Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

Fundamentals of Universal Gravitation

Ogaba Philip Obande
Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria (Retired)
Email: gababands@gmail.com

Abstract

Universal gravitation is investigated with principles of foundational classical (Newtonian) physics. The results reveal gravitation an atomic field action; hence, Newton's law, although absolutely valid, unavoidably misleads in creating the impression of matter rather than waveform action. Six force constants fully define gravitation: (i) a waveform torque field $G_{\Gamma(w)}$; (ii) an expansion force field G_P; (iii) a centripetal force field G_v; (iv) a matter-wave torque field $g_p \sim 10^5 G_{\Gamma(w)}$ (the force fields $G_{\Gamma(w)}$, G_P and G_v constitute gravitational inertial rest frame); (v) a Galilean acceleration field g_w and (vi) nuclear inverse mass-squared centripetal force constant $F_w/m_w^2 = 8.02\ x\ 10^{59}\ N\ kg^{-2}$. The inertial rest frame force constants sum up to give observational G = 2.266 + 2.61 + 2.61cos46°) x 10^{-11} = 6.689 x 10^{-11} $m^3\ kg^{-1}\ s^{-2}$. Notably, the procedure is able to account also for observational $\sim 45^o$ inclination of galaxies and their aligned conjunctions. An attempt is made to account for angular momentum quantization and rectilinear, parabolic or elliptic profile of objects in gravitational acceleration. Same quantitative expression, $g_w^4 = mr^2\omega\,\pi c_o$, defines the photon and gravitation thus uniquely unifying gravitation, electricity and magnetism; furthermore, the expression reveals the photon packed with tremendous energy amounting to some $1.83\ x\ 10\ to\ 2.0\ x\ 10^{21}\ watt\ s^{-1}mol^{-1}$. It is argued that: (i) neither mass nor gravitation curves spacetime; (ii) the principles that sustain cosmic time-scale dynamic equilibrium, scale invariance and inertia are incompatible with quantum gravitation; and (iii) the cosmic vacuum field comprises gravitational (photonic) waves, hence the interferometer likely measures shock waves.

Key words: Angular momentum: Cosmological periodic envelope: Gal: Newtonian gravitation constant: Nuclear inverse mass-squared force constant.

1 INTRODUCTION

Two important publications capture the essence of the quantum volume and diversity of literature on gravitation theories: [1] BH, GTG, and [2] VTG. BH provides one of the most valuable and exhaustive compilations-with-commentaries on concerted global efforts to develop a gauge theory of gravitation. Svidzinsky (Svidz)'s paper [2] addresses the same subject from a commendable perspective, his approach is not entirely new, but definitely innovative. As observed in a rare, succinct and truly professional editorial to the paper by Chen [3], no conceivable notion is spared in the global research effort to explain gravitation. The common experience though is that the excitement which usually attends a new approach sooner or later often falls short of the expected holistic picture.

Newton, of course, originally found an empirical inverse square law that relates distance to the force of gravity, in the present context it reads,

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

$$G_N = M_{p1}M_{p2}/Fr^2 \qquad (1)$$

where indices N and p stand respectively for Newton and particulate matter. Classical investigation reveals that, although it is unquestionably valid, (1) is unavoidably misleading; it creates the notion that gravitation is an action of particulate matter [4]. This notion might have influenced the consensus that its wider applications failed to meet the criteria for a valid theory of gravitation, the minimum requirement, of course, includes prediction of mercury's perihelion shift, explanation for deflection of light grazing a large cosmological body, and explanation for the Viking spacecraft time-delay experiment [5].

To correct the perceived limitations, Einstein came up with the brilliant ideas of general and special relativity, GR and SR. GR's score card on the minimum requirement tests is simply phenomenal. However, GR and SR's conceptual foundations continue to generate considerable controversies and to date they leave the global physical community sharply divided on several key foundational issues [6]; there seems no end in sight. Relativity, however, remains the foundation upon which physics' best model of reality, the Standard Model SM, is founded. Unyielding dissatisfaction with the SM [7] is what efforts such as Svidz's [2] seek to redeem using none other than the existing concepts; it is, therefore, not surprising that despite its brilliance his 'vector theory of gravitation' VTG is received with understandable scepticism. A common experience is that the closer we seemed to getting gravitation right, the further we actually found ourselves from observational reality. It is evident that what started out as a search for possible solution to perceived errors of the Newtonian approach seems now to have compounded the problem the more.

Over the years we have been investigating the prospect of a classical approach for particle physics – the classicalization project CP. The project has produced compelling lines of evidence in support of some very interesting positions: (i) the classical mass formula CMF $m = E/c^2 = h\nu/c^2$ is under-investigated and grossly under-utilized thus, physics of the cosmic vacuum field CVF remained entirely unknown; (ii) actions in invisible space motivate visible effects [8-11]. Thus, without a clear understanding of the CVF it is absolutely impossible to develop an applicable theory of actions that are exclusive to that field and gravitation happens to be a most visible action in invisible space. After centuries of trying, it should now be evident that no trick exists in concordance physics which is able to make visible space field parameters suitable for construction of a reliable theory of gravitation, same applies to other observational CVF actions such as atomic mass phenomenology, the fundamental physical constants, cosmic mass and energy densities, metric expansion of physical space, et cetera. Here, we report on results of classical investigation of actions that motivate gravitation in its entirety.

2 METHOD

Most of what follows is collated from published CP procedure. Atomic mass is evaluated with use of the classical mass formula CMF,

$$\boldsymbol{m = E/c^2 = h\nu/c^2} \qquad (2)$$

Detailed analysis of (2) reveals that: (i) oscillation frequency ν identifies with the

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

primitive e-m radiation that defines the atom; (ii) ν is a quadruplet, each of its four values refers to a phase of a quadri-phasic common reality; (iii) ν gives rise to four atomic mass generations three of which are well known [12-14], the fourth, daily encountered yet unknown, identifies with the atomic waveform; (iv) the waveform, characterized with ultra-low atomic mass values, constitutes the CVF; thus, the vacuum field is physical [15-19], it comprises a pool of atomic e-m oscillations each defines the chemical element; (v) the atom's physical properties derive from linear correlation of classical simple harmonic motion SHM parameters of its e-m oscillation; these, of course, include four atomic mass m variants and corresponding variants of frequency ν, radius r, angular speed ω, stress σ, strain γ, modulus ϵ, density ρ, and centripetal force F. Evaluation procedure of these parameters have been presented, [16,20].

