Applied Physics Research; Vol. 8, No. 5; 2016
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

On the Photon's Identity: Implications for Relativity and Cosmology

Ogaba Philip Obande[1]

[1] Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria

Correspondence: Ogaba Philip Obande, Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria. E-mail: obandedav2@yahoo.com

Received: July 19, 2016 Accepted: August 23, 2016 Online Published: September 30, 2016

doi:10.5539/apr.v8n5p10 URL: http://dx.doi.org/10.5539/apr.v8n5p10

Abstract

Light is investigated with simple harmonic motion formalism; the procedure reveals the photon's physical characteristics but fails to provide its exact identity. Its speed identifies with angular velocity, i.e., $c = \omega_{pho}\ s^{-1} = 2.99792458 \times 10^8$ rad s^{-1}, its velocity $v_{pho} = \pi c$ and radius $r_{pho} = \pi$ m. In other words, it is a non-matter energy packet which radiates at a characteristic radio frequency $\vartheta_{pho} = 47.71345$ MHz and $\lambda_{pho} = 2\pi$ m. Although the wavelength corresponds to λ values of wave (bosonic) forms of Cd and In, the quantum mass does not register with an element of the chemical periodicity. Notably, its rest mass is well above the electron's and raises mass conservation issues with the pair production mechanism $\gamma + \gamma \leftrightarrow e^+ + e^-$. The evidence reveals that no natural e-m radiation oscillates above $\vartheta \sim 7 \times 10^9\ s^{-1}$; microcosmic particulate "dark" matter is identified with α- emitters, therefore, detectable. The result also suggests redefinition of the mass-energy equivalence formulation in terms of velocity rather than speed. Implications of these findings for Relativity and Cosmology are highlighted.

Keywords: electromagnetic spectrum, light speed and velocity, photon identity, photon-electron pair production, Relativity

1. Introduction

Persistent controversy over the doctrines of special SR and general relativity GR is hurting physics. It puts a premium on the subject with a tendency to over-emphasize and narrow physical research to mostly relativity issues; it constricts independent thinking and removes focus from other possibilities. There is evidence in the literature to suggest that the controversy is sustained by some misconception or inadequate understanding of the fundamental physics upon which relativity is founded. Until we appreciate the precise natures of light and the vacuum, verbal aggression over relativity can only get worse. One says that light speed is constant (Abdo, et al., 2009), another calls this view a remarkable illusion (Gift, 2010); relativity assumes zero-mass photon (Raghuprasad, 2008), however, experimental evidence abound to the contrary (Biswas et al., 2010); some see no evidence for material vacuum (Schiff, 1960), others cannot understand how such a patent reality would elude anyone (Cahill, 2005; Wright, 2010). Arguably, topmost on the funny side of the debate are Prof. Amelino-Camelina (2009)'s concrete evidence demonstrating a "… burst of support for relativity" and Prof. Gift (2015)'s concrete evidence bursting this support. Someone notes that relativity can be comprehended only by prime intellectuals and blames the situation on the fact that most physicists do not know enough mathematics to handle Einstein's highly advanced concepts (Prather, 2013); another (Lo, 2012) laments "The inadequacy in the mathematics of Einstein and the deficiency in the physics of mathematicians… ". Were it not for its distractive tendency and the subject's decisive role in extant physical paradigm, the amusement would surely be worth the while.

Worried by what he sees as an unhealthy development in the field of atomic physics, a concerned observer (Gebelhoff, 2015) wonders if "Scientists are blocking their own progress" and questions, "Is our understanding of the world based on pure objective reason, or are the theories that underpin it shaped by generational biases?" He proceeds to inform that "Researchers design experiments and make observations in ways that support hypothesis"; and finally advises that "… those who question consensus ought to be given the opportunity to make their own case, not ignored, silenced or pushed to the back of the line". Another (Hogan, 2016) noted that "To recapture its fizz, physics desperately needs not new ideas but new facts … discoveries not inventions. Things have gotten so bad that physicists are openly fretting about the future of their field …". A stakeholder (Eskew, 2016), apparently fed up with the situation, recently recommended total suspension of the principle of relativity; presumably, pending satisfactory resolution of the contentions and in clear support of this view,

another (Klinaku, 2016) bemoans perceived physics' "hostage to a postulate". At the moment, the community is divided into avowed supporters of the totality of provisions of SR and GR (Abdo, 2009; Schiff, 1960; Amelino-Camelia 2009; Prather, 2013; Hafele, 1972; Herr, 2014; Schlatter, 2010; Steinhardt, 2007; Fomalont, 2009; Abott, 2016); those who present evidence to refute certain provisions (Smarandache, 2005; Allanach, 2005; Fortune, 2012; Sauerheber, 2014; Pai, 2015) and those that totally, if vehemently, reject all provisions of both theories (Crothers, 2005, 2008; Gift, 2010 and2015; Raghuprasad, 2008; Biswas, 2010; Cahill, 2005; Wright, 2010; Lo, 2012; Eskew, 2016; Klinaku, 2016; Wang, 2015; Capezzalli, 2016; Phipps, 2016). We make this submission hoping to highlight the basic fundamentals perchance it might provide sign posts to resolving some of the thorny issues.

