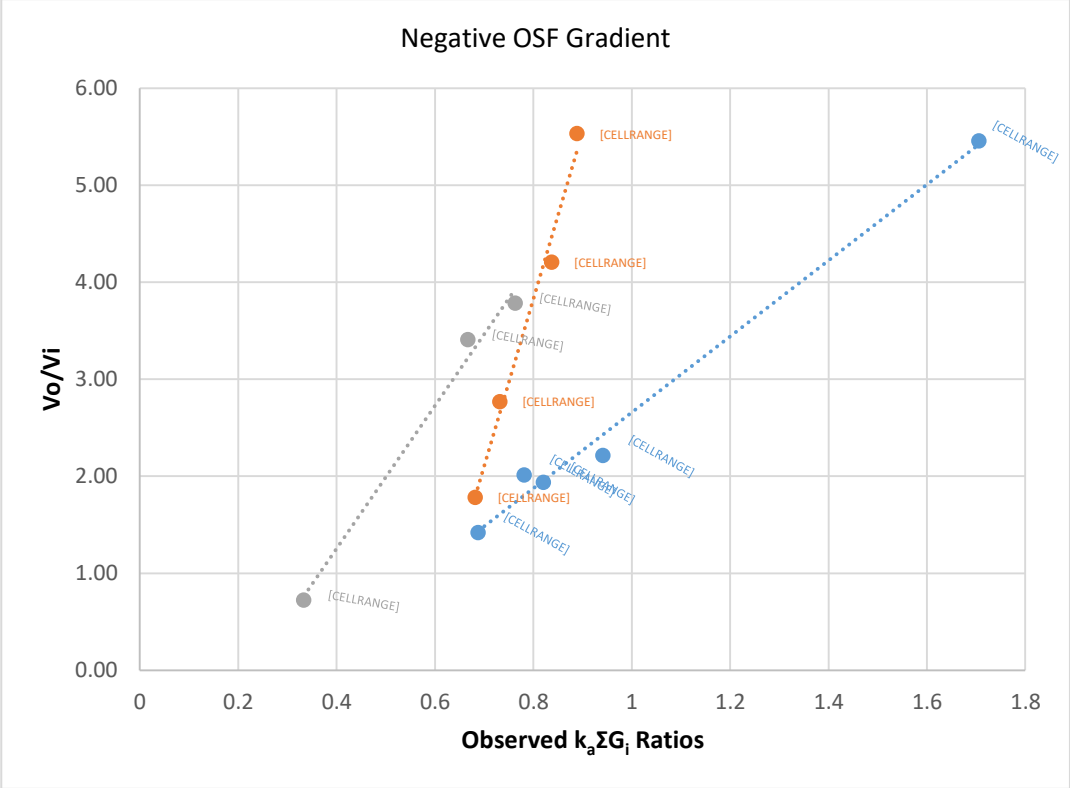

FIG. 4. **Negative OSF kaΣG$_i$ ratios as a function of galactic radii ratios.**

The main inference is that the isotopic gravitational coefficients G_i are the primary determinants, and therefore nucleosynthesis, of galactic radii and galaxy rotational anomalies, and,

1. A gravitational ratio function greater than 1 shows that the outer stars had a nucleosynthesis process slower than the inner stars, and vice versa.

2. FIG. 2 shows that variations in the ISF determine the variations in the galactic radii and rotation.

3. FIG. 3 shows that variations in the OSF for positive and flat gradients have a similar evolutionary process with ISF and determine the variations in the galactic radii and rotation.

4. FIG. 4 shows that galaxies with negative gradients have either a different evolutionary process from the others or the evolutionary process changed at some point in a galaxy's evolution. If the latter, the gravitational ratio functions determine the rotational velocity ratios, resulting in a significant change in the galactic formation historically identified at the peak of the rotational velocities (FIG. 1, Negative column).

Simplifying equation (60) with (69) gives (70)

$$\sum_i w_i G_{i,O} \approx \sum_i w_i G_{i,I} \tag{69}$$

$$\frac{k_{a,O}}{k_{a,I}} \approx pe^{q\frac{(R_O - R_I)}{R_O}} \tag{70}$$

Equation (70) shows that the ratio of aggregation constants $k_{a,O}/k_{a,I}$ is a function of the range R_O-R_I, and size R_O of the galaxy. Or given a consistent galactic process, the distribution of matter across the galaxy, plays a critical role for rotational curves.

It is therefore inferred that p and q, are functions of (a) the speed of gravity in spacetime, (b) stellar nucleosynthesis, (c) original mass of the galaxy and (d) how this mass was distributed, but further research is required.

