GALILEAN ELECTRODYNAMICS

Experience, Reason, and Simplicity Above Authority
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From the Editor's File of Important Letters:

Atmospheric Muons: SRT Confirmation?

One of the long-standing 'proofs' of Einstein's Special Relativity Theory (SRT) is the presumed time dilation effect that muons created during cosmic ray collisions with particles in our upper atmosphere experience as they plummet downward at near light speed c. Given the assumption that all are created at one high altitude, relativists see only a 'slowing' of their 'clocks' as the means by which their decay can be sufficiently delayed so that an unexpectedly (according to classical physics) large number reach sea level. One of the earliest experiments allegedly demonstrating this was by Frisch and Smith in 1963. Dissident physicists have offered non-relativistic explanations for the relatively high numbers of atmospheric muons reaching sea level, including the possibility that they are created by cosmic ray collisions with particles throughout our atmosphere, not just at a single altitude. The plausibility of this argument is examined here as an alternative explanation to relativistic time dilation as the only acceptable answer offered by mainstream physics today.

It is commonly assumed that atmospheric muons are created only in the upper atmosphere, at an altitude of ~ 15 km [1], where cosmic rays collide with particles. If created only at these altitudes, and given their half-life of only 2.2 μs, half should decay every $(2.2\times10^{-6}\,\mathrm{s})\times(3\times10^{8}\ \mathrm{m/s})$ = 660 m if they are traveling at near light speed c. This would leave only $1/2^{15000/660} \approx 1/2^{23} \approx 10^{-7}$ (one ten-millionth) reaching sea level. Experiments such as that by Frisch and Smith in 1963 indicated that the number of muons reaching near sea level is much greater than would be expected from these standard assumptions, prompting them, and successive physicists, to conclude that the muon half-lives were significantly lengthened due to their near-c speeds as postulated by Einstein's relativity theories. See [2] In fact, they measured a decrease from an altitude of ~ 2 km down to sea level of only 151 out of 563 muons, or $\sim 27\%$. Even over this relatively short distance, a 2.2-μs half-life would suggest a decrease by $1-1/2^{2000/660} \approx 1-1/2^{3} \approx 88\%$. Therefore, they concluded that relativistic time dilation had 'slowed' the internal decay 'clocks' of the muons, by an average factor of ~ 8.4.

Dissident physicists have considered possible non-relativistic explanations for observed results, typically being dismissed by relativists by patching up 'The Standard Model' with fictions such as Dark Matter/Energy, Big Bang Inflation, *etc*. Specifically related to atmospheric muons is the discussion from [3]: "[W]hy are we adamant that we know everything about the muon and controlled all the factors which could affect its speed and life span? Relativists propose time dilation as if our knowledge about the life span and the speed of muons is perfect and absolute. Under certain conditions (gravity, energy state, environment, *etc*.) why not a muon [that can] travel faster or live longer before it decays into the smaller particles." Muon's time dilation is only a calculated/predicted effect from the mathematics of relativity and hence can't be accepted as a proof of relativity. Muon's time dilation is what we would propose in the given scenario if the theory of relativity is correct. Relativists resort to circular logic here; *i.e.*, they believe that relativity is true, so they imagine time dilation as really happening for the muons and then they claim their imagination of time dilation as proof of relativity — they keep going in circles in every scenario that they claim proves SRT. **(Continued on p. 16)**

A Unified Definition for all Basic Forces in Nature

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This paper considers that our cognizable Nature (including the whole Universe) is scale-specifically quantized, including all its observers like us; and if there exists even any non-quantized part that will be beyond ours' quantized cognizance. The quantized part of Nature comprises various scales of particles or systems from conceptual micro- most to the whole universe itself as macro-most. Each of those scales, in inertial states, can be defined by a common inverse equation as an outcome of two inverse sets of total 10 common internal parameters (CIPs) with all scale-specific quantized magnitudes. However, inverse relationship between scale specific quantized inertial-motion and inertial-mass-energy among all those 10 CIPs appears most connotative in present context. The paper also considers, any scales of Astronomical Objects (AOs) from micro- most to macro-most are as if particles or systems due to corresponding scale-specific mass-energies resultant with all scale-specific gravitational-escape-velocities. Consequently the gravitation of any gravitating-bodies (including all AOs), defines by General Relativity Theory, as space-time curvature (i) appears scale-specifically curved and (ii) enfolds a corresponding mass-energy, which is nothing but a scale-specific sum of all inescapable homogeneous smallest bound particles.

Each of such homogeneous smallest bound particles in respective gravitating-body has to be any kind of gauge-fields out of any fermions or bosons in Standard Model of Particle Physics (SMPP). Therefore, any scale of gravitating-bodies will be nothing but a scale-specific sum of all homogeneous smallest bound gauge-fields wrapped by corresponding curved space-time. Ultimately, in all those scales of gravitating bodies, the scale-specific gravitation as defined in above paragraph appears equal to any gauge-forces in SMPP. Not only that, the same equality can also be extended beyond all scales of visible matter up to the dark matter and dark energies in all gravitating bodies. As a consequence' there will be a common unified non-inertial equation for all scales of gravitating-bodies in our cognizable Nature. Additionally, that unified equation also indicates to have a mutual mirror imaged counterpart and both always co-exist in a pair. This could resolve many inconsistencies like E-P-R paradox, asymmetries in observable amounts of particles over antiparticles, and so on in current physics. "

Key Words: Quantize-gravitation, Gravity-equivalent-gauge-fields, unified-equation, unification-of-physics.

1. Introduction

Our cognizable Nature, as per present understanding in physics, at its most fundamental levels conceptually unfolds to us as quantized. Because, there, both observers like us (who are intrinsically limited to see anything beyond quantum exchange of messages), and observables (*i.e.* the surroundings with a capability to respond through such quantum messaging) basically appear to be made with only a quantized type of materials and logic. As a result, if there is anything outside of such quantized realm, it will be intangible (to us) in terms of its existence as well as its pattern of logic.

Hence, in the tangible quantized part of Nature, every cognizable event or material bodies (including observers) appear to follow a quantize model of logic which accommodates all scales of particles or systems. Every such particles or systems have specific scales conceptually starting from a micro-most to a macro-most. Then whole Big-Bang/Big-Crunch cyclic oscillating Universe can be considered as the macro-most scale [1], which consists of all other particles or systems along with that cyclic oscillation. But on the contrary, any precise contender for a micro most scale is not yet precisely recognized. Obviously, that will not be a boson with all its smallest possible quantized mass-energies, because there is still a vast portion in the quantized part of Nature, that does not communicates through such bosons. Then dark matters needs further smaller scales of such particles. And although it is not yet precisely known about Quintessence in domain of dark energy but conceptually would be smaller than a boson.

In Sect. 2, there are mathematical formulations related to a common expression for all scales of particles or systems of that quantized part of Nature beside defining the Einsteinian Field Equations (EFEs) of General Theory of Relativity (GRT) for gravitation in all scale specific ways. The Sect. 3 shows the equality between that such scale- specific gravitational force from EFEs and Gauge Fields of Forces (GFFs) in Standard Model of Particle Physics (SMPP) in all scales of gravitating bodies (GBs). Sect. 4 is the consequences of the previous Section, which ultimately defines a non-inertial unified mirror-imaged pair expressions for all possible scales of particles or systems in Nature including all recognized (and even yet to be recognized GFFs) with gravitation. In Sect. 5, there are some inferences on the basis of above sections to explain some of phenomena like the E-P-R paradox, reason for observed matter and anti-matter asymmetries; and the Sect. 6 is the Conclusion.

2. Scale-Specific Mathematical Formulations for Nature

Basically, in this Section we mathematically formulate the above-quantized part of Nature, first through a common expression for all scales of particles or systems in their inertial states; and in next Section, and then the conventional EFEs [2] of gravitation in GRT in scale specific ways, irrespective of particles or systems.

2.1. Common Inertial Expression of all Particles or Systems in Nature:

All those micro to macro scales of particles or systems are irrespective of their scales have intrinsically discrete or quantized scale specific magnitudes due to the scale columns have 0.25″ space between specific discrete or quantized magnitudes of total ten common internal parameters (CIPs) which configure each of those same particles or systems [1]. Moreover, all those total 10 CIPs are grouped in two inverse but mutually mirror-imaged sets *e.g.* (1-inertial mass-energy + 3-space + 1-time) and (1-inertial-motion + 3-anti-space + 1-anti-time) [3], where each of CIPs can be considered as specific dimension of the particles or systems. That is, the quantized Nature is unfolded with total 10 (5+5) inversely related dimensions to us.

For convenience, we can symbolize each of the unfolded 10 dimensions with intrinsic scale specific quantized magnitudes as 1 for mass-energy (Δm), 3 for space (Δs), 1 for time (Δt), 1 for inertial-motion (Δv), 1 for anti-space (Δt_{u}), and 3 for anti-space (Δs_{u}) where the radius (Δr) and anti-radius (Δr_{u}) of corresponding Δs and Δs_{u} are also considered scale specifically quantized; and postulated $\Delta r_{\mathrm{u}} = \Delta\lambda$ is respective de Broglie wavelength for each scale of particles or systems [1].

Each of those 10 (5+5) CIPs, as dimensions are possessed their all intrinsic scale specific magnitudes respect to any specific scale of particles or systems. Therefore, each of those scale specific magnitudes of 10 CIPs will be an observer-independent constant magnitude irrespective of an observer's position in the Nature. But the magnitude of such constant will be automatically changed if the scales of such particles or systems will change. Therefore, every such observer independent constants will be universal but in their scale specific ways; as a result we can say such constants as scale specific universal constants (SSUCs).

In addition, all those same 10 (5+5) CIPs as SSUCs are inversely related in two sets; then, there will emerge some inverse proportionality from such SSUCs irrespective of scales of the particles or systems in Nature. Those inverse proportionality constants will also be the 'observer independent' constants as like as SSUCs, but will also remain unchanged with change in scales of the particles or systems; as a result we can define them simply as universal constants (UCs) irrespective of scales. Those UCs will be *e.g.* for $K_1 = \Delta m\ \Delta\lambda$ from conventional de Broglie's equation $h / c = m\lambda = K_1$ where h is Planck's constant and c is inertial speed of light. From the same, due to considerations of scale- specific quantization of inertial motions Δv for all particles or systems there will be another inverse relationship [1] as

$$K_2 = \Delta m\ \Delta v \tag{1}$$

beside other UCs from similar inverse relationships *e.g.* $K_3 = \Delta r\ \Delta\lambda$, $K_4 = \Delta s\ \Delta s_u$, $K_5 = \Delta t\ \Delta t_u$, $K_6 = \Delta r\ \Delta v$; and finally there will be a universal relationship [2] for all 10 (5+5) CIPs as

$$K = K_2\ K_4\ K_5 = (\Delta m\ \Delta s\ \Delta t) \cdot (\Delta v\ \Delta s_u\ \Delta t_u) \quad , \tag{2}$$

and where corresponding CIPs considered [1] as $\Delta s = \frac{3}{4}\pi\Delta r^3$, $\Delta t = 2\pi\Delta r$, $\Delta s_{\mathrm{u}} = \frac{3}{4}\pi\Delta\lambda^3$, and $\Delta t_u = (2\pi\ \Delta\lambda)$. As a result, among all those UCs, the K can be considered as an ultimate UC and Eq. (2) as a Common Unified Expression [3] in inertial states for all micro to macro scales of particles or systems in quantize Nature.

As a consequence, the c in Eq. (1), considered in Special Relativity Theory (SRT) as the only 'observer independent' constant inertial motion, merely appears as one of SSUCs say $c = \Delta v_c$ for a specific scale of photons only on the Electromagnetic Spectrum. Therefore, the conventional set of all equations in SRT respect to that $c = \Delta v_c$ will be scale-specific or local. Then, there will be all similar scale specific or local sets of SRT equations with respect to all such scale specific magnitudes of Δv in Eq. (1); and finally all such scale-specific local SRT equations can be universalized by introducing of $K_2 / \Delta m$ in Eq. (1) in place of $\Delta v_c = c$ in the same scale-specific local sets of SRT equations [3].

Therefore, in such a universalized set of SRT equations through $K_2 / \Delta m$ in Eq. (1) in places of $\Delta v_c = c$, there will be the possibilities of superluminal quantized inertial motions with $\Delta v > \Delta v_c = c$ (but with non-negative magnitudes of time) correspond to some scales of particles which have lower scale specific magnitudes of quantized $\Delta m < \Delta m_c$ compare to inertial mass-energies $K_2 / \Delta m_c$ of the photons with $\Delta v_c = c$.

2.2 Scale-Specific Formulation of Gravitation for Particles or Systems:

Besides the considerations of conceptual inertial states for all those micro to macro scales of particles or systems and inverse relations of corresponding CIPs, there are also non- inertial or fundamental forces that are experienced by the same particles or systems in quantized part of Nature. Those fundamental forces fabricate all 'intra' and 'inter' structures in irrespective of particles or systems. Then, the issue is whether those fundamental forces are quantized and unified. The electromagnetic, weak and strong fields of forces already appeared as respective GFFs in SMPP in relevance of quantized matter. But gravitation defined by EFEs in GRT as the curved spacetime that enfolds that quantized matter. This Sub-section will try to mathematically reformulate the EFEs in GRT on the basis of Eqs. (1 & 2) in scale-specific ways; where such EFEs in GRT [2] basically reveal:

i) a direct proportionality relationship between the amount of curvatures of spacetime and the amount of total mass-energies with the respective GBs;

ii) an equilibrium between an inward pressure of curvature or collapse of that spacetime and outward counter forces of total matters in respective GBs; and

iii) a non scale-specific considerations of the curved spacetime and total matters associated with the respective GBs.