2. Material Characteristics of Electromagnetic e-m Radiation of a Medium

Ratio of magnitudes of electric E to magnetic B fields of an e-m radiation propagating in a medium, of course, gives the medium's e-m characteristics defined in the constant c, i.e.,

$$E/B = 1/\sqrt{\mu\varepsilon} = c \quad (1)$$

where ε and μ are respectively electric permittivity and magnetic permeability constants of the medium. For propagation in the vacuum, $c = c_o$, is a universal constant, the vacuum light speed. In formulating SR, Einstein, as a matter of course, adopted the concept of light speed invariance, he also re-interpreted Lorentz's original transformation into a formidable factor $\gamma = \sqrt{1-(v/c_o)^2}$ which identifies c_o with universal speed limit. On these pillars and assumed zero-mass photon, Einstein built his enigmatic doctrines of Relativity. Here, we seek to investigate the photon's identity, its assumed zero-mass, Newtonian vacuum emptiness and universal constancy of light speed. Our privileged perception of the fundamentals of classical physics reveals that, with specific reference to these subjects, the protracted debate is fueled by enduring misconceptions. More worrisome, the situation motivates what seems an unintentional drive to overturn established concepts of classical physics. Equation (1) defines e-m characteristics of a medium that "permits" transmission of electric field and simultaneous permeation of the conjugate magnetic field. The expression is well tested and values of its parameters in the vacuum and in other materials are well established; this being the case, c_o variance can arise only if the e-m transmission medium is re-engineered. In addition to defining medium characteristics, as we shall see, c also plays key roles in fixing values of atomic mass and several fundamental constants; we attempt an investigation of its identity.

3. The Classical Photon

The classical photon is much more profound than imaginable within the bounds of conjecture, it turns out, for instance, that the term "photon" currently encompasses the following identities: (i) the electron wave packet; (ii) wave packet of each element, and (iii) the composite wave packets of all chemical elements pooled together to form a unique superfluid which exclusively defines the material vacuum (Obande, 2016a), it manifests the e-m spectrum (Obande, 2015a). We present Table 1 to show that each wavelength in the spectrum is characteristic radiation of a chemical element. The table comprises two broad sections, one set of data for (microcosmic) bosonic waves and a second set for macro- and microcosmic fermionic (particulate matter, or de Broglie) waves.

3.1 Theoretical and Empirical e-m Spectral Frequencies and Wavelengths

The table has been presented in passing but not discussed (Obande, 2015a). Observe that theoretical ϑ_w and λ_w values agree with empirical values furthermore, λ_p agrees with corresponding λ_w, however, theoretical and empirical ϑ_p values diverge significantly. These differences reflect a crucial handicap of physics over the centuries since Planck and Einstein developed their independent (seemingly conflicting) energy equations. Planck's $E = h\vartheta$ perfectly accounted for black body radiation and provided much needed evidence for the wave nature of light while Einstein's $E = mc^2$ supported a "corpuscular" light theory. The apparent contradiction was further compounded when de Broglie combined the two energy equations into $h\vartheta = mc^2$ implying that the atom is intrinsically a wave-particle doublet – a ghostly entity whose exact nature remains un-demystified to date. Although he posited the existence of matter (fermionic) waves and correctly interpreted ϑ an internal "phenomenon" that defines inertial (rest) mass, like most physicists to date, de Broglie (1923), understandably, missed the implicit differentiation of his combined energy equation into the purely wave and purely matter components. In our opinion, if understood in its correct context, the combined energy equation is, arguably, one of de Broglie's greatest contributions to holistic appreciation of matter's inherent structure; it presents a composite wave-particle atom and reveals that Planck's and Einstein's equations give energies of the elemental bosonic (wave) and fermionic (particle) forms respectively, (we have shown that theoretically $mc^2 = k_E h\vartheta$ where the constant k_E gives matter/wave energy ratio of the atom, its value varies randomly from 1.0172 to 104 depending on the element and its reference frame, it is highest for invisible particulate Fe, Obande, (2015b)). Thus, we have,

$$m_w = h\vartheta_w/c_o^2 \quad (2a)$$

$$m_p = h\vartheta_p/c^{o2} \quad (2b)$$

where ϑ is element specific e-m oscillation frequency, subscripts w and p, of course, denote wave (boson) and particle (fermion), c_o and c^o are values of the bosonic and fermionic material constant E/B with c_o = 2.99792458 x 10^8 "m/s" and c^o= 3.715352291 x 10^{-14} "m/s" respectively. Hitherto, physics has been unable to analyze the atom with eq. (2), this handicap has tied down classical physics since Planck's classical quantization of radiation mainly for lack of a theoretical framework for ϑ value; existing established values are products of exceptional experimentation expertise of founding fathers of classical physics. We think λ_w and λ_p values agree because the latter was successfully extrapolated from the former dating back to black body radiation studies but we have no idea how ϑ_p value was obtained without use of eq. (2). It is revealed here that the empirical procedure produces accurate values of ϑ_w, λ_w and λ_p, however, it yields ϑ_p values several orders of magnitude higher than theoretical values. Observe in Table 1 that no natural e-m radiation oscillates above $\vartheta \sim 7 \times 10^9$ s^{-1}.