2.1 *Quantitative gravitation analysis*

Gravitation parametric quantitative analysis yields six constants: (i) Newtonian waveform *torque* force constant, $\boldsymbol{G_{\Gamma(w)}}$; (ii) Newtonian waveform gravitational *expansion* force constant $\boldsymbol{G_P}$; (iii) Newtonian waveform centripetal (gravitational) acceleration force constant $\boldsymbol{G_v}$; (iv) Newtonian *matter-wave torque* force constant $\boldsymbol{g_{\Gamma(p)}}$; (v) Galilean waveform gravitational acceleration constant $\boldsymbol{g_w}$; (vi) nuclear inverse mass-squared gravitational (centripetal) acceleration force constant $\boldsymbol{F_n}$. Notably, summation of $\boldsymbol{G_{\Gamma(w)}}$, $\boldsymbol{G_P}$ and $\boldsymbol{G_v}$ reproduces the Newtonian constant $\boldsymbol{G_N}$, we present the details.

2.1.1 *Newtonian waveform torque field*

Nature achieves spontaneous rotation by contriving different ways of effecting torque [18], some of the most effective are the ones that motivate gravitation G, electricity E and magnetism M [4]. Gravitation rotational torque is achieved through linear correlation of field radius and density, i.e.,

$$\boldsymbol{G_1 = G_{\Gamma(w)} = r_w \rho_w^{0.25} = 2.291\ x\ 10^{-11}} \quad (3a)$$

where index w, of course, refers to wave; dimensional analysis gives,

$$\boldsymbol{G_{\Gamma(w)} = (3m_w r_w/4\pi)^{0.25} = 2.266\ x\ 10^{-11}\ (Nm)^{0.25}}$$

2.1.2 Gravitational expansion and compression

Field density correlates with stress to simultaneously motivate expansion and compression, i.e.,

$$G_2 = \rho_w/\sigma_w^{1.33} = 2.754\ x\ 10^{-11} \quad (3b)$$

dimensional analysis gives,

$$G_2 = 3/(4\pi r_w^3 m_w^{0.3} \omega_w)$$

$$= 2.61x10^{-11}\ (m_w^{0.3} r_w^2 \omega)^{-0.3} (m/s)^{-2.3}$$

G_2 is a doublet comprising G_{21} and G_{22} where,

$$G_{21} = G_P = 2.61\ 10^{-11}\ (mr^2\omega)^{-0.3} \quad (3c),$$

it gives rise to gravitational field expansion, and

$$G_{22} = G_v = 2.61\ 10^{-11}\ (m/s)^{-2.333} \quad (3d)$$

it is responsible for field compression, normally associated with gravitational attraction.

2.1.3 *Newtonian matter-wave torque*

Order of magnitude of $g_{\Gamma(p)}$, 10^{-6}, creates the impression of Galilean acceleration but the

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

metrics clearly identify with *matter-wave* torque, it writes,

$$g_{\Gamma(p)} = r_p \rho_p^{0.25} = 6.7920\ x\ 10^{-6} \quad (4)$$

dimensional analysis gives,

$$g_{\Gamma(p)} = (3m_p r_p/4\pi)^{0.25} = 5.712\ x\ 10^{-6}\ (Nm)^{0.25};$$

notably, $g_{\Gamma(p)} \cong 10^5 G_{\Gamma(w)}$.

2.1.4 Galilean gravitational acceleration constant

One notices that Galilean gravitational acceleration unit gal g_w hardly gets a mention in the literature but, as we shall see, without it a valid account of gravitational acceleration becomes a tricky business. It is a waveform doublet force field with what some day might turn out to be one of the most important field parametric couplings in all of theoretical physics; it writes,

$$\boldsymbol{g_w = \epsilon_w/\sigma_w^{0.75} = 2.3496\ x\ 10^{-6}} \quad (5)$$

dimensional analysis yields,

$$g_w = m_w^{0.25}(\pi r_w)^{0.75}\omega_w^{0.5} = 2.348\ x\ 10^{-6}\ (\mathrm{mr^2\omega})^{0.25}\pi c_o^{0.25}$$

2.1.5 Nuclear inverse mass-squared centripetal acceleration

Graphical correlation gives,

$$F_n = F_w/m_w^2 = 7.9433\ x\ 10^{59} \quad (6)$$

and dimensional analysis gives,

$$F_n = 8.0267\ x\ 10^{59}\ ms^{-2}kg^{-2}$$

where, F_n is inverse mass-squared force acting on the rotating energy packet's core or nucleus, $F_w = m_w r_w \omega_w^2$ is, of course, centripetal force acting on a wave packet in harmonic oscillation and $F_n = F_w/m_w^2$. Observe that nuclear centripetal acceleration force F_n follows similar inverse square law that defines Newtonian gravitation, while G_N is defined by inverse *distance* squared, F_n is defined by inverse *mass* squared. Based on exponential size of its numerical value we attribute F_n to the strong nuclear (binding) force SNF. Notice that the dimensions, ms^{-2}/kg^{-2}, rewrite $(ms^{-1}/kg)\ (rad\ s^{-1}/kg)$; in other words, acceleration in spacetime is, *invariably*, a combination of uniform angular speed and radial velocity. The combination is implicated in quite a wide variety of effects including orbital precession, evolution of matter [21], natural radioactivity [22], expansion of physical space [23].

3 RESULTS

The results are presented in Tables 1 to 3 and Fig. 1. Table 1 presents atomic F_w/m_w^2 values; Table 2 shows the composite force constants of gravitation, comprising: Newtonian - G_1, G_2, and $g_{\Gamma(p)}$; Galilean - g_w, and atomic inverse mass-squared centripetal force, F_n. Table 3 presents F_n values of cosmological bodies, and Figure. 1 illustrates atomic field parameters that jointly motivate *gravitation and electromagnetism*. A most noticeable feature of the data in Tables 1 to 3 is the revelation that gravitation is of *atomic origin*; the data is possibly among the most condensed compilations of reality's visible and invisible essence, quantitative expressions are incorporated to ease reference, particularly in view of newness of the approach; the raw data is available in Table 2 of [4].