2.2.1. Scales of Gravitationally-Shaped-Bodies (GSBs):

Although all micro or macro scales of GBs are experienced by gravitation, but in domain of all 'visible matters', conventionally it appears dominating over all other three GFFs from a scale of mass- energies $> 10^{12} >$ kg correspond to a typical planetesimal with radius $\Delta r = 1\,\text{km}$. Therefore, a planetesimal, being the smallest scale of GSBs, shapes itself by its dominating gravitational force over all other three GFFs. Starting from that one smallest scale of GSBs, there are all incremented bigger mass-energies oriented scales of GSBs like different magnitudes of planetary objects, from the scales of rocky planets to gas giants, from brown dwarfs to sub-solar objects, from a solar-star to massive giant stars, from a binary system of stars to the huge constellations of stars, from a galaxy to the clusters of galaxies, from a super cluster of galaxies to the filaments, from filaments and huge voids to the whole universe.

Hence, in macro levels as well, all those GSBs are also composed of different scales of micro GBs. Moreover, conceptually each of those GSBs always as any definite sums of quantized mass-energies of its comprising micro GBs or quantized particles or systems which are possessed scale specific magnitudes of above (5+5) 10 numbers of mirror imaged CIPs.

2.2.2. Scale-specific Homogeneity of Smallest Bound Particles in GSBs:

The different scales of GSBs, starting from a planetesimal to the whole Universe, there are different scale specific magnitudes of mass-energies as like as Δm in all scales of GBs. However, for conveniences, we use ΔM in places of Δm for scale-specific quantized magnitudes of ΔM for any GSBs only. However, due to different scale specific magnitudes of ΔM of GSBs, there will be also the corresponding scale-specific magnitudes of escape-velocities, say Δv_{e}. Therefore, say the $\Delta v_{\text{e-1}}$ ($< \Delta v_{\text{e}}$) will be the highest quantized motion (but with inversely smallest mass-energy) of any gravitationally bound particle that just missed to escape out through the corresponding gravitational field strength (GFS) of respective ΔM. Then from Eq. (1) we have:

$$\Delta v_{\text{e-1}} = K_2 / \Delta m_{\text{e}-1} \quad , \tag{3}$$

where $\Delta m_{\text{e}-1}$ will be the smallest bound integer unit of any un-escaped mass-energy in the corresponding scale of GSB; and from which we also imagine the same GSB as if a homogeneous fluid which is equal to a corresponding scale-specific integer (say Δn) sum (say $\Delta q_{\text{e}-1}$) of all $\Delta m_{\text{e}-1}$ in Eq. (1)

$$\Delta M_{\text{e}-1} = \Delta n \cdot \Delta m_{\text{e}-1} = \Delta (n \cdot m)_{\text{e}-1} = \Delta q_{\text{e}-1} \quad . \tag{4}$$

If magnitudes of $\Delta M_{\text{e}-1}$ and $\Delta m_{\text{e}-1}$ are changed, *i.e.*, due to change in specific change in scale of the GSBs, then automatically the respective magnitude of Δn will also change into another scale-specific integer quantity.

The Eq. (3) also depicts that every $\Delta v_{\text{e}-1}$, for corresponding homogeneous mass- energies of $\Delta M_{\text{e}-1}$ for any scale specific of GSBs equal to ($\Delta n \cdot \Delta m_{\text{e}-1}$) in Eq. (4) must converge at the center of mass for the same GSBs. Then, same scales of GSBs will also have equal scale-specific convergence, or curved spacetime; say:

$$\Delta p_{\text{e}-1} = \Delta s \, \Delta t = (\tfrac{3}{2}\pi^2 K_6^4 \big/ K_2^4) \quad , \quad \Delta M_{\text{e}-1}^4 = \in \Delta q_{\text{e}-1}^4 \quad , \tag{5}$$

where K_6 & K_2 are as mentioned above are UCs, and the $\in$ is a proportionality constant.

2.2.3 Scale-specific Gravitational Field Equations:

Within event horizon of a black hole, conventionally, there is respective escape velocity $\Delta v_{\text{e}} > c$; and obviously there $c = \Delta v_{\text{e}-1} < \Delta v_{\text{e}}$ in Eq. (3). Therefore, the EFEs [2] in GRT respect to the equal or lower magnitudes of $\Delta v_{\text{e}-1} = c$ would be a local equation, as the c is nothing but a SSUC correspond to a specific scale of photons as we mentioned in above [§2.1]. Therefore, the same EFEs can be generalized [3] for all GSBs irrespective of scales in Eq. (5)

$$\begin{gathered}\Delta\, p_{\text{e=1}} = \left(R_{\mu\nu} - \tfrac{1}{2} R g_{\mu\nu} + \text{g}_{\mu\nu}\Lambda \right) = (8\pi G / c^4)\, T_{\mu\nu} = \\ \left(8\pi G \big/ K_2^4 \right) \Delta m_{e-1}^4 T_{\mu\nu} = \left(\tfrac{3}{2}\pi^2 K_6^4 \big/ K_2^4 \right) \Delta (n \cdot m)_{\text{e}-1}^4 = \in \Delta q_{\text{e}-1}^4 \ .\end{gathered} \tag{6}$$

where the total stress-energy tensor or stress-energy-momentum tensor $T_{\mu\nu} = \Delta M_{\text{e}-1}$, and 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, the Λ is cosmological constant, c is inertial speed of light [2]. If the Einstein tensor in Eq. (6) is

$$G_{\mu\nu} = R_{\mu\nu} - \tfrac{1}{2} R g_{\mu\nu} \quad , \tag{7}$$

as a symmetric second-rank tensor which is a function of the metric, subsequently Eq. (6) will become:

$$\begin{aligned}\Delta\, p_{\text{e}-1} &= (G_{\mu\nu} + g_{\mu\nu}\Lambda)_{\text{e}-1} = (8\pi G / K_2^4).\, (T_{\mu\nu})_{\text{e-1}} \Delta m_{\text{e}-1}^4 \\ &= \in \cdot \Delta (n \cdot m)_{\text{e}-1}^4 = \in \cdot \Delta q_{\text{e}-1}^4 \quad ,\end{aligned} \tag{8}$$

for all scales of GSBs [3] due to scale-specific quantized convergence of $\Delta p_{\text{e}-1}$ and corresponding homogeneity of all smallest bound particles $\Delta q_{\text{e}-1}$. Then Eq. (8) can also be regarded as scale-specific quantized version of EFEs in GRT irrespective of any scale-specific magnitudes of $\Delta v_{\text{e-1}} < c$, $\Delta v_{\text{e}-1} = c$, and $\Delta v_{\text{e-1}} > c$ compare to merely $c = \Delta v_{\text{e}-1} < \Delta v_{\text{e}}$ in Eq. (3) for EFEs in GRT. Then such scale specific EFEs in Eq. (8) reveals gravitation [3]:

i) the curvature of spacetime proportional to the corresponding mass-energies of GSBs (or GBs) in all scale-specific ways;

ii) every GSBs (or GBs) are an equilibrium between an inward amount of curvature (collapse force) of spacetime and outward counter forces generated by its total amount of mass-energies (GFFs) in scale-specific ways; and finally

iii) each of same GSBs (or GBs) with scale-specific quantized mass-energies can define as corresponding integer sum of all homogeneous and gravitationally bound smallest particles within that scale-specific curved spacetime.

2.2.4 Emergence of Scale-Specific Quantized

Anti-Gravitational Force:

Therefore, every scales of particles or systems or GBs or GSBs are possess quantized inverse (5+5) 10- CIPs; and in Eq. (2), all the CIPs *e.g.* Δs, Δt & Δm in left-hand set are related to the gravitational force in Eq.(8).

Then, for all mirror-imaged right-handed CIPs, *e.g.* Δs_{u}, Δt_{u} & Δv in same scales of GSBs, there will be another simultaneous right-handed Field Equation [3] from Eq. (2)

$$\begin{gathered}(\Delta p_{\mathrm{u}})_{\mathrm{e}-1} = \frac{3}{2}\pi^2 \Delta\lambda^4 = \\ \frac{3}{2}\pi^2 (K_1^4 / K_2^4)[\Delta(v/n)_{\mathrm{e}-1}^4] = \in_{\mathrm{u}} (\Delta q_{\mathrm{u}})_{\mathrm{e}-1}^4 \quad ,\end{gathered} \tag{9}$$

where the $(\Delta p_{\mathrm{u}})_{\mathrm{e}-1}$ and $(\Delta q_{\mathrm{u}})_{\mathrm{e}-1}^4$ are the right handed convergence of anti-spacetime and homogeneity of captive particles' with highest quantized inertial motion respectively; and $\in_{\mathrm{u}}$ is simultaneous mirror-imaged proportionality constant irrespective of scales for same GSBs. Then Eq.(9) is a simultaneous right-handed or Mirror-imaged Field Equation of Eq. (8) for same GSBs in Eq.(2) for Δs_{u}, Δt_{u} & Δv. Therefore, the Eq. (9) can also be writen as simultaneous mirror-image or right-handed gravitation compare to conventional left-handed gravitation in Eq. (8) or mutual *vice versa* in every scales of GSBs in Eq.(2). Then, for convenience, that mirror-imaged or right-handed gravitation in Eq. (9) can be termed as the Anti-gravitation with all simultaneous scale-specific magnitudes for every scales of GSBs or GBs [3] in Nature.

2.2.5 A Common Gravitational & Anti-gravitational Definition of all GSBs: The Eq.(2) will be, due to co-existence of simultaneous Mirror-imaged Left-handed Gravitation in Eq. (8) related to CIPs *e.g.* Δs, Δt & Δm and Right-handed Anti-gravitation in Eq. (9) for CIPs *e.g.* Δs_{u}, Δt_{u} & Δv, there will be ultimately the

$$\left[\Delta p_{\mathrm{e}-1} = \in \cdot \Delta q_{\mathrm{e}-1}^4\right] = K \Big/ \left[(\Delta p_{\mathrm{u}})_{\mathrm{e}-1} = \in_{\mathrm{u}} (\Delta q_{\mathrm{u}})_{\mathrm{e}-1}^4\right] \quad , \tag{10}$$

and Eq.(10) could be considered as the non-inertial definition for all scales of GSBs (or GBs) in Nature compare to inertial definition for the same in Eq. (2). The Eq. (10) also depicts that every scales of GSBs (or GBs) are nothing but the inverse symmetry of simultaneous scale-specific gravitational and anti-gravitational forces [3].

3. Scale-Specific Equality of Curved Spacetime with Sum of Homogeneous Gauge-fields

In Eq. (8), the $\Delta p_{\mathrm{e}-1} = (G_{\mu\nu} + g_{\mu\nu}\Lambda)_{\mathrm{e}-1}$ as corresponding scale-specific magnitudes of curved spacetime is equivalent to the relevant total scale-specific mass-energies $\Delta M_{\mathrm{e}-1} = (T_{\mu\nu})_{e-1}$ of the GSBs with respective $\Delta v_{\mathrm{e}-1}$ in Eq. (3). Consequently, the $(T_{\mu\nu})_{\mathrm{e}-1}$ in Eq.(8) will be equal to a scale-specific integer amount of (Δn^4 . $\Delta m_{\mathrm{e}-1}$). Therefore, in domains of visible matters in Nature, the $\Delta m_{\mathrm{e}-1}$ will be any of fermions or bosons in GFFs in SMPP [4]. Then proceeding section will imply possible impacts of such $\Delta m_{\mathrm{e}-1} \equiv$ GFFs in Eq. (8) in visible matters domain of the Universe.

3.1. Gravitational Crushing of Smallest Bound Particles in Different Scales of Visible Matter GSBs

Astrophysically, it is now realized that, when gravitational forces dominate over GFFs in heavier (scales of) GSBs, the corresponding $\Delta m_{\mathrm{e}-1}$ in Eq. (3) & Eq.(8) in one heavier scale of GSB also crush into further smaller scales of $\Delta m_{\mathrm{e}-1}$ for corresponding much heavier scales of GSBs. In domain of visible matter in very heavier scales of GSBs, it often occurs that, through scale specific incremented gravitational crushing of corresponding $\Delta m_{\mathrm{e}-1}$ = the heavier fermions could ultimately turned into lighter fermions and/or heavier bosons. Then next, one $\Delta m_{\mathrm{e}-1}$ = one heavier boson crushed into lighter one up to $\Delta m_{\mathrm{e}-1}$ = a photon of radio wave with longest possible wavelength (with lightest mass-energy among visible matters).