Table 1. Comparison of theoretical and empirical ϑ/Hz and λ/m e-m spectral values

Chemical group	Atom	Atomic No. Z_R	ϑ theor.	ϑ emper.	λ theor.	λ emper.	Source/Use
	Microcosm: bosonic fields, ϑ_w eq. (2a)			ϑ_w	c_o/ϑ_w	c_o/ϑ_w ?	
1	Ab = e-	1	1	-	3 x 10^8	~ 10^8	Long
2	Bl – En	2 – 6	2 – 16	2 – 10	1.5E5 - 1.9E7	10^8 - 10^7	Waves
3	Ey –Vt	7 -15	1.6E1 - 1.9E2	10 - 10^2	1.2E7 - 1.6E6	10^7 - 10^6	Audio
4	Ou –H	16 – 24	2.6E2 - 2.0E3	10^2 -10^3	1.2E6 - 1.5E5	10^6 -10^5	Waves
5	L – O	25 – 34	2.6E3 - 2.5E4	10^3 -10^4	1.2E5 - 1.2E4	10^5 - 10^4	Radio
6	F – Ar	35 – 44	2.9E4 - 2 6E5	10^4 - 10^5	1.0E4 - 1.1E3	10^4 - 10^3	
7	K – Cu	45 – 55	2.6E5 - 2.6E6	10^5 -10^6	1.1E3 - 1.1E2	10^3 - 10^2	
8	Zn – Mo	56 – 68	2.9E6 - 2.5E7	10^6 -10^7	1.0E2 -1.2E1	10^2 - 10^1	
9	Tc – Pr	69 – 85	2 9E7 - 2.5E8	10^7 - 10^8	1.0E1 - 1.2E0	10^1 - 10^{-1}	Waves
10	Nd – Fr	86 – 113	2.8E8 - 1.1E9	10^8 -10^9	1.1E0 - 2.8E-1	10^{-1} - 10^{-2}	Micro-
1	Ra – Am	114 -121	2.1E9 - 6.4E9	10^9 - 10^{10}	1.4E-1 - 4.7E-2	10^{-2} - 10^{-3}	Waves
						Stars	IR, V, UV, X- & γ- rays
				10^{10} -10^{22}		10^{-14} - 10^{-13}	Gamma
	Micro- and macro- fermions: ϑ_p, eq. (2b)			ϑ_p	c^o/ϑ_p	c_o/ϑ_w?	Rays
1	Ab = e-	1	1	10^{22} - 10^{23}	3.7E-14	10^{-14} - 10^{-15}	α-
2	Bl – En	2 – 6	2 – 16	10^{24} - 10^{25}	1.8E-14 - 2.3E-15	10^{-15} - 10^{-16}	Particles
3	Ey –Vt	7 -15	2.4E1 - 2.0E2	10^{25} - 10^{26}	1.5E-15 - 1.9E-16	10^{-16} - 10^{-17}	
4	Ou –H	16 – 24	2.6E2 - 2.1E3	10^{26} - 10^{27}	1.4E-16 - 1.8E-17	10^{-17} - 10^{-18}	High
5	L – O	25 – 34	2.6E3 - 2.5E4	10^{27} - 10^{28}	1.4E-17 -1.5E-18	10^{-18} - 10^{-19}	Energy
6	F – Ar	35 – 44	2.9E4 - 2.7E5	10^{28} - 10^{29}	1.3E-18 -1.4E-19	10^{-19} - 10^{-20}	
7	K – Cu	45 – 55	2.7E5 - 2.7E6	10^{29} - 10^{30}	1.4E-19 - 1.4E-20	10^{-20} - 10^{-21}	
8	Zn – Mo	56 – 68	2.9E6 - 2.6E7	10^{30} - 10^{31}	1.3E-20 - 1.5E-21	10^{-21} - 10^{-22}	α-
9	Tc – Pr	69 – 85	3.0E7 - 2.6E8	10^{31} - 10^{32}	1.2E-21 - 1.4E-22	10^{-22} - 10^{-23}	
10	Nd – Fr	86 – 113	2.8E8 - 1.1E9	10^{32}- 10^{33}	1.3E-22 - 3.4E-23	10^{-23} - 10^{-24}	
1	Ra – Am	114 -121	2.2E9 - 6.6E9	10^{33} - 10^{34}	1.7E-23 - 5.7E-24	10^{-24}	Particles

Table 1 reveals as follows:

i. The e-m spectrum is produced by oscillations of energy packets that constitute the cosmic reality. Most of these radiations arise from e-m oscillations that define the chemical elements.

ii. The electron bosonic form e_w^- oscillates with the normal mode $\vartheta_{e(w)} = 1.0\ Hz$ to give $\lambda_{e(w)} = 2.99792458\ x\ 10^8$ m, i.e., at the long wave end and marks the upper bound of wavelengths constituting the e-m spectrum. Conversely, its fermionic form e_p^- has $\lambda_{e(p)} = 1.8262\ x\ 10^{-14}$ m is a gamma radiation.

iii. Wavelengths from audio to radio frequencies in the kHz region are radiations of bosonic forms of invisible "elementary particles" $Bl_{(w)}$ to $Cg_{(w)}$ and the visible elements $H_{(w)}$ to $O_{(w)}$ (Obande, 2016b).

iv. Usual radio communication frequencies in MW, SW up to FM bands belong to radiations of bosonic forms of the elements $F_{(w)}$ to $Pr_{(w)}$.

