GALILEAN ELECTRODYNAMICS

Experience, Reason, and Simplicity Above Authority
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CONTENTS

EDITORIAL POLICY

Galilean Electrodynamics aims to publish high-quality scientific papers that discuss challenges to accepted orthodoxy in physics, especially in the realm of relativity theory, both special and general. In particular, the journal seeks papers arguing that Einstein's theories are unnecessarily complicated, have been confirmed only in a narrow sector of physics, lead to logical contradictions, and are unable to derive results that must be postulated, though they are derivable by classical methods.

The journal also publishes papers in areas of potential application for better relativistic underpinnings, from quantum mechanics to cosmology. We are interested, for example, in challenges to the accepted Copenhagen interpretation for the predictions of quantum mechanics, and to the accepted Big-Bang theory for the origin of the Universe.

On occasion, the journal will publish papers on other less relativity-related topics. But all papers are expected to be in the realms of physics, engineering or mathematics. Non-mathematical, philosophical papers will generally not be accepted unless they are fairly short or have something new and outstandingly interesting to say.

The journal seeks to publish any and all new and rational physical theories consistent with experimental fact. Where there is more than one new theory that meets the criteria of consistency with experiment, faultless logic and greater simplicity than orthodoxy offers, none will be favored over the others, except where Ockham's razor yields an overwhelming verdict.

Though the main purpose of the journal is to publish papers contesting orthodoxy in physics, it will also publish papers responding in defense of orthodoxy. We invite such responses because our ultimate purpose here is to find the truth. We ask only that such responses offer something more substantive than simple citation of doctrine.

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From the Editor's File of Important Letters:

Force-Based Gravity

As a guide in his development of Special Relativity Theory (SRT) [1], Einstein clearly used Maxwell's electromagnetic theory. This origin accounts for Einstein's emphasis on the speed of light in his treatment of SRT. In a short follow-up paper, Einstein revealed the relation between mass and energy [2]. Early experiments confirmed this relation [3]. Had Newton known that energy had mass, he would have changed his dynamics and anticipated some physical facts presently attributed to SRT. The change needed for dynamics would have led Newton to change his theory of gravity in a way analogous to the modification of dynamics. The present paper describes the modified Newtonian approaches to dynamics and gravity, which turn out to yield the same spacetime relations of SRT, and the same experimental results as General Relativity Theory (GRT). In the case of gravity, the modified Newtonian gravity, or force-based gravity, is obviously different physically from the geometry-based gravity of GRT. With GRT, gravitational force is a result of spacetime change caused by the presence of mass. Here, Newton-like forced-based gravity will be shown to produce results comparable to those otherwise attributed to spacetime change.

Modified Newtonian Dynamics

On the basis of post-Newton experiments that revealed the equality of mass and energy, the classical momentum of a mass, m, needs to be modified. The momentum is increased because of the energy supplied in accelerating m to the velocity $\mathbf{v}$. The classical momentum, $\mathbf{P} = m\mathbf{v}$, needs to be replaced with $\mathbf{P} = m\mathbf{v} + (W / c^2)\mathbf{v}$, where W is the work needed to accelerate m to the velocity, $\mathbf{v}$, and c is a constant that gives the appropriate energy-to-mass conversion. The incremental work, dW, is given by the force on the mass times the displacement: $dW = \mathbf{F}\bullet d\mathbf{x}$, where $\mathbf{F}$, which can be called the inertial force, is given by $\mathbf{F} = d\mathbf{P} / dt$.

Assuming m to be constant, incremental work becomes

$$dW(v) = \tfrac{1}{2}(mc^2 + W)d(v^2 / c^2) + v^2 d(W / c^2) \quad . \qquad (1)$$

Integration yields:

$$W(v) = mc^2\left(1\Big/\sqrt{1 - v^2 / c^2} - 1\right) \quad , \qquad (2)$$

which is the well-known expression for relativistic kinetic energy. If this $W(v)$ is used in $\mathbf{P}$, then, $\mathbf{P}(v) = m\mathbf{v}\Big/\sqrt{1 - v^2 / c^2}$, which is the experimentally valid relativistic momentum.

Writing $\mathbf{P} = md\mathbf{x} / dt$, the question can be asked: which of these quantities involved in $\mathbf{P}$ might be affected by velocity so that at low velocity it is correct, but at high velocity it is not? On the basis of Eq. (2), it would appear that the mass, m, increases with velocity. But another possibility exists. Consider the following situation: mass m is moving with velocity, $\mathbf{v}$, between the points A and B, which are located a distance dx apart. Let the reference frame in which A and B are fixed be referred to as 'the rest frame'. The reference frame moving with m will be referred to as 'the moving frame'. An observer in the moving frame sees m to be at rest.

(Continued on page 52)

Quantized Curvatures of Spacetime for all Scales of Gravitating Bodies

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This paper considers all particles, or material bodies, to be intrinsically quantized in mass-energy, as well as in inertial-motion, with different particles or bodies at different scales of size having different allowed magnitudes of mass-energy and inertial-motion. Such quantized mass-energy and inertial-motion are also inversely co-related. Then, inertial and gravitational acceleration(s) of any particle or material body under influence of force(s) can be assumed to be the sum of all its discrete infinitesimal changes in the different scales of quantized inertial motions (along with quantized mass-energies) involved.

On other hand, the internal gravitation in material bodies starts to dominate over other non-gravitational forces from a scale of planetesimal ($>10^{12}$ kg) through various ranges of incremented scales like dwarf planets, solid planets, gas planets, brown dwarfs, stars, stars' constellations, galaxies, clusters of galaxies up to the macro most scale (*i.e.* universe) with all scale specific mass-energies. Consequently, for all those smaller to bigger scales of gravitation dominated material bodies or gravitating bodies (GB's), there are corresponding lower to higher magnitudes of escape velocities (v_{e}).

If two parallel moving particles of same scale with quantize motion *just below* the escape velocity ($v_{\mathrm{e-1}}$) toward center-of-mass of particular GB, due to infinitesimally changing quantized inertial-motions will, in the course of gravitational acceleration, converge at the center-of-mass. But, if those two particles have quantized motion less than the $v_{\mathrm{e-1}}$ they will converge before the center-of-mass, and if the motion greater than $v_{\mathrm{e-1}}$, then the particles will fly by the center-of-mass. Since, escape velocities are different in different scales of GB's, there will also be the corresponding scale specific *maximum limits of convergence* of highest quantize motions ($=v_{\mathrm{e-1}}$) in GB's which depicts the existence of scale specific curvatures of spacetime in different scales of GB's. Alternately, due to the inverse relation of quantize motions with quantize mass-energies, there would be also a respective scale specific *maximum limits of homogeneity* of smallest quantize mass-energies ($=m_{\mathrm{e}-1}$) in same GB's which are *just above* the escapable quantize mass-energies (m_{e}).

Therefore, the gravitational field equations for the curved spacetime of GB's in General Relativity Theory (GRT) ultimately become quantized in a scale-specific way. Consequently, each of those different scales of GB's ultimately appears as the product of two inverse fields, where if one already accustomed as gravitational and then oppositely other one would be as anti-gravitational. In inferences, the field equations of GRT, respect to the inertial speed of light c, are considered as *local*; the blackness of any black hole depends on the observer's capacity to receive signals escaping from it; and every scale of GB's appear as simultaneous left and right-handed pairs.

Key words: Scales of Gravitating-Bodies, Event-Horizons, Quantized-motions, Quantized-acceleration, Convergence, Homogeneity, Anti-Gravitation.

1. Introduction

Nature, as it is here considered, comprises all the possible micro to macro scales of particles, or systems of particles, where the Big-Bang-Big-Crunch oscillating whole Universe is, conceptually, the most macro-scale (or one of such most macro-scales). However, all those scales of particles, irrespective of their micro or macro scales, can experience gravitation both externally and internally; therefore, those are equally valid gravitating bodies (GB's). In the macro domain of Nature those GB's can even be defined as different scales of Astronomical Objects (AO's) [1,2] with some kind of scale-specific intrinsic magnitudes in their few common internal parameters (CIP's) for that scale of object [3] like mass-energies, say Δm, radius, say Δr, *etc.*, besides the de Broglie wavelength $\Delta\lambda$, which are profoundly shaped by the gravitational force.

It is very well known that in today's astronomical findings, there exist various smaller to bigger scales of gravitationally shaped GB's. Those may initiate from a 'palnetesimal' ($\Delta r \geq 0.5$ km) [4] up to a rocky planet; a gas giant up to a brawn dwarf; a red giant up to a sub-solar star; from a solar-star to a gaint star; a neutron star to a black hole; a cluster of stars up to galaxy to cluster of galaxies. Then, similarly, up to a super cluster of galaxies, up to the filaments, and from the filaments and huge voids up to the whole Universe itself.

However, key objective of this paper is to determine whether the gravitational force (which is also identified as curved spacetime) associates with all particles, from micro to macro scales, *i.e.* shapes to all different scales of GB's. Or will it have scale-specific quantized magnitudes? If yes, the next question is whether that scale-specific quantized gravitation of any scale of GB's could be compatible with the field equations of General Relativity Theory (GRT).

2. Mathematical Formulation

All the radii Δr considered here correspond to spherical volume increments:

$$\Delta s = \frac{3}{4}\pi\Delta r^3 \quad (1)$$

and mass increments Δm of all micro to macro scales of GB's.

Due to such scale-specific magnitudes of Δm, we can obtain from the gravitational field equations in GRT [5], that there are different scales of corresponding gravitational field strengths (GFS's) and Escape Velocities [6] in all those micro to macro scales of AO's, say Δv_e. Then, due to such scale-specific Δv_e in each of such specific scales of AO's with respective GFS's, there will also be the corresponding maximum limits in the *inescapable particle motions*, say Δv_{e-1}. We can also imagine the same Δv_{e-1}, as if, any 'message' that just cannot escape through the GFS of AO among all other inescapable low speeds of different messages due to

$$\Delta v_{e-1} < \Delta v_e \quad (2)$$

and not capable of reaching to the external surroundings or observers from that AO.

Now, we imagine two classes of observers in the external surroundings. In Eq. (2), there will be one class that can receive and analyze any messages from the AO with motions up to, say,

$$\Delta v_1 < \Delta v_{e-1} \quad , \quad (3)$$

and another with motions up to, say,

$$\Delta v_2 = \Delta v_{e-1} < \Delta v_e \quad , \quad (4)$$

and a third one with motions beyond, say,

$$\Delta v_3 > \Delta v_{e-1} \quad . \quad (5)$$

Then the first two classes of observers, those with limitations of receiving from that particular AO, any messages beyond Δv_1 and/or Δv_2, will have a corresponding *Event Horizon* (EH), and that makes no sense whether or not that AO is an object like a black hole (*i.e.* with respect to $c = \Delta v_{e\text{-}1}$). Factually, that will prohibit them to know anything about of the particular AO beyond that respective EH due to non-reception of any messages $\Delta v_2 = \Delta v_{e-1} < \Delta v_e$ and/or $\Delta v_1 \le \Delta v_{e-1}$ from inside.

Likewise, this can also be possible in cases of all other micro to macro scales of AO's with corresponding magnitudes of Δm and GFS's in Nature. Because, for each of those different scale-specific magnitudes for Δv_{e-1} and Δv_e in Eq. (2), there will be all corresponding maximum limits of inescapable motions $\Delta v_2 = \Delta v_{e-1} < \Delta v_e$ and/or $\Delta v_1 \le \Delta v_{e-1}$ of messages as well beside respective classes of observers with corresponding limitations to receive $\Delta v_3 = \Delta v_e > \Delta v_{e-1}$. Then, obviously, there will be the different scales specific EH's in all scales AO's or GB's with all respective classes of observers with limitations in Nature. Since all those scales of AO's or GB's possess corresponding magnitudes of Δm (and GFS & EH), the respective magnitudes of both Δv_{e-1} & Δv_e in Eq. (2) will be directly proportional to the magnitudes of Δm, GFS and EH.

2.1 Different Scales of Quantized Inertial Motions

The constant speed of light c that we have in Special Relativity Theory (SRT) can be considered as a *quantize-inertial-motion* (say $\Delta v_c = c$) intrinsic to a specific [3] class or scales of photon-particles with corresponding quantized magnitude of the de Broglie wavelength (say $\Delta\lambda_c$) and inertial mass-energy (say Δm_c) on the electromagnetic spectrum (EMS). On same EMS, we have there also; so many other different classes or scales of photons, with their corresponding intrinsic quantize magnitudes of the both $\Delta\lambda$ and Δm. Now, in many circumstances, from which it can envisage [3] that, each of those diverse scales of photons on the EMS have their different scales-specific intrinsic magnitudes of inertial-motions which are $\Delta v \neq c$ [7] but with a direct proportional relationship against corresponding scale-specific magnitudes of $\Delta\lambda$.

Therefore, if that $c = \Delta v_c$ is considered merely as a one of such quantized constant-inertial-motions respect to a particular scale of photons out of all different scales of photons on EMS, then restrictions imposed on existence of any superluminal motions (say $\Delta v'_c > c$) by SRT can be no more there [3]. That can be possible by replacing the $c = \Delta v_c$ in any SRT equations by any different magnitudes of such quantized constant inertial-motions of other possible photon particles where say $\Delta v > \Delta v_c = c$ [3], and from that modified SRT equation we can obtain $\Delta v > c$ in the same Nature with no negative values of time.