Then, in different heavier scales of GSBs in visible matters, through all such gradual smaller and smaller scale-specific crushing of respective $\Delta m_{\mathrm{e}-1} \equiv$ any Quantum Field among GFFs is the steady unlacing onward respective Super-symmetric Gauge Unifications of GFFs of SMPP [4], *e.g.* from one heavier scale of fermion fields to a lighter scale gluon fields = SU(3); then gluon fields to electroweak & Higgs Boson fields = SU(2); and ultimately to the scales of Higgs boson & photon fields = U(1) (up to a possible lightest radio wave photon on electromagnetic spectrum) say

$$\Delta m_{\mathrm{e}-1} \equiv \mathrm{SU}(3) \times \mathrm{SU}(2) \times \mathrm{U}(1) \quad . \tag{11}$$

3.2. Curved Spacetime Equivalence of Homogeneous Gauge Fields in GSBs of Visible Matter GSBs

As we have different range of scales of GSBs for visible matters from a planetesimal to whole universe, conceptually there will have different range of observers as well capable of receiving or non- receiving of the corresponding magnitudes of Δv_{e} [$> \Delta v_{\mathrm{e}-1}$ in Eq. (3)]. From Eq. (1), we can consider that even an observer will have the capacity to receive any signal $\Delta v = \Delta v_{\mathrm{e}} > c$, then a black hole with $\Delta v_{\mathrm{e}-1} = c$ in Eq. (3) will no longer be a black hole to him. The same phenomenon can be possible in all other heavier scales of GSBs beyond a black hole with $\Delta v_{\mathrm{e}-1} = c$ in Eq. (3) in cases of corresponding observers with more and more capability of receiving higher magnitudes of $\Delta v = \Delta v_{\mathrm{e}}$ in Eq. (1).

In Eqs. (5 & 8) there will be all scale-specific magnitudes of $\Delta M_{\mathrm{e}-1} = (T_{\mu\nu})_{\mathrm{e}-1} = (\Delta n \cdot \Delta m_{\mathrm{e}-1})^4$ for GSBs starting from a planetesimal to the whole universe. Suppose there a specific scale of visible matters GSB in Eqs. (4), (5) & (8) possesses $\Delta m_{\mathrm{e}-1}$ gluons; then

$$\Delta M_1 = \Delta(n \cdot m_{\mathrm{e}-1}) = \left[\Delta n / \Delta \mathrm{SU}(3)\right]_{\mathrm{e}-1}^4 \quad , \tag{12}$$

where $\Delta M_1 = \Delta M_{e-1}$ in Eqs. (4), (5) & (8) for SU(3) Gauge Group in the SMPP. Then, due to Eq. (12), Eq. (8) will appear as:

$$(G_{\mu\nu} + g_{\mu\nu}\Lambda)_{e\text{-}1} = \in \cdot \Delta(n \cdot m)^4_{e-1} = \in \cdot \Delta\left\{n\left[SU(3)\right]\right\}^4_{e-1}. \quad (13)$$

where the scale-specific quantized curvature of spacetime for the particular GSB in Left- hand side becomes equal to the scale-specific gluon gauge field in right-hand side.

Therefore, in Eq. (13), the whole scale-specific ΔM_1 in Eq. (12) of the GSB appears as one homogeneous SU(3) gluon field of SMPP which becomes equal to total scale- specific quantized curvature of spacetime $(G_{\mu\nu} + g_{\mu\nu}\Lambda)_{e\text{-}1}$ for scale-specific gravitation through quantized EFEs of GRT in Eq. (8). That equivalence or unification in-between scale-specific curved spacetime and SU(3) gluon Gauge Field observes in a specific scale of GSB with minimum mass-energies equal to ΔM1. The right candidate for such ΔM_1 can be an Exotic Quark Star.

Similarly in Eq. (12) for a further heavier scale of visible matters GSB, say, for a corresponding Super-symmetric Δm_{e-1} gluons ≡ electroweak bosons; then equivalent Gauge Groups for whole scale-specific mass-energies will be say

$$\Delta M_2 = \left[\Delta(n \cdot m_{e-1})\right]^4 \cong \left[\Delta n \cdot \Delta\mathrm{SU}(3) \times \mathrm{SU}(2)_{e-1}\right]^4 , \quad (14)$$

and for that ΔM_2 in Eq. (8) with equivalent scale-specific curvatures of spacetime will be

$$\left(G_{\mu\nu} + g_{\mu\nu}\Lambda\right)_{e-1} = \in \Delta(nm)^4_{e-1} = \in \Delta\left\{n\left[\mathrm{SU}(3) \times \mathrm{SU}(2)\right]\right\}^4_{e-1}. \quad (15)$$

in the specific scale of GSB. Astronomically, that scale will be an Exotic Electroweak Star or can be a specific class of Black Hole.

Again, for the respective $\Delta m_{e-1} \equiv$ photons in Eq. (3) for a particular scale of GSB with corresponding visible matters mass-energies in Eq. (12) will become:

$$\Delta M_3 = \Delta(nm)^4_{e-1} \equiv \left\{\Delta n \ \Delta\left[\mathrm{SU}(3) \times \mathrm{SU}(2) \times \mathrm{U}(1)\right]_{e-1}\right\}^4 , \quad (16)$$

when in same Eq.(8) for the corresponding equivalent curvature of spacetime will be

$$\begin{aligned}\left(G_{\mu\nu} + g_{\mu\nu}\Lambda\right)_{e-1} &= \in \Delta n^4 \ \Delta m^4_{e-1} \\ &= \in \Delta n \left[\mathrm{SU}(3) \times \mathrm{SU}(2) \times \mathrm{U}(1)\right]^4_{e-1}\end{aligned} \quad (17)$$

and such a GSB can be an Exotic Boson Star or another specific class of Black Hole; and all the variables in Eqs. (14 – 17) have their scale-specific magnitudes.

Therefore, up to a smallest scale of quantized mass-energies of Δm_{e-1}, say equal to a longest wavelength radio photon on electromagnetic spectrum in the range of visible matters definable by the SMPP, the Eq. (17) will be the unified relationship between all three non-gravitational gauge forces and scale-specific curvature of spacetime in corresponding visible-matter GSBs.

4. Consequences

Eq.(17) corresponds to visible matter GSBs but the gravitation is universal, and influences all scales of GSBs or GBs irrespective of visible matters, dark matters and dark energies. Then, if the smallest possible scale of mass-energy in domain of visible matters say Δm_{e-1} is a radio-wave photon with longest wavelength in Eq.(17), then the same equation can imagine as a critical macro scale of collapsing GSB with its $\Delta M_3 = (\Delta n \cdot \Delta m_{e-1})^4$, which can comprise a homogeneous sum of all those inescapable smallest bound mass-energy radio wave photons in domains of visible matters.

But beyond that critical scale of GSB in visible matters domain, there are still so many other heavier macro scales of GSBs up to the scale of macro most scale universe with rest of 95% invisible matters. All those also have their similar heavier gravitational collapse resulting to crush of corresponding Δme-1 into further smaller and smaller scales beyond starting from that scale of Δm_{e-1} = a radio wave photon of ΔM_3 in Eq. (17). Therefore, conceptually such a smallest radio wave photon of Δm_{e-1} can transform into a further smaller mass-energy's dark matter beyond visible matters. Because, beyond of that critical scale of ΔM3 in Eq. (17) there are still heavier scales of GSBs those can facilitate collapsing of dark matters say $\Delta M_4 > \Delta M_3$; and further there will be more heavier scales of GSBs those can make possible collapsing of even dark energies say $\Delta M_5 > \Delta M_4$ up to the macro most scale of whole universe which will have ultimately the Δm_{e-1} are dark-energy entities. In this Section, the Eq. (17) will extend from visible matters to dark matters and dark energies in the cognizable part of Nature.

4.1. Equivalent Gravitation and Gauge Fields beyond Visible Matter

In Eq. (17), if there Δm_{e-1} < smallest mass-energy for a conceptual radio photon/Boson for a scale of collapsing GSB with $\Delta M_3 < \Delta M_4$, and if there total numbers of homogeneous Gauge Groups in domains of Dark Matters is say $\mathrm{XU}(N_{DM})$, in Eq. (16)

$$\begin{aligned}\Delta M_4 &= \Delta(nm)^4_{e-1} \\ &\equiv \Delta\left\{n\left[\mathrm{SU}(3) \times \mathrm{SU}(2) \times \mathrm{U}(1) \times \mathrm{XU}(N_{DM})\right]\right\}^4_{e-1} ,\end{aligned} \quad (18)$$

where X represents yet unknown gauge groups, and N represents matrix, and DM stands for 'dark matters'. Then due to Eq. (18) we will obtain respectively from Eq. (17)

$$\begin{aligned}(\mathrm{G}_{\mu\nu} + \mathrm{g}_{\mu\nu}\Lambda)_{e-1} &= \in \Delta(nm)^4_{e\text{-}1} \\ &= \in \cdot \Delta\left\{n\left[\mathrm{SU}(3) \times \mathrm{SU}(2) \times \mathrm{U}(1) \times \mathrm{XU}(N_{DM})\right]\right\}^4_{e\text{-}1} .\end{aligned} \quad (19)$$

and Eq.(19) will be a scale-specific equality between scale-specific curvatures of space-time and Super-symmetric unified gauge fields in some heavier scales of GSBs in domains of visible matter & dark matter.

Similarly, in further heavier scales of GSBs with $\Delta M_5 > \Delta M_4$ beyond Eqs.(18 & 19), if there $\Delta m_{e-1} <$ smallest mass-energy dark matter particles for a corresponding scale of collapsing GSB with ΔM_5, then the same Δm_{e-1} would conceptually be a candidate of dark energy particles. Consequently, if we consider the total numbers of Gauge Groups in domains of that dark energies are YU(NDE), then for the same ΔM_5 in Eq. (18)

$$\Delta M_5 = \Delta(n \cdot m\ )^4_{e-1} \equiv \Delta\left\{n\left[\mathrm{SU(3)} \times \mathrm{SU(2)} \times \mathrm{U(1)} \times \mathrm{XU(N_{DM})} \times \mathrm{YU(N_{DE})}\right]\right\}^4_{e-1} \quad , \tag{20}$$

where Y represents as yet unknown gauge groups, and N represents matrix and DE for dark energies domain. Then due to Eq. (20) we obtain from Eq. (19)

$$\left(\mathrm{G}_{\mu\nu} + \mathrm{g}_{\mu\nu}\Lambda\right)_{e\text{-}1} = \in \cdot \Delta(nm)^4_{e-1} = \in \cdot \Delta\left\{n\left[\mathrm{SU(3)} \times \mathrm{SU(2)} \times \mathrm{U(1)} \times \mathrm{XU(N_{DM})} \times \mathrm{YU(N_{DE})}\right]\right\}^4_{e-1} \tag{21}$$

which will be ultimately a scale-specific equality between scale-specific curvatures of space-time and Super-symmetric unified gauge fields in heavier scales of GSBs in relations of visible matters, dark matters & dark energies. Therefore, the Eq. (21) will also be the unified relationship between scale-specific curvatures of spacetime or gravitation and all Supersymmetric gauge forces in GSBs. Also in micro scales of gravitating bodies or GBs some of relevant parameters as well as CIPs in Eq. (21) will have very very smaller or negligible values. As a result, the same Eq. (21), for those non- heavier scales of GSBs or micro scales of smaller GBs, can show the relevant conventional expressions in relation of the SMPP or GRT correspond to the domains of visible matters, dark matters and dark energies. Therefore, Eq. (21) will be a unified non-inertial definition for all fundamental natural forces; compare to the inertial definition of the same in Eq. (2).

4.2. Simultaneous Anti-Gravitation and Anti-Gauge Fields for all GSBs:

For conveniences, in brief the Eq. (20) for all gauge forces of ΔM6 with all other GSBs or GBs are in brief say

$$\Phi = \mathrm{SU(3)} \times \mathrm{SU(2)} \times \mathrm{U(1)} \times X\mathrm{U}(N_{\mathrm{DM}}) \times Y\mathrm{U}(N_{\mathrm{DE}}) \quad , \tag{22}$$

then from the Eqs. (2 & 11) simultaneous $(\Delta q_u)^4_{e-1}$ of the same ΔM_6 or GSBs or GBs are

$$\Phi_u = \left[\mathrm{SU(3)} \times \mathrm{SU(2)} \times \mathrm{U(1)} \times X\mathrm{U}(N_{\mathrm{DM}}) \times Y\mathrm{U}(N_{\mathrm{DE}})\right]_u \quad , \tag{23}$$

and from Eq. (9), there are corresponding right-handed Gauge Groups and Anti-Gravitation

$$(\Delta p_u)_{e-1} = \in_u \Delta\left\{\left[\mathrm{SU(3)} \times \mathrm{SU(2)} \times \mathrm{U(1)} \times \mathrm{XU}(N_{\mathrm{DM}}) \times \mathrm{YU}(N_{\mathrm{DE}})\right]_u \big/ n\right\}^4_{e-1} = \in_u \Delta(\Phi_u / n)^4_{e-1} = \in_u K_2^4 / \Delta(n\Phi)^4_{e-1} \tag{24}$$

Now we can finally re-write the Eq. (2) from Eq. (24) for all scales of GSBs or GBs

$$\left[(\mathrm{G}\mu\nu + \mathrm{g}_{\mu\nu}\ \Lambda)_{e-1} = \in \cdot \Delta(n\Phi)^4_{e-1}\right] = K \Big/ \left[(\Delta p_u)_{e\text{-}1} = \in_u \cdot \Delta(\Phi_u / n)^4_{e-1} = \in_u K_2^4 / \Delta(n\Phi)^4_{e-1}\right] \tag{25}$$

and that Eq. (25) will be the non-inertial unified definition comprising all left-handed and right-handed forces in quantized cognizable *part* of Nature from the conceptual micro-most scale to macro-most scale the whole universe itself. Therefore, Eq. (25) is a unified non-inertial definition including all left and right handed fundamental natural forces.