This analysis had four surprises,

(i) That there is a term $k_{a,R}$ for the arrangement of matter as opposed to the quantity of matter. The spherical property (41) is an example. External gravitational field strengths decrease with distance. However, internal gravitational field strength increases with distance.

(ii) The existence of ISF and OSF necessarily requires that the aggregation of matter $k_{a,R}$, is different between the two.

(iii) The negative spatial velocity gradients are of a different process type to the other galactic processes, linear V_O/V_I, versus exponential $(R_O\text{-}R_I)/R_O$, respectively.

(iv) NGC 3034's OSF *ratio function* < 1.

$$\frac{k_{a,O}(\sum_i w_i G_{i,O})}{k_{a,I}(\sum_i w_i G_{i,I})} < 1 \qquad (71)$$

Implying that nucleosynthesis at the center of the NGC3034 galaxy progressed at a faster rate than both, with comparable galaxies, and with its early stars.

Lessons from Podkletnov

Having disengaged mass from the gravitational acceleration, it was proposed [3, 10] that it is quark motion within the protons and neutrons that produce gravitational fields. The inference here is that electrons do not contribute to gravitational source even if these have mass. Noting that it is the spherical shape of the electron's electric field that is the underlying physical cause of the cross-product term [5,6] of the moving electron's force in a magnetic field, the pertinent question is, if nuclear-level motion produces gravitational fields, why not at a macro-scale?

This is where Podkletnov-type experiments gain their importance. Podkletnov had reported that his experiments had demonstrated gravity shielding properties; that an electrified superconducting ceramic disc (FIG. 4) at temperatures below T_C (critical temperature) would exhibit gravity shielding effects above the disc when this disc was spun to 5,000 rpm.

A review of Podkletnov's [17-19] papers using the source-field-effect schema proposed that any hypothesis on superconducting gravity shielding should explain four observations, the stationary disc weight loss, spinning disc weight loss, weight loss increases along a radial distance and weight increase.

Noting that, if done correctly it is not necessary to use superconducting magnets, further experimental research is required as others [20,21] who have attempted to reproduce Podkletnov's experiments were not able to complete their experiments, not disprove Podkletnov.

The top side of the ceramic disc had overlapping electric and magnetic fields while the bottom side did not as the bottom side of this ceramic disc was not superconducting. By the Ni Field method [6] the top side of the spinning disc had an upward acceleration that negated gravity. The latent velocity of the electrified superconducting magnetic field should have a latent velocity v_{high} at higher part of the field that is greater than the latent velocity v_{low} at the lower part of the field.

$$v_{high} > v_{low} \tag{72}$$

This occurs when their respective high and low parameters (electric field strength *E*, magnetic field strength *B* and height above disc *d*) along an electric field line obey,

$$B_{high}E_{high}d_{high} > B_{low}E_{low}d_{low} \tag{73}$$

As the bottom side did not have overlapping magnetic and electric fields, this would not apply. If it did then the symmetrical structure would cancel any force field effects. Therefore, the electric/magnetic field effects were asymmetrical, with an effect on the top side and none on the bottom side.

Similar asymmetry is observed in a gravitational field. Particles deform asymmetrically [5,6,19] and a particle's, near side (of the gravitational source) is flatter and denser than the far side. Likewise, with mechanical and electromagnetic forces. It was shown [5,6,19] that this asymmetrical field effect is present with charged particles.