However, ultimately through that process of all modified SRT equations, as well as from the de Broglie's inverse relationship, in-between scale-specific quantize $\Delta\lambda$ and Δm of photons we can get another inverse relationship in-between Δv & Δm on the same EMS [3]. Then, through such an inverse relationship between Δv & Δm, exclusively in micro domain of Nature, where all different scales of particles show their corresponding intrinsic quantized magnitudes of masses Δm will have respective intrinsic quantize magnitudes of motions Δv as well. That quantize property of motion observes in all photons, as well as in non-photonic scales of particles like other bosons and fermions (neutrinos, electrons, neutrons, protons, atoms, and so on), with corresponding magnitudes of Δv and Δm [3]. Therefore, from such inverse relationship of Δv & Δm in de Broglie's relationship, we have direct proportionality between $\Delta\lambda$ & Δv in all micro scales of particles.

But such scale-specific quantized magnitudes of constant-quantize-inertial-motions Δv in macro scales of particles, or in domain of AO's, bigger than the molecular scales or more, are not precisely known. Rather, those different scales of AO's in macro domain appear in their relative sense of motions instead of any quantum. However, conceptually, all the micro scales of particles, which have their corresponding, quantize magnitudes of CIP's like $\Delta\lambda$, Δm, and even Δv, comprise all those macro scales of particles, as we now observe in all the structures formed everywhere in the post Big-Bang Universe. Hence, each of those macro scales of particles will have their corresponding quantize magnitudes in CIP's like $\Delta\lambda$ and Δm. Then, we can consider that there will be also the different intrinsic scale-specific quantize magnitudes of constant-inertial-motions of Δv as another CIP for all those same macro scales of particles or AO's beside all micro scales in Nature, no matter those Δv for respective macro-scales can be measured or not.

2.2 Inertial Definition Common to All Scales of Particles

All those same micro to macro scales of particles in Nature are intrinsically rotate 'left' handedly [8], and then, their correspondingly occupied spaces in Eq. (1) as well as measurements of time in all those scales of particles say Δs & Δt will be also intrinsically 'left' handed [3]. Therefore, for symmetry, there will be an intrinsic 'right' handed mirror images for the both Δs & Δt, *i.e.* say anti-space (Δs_u) & anti-time (Δt_u) respectively [3]. Therefore, we can deduce a set of inter-relations [3] among all those above CIP's for every micro to macro scales of particles (including all AO's) in Nature

$$\Delta m \cdot \Delta\lambda = K_1 \quad , \quad \Delta m \cdot \Delta v = K_2 \quad , \qquad (6, 7)$$

$$\Delta r \cdot \Delta\lambda = K_3 \quad , \quad \Delta s \cdot \Delta s_u = K_4 \quad , \qquad (8, 9)$$

$$\Delta t \cdot \Delta t_u = K_5 \quad , \quad \Delta v \cdot \Delta r = K_6 \quad . \qquad (10, 11)$$

From Eq. (1), for $\Delta s = 3\pi\Delta r^3 / 4$, there would be $\Delta s_u = 3\pi\Delta\lambda^3 / 4$, and for $\Delta t = 2\pi\Delta r$ there would be $\Delta t_u = 2\pi\Delta\lambda$ in Eqs. (9 & 10) respectively. Therefore, in Eqs. (6 - 11), there will ultimately be two sets of CIP's (Δs, Δt, Δm, Δr) and (Δs_u, Δt_u, Δv, $\Delta\lambda$) in all scales of particles as mutual mirror images to each other. Then, from Eqs. (6-11), we can deduce a common definition [3] for all micro to macro scales of particles in Nature in inertial (*i.e.* force-free) state:

$$(\Delta m \cdot \Delta s \cdot \Delta t) \cdot (\Delta v \cdot \Delta s_u \cdot \Delta t_u) = K_2 \cdot K_4 \cdot K_5 = K \quad . \qquad (12)$$

In Eqs. (6-12), all CIP's: Δm, $\Delta\lambda$, Δv, Δr, Δs, Δs_u, Δt & Δt_u possess their corresponding scale-specific intrinsic quantized magnitudes, and each such magnitude is a universal constant too. However, all those universal constants are scale-specific universal constants (SSUC's). The magnitudes of all those constants with respect to any particular scales are observed to remain unchanged, irrespective of the locations of observers in nature, whereas they would have different values if there were any change in scales of the particles. On the other hand, in the same Eqs. (6-12) there are *constants* K_1, K_2, K_3, K_4, K_5, K_6 & K which also appear as universal constants to every observer anywhere in Nature, irrespective of all scales of particles. Therefore, these constants are universal constants (UC's).

Sect. 3 defines the equivalence of quantized inertial and gravitational accelerations as sum of all infinitesimal changes in discrete quantize-motions Δv as defined above. In Sect. 4, such an equivalence leads us to deduce any gravitational field of AO's or GB's ultimately as the scale-specific convergence or curvature of spacetime, which creates equally the scale-specific homogeneity of respective lightest signal-particles in it to achieve respective maximum hydrostatic equilibrium in the same AO's or GB's in Nature. Therefore, in Sect. 5, the above notion of scale-specific convergence of spacetime is linked with Einstein Field Equations (EFE's) of GRT. The EFE's appear scale specifically quantized, along with a simultaneous existence of scale specific inverse or anti-gravitational fields in all same AO's or GB's in Nature; and Eq. (12) ultimately emerges as non-inertial (gravitational) common definition in Eq. (56) for all micro to macro scales of GB's. In Sect. 6, as inferences, the field equations of GRT appear as local with respect to c; and each of the GB's in Nature, irrespective of their scales are conceptually appeared as left and right handed pairs simultaneously. Sect. 7 summarizes the whole story.

3. Equivalence of Infinitesimal Quantized Accelerations

In both Classical Mechanics and GRT, the concepts of a material body as well as its acceleration are not precisely defined in quantized ways, i.e. are considered as continuous. Although, the large scale universe, which is still better explain by Classical Mechanics and GRT, appears to comprised by all material bodies with intrinsic quantum properties. The Eqs. (6 & 7) state that all such quantized material bodies should have any specific scale in Nature with intrinsic scale-specific quantize property of mass-energy and inertial motion beside some other CIPs. Then, two sub-sections below will elucidate whether such quantize material body accelerates as well in quantized means under influences of any gravitational and non-gravitational (or "inertial") forces.

3.1 Inertial Acceleration is the Sum of Infinitesimal Quantized Inertial Motions

The Classical expression for inertial acceleration $\mathbf{a}$ of a material body of mass m in the direction of force $\mathbf{f}$ is

$$\mathbf{a} = \mathbf{f} / m \quad , \qquad (13)$$

where scale-specific intrinsic quantize property of that m is not precisely mentioned. However, in Eq. (13), that m will always have **i)** any scale specific intrinsic quantized magnitude in Nature, and **ii)** an inverse relationship with $\mathbf{a}$ in the direction of constant $\mathbf{f}$ from Eqs. (6, 7 & 12). Then from Eq. (7), Eq. (13) could be re-written in such a way through $m \to \Delta m$, where Δm refers to the quantum size, as

$$\mathbf{a} = \mathbf{f} / \Delta m \quad , \qquad (14)$$

where $\mathbf{a}$ & Δm are still inversely related in scale-specific ways.

Then, in Eq. (14) we can write from Eq. (7), there will be all instantaneous and infinitesimal discrete changes in the magnitudes of $\mathbf{a}$ for all simultaneous scale-specific *quantum changes in magnitudes* of $m = \Delta m$ for that material body as mentioned in Eq. (13) because of the universal inverse relationship between

Δm & $\Delta \mathbf{v}$ in Eq. (7). That is, in Eq. (14), in the direction of $\mathbf{f}$, for each of the instantaneous and infinitesimal quantum change in scale of, say, $\Delta m'$, there will be the corresponding instantaneous as well as infinitesimal inverse quantum change in scale of motion, say, $\Delta \mathbf{v}'$. Therefore, that instantaneous and infinitesimal quantum *change in motion* $\Delta \mathbf{v}'$ of Δm, on the direction of $\mathbf{f}$, will be nothing but the instantaneous and infinitesimal inertial acceleration $\mathbf{a}'$ for that Δm.

Then, each of such instantaneous as well as infinitesimal scale-specific quantum changes in motions $\Delta \mathbf{v}'$ of Δm, on the direction of $\mathbf{f}$ can define in Eq. (14) through Eq. (7) as

$$\mathbf{a}' = \mathbf{f} / \Delta(m - m') = (\mathbf{f} / K_2) \cdot \Delta \mathbf{v}' \tag{15}$$

where, for every quantum changes in specific scales of $\Delta m - \Delta m'$ on the direction of $\mathbf{f}$ for $\mathbf{a}'$, we will have: **1)** a corresponding instantaneous and infinitesimal changes in scale-specific quantize magnitudes of $\Delta \mathbf{v}'$, and **2)** that $\Delta \mathbf{v}'$ is directly proportional to $\mathbf{a}'$ as well. Therefore, Eq. (15) depicts that in the level of all instantaneous, as well as infinitesimal, rate of changes in motions $\Delta \mathbf{v}$ of Δm on direction of $\mathbf{f}$, there will ultimately be the all instantaneous and infinitesimal quantum magnitudes of $\mathbf{a}' = \Delta \mathbf{a}$ in the Eq. (7) as

$$\Delta \mathbf{a} = \mathbf{f} / \Delta(m - m') = (\mathbf{f} / K_2) \cdot \Delta \mathbf{v}' \quad . \tag{16}$$

From Eq. (16), we also have quantized magnitude for the force:

$$\Delta \mathbf{a}\left[\Delta(m - m')\right] = \Delta \mathbf{f} \quad , \tag{17}$$

where we have for such total influence of forces $\mathbf{f}$ on the m in Eq. (13)

$$\mathbf{f} = \Delta \mathbf{f}_1 + \Delta \mathbf{f}_2 + \ldots + \Delta \mathbf{f}_{n-1} + \Delta \mathbf{f}_n \tag{18}$$

for any duration of time; say, $t = (\Delta t_1 + \Delta t_2 + \ldots + \Delta t_{n-1} + \Delta t_n)$ where the Δ's signify instantaneous and infinitesimal discrete changes in time. For the corresponding total quantized inertial acceleration $\mathbf{a}$ of that Δm, we have from Eq. (13)

$$\mathbf{a} = \Delta \mathbf{a}_1 + \Delta \mathbf{a}_2 + \ldots + \Delta \mathbf{a}_{n-1} + \Delta \mathbf{a}_n \tag{19}$$

for total changes in quantize motions of m during the course of such inertial acceleration

$$\mathbf{v} = \Delta \mathbf{v}_0 + \Delta \mathbf{v}'_1 + \Delta \mathbf{v}'_2 + \ldots + \Delta \mathbf{v}'_{n-1} + \Delta \mathbf{v}'_n \tag{20}$$

with corresponding total inverse changes in quantize magnitudes of m itself in Eq. (13) via Eq. (7) as

$$K_2 / m = K_2\left[1/\Delta m_0 - 1/\Delta m'_1 - 1/\Delta m'_2 - \ldots - 1/\Delta m'_{n-1} - 1/\Delta m'_n\right] \quad , \tag{21}$$

where Δm_0 and $\Delta \mathbf{v}_0$ are the respective initial scale-specific quantized inertial mass and motion of the classical material body m in Eq. (13). That inertial acceleration increments in Eq. (19), $\Delta \mathbf{a}_1$ to $\Delta \mathbf{a}_n$, will sum up to all instantaneous and infinitesimal changes in quantized inertial-motions $\Delta \mathbf{v}'_1$ to $\Delta \mathbf{v}'_n$ in Eq. (20) of the material body with all corresponding changes in quantized magnitudes of $\Delta m'_1$ to $\Delta m'_n$ in Eq. (21) in the direction(s) of influencing force(s) $\Delta \mathbf{f}_1$ to $\Delta \mathbf{f}_n$ in Eq. (18), and *vice versa*.

3.2 Equivalence Between Infinitesimally Quantized Inertial and Gravitational Accelerations

Due to Eq. (7), the 'inertial acceleration' $\Delta \mathbf{a}$, of any object Δm in Eq. (16) is infinitesimally quantized under influence and direction of the force $\Delta \mathbf{f}$ in Eqs. (17 & 18), where that $\Delta \mathbf{f}$ represents any non-gravitational force; call them all *inertial force(s).* Then, there will be an obvious question: are the gravitational force(s), say $\Delta \mathbf{f}_g$ of GB's with same corresponding, Δm, equivalent to the inertial force(s) $\Delta \mathbf{f}$ in Eq. (17) and any similar infinitesimal and instantaneous gravitational acceleration, say $\Delta \mathbf{g}$, quantized like quantized inertial acceleration (QIA), the $\Delta \mathbf{a}_1$ in Eq. (19), or $\Delta \mathbf{a}$ in Eq. (16) in GB's? These questions arise because in GRT there is equivalence between inertial and gravitational accelerations.. [9]

Because of that instantaneous and infinitesimal equivalence between $\Delta \mathbf{a}_1$ and $\Delta \mathbf{g}_1$ in Eq. (19) , we can start again from the classical example of imaginary accelerated 'Lift' in GRT, which can occur under influences of both inertial forces $\mathbf{f}_i$ and gravitational forces $\mathbf{f}_g$, but with appropriate modifications. Will there be any differences in feeling of inside observer while under instantaneous and infinitesimal accelerations of 'Lift' in both $\Delta \mathbf{a}_1$ and $\Delta \mathbf{g}_1$ from corresponding 'upward thrusts' from the floor?