4.3. Simultaneous Existence of Real & Right-Handed Real Pairs for Quantized Everything in Nature

The mirror imaged CIPs are right-handed. Those are also quantized (i.e. with non-zero & non-infinite values) and real (*i.e.* follow the causal logic patterns) as like as left-handed inverse CIPs in Eq. (2). But any of such right-handedly real (RHR) CIPs cannot be measured directly from the *side* of any left-handedly real (LHR) measurement processes. Practically, both of those inverse or mutual mirror image sets of CIPs (Δs , Δt & Δm) and (Δs_u , Δt_u , & Δv) in Eq.(2) cannot be measured directly by any such LHR or RHR observers at any single moment simultaneously. Because, any single observer cannot stay simultaneously at both left and right-handed ends for such observation. If he has ability to measure directly left handed CIPs Δs , Δt & Δm in one set then all the right handed CIPs Δs_u , Δt_u & Δv in the other set of particles or systems need to be indirectly calculated through Eq.(2); or *vice versa*. Therefore, in Eq. (2), since the corresponding directions for each of such LHR and RHR of the CIPs in respective sets are intrinsic (i.e. observer independent), and if one such observer like us are possessing all their non-zero & non-infinite magnitudes, then any of such real & quantized observer cannot simultaneously co-exist in both of the LHR & RHR directions simultaneously.

Therefore, any particles or systems in Nature definable by Eq. (2) will be at its LHR appearance on a mirror to one LHR-observer would be like

$$(\Delta m \cdot \Delta s \cdot \Delta t) = K / (\Delta v \cdot \Delta s_u \cdot \Delta t_u) \quad ; \tag{26a}$$

and conversely, to another observer who is say RHR, with RHR-CIPs onward intrinsic RHR direction from opposite side of the mirror, would have the same particle or system in its RHR-mirror-image of the Eq. (26a)

$$(\Delta v \cdot \Delta s_u \cdot \Delta t_u) = K / (\Delta m \cdot \Delta s \cdot \Delta t) \quad . \tag{26b}$$

Then, due to intrinsic or observer independent left and right-handed directions of all 5+5 inverse CIPs in Eq. (2), the Eqs. (26a & 26b) from same Eq. (2) also reveal an intrinsic or observer independent simultaneous LHR and RHR mirror-imaged pair existences for every scale of particles or systems in inertial states.

Not only such LHR and RHR observer independent pair co-existence like Eqs. (26a) & (26b) for any of those particles or systems irrespective of scales, but each of the 5+5 CIPs in both of those LHR & RHR in pair are always mutually linked together in spite as intrinsic mutual mirror-images in Eq. (2). For example, if magnitude of any of those 5+5 10-CIPs changes in any of the mutual mirror-image pair of a particle or system, then the magnitudes of all other CIPs also change simultaneously, without need of exchanging any kind of quantized message or signal in between those two LHR & RHR pair.

Subsequently, Eq. (25) is the non-inertial extension of Eq. (2) for all same scales of particles or systems of GBs or GSBs in same quantize part of Nature. The Eq. (25) is not only appeared as a unified non-inertial equation for all scales of particles or systems under influences of all left-handed gravitation & gauge forces with right-handed anti- gravitation & anti-gauge forces but the same also demonstrates all (5+5) 10 mutual mirror imaged left and right handed CIPs in same in Eq. (2). As a result, the gravitation $(G_{\mu\nu}+g_{\mu\nu}\Lambda)_{e-1}$ and all gauge forces ($\Delta n^4 \Delta\Phi^4_{\mathrm{e}-1}$) that are only related to the intrinsically left handed CIPs (Δs, Δt & Δm) in Eq. (25) can be regarded as left-handed or say real forces. On the other hand, the anti-gravitation $(\Delta p_{\mathrm{u}})_{\mathrm{e}-1}$ and all anti-gauge forces $\{\Delta n^4/\Delta(\Phi_{\mathrm{u}})^4_{\mathrm{e}-1}$ that result from the intrinsic right handed CIPs (Δs_{u}, Δt_{u} & Δv) in Eq. (25) can be considered as right-handed or virtual forces.

Therefore, to one LHR-observer (who can directly measure those real CIPs), or onward intrinsic left-handed direction, the same GBs or GSBs will appear to him as real/virtual (or say for convenience as real) and we already have for the same in Eq. (25).

Conversely, to the RHR observer (who can directly measure only RHR-CIPs), or onward intrinsic RHR direction, the same GBs or GSBs will appear to him as RHR in the same moment of observation but from other side as a mutual mirror image of the Eq. (25)

$$\begin{aligned}&\left[(\Delta\, p_u)_{\mathrm{e}-1} = \;\in_u \Delta\, n^4 \big/ \Delta(\Phi_u)^4_{\mathrm{e}-1}\right] \\ &= K\Big/\left[(G_{\mu\nu}+g_{\mu\nu}\Lambda)_{\mathrm{e}-1} = \;\in \Delta\, n^4 \cdot \Delta\,\Phi^4_{\mathrm{e}-1}\right] \;.\end{aligned} \qquad (27)$$

Hence, Eqs. (25 & 27) can also be regarded as simultaneous observer independent LHR and RHR pair existences for every scale of GBs or GSBs in non- inertial states as like as we have for inertial state of the same in Eqs. (26a) & (26b) where in both states particles or GBs are comprised by same 5+5 CIPs with intrinsic (i.e. observer independent) quantized magnitudes in scale specific ways. Then, as in Eqs. (26a & 26b), if the intrinsic quantized magnitude of any one of 5+5 CIPs in any of the LHR or RHR in pair in Eqs. (25 & 27) changes, simultaneously the intrinsic quantized magnitudes of all other CIPs will also change accordingly in both LHR and RHR in pair without need for exchanging any kind of real & quantize messages or signals in between those.

Eq. (25) also defines the macro-most scale ΔM_6, as well as all its constituent smaller scales of GBs or GSBs that are also integrated parts of the same Big-Bang/Big-Crunch cyclic oscillation. The same ΔM_6 also possesses an intrinsic (i.e. observer independent) Big-Bang to Big-Crunch cyclic oscillation that also includes observer like us. Therefore, the same ΔM_6 also appears to have a pair of an intrinsic co-existing LHR and RHR in Eq. (25) & Eq. (27) due to such intrinsic Big-Bang/Big-Crunch cyclic oscillation. An observer, who is heading towards expansion of ΔM_6 starting from the Big-Bang to Big-Crunch in Eq. (25), will observe that same cyclic oscillating phenomenon as LHR, i.e. he will be cyclically from its Big-Bang to Big-Crunch then again from Big-Crunch to Big-Collapse and again from Big-Bang expansion and collapse of all LHR in CIPs (Δs, Δt & Δm) those are directly measurable by him. Those same LHR in CIPs (Δs, Δt & Δm) are also bearing the gravitation and gauge-forces. That is to an intrinsic left-handed or LHR-observer like us the same cyclic oscillating universe ΔM_6 in Eq. (25) appears as LHR.

Conversely, an observer who is simultaneously heading towards collapse of same ΔM_6 starting from same Big-Bang to Big-Crunch then again from Big-Crunch to Big-Collapse through the simultaneous collapse and expansion of all RHR in CIPs (Δs_{u}, Δt_{u}, & Δv) those are directly measurable by him. Those same RHR in CIPs (Δs_{u}, Δt_{u}, & Δv) are also accompanied the anti-gravitation and anti-gauge-forces in Eq. (27). That is, to an intrinsic right-handed or RHR-observer simultaneously with in the same cyclic oscillating universe ΔM_6 in Eq. (27) appears as RHR.

Moreover, since a LHR-observer or a RHR-observer can only directly measure or exchange with the corresponding LHR-CIPs (Δs, Δt & Δm) or RHR-CIPs (Δs_{u}, Δt_{u}, & Δv) of that same cyclic oscillating universe ΔM_6 in Eqs. (25) & (27), an observer irrespective of LHR or RHR cannot simultaneously exchange with the both LHR and RHR existences in the pair. This is equivalent to any simultaneous LHR and RHR co-existing pair of any scales of particles or systems as integrated parts of the same ΔM_6 defined in Eqs. (25) & (27). Consequently, we can also state that, any such particles or systems with simultaneous LHR and RHR in pair, defines in Eqs. (25) & (27), never can be co-existed in any one particular direction normally.

5. Inferences

In above Sub-section 4.3, to the observers like us, everything that defines by the Eq. (25) as different scales of GSBs or GBs including ΔM_6 are appeared as LHR, and conversely those are RHR cannot be co-existed with us in our way of LHR-observations. Conversely, those same scales of GSBs or GBs including ΔM_6 which can be defined by Eq. (27) will appear to RHR-observers as RHR, and everything LHR cannot be co-existed with them in their way of RHR-observations. This Section will show some implications of Eqs. (25) & (27) to overcome a few inconsistencies in current Physics.

5.1. EPR Paradox Resolved

The Eqs. (27a & 27b) is considered universally applicable to all scales of particles or systems as well as GSBs or GBs, including ΔM_6; and if the magnitudes of any one of the CIPs in any of the LHR and RHR parts of the pair becomes changed in any way, then, simultaneously, all other magnitudes of CIPs in both parts of the pair will automatically and instantaneously change in inverse ways being mirror images to each other. There will have be no need for any signal exchanges in-between other CIPs or parameters whether those two parts are separated by any spatial distances or not.

In the EPR Paradox, the same thing appears to happen in spatial separations of any particle & anti-particle pair. Since, such a particle is LHR as integrated part of the ΔM_6 in our way of LHR-observations, and the anti-particles, those are very much unsustainable on the way of our LHR-observations, can be a RHR. Due to Eqs. (26a & 26b) and (25 & 27) for all those same particle and anti-particle pair, there is no need for any quantize communication or signal exchange in-between those particle and antiparticle in the pair whatever spatial separation can be there in-between the both. If quantize magnitude of anyone CIP out of total 5+5 in LHR changes then automatically and instantaneously cause all inverse changes in the other 9 CIPs of LHR part as well as in all 5+5 CIPs of RHR part of the pair, without any signal exchanges. Therefore, the EPR Paradox in-between any particle & anti-particle pair can be resolved as if the simultaneous mirror-imaged inverse changes in all quantized magnitudes of CIPs in both through Eqs. (26a & 26b) and (25 & 27).

5.2. Symmetry Between Particle and Anti-Particle

The particles and systems that behave the same as GBs or GSBs, including ΔM_6 in Eq. (27a), are LHRs, and, as sustainable as LHR observables, appear to us in onward expansion. Because we are LHR observers, we are also onward expansion of the Big-Bang/Big-Crunch cyclic oscillating Universe ΔM_6. On the other hand, the anti-particles or anti-systems, including anti ΔM_6 are RHR to LHR observers like us. As a result, all such anti-particles or anti-systems defined by the Eq. (27b) cannot appear to us as sustained like LHR observations.

Therefore, despite equal existences of particles and anti-particles irrespective of scales, all the particles or systems as LHRs appear to us (as LHR-observers) as sustainable all around. As a result, in cases of micro scales of anti-particle of any particle, we found there always need of huge intervention of energies on the same, which actually needs to alter the simultaneous intrinsic right-handed direction of such tiny RHR antiparticle in the way of LHR direction of observation, but that RHR antiparticle can sustain to exist in LHR direction for a very very small fraction of time. But in cases of macro scales of systems of particles such type of LHR-observations on the left-handed direction of any corresponding RHR anti-system of anti-particles can practically be an impossible LHR event. That will need equally a huge intervention of energies to change the RHR directions of such macro anti-system of anti-particles onward LHR-observations as any RHR entity. As a result, we never find any anti-systems of anti-particles in macro scales. But conversely, to an RHR observer with Eq. (27b), those same scales of RHR anti- particles or anti-systems including anti ΔM_6 will appear sustainable; and mutually all our real entities will appear to that RHR observer as unsustainable.

So as a result, to an LHR observer, who, like us, is in onward expansion of ΔM_6 in all intrinsic LHR ways, will that see that all his LHR observables, like particles or systems, are sustained all around, and he will not locate any RHR anti-particles or anti-systems to sustain in his fieldof observations. As a result, an apparent asymmetry in existence of particles over anti-particles emerges, although he may know that there is symmetry for all mutual mirror-imaged particles or systems. On the other hand, the virtual observer will have the similar apparent asymmetry in existence of anti- particles over particles, although he may aware that there must be symmetry between mirror images, irrespective of the side of observation.

6. Conclusion

In the above Sections, there emerged a unified non-inertial definition for all fundamental natural forces of relevance for all scales of particles or systems that can be regarded as Gravitating Bodies or Gravitationally Shaped Bodies,, including the macro-most Big-Bang/Big-Crunch cyclic oscillating Universe, due to universal equivalence of Gauge Forces with Gravitation (as curved spacetime) beside their mirror images in quantize parts of Nature by extending both General Relativity Theory and Standard Model Particle Physics. This also leads us to a unified expression for all natural forces that fabricated the whole quantized part of Nature.

But still, we do not know whether there is anything in same Nature beyond that unified quantum cognizance of ours. That's like vacuum energies, to which any exchange of LHR or RHR quantized and real signals seems impossible; *i.e.*, a huge portion of Nature we can never know. But even is the knowable part of Nature, which appears to us as real, unified, and quantized, - that same Nature which splits into two parts like LHR and RHR, which are beyond direct inter-communication. Furthermore, in our direct communicable LHR part, according to present astrophysical estimates, only about 5% is now directly 'visible' to us through exchange of all levels of sub-nuclear to electromagnetic spectra; and the rest is still 'dark'; that is, it communicates only through gravitation.