4 ANALYSIS

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

4.1 *Newtonian gravitation phenomenology*

The analytical procedure reveals Newtonian gravitation a hybrid packet of vacuum and matter field couplings, i.e., gravitation combines distinctive vacuum and matter phases of reality; it explains its spatial phase-invariance, i.e., visible and invisible matter are subject to same gravitation laws despite mutual orthogonality [24]. Two orthogonal torque $(Nm)^{0.25}$ planes comprising the waveform, $G_{\Gamma(w)}$ and matter-wave $g_{\Gamma(p)}$, eqs. (3a) and (4), 'spin' the body in an inertial rotational 'rest' frame; an inverted angular momentum waveform field G_P, (3c) creates a localized expansion field to keep constituents from collapsing; simultaneously, an accelerated inverted waveform velocity (centripetal force) field G_v (3d) counter-balances the expansion field to secure 'static' equilibrium and maintain fixed separation between the gravitating bodies over cosmic time frame. The force fields (3a), (3c), (3d) and (4) constitute Newtonian gravitational inertial rest frame. In other words, gravitation is *not* just simple mutual attraction between two or more bodies; G_v pulls the bodies together centripetally while simultaneously G_p pushes them apart pneumatically they thus attain fixed equilibrium separation over cosmic time scale. One finds, therefore that nature has an in-built mechanism whereby internal collapse of bodies in *active* gravitation is voided; it refutes the popular mathematical conjecture of a 'Bing Bang' scenario. If the picture afforded in (3a), (3c) and (3d) gave a complete description of gravitation, moduli of the inertial force fields would reproduce observational G value, however, we find as follows:

$$G_N = |G_\Gamma| + |G_p| + |G_v| \qquad (7)$$

Table 1. Atomic unit-mass gravitational constant

PE	e	H	Fe	Br	U
r/m	1.5E+08	7.3E+04	7.1E+01	3.8E+01	3.1E-02
m_w/kg	7.4E-51	1.5E-47	1.5E-44	2.9E-44	3.6E-41
ω/rad/s	6.3E+00	1.3E+04	1.3E+07	2.5E+07	3.0E+10
F_w/N	4.4E-41	1.8E-34	1.9E-28	6.7E-28	1.0E-21
F_w/m_w^2	8.0E+59	8.0E+59	8.0E+59	8.0E+59	8.0E+59

Table 2. Gravitational force constants

PE	G_1 $r_w\rho_w^{0.25}$	G_2 $\rho_w/\epsilon_w^{1.333}$	g_p $r_p\rho_p^{0.25}$	g_w $\varepsilon_w/\sigma_w^{0.75}$	F_n F_w/M_w^2
E	2.3E-11	2.6E-11	6.8E-06	2.3E-06	8.0E+59
H	2.3E-11	2.6E-11	6.8E-06	2.3E-06	8.0E+59
C	2.3E-11	2.6E-11	6.8E-06	2.3E-06	8.0E+59
Si	2.3E-11	2.6E-11	6.8E-06	2.3E-06	8.0E+59
Fe	2.3E-11	2.6E-11	6.8E-06	2.3E-06	8.0E+59
Ta	2.3E-11	2.7E-11	6.8E-06	2.3E-06	8.0E+59
Rn	2.3E-11	2.7E-11	6.8E-06	2.3E-06	8.0E+59
U	2.3E-11	2.7E-11	6.8E-06	2.3E-06	8.0E+59
Am	2.3E-11	2.7E-11	6.8E-06	2.3E-06	8.0E+59

$$= (2.266 + 2.610 + |2.610\cos 46^o|)\, x\, 10^{-11}$$

$$= 6.689\, x\, 10^{-11}\, m^3 kg^{-1} s^{-2}, \text{i.e.,}\ (m/s)^2 m/kg$$

where G_Γ, G_P and G_v refer respectively to the three causal waveform force constants: rotation $\Gamma_w^{0.25}$, expansion $P_w^{-0.3}$, and compression $v^{-2.333}$. The net effect of these and other force fields, of course, creates significant internal pressure within the energy packet [18,25]; notice that the expansion effect of $P_w^{-0.3}$ identifies with the notion of 'anti-gravity', similarly, the

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

compression effect of $v^{-2.33}$ naturally interprets as 'attraction'. In evaluating these quantities one

Table 3. Nuclear unit mass-squared gravitational force constants of cosmological bodies

Body	Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Sagr A*
Eqt. rad/m	7.0E+08	2.4E+06	6.1E+06	6.4E+06	3.4E+06	7.1E+07	6.0E+07	2.6E+07	2.5E+07	1.2E+10
Nucl. vol./m^3	1.1E+11	4.8E-10	1.6E-06	1.0E+00	3.6E-09	1.2E+01	2.5E+00	9.0E-03	1.5E-02	7.2E+30
Rot. Vel./ m/s	2.0E+03	3.0E+00	1.8E+00	4.7E-01	2.4E+02	3.5E+00	2.7E+00	7.2E-01	7.4E-01	7.7E+06
Vac. mass/kg	2.8E-25	1.3E-45	4.1E-42	2.7E-36	9.3E-45	3.1E-35	6.5E-36	2.3E-38	3.8E-38	1.9E-05
F_w/N	1.6E-27	4.7E-51	2.2E-48	9.1E-44	1.6E-46	5.3E-42	8.1E-43	4.8E-46	8.6E-46	9.2E-02
F_w/m_w^2	2.0E+22	3.0E+39	1.3E+35	1.3E+28	1.8E+42	5.6E+27	1.9E+28	8.6E+29	5.8E+29	2.6E+08

Note: Equatorial radius, nuclear volume and equatorial rotational speed were retrieved from Wikipedia under the relevant subject, en.wikipedia.org/wiki/Subject, see Section 4.3

must ensure that the numerical value must be accurate to minimum nine decimal places for reliable results. Notice also that calculated $G = 6.689\,x\,10^{-11}$ reproduces 2014 CODATA almost to its exact value, $6.674\,x\,10^{-11}\ m^3\ kg^{-1}s^{-2}$; furthermore, the moduli summation amazingly reveals the gravitating envelope inclined at 46^o to the horizontal in remarkable agreement with observational 45^o inclination of galaxies and their aligned conjunctions [26-29].

To our best knowledge this is the first time parametric analysis has reproduced accurate values of observational gravitation parameters. To say we were not surprised by these results is to be economical with the truth; we were shocked to find that purely theoretical arguments could reproduce observational G value to such degree of precision and perfectly account for inclination of galaxies and their aligned conjunctions. It librates from an element of doubt the philosophies underlying the CP and restores greater confidence on its underlining assumptions. Notably, prior evaluations of: absolute atomic mass [17]; the fundamental physical constants [16,20], mass and energy densities of the cosmos, [19] and recent explanation of the Hubble drift [23] have all received a strong backing from the present results.