v. The microwave region comprises radiations of bosonic forms of the heavier elements $Nd_{(w)}$ to $Am_{(w)}$.

vi. The stars are shown sandwiched between the micro- and macrocosms perfectly in line with the cosmic large-scale and ir, v, uv, x- to γ-rays arise from stellar radiations in line with observation.

vii. All radiations, from γ-rays to the most energetic α-emission belong to visible and invisible fermionic matter; notably, invisible (so-called "dark") matter radiates in this region, its massive relative atomic mass value (Obande, 2016b) and much shorter λ_p values (Table 1) account for observations of unusually energetic γ-rays and α-emissions, see Edwin (2012) and Dylan et al. (2014);

viii. Oscillation frequency reaches 10^9 Hz with an increase in atomic number, however, a common invariant speed of light c defines all elemental wave packets.

Thus, Table 1 reveals that the photon is not specified in elemental e-m radiations.

4. Light Speed and Velocity

The vacuum of free space comprises exclusively bosons, it is classical Dirac sea, not of electrons *per se* but of waveforms of same chemical elements that define our visible world. In other words, light is the medium of space; it does not travel through another, it is the material vacuum (Obande, 2016a). Since it is an established simple harmonic motion SHM, assumed linear transmission of its wave packet is questionable, according to de Broglie (1923), ϑ is an internal (i.e., cyclic) phenomenon. In this section, we attempt quantitative analysis of the photon, speed and velocity of light in the context of SHM. Without a theoretical perspective of these subjects it is impossible to meaningfully assess Einstein's relativity. To our best knowledge, no recorded attempt has been made to investigate the subject; the goal is to identify c with specific SHM parameter.

Angular speed ω of a SHM relates to the causal periodic oscillation ϑ as,

$$\omega = 2\pi\vartheta \ \ rad \ \ s^{-1} \tag{3}$$

Graphical analysis shows that

$$|v| = \ |r\omega| = \ \pi c \tag{4}$$

where v and ω are, contextually, velocity and speed of light respectively. Equation (4) would identify c with ω if it could be shown that, for the photon, $r_{pho} = \pi$. Now, if $c = \omega$, other SHM parameters retrieve as follows: $\vartheta_{pho} = 2.99792458 \ x \ 10^8/2\pi \ = \ 4.771345$ x 10^7 s^{-1}; $v_{pho} = r\omega = \pi c = 2.99792458\pi \ x \ 10^8 \ m \ s^{-1}$; $\lambda_{pho} = v/\vartheta = 9.41826 \ x \ 10^8/4.7713452$ x $10^7 = 6.283185307$ m and $r_{pho} = \lambda/2 = 3.141592654 = \pi$ m in line with (4). In other words, theoretically, conventional speed of light c is actually the photon's characteristic angular speed, i.e., $c = \omega_{pho} = 2.99792458 \ x \ 10^8$ rad/s, *not* m/s; thus, c presents quite naturally as the familiar information carrier with the appropriate unit cycles/s or Hertz.

Given the above analysis, the mass-energy equivalence formulation becomes $h\vartheta = mv^2$ where $v = \pi c$ (i.e., rω) and re-defines absolute atomic mass value to read $m = h\vartheta/v^2$, e.g., for e-, $m_{e(w)} = h\vartheta_w/v_{pho}^2 \ = h/(\pi c)^2 = 7.47x10^{-52}$ kg. With the present more detailed analysis of the photon, $7.46989912 \ x \ 10^{-52} \ kg$ appears a more accurate value of bosonic electron mass than $m_{e(w)} = h/c^2 = 7.3725 \ x \ 10^{-51} kg$ reported earlier. Thus, for light, theory gives *speed* c = $\omega_{pho} \ = 2.9979 \ x \ 10^8 \ rad \ s^{-1}(Hz)$ and *velocity* $v_{pho} = \ \pi/\sqrt{\mu_0\varepsilon_0} \ = \pi c = 9.47 \ x \ 10^8 \ m \ s^{-1}$.

The theoretical analysis presents the photon as follows:

i. its oscillation at $\vartheta_{pho} = 4.771345 \ x \ 10^7 \ s^{-1}$ does not identify with an elemental e-m radiation indicative of an unfamiliar non-elemental entity;

ii. it identifies with light of invariant angular speed $c = \omega_{pho} = 2.99792458 \ x \ 10^8 \ s^{-1}$ and tangential velocity $v_{pho} = \pi c = 9.41825784 \ x \ 10^8 \ m \ s^{-1}$;

iii. it would rewrite the mass-energy equivalence formulation from $h\vartheta = mc^2$ to read $h\vartheta = mv^2$ and give $m = h\vartheta/v^2$ with $\lambda = v/\vartheta = 2\pi \ m$ as more realistic expressions for absolute atomic mass and wavelength respectively;

iv. its bosonic mass $m_{pho} = 6.62608 \ x \ 10^{-34} \ x \ 4.771345 \ x \ 10^7/(\pi c)^2 = \ 3.56415 \ x \ 10^{-44}$ kg/atom is, notably, eight orders of magnitude higher than electron's.

