

Compilation on the Physical Reality

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Abstract

The compilation summarizes results so far gathered in a project that investigates the atom with classical (Newtonian) physics. It posits that the atom's wave-particle dual nature is real, objective and intrinsic; the wave gives rise to the cosmic vacuum field while the particle, of course, manifests condensed matter. Light's π radians oscillation manifests, on molar scale, significant radial tension in the vacuum field, the effect, amongst others, causes molecular matter to precipitate out of the vacuum – so-called 'molecular outflow'. Cosmic vacuum field radial tension relates to molecular mass, in other words, a mass-radius (M-R) relationship is uncovered. It is argued that using the M-R relation it is possible to perform a valid simulation of the cosmic physical reality. The three states of matter are meaningfully accounted for using the atom's e-m radiation wavelength. It is explained that force, be it of any kind whatsoever, originates in the atomic waveform, i.e., the cosmic vacuum field.

Key words: Causal molecular out-flow: radiation field tension: vacuum elemental condensation: visible and invisible universes: wave-particle duality.

1. INTRODUCTION

Physics is unlikely to break away from the present stagnation and make one more major forward leap without addressing some key areas in which current concordance views are grossly in error, we cite only three cases: the atom is *not* a point mass, it is *colossally* extended, Born (1935); wave-particle duality is real, physical and intrinsic and, the wave function is *not* statistical, it is definitive, specific, and determinant of atomic structure and properties. Until issues with these and many more areas are comprehensively resolved, physics shall continue to provide delightful playgrounds for the fantasy of pure mathematicians and their aspirants. Here, we submit for the records a comprehensive set of data on the physical reality; the data are not discussed in detail as that would require quite a volume, however, after the presentation a few of the interesting implications are highlighted.

The set consists of observational (non-speculative, non-conjectural) values of the atom's physical parameters generated through a familiar procedure that routinely evaluates absolute atomic mass. As is well known, four atomic mass- or particle-generations are experimentally identifiable, Francis (2015), each actually gives rise to a unique state or phase of corporeal existence, i.e., a universe. Reality is thus

quadri-phasic, Obande (2018) and, on the basis of atomic mass value, the visible universe posts the lightest of atoms of the common chemical periodicity that defines the cosmic whole, Obande (2019a). The presentation comprises four tables: Table 1 gives mass-energy $m - \nu$ profiles of each universe's chemical periodicity; Table 2 presents data that reveal cosmic universality of the laws of physics (in all four universes) exemplified with use of the familiar mass-energy equation; Table 3 is a list of the visible atom's mass values in relevant units, and Table 4 presents a list of some of the atom's physical properties evaluated from its harmonic rotational parameters. Although the subjects are not entirely new, the approach is, to our best knowledge, pioneering, therefore, details are provided on the subject of each table's columns.

2. DATA PRESENTATION

An attempt to evaluate observational (relative) atomic mass using the *simplest possible* expression would reveal a reality consisting of four reference frames or universes which work in harmony to define a common experience of a composite reality, these are: (i) cosmic vacuum field universe U_w^* composed entirely of definitive atomic e-m fields or quantum wave (w) packets; (ii) particulate (p) matter component of the vacuum field U_p^* ; (iii) our visible p-

matter universe U_p^o and (iv) invisible p-matter analogue U_p^i of our universe, Obande (2016a, 2015a, 2013). In what follows, mass m and energy ν values

TABLE 1: Mass-energy $m - \nu$ profiles of the observable cosmos, i.e., U_w^* , U_p^* , U_p^o , U_p^i

Column 1: Atomic Symbol

The investigation was inspired by a publication of Walter and Lao Russell (1981) in which the authors claim existence in nature of 121 chemical elements, 23 precede hydrogen and 3 intervene H and He to give a complete and seamless chemical periodicity; it starts at the origin (0,0,0) of spacetime with no gap in-between any two adjacent elements. With hope that the Establishment would be favorably disposed, we took liberty to propose non-conflicting abbreviations for Russells' unknown or invisible elements; furthermore, the name 'nigerion' (Ng) replaces 'blackton' (Bl), $Z_n = 2$, to enable Nigeria, the author's nationality, find a place in scientific literature.