References

[1] Dipak Kumar Bhunia, "A Common Definition for all Particles in Nature", Galilean Electrodynamics, Vol. **25**, Sl No. 4 (Winter 2014).

[2] Einstein Field Equations, Wikipedia, www.en.wikipedia.org/wiki/Einstein_field_equations]

[3] Dipak Kumar Bhunia, "Quantized Curvatures of Spacetime for all Scales of Gravitating Bodies", Galilean Electrodynamics **28**, No. 3 (May/June, 2017),

[4] Gauge theory, Wikipedia, https://en.m.wikipedia.org/wiki/Gauge_theory

The Self-Energy and the Charge of the Electromagnetic Heterodyne

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This paper uses Maxwell's equations to create a model for an electromagnetic (EM) heterodyne field. (Background knowledge from our previous papers [3-5] is helpful here.) The model gives the so-called 'self-energy' (or 'mass') of the heterodyne field. Whether at rest or in motion, the energy of the heterodyne field matches the energy of a charged particle,. We compare the charge of the heterodyne model to the charge of the real electron. This comparison raises questions about the nature of both charges.

Key Words: heterodyne model, electromagnetic waves, electromagnetic field, mass, energy, energy density, charge, spin.

1. Introduction

At the beginning of the last century, H.A. Lorentz [1] and M. Abraham proposed ideas according to which the mass of an electron is associated with the 'self-energy' of its electric field. In later decades, Relativity became successfully included [2], and it was not until the discovery of matter waves that interest in their theory began to wane.

Their narrative involved the relationship $m \propto 1/r^2$, associated with determining the self-energy (mass, m) of the electron's field within a spherical volume of finite radius r. For $r = 0$, the value of m became infinite, in contravention of conservation principles, posing a particular challenge to the theory.

The electronic charge was also treated as a fundamental constant, and the possibility that it could be reducible or derivable from anything else was not contemplated.

The present paper develops the mass of a particle using our 'heterodyne' model of matter. [3-5] The field of the heterodyne particle is composed of an electromagnetic (EM) wave pair. Development of the field also allows a quantity to be developed whose SI unit is the coulomb, and whose value correlates very closely to that of electronic charge.

The heterodyne approach regards a stationary particle as composed of an identical pair of counter-traveling, light-speed waves, one radiating out from a source, the other propagating inwardly to a sink, where both source and sink are coincident at the center of the particle. Interference of the two waves results in the formation of a spherical standing wave. This is described mathematically by a 'sinc-function', which has the advantage of ensuring the particle's mass remains finite for all values of r. It thus eliminates the singularity mentioned above. The heterodyne particle can be represented by the following product-to-sum relationship,

$$\underbrace{\Psi_0 = 2i\psi_0(r)\sin(p^0 r/\hbar)e^{(-iW^0t/\hbar)}}_{\text{(standing wave)}} = \psi_0(r)\times$$

$$\Big\{\underbrace{\exp\left[(-i/\hbar)(W^0t - p^0 r)\right]}_{\text{(out-going wave)}} - \underbrace{\exp\left[(-i/\hbar)(W^0t + p^0 r)\right]}_{\text{(in-going wave)}}\Big\}. \quad (1)$$

where $\psi_0(r)$ is an amplitude function describing the spherical character of the waves, t is the time coordinate, r is the radial distance from the source/sink and $\hbar$ is the reduced Planck constant. The symbols p^0 and W^0 represent the respective momentum and energy of the counter-traveling waves and are related to each other by $W^0 = cp^0$. The superscripts and subscripts '0' are used to indicate that the quantities to which they are attached are as measured in the particle's rest frame. The subscripted terms are functions of the coordinates while the superscripted terms have a fixed value. For convenience, we will denote the outgoing and ingoing wave of (1) by ψ_0^+ and ψ_0^-, respectively. For the present, we will postpone interpreting the meaning of Ψ_0 and $\psi_0^\pm$.

When the heterodyne particle is observed to be moving at speed v relative to the rest frame, the counter-traveling waves appear Doppler shifted and their combined interference forms a wave-group moving at v (corresponding to the moving particle) with a phase wave rippling through the group at the faster speed, c^2/v. This accommodates both the wavelike and particle-like characteristics of the particle, which match, identically, the group and phase properties of de Broglie's matter waves. Accordingly and in keeping with our previous studies, we associate the heterodyne waves with matter waves [3].

In the past, the present authors have been interested in connecting Ψ_0 and $\psi_0^\pm$ with EM waves, particularly given their light-speed nature. But we were also reticent to make this link, since forming spherical waves using interdependent electric and magnetic vectors that must also satisfy Maxwell's equations is formidable. What follows explores how this might be achieved using a simplified form of Maxwell's equations. Our emphasis, therefore, will not be on the wave behavior of the heterodyne system (the focus of our past three articles), but rather, on how the matter of a heterodyne particle relates to its field energy.

2. Developing Electric Potential for Describing the Heterodyne

We begin by introducing spherical waves of electric potential, such that $V^{\pm} = Q^{\pm}/4\pi\varepsilon_0 r$ represent scalar potentials and $\mathbf{A}^{\pm} = \left[(\pm Q^{\pm}/c)/4\pi\varepsilon_0 r\right]\hat{\mathbf{r}}$ represent vector potentials, where $\hat{\mathbf{r}}$ is the radially directed unit vector and where $Q^{\pm} = Q^0 \exp\left[(-i/\hbar)(W^0 t \mp p^0 r)\right]$. The '$\pm$' superscripts attached to the potentials $V, \mathbf{A}$ correspond to outward (+) and inward (-) radial propagations, while the boldface $\mathbf{A}$ denotes its vector nature. Independence of θ and φ allows the option to drop the boldface on $\mathbf{A}^{\pm}$, since the propagations are always directed parallel to $\hat{\mathbf{r}}$.

At a later stage, we can write the potentials in linear combinations, $V = k_1 V^+ - k_2 V^-$ and $\mathbf{A} = k_1 \mathbf{A}^+ - k_2 \mathbf{A}^-$ $(k_1, k_2 \in \mathbf{C})$, corresponding to terms of equation (1) and so associate them with the heterodyne particle description if appropriate. With that in mind, there are clear advantages with the current representation. First, because the waves are independent of θ and φ, and because $\nabla \times \mathbf{A}^{\pm} = 0$, the corresponding magnetic inductions ($\mathbf{B}^{\pm} = \nabla \times \mathbf{A}^{\pm}$) are eliminated. The second advantage follows directly from the first. Since $\mathbf{B}^{\pm} = 0$, two of Maxwell's four equations (namely $\nabla \bullet \mathbf{B}^{\pm} = 0$ and $\nabla \times \mathbf{E}^{\pm} = -\partial \mathbf{B}^{\pm}/\partial t = 0$) are automatically discarded from our considerations, thus, reducing its overall complexity significantly.

3. Formulating Electric Field Intensities

The latter of the two discarded Maxwell equations is particularly important, in that it places a mathematical constraint on the electric field intensities, $\mathbf{E}^{\pm}$. Since $\nabla \times \mathbf{E}^{\pm} = 0$, then we expect that the quantities $\mathbf{E}^{\pm}$ should, likewise, be independent of θ and φ, and hence facilitate further simplification. It should also remove any need to represent the $\mathbf{E}^{\pm}$ quantities as radial vectors. The relevance of these points arises from our interest in relating Ψ_0 and $\psi_0^{\pm}$ to $\mathbf{E}$ and $\mathbf{E}^{\pm}$ (*i.e.* EM waves) and, hence, in connecting $\frac{1}{2}\varepsilon_0 |\Psi_0|^2$ to energy density. A simplified form of $\mathbf{E}^{\pm}$ would certainly make calculations more straightforward. However, at this point the proof that $\nabla \times \mathbf{E}^{\pm} = 0$ and, in fact, the formulation of the quantities, $\mathbf{E}^{\pm}$, themselves, are yet to be established.

To that end, we use the general definition, $\mathbf{E} = -\nabla V - \partial \mathbf{A}/\partial t$, to derive electric field intensities, $\mathbf{E}^{\pm}$, generated by $V^{\pm}$ and $\mathbf{A}^{\pm}$. As before, we can construct these quantities into a linear combination, $\mathbf{E} = k_3 \mathbf{E}^+ - k_4 \mathbf{E}^-$, at a later stage, if required. We emphasise that we are seeking an EM interpretation for the Ψ_0 and $\psi_0^{\pm}$ that will allow us to determine the heterodyne's energy density. In that case, the electric fields, rather than electric potentials, would be better associated with equation (1). $\mathbf{E}^{\pm}$ might then be loosely represented by the counter-going waves of that equation and $\mathbf{E}$ represented by Ψ_0.

The first term of the defining formula for electric fields yields $-\nabla V^{\pm} = \left[Q^{\pm}/4\pi\varepsilon_0 r^2\right]\hat{\mathbf{r}} \mp \left[(p^0/\hbar) i Q^{\pm}/4\pi\varepsilon_0 r\right]\hat{\mathbf{r}}$, while the second term (noting that $W^0/c = p^0$) yields $-\partial \mathbf{A}^{\pm}/\partial t = \pm\left[(p^0/\hbar) i Q^{\pm}/4\pi\varepsilon_0 r\right]\hat{\mathbf{r}}$. Thus, $-\nabla V^{\pm} - \partial \mathbf{A}^{\pm}/\partial t$ reduce to a pair of single-term expressions; namely, $\mathbf{E}^{\pm} = \left(Q^{\pm}/4\pi\varepsilon_0 r^2\right)\hat{\mathbf{r}}$. Given the initial complexity of the definition, the expressions for $\mathbf{E}^{\pm}$ are remarkably simple. Not only is $\nabla \times \mathbf{E}^{\pm} = 0$ automatically satisfied, as hoped, but use of the vector representation remains arbitrary.

As might be anticipated, apart from the periodic fluctuations in $Q^{\pm}$, the expressions for $\mathbf{E}^{\pm}$ have the same form as those representing a steady point charge. It might, therefore, be possible to liken them to the fields of ordinary charged particles. Given that the scale of frequencies and wavelengths of the $\mathbf{E}^{\pm}$ waves are associated with those of matter waves, fluctuations in $Q^{\pm}$ would be undetectable. The effective values of $Q^{\pm}$ would appear constant, determined by their averages or root-mean-square values and the corresponding fields would display behavior entirely consistent with that of a typical particle of uniform charge.

4. The Electric Field Intensity of a Heterodyne Particle

We now represent the heterodyne's electric field intensity, E, using the linear combination $E = 2E^+/a - 2E^-/a$, where $2E^+/a$ and $2E^-/a$ correspond to the outgoing and ingoing wave of equation (1), respectively, and where a is a normalization constant, yet to be determined. The factor 2 is included to simplify later calculations. Expressed explicitly, this yields

$$E = \left(2Q^0/a4\pi\varepsilon_0 r^2\right)\exp\left[(-i/\hbar)(W^0 t - p^0 r)\right] - \left(2Q^0/a4\pi\varepsilon_0 r^2\right)\exp\left[(-i/\hbar)(W^0 t + p^0 r)\right] \quad . \tag{2}$$

Comparing Eq. (2) with Eq. (1), we can equate E with Ψ_0 and for consistency we can also replace $E^{\pm}$ [the terms of (2)] with the symbols, $\psi_0^{\pm}$. Using the sum-to-product formula our description of the heterodyne particle now becomes

$$\Psi_0 = \psi_0^+ - \psi_0^- = \frac{(i4Q^0/a)}{4\pi\varepsilon_0 r^2}\sin(p^o r/\hbar)\exp(-iW^0 t/\hbar) \quad . \tag{3}$$

Clearly, the matter wave behavior of the heterodyne can be readily connected to its own fluctuating electric field.

For succinctness we represent the numerator of (3) as $Q(r,t) \triangleq Q$, so that the field of the heterodyne particle also takes the same form as that describing a point charge, namely

$$\Psi_0 = Q/4\pi\varepsilon_0 r^2 \,. \tag{4}$$

Again, the heterodyne description would be consistent with such a particle in that, any fluctuations in Q (of the order of matter waves) would not be detectable normally and the heterodyne's electric field would appear, for all intents and purposes, as steady.

Although Gauss's law (Maxwell's divergence equation) applies generally to all electric fields, we wish to show that this is true for an electric field of the form $E = Q/4\pi\varepsilon_0 r^2$, even when the charge, Q, varies with r and t. Applying the divergence, we find $\nabla\bullet\mathbf{E} = r^{-2}\dfrac{\partial}{\partial r}\left(r^2 E\right) = (1/4\pi\varepsilon_0 r^2)\dfrac{\partial Q}{\partial r}$. For a spherical shell of thickness dr, the volume element becomes $d\tau = 2\pi r^2 dr\int_0^{\pi}\sin\theta\, d\theta = 4\pi r^2 dr$ (see Fig. 1) and we finally obtain $\nabla\bullet\mathbf{E} = \rho/\varepsilon_0$ (where $\rho = \partial Q/\partial\tau$ is the charge density). Thus, one of Maxwell's equations remains intact, even for a varying charge.