4.2 Gravitational acceleration

We reason as follows: the gravitating envelope is held in an inertial rest frame by the combined scalar fields $|G_{\Gamma(w)} + G_P + G_v + g_p|$, it acquires gravitational acceleration upon coupling to $g_w = (m_w r_w^2 \omega_w)^{0.25} \pi c_o{}^{0.25}$ (5), where $r\omega = \pi c_o = v_o$ [6]. Observe that the force field couplings defined in eqs. (3a), (3c), (4) and (5) provide rare insights into the phenomenology and theoretical foundations of inertia.

The atom is a logarithmic spiral [30], the structure is much more conspicuous in the waveform than in condensed matter as a result, space is a continuous series of spiral sizes. The concept was first brought to light in an original conjecture by Descartes [31], later explained in greater detail and formalised by Huygens [32]. A CP programme recently used the concept to account for metric expansion of physical space [23]; the literature shows that the concept seems to be gaining renewed traction [15].

Viewed against the Cartesian space background (5) indicates that gravitational

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

acceleration is essentially movement of the coupling $\{|\vec{g}_w| + |G_{\Gamma(w)} + G_v + G_P + g_p|\}$ down the arms of vacuum spacetime logarithmic spiral. A lin-lin plot of atomic mass m vs. mass number Z results in nine exponential segments each represents a period, whereas log-log plot of same is perfectly linear, see Figs. 1 and 6 [33]. In other words, the spiral arms give rise to periodicity thus, the feature originates in the vacuum phase, condensed matter periodicity is emergent. We submit that freefall along logarithmic spirals manifests gravitational acceleration [15,30].

The trajectory of an object in gravitational freefall depends, of course, on projection angle. With vertical drops (zero projection angle), the trajectory appears perfectly rectilinear; this is because the object and radius of the spiral arm into which it is dropped are similar in size, e.g., Galileo's famous weight-drop experiment. With an increase in projection angle, the same trajectory balloons into the familiar parabolic/elliptical tracks of projectiles and cosmic bodies. Movement along the logarithmic spiral arm is illustrated in Fig. 1 as an angular momentum wave packet spiralling along the photonic radial (tangential) motion; we plan to submit an independent elaboration on the subject. Notice that (5) reveals not only a massive photon, its intrinsic angular momentum makes it much more involved than conventional notion would suggest.

4.3 Nuclear inverse mass-squared gravitational acceleration

Data in Table 3 explain as follows: (i) taking the object (periodic envelope PE)'s radius at the equator serves to avoid longitudinal radial variation; (ii) core (nuclear) volume is calculated from radius value retrieved from Wikipedia's Schwarzschild_radius; (iii) equatorial velocity retrieves from the object's Wiki source; (iv) vacuum mass equivalent is calculated from particulate body's core volume using the reported cosmic vacuum density $\rho_{vac} = 2.61\ x\ 10^{-36}\ \ kg/m^3$ [19]; (v) nuclear centripetal force follows from the classical expression $F_w = m_w v_w^2/r_w$. Tables 1 to 3 reveal not only atomic origin of gravitation, they also illustrate *oneness* of centripetal and gravitational forces, a fact already well-known to jet propulsion labs the world over. Within the context of the analysis no other force compares to the sheer grip of the centripetal (gravitational) vacuum field coupling $F_{n(w)} = F_w/m_w^2 = 8.027\ x\ 10^{59}\ \ ms^{-2}kg^{-1}$. It is identified with the *Strong Nuclear Force* SNF solely on account of its inconceivable strength. Notice that the quotient is invariant in the vacuum field but specific to matter field. It implies that nature designs the condensed matter energy packet to degrade much faster than its vacuum counterpart; an invariant matter field $F_{n(p)} = F_p/m_p^2$ would obliterate key distinctions between vacuum and condensed matter worlds and result to a totally different experience of reality. The Solar System serves in Table 3 to illustrate F_w variation in cosmological bodies, the Milky Way's nucleus, Sagittarius A* is included to provide a much wider perspective. Table 3 suggests possible existence of a correlation between age of the planet and $F_{n(w)}$ value; the table might make an interesting investigation. It is particularly interesting to note that despite the rate and quanta of energy churned out from the nuclei, F_w values of the Sun and Sagr A* are in

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

each case lower than those of the planets, the finding seems informative.

4.4 Gravitation motivated electromagnetism

Equation (5) is attributed to Galilean acceleration only on account of identification of its numerical (exponent) value with established Gal. Fig.1 clearly identifies the equation with a slight modification that incorporates an intrinsic angular momentum field $m_w r_w^2 \omega_w$. We have reason to expect that (5) might, some day, turn out as one of the most important equations in theoretical physics. It describes an intrinsic photonic angular momentum field ($m_w r_w^2 \omega_w$), the structure is illustrated in Fig. 1.

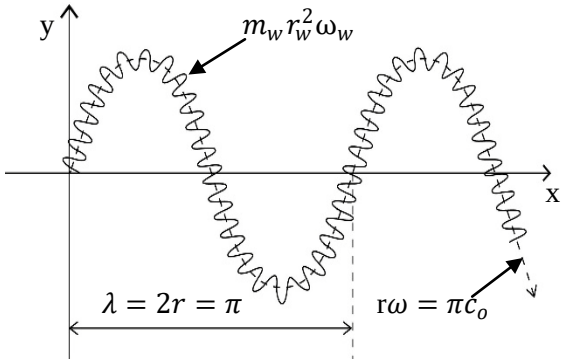

Fig. 1. Vacuum angular momentum force field $m_w r_w^2 \omega_w$ spiralling the vacuum oscillator c_o

Taken together, Fig. 1 and eq. (5) indicate three distinguishable 'speeds' of 'light': (i) *vacuum scalar oscillation* c_o associated with rest mass; (ii) *photonic superluminal tangential velocity* πc_o associated with radiative vacuum, the energy packet πc_o is quite peculiar in that its modulus does not belong to the spectrum of an element of the chemical periodicity, it is thus a non/un-matter energy packet, [6,34]; (iii) the photonic 'graviton', i.e., motivator of gravitational acceleration, the gal g_w.

Notice that, $g_w = m_w^{0.25}(\pi r_w)^{0.75}\omega_w^{0.5}$, (5), applies to only a quadrant (the vacuum field) of the spherical cosmic envelope; it is raised to the fourth power g_w^4 to acquire globalization and this enables the vacuum field permeate the three particulate-matter spatial fields as has been severally conjectured [8-11]. However, vacuum permeation of matter field does not have an effect on matter radiation $c^o = 3.71352291\ m/s$ [35]. In order to retain focus and observe space restriction we are unable to elaborate here on effects of the distinctions between the c_o generations, an independent submission on the subject is anticipated. The literature, however, suggests existence of awareness of a distinction between radiative $\lambda = r\omega = \pi c_o$ and non-radiative vacuum oscillation c_o [36]. The present results unambiguously show that gravitation and light are (quantitatively) inseparable, the duo oscillates with c_o and translates with superluminal velocity $\pi c_o = v_o$.