Suppose that we carry with us a very smart device that we can fix onto the inner vertical wall of that Lift, say at point A on Fig. 1. However, our device is so fine-tuned that it is able to spontaneously emit a photon signal with speed c straight to B on the opposite wall as the lift starts to move at $\Delta \mathbf{v}'_1$ in Eq. (20) for any instantaneous acceleration $\Delta \mathbf{a}_1$ (or $\Delta \mathbf{g}_1$) in Eq. (19) for any instantaneous influencesof forces $\Delta \mathbf{f}_1$ in Eq. (18).

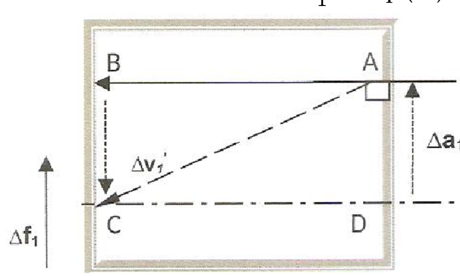

Figure 1. For $\Delta t_1 = 1$ sec, quantized infinitesimal acceleration of 'Lift' $\Delta \mathbf{a}_1 \Delta t_1 = \Delta \mathbf{a}_1 = \Delta \mathbf{v}'_1$ shifting of a light ray inside BC=DA distance traveled by lift outside under instant influence of instantaneous force $\Delta \mathbf{f}_1$.

In GRT, the observer who stands on the floor of a *Lift* would feel an upward thrust from his floor when the Lift accelerates at $\Delta \mathbf{a}_1$ (or $\Delta \mathbf{g}_1$) in Eq. (19).

Now, if the *Lift,* in Fig.1 would place conveniently in the gravitational field of Earth from outside, the inside observer could not recognize whether the acceleration of the *Lift* is happening due to gravitation or inertial forces from his upward thrusts of the floor. Again, if the same *Lift* would place in somewhere remote where impact of gravitation is negligible, and could exert some instant inertial forces which can generate equal instantaneous and infinitesimal acceleration as was while in earth but in opposite direction, the inside observer will equally unable to recognize whether that acceleration due to gravitation or inertial force from his similar thrust of the floor. But he could measure that amount of infinitesimal and instantaneous change in motion of *Lift* from the distance of shifting of photon signal's path on the opposite wall, say at distance $\mathrm{BC} = \Delta\mathbf{v}_1'$, and instant acceleration of the *Lift*, either as

$$\Delta\mathbf{v}_1' \equiv \Delta\mathbf{a}_1 \quad \text{or} \quad \Delta\mathbf{v}_1' \equiv \Delta\mathbf{g}_1 \qquad (22, 23)$$

after duration Δt_1. Since in Eq.(19) an instantaneous value of quantized acceleration of *Lift* $\Delta\mathbf{a}_1 = \Delta\mathbf{g}_1$ in Eqs. (22 &23) will be equal to the instantaneous quantized motion $\Delta\mathbf{v}_1'$ of the same *Lift* in Eq.(20).

Even from those Eqs. (22 & 23) respectively, he can calculate those instantaneous forces on the *Lift* as either $\Delta\mathbf{f}_1$ or $\Delta\mathbf{f}_{g1}$ from Eqs. (16 & 18). But he could not differentiate inside between type of forces like $\Delta\mathbf{f}_1$ and $\Delta\mathbf{f}_{g1}$, or accelerations like $\Delta\mathbf{a}_1$ and $\Delta\mathbf{g}_1$; although he could realize that all those parameters would possess quantized at levels of infinitesimals. These not only illustrate the Equivalence of inertial and gravitational accelerations of GRT, but also depict their Equivalences in infinitesimal and instantaneous levels.

However, from Eq. (7), instead of photon signal particles, one can use any other scales of signal particles inside of the Lift. But that could only show the differences in quantized magnitudes of the parameters in Eqs. (22, 23). The feelings of the inside observer would remain unchanged.

4. Scale-Specific Convergence & Homogeniety of Smallest Bound Particles

Every scale of GB's where above *Lift* can place will have two components in one: its total mass-energies, embedded within its own gravitation or curved spacetime. Both Classical and GRT formulations state that there are definite proportionality relationships between those two in every scale but are not scale-specific. Therefore, the sub-sections below will describe whether the gravitation would be scale-specific along with corresponding scale-specific magnitudes of mass-energies in all scales of GB's.

4.1 Scale-Specific Convergence of Smallest Bound Particles in Curved Spacetime

In Fig. 2 we can imagine to add two other similar devices on the outside bottom of Lift in Fig. 1, as those can simulataneously eject two identical signal-particles downward vertically. Then those two new devices will also eject spontaneously two corresponding same scale of signal-particles, with the earler device inside, have identical quantized magnitudes of Δv equal to infinitesimal changes in any quantized gravitational acceleration in Eq. (21) of the said Lift under respective gravitational force(s) of any GB. However, during the moment of their emergence from those respective devices, those two signal-particles will start moving parallel to each other. But after that, under the influences of the gravitational force(s) of particular GB, both signal particles will gradually lean from their mutual parallel paths and converge to each other onwards the center-of-mass of the respective GB.

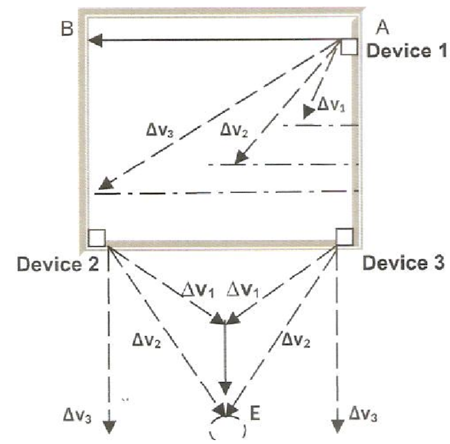

Figure 2. Convergence of bound particles with quantized motions at the center of mass E of different scales of gravitating bodies.

If that Lift in Fig. 2 is on the EH of any specific scale of GB, and:
i) will infinitesimally accelerate with, say, $\Delta\mathbf{g}_1 = \Delta\mathbf{a}_1$ in Eq. (19), then the quantized signal particles ejected simultaneously from the devices (2 & 3) with quantized motions say Δv_2 in Eq. (3) will converge before reaching at E. If the:
ii) Lift infinitesimally accelerates with, say, $\Delta\mathbf{g}_2 = \Delta\mathbf{a}_2$ in Eq. (19), then the quantized signal particles from devices (2 & 3) with quantized motions say Δv_2 in Eq. (4) will converge at E. If the
iii) same Lift infinitesimally accelerates with say $\Delta\mathbf{g}_3 = \Delta\mathbf{a}_3$ in Eq. (19), then the quantized signal particles from devices (2 & 3) with quantized motions say Δv_3 in Eq. (5) will not converge but fly by mass E.

Since there are different scale-specific EH's in GB's and scale-specific magnitudes for respective Δv_1, Δv_2 and Δv_3 in Eqs. (3 – 5), we can assume that there will be also the different scale specific convergences of those three types of signal. Therefore, if those signals are converged scale-specifically in different GBs, then the space as defined in Eq. (1) will be, not only curved, but also scale-specifically quantized in same GB's. Moreover, the Δv_2 in Eq. (4), would be the scale specific highest magnitude of quantized signal particles which just misses to escape through respective EH of GB. Then, such scale-specific curvature of space, in particular scales of GBs, can be defined by the convergence of highest quantized signal-particle motion Δv_2 in Eq. (4). Since the magnitudes of that Δv_2 in Eq. (4) will be always intrinsically quantized, its corresponding magnitude of *convergence* at E or curved space of every GBs will also be quantized in scale-specific way.

Again, we have also $\Delta t = 2\pi\Delta r$ for a quantized time scale, from Eq. (10), quantized mass Δm from Eqs. (6, 7), and quantized volume of space Δs from Eqs. (1,9), as respective CIPs for all scales of particles or systems in nature that never could be separated in those GB's. Then the intrinsic quantized magnitudes of Δs , Δt & Δm for every scale of GBs in Eq. (12) as CIPs are inseparable as well. Therefore, from Eqs. (6-12), all those same scales of GB's in Nature would have *scale-specific quantize convergence (curvature) of spacetime* say

$$\Delta p = \Delta s \cdot \Delta t \quad , \tag{24}$$

where $\Delta t = 2\pi\Delta r$ and Δs has been defined in Eq. (1). Therefore, from Eqs. (9, 10), Eq. (24) can be re-written as

$$\Delta p = \Delta s \cdot \Delta t = (\frac{3}{4}\pi \cdot \Delta r^3)(2\pi \cdot \Delta r) = \frac{3}{2}\pi^2 \cdot \Delta r^4 \quad , \tag{25}$$

where Δr is the scale-specific quantize magnitude of radius for the Δp . Again from Eq. (11) we may have further in Eq. (25) as

$$\Delta p = \frac{3}{2}\pi^2 \Delta r^4 = \frac{3}{2}\pi^2 K_6^4 / \Delta V^4 \quad , \tag{26}$$

where for convenience, the ΔV is scale-specific quantize magnitude of motion for macro scales like GB's although we defined the same as Δv in Eq. (7) in general for all scales of particles in Nature. Then we can further define each of such scale-specific quantize convergence of spacetime of all scales of GB's in Nature respect to the highest inescapable quantized motions $\Delta v_{\mathrm{e}-1}$ from Eq.(4) as well as from Eq. (7) in Eq. (26) as

$$\Delta p_{\mathrm{e}-1} = \frac{3}{2}\pi^2 K_6^4 / \Delta V^4 = (\frac{3}{2}\pi^2 K_6^4 \big/ K_2^4)\Delta M^4 \quad , \tag{27}$$

where $\Delta p_{\mathrm{e}-1}$ is also the usual quantized spacetime curvature of the specific-scale of GB or we can also consider it as the respective normal hydro-static-equilibrium (HSE) state for ΔM of that scale of GB under gravitation. However, for our further conveniences in proceeding text, we will define such scale-specific mass-energies or simply mass of any GB as ΔM instead of the generalize symbol Δm in Eqs. (6 & 7) for mass-energy of any micro to macro scales of particles or systems (including any GB's as well) in Nature

4.2 Scale-Specific Optimum Homogeneity of Smallest Bound Masses in Curved Spacetime

We already have the scale-specific highest possible convergence of quantized motion for signal-particles in Fig. 2 at the respective center-of-mass E of any relevant GB is $\Delta v_2 = \Delta v_{\mathrm{e}-1}$ in Eq. (4). Then from the Eq. (7) in same Eq. (4), we have for such highest possible converging quantized motion's quantized mass

$$\Delta v_2 = \Delta v_{\mathrm{e}-1} = K_2 / \Delta m_{\mathrm{e}-1} \tag{28}$$

which just cannot escape through the respective EH of the GB. Alternately, we can write that the same $\Delta m_2 = \Delta m_{\mathrm{e}-1}$ in any corresponding scale of GB is the respective smallest scale of particles in it which just cannot escaped from its corresponding EH. That is, all the GB's will have maximum corresponding HSE for those respective smallest homogeneous quantize masses of $\Delta m_2 = \Delta m_{\mathrm{e}-1}$ in Eq. (28) with respective highest quantize motions $\Delta v_2 = \Delta v_{\mathrm{e}-1}$ in Eq. (4).

Alternately, from Eq. (3) there can also be other scales of heavier signal-particles with lower quantized motions $\Delta v_1 < \Delta v_2 = \Delta v_{\mathrm{e}-1}$. Therefore, from Eq. (7) we will have the quantized mass for same as

$$\Delta v_1 = K_2 / \Delta m_1 > \Delta m_{\mathrm{e}-1} \quad , \tag{29}$$

which can converge (due to their corresponding lower quantized motions) before reaching the respective center-of-mass E of same GB and can be the integer multiples of $\Delta m_2 = \Delta m_{\mathrm{e}-1}$ in Eq. (28). Similarly, also there will be other respective higher quantized motions $\Delta v_3 > \Delta v_2 = \Delta v_{\mathrm{e}-1}$ of different signal-particles, can fly by the center-of-mass E of the GB from Eq. (5) without converging. Therefore from Eq. (7), we will have for its quantized mass

$$\Delta v_3 = K_2 / \Delta m_3 < \Delta m_{\mathrm{e}-1} \quad , \tag{30}$$

and will escape out through the respective EH of the GB. As a result, such signal-particles with Δm_3 in Eq. (30) will never be any parts in so called homogeneity of smallest quantize masses in the relevant GB.