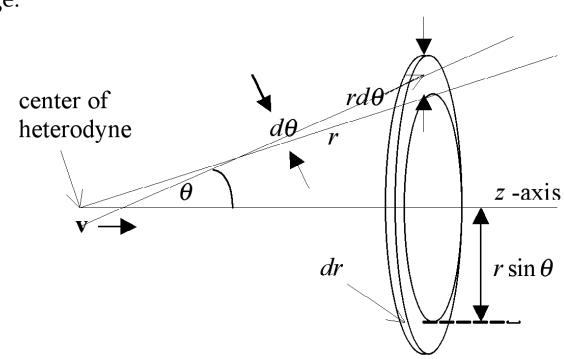

Figure 1. Infinitesimal volume element used to determine the divergence of $\mathbf{E}$.

Fig. 1 shows the infinitesimal volume, $d\tau$, of a curved annular shell with thickness, dr, defined by the respective inner and outer radius of curvature, r and $r + dr$ (both radii measured from the center of the heterodyne). The width of the curved shell is bounded by the radii $r\sin\theta$ and $r(\sin\theta + d\theta)$, both radii centered on the z-axis.

We now apply the divergence specifically to (3) to find the charge density of the heterodyne particle. This yields

$$\rho = \frac{i4Q^0 p^0}{a\hbar}\frac{1}{4\pi r^2}\cos(p^0 r/\hbar)\exp(-iW^0 t/\hbar) \quad .$$

Since $B^{\pm} = 0$, then the heterodyne's magnetic induction, $B = b_1 B^{+} + b_2 B^{-}$ (the linear combination of $B^{\pm}$, where b_1, b_2 are complex constants), is also zero. Hence, the last of Maxwell's equations reduces from $\nabla\times B - c^{-2}\partial E/\partial t = \mu_0 J$ to

$$\mathbf{J} = -\varepsilon_0 \partial\mathbf{E}/\partial t \,, \tag{5}$$

where $\mathbf{J}$ is current density. In keeping with our previous discussions, we note that, while $\mathbf{J}$ is a vector, its representation as such can be dropped as previously explained. Of course, this is also true for the representation of Ψ_0 and $\psi_0^{\pm}$: their independence of θ and φ ensures that, in general, they can be treated as scalars, which allows an automatic association with the scalar behaviour of matter waves to be made. We can now determine the heterodyne's current density specifically, by applying (5) to (3), which produces

$$\mathbf{J} = \frac{4Q^0 W^0}{a\hbar}\frac{1}{4\pi r^2}\sin(p^0 r/\hbar)\exp(-iW^o t/\hbar)\hat{\mathbf{r}} \quad .$$

Taking the divergence of (5) yields $\nabla\bullet\mathbf{J} = -\varepsilon_0\partial(\nabla\bullet\mathbf{E})/\partial t$, so that the continuity equation, $\nabla\bullet\mathbf{J} + \partial\rho/\partial t = 0$, is satisfied.

5. Propagation Modes: Interpreting 'Spin'

We now consider the mode of propagation of Ψ_0 and $\psi_0^{\pm}$. Broadly, EM waves have long been associated with transverse propagation and there are convincing arguments as to why this should be so. Of course exceptions are known, such as longitudinal propagation through plasmas. One might mount the case, therefore, that there is no reason to exclude longitudinal waves in new situations, and that, specifically, there is no physical inconsistency between the longitudinal propagation of the waves in the heterodyne system and its governing equations. The existence of matter waves may be the very verification of a wider application of longitudinal EM waves that has not, as yet, been considered.

Nevertheless, given the nature of EM waves in general, and our attempt to describe the heterodyne system in terms of them, it seems logical to continue on the basis that Ψ_0 and $\psi_0^{\pm}$ are indeed transverse (*i.e.* their displacements oscillate transversely to the direction of wave propagation). In that case the amplitude of each wave can be decomposed, in the usual way, into two component displacements, the directions of which are independent of each other and independent of the propagation direction. For propagation that is radial into or out from the center of the heterodyne, along $\mathbf{r}$, the component displacements are directed at 90° to each other in a plane that is transverse to $\mathbf{r}$.

A phase difference between the two components gives rise to different polarizations, which in turn allows the concept of spin to be incorporated naturally into the heterodyne model. The phase difference is independent of the frame of reference so that polarization (or spin) manifests as an invariant. Interestingly, if the phase difference between ψ_0^{+} and ψ_0^{-} in equation (1) is $n\hbar$ (n an integer), then the averaging effect of applying the sum-to-product formula in (1) produces a spin value $n\hbar/2$. Assigning an odd, even or zero value to n allows the heterodyne approach to then account for half, unit, and zero spin particles. This is an important feature of the heterodyne model, discussed in our second paper [4].

Clearly, for the heterodyne, an arbitrary wave propagating radially along $\mathbf{r}$, has an amplitude that marks out a transverse asymmetric motion about $\mathbf{r}$. This asymmetry will necessarily interfere with the transverse amplitudes of neighboring waves immediately surrounding $\mathbf{r}$, producing annulments and reinforcements in which uniform 'spin' is lost. A resolution of this is to retain the phase difference between the counter-traveling waves, ψ_0^+ and ψ_0^-, but to return to the notion of longitudinal propagation. The longitudinal wave motion then ensures the removal of interference from nearby waves. For a fixed phase difference between ψ_0^+ and ψ_0^-, the radial (longitudinal) oscillations of Ψ_0 remain in phase over any arbitrary spherical surface about the heterodyne's center (*i.e.* all parts of the wave on the sphere undergo synchronous longitudinal motion). Further, a particle's half, unit and zero spin characteristics still result from an application of the sum-to-product formula. Thus, the mathematics and corresponding properties are preserved, although, since the oscillations are not transverse they can no longer be associated with the manifestation of spin in any physical sense. Notably, this virtual interpretation of spin is in complete accord with modern quantum theory.

While some may be reluctant about incorporating longitudinal EM waves into mainstream thinking, the authors believe they are no more difficult to accept than Copenhagen's concepts of unobservable probability waves and a particle that simultaneously occupies every possible state of being when not observed.

As the above implies, the mode of propagation does not impinge on our considerations of the heterodyne field. The symbols Ψ_0 and $\psi_0^\pm$ may be used to represent either transverse or longitudinal waves with minimal changes to existing arguments. As such, at this stage we will make no resolute commitment about the wave type, and our symbolism will continue to reflect this, although we find longitudinal propagation very probable.

6. 'Self-Energy' (Mass) of a Heterodyne at Rest

Since Ψ describes an electric field, the energy density of the field can be represented in the form $\frac{1}{2}\varepsilon_0\left|\Psi_0\right|^2$. We note the obvious parallel in formalism between this expression and that describing probability density, $\left|\Psi\right|^2$, posited by the Copenhagen school. Of course, there are also significant interpretational differences between these two representations. In the former, $\frac{1}{2}\varepsilon_0\left|\Psi_0\right|^2$ describes the spatial distribution of the heterodyne's field energy and as such relates to a single particle. In the Copenhagen case, $\left|\Psi\right|^2$ is associated more with the chances that a particle or particles within a population are to be found in a particular 'state' or position. The distribution is governed by 'probability waves' that are themselves undetectable and non-derivable. Clearly then, the EM interpretation suggests comparative advantages: it is both simpler and derived from physically "real" entities.

When integrated over all space, either of these densities should lead to a definitive value. A particular obvious example in the Copenhagen case is the normalized probability of finding the particle somewhere in the Universe, namely $P = \int_{\tau=0}^{\infty}\left|\Psi\right|^2 d\tau = 1$.

Application of the same definite integral to energy density allows the total energy, W_{tot}, within the heterodyne field to be determined. That is,

$$W_{\text{tot}} = \frac{1}{2}\varepsilon_0\int_{\tau=0}^{\infty}\left|\Psi_0\right|^2 d\tau \quad , \tag{6}$$

where $d\tau$ is as previously defined.

After expanding the integrand of (6) using (3) and canceling factors, the integral reduces to that of a modified sinc² function, $\int_0^\infty r^{-2}\sin^2(p^o r/\hbar)dr$. These types of integrations are well studied, and in this specific case, the integral evaluates to $\pi p^o/2\hbar$. The total heterodyne energy then simplifies:

$$W_{tot} = \frac{2Q^{o2}}{a^2\pi\varepsilon_o}\int_0^\infty r^{-2}\sin^2(p^o r/\hbar)\,dr \;\to\; W_{\text{tot}} = \frac{p^0 Q^{02}}{a^2\hbar\varepsilon_0} \quad . \tag{7}$$

We emphasize that, by virtue of the $\sin^2$ function, the integral is well behaved for all values of r; the self-energy does not form a singularity at $r = 0$ and Lorentz's infinite mass (energy) problem is non-existent.

Because $p^0/\hbar$ has the dimension of inverse length, and a is dimensionless, then $p^0(Q^0)^2\big/a^2\hbar\varepsilon_0$ has the units of potential energy. The fact that the units on both sides of (7) match may seem a minor observation, but it is noteworthy as an indicator of the validity and correctness of the EM heterodyne approach.

We will express (7) in terms of mass since the rest mass, m^0, of a particle can be easily referenced. Given that $W^0 = cp^0$ and $W^0 = m^0c^2$, then $p^0 = m^0c$. Substituting this and $W_{\text{tot}} = m_{\text{tot}}c^2$ into (7) and dividing through by c^2 yields

$$m_{tot} = m^0(Q^0)^2\big/a^2c\hbar\varepsilon_0 \quad . \tag{8}$$

Obviously, both sides of (8) are dimensionally equivalent. To ensure m_{tot} and m^0 are also numerically identical, we 'normalize' (8), such that $(Q^0)^2\big/a^2c\hbar\varepsilon_0 = 1$. Thus, $(Q^0)^2 = a^2c\hbar\varepsilon_0 = 2.797\times10^{-37}a$ C. With this expression for $(Q^0)^2$, the relationship between W_{tot} and W^0 (m_{tot} and m^0) changes from one of proportionality to one of direct equality.

7. Q^0 and Electronic Charge

The quantity, $Q^0 = a\sqrt{c\hbar\varepsilon_0}$, evaluates to $5.289\times10^{-19}a$. We note that $\sqrt{c\hbar\varepsilon_0}$ is dimensionally identical to and has a magnitude of the same order as that of the basic electronic charge, $q_e = 1.602\times10^{-19}$ C. This similitude is particularly remarkable, considering that the derivation involving $\sqrt{c\hbar\varepsilon_0}$ has not been based, in any way, on the electron or similarly charged particle.

We note that if a is assigned the value 0.3028, then Q^0 equals the electronic charge, q_{e}, precisely. The small factor of 0.3028, is even more striking in view of the orders of magnitude involved in determining $\sqrt{c\hbar\varepsilon_0}$. (We identify the fine structure constant, $\alpha = q_e^2 / 4\pi\varepsilon_0 c\hbar$, and its remarkable similarity to $a^2 = (Q^0)^2 / c\hbar\varepsilon_0$. In particular, we note that in *natural units* (where $\varepsilon_0 = c = \hbar = 1$), the electronic charge takes the value $q_{\mathrm{e(nat.)}} = \sqrt{4\pi\alpha} = 0.3029$, an uncanny match with the value a.) Clearly, the correspondences between $a\sqrt{c\hbar\varepsilon_0}$ and q_{e}, including the relativistic invariance of both, suggests something beyond mere coincidence that is not inconsequential.

Given that $c, \hbar, \varepsilon_0$ are universal constants, Q^0 itself must be assigned the same status. That is, Q^0 represents a value that is immutable and independent of the particle it refers to. In contrast, the expressions for energy or mass, (7) and (8), cannot simply be reduced in the same way to an amalgam of constants. Their rest values are particle dependent. The total rest energy (mass) of an electron, for instance, is different to that of a proton. Again, these may seem minor observations, but they raise interesting questions about the origin and nature of electronic charge. Since Q^0 derives from $c, \hbar, \varepsilon_0$, it may no longer be meaningful to consider electronic charge as a rudimentary constant in its own right.

8. Field Energy of the Moving Heterodyne

To round off this paper, we will briefly consider the field energy of the heterodyne as seen in motion. We will distinguish reference frames using the usual primed/unprimed notation.

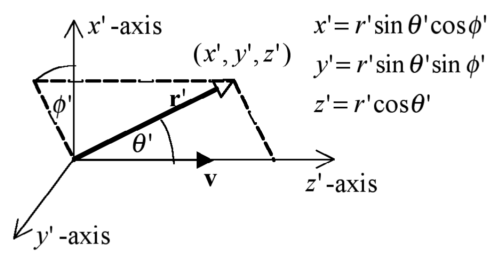

Figure 2. Representation of the reference frame in which the heterodyne particle passes along the z'-axis at velocity $\mathbf{v}$.

We observe the heterodyne traveling along the positive z'-axis at speed $v = |\mathbf{v}|$ (as shown in Fig. 2) and passing through the origin (0,0,0) of both frames at $t = t' = 0$. At that instant we consider the heterodyne's field at position (x', y', z'), distance $r' = |\mathbf{r}'|$ from the origin.

The total energy of the heterodyne field can be determined by transforming Ψ_0 and $d\tau$ in Eq. (6) then carrying out the integration. However, performing the operations in that order is daunting, with a high propensity for error. A more straightforward approach is to reverse the process, integrating (6) first, then transforming. This leads to equation (7), but with the factor p^0 replaced by its transformed equivalent, namely $\Delta p_\theta = \sqrt{W^o(1-\beta^2)} / c(1-\beta^2\cos^2\theta)$. (Derivation of this transformation is given in our first paper [3].)