4.1 Comparison of the Photon, Elemental Bosons and Light

Table 2. Comparison of the bosonic electron with the photon

Property	Radius r/m	Frequency ϑ /s^{-1}	Rot. Speed ω/rad s^{-1}	Tang. vel. rω /ms^{-1}	Boson mass $m_{(w)}$/kg	Density ρ/kg m^{-3}	Rot. Force F/N	Strain τ /%
Photon	π	$4.78x10^7$	3 x 10^8	$9.42x10^8$	$3.56x10^{-44}$	$2.7x10^{-50}$	$7.8x10^{-33}$	10.13
Electron	$1.499x10^8$	1.00	2π	9.42 x 10^8	$7.47x10^{-52}$	$5.2x10^{-76}$	$4.4x10^{-41}$	$2.1x10^{-7}$

Table 2 presents the photon with the following peculiarities: (i) its ϑ, r, ω, and m values correspond to those of bosonic Cd and In; (ii) its ρ value corresponds to those of Rb and Sr; (iii) its rotational centripetal force F comes between those of Na and Mg; (iv) its atomic strain corresponds to indium's; (v) magnitude of its radius is exactly one half of electron's rotational speed, i.e., $|r_{pho}| = |0.5\omega_{e(w)}|$ similarly, (vi) electron's radius magnitude is exactly one half of its rotational speed, i.e., $|r_{e(w)}| = |0.5\omega_{pho}|$. The suggestion of existence of a photonic energy packet λ = 2π (a radio wave), rectilinear speed v = πc and kinetic energy = ½mv^2 = 1.5808 x 10^{-26} J is worth investigating as it could be of significant theoretical (and practical) interest if verified; it would seem to be responsible for visibility of matter.

More significantly, (i) with $v = \pi c$ the photon does present with superluminal translation; (ii) with $m = h\vartheta/v^2$ it is the singular invariant determinant of atomic mass; thus, the slightest variation in its value would alter atomic mass values and those of all known fundamental parameters; (iii) since it transforms the atom's angular speed to velocity, it likely functions actually as a ***projector*** , i.e., a mechanism that casts atomic wave packets onto the vacuum of space to appear as (i.e., create the illusion of) ponderable reality; (iv) it is the only entity that combines physical attributes of bosons of different metallic elements yet does not identify with a chemical element. As observed by Halliday (2002), "The concept of a light quantum or photon, turns out to be far more subtle and mysterious than Einstein imagined. Indeed, it is still poorly understood". Although we have been able to account for its causality and described its physical characteristics, we are no closer to its exact nature.

Observe that the analysis constrains the pair production mechanism γ + γ ↔ e$^-$ + e$^+$. Every radiation in the entire e-m spectrum, including the strange photonic entity just described, has atomic mass value greater than electron's (Obande, 2016b), therefore, as written, the mechanism raises challenging energy balance issues with practical implications.

4.2 Implications for Relativity

The analysis reveals that: (i) widespread evidence for non-zero photon mass refutes the massless photon postulate; and, indeed, no e-m radiation is truly massless since it would imply a local zero-energy domain, impossible within the cosmic envelope; (ii) the mass-energy equivalence formulation $h\vartheta = mv^2$ is unconditionally valid and truly universal, accurate reproduction of absolute and relative atomic mass values with the formulation provides irrefutable evidence (Obande, 2016b); (iii) Newtonian gravitation does not contribute to the photon's energy (Wang, 2015); e-m radiations are in rotational ($\omega/rad\ s^{-1}$) not rectilinear motion, these energy packets can be refracted by change in index n but unbendable by gravitation; (iv) Newtonian vacuum emptiness does not exist, the vacuum comprises e-m radiations of the chemical elements, i.e., light or radiation is the material vacuum; (v) the photon's velocity $v = \pi c$ and angular speeds exceeding 10^{10} s^{-1} provide evidence for natural superluminal speeds.

4.3 Implications for Cosmology

Given the present results, (i) measured cosmological dimensions should multiply by π to obtain true values relatable to reality; (ii) cosmological age of the observable universe should likewise multiply by π to give some 43 billion years; (iii) as is well known, cosmic radiations covering the entire range of the e-m spectrum comprise mostly radiations of the chemical elements; notably, high energy α-emitters identify here with invisible particulate "dark" matter, therefore detectable; ir, v, uv, x- and γ- rays are, of course stellar emissions; the characteristic radio emission λ = 2π identifies here with a non-elemental (non-matter, phantom) "photonic" e-m radiation.

5. Atomic Mass of the Elemental Boson

Some elemental bosonic m_w and fermionic m_p values obtained previously (Obande, 2016b) are presented in Table 3 to facilitate verification of values of λ_w and λ_p in Table 1, i.e.,

$$\lambda = c/\vartheta = h/mc \quad (5)$$

e.g., for e-: $\lambda_{e(w)}$ = 2.99792458*10^8/1.0 = 6.626057 x 10^{-34}/(7.3725 x 10^{-51}*2.99792458*10^8) = 2.99792458 x 10^8 m and $\lambda_{e(p)}$ = 3.715352291*10^{-14}/1.0172 = 6.626057 x 10^{-34}/(4.8828125 x 10^{-7}*3.715352291*10^{-14}) = 3.652528795 x 10^{-14} m; for ϑ_w and ϑ_p values, see Obande 2015b). Note that instead of present values, values of parameters in (5) reported earlier have been used here for realistic comparison with the earlier results.