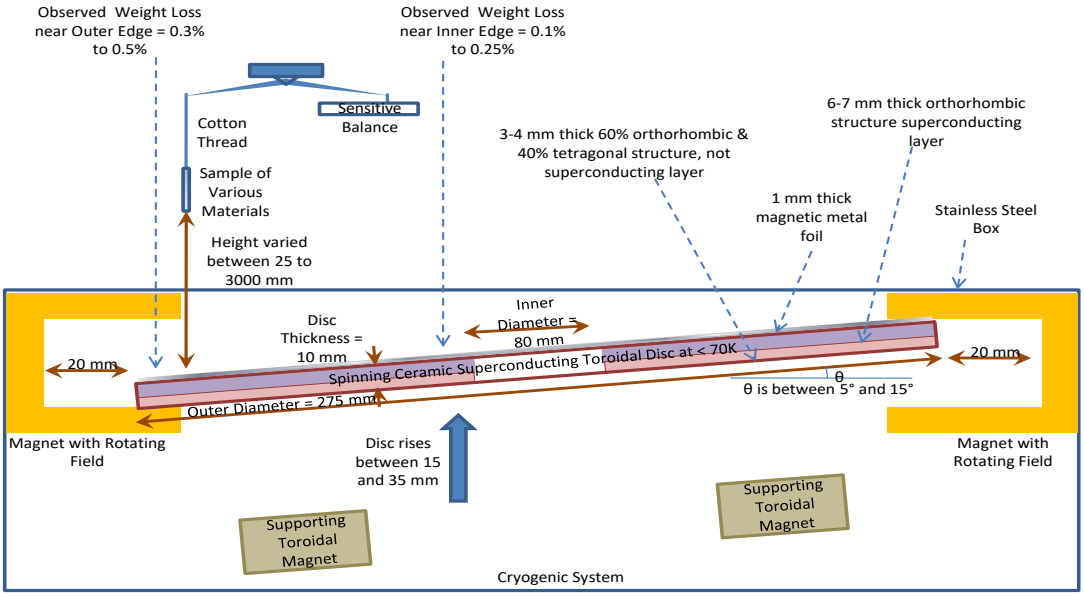

FIG. 4**. Electromagnetic acceleration with the superconducting (constant) magnetic field model.**

Engine Design Principles

As eqn. (2) is the universal descriptor of macro forces, it is now possible to deconstruct motion [22] from a propulsion perspective; a force field engine – an engine that generates a Ni field – must exhibit two properties. First is field modulation, the ability to increase or decrease field strength. Field strength is how velocity and acceleration are attained and thereby control the rate of motion. Second is field vectoring, the ability to change the direction of the Ni field, and thereby navigate in a space.

The analysis of Podkletnov's experiments shows that, to build a force field engine, a Ni Field is required that obeys four design rules. These rules are:

i. The field effects must result in a spatial gradient of latent or real velocities. These velocities are latent with gravitational and electromagnetic fields, and real with mechanical structures such as centripetal motion.
ii. The field must be asymmetrical, and non-cancelling. This is observed in the asymmetrical ovoid-like [5,6] shaped particles in gravitational fields. In the Podkletnov experiments [17,18] this is achieved by the asymmetrical structure of the electrified magnetic field. Note that there are no net forces in charged particles and naturally occurring magnetic fields as these fields are symmetrical.
iii. Vectoring [5,19] is provided by direction of the spatial gradient of velocities. In gravitational fields, this vectoring is along the radii of the field. In the electron moving in a magnetic field, this vectoring is derived from the direction of the magnetic field acting on the spherical shape of the electron's electric field.
iv. Modulation [5,19] is provided by the field strengths. In gravitational fields modulation is accomplished by the amount of matter, with mass as a proxy for this quantity of this matter and by the radius of the gravitating source. In the electron moving in a magnetic field, this modulation is derived from the magnetic field strength.

Returning to eqn. (7), are there multiple sources for the Ω function? Yes, there are three that one of the authors had investigated. The first is the Laithwaite Big Wheel experiment. This is a very controversial experiment, however, documenting Laithwaite's experimental results and comparing with centripetal, and gyroscopic theoretical results show significant incompatibility. It was determined that the correct solution given acceleration a created by a rotating-spinning disc's three-dimensional Ni Field with disc spin ω_s, disc radius s, spinning disc's rotation ω_d, rotation radius d and hypotenuse h formed by s and d is given by,

$$a = \omega_s \omega_d \sqrt{h} \tag{74}$$

Though Laithwaite demonstrated weight loss, this is a weight change phenomenon as both weight loss and gain are observed. If the sense of the spin and rotation are different, the direction of the acceleration is reversed, as one of the ω's is negative.
Hayasaka and Takeuchi [23] had reported that a gyroscope would lose weight, but Lou J et al. [24] could not reproduce this effect. Given their experiments downward pointing spin vector, (74) shows that Lou et al. were correct because (74) requires that acceleration produced be orthogonal to both spin and rotation.

Therefore, for weight change to be observed, the spin vector should be orthogonal to the gravitational field, while spin vector is rotated in a manner that is orthogonal to the spin plane. Thus, confirming, that the Ω function (7) can be replaced by purely mechanical functions.

The second, a mathematical property is now explained by a physical process. The cross-product (73) in electromagnetic theory, is due to the spherical shape of the electron's field and causes an acceleration that is orthogonal to its velocity and the magnetic field lines.

$$a = q(v \times B)/m \tag{75}$$

The third is Podkletnov's experiment discussed above.
Therefore, the ideal approach to gravity modification is to use electric and magnetic fields to create the Ni field with the following considerations [24-27].

1. The electric and magnetic fields must be orthogonal to each other.

2. There should be relative physical motion between the electric and magnetic fields.
3. The resulting electromagnetic velocity vector should be parallel to the physical velocity vector.
4. The net of the physical and electromagnetic velocities, form a spatial gradient of velocity vectors.
5. The acceleration produced will be orthogonal to this spatial velocity gradient.