Then in Eq. (28), we can assume that, in every respective scale of GB, there will be the corresponding *optimum homogeneity* of particular smallest signal-particles of mass $\Delta m_{\mathrm{e}-2}$ which just unable to escape through the corresponding EH in Eq. (4) for that specific GFS where obviously the corresponding scale-specific mass of GB will be an integer (say n) multiple of that Δm_{e-1}. Therefore, such corresponding scale-specific *optimum homogeneity* of respective scale of smallest signal-particles in any GB, from Eq. (28) will be

$$\Delta q_{\mathrm{e}-1} = \Delta M = n\Delta m_{\mathrm{e}-1} \tag{31}$$

since in Eq. (31) ΔM & $\Delta m_{\mathrm{e}-1}$ have all scale-specific magnitudes in different scales of GB's, the Δn will have all scale-specific magnitudes. From Eq. (7) we can further re-write Eq. (31) as

$$\Delta q_{\mathrm{e}-1} = \Delta n \cdot \Delta m_{\ \mathrm{e}-1} = \Delta M = K_2 / \Delta V \tag{32}$$

4.3 Optimum Convergence & Homogeneity are Directly Proportional

Due to the Eq. (32) we can further re-write Eq. (27) through Eq. (7) as

$$\Delta p_{e-1} = (\frac{3}{2}\pi^2 K_6^4 / K_2^4)(\Delta q_{\mathrm{e}-1})^4 \quad , \tag{33}$$

and since $(\frac{3}{2}\pi^2 K_6^2 / K_2^4)$ is a proportionality constant, therefore $\Delta p_{\mathrm{e}-1}$ is *directly proportional* to $(q_{\mathrm{e}-1})^4$ in every micro to macro scales of GB's in Nature.

5. Consequences

Eq. (33) depicts a direct proportionality between scale-specific quantized convergence (or quantized curved spacetime) and fourth power of scale-specific quantized homogeneity of the smallest inescapably bound particles at all scales of GB's. That seems to be to some extent alighned with the field equations of GRT, which express gravitation of the same GB's but in non-quantized way. The Sub-Section below describes the same in scale-specific quantized ways. The next Sub-Section will show the application of that scale-specific quantized gravitational field equations in Eq.(12) for all GB's.

5.1 GRT Field Equations with Scale-Specific Optimum Convergence & Homogeneity

In GRT, the Einstein Field Equations (EFE's) [5] that equate local spacetime curvature (expressed by the Einstein tensor) with local energy and momentum within that spacetime (expressed by *stress-energy-momentum tensor*)

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} + g_{\mu\nu}\Lambda = \left(8\pi G / c^4\right) T_{\mu\nu} \quad , \qquad (34)$$

where $R_{\mu\nu}$ is the Ricci curvature tensor, R is the scalar curvature, $g_{\mu\nu}$ is the metric tensor, G is gravitational constant, Λ *i*s the cosmological constant, c is inertial speed of light, and $T_{\mu\nu}$ is the stress-energy tensor or stress-energy-momentum tensor. If the Einstein tensor in Eq. (34) as

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} \quad , \qquad (35)$$

a symmetric second-rank tensor which is a function of the metric. Subsequently, EFEs will be in more compact form:

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = (8\pi G / c^4) T_{\mu\nu} \quad . \qquad (36)$$

However, by using geometrized units for $G = c = 1$, the Eq. (38) can be written as

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = 8\pi T_{\mu\nu} \quad , \qquad (37)$$

where the left side stands for the curvature of spacetime by the metric and right side for the mass-energy-momentum contents within that curved spacetime. Then EFE's ultimately appear as a set of equations defines how mass-energy-momentum curves the spacetime.

However, in Eqs. (36 & 37), we have a *direct proportional relationship* in between spacetime curvature $(G_{\mu\nu} + g_{\mu\nu}\Lambda)$ and $T_{\mu\nu}$ as if we have a similar direct proportional relationship in between quantized $\Delta(s \cdot t)$ and Δm in Eq. (12) and between Δp_{e-1} and $(\Delta q_{e-1})^4$ in Eq. (33). Although, in Eqs. (36) & (37), those same parameters appear differently as $(G_{\mu\nu} + g_{\mu\nu}\Lambda)$ and $T_{\mu\nu}$, respectively, for the same GB's.

However, through Eq. (7), there will be $c = \Delta v_c$ in Eq. (36) as one of SSUC's among all scales of quantize magnitudes of inertial-motions unlike UCs: 8π & G as like as K_1, K_2, K_3, K_4, K_5, K_6 & K in Eqs. (6) - (12), which remain unchanged over all scales of GB's. Then from Eq. (36) can obtain

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = (8\pi G / c^4) T_{\mu\nu} = (8\pi G / K_2^4) \Delta m_c^4 T_{\mu\nu} \qquad (38)$$

where $c = \Delta v_c = K_2 / \Delta m_c$ from Eq. (7) and the Δm_c is scale-specific quantize magnitude of inertial mass for corresponding photon. Therefore, the Eq. (38), respect to $c = \Delta v_c = K_2 / \Delta m_c$ as SSUC's, appears as a *local* to define the gravitational characteristics of the particular scale(s) of GB's in Nature. Then Eq. (38) can be universilized irrespective of any scales of GB's in Nature as

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = (8\pi G / c^4) T_{\mu\nu} = (8\pi G / K_2^4) \Delta m^4 T_{\mu\nu} \qquad (39)$$

where $\Delta v = K_2 / \Delta m$ in Eq. (7) for any scales of particles in Nature. That $\Delta v = \Delta v_c = (\Delta v_c)_{e-1}$ can be the maximum speed that just cannot escape through the EH of a particular black hole (GB) in Eq. (4). Therefore, for that particular black hole, the Eq. (39) will be like:

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = \left\{ 8\pi G \big/ [(\Delta v_c)_{e-1}]^4 \right\} T_{\mu\nu} = (8\pi G \big/ K_2^4) [(\Delta m_c)_{e-1}]^4 T_{\mu\nu} \qquad (40)$$

because Eq. (7) makes $(\Delta v_c)_{e-1} = K_2 / (\Delta m_c)_{e-1}$ in Eq. (28) of particular scale of photons in that blackhole. Then, the Eq. (40) can further universalize for any scales of GB's with corresponding maximum scales of inescapable particles through respective EHs

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = \left(8\pi G \big/ \Delta v_{e-1}^4\right) T_{\mu\nu} = \left(8\pi G \big/ K_2^4\right) (\Delta m_{e-1})^4 T_{\mu\nu} \quad (41)$$

inclusive of all scales of black hole as well. However, in Eqs. (31) & (32), the same total mass-energy in every micro to macro scales of GB's in Nature in Eqs. (34) & (36) has considered as scale-specifically quantized in magnitudes *i.e.* ΔM. Therefore, in Eq. (41) the parameter $T_{\mu\nu}$ would have also scale-specific magnitudes due to the scale-specific magnitudes of such GB's. That is in Eq. (41) there will be

$$\Delta M = T_{\mu\nu} \qquad (42)$$

for all corresponding scales of GB's in Nature. Since on the right hand side of Eq. (41), the $8\pi G \big/ K_2^4$ is the UC irrespective of all micro to macro scales of GB's in Nature and other parameters like Δm_{e-1}^4 & $\Delta M = T_{\mu\nu}$ of the same are merely possess SSUC magnitudes. Then obviously, all the parameters in left hand side in same Eq. (41) will also ultimately have their SSUC magnitudes; and can define for the same GB's in scale-specific way as

$$(G_{\mu\nu} + g_{\mu\nu}\Lambda) \equiv \Delta p_{e-1} \qquad (43)$$

from Eqs.(26) and (28). Therefore, Eq. (41) can be further re-written for any specific scale of GB as

$$\Delta p_{e-1} = (8\pi G / K_2^4)(T_{\mu\nu})_{e-1}(\Delta m_{e-1})^4 \quad , \tag{44}$$

and then from Eqs. (27, 32 & 33) we can also write for the same GB as

$$\Delta p_{e-1} = \left(\tfrac{3}{2}\pi^2 K_6^4 \big/ K_2^4\right)(\Delta n)^4 \Delta m_{e-1}^4 \quad . \tag{45}$$

Since in Eq. (43) for the same GB in Eqs.(44) & (45) there is

$$\Delta p_{e-1} = \Delta s \cdot \Delta t = (G_{\mu\nu} + g_{\mu\nu}\Lambda)_{e-1} \tag{46}$$

and from the same Eqs.(44) & (45) also there will be

$$(8\pi G / K_2^4)(T_{\mu\nu})_{e-1} \cdot \Delta m_{e-1}^4 = (\tfrac{3}{2}\pi^2 K_6^4 / K_2^4)(\Delta n)^4 \Delta m_{e-1}^4 \quad . \tag{47}$$

Therefore, the quantized magnitude for the total mass-energy in EFEs of GRT will be:

$$(T_{\mu\nu})_{e-1} = \left[3\pi K_6^4 (\Delta n)^4\right] \big/ 16\, G = \left[3\pi K_6^4 \big/ 16\, G\right] \cdot (\Delta n)^4 \tag{48}$$

for any corresponding integer magnitude of Δn to count the scale-specific Δm_{e-1} in a GB. Hence, from Eq. (46), the Eq. (44) can be further written as

$$\Delta p_{e-1} = (G_{\mu\nu} + g_{\mu\nu}\Lambda)_{e-1} = (8\pi G / K_2^4) \cdot (T_{\mu\nu})_{e-1} \Delta m_{e-1}^4 \\ = \in \Delta q_{e-1}^4 \quad , \tag{49}$$

where proportionality constant $\in = (\tfrac{3}{2}\pi^2 K_6^4 / K_2^4)$; and the Eqs.(45 & 49) from Eq. (33) are identical to define the corresponding EFEs of the same GB which is scale-specific quantized. Furthermore, the Eq. (49) also depicts an enfolding but scale-specific quantize curvatures of spacetime (Δp_{e-1}) in every micro to macro scales of GB's; and that (Δp_{e-1}) is directly proportional to the fourth square of optimum homogeneity (Δq_{e-1}) of the respective scale of constituent particles with smallest quantize mass Δm_{e-1} which can be counted by respective integer Δn^4 in Eq. (48). Then we will have all the scale-specific quantizations for EFE's in GRT for Eqs. (34, 37) in every scales of GB's in Nature through Eqs.(33 & 43) ultimately in the Eq. (49).

5.2 Simultaneous Mirror-Image Field of Gravitation with all Gravitating Bodies

The Eqs.(33, 45 & 49), the SSUC parameters Δp_{e-1}, Δq_{e-1} and $(T_{\mu\nu})_{e-1}$ are left-handed due to intrinsic left-handedness of CIP's; *e.g.* Δs, Δt, Δv_{e-1}, ΔM and Δm_{e-1} in Eq. (12) for a common expression of every scales of particle-systems including all scales of GBs in Nature. Therefore, the extended gravitational field equations of GRT, as we have in Eq. (49), to define scale-specific optimum convergence (or curvature of spacetime) & homogeneity of respective smallest bound particles will be intrinsically left-handed.

In Eqs. (9, 10), conceptually there we have simultaneous anti-space Δs_u & anti-time Δt_u as right-handed mirror images of CIPs Δs & Δt respectively for every GB's. Therefore we have from Eqs. (9, 10) the anti-space & anti-time as

$$\Delta s_u = \tfrac{3}{4}\pi \cdot \Delta\lambda^3 \quad , \quad \Delta t_u = 2\pi\Delta\lambda \tag{50, 51}$$

for all same micro to macro scales of GB's in Nature. Then from Eq. (24), there will be also a simultaneous *scale-specific quantize mirror-imaged convergences* of such quantize anti-spacetime in every same micro to macro scales of GB's through Eqs. (9 & 10) as

$$(\Delta p_u)_{e-1} = (\Delta s_u \Delta t_u) \tag{52}$$

and from Eqs.(50 & 51), such mirror image convergences in Eq. (52) by Eqs.(6 & 7) can define as

$$(\Delta p_u)_{e-1} = \frac{3}{2}\pi^2 \Delta\lambda^4 = \frac{3}{2}\pi^2 \frac{K_1^4}{\Delta M^4} = \frac{3}{2}\pi^2 \frac{K_1^4}{K_2^4} \times \frac{\Delta v_{e-1}^4}{\Delta n^4} \tag{53}$$

simultaneously in all scales of GB's in Nature.

In Eq. (31), the different scale-specific homogeneities of respective smallest scale of inertial-mass Δm_{e-1} which just cannot escape through the particular magnitude of corresponding EHs of curved spacetime Δq_{e-1} enfolds with specific mass ΔM of GB's. Therefore, conversely, we can also imagine the same as if a count of all similar or homogeneous highest quantized inertial-motions Δv_{e-1} in Eq. (4) of signal-particles with Δm_{e-1} in Eq. (28), which just cannot escaped through the corresponding EHs of the GB's. If $(\Delta q_u)_{e-1}$ is such homogeneity of Δv_{e-1} in Eq. (4) in corresponding GB, then we can define the same from Eqs. (31, 32 & 33)

$$\Delta q_{e-1} = \Delta M = \Delta n \cdot \Delta m_{e-1} = K_2 \Delta n / \Delta v_{e-1} = K_2 / (\Delta q_u)_{e-1} \ , \tag{54}$$

and from Eq. (54) we can rewrite the Eq. (53) as

$$(\Delta p_u)_{e-1} = \tfrac{3}{2}\pi^2 \Delta\lambda^4 = \tfrac{3}{2}\pi^2 K_1^4 (\Delta v_{e-1})^4 / K_2^4 \Delta n^4 = \in_u (\Delta q_u)_{e-1}^4 \tag{55}$$

where $\in_u$ is the mirror-imaged proportionality constant; and the Eq. (55) defines all right-handed mirror image convergence of anti-spacetime and homogeneity of just not escaped highest order of quantized motion through EH of the respective GB. Therefore, the Eq. (55) is also the simultaneous right-handed mirror image field for Eqs. (33 & 49) for the same GB. Also, the right-handed parameters $(\Delta p_u)_{e-1}$ are directly proportional to fourth power of $(\Delta q_u)_{e-1}$ in Eq. (55), as are left-handed parameters Δp_{e-1} and Δq_{e-1} in Eqs. (33) & (49).