Table 3. Atomic mass/g of: bosons, $^{\dagger}U^{*}_{abs}$ and fermions, U_r

Group	Element	U^{*}_{abs}	U^{*}_{r}	U^{o}_{r}	U'_{r}
1	e-	7.47E-49	4.883E-04	9.766E-04	4.883E-04
2	Bl	1.493E-48	9.766E-04	1.953E-03	9.766E-04
	En	1.196E-47	7.813E-03	1.563E-02	7.813E-03
3	Ey	1.792E-47	1.172E-02	2.344E-02	1.172E-02
	Vt	1.435E-46	9.375E-02	1.875E-01	9.375E-02
4	Ou	1.887E-45	1.250E-01	2.500E-01	1.250E-01
	H	1.510E-44	1.000E+00	2.000E+00	1.000E+00
5	L	1.887E-44	1.250E+00	2.500E+00	1.250E+00
	O	1.812E-43	1.200E+01	1.600E+01	4.000E+00
6	F	2.114E-43	1.400E+01	1.900E+01	5.000E+00
	Ar	1.933E-42	1.280E+02	4.000E+01	8.800E+01
7	K	1.933E-42	1.280E+02	3.900E+01	8.900E+01
	Cu	1.933E-41	1.280E+03	6.400E+01	1.216E+03
8	Zn	2.126E-41	1.408E+03	6.500E+01	1.343E+03
	Mo	1.855E-40	1.229E+04	9.600E+01	1.219E+04
9	Tc	2.165E-40	1.434E+04	9.900E+01	1.424E+04
	Pr	1.865E-39	1.235E+05	1.410E+02	1.234E+05
10	Nd	2.055E-39	1.361E+05	1.440E+02	1.360E+05
	Fr	7.916E-39	5.243E+05	2.330E+02	5.241E+05
1	Ra	1.583E-38	1.049E+06	2.260E+02	1.048E+06
	Am	4.750E-38	3.146E+06	2.430E+02	3.145E+06

6. The Gravitational Contribution Conjecture

Lo (2012) has faulted Einstein's "three great theories" on some grounds of "oversights", (i) "In special relativity, he failed to see that $E = mc^2$ is only conditionally valid"; (ii) "In quantum theory, he failed to recognize that photons must include non-electromagnetic energy" (iii) "In general relativity, his principle of covariance and theory of measurement are invalid". He cites independent positions including, purportedly, similar views held by Whitehead (1962) and Zhou (1987) to back his claims. We are not qualified to hold a brief for Einstein but are constrained to address points (i) and (ii) in the light of our present and previous findings. He argues that existence of a charge-mass repulsive force $F = q^2m/r^3$ of "a point charge q and a point mass m separated by a distance r … unequivocally rejected the speculation that $E = mc^2$ was valid for electromagnetic energy …". Rather than delve into lengthy discussion of the subject, we simply note that we found "unequivocally" that the photon, vacuum and c_o are significantly different from their conventional notions, therefore, most extant speculations based on the prevailing notions would need re-examination. Furthermore, (i) as explained above, the photon is not subject to Newtonian gravitation, therefore, G makes no contribution to its energy (Wang, 2015); (ii) there is evidence to support his "repulsive" force, it results from gravitational, electric and magnetic fields of *the atom's intrinsic spin*. Depending on the interaction specifics and angular orientation of the coupling forces, mutual attraction or repulsion is realizable (Obande, 2015c). Cited results of experiments by Tsipenyuk and Andreev and others are quite typical of mutual interactions of these force fields with one another or with the earth's field; the effect is observable also with light (Rancourt, 2011; Rancourt et al., 2015 and Porcelli, 2016). Aside these named causalities, we would rather seek basis of the $1/r^3$ force in Mazilu et al. (2014)'s exceptional presentation of the subject. Lest we forget so soon, history teaches that the mass-energy equivalence principle was so successful some of the colorful scientists involved in its validation later wished the equation was never formulated.

7. Summary and Conclusion

In order to provide a platform for realistic assessment of Einstein's Relativity Theories and check perceived tendency to convolute established concepts of classical physics, the phenomenology of light was investigated with fundamental physics, the results are summarized.

i. Each wavelength of the e-m spectrum is characteristic radiation of a chemical element; with $\lambda_{e\text{-}(w)} = 1.499 \times 10^{8}$ m and $\lambda_{e\text{-}(p)} = 3.652529 \times 10^{-14}$ m the electron is the only element that radiates at both ends of the e-m spectrum thus, its radiation seems to enclose all other elemental radiations. Notably, because its e-m energy packet is the least massive the pair production mechanism $\gamma + \gamma \leftrightarrow e^{-} + e^{+}$ would seem energetically unbalanced.

ii. Conventional speed of light c = 2.99792458 x 10^8 turns out not translational but angular motion, an invariant angular speed of all e-m vacuum radiations, i.e., c = ω_{pho} rad s^{-1} *not* m s^{-1}. The ω quantum envelope presents with a characteristic radius r = π m; it reveals a clear distinction between light speed c (ω) and velocity (πc) and rewrites the mass-energy equivalence formulation to read hϑ = mv^2 with λ = v/ϑ.