As was also explained in that article, the heterodyne's energy density appears as concentric shells whose general shape depends on the observed speed of the heterodyne. At low speeds they are spherical in form, while at relativistic speeds they contract along the line of motion into ovoid forms. Since they define the form and structure of the heterodyne itself, they travel collectively as a single unchanging unit. This contrasts with the concept of 'spreading wave packets' of probability associated with other models.

Substituting p^0 with Δp_θ in Eq. (7), the transformed total energy becomes $W'_{\mathrm{tot}} = W^0 (Q^0)^2 \sqrt{1-\beta^2} / ca^2\hbar\varepsilon_0(1-\beta^2\cos^2\theta)$. Given that $(Q^0)^2 = a^2 c\hbar\varepsilon_0$ and with a longitudinal measurement, $\theta = 0$, (maximum value for $\cos\theta$) the total energy simplifies to the familiar expression, $W'_{\mathrm{tot}} = W^0 / \sqrt{1-\beta^2}$. This field energy and its mass equivalent, $m = m^0 / \sqrt{1-\beta^2}$, are in complete agreement with the wave descriptions presented in our earlier work, all of which are consistent with reality.

9. Conclusion

Our previous investigations showed that waves within the heterodyne field can propagate only at light-speed. This has led us, in the present paper, to attach EM attributes to the heterodyne particle. Specifically, we describe the heterodyne in terms of an electric standing wave. This description is observed to be identical to that representing a point charge, provided the standing wave and the counter-traveling waves that constitute the heterodyne are regarded as having frequencies of the same order as matter waves (an association we established in earlier work). Use of the sinc and sinc² functions ensured the energy (mass) of the heterodyne field remained finite for all values of r, eliminating Lorentz's singularity problem. Resolution as to the mode of propagation of the electric waves was left open, although it was pointed out that no important mathematical or material features of the approach were lost in adopting longitudinal propagation. In fact, the spin description married comfortably with matter waves.

We integrated the energy density of the heterodyne's electric field over all space to determine its total 'self-energy' (mass) at rest. After normalisation, a correspondence with the actual value was achieved and the heterodyne was found to carry a quantity of charge, Q^0, defined by $a\sqrt{c\hbar\varepsilon_0}$, where a is a dimensionless constant. Nearness of the value $\sqrt{c\hbar\varepsilon_0} = 5.289 \times 10^{-19}$ to the electronic charge, $q_{\mathrm{e}} = 1.602 \times 10^{-19}$, was noted and with $a = 0.303$, the equality $Q^0 = q_{\mathrm{e}}$ was obtained. We regard this as significant, in that $\sqrt{c\hbar\varepsilon_0}$ was derived with no reference given to the electron or similarly charged particle. The connection between $\sqrt{c\hbar\varepsilon_0}$ and Q^0 raised a question about the long-held assumption that charge is not reducible to more fundamental quantities. That Q^0 has the unit of charge, is a universal constant independent of the particle to which it is attached and differs from the electronic charge by a small factor of 0.303 should also be considered significant. We believe these similarities with the electron are more than coincidental.

Our final deliberations showed that the self-energy (mass) of the moving heterodyne field reflects the same dependency on $1/\sqrt{1-(v/c)^2}$ as its wave and that both correlate with the description of a typical relativistic particle in motion. The advantage of the present approach is that it incorporates matter wave behavior and features of the Lorentz model into a single-particle description.

References

[1] H.A. Lorentz, **The Theory of Electrons** (Dover Publications, New York, 1952), 2nd ed.

[2] F. Rohrlich, "Self-Energy and Stability of the Classical Electron", Am. J. Phys. **28**, 639-643.

[3] C.O. Hawkings & R.M, Hawkings, "Scalar Heterodyne Approach to Matter Waves and Wave-Function Collapse" Galilean Electrodynamics, May/June 2013, Vol.4 Number 3, 43.

[4] C.O. Hawkings & R.M Hawkings, "Decay, Annihilation, Spin and Uncertainty: Application of the Heterodyne Model", Galilean Electrodynamics **26** (5) 95-100 (2015).

[5] C.O., Hawkings & R.M, Hawkings, "A 'No Moving Parts' Heterodyne Atom" Galilean Electrodynamics **28**, 97-100 (2017).

Atmospheric Muons: SRT Confirmation? cont. from p. 2

Why not [suppose that] the muons produced in the laboratory experience the same time dilation and length contraction if their speed was same as that of the cosmic ray muons? And if they did, why haven't we seen the laboratory muons travel the same 16000 meters as their cosmic counter parts? And if they travelled 16000 meters distance in their life span of 2 microseconds, what would be their speed?"

Since atmospheric muons apparently are created by particle collisions with cosmic rays, why should these collisions be limited only to the upper atmosphere when atmospheric density increases with decreasing altitude? If muons could be created throughout the atmosphere, what might be observed with decreasing altitude? Could observations similar to that by Frisch and Smith be explained by simply assuming muons are created throughout the atmosphere, not just in the upper atmosphere, thereby eliminating the need for 'time dilation' as a panacea?

Creation of Muons as a Function of Atmospheric Density

From Reference [4], a plot of atmospheric density vs. altitude shows an exponential-like increase with decreasing altitude, from near-zero density at ~ 35 km to ~ 1.3 kg/m^3 at sea level (0 km), as shown in Figure 1. Where muons supposedly are created (~ 15 km), the atmospheric density is only ~ 0.2 kg/m^3, or < 1/6th of the maximum. Would it not seem logical to assume cosmic rays create muons at altitudes less than 15 km where collisions with particles should be more likely, perhaps all the way down to sea level? Countering this to some extent (evaluated below) is the decrease in cosmic ray intensity with decreasing altitude, from a maximum at ~15 km (~ 70/min [5]) to a minimum at sea level (~ 8/min, from the same reference), as shown in Fig. 2.

Let us assume that the creation of muons is directly proportional to the ratio of the atmospheric density at altitude y to that density at ~ 15 km = 15,000 m (here we use 15,180 m so that equal intervals of 660 m exist down to sea level, corresponding to the distance over which half of the muons created at altitude y decay) as well as to the ratio of the cosmic ray intensity at altitude y to that intensity also at ~15 km = 15,000 m (again using 15,180 m). Start with one muon created at 15,180 m and calculate the number created and remaining undecayed for every decrease in altitude by 660 m down to sea level. The net number of muons at each altitude decrement is shown in Fig. 3 here and Table 1 on p. 20.

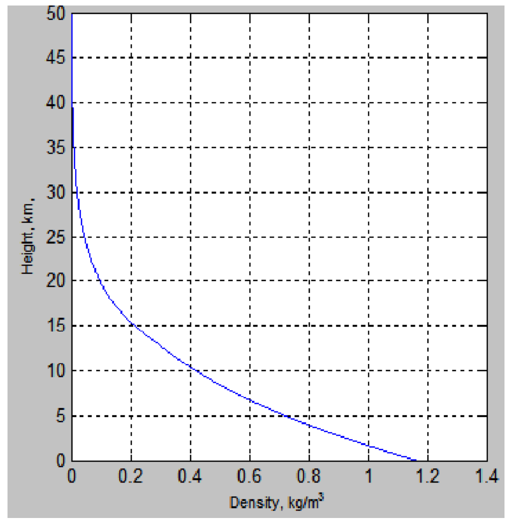

Figure 1. Atmospheric Density *vs.* Altitude

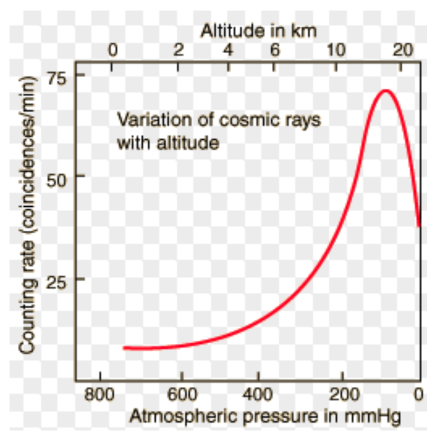

Figure 2. Cosmic Ray Intensity *vs.* Altitude.

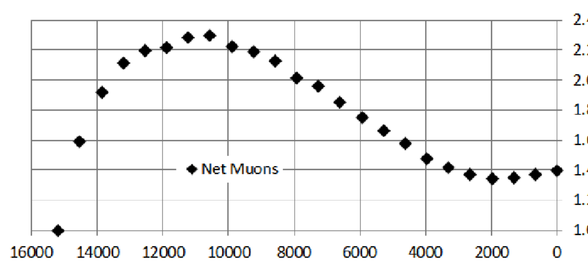

Figure 3. Net Number of Muons *vs.* Altitude (m).

Concluded on p. 20

Mass-Energy States of the Pion Particle

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The laws of conventional physics, Coulomb's Law, Quantum Mechanics, Special Relativity Theory (SRT) are combined to formulate the mass-energy states of the pion, an elementary particle. The structure of the pion is revealed from the electron-positron relationships orbiting each other near speed c, the speed of light. This structure is based on only two forces, the force of attraction between particles and the inertial centrifugal force. The resulting formulae suggest that two orbiting particles create one particle. Based on the formulae developments for the pion, a possible structure for the electron structure is also presented.

1. Introduction

This development of the formulae in this article suggests that matter particles at the sub-atomic level can be composed of two orbiting particles of opposite charges. Some mass-energy states relating to known elementary particles correlate with the mass-energy states of the pion and are presented.

The following major concepts form the basis for the formula derivations: **1)** Bohr's Atom concepts of force balance and total angular momentum, with Planck's constant, **2)** Special Relativity Theory (SRT), and **3)** the fine structure constant. The attractive force is the standard Coulomb force between opposite electrical charges. The Coulomb force appears to create the strong nuclear force when the 'charged' particles are moving at or near the speed of light. The relativistic mass increase of the orbiting electron and positron create the mass of the pion. The fine structure constant α relates the strong relativistic force to the Coulomb force.

2. Force Balance Between Electron and Positron Orbiting Each Other

Using SRT, the force balance between the orbiting pair is represented by the Coulomb force and the centrifugal force acting through the center of mass, CM. See Fig. 1

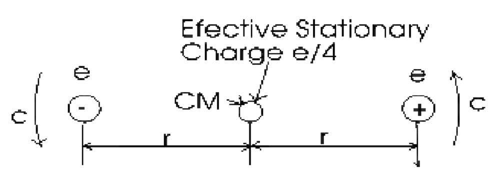

Figure 1. Orbiting electron-positron pair.

As seen at the CM, these forces are:

$$\gamma k e^2 \big/ 4r^2 = \gamma m_e c^2 \big/ r \quad , \tag{1}$$

where $\gamma = 1\big/\sqrt{1 - v^2 / c^2}$; v is the speed of the orbiting positron and electron, and whose value is near c, the speed of light; m_e the rest mass of either the electron or positron; e is the magnitude of the electrical charge of either the electron or positron; $k = 1/4\pi\varepsilon_0$; ε_0 is the permittivity of free space; and r is the distance between one orbiting particle and the CM. Ordinarily, in SRT one would not represent the force between two moving particles with just a γ in the numerator on the left side of the above equation [1]. But because the force is acting through a stationary CM it can be represented this way. (This is the concept whose difficulty to see and accept is the greatest in this whole analysis.)

The reference for the application of SRT is the CM. An effective stationary charge of $e/4$ is placed at the CM for SRT considerations. The centrifugal force on the right side of the above equation is represented by speed c because the velocity is assumed to be very near c. Also, the γ on the right side of the above equation represents the mass increase of the electron or positron due to its velocity relative to CM. Note that the γ's on each side of the equation cancel in math manipulations, but must remain in some situations. The radius of the orbit is r. The radius r is assumed to remain nearly constant for the various energy levels and values of γ's. According to SRT, when particle speed is near c, particle mass can vary radically with just a small change in speed. For examples of this effect, see Table 1.

Table 1. Mass $\gamma m_e = m_e \big/ \sqrt{1 - v^2/c^2}$

v/c ratio	γ factor	v/c ratio	γ factor
0.999999990	7071.1	0.999995000	316.2
0.999999950	3162.3	0.999990000	223.6
0.999999900	2236.1	0.999950000	100.0
0.999999500	1000.0	0.999900000	70.7
0.999999000	707.1	0.999500000	31.6

3. The Fine Structure Constant α and the Pion Particle

Re-arranging Eq. (1):

$$\gamma k e^2 = 4 \times r \times \gamma m_e \times c^2 \quad . \tag{2}$$

There are several important things to note about Eq. (2):

1) If we set $\gamma = 1/\alpha$, which is not unreasonable since the particles are orbiting each other near the speed of light c, then Eq. (2) becomes:

$$ke^2 \big/ \alpha = 4 \times r \times (m_e \big/ \alpha) \times c^2 = \hbar c \quad , \tag{3}$$

where $\hbar$ is Planck's constant h divided by 2π. And $\hbar c$ is the numerator of the Planck force. It is a strong force that matches the color force of quarks in the proton [2]. The fact that it matches gives strong support to this description of the fine structure constant α. So we may define the inverse of the fine structure constant ($1/\alpha$) as the relativistic gamma factor that modifies the coulomb force and the balanced orbiting masses when the forces are in a state of balance and the masses orbiting at or near the speed of light. This is supported by the fact that $ke^2 = \hbar c\alpha$.

2) We also note that α is associated with the mass m_e, and not the radius of rotation r. The γm_e in (2) refers to the mass of one of the orbiting particles. The total mass of the rotating pair is $2m_e/\alpha = 274.07 m_e$ which is very close to the mass of the charged pion, which is reported to be $273.14\, m_e$. In this author's opinion, this is too close to be coincidental.