5.3 A Common Non-Inertial Definition for All Scales of Gravitating Bodies

The Eq. (12), which defines a common inertial expression, has accommodated both left and right-handed CIPs of the all scales of particles or systems of particles. In left-hand side of Eq. (12), there are all left-handed CIP's Δm, Δs, Δt & Δr; and in right-hand side all right-handed CIP's Δv, Δs_u, Δt_u & $\Delta\lambda$ to define all scales of particles or systems, including all GB's.

The Eqs. (33 & 49) for scale-specific gravitational fields are also consist of all those same left-handed CIPs for any scales of GB's; *e.g.*, Δm, Δs, Δt & Δr. Conversely, in Eqs. (53, 54, 55), which depict the simultaneous existence of scale specific right-handed mirror image of gravitational fields, are also comprised of all right-handed CIP's; *e.g.* Δv, Δs_u, Δt_u & $\Delta\lambda$.

Then the simultaneous existence of both left and right handed gravitational fields of any specific scale of GB can be define from Eq.(12) through Eqs. (33 & 49) and Eqs. (53, 54 & 55)

$$\left[\Delta p_{e-1} = \in \Delta q_{\mathrm{e}-1}^4\right] = K \Big/ \left[(\Delta p_u)_{\mathrm{e}-1} = \in_u (\Delta q_u)_{\mathrm{e}-1}^4\right] \quad . \tag{56}$$

6. Inferences

The Eqs.(49 & 55) are the consequences of the Eq.(33) for all GB's in Nature. Similarly the Eq. (56) is also the consequence of Eq. (12) towards non-inertial expression for all scales of GB's in Nature. From these, we will have some inferences in following Sub-Sections.

6.1 Field-Equations in GRT Restricted to *c*

The Eqs. (34 & 36) will be identical respect to $\Delta v_{\mathrm{e}-1} = \Delta v_c = c$ with corresponding $\Delta m_{\mathrm{e}-1} = \Delta m_c = K_2 / c$. Then all the predictions will do through the EFE's in GRT (respect to such c) in Eq. (34) would be same in Eq. (41). Moreover in Eq. (34), the constant $c = \Delta v_c$ is SSUC in Eqs. (36) & (41), respectively. Therefore, the observers would have different scale-specific magnitudes with respect to all such SSUC-magnitudes of Δv of those same GRT predictions made by the Eq. (34) and those GRT field equations can universalize only with respect to the Eqs. (44 & 49). That is, all GRT predictions will be as usual or identical only with respect to the $\Delta v = \Delta v_c = c$.

6.2 The Blackness of a Black Hole depends on the Observer's Capacity to Receive Escaped Messages

Eq. (49) states that there will be all scale-specific EFE's in GRT for all scales of GB's with respect to every different SSUC magnitudes of both $\Delta v_{\mathrm{e}-1}$ and $\Delta m_{\mathrm{e}-1}$ in Eq. (7). In Eq. (4), if any GB possesses $\Delta v_2 = \Delta v_{\mathrm{e}-1} = c$, then obviously in Eq. (5) it would have for any $\Delta v_3 > c$. Then the GB will be a black hole. If there is an observer, outside of its respective EH with capacity to receive and analyze signal messages that say $\Delta v_3 > c$, then to that observer, that GB would not be a black hole any more.

Moreover, if we have Schwarzschild radius [10] for any GB's in nature say $r = 2GM / c^2$, where due to Eqs. (7, 8 & 11) all the CIP's *e.g.* r, M & c would be SSUC's. Then, for those, Eqs. (7, 8 & 11), the Schwarzschild radius of any scales of GB's would be

$$\Delta r = 2G \cdot \Delta M / c^2 \quad , \tag{57}$$

and in Eq. (4) if $\Delta v_2 = \Delta v_{\mathrm{e}-1} = c$ in a generalized way for all GB's, then Eq. (57) can be re-written as

$$\Delta r = 2G\ \Delta M / \Delta v_{\mathrm{e}-1}^2 \quad , \tag{58}$$

where, there would be all scale specific different magnitudes of blackness's of GB's.

6.3 Gravitating-Bodies: as inverse products of simultaneous Gravitation & Anti-Gravitation Fields

Eq. (56) shows that all micro to macro scales of GB's in Nature are nothing but the HSE's of simultaneous scale-specific quantized left (gravitational) and right (anti-gravitational) handed fields. The inverse equilibrium between left-handed gravitational field as the result of $\Delta p_{\mathrm{e}-1}$ & $\Delta q_{\mathrm{e}-1}$ in Eq. (49), and the simultaneous right-handed anti-gravitational field as the result of $(\Delta p_u)_{\mathrm{e}-1}$ & $(\Delta q_u)_{\mathrm{e}-1}$ is the ultimate form of the all scales of GB's in Nature from Eq. (55). Then ultimately, the $\Delta p_{\mathrm{e}-1}$ & $(\Delta p_u)_{\mathrm{e}-1}$ also show the simultaneous scale-specific quantized convergences or curvatures of spacetime and anti-spacetime in all those same scales of GB's, respectively.

6.4 Every Gravitating Body, Irrespective of Scale, Appears as a Left & Right Handed Pair

Two different mirror-imaged observers could observe Eq. (56) and realize it oppositely. Eq. (56) shows the scale specific gravitational field as well as curvature of spacetime of GB in left-handed way to one observer. That is, in any left-handed observation a GB, will appear as the product of left-handed curved in spacetime and right-hand flattened in anti-spacetime.

Conversely, the same Eq. (56) in any conceptual right-handed way of observation from opposite side of a mirror, the same GB will appear as a product of right-handedly curved in anti-spacetime and simultaneously left-handed flattened in spacetime. Both mirror observers can simultaneously observe that same GB in such both left and right handedly even at the same moment.

Then ultimately gravitation in Eq. (56) can be considered as left-handed and is a curved spacetime with simultaneous flattened anti-spacetime. Alternately, the anti-gravitation through same Eq. (56) conceptually appears as right-handed (as mirror image of gravitation) and is a curved anti-spacetime with simultaneous flattened spacetime of same GB. Then we can write for both of those two mutual mirror images of gravitation and anti-gravitation of the any GB from Eq. (56), as

$$\left[\Delta p_{\mathrm{e}-1} = \in \Delta q_{\mathrm{e}-1}^4\right] = K \Big/ \left[(\Delta p_u)_{e-1} = \in_u (\Delta q_u)_{\mathrm{e}-1}^4\right] \tag{59a}$$

$$\left[(\Delta p_u)_{\mathrm{e}-1} = \in_u (\Delta q_u)_{\mathrm{e}-1}^4\right] = K \Big/ \left[(\Delta p)_{e-1} = \in \Delta q_{e-1}^4\right] \tag{59b}$$

Therefore, for every scale of GB's in Nature, as we have in the Eqs. (59a, 59b) will have a simultaneous left and right handed mutual mirror-imaged pair existence depending on left and right handed ways of observations. If the quantized or scale-specific magnitudes of any one of parameters or CIP's in any one of the pair will change, then spontaneously the magnitudes of the all relevant parameters or CIP's along with all corresponding mutual mirror image parameters or CIP's of the same GB will change automatically as well as intrinsically through transformation of the GB from one scale to another.

7. Conclusion

It is one of few most basic ideas in Physics that the 'inertial mass-energy' and 'inertial motion' of any material bodies are intrinsically and inseparably correlated. Later, the foundation of Modern Physics, from very first decade of the previous century, was actually started with propagations of Quantum Principles related to that inertial mass-energy beside Constancy Proposals of inertial motion of a photon. But later the quantum principle rippled in almost every scale of particles or systems in Nature, while the quantum considerations of inertial motion never unfolded beyond the scale of photons (if one considers the inertial constancy in motion *c* as a quantum magnitude of inertial motion for the same). If all particles and systems present in Nature not considered to have scale-specific quantized magnitudes of inertial motions, besides quantized inertial mass-energies, then definitely the scopes of today's Physics towards unification will continue to be limited due to searching for the key to a room in only a half of the total baggage. In that context, the current paper attempts to show how new opportunities for unification can emerge if we introduce quantum principles for both inertial mass-energies and motions for all scales of material bodies.

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Force-Based Gravity (Continued from p. 42)

It is apparent that the distance dx between the rest points A and B has nothing to do with the velocity of m. The only other possibility for dependence is the time interval for m to go from A to B. The normal time, dt, is measured by noting the time that m coincides with A according to a clock in the rest frame, and then noting the time that m later coincides with B. dt is the time interval between two spatially separated events: the coincidence of m with A and the coincidence of m with B.

A simpler, more direct way to measure the time interval would be to put a clock in the moving frame with m. In this frame, A is moving and goes by m. The time is noted. Then B goes by m and the later time is noted. The time interval between the coincidence of A with m and the coincidence of B with m is measured at the same place according to the observer in the moving frame. Because the method of measuring the time interval here does not involve spatially separated events, it is simpler and more direct. It can be considered the more appropriate time interval or the proper time. This time interval will be designated, dt'.

In Newtonian physics, dt' is equal to dt. The natural presumption is that time is absolute and should not depend upon relative motion. However, the relation $\mathbf{P} = m\mathbf{v}\Big/\sqrt{1-v^2/c^2}$ indicates that this may be a false assumption. The time interval, dt', may not equal dt, and based on $\mathbf{P}$, could be given by $dt' = dt\sqrt{1-v^2/c^2}$. Experimental measurements have, in fact, shown that time dilation does occur, and is given by the stated relation. In effect, the velocity of m is determined by the length, dx, of the rest frame, divided by the time, dt', of the moving frame. In other words, the real velocity of m is dx/dt'. Nevertheless, according to the space and time of the rest frame, it is the mass of m that increases.

A question remains, however, because the clock in the moving frame is identical to the clock in the rest frame. Why is the time, dt', different from dt? In the moving frame, the distance between A and B can be designated dx'. This distance is determined by using a measuring rod in the moving frame to determine where on the rod the moving points A and B are at an identical time according to the observer in the moving frame. This distance must be equal to $dx\sqrt{1-v^2/c^2}$ in order for the points A and B to pass in the time dt'. So a moving length, dx, in this case, appears contracted by the contraction factor, $\sqrt{1-v^2/c^2}$.

Unlike time dilation, there has been no direct measurement of length contraction. One indirect indication of contraction has been described in Webster [4], and also in Feynman [5]. It involves two straight, parallel wires carrying current. The wires attract or repel one another depending upon whether the currents are in the same or opposite directions. The basis for the attraction or repulsion is the way moving electrons in one wire see the spacing of the moving electrons and positive lattice points in the other wire. Because of relativistic length contraction of the spacing of charges, a wire can appear to be positively or negatively charged according to the conduction electrons in the other wire. The force, normally determined by the interaction of a magnetic field and a current, is, instead, determined by an electrostatic interaction.

Newtonian gravity can be modified in a way that is analogous to the way Newtonian dynamics was modified in SRT. The Newtonian gravitational force, like the inertial force, leads to work/energy and, consequently, an apparent increase in gravitational mass. **(Concluded on p. 60)**

Towards a General Theory of Orbital Motion: the Thermo-Gravitational Oscillator

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Starting from Le Sage's theory of gravitation, we postulate that the thermal energy of a planet essentially counteracts the effect of shadowing from Le Sage's surrounding isotropic energy. Both components are assumed to be in a dynamical equilibrium, acting in opposite directions along the line connecting a planet and the Sun, having the same ratio as their respective components along the tangent of the planet's orbit. As result, the only parameters involved are the gravitational constant, which is not necessarily the same as Newton's, and the planets thermal coefficients, without any reliance on the masses of the two bodies. The planet's actual trajectory is expected to come out 'naturally' from the application of a directly formulated closed path zero-work/minimal-action expression. Applying this principle to explain large-scale phenomena (Andromeda's dwarf-stars trajectories, and possibly 'anomalous' stars velocities, Pioneer 10/11 anomaly, *etc.*), and its extending it to the atomic level appears quite straightforward, and may furnish fundamental breakthroughs.

1. Introduction

Besides problems encountered in application to galactic and atomic scales, the currently accepted theory of gravitation, and the theory of orbital motion it implies, exhibit inconsistencies even when applied to the Solar system. The exclusive reliance on gravitation as the only central force does not allow for the exact prediction of the planet's trajectories in accordance with the Kepler's second Law, [1], and furthermore orbit fitting to an elliptical shape is contingent on the initial conditions. [2] The basic shortcoming of Newton's theory of orbital motion is the presumed absence of the tangential acceleration component, quite contrary to well established observational results, which are deduced either from the 'naïve' interpretation of the Kepler's Third Law, which actually related to the average values of the orbital radius and elapsed time, or from the improper interpretation of Kepler's Second Law, implying circular motion.