iii. The photon identifies with an invariant velocity v = $\pi/\sqrt{\mu_o \varepsilon_o}$ = 9.418 x 10^8 m s^{-1} and the following characteristics: ϑ = 4.771345 x 10^7 s^{-1}; ω = 2.99792458 x 10^8 s^{-1}; r = 3.141592654 m and m = 3.564147 x 10^{-44} kg; notably, its atomic mass value does not identify with any element of the chemical periodicity but its physical properties identify with different metallic elements. Interestingly, theory does not seem to register the photon with stellar radiations but radio frequency! Thus, although its properties are theoretically accessible, its exact identity remains a deep mystery.

iv. The results present the following implications for Relativity and Cosmology: the photon has non-zero mass; mass-energy equivalence is unconditionally valid; the vacuum comprises e-m radiations of the chemical elements; natural superluminal speeds exist. Cosmological dimensions should multiply by π to obtain realistic values and age of the universe should multiply likewise to get some 43 billion years. Causalities of cosmic e-m radiations are specified; notably, microcosmic particulate (so called "dark") matter emits γ and α- particles hence, accessible with relevant detectors; radio waves with characteristic λ = 2π indicate non-elemental radiations identified here with a non-matter photonic emission that likely plays significant roles in defining reality.

Possibly for the first time, an energy packet has been revealed which we identify with the term "photon" simply to differentiate it from other familiar e-m quanta. The packet is mysterious in every respect as: it is not identified with energy packets of the chemical periodicity; its physical properties tally with those of metallic elements and it radiates with a uniquely exact radio wavelength λ = 2π m. These and previous revelations based on use of the mass-energy equivalence formulation compel us to doubt if a more embracing "Theory of Everything" superior to the simple expression hϑ = mv^2 (v = πc) can be found. The above theoretical descriptions of a strange "photonic" energy packet are presented for independent verification.

References

Abbott, B. P., Abbott, R., Abbott, T. D., Abernathy, M. R., Acernese, F., Ackley, K., ... & Adya, V. B. (2016). Observation of gravitational waves from a binary black hole merger. *Physical review letters*, *116*(6), 061102. http://dx.doi.org/1103/PhysRevLett.116.061102

Abdo, A. A., Ackermann, M., Ajello, M., Asano, K., Atwood, W. B., Axelsson, M., ... & Bastieri, D. (2009). A limit on the variation of the speed of light arising from quantum gravity effects. *Nature*, *462*(7271), 331-334. http://dx.doi.org/10.1038/nature08574

Allanach, B. (2005). D0 The space-warp. *Nature Phys., 1*, 15. http://dx.doi.org/10.1038/nphys130

Amelino-Camelia, G. (2009). Astrophysics: Burst of support for relativity. *Nature, 462*(7271), 291. http://dx.doi.org/10.1038/462291a

Biswas, A., Krishnan, R., & Mani, S. (2010). Limiting Speed in Nature. *Phys. Essays, 23*, 373. http://dx.doi.org/10.4006/1.3428517

Cahill, R. T. (2005). The Michelson and Morley 1887 Experiment and Discovery of Absolute Motion. *Prog. Phys., 3*(1), 25.

Capezzali, G. (2016). Inverted dynamics. *Phys. Essays, 29*(1), 27. http://dx.doi.org/10.4006/0836-1398-29.1.27

Crothers, S. J. (2005). Introducing Distance and Measurement in General Relativity: Changes for the Standard Tests and the Cosmological Large-Scale. *Prog. Phys., 3*(1), 45.

Crothers, S. J. (2008). On Certain Conceptual Anomalies in Einstein's Theory of Relativity. *Prog. Phys., 1*(1), 52.

Daylan, T. (2014). The Characterization of the Gamma-ray Signal from the Central Milky Way: A Compelling Case for Annihilating Dark Matter.

de Broglie, L. V. (1923). Radiation – Waves and Quanta. *C. R. Acad. Sci. Paris, 177*, 507. http://dx.doi.org/10.1038/11254a0

Edwin. C. (2012) Gamma rays hint at dark matter. Retrieved from http://physicsworld.com/cns/article/news/2012/apr/24/gamma-rays-hint-at-dark-matter

Eskew, R. C. (2016) Suspending the Principle of Relativity. *Appl. Phys. Res., 8*(2), 82. http://dx.doi.org/10.4006/10.5539/apr.v8n2p82

Fomalont, E. B., Kopeikin, S. M., Lanyi, G., & Benson J. (2009). Progress in Measurements of the Gravitational Bending of Radio Waves Using the VLBA. *Astron. J., 699*(2), 1395. Retrieved from http://iopscience.iop.org/article/10.1088/0004-637X/699/2/1395/meta

Fortune, E. S. (2012). Relativity of the velocity of light. *Phys. Essays, 25*(1), 62. http://dx.doi.10.org/4006/0836-1398-25.1.62

Gebelhoff, R. (2015). The Washington Post, Dec. 21. Retrieved from http://washingtonpost.com/news/in-theory/wp/2015/12/2/are-scientists-blocking-their-own...