5 DISCUSSION

5.1 Gravitation causality

In the interest of preserving the underlining mathematics of atomic point mass conjecture, the extended atom, actively promoted by Born [37], remains unspeakable despite compelling lines of supporting evidence [38,39]. Empirical evidence in support of the atom's intrinsic angular momentum gets seemingly fixed with an indigestible menu of explanations. The challenge is not with the physics but the mathematical procedure to quantize physical rotation; to date, one still finds explanations like: 'The atom does not physically rotate, quantum angular

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

momentum is an intrinsic property'. None of the proponents of this strange idea bothers to provide the details of the 'intrinsic property' that leads to the stationary atom's quantized angular momentum. However, we present here solid classical evidence to the effect that scale-invariant (atomic to cosmic) rotation motivates gravitation and all other physical properties of matter [18]. Once the atom gets recognized as an extended body perpetually in harmonic oscillatory motion, the puzzle automatically resolves; most of its properties, including angular momentum, present quite naturally as harmonic rotational (SHM) parameters [16]. The electron wave-packet is the quantum unit, all others are geometric (logarithmic) multiples of this unit. It routinely facilitates parametrization of gravitation.

Intrinsic rotation results from existence of direct proportionality in variation of atomic radius with field density; for the vacuum field, we have $r_w = 2.29\,x\,10^{-11}/\rho_w^{0.25}$ (3a), while matter field gives, $r_p = 6.79\,x\,10^{-6}/\rho_p^{0.25}$ (4). Angular momentum $\boldsymbol{P}$ quantizes through a simple engineering device that tailors the atom's harmonic parameters to ensure mass-number invariance of $\boldsymbol{P}/atom = mr^2\omega = 1.041\ x\ 10^{-33}\ kg\,m^2\,rad\,s^{-1}$, values of m, r and ω increase proportionately with an increase in mass number to keep $\boldsymbol{P}$ invariant. The same device also ensures $\boldsymbol{P}$ is spatial phase-invariant; however, the resulting torque $\Gamma = mr^3\omega^2$ is phase-specific with $\Gamma_w = 9.80\,x\,10^{-25}$ and $\Gamma_p = 1.21\,x\,10^{-46}\ kg\,m\ (m/s)^2\,(rad\,s^{-1})^{-1}$ [4] for wave and matter fields respectively.

5.2 Gravitational energy potential well

The present results do not indicate existence of a gravitational energy potential well into which gravitating objects may roll to minimize the system's internal energy. A combination of harmonized force fields correlate to simultaneously bind, rotate, expand and compress to define gravitational inertial rest frame; the frame couples to the Galilean vector $\vec{g}_w$ to effect acceleration at superluminal velocity πc_o. With respect to energy profile, the inertial rest frame represents a minimum for the system of gravitating bodies; pictorially, it comprises a *packet* inside which the bodies are held rather than a *well* into which they roll. However, the network of gravitational and other parametric correlations present the physical vacuum comprising a mesmerizing grid of interwoven lines of force comparable to an intricately woven fabric. The texture is much more complex than feasible outside the domain of the superfluid; the parameters seamlessly inter-penetrate in the most amazing way imaginable. It is deducible from the literature that crystal planes are constrained by planes of these criss-crossing vacuum force fields, in effect the network provides templates upon which crystal planes evolve [21], the picture raises the prospect of tailoring crystals to suit specific purposes.

5.3 Mass and curved spacetime

Mass does *not* curve spacetime, neither does spacetime curvature trace in any way to rest mass; however, torque-motivated rotation would quantitatively identify with the curl of gravitational field. The streaming concept of mass needs total overhaul grounded on established fundamentals. Mass derives from longitudinal strain imposed on the field [40], it is

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

phase-invariant and defined in the parametric coupling,

$$k = \tau/(\omega/r)^{0.5} \quad (8)$$

where τ is longitudinal strain or tension on the atomic e-m oscillation, (we suspect that this radiative vacuum tension might not be totally unconnected with the familiar but ill-defined metric tensor of relativity), ω is angular speed, r envelope radius and proportionality constant $k = 931{,}494\ MeV$ is, of course, electromotive equivalent of the amu. The phenomenon has been investigated to an extent but, much work still remains to get beyond the tip of the iceberg called mass [17].

5.4 Quantum gravity

Wheeler is on record for raising the poser: 'How come the quantum?' [41], as far as we know the question remains valid and unanswered. The quantum retains its literal meaning in theoretical physics, i.e., specific or *discrete* amount. The electron is the fundamental mass/energy quantum, every other packet is derived. Let $\nu_{e^-} = s^{-1}$ then $E_{e^-} = h\nu = 6.626\ x\ 10^{-34}\ J$ and $m_{e^-} = E/c_o^2 = 7.3725\ x\ \ 10^{-51}\ kg$ [17], it accounts for ubiquity of Planck in all of the sciences. An x-y plot of the elements' atomic properties unavoidably always intercepts the axes at x = 0, y = electron's value [16]; these observations speak unequivocally to electron's full elemental status and fundamentality. For reasons best known to those who thought it wiser, a new scheme was invented to account for atomic mass phenomenology and evolution. It seeks to replace the well-established scheme handed down from the classical luminaries, founding fathers of experimental and theoretical physics. The ceaseless struggle to make sense of the new scheme provokes Wheeler's timeless question.

In building the chemical elements nature designs the electron to make its harmonic parameters evolve in precisely measured *discrete* geometric progression, see the values in the appendix to [23]; thus, the cosmic vacuum field, comprising the elements' atomic waveforms, is not continuous but *discrete* and *periodic*. But, gravity is not quantized [42-44], reality's design is not compatible with quantum gravity beyond the photonic 'graviton', that is, photon with intrinsic angular momentum [45,46]. The explanation needs no belabouring, a ready cue from chemistry would suffice, quantum interaction: (i) is a unit (discrete) process, which, with cosmic time, is bound to set up its specific oscillation capable of disrupting the existing universal harmony; (ii) often serves to minimize the system's internal energy, gravitation achieves same objective minimally with a classical design that confers inertial rest upon a system in perpetual active dynamic setting; (iii) is often attained with total or partial energy packet transfer, or significant geometric re-arrangement; in gravitation such a process would not only continually disrupt the overwhelming symmetry (e.g,, scale invariance) of spacetime, it would jeopardize life itself by putting it under perpetual threat of attrited annihilation; (iv) is often exothermic, cosmic-scale exothermicity could create temperature scales capable of killing off many organic lives as we know it on Earth.