Thus, acceleration modulation is derived by the steepness of the velocity gradient, and vectoring is achieved by the direction of this spatial gradient. Using these rules, FIG. 5 provides an example of a Unibeam Projector, a possible tractor beam device. It is a topological modification of Podkletnov's spinning superconducting disc. By (17) and (18) superconducting magnetic field is not required [5], therefore, a Ni Field can be created by spinning a magnetic solenoid enclosed by an orthogonal electric field. The spatial gradient of the Ni Field will be along the radii orthogonal to cylinder, from the center of the solenoid to the outer electric field electrodes. If the outer electrodes are formed by sectional strips, then by turning on selected strips synchronized to the rotation one should be able to create a unidirectional Ni Field or a tractor beam and a means to spaceship artificial gravity.

Vectoring is achieved by changing the synchronized electrified sectional strip. Modulation is achieved by power to the solenoid. If the net high velocity, tangential rotational velocity $v_{r,high}$ + latent electromagnetic velocity, v_{high} near the outer electrode is greater than the net low velocity, tangential rotational velocity $v_{r,low}$ + latent electromagnetic velocity, v_{low} near the inner electrode (76) than the acceleration is outward or repulsive, else it is inward and attractive.

$$v_{r,high} + v_{high} > v_{r,low} + v_{low} \tag{76}$$

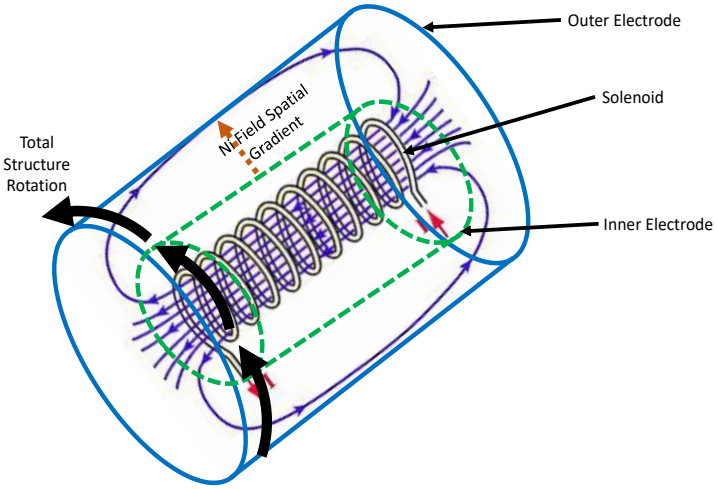

FIG. 5. **The Unibeam Projector, a rotating electrified solenoid.**

What about Newton's 3rd Law of Motion (N3L)?

A foundation of the physics of forces, Newton's Third Law of Motion (N3L) requires that for every action there is an equal and opposite reaction. Though considered one of the pillars of modern physics, however, using Ni fields, it can be shown that N3L is a special case.

N3L as momentum exchange is (i) a local region Law and (ii) in addition requires contact with another external mass. When a single gravitating particle is accelerating towards a gravitational field, there is no external mass in that local region for N3L. N3L is replaced by an external gravitational field. One could make the case that there is momentum exchange between two gravitating masses, but before contact, there is the space between them i.e. not local and no contact.

Per Einstein's STR, any particle that exhibits velocity will observe a length contraction in the direction of its velocity known as LFT. For non-point sized particle in a gravitational field, the near side of this non-point sized particle observes a greater acceleration than the far-side (with respect to the gravitational source). Since distance obeys LFT and NGT there is a gradation of length contraction of the particle from the far-side to the near-side, an originally spherical particle is now ovoid-like in shape or flattened egg-shaped, with the pointed side of the egg facing away from the gravitating source.

When two gravitating particles attract each other, they are ovoid-like with the blunt-side facing each other. There is symmetry that is orthogonal to their axis of motion. On collision (local region and contact), egg-shape reverses but symmetry is still maintained. N3L is obeyed because this symmetry is present due to Transference and Transformation Consistency.
When this symmetry is broken, N3L is not observed. Now, if one replaces one particle with an external Ni field, one observes the same "collision" trajectory without the momentum exchange i.e. a gravitational or accelerating Ni field. N3L is only obeyed, and conservation of momentum is observed when symmetry is present. Therefore, N3L is a special case only when symmetry is present.

Conclusion

This paper has shown that it is possible to develop a gravitational theory that encompass, cosmology, near field gravity measurement inconsistencies, and gravity modification. In doing so, suggests that further research into the nature of spacetime is required, and its effects on cosmology, and gravity modification.

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