Gift, S. J. G. (2010). Light speed invariance is a remarkable illusion. *Phys. Essays, 23*(1), 1. http://dx.doi.org/10.4006/1.328083

Gift, S. J. G. (2015). Burst of trouble for relativity: New test of light speed constancy using electromagnetic signal pulses from a geostationary satellite. *Phys. Essays, 28*(1), 20. http://dx.doi.org/10.4006/0836-1398-28.1.20s

Hafele, J. C., & Keating, R. E. (1972). Around-the-World Atomic Clocks: Predicted Relativistic Time Gains. *Science, 177*(4044), 166.

Halliday, D., Resnick, R., & Walker, J. (Eds.). (2002). Fundamentals of Physics (6th edn.). John Wiley & Sons (Asia) Pte Ltd., Replika Press, Delhi, p. 954.

Herr, W. (n.d.) *Relativity. CERN.* Retrieved from http://cern.ch/Werner.Herr/cas2014/lectures/relativity.pdf

Hogan, J. (2015). Are Scientists Blocking their own Progress? Retrieved from http://blogs.scientificamerican.com/cross-check/how-physics-lost-its-fizz/

Klinaku, S. (2016). Physics hostage to a postulate. *Phys. Essays, 29*(2), 225. http://dx.doi.org/10.4006/0836-1398-29.2.225

Lo, C. Y. (2012) Gravitation, physics and technology. *Phys. Essays, 25*(4), 553. http://dx.doi.org/10.4006/0836-1398-25.4.553

Mazilu, N., Agop, M., Axinte, C. I., Radu, E., Jarcău, M., Gârţu, M., ... & Vrăjitoriu, L. (2014). A Newtonian message for quantization. *Physics Essays*, *27*(2), 204-214. http://dx.doi.org/10.4006/0836-1398-27.2.204

Obande, O. P. (2015a). Classical mechanics analysis of the atomic wave and particulate forms. *Int. J. Eng. Sci., 4*(6), 1. Retrieved from http://www.theijes.com/papers/v4-i6/Version-2a0462010.pdf

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. http://dx.doi.org/10.4006/0836-1398-28.1.78

Obande, O. P. (2015c). Classical Definition of Gravitation, Electricity and Magnetism. *Appl. Phys. Res., 7*(6), 85 http://dx.doi.org/10.5539/apr.v7n6p85

Obande, O. P. (2016a). A classical perspective of the cosmological constant. *Phys. Essays, 29*(2), 228. http://dx.doi.org/10.4006/0836-1398-29.2.228

Obande, O. P. (2016b). Atomic Mass: Origin, Units and Constants. *Appl. Phys. Res., 8*(1), 92. http://dx.doi.org/10.5539/apr.v8n1p92

Pai, S. T. (2015). Can the photon be both massive and massless? *Phys. Essays, 28*(1), 55. http://dx.doi.org/10.4006/0836-1398-28.1.55

Phipps, T. (2016). Timekeeping evidence refutes the relativity principle. *Phys. Essays, 29*(2), 62. http://dx.doi.org/10.4006/0836-1398-29.1.62

Porcelli, E., & Filho, V. S. (2016). On the anomalous forces of high voltage symmetrical capacitors. *Phys. Essays, 29*(1), 2. http://dx.doi.org/10.4006/0836-1398-29.1.002

Prather, B. (2013). Is Space-Time Curved? *Prog. Phys., 3*, 157.

Raghuprasad, P. K. (2008). Speed of Light: To beat or not to beat. Retrieved from http://www.spinninguniverse.com/particles/speed_of_light.hc

Rancourt, L. (2011). Effect of light on gravitational attraction. *Phys. Essays, 24*(4), 557. http://dx.doi.org/10.4006/1.3653936

Rancourt, L., & Tattersall, P. J. (2015). Further Experiments Demonstrating the Effect of Light on Gravitation. *Appl. Phys. Res., 7*(4), 14. http://dx.doi.org/10.5539/apr.v7n4p4

Reinhardt, S., Saathoff, G., Buhr, H., Carlson, L. A., Wolf, A., Schwalm, D., ... & Holzwarth, R. (2007). Test of relativistic time dilation with fast optical atomic clocks at different velocities. *Nature Physics*, *3*(12), 861-864. http://dx.doi.org/10.1088/1742-6596/312/10/102014

Sauerheber, R. D. (2014). On the nature of light and relativity. *Phys. Essays, 27*(1), 116. http://dx.doi.org/10.4006/0836-1398-27.1.116

Schiff, L. J. (1960). On Experimental Tests of the General Theory of Relativity. *Am. J. Phys., 28*(4), 340. http://dx.doi.org/10.1119/1.1935800

Schlatter, A. E. (2010). A bound on Classical velocity. *Phys. Essays, 23*(2), 268. http://dx.doi.org/10.4006/1.3361819

Smarandache, F. (2005). There is No Speed Barrier for a Wave Phase Nor for Entangled Particles. *Prog. Phys., 1*, 85.

Wang, L. J. (2015). One hundred years of general relativity - A critical review. *Phys. Essays, 28*(4), 421. http://dx.doi.org/10.4006/0836-1398-28.4.421

Whitehead, A. N. (1962). *The Principle of Relativity* (CUP, Cambridge).

Wright, S. E. (2010). Electromagnetic sources and observers in motion I—Evidence supporting the EM propagation medium for the transmission of light. In *PIERS Proceedings* (pp. 71-76).

Zhou, P. Y. (1987). 37th Int. Conf. Experimental Gravitational Physics. Guang Zhou, China.