Le Sage's theory is that gravitation arises from a postulated isotropicaly-acting energy agent, as an effect of the object's mutual shadowing. Although epistemologically quite appealing, Le Sage's theory could not pass a test based on the well-entrenched Newton gravitational law. Fairly successful reproductions of the mass-dependent form [2] may only have hindered wider appreciation of its intrinsically dynamical nature. As a matter of fact, the Newton's gravitational law was derived in a rather tautological (circular) manner, relying on the objects' masses also in definition of the gravitational constant. The incorporation of his Third Law, about action and reaction, which even Newton himself had been reluctant to rely on explicitly, and despite many objections (notably Leibniz's), into the theory of orbital motion, has been another misdeed, both with detrimental impact on the further development of physics, and the almost insurmountable difficulties it has been facing, including the forces unification.

When it came to applying Newton's gravitation theory based laws of orbital motion to atomic scales, the problem arose when it became apparent that the electrons would have fallen down to the nucleus if they were to emit radiation while orbiting, and the classical physic had gotten abandoned in favor of the quantum-mechanical principles, but there has been no concern whatsoever and/or quest pursued for the reason why the planets do not fall to the Sun if the gravitational force might become prevailing over the 'initially' imparted kinetic energy. Is it really tenable that the initial kinetic energy impetus could have been sufficient to provide the apparent stability of the planetary motions around the Sun, and/or that only its exhaustion would contribute to the planets eventual spiraling towards the Sun ?!? Isn't it possible that actually the Sun's thermal energy is the cause of the dynamic stability of the Solar system, and that only its exhaustion would ultimately lead to the prospective collapse!?

In spite of the long proclaimed obsoleteness of the ether concept and its stigmatization, there has been of late evidenced its revival in various ways, including even the quantum zero point fluctuations 'derivative', and its relating to Le Sage's pool of isotropic energy agent. By allowing even for the background cosmic radiation to be one candidate for the global gravitational shadowing, there must then be a counteracting mechanism to its purely 'pushing' effect, and the heat becomes a viable candidate. (This is something that Engels hinted in Dialectic of Nature.)

This paper is based on 1) the above considerations; 2) an earlier attempt by the second author here, Gordić, to involve thermal energy along with gravitational energy (which had been derived from the Third Kepler's Law, and thus turned out not consistent); and 3) a specific and rather rudimentary analysis of the resulting equation of the gravitational and thermal energies [4]. It exposes a more compelling approach, without any reliance on the Newton's third law of action and reaction.

2. Orbital Motion as a Dynamic Equilibrium

The following considerations are based on dynamic equilibrium between the Le Sage-like gravitational, and the postulated thermal components of the effective force driving the planet around the Sun over certain path. In essence, the gravitational component itself is thermal, and what we expose here is more like an outline of ultimately thermo-dynamical theory of orbital motion. (The 'thermal' aspect of gravitation is found in [5], Sect. 7a, as a link between gravitationally dependent magnetic field and the induced current; however, it does not have any relationship with the framework proposed in this article; a similar, but much more elaborate and consistent approach is in [6], where the electromagnetic background radiation medium is considered in the range of frequencies from zero to infinity; another work, which explicates the Le Sage's energy as thermal one is [7], but its application to Solar system remains 'trapped' into the mass-dependent and the single central force determined Newtonian framework of the orbital motion, similarly to [6].)

On Fig. 1, starting from the radial components of Le Sage's and the postulated thermal 'force' components, their projections on the tangential line to a non-predefined orbital trajectory bear the same ratios (as those very components) due to the sameness of the opposite angles made by crossing of two straight lines. We start from the elementary work done on the elementary segment $ds = \cos(\alpha) \cdot dr$ of a trajectory, and subsequently equating its integral over a trajectory to zero, akin to the presumed conservative force field. The work done per unit mass is the result of two components: 1) a work component from the gravitational (field) force, that is the corresponding acceleration towards the Sun (γ representing the gravitational, not necessary universally valid, constant), and the component (energy) of the 'thermal' field, which actually acts as a kind of counterforce to the former one (centripetal differing from centrifugal force); that is (ξ representing the thermal coefficient of a planet body)

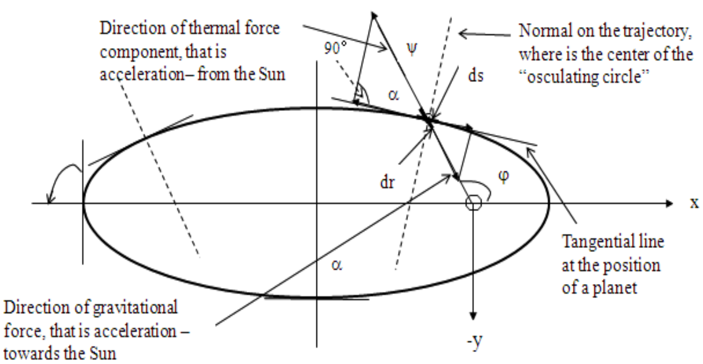

Figure 1. Illustration of thermo-gravitational equilibrium in the planetary motion of a planet around the Sun.

$$dE / m = (\gamma / r^2) dr \quad , \tag{1}$$

$$dQ / m = \xi \cdot dT \quad . \tag{2}$$

In order to represent the two field force components by the same variable, the actual dependence of the planet's temperature on its distance from the Sun is needed. What is required is the related function

$$T = f(r) \quad , \tag{3}$$

so that (2) goes over to

$$dQ / m = \xi \cdot f'(r) \cdot dr \quad , \tag{4}$$

where prime denotes the first derivative over the argument r.

Based on (1) and (2), the dependence of the effective force[1] of the composite thermo-gravitational field on the planet-Sun distance can be represented as

$$F(r) = \gamma / r^2 + \xi \cdot f'(r) \quad . \tag{5}$$

It will be interesting, and possibly insightful, to mention here two things: first, the term 'force' has been used in only a descriptive, and not the causative sense, differently from its use by Newton; second, although the (Earth) body mass is figuring in such a formal elementary works definition, it falls-out from considerations due to equating the total work over the trajectory to zero, or in the an alternative, and possibly more appropriate application of the principle of the Least Action. This is how the mass becomes totally irrelevant for the orbital motion consideration/explanation, in quite a good agreement with the observations from the Galilean time, which support full independence of the acceleration caused by the Earth on 'attracted' objects' mass.

If the function $f(r)$ is not known, in particular the one that characterizes the effective radial component that is counteracting the Le Sagian gravitational push one possibility is to arrive at it by starting from the known trajectory's elliptical equation and some sort of combined numerical/analytical determination of it based on minimization of

$$\oint \{ [\gamma / r^2 + \xi \cdot f'(r)] \cdot \cos(\alpha) \} \cdot dr \quad , \tag{6}$$

where the integration is done on the given ellipse equation. (The value of this closed-path line integral is given by the area of the vertical wall erected on its two-dimensional line, with the height is defined by the function.)

Another possibility would be to suppose the planet's temperature to be related inversely to its distance from the Sun, as in [9}, so that (5) becomes

$$F(f) = \gamma / r^2 - \mu / r^3 \tag{7}$$

with μ representing a modified ξ constant. By all means, it can be expected that, with appropriate constants, the minimization of the expression in (6) should reveal the dependency between the radius, its angle, *i.e.* time, thus the actual trajectories.

To further substantiate, to some extent, the proposed approach toward arriving at a truly general theory of orbital motion, applicable from atomic to cosmic scales, the equated differential works of the two collinear and antipodal 'field-force' components, named here the thermo-gravitational oscillator (TGO) equation, is analyzed quasi-dynamically in Appendix A1. Also, Appendices A2 and A3 give justifications for the inconsistencies of the two pillars of the Newtonian physics: heuristically derived law of gravitation, and the sufficiency of just one central force to effectuate the motion over the elliptical path.

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[1] Here we actually have the force normalized by the mass *m*, which however later falls-out from considerations due to minimizing the total work over the closed trajectory; this is how the mass becomes totally irrelevant for the orbital motion consideration/explanation, in quite a good agreement with the observations which support independence of the acceleration caused by the Earth on objects' mass.

3. Conclusion

Although not fully complete, this analysis suggests a possibility to confirm the proposed approach of the forces/mechanisms determining the orbital planetary motion around the Sun in the way that overcomes the likely shortcomings and hindrances coming from the currently valid gravitational[2] and on it based theory of orbital motion, in that it might be able to deliver the planetary trajectories which obey to the Kepler's empirically established regularities in the form of his First, Second and Third laws. Moreover, in this way, or through possible formulations of kinetic and potential energies, a set of stationary orbits might be derivable by applying the principle of the minimal/stationary action, through formation of Lagrangeans or Hamiltonians.

A conceptually appealing explanation of the underlying dynamical equilibrium mechanism on the Sun-Earth system is the following: the Earth gains thermal energy when approaching the Sun, but that same thermal energy contributes to the Earth's escaping the maximal "Sun's gravitational attraction" at the position of perihelion, and allows it to reach position of aphelion by gradually decreasing its temperature, so that the Lesage's shading effects start dominating, and so on - the system Earth-Sun constituting a kind of thermo-gravitational oscillator (TGO). Evidently, contrary to its modeling as a conservative (potential force) system, the largely non-zero work done over a closed loop should likely reveal its essentially non-conservative nature, which may apply to other natural dynamical systems as well.

The quite recent unexpected realization of the Andromeda's dwarf-stars having similar trajectory constellations as the ones of the Solar system might be related to the fact that the dwarf-stars are relatively cold objects, while the long ago observed anomalous rotational speeds of the stars on the outskirt of galaxies may have something to do with the fact that a star is too hot an objects for their motions to be (nearly) dominated by the 'pure' gravitational attraction, and the existence/postulation of the so-called dark matter be justified. On the other hand, at the atomic level, there might be necessary to similarly take into consideration some other form(s) of energy in addition to the mere electrostatic attraction between an electron and its nucleus, a prospect that could possibly lead to a much closer relationship between classical and quantum mechanics, or even make the latter obsolete.

A very encouraging support for the non-central nature of the forces in an atom could be the recently published quite successful Algebraic Chemistry, [8]. The underlying presence of electron subsystems could be taking place by the counteracting of their (electrostatic) repulsion by the back-ground, i.e. the ether-like isotropic energy, while at the same time the preventing their collapsing onto the atom nucleus due to the electrostatic attraction.

All this, along the continual questioning of the classical momentum conservation validity for the systems 'immersed' in the 'ether', [10], in particular related to violation of the Ampere's law, might then lead to far-reaching consequences concerning not only the very validity of quite peculiar notions and concepts of the quantum mechanics, but contribute towards bringing gravitational force (much) closer to the other three known ones.

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[2] We here neglect the GTR modifications of the Newton theory of gravitation due to the very untenability of the STR as its basis …

Appendix 1. A Problem in Newton's Concept

Based on deduction of the centripetal acceleration by Wren, Hook and Haley from Kepler's Third Law and his constant k , in the form $a_c = 4\pi^2 k / r^2$, possibly just confirmed by the apple-moon tinkering, Newton applied his second and third laws to arrive at the well known expression for the gravitational force between the two material points of masses M and m as

$$F_c = G \cdot M \cdot m / r^2 \quad , \tag{A1.1}$$

where the so-called gravitational constant γ was introduced as inversely proportional to the Sun's mass M , as

$$G = 4\pi^2 k / M \quad , \tag{A1.2}$$

which modified the previously deduced, mass-independent centripetal acceleration into

$$a_c = G \cdot M / r^2 \quad , \tag{A1.3}$$

introducing the concept of the Sun's gravitational field and its 'strength' as dependent of the Sun's mass.

Although was known from Galileo, and from Lucretius' much earlier thought experiment, that the gravitational force, *i.e.* acceleration does not depend on the mass of the (by the Earth attracted) object, through the implicit reliance on his third law, Newton did involve also the mass of the 'attracting' body (Sun), through definition of gravitational constant as per (A1.2), in addition to the mass of the attracted one (Earth), in his law of gravitation expressed by (A1.1).

The compelling effectiveness of this quite artificially, inconsistently and in a way 'circularly' derived formula in explanation of gravitational effects on earth and within the solar system, has made it unquestionable truth, although since long it has been found inapplicable to the level of atom, and not so recently on galactic level. Its virtual validity was of the kind that the very plausible Le Sage theory of gravitation as the shadowing effect of an isotropic energy was rejected on the account of not being able to demonstrate the proportionality of the force with the product of masses. Besides clearly obeying the inverse square law, and by at all not needing of masses of the object involved, this being in a clear accordance with the Keppler's third law, it makes the issue of instantaneous action (as well as the velocity of "gravitons") on distance totally immaterial. That something is wrong with the Newton's gravitational constant is indicated by the very inability to determine it with precision of more than two decimal places.