3) The radius of the orbiting pair is calculated from Eq. (3);

$$r = ke^2 \big/ 4m_e c^2 = r_e / 4 = 7.044850719 \times 10^{-16}\,\text{m} \quad , \tag{4}$$

where $r_e = 2.890285814 \times 10^{-15}$ m is the conventional electron radius. This result is in the same range as the proton radius, 8.4×10^{-16} m.

4) Using Bohr's Atom assumption that the *total* angular momentum is $m \times r \times c = n\hbar$ we get:

$$2m_e / \alpha \times r_e / 4 \times c = n\hbar \quad . \tag{5}$$

Eq. (5) will agree with Eq. (3) if $n = 1/2$.

5) Thus we have presented a structure of the pion that agrees with what is written in the physics books about the pion: It has a charge of e from (2); it has a mass of $274\, m_e$ (calculated); and a spin of $\hbar/2$.

4. Important and Interesting Formulae Resulting from Eq. (3)

Eq. (3) depicts the relationships of several physical constants that have an important place in basic physics. This section will describe some of them. First is one showing the relationship of Plank's reduced constant $\hbar$ with r_e, m_e, α, c. Substituting (4) into (3) and solving for $\hbar$:

$$\hbar = r_e m_e c / \alpha \quad . \tag{6}$$

Also, in terms of the coulomb force:

$$\hbar = ke^2 / c\alpha \quad \text{and} \quad ke^2 = \hbar c\alpha \quad . \tag{7}$$

Another interesting formula is the expression of the charge squared e^2 in terms of r_e and m_e. By noting that $k = c^2 \times 10^{-7}$ and solving for the charge squared e^2 in (3):

$$e^2 = r_e m_e \times 10^7 \quad . \tag{8}$$

Note that r_e is not the radius of rotation in (3) and m_e is *not* the magnitude of the mass rotating in (3), but that they are characteristics of the basis electron or positron.

Another 'fallout' from (3) in generalized terms is the Bohr Atom assumption:

$$m_{\text{total}} \times r_{\text{rotation}} \times c = n\hbar \quad . \tag{9}$$

as shown in (5). Also, this is related to the de Broglie relation for light photons.

5. The Mass-Energy States of the Pion

Bohr stated the assumption that the total orbital angular momentum of orbiting particles is $m \times r \times c = n\hbar$, $n = 1/2, 1, 3/2, 2$, *etc*. Writing out this equation for the pion situation:

$$\gamma 2m_e \times r_e \big/ 4 \times c = n\hbar \tag{10}$$

We see in (10) that as the energy of the system increases, γ increases along with the energy state defined by n. The total mass m of the orbiting pair is represented as:

$$m = \gamma 2m_e = m_n m_e \tag{11}$$

where m_n is the total mass at energy state n expressed in units of m_e. Substituting (11) into (10), using (6), and solving for m_n:

$$m_n = \gamma 2 / \alpha = 4n / \alpha \quad . \tag{12}$$

The mass-energy states of Eq. (12) are easily computed and compared with known energy states of baryons and mesons [3]. See Table 2.

Eq. (12) is a simple linear discreet equation with a slope of $4/\alpha$. The first value of m_e for $n = 1/2$ is 274.07. At $n = 8$ the value of m_e is 4385.15. The value of the radius of the orbiting pair is constant for all n and is $r_e/4$. The speed of each particle is at or near c. Observe from Table 1 how the speed of the particle can be near c, yet the mass can vary considerably due to relativity.

It is to be noted from (11) that:

$$\gamma_n = m_n m_e \big/ 2m_e = m_n / 2 \tag{13}$$

Table 2 compares between computed output masses to Known Particle Masses. Masses are given in m_e units. Matches are within 1/2 percent. The known elementary masses include P-Baryons and b-Mesons

Table 2. Comparison between Computed Particle Masses and Measured Particle Masses

	n	computed	measured
1	0.5	274.07	p[2] 273.15
2	2.5	1370.36	p[6] 1369.85
3	4.5	2466.65	p[18] 2465.72
4	4.5	2466.65	p[19] 2473.55
5	5.5	3014.79	p[29] 3013.66
6	8.5	4659.22	p[52] 4639.87
7	8.5	4659.22	p[53] 4647.69
8	8.5	4659.22	p[54] 4657.48
9	10.0	5481.44	p[57] 5479.39
10	4.0	2192.58	b[3] 2183.14
11	5.0	2740.72	b[12] 2749.48
12	5.5	3014.79	b[18] 3001.53
13	5.5	3014.79	b[19] 3003.88
14	6.0	3288.86	b[24] 3272.76
15	6.0	3288.86	b[25] 3287.63
16	6.0	3288.86	b[26] 3303.29
17	6.5	3562.94	b[34] 3551.60
18	6.5	3562.94	b[35] 3561.60
19	7.5	4111.08	b[47] 4109.54
20	8.0	4385.15	b[49] 4403.08
21	9.5	5207.37	b[55] 5185.85
22	11.5	6303.66	b[58] 6320.87

Discussion of Results in Table 2

The large number of matches within ½ percent supports the analysis and the idea that (2) and (3), while being equations that depicts two orbiting particles (electron and positron), provide a description of one particle (pion). The results do point to a way in which basic matter may be regarded. Stability is achieved by balance of two forces: attraction force and centrifugal force. Quantum theory and SRT are also incorporated. The mass-energy states are achieved by SRT with velocity near the speed of light. The radii of the particles remain constant for different n's and is in the nuclear size range. The particle acts like an energy container. The comparisons ignore angular momentum and charges of the known particles. Only the masses of the known particles were taken in consideration. Thus, more work is required for further analysis. The results suggest that basic charged particles are just composed of two orbiting particles and that charge and electric fields are representations of particle size r_{e} and basic rest mass m_{e} as in (8). With charge represented in this manner, it becomes possible that matter is fractal in structure.

6. The Electron

Since we have used Eq. (1) and Bohr's assumption to create the pion from two orbiting masses, the electron and positron, maybe we can use the same equations to find the mass value m_{p} of one of two orbiting oppositely charged particles to create a particle having the characteristics of an electron. Charges are conserved. The electron has a negative charge of magnitude e, a mass value of m_{e}, and a spin of $\hbar/2$. Start with an equation like Eq. (3):

$$ke^2/\alpha = 4\times r\times(m_{\mathrm{p}}/\alpha)\times c^2 = \hbar c \quad . \tag{14}$$

We desire that twice the mass in (14) to be equal to m_{e}:

$$2m_{\mathrm{p}}/\alpha = m_{\mathrm{e}} \quad \text{or} \quad m_{\mathrm{p}} = \alpha m_{\mathrm{e}}/2 = m_{\mathrm{e}}/274 \quad . \tag{15}$$

Substituting m_p of (15) into (14) and solving for r:

$$r = \frac{ke^2}{\alpha\times 4\times m_e c^2/2} = \frac{r_e}{2\alpha} = 1.9307963218\times 10^{-13}\,\mathrm{m} \quad . \tag{16}$$

Applying Bohr's assumption, $m\times r\times c = n\hbar$:

$$m_{\mathrm{e}}\times r_{\mathrm{e}}/2\alpha\times c = n\hbar \quad . \tag{17}$$

Eq. (17) matches Eq. (14) if $n = 1/2$.

Thus, it is demonstrated a particle can be represented with (14) that has characteristics of the electron or positron: It has a mass of m_{e}, a spin of $\hbar/2$, and a charge of e that follows from Eq. (14). Perhaps there is a photon of mass $m_{\mathrm{e}}/274$, with a spin of $\hbar/2$, and a charge of e that has two smaller charge particles orbiting in it and that particle is one of the orbiting particles in the electron or positron.

7. A Fractal Theory of Matter

The formulae deriving the characteristics of the pion and possibly an electron suggest that matter is fractal in nature.

Here are some characteristics that these particles might have:

1) Two orbiting charged particles make one orbiting particle in a bigger particle. See Fig. 2.

2) Each such particle has a charge of e.

3) Each such particle has a spin of $\hbar/2$.

4) Each such particle has a relativistic mass increase moving at near light speed c, making it smaller to fit into the larger particle.

5) The charge is created by its size, rest mass, and angular momentum.

6) The fractal formula is (14) with r and m_{p} generalized appropriately to be variables that keeps the forces balanced. This establishes 'scales' of the fractal.

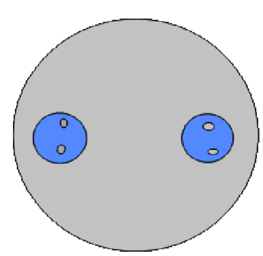

Figure 2. Possible fractal nature of particles of matter .

What would create the first pair in the fractal remains an open question. The proton particle may be somewhat more complex than a fractal particle, since it is composed of three quarks. However, there may be a way to fit it into the fractal theory.

Matter is mostly relativistic energy moving at light speed. Another problem with this fractal idea is how to get bigger, light-weight masses into smaller, heavier masses. However, light does not seem to have this problem. Photons of large wavelength can condense their energy and size into a much smaller atom.

6. Conclusion

The formulae representing the orbiting electron-positron relationship at the subatomic level is shown to have the characteristics of a charged pion particle. In a similar manner a particle having the characteristics of an electron is developed. The probable cause of the inverse of the fine structure constant α is identified as a relativistic gamma factor increase. Some mass-energy states of a pion have been shown to match masses of known elementary particles. All the results, taken together, suggest a simple fractal theory of matter that could be used in describing particles of matter.

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References

[1] James Keele "SR Theory of Electrodynamics for Relatively moving Charges", Proceedings of the Natural Philosophy Alliance, 16th Annual Conference of the NPA, 25-29 May, 2009, at the University of Connecticut, Storrs, 6 (1) pp. 118-122

[2] R.J. Heaston, "A New Look at the Concept of Force", Speculations in Science and Technology, Vol 6, No. 5 (1983) – pp. 485-497.

[3] CRC Handbook of Chemistry and Physics, 52nd edition, The Chemical Rubber Co., 18901 Cranwood Parkway, Cleveland, Ohio 44128, 1971, p. F-211 to F217.

Atmospheric Muons: SRT Confirmation? cont. from p. 16

Table 1. Net Number of Muons *vs*. Altitude

altitude (m)	density kg/m^3	intensity muons / min	muons created	muons undestroyed	net muons
15,180	0.196	71.21	1.000	0	1.000
14,520	0.217	70.08	1.089	0.5	1.589
13,860	0.238	65.91	1.124	0.795	1.919
13,200	0.259	62.12	1.153	0.959	2.112
12,640	0.280	56.82	1.140	1.056	2.196
11,880	0.315	49.64	1.120	1.098	2.218
11,220	0.340	48.19	1.174	1.109	2.283
10,560	0.375	43.12	1.158	1141	2.300
9900	0.410	36.59	1.075	1.150	2.225
9240	0.445	33.70	1.074	1.112	2.187
8580	0.480	30.07	1.034	1.093	2.128
7920	0.515	25.72	0.949	1.064	2.013
7260	0.565	23.53	0.952	1.006	1.959
6600	0.615	19.85	0.875	0.979	1.854
5940	0.665	17.28	0.823	0.927	1.750
5280	0.715	15.44	0.791	0.875	1.666
4620	0.765	13.60	0.746	0.833	1.579
3960	0.815	11.76	0.687	0.789	1.476
3300	0.890	10.66	0.680	0.738	1.418
2640	0.965	9.56	0.661	0.709	1.370
1980	1.040	8.82	0.667	0.685	1.342
1320	1.120	8.46	0.679	0.671	1.360
660	1.200	8.09	0.695	0.675	1.370
0	1.280	7.72	0.708	0.685	1.393

3. A Speculation

The trend shown in Fig. 3 indicates the number of muons *vs*. altitude rises initially with decreasing altitude as the atmospheric density increases fairly steadily while the cosmic ray intensity decreases sharply but is still at its highest levels. Subsequently the number of muons decreases with decreasing altitude, leveling off as one approaches sea level at ~ 1.4 as the steady increase in atmospheric density is countered by the leveling off of the decrease in cosmic ray intensity and continued decay of previously created muons. The trend over the same range measured by Frisch and Smith (~ 2000 m to sea level) is slightly upward (1.342 to 1.393), an increase by $\sim$ 4% *vs*. their observed decrease by $\sim 27\%$. However, this does not even remotely approach the presumed non-relativistic decrease of ~88% over that same range that would be expected if all atmospheric muons were created at one altitude (~ 15 km) then decayed with the 2.2-μs half-life as they plummeted toward sea level at near-*c* speed. Therefore, while the relativists will contend that the Frisch-Smith observations are explained by relativistic time dilation, dissidents like myself might counter that other non-relativistic explanations are also plausible. Given the extreme simplicity of my model here (direct proportionalities to only the ratios of atmospheric density and cosmic ray intensity), it is easy to imagine other secondary effects that could change the slight increase over the Frisch-Smith range that I estimate to align with the decrease they observed without resorting to relativistic time dilation as a panacea.

References

[1] http://hyperphysics.phy-astr.gsu.edu/hbase/particles/muonatm.html

[2] http://en.wikipeida.org/wiki/Time_dilation_of_moving_ particles)

[3] http://debunkingrelativity.com/muons-time-dilation/

[4] http://en.wikipedia.org/wiki/File:Comparison_US_Standard_atmosphere_1962.svg

[5] http://hyperphysics.phy-astr.gsu.edu/hbase/Astro/cosmic. html)

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