Modern physics has consigned into oblivion age-long invaluable contributions to the subject. Specific case may be made of Weber's fundamental law of electrodynamics action in which it is quantitatively shown that gravitation,

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

electricity and magnetism are *all* due to *waves travelling with the velocity of light*; Newton's law of gravitation turns out the first term of Weber's generalized action law. [8,47]. The present results would question the system that logs away invaluable results founded on well-established traditions in favour of interminable expensive search in the clouds for the exotic. Only during the final literature search did we chance upon Weber's excellent theoretical framework on unification of gravitation, electrodynamics and magnetism. In view of previously published quality research results on the subject, re-affirmation by the present results, and huge resource input in manpower, finance and infrastructure, it might be wiser to drastically scale down further investment in the illusive search for quantum gravity. The *photon* is the quantum and motivator of gravitational acceleration, it is the '*graviton*'.

5.5 The photon's energy potential

Equation (5) gives the unit atomic waveform angular momentum $g_w^4/\pi c_o = 1.041\,x\,10^{-33}$, $kg\,m^2\,rad\,s^{-1}$; it is a universal (vacuum and matter field) invariant, tangential projection at πc_o transcribes the numerical gal in thermal units, i.e, $g_w^4 = 3.04\,x\,10^{-23}\,watt\,s^{-1}\,atom^{-1}$. Literature's $N_A = 6.022\,x\,10^{23}$ gives a modest $18.3\,watt\ \ s^{-1}mol^{-1}$, while theoretical $N_A = 6.623\,x\,10^{43}$ units [35] gives an incredible $2.0\,x\,10^{21}\ \ watt\,s^{-1}\,mol^{-1}$. Either value reveals the photon packed with tremendous inherent molar energy. The value would account for atomic basis of the LASER/MASER technology; much more importantly, the finding simply implies that with the right technology humanity needs only to harness the photon's intrinsic energy the value of which compares to atomic energy on molar bases, see Table III [35]. This specific result seems so incredible an independent verification of the underlying philosophy, the arithmetic and the metrics would be highly appreciated. The photon's electromagnetism shall be addressed in a separate submission.

5.6 Unification of gravity, electricity and magnetism

Eq. (5) presents a unique energy unification scenario, it expresses, in a very simple way, the essence of gravitational acceleration, electricity and magnetism GEM; in view of space we are able to give the subject only a brief mention. It was submitted [16] that torque fields motivate all three effects, the field was ranked according to its exponent in order to explore the quantitative basis for literature ranking of the strong, electromagnetic and weak force. The present results would question exclusive use of strength of the torque field to rank the three observational effects because: (i) torque does not feature patently in electrodynamics action, e.g., eV equivalent of the amu [17]; (ii) as depicted in Fig. 1, (5) describes the three effects with same parametric combination, i.e., they are fundamentally inseparable; (iii) in terms of strength of the coupled field none other compares to the sheer grip of the inverse mass-squared gravitational (centripetal) acceleration, $F_n = 8\,x\,10^{59}\,N/kg^2$, on which basis we may comfortably rank gravitation strongest of all three effects. It would seem that classification of force fields as strong, electromagnetic and weak is misleading; they are variants of a fundamental causality with no clear distinction except in the observational effects [8, p. 263].

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

5.7 Gravitation or shock waves?

Figure 1 is proof that gravitation waves but, only in the context of light waves, the result supports earlier findings that gravity travels at vacuum velocity of light [48]. Gravitation parametric analysis does not indicate a wave other than light waves, it raises the obvious question: What then does the interferometer measure? Our immediate response would be '*shock waves'*. The present result strongly implicates the photon alone in gravitation phenomenology; with the exception of mechanical perturbations, none other than light waves is involved. This should be good news; expectedly, a photonic graviton would greatly ease the search for quantum gravity unless it insisted on finding some other quantum packet outside the photon. A vital hint concerning the object the interferometer measures hinges on feasibility of measuring light quanta/interference patterns by mechanical means regardless of the pattern's strength or device sensitivity unless, of course, the pattern induced mechanical perturbations.

The cosmic vacuum field is photonic, (5) makes no distinction between this field and gravitational acceleration potential or inertial reference frame. One is, therefore, inclined to the view that the interferometer measures mechanical perturbations in the CVF. In other words, cosmic collision produces shock waves [49]; it would call for more research to unveil the physical nature of the vacuum field. This field is normally assumed superfluidic (Bose-Einstein Condensate); its ability to transmit shock waves across cosmic distances would imply that above certain threshold, impact could generate mechanical disturbances in a superfluid and cause its tranof lightission across the cosmic expanse. In other words, friction could be generated in a superfluid if the condition was right. We think greater dividend might be realised if, in addition to detecting gravitational/shock waves, the interferometer formed part of a wider research facility committed to demystifying the vacuum field.

5.8 Test of a new gravity theory

Ideally, the ultimate test of a new gravity theory should be a measure of how close calculated G was to the observational value. Rather sadly, however, for lack of a theoretical framework, this simple test has eluded physicists. In saying, '… I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypotheses; …' Newton himself openly admits the difficulty associated with constructing a valid gravitation theory from fundamental principles. In order to find a way around the challenge, it became necessary to device such tests as summarized in [5]. However, it is 'shown through three different approaches that, contrary to a long-standing conviction, the orbit of Mercury behaves as required by Newton's equations with a very high precision …' [50]; this position resonates with Weber's law of electrodynamics action [47]. We are unaware of a refutal, if right, Corda's position would have a number of disturbing implications: (i) it would mean that failure of the test might not necessarily imply a wrong theory but could be due to deficient application, as might well be the case with Newtonian gravitation; (ii) it would expose researchers' general readiness to accept a position before due diligence was observed, particularly if the position was packaged in elegant mathematics;

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 18 July 2022 doi:10.20944/preprints202207.0263.v1

and more importantly, (iii) it would mean that a new theory able to pass the prescribed tests automatically qualified, though wrongly so, for correct description of reality. It is, therefore, no surprise that a plethora of gravitational theories all passed these and other, more 'rigorous', tests yet, gravitation remained unfathomed.