Further, increased objects weight on the pole from the one placed on equator is often used as an evidence for the validity of Newton's law of gravitation, although this effect might equally well be explained by the more pronounced shadowing effect from different radii of the effective 'osculating' screening spheres. Similarly, it is often argued that the hypothetical corridor that would cross the Earth through its center would enable building of an elevator that would go back and forth from one to the other end in an oscillatory manner. But it might rather very likely get stuck somewhere in the middle with much more 'dumped' oscillations than would have been expected. A quite compelling treatise and analysis of the Le Sage's theory of gravitation, from the point of view of both mass-independency and the manifestations of uniform rectilinear motion as well as the effect of inertia are provided in [11].

On the other hand, the very well known Casimir effect might just be a manifestation of the gravitational force of the Le Sage type, and in particular the most recent result showing the inverse square proportionality in the case of the so-called thermal Casimir force [12] may contribute to the reaffirmation of this very viable alternative to currently valid Newton's law of gravitation. (Regarding the reliance on Le Sage's theory of gravitation in the context of arriving at the fundamentally different law, that is mechanism of the orbital motion, is not as much regarding the inverse square law as an alternative, but rather its essential thermal nature.)

Furthermore, the gravitational anomaly discerned by Etövös, through its various re-analyses of his findings, most thoroughly encompassed in [13] (where the author put it in relation to Le Sagian gravity), bring to light the importance of the volume of the equal-weight bowls, so that the bodies specific density, thus its specific heat looked as an important factor complementary to the mass. An alternative view to the postulated impact of the environmental heat buoyancy towards the explanations of Etövös' residuals, would actually be the bodies thermal energy, in the context of the thermo-gravitational effect, introduced in the main part of this article. The extensive experimental evidence of the gravitational anomalies related to the Sun's eclipse, [10], could also be related to actual, short-term transitional temperature changes of the areas of earth which may influence its global temperature, as well as producing the anty-gravitational effects on the involved bodies' weights. Same might be the case with Majorana's shielding.

Although the very (integral) TGO equation should make the masses irrelevant for the gravitational interaction, when one tries to show that through the un-tenability of proportionality of the attraction force by the masses[3], on one, and the independency of the respective accelerations, on the other side, the physics book argument goes as: $F_1 = \Gamma \cdot M \cdot m_1$; $F_2 = \Gamma \cdot M \cdot m_2$; $F_1 = a_1 \cdot m_1$; $F_2 = a_2 \cdot m_2$; and, since (evidently, when suspending two bodies of different masses on two identical springs) the individual 'forces' are proportional with those masses, the conclusion is drawn that the corresponding accelerations should also be same, as they evidently are … The absurdity of Newton's gravity theory can be seen from changing the point of view, by looking at the Earth as being attracted by the two masses: consider a led and wooden bowls of same volume, that is with differing masses, m_1 and m_2 at distance r from center of the Earth of mass M.

As before, denote 'forces' by which Earth attracts the two bowl by F_1 and F_2, and those they 'attract' the Earth by F_1^M and F_2^M, so that

$$F_1 = GMm_1 / r^2 (=) a_1^m m_1 \quad , \quad F_2 = GMm_2 / r^2 (=) a_2^m m_2 \quad ,$$

$$F_1^M = Gm_1 M / r^2 (=) a_1^M M \quad , \quad F_2^M = Gm_2 M / r^2 (=) a_2^M M \quad .$$

While both empirically and formally (admittedly, through Newtonian 'rationalization') $a_1^m \equiv a_2^m$, empirically; *i.e.*, evidently $a_1^M \equiv a_2^M \equiv a_1^m \equiv a_2^m$, but formally $a_1^M \neq a_2^M$, since $m_1 \neq m_2$!?!)

The proper insight, however, should be that here it goes about the 'misuse' of the force-concept, but that it rather is related to 'weight' – thus the difference between the summary effects of the Le Sage's 'pushing' effect on the bodies with different matter densities. The evident problem with the Newtonian gravity of 'conversion' from static to dynamic framework, pertinent to electromagnetism and 'overcome' by the introduction of retardation potential, has been brought-up in [14], along with the considerations of and strictly distinguishing the causal and the definitional aspects of the Newton's second law, what can be brought in connection with the criticism above.

As a particular proof of the correctness of LeSage's theory of gravitation could serve on it based explanation of the so-called Pioneer-anomaly; that is, of the anomalous acceleration of some $8.9 \times 10^{-10}\,\mathrm{m/s^2}$ directed towards the Sun, [15]. Since recently (officially) accepted solution based on the thermal 'thrust' on the rear side of the antenna facing the Earth (essentially the Sun at the separations as large as 20 and more AUs), [16], largely likens the scene from the cartoon where Popeye moves towards the shore by blowing into the sails of his boat, something impossible due to the momentum conservation. On the other side, considering the effect of the increased heat on the spacecraft side facing the Sun, it could turned out that it actually imbalances the La-Sage's shadowing effect in such a way to contribute to the effective ('anomalous') centripetal acceleration. Such an attempt could largely rely on a quasi-dynamical analysis of the TGO equation, of the kind conducted in the Appendix 3.

Appendix 2. Central and Tangential Forces

The insistence on the exclusively central force caused orbital planetary motions has been tied with more or less obvious formal difficulties and inconsistencies from the Newton's own derivation, all the way to the relatively recent Feynman's attempt, not having been able to come to terms and apparently unsatisfied with the Newton's method, to arrive at the 'desired' solution by alternatively approaching the problem of matching the elliptical orbit to the central inverse square force, as accounted in his so-called "Lost Lecture on Gravitation", [1].

Although some 20 years before his writing of the "Principia" Newton was reluctant to go for the gravitational force as the only acting one, and thus to apply his third law by effectively equating the centrifugal and centripetal forces, Newton, through his 'speaker' Kelly, did not (want to ?) have any understanding for Leibniz's objections on that basis[4]. Actually, the now considered

[3] Shapes, volumes, densities, thus effectively – masses, would merely define the gravitational constants in particular situations.

[4] Indeed, it should not be acceptable to consider the action and reaction acting on the same body – in this case in particular, a planet. At least the third Newton's law was formulated (primarily for static situations, though) in mutual influence of two bodies as equality of forces exercised in one and the other directions, and not as equality of two forces (centripetal and centrifugal) acting on the one.

somewhat correct, but unjustifiably 'forgotten', derivations that demonstrate the fitting of curvilinear motion as result of independently acting centripetal and centrifugal forces, had been fiercely attacked by Newton himself. Yet, the Leibniz postulated (and derived in [17] and its References) dependency of the effective (resulting) centripetal acceleration (referenced towards center) of the form, [16],

$$a_c = a / r^3 - b / r^2 \tag{A2.1}$$

(referenced toward center) falls very well along the lines of the proposition made in this article [see Eq. (7)]. Namely, the presence of the first part in (A2.1) can be related to the effective thermal force acting in the direction opposite to the gravitational force, something that Leibniz related to levitation.

The modern, analytical derivations, without exception, implicitly (through conservation of angular momentum) or explicitly (by directly equating the tangential acceleration to zero) constrain whatever generally assumed force to the strictly central one. (Often that is motivated/supported by the third Kepler's law, *i.e.* constancy of the sectorial speed, seen as $r^2 \cdot \phi'$, totally neglecting the intricacies related to the required higher orders of infinitesimality when it comes to approximate arcs with polygons, and the like, which has actually been the main issue in the classical, geometrical approaches towards fitting the curvilinear/elliptical orbits to the presupposed central forces, [18]. A profound critic of Newton's orbits fitting by the purely gravitational force is given in [19].)

The typical example of these analytical derivations is the one found in [20]. Therein, after providing expressions for the radial and the force in the direction perpendicular to the radius, equation 6, the latter one is made equal to zero in equation 7, with the motivation that the "gravity force is a *central force*". This however is quite straightforward to denounce by simply calculating the corresponding, or say tangential acceleration from the known observational data. (For example, the animation available at [21], supposedly correct enough, clearly indicates the time-variable tangential speed, thus the inadequacy of the commonly practiced treatise of this problem.)

The proposed (in this Paper) thermal, in the addition to the gravitational force/acceleration, or, conceptually, field components, might be the source of the postulated/demonstrated component by Leibniz, possibly something that Euler (and others, like Maupertius, Lagrange, *etc.*) in his unwillingness to accept action at distance would have desired knowing, and what would have been the right set-up for exercising his Calculus of Variation, which has lead to the PLA (Principle of Least Action).

An additional force, as suggested earlier in this memo, might be needed also at atomic level, too, for which certain support can be found in [8], as hinted before.

Finally, related to the co-linearity of the gravitational and thermal 'force field' components, it might be worth mentioning that the peculiar comet's tail direction - opposite to the Sun - during its perihelion passage may serve as de-facto evidence of the thermal component acting in opposition to the gravitational one.

Appendix 3. Going Toward Quantization

While it is to be expected that through consistent evaluation of the line integral (6), or an adequate application of the Principle of Least Action (PLA) a set of possibly decoupled planetary orbits would be revealed with possible forms that exhibit 'quantization' effect, in the following we approach the analysis in a quasi-dynamical context. In that sense, we don't postulate any particular dependence of the planet's temperature on its distance from the Sun, but rather start from equating the elementary works done by the two force/field components in (1) and (2)

$$\xi \cdot dT = (\gamma / r^2) \cdot dr \quad . \tag{A3.1}$$

By independently integrating the left and right sides of (A3.1) within the respective limits of T_0 to T_1, and r_0 to r_1, we have

$$\xi (T_1 - T) = \gamma (1 / r_0 - 1 / r_1) \quad . \tag{A3.2}$$

By introducing the incremental temperature and distance intervals $\Delta T = T_1 - T_0$ and $\Delta r = r_1 - r_0$, with $G = \xi / \gamma$, we arrive at dependence of the increment on the planet's distance from a presumably stable average distance from the Sun and the (needed) increment in the planet's temperature to effect its increased separation in form

$$\Delta r = r_0 \left[1 / (1 - r_0 G \cdot \Delta T) - 1 \right] \quad . \tag{A3.3}$$

We call this the equation of thermo-gravitational oscillator, with typical form as illustrated in Fig. A3.1.

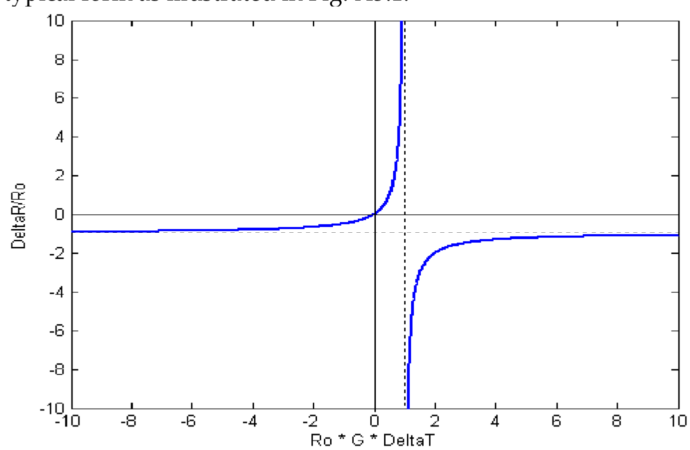

Figure A3.1. Dependence on temperature increase of the increment of the planetary distance from the Sun.

This can be interpreted as follows. Starting from its stable orbit[5] (that is a position on it) of a planet with average radius r_0 and its (average) temperature T_0, with an infinitely large de-

[5] Note that the 'working point' of a planet is mostly a tiny (with exception of Mercury and Pluto) segment covering the curve crossing the horizontal axis, so that the ratio of the corresponding projection on vertical axis is on the order of the eccentricity of the planets orbit, amounting from slightly less than 1% to almost 10% (20% and 25% for Mercury and Pluto).

crease in temperature ($\Delta T \to -\infty$), the increment of the planetary radius goes down to $\Delta r = -r_0$; that is, the planet falls to the Sun.

On the other hand, with an increase in the planets temperature (say by its external heating much in excess of the one it receives from the Sun[6]), the distance from the Sun would exponentially increase, as governed by the vertical asymptote at the value $\Delta T = 1/(G \cdot r_0)$, which suggest its full escaping from the "Sun's gravitational field" (or, better, to the separation at which the Le Sages shadowing effect becomes negligible). Whereas the behavior of the curve to the left of its asymptote bears quite good relation to the physicality of the situation, this seems not to be the case with the part of the TGO function to the right of it. Still, it might be worth taking into consideration that part as well. (It appears quite tough the relate the negative increments of the orbit's radius to positive increments of temperature; an option is to think about temperature increments as negative which allow for the planet to be brought back towards the Sun, or to think in terms of projection of $\mathbf{r}$ on x -axis?)

To get some further insights into some elementary features of the planetary orbits from this rather qualitative analysis, we take the relatively well-established relationship between the average radius of the planetary orbits[7] expressed by the Titus-Bode rule with reference to the Earth's distance from the Sun (1 AU):

$$r_n = 0.4 + 0.3 \cdot 2^n \quad , \quad \text{for } n = -\infty, \ldots, 0, 1, 2, 3, \ldots , \qquad \text{(A3.4)}$$

where the index for the Earth is $n = 1$. Figure A3.2 shows the corresponding TGO functions in the range around the vertical asymptote, assuming that the thermal coefficients are the same for all the planets, and with $G = 1$.

What can be noticed from these plots in qualitative sense might be that the slopes at the zero-crossing are increasing for the outer planets, meaning that smaller variations in the planets temperature contribute to larger absolute variations of the orbital radius between the perihelion and aphelion positions[8], which is quite reasonable. (The planets temperatures, with exception of Mars, decrease with their distance form the Sun; on the effective energy counteracting the gravitational - cosmic microwave - background radiation have influence also the presence and characteristics of their atmosphere, so that the specific heat capacity - multiplied by the planet mass - might still need correctional factors regarding its role in the TGO equation and the related planetary dynamics. The ratio of the highest and lowest value of planetary specific temperatures is about 10.)

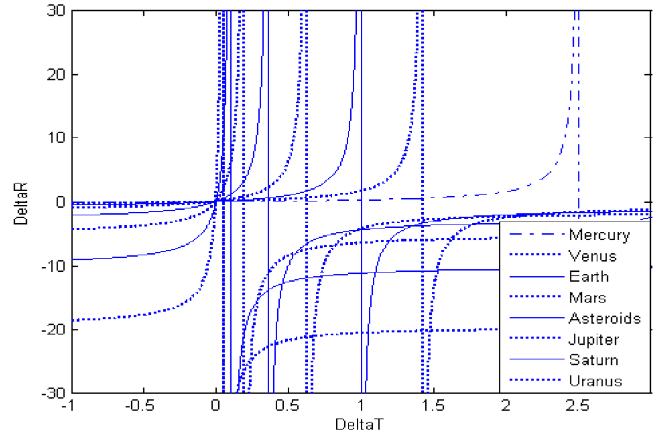

Figure A3.2. Family of curves representing the TGO plots for the indicated planets, assuming same ξ coefficients.

For the plots on Fig. A3.3, every planet's TGO qualitative analysis was done relative to its nominal trajectory, that is its average distance from the Sun, and their related effective temperatures. Fig. A3.4 represents the situation in which the TGO curves are given with explicitly imposing the relative distances as per the Titus-Bode rule, while not introducing differences in the planets effective temperatures.

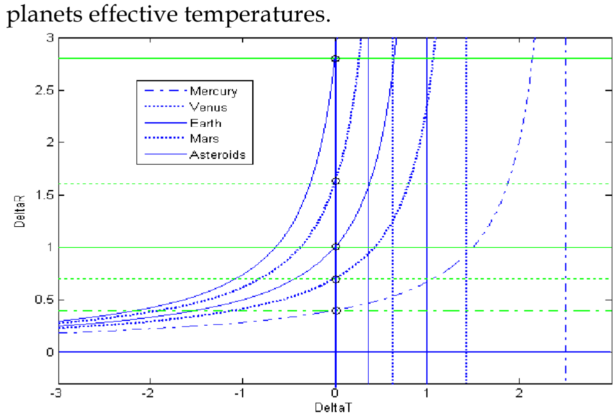

Figure A3.3. Same as Fig. A3.2, only for the first three planets and with lifted-up curves by their average distances.

Let us see how the TGO curves would look like if we explicitly impose the relative distances as per the Titus-Bode rule, while not introducing differences as to the planets effective temperatures. Fig. A3.3 represents such a situation. With such modification, the curve plots then become asymmetrical around the respective vertical asymptotes, as illustrated in Fig. A3.4.

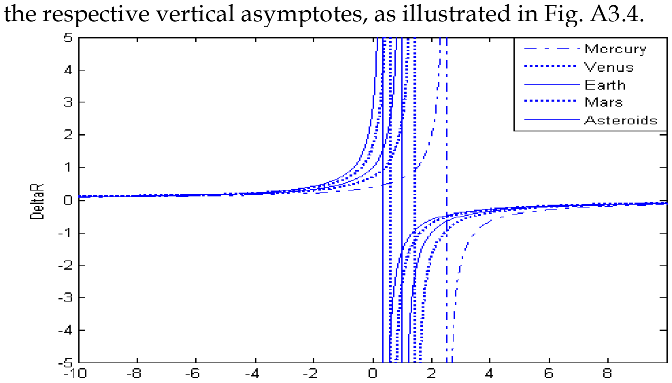

Figure A3.4. Asymmetry of TGO plots after their lifting by planets' actual (approximate) separation from the Sun.

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[6] For example, by hypothetically flooding the Earths surface by the layer of lava material taken out of its core …

[7] With exclusion of Neptune and Pluto, and inclusion of the Asteroids belt for n=3.

[8] The planets temperatures, with exception of Mars, decrease with their distance form the Sun; on the effective energy counteracting the gravitational (cosmic microwave) background radiation have influence also the presence and characteristics of their atmosphere, so that the specific heat capacity (multiplied by the planet mass) might still need correctional factors regarding its role in the TGO equation and the related planetary dynamics. The ratio of the highest and lowest value of planetary specific temperatures is about 10.

The following continues with the quasi-static qualitative analysis of the TGO equation, but now look at the temperatures and radii increments within the planets' trajectories (not restricting them to just relatively short segments around the small circles indicated on the curves in the Fig. A2.3, but considering the distance and temperature increments between the shortest and the largest separations form the Sun, and considering the vertical asymptote as a barrier to enter the 'corridor' of the next planetary orbit, which had to be overcome). Towards that end, starting with the first planet (Mercury), introduce the following designations: $\Delta T_{0k} = T_{1k} - T_{0k}$ and $\Delta r_{0k} = r_{1k} - r_{0k}$, with the first indexes 0 and 1 used to respectively designate positions of perihelion and aphelion, and the second index k indicating the order number of planet. In the case of Mercury, $\Delta T_{01} = T_{11} - T_{01}$ and $\Delta r_{01} = r_{11} - r_{01}$. The TGO equation as a result of independent integration along temperature and distance variables is:

$$\Delta r_{01} = r_{01}\left[1/(1 - r_{01}G \cdot \Delta T_{01}) - 1\right] \quad , \qquad \text{(A3.5)}$$

with the vertical asymptote at $\Delta T_{01} = 1/(r_{01} \cdot G)$, produced from equating the denominator in (A3.5) with zero.

If as the closest separation for the following 'planetary corridor' is taken (approximately, while 'theoretically', based on the TGO curve, it is infinite) [9] $r_{02} = r_{01} + \Delta r_{01}(\Delta T_{01}/2)$, one gets

$$r_{02} = r_{01} + r_{01}\left[(1 - r_{01}G/2 \cdot r_{01}G)^{-1} - 1\right] = 2 \cdot r_{01} . \qquad \text{(A3.6)}$$

The second TGO equation now becomes

$$\Delta r_{02} = r_{02}\left[(1 - r_{02}G \cdot \Delta T_{02})^{-1} - 1\right] \quad , \qquad \text{(A3.7)}$$

and its vertical asymptote is at

$$\Delta T_{02} = 1/r_{02} \cdot G = 1/2 \cdot r_{01} \cdot G \quad ; \qquad \text{(A3.8)}$$

that is,

$$\Delta T_{02} = \tfrac{1}{2}\Delta T_{01} \quad . \qquad \text{(A3.9)}$$

This means that the temperature increment needed to take the planet out of the second corridor is half that the one for the first corridor, whereas the corresponding increment of distance (again at the half of the related temperature increment) is

$$\begin{aligned}\Delta r_{02}\left(\Delta T_{02}/2\right) &= r_{02} \cdot \left[(1 - r_{02}G \cdot \Delta T_{02}/2)^{-1} - 1\right] = \\ 2 \cdot r_{01} \cdot \left[(1 - 2 \cdot r_{01}G \cdot \Delta T_{01}/4)^{-1} - 1\right] &= 4 \cdot r_{01} = 2^2 \cdot r_{01} \quad ,\end{aligned} \qquad \text{(A3.10)}$$

while the smallest separation of the next, third corridor becomes

$$r_{03} = r_{02} + \Delta r_{02}(\Delta T_{02}/2) = (2 + 2^2) \cdot r_{01} \quad . \qquad \text{(A3.11)}$$

The average distances of the planetary orbits would then depend on deliberately selected temperature increments that correspond to the maximal separation of the 'outer' orbit, and they would likely have mutual ratios given by powers of 2. (All this is conditioned on assumptions and lacks exactness, though. A formal replacement of 1 by the ratio $2^n/2^n$ with allowance for a planets aphelion position to coincide with the next outer planet's perihelion, initially conducted in the context of work in [4], a related document to be found at [22], reveals a very compelling relationship among the corresponding true average planetary radii, even predicting the presence of the two distinctive asteroids belts in the range of distances related to the actual ones.)

[9] Approximately, while 'theoretically', based on the TGO curve, it would be infinite …

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Force-Based Gravity, **Continued from p. 52**

Newtonian Gravity Modified: Force-Based Gravity

The simplest gravitational situation is a large mass, M, essentially fixed, attracting a small mass, m. The Newtonian gravitational force is given by $F = -GMm / r^2$. The work done by the gravitational force in moving m from faraway to r is the integral of the force over the distance. This gravitational work is given by $W = GMm / r$.

Just as the time derivative of the Newtonian momentum $\mathbf{P}$ yields the Newtonian force of acceleration, or inertial force, so, also, the space derivative of the Newtonian gravitational work W yields the Newtonian gravitational force. Newtonian momentum is increased by including the mass of the energy expended by the inertial force in accelerating a mass to some velocity, v. Analogously, Newtonian gravitational work is increased by including the mass of the energy expended in moving a mass by gravitational force to some distance, r, away from M. That is, there is the work on the mass, m, itself, plus the work on the mass associated with this work. The modification of gravitational work analogous to the modification of Newtonian momentum is given by $W = GMm / r + GM(W / c^2) / r$. The gravitational force and work are:

$$F = -GMm / r^2 - GM(W / c^2) / r^2 + (GM / r)d(W / c^2) / dr$$

& $$W = (GMm / r)\big/(1 - GM / rc^2) = mc^2\left[1\big/(1 - GM / rc^2) - 1\right] .$$

The W resembles the inertial work. The term $(1 - GM / rc^2)$ is analogous to the contraction factor $\sqrt{1 - v^2 / c^2}$ of SRT. So the gravitational mass of m is increased by the factor $1\big/(1 - GM / rc^2)$.

Equations for F and W can be used to find an equation for the differential of W, $dW = Fdr$. The result is,

$$dW = -\left[(GMm / r^2)\big/(1 - GM / rc^2)\right]dr + (GM / r)d(W / c^2)$$

The $dr\big/(1 - GM / rc^2)$ here is analogous to the $dt\sqrt{1 - v^2 / c^2}$ from SRT. The $\sqrt{1 - v^2 / c^2}$ enhances the mass in the rest frame and dilates the time in the moving frame. In force-based gravity, $(1 - GM / rc^2)$ enhances the mass for far spacetime and contracts the length for near spacetime,. This contraction of length is expressed as $dr' = dr\big/(1 - GM / rc^2)$. At radius r, the length of a 1-meter stick held radial is $(1 - GM / rc^2)$ as compared to a meter stick far away from M. The time for light to traverse the nearby meter stick is $dt' = dt(1 - GM / rc^2)$, where dt far away from M is $1 / c$. So the clock at $\mathbf{r}$ is slow compared to the far-away clock.

The various experimental checks that support GRT can also be shown to support a force-based gravity. One exception is the perihelion precession of Mercury, which, according to force-based gravity, results in a precession that is 5/6 of the measured value and the GRT value. The trouble is that the analogy between modified Newtonian dynamics and force-based gravity is not quite as straightforward as presented here. Although Newtonian dynamics does not involve gravitational work, a force-based gravity does involve inertial work. The effect of inertial work needs to be included for the freely falling mass, m. The last term on the right of the expression for force, F, given above, needs to be doubled to account for the enhanced mass due to inertial work (motional mass increase). The resulting force expression can be used to find the total gravitational work by integrating this further modified force over the radial distance traveled by m. The result is: $W(r) = mc^2[1\big/\sqrt{1 - 2GM / rc^2} - 1]$.

The gravitational contraction factor now becomes $\sqrt{1 - 2GM / rc^2}$, replacing the factor $(1 - GM / rc^2)$. When this adjusted factor is used to calculate precession, agreement with the measured value results. If Newtonian gravity were modified only with the effects of SRT, the perihelion precession would be 1/6 of the measured value [6]. This agrees with the above discussion.

In the case of gravitational redshift, the factor $\sqrt{1 - 2GM / rc^2}$ is the same as GRT. That is, the frequency of light received faraway from M is redshifted an amount given by $\nu = \nu_0\sqrt{1 - 2GM / rc^2}$, [6], p. 222. To first order, $\nu = \nu_0(1 - GM / rc^2)$, which is as accurate as measurement allows.

When $2GM / rc^2$ is small, as it is when r is large, $W(r)$ reduces to the Newtonian work, GMm / r. This work is the counterpart of the Newtonian inertial work given by $mv^2 / 2$. The $W(v)$ and the $W(r)$ are the relativistic versions of Newtonian dynamical work and Newtonian gravitational work. Inertial work is usually called kinetic energy, and gravitational work could be called 'gravitic' energy. Spacetime change is determined by v when inertial force acts, and by r when gravitational force acts.

The physics here is subtle, which probably explains why it has been missed all these years.

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