An investigator has taken a deeply critical look at the reigning paradigm upon which all else hangs, he concludes that: 'In view of these and other findings, it is doubtful whether a geometrized gravitational theory – which is reminiscent of Kepler's laws – is capable of describing the dynamic phenomena due to gravitational forces' [51], the view re-echoes the present results.

6. SUMMARY

Newton's law of gravitation is, of course, valid; however, it unavoidably gives the wrong impression that gravitation is a matter- rather than vacuum-field action.

Gravitation is of atomic origin, it results from linear correlation of simple harmonic parameters of the atom's *physical rotation*. The effect is centripetal acceleration, therefore, its attractive force results *not* from within but centripetal compression from without.

Six constants fully define gravitational action: (i) four are Newtonian including, eqs. (3a), (3c), (3d) and (4), they collectively define inertial rest frame of the gravitating body; (ii) Galilean acceleration constant; and (iii) nuclear inverse mass-squared centripetal force constant, identified with the strong nuclear force.

Gravitational inertial rest frame force field motivators sum up to give observational G, i.e., $|G_\Gamma + G_p + G_v \cos 46^o| = 2.689\ x\ 10^{-11} m^3/kg/s^2$; the procedure also yields observational $\sim 45^o$ inclination of galaxies and their aligned conjunctions.

The atom's angular momentum $\boldsymbol{P} = 1.041\ x\ 10^{33}\ kgm^3 rad\ s^{-1}$, is spatial phase-invariant, i.e., same value applies to wave and matter fields; however, the torque (or curl) field is phase-specific being, $\Gamma_w = 9.8\ x\ 10^{-25}$ and $\Gamma_p = 1.2\ x\ 10^{46}\ m/s\ (rad/s)^{-1}$ for wave and matter fields respectively.

Acceleration in spacetime is invariably a combination of angular speed and radial velocity. It is known to motivate a wide range of effects from orbital precession to natural radioactivity.

A body in gravitational acceleration scales down the arms of spacetime's fundamental logarithmic spiral structure; a dead-weight drop trajectory appears perfectly rectilinear; however, with an increase in projection angle the trajectory transforms from parabolic to elliptic tracks.

Electron is the fundamental quantum energy packet, every other energy packet is derived; atomic angular momentum quantization results from mass-number invariance of rotational parameters of electron's mass evolution.

Same quantitative expression defines gravitational acceleration, electrodynamics and magnetism, it reveals perfect unification of actions that define observational reality.

The photon intrinsically packs with substantial molar energy, $18.3\ watt\ s^{-1} mol^{-1}$ for

literature's $N_A = 6.02\,x\,10^{23}$ or 2.0 $x\,10^{21}\ watt\ s^{-1}mol^{-1}$ for theoretical $N_A = 6.62\,x\,10^{43}\ units$. It is argued that with the right technology the photon could offer the cheapest and most environmentally friendly inexhaustible energy source.

With the exception of torque-motivated intrinsic rotation, neither gravitation nor mass curves spacetime; gravitation comprises an inertial packet in superluminal acceleration and mass comprises specific atomic waveform parametric coupling.

For thermodynamics and mechanistic reasons nature, by design, precludes quantum gravitation; however, the view, buttressed with centuries-old published positions, now seems long forgotten.

Same quantitative expression defines the photon and gravitational acceleration implying that vacuum space is composed of photonic gravitational waves! Thus: (i) in line with literature position, gravity moves at superluminal velocity πc_o and (ii) the interferometer likely measures none other than shock waves.

7 CONCLUSION

The classical (Newtonian) approach realises a gravitation theory that is visual, cognitive and conceptual. A plus sign for the method is that in every case the position is supported with simple, easily verifiable, quantitative expressions that leave little, if any, room for doubt. The results re-affirm an insistent position that effects motivated by actions in invisible (vacuum) space cannot be successfully described with visible matter parameters. The limitation is most likely responsible for difficulties with use of conventional procedure to account for such actions as atomic mass phenomenology, vacuum field energy density, metric space expansion, the fundamental physical constants.

Acknowledgement

The 'Classicalization Project' CP relies much on inspiration from published records of scientific approaches of Sir Isaac Newton. He is, without doubt, the perpetual Chair of Classical Physics, which has stood its ground as the only conjecture-free physics that correctly describes reality.

References

[1] Blagojevic, M., Hehl, F. W., 2013, Guage theories of gravitation – A Reader with Commentaries. Imperial College Press, London arxiv.org/ftp/arxiv/papers/1210/1210.3775.pdf.

[2] Svidzinsky, A. A., 2017, Vector theory of gravity: Universe without black holes and solution of dark energy problem. arxiv.org/pdf/1511.07058.pdf. Phys Scr.12. 125001

[3] Chen, G. (2017). Editorial on 'Vector theory of gravity. Phys. Scr. 92, 6. Doi:10.1088/1402.4896/aa93a9.

[4] Obande, O. P. (2016a). Classical definitions of gravitation, electricity and magnetism. Appl. Phys. Res. 7(6), 85. Doi: 10.5539/apr.v7n6p85

[5] Moffat, J. (2013). Experimental tests of a new theory of gravitation. Can. J. Phys. 59(2), 283

[6] Obande, O. P. (2016b). On the photon's identity: Implications for Relativity and Cosmology. Appl. Phys. Res. 8(5), 10. Doi:10.5539/apr.v8n5p10

[7] CDF Collaboration et al. (2022). High precision measurement of the W-boson mass with the CDF II detector; Doi:10.1026/science.abk1781

[8] See, T. F. F. (1920). New theory of the Aether, 3rd Paper. Astron. Nachr. 212(5079),235. NASA Astrophys. Data System. adsabs.havard.edu/pdf/190AN ….212…2358

[9] Lorentz, H. A., (1952). *The Theory of Electrons*. Dover, Harlem, p.45

[10] Misner, C. W., Thorne, K. S. Wheeler, J. A., (1973). *Gravitation*. W. H. Freeman & Co, San Francisco

[11] Mazilu, N. (2008). Mechanical problem of ether. Apeiron, 15(1),48

[12] Francis, M. R. (2015). The mystery of particle generations. symmetrymagazine.org/article/august2015 /the-mystery-of-particle-generations

[13] Weinberg, S. (2020). Models of lepton and quark masses. Phys. Rev. D101, 0350020

[14] Burdyuzha, V. (2014). Three levels of particles are necessary for our universe and the next level of matter J. Mod. Phys. 5(17), 191. Doi: 10.4236/jmp517191

[15] Boldyreva, L. B. (2018). Spin system of the physical vacuum as a source of energy. Int. J. Phys. 6(4), 128. Doi:10.12691/ijp-6-4-5k

[16] Obande, O. P. (2017a). On the fundamental physical constants: I. Phenomenology. Appl. Phys. Res. 9(5), 42. Doi: 10.5539/apr.v9n5p42

[17] Obande, O. P. (2016c). Atomic mass: Origin, Units and Constants Appl. Phys. Res. 8(1), 92. Doi: 10.5539/apr.v8n1p92

[18] Obande, O. P. (2019a). On intrinsic rotation of bodies. JHEP Grav.& Cosm. 5, 868. Doi:10.4236/jhepgc.2019.5304

[19] Obande, O. P. (2019b). Mass and energy densities of the cosmos. Appl. Phys. Res. 11(6), 19. Doi:10.5539/apr.v11n6p19

[20] Obande, O. P. (2017b) On the fundamental physical constants: II. Field coupling geometry. Appl. Phys. Res. 9(5), 62. Doi: 10.5539/apr.v9n5p62

[21] Golubev, S. N. (2016). Structure mechanism of ordinary mass formation. J. Mod. Phys., 7, 875. Doi: 10.4326/jmp.2016.7909

[22] Obande, O. P. (2015a). Classical mechanics analysis of the atomic wave and particulate forms. Int. J. Eng. 4(6), 1. www.theijes.com/papers/v4-i6/version-2/A046201011.pdf

[23] Obande, O. P. (2021). A classical physics approach for space expansion: The Hubble Drift. Appl. Phys. Res. 13(2), 39. Doi: 10.5539/apr.13n2p39

[24] Obande, O. P. (2017c). The Pan-STARRS static sky: A classical physics goldmine for cosmology, astrophysics and atomic physics. Appl. Phys. Res. 9(6), 75. Doi: 10.5539/apr.v9n6p75

[25] Burkert,V. D., Elouadrhini, L. & Girod, F. X. (2018). Pressure distribution inside the proton. Nature, 557, 396. Doi: 10.1038/s41586-018-006

[26] West, M.J. et al. (2017). Ten billion years of brightest cluster galaxy alignments. Nature Astron. 1(7), 0157

[27] Taylor, A. R. & Jagganathan, P. (2016). Alignment of radio-galaxies in deep radio images of ELAIS N1. MNRAS Lett. 495(1), L36

[28] Reiss, A. et al. (2016). A 2.4% determination of the local value of the Hubble constant. ApJ., 826, 56. Doi: 10.3847/0004-63

[29] Crockett, C. (2014). Galaxies may be aligned across 1 billion light years. Science News 186(13), 6-6

[30] Gomez, L. F., Ferguson, K. R. et al. (2014). Vortex droplets inside individual helium droplets are imaged using x-ray diffraction. Science, 22 August. Doi: 10.1126/science.1252395

[31] Descartes, R. (1644). *Prinzipien Philosophie, Teil 3* von der Sichtharen Welt, Absmitt 23

[32] Huygens, C. (1690). *Cosmotheoros*. pasengenproject.com/blog16/2012/11/24/ Christain-huygens-descartes-vortex

[33] Obande, O. P. (2013). Notes on Russellian cosmogony Part I: Absolute Atomic Mass. Int. J. Eng. 2(4), 68. www.theijes.com/papers/v2-i4/part.%20(2)/M0242068077.pdf

[34] Goldfain, E. and Samarandache, F. (2008). On emergent physics: "Unparticle" and exotic "Unmatter" states.Prog. Phys. 4, 10

[35] Obande, O. P. (2015b). Notes on Russellian cosmogony. II. A procedure for theoretical evaluation of relative atomic mass and internal energy. Phys. Essays 28(1), 78. Doi: 10.4006/0836-1398-28.1.78

[36] Lo, C. Y. (2012). Gravitation, physics and technology. Phys. Essays 25(4), 553. Doi: 10.4006/0836-1398.25.4.553

[37] Born, M. (1935). *The Mysterious Number*. www-old.ias.ac.in/j_archive/ proca/2/ top.html

[38] Raman, C. V. & Bhagavantam, S. (1931). Experimental proof of the spin of the photon. Ind. J. Phys. 6(3244), 353; Doi: 10.1038/1290022a0

[39] Uhlenbeck, G. E., & Goudsmit, S. (1926). Spinning electrons and the structure of spectra. Nature, 117(2938), 264

[40] Macken, A. J. (2011). *The universe is only spacetime*. www.onlyspacetime.com

[41] Wheeler, J. A. (1986). Why the Quantum? Ann. New York Acad. Sci. Doi:/10.1111/j.1749-6632. 1986.tb 12434.x

[42] Choi, C. Q. (2018). Is gravity quantum? Sci. American, 14 August. Scientificamerican.com/article/is-gravity-quantum/

[43] Rovelli, C. (2008). Quantum gravity. Scholarpedia 3(5), 7117. Doi: 10.4249/scholarpedia.7117

[44] Lieu, R. (2018). Exclusion of standard $\hbar\omega$ gravitons by LIGO observation. Class. Quant. Grav. 35, 19LT02. Doi:10.1088/1361-6382/aadb30. arXiv:1712.04437[astro-ph.HE]

[45] Arnaut, H. H. and Barbosa, G. A. (2000). Orbital intrinsic angular momentum of single photons generated by parametric down-conversion Phys Rev. Lett. 85(2), 286; Doi:10.1103/PhysRevLetts.85.286

[46] Stewart, A. M. (2005. Angular momentum of light. arXiv:0504078.pdf

[47] Weber, W. H. (1864). Determination of Electromagnetic measure: particularly in respect to the connection of the Fundamental laws of Electricity with the law of gravitation. Translated from the German by George Gregory. 21sci-tech.com/translations/Weber-EM8-pdf

[48] Tang K. Y. et al. (2013). Observational evidences for the speed of gravity based on Earth tide. Chin. Sci. Bull. Theor. Phys. 58(4-5), 474477; online: doi:10.1007/s11434-012-5603-3

[49] Gasperin, F. et al. (2022). A&A 695, A146. Doi: 10. 1051/0004-6361/2021 42658

[50] Corda, C. (2020). preprints202006.0236v1(1).pdf

[51] Engelhardt, W. (2017). Free fall in gravitational theory. Phys. Essays 30, 3. Doi: 1.4006/0836-1398-30.3.294