Column 2: Conventional Elements

Established relative atomic mass values are listed in column 2, the 23 pre-hydrogen elements and the 3 elements intervening H and He speak strongly to the subjective nature of conventional atomic mass numbering and electronic structure assignment.

Column 3: The Chemical Periodicity

In contrast with the conventional, Russells' chemical periodicity consists of nine groups and nine periods to reflect nature's atomic mass number evolution, details of the arrangement have been presented, Obande (2018). Observe the way in which the lanthanides and actinides fit in to give natural extensions of what the Russells call 'isotopes', these elements include most of conventional transition elements. The three trans-uranium elements, Np, Pu, Am and nature's first three elements, alberton, Ab (electron, e-), nigerion, Ng (blackton, Bl) and boston, Bs, which precede the first noble gas, alpanon, A would seem to constitute a 'knot' that ties the end of the periodicity to its beginning; the device gives rise to a cosmic perpetual-motion machine, an endless electro-dynamics cycle operating at all scales of existence to manifest observational steady-state, self-replicating cosmos, Obande (2021).

of atoms of these universes are distinguished with relevant lower and upper case indices; the data are presented.

Column 4: Z_n - Natural Mass Number

With a view to honoring the Russells this parameter was initially denoted Z_R , Obande (2019a, 2016b, 2016c, 2015a, 2015b), however, with time its exceptional ability to quantify growth processes in nature warranted its re-designation to natural mass number, Z_n . According to Russell and Russell (R&R 1981), nature's chemical periodicity consists of 121 elements, it starts at atomic electron e-, $Z_n = 1$ and ends at americium Am $Z_n = 121$. A doubt regarding this position is overruled by an amazing ability to reproduce accurate observational values of physical constants, Obande (2017a) and electronic structure, (2017b).

Column 5: ν_w^* - Atomic e-m Oscillation (Cosmic Vacuum Field) – (dark energy I)

Value of the specific atomic waveform e-m field evolves in multiple geometric progression, it varies from e-'s $\nu = 1.000 \text{ Hz}$ to Am's $\nu = 6.443 \times 10^9 \text{ Hz}$. The detailed procedure, which relies on cues from Russells' publication, R&R (1981, pp. 31, 39), has been reported, Obande (2013).

Column 6: m_w^* - Absolute Atomic Mass

Absolute atomic mass value quantification was not imaginable prior to access to the atom's specific ν value. As is well known, it is not unusual for progress in scientific endeavour to rely on inspiration, Kekule's benzene ring structure account readily comes to mind; a similar experience would seem the case with Russells' ν values. The parameter is, of course, denoted m_{abs} but it is reasoned that designating it m_w^* , would facilitate quicker recognition; it retrieves from the classical mass formula, CMF, $m_w^* = h\nu_w^*/c_0^2$. At the moment theoretical physics lumps together atomic parameters of all four phases of reality and treats them as though they belonged to visible reality only, however, we envisage a time when advancement would eventually necessitate a clear distinction between the phases of what seems physically undifferentiated reality.

Column 7: m_p^* - Relative Atomic Mass (dark matter I)

The parameter m_p^* refers to *invisible* condensate of the vacuum field quantum wave packet, m_w^* ; the object is daily encountered in experimental particle physics but, rather sadly, it is not recognized at the theoretical front. Hydrogen's empirical atomic and molecular mass values, $m_p^* = 1.0 \text{ g/u} = 931.494 \text{ MeV}$ and $2m_p^* = 2.0 \text{ g/u} = 1863 \text{ MeV}$ respectively, provide valuable pointers to visible and invisible dual nature of the atom and also of physical reality, see Table 3, cols. 9, 10 and 11, we identify m_p^* with level I, ('deeper' level) 'dark matter', Obande (2018, 2016a). Quantitatively, $m_p^* = h\nu_p^*/c^{o2} = m_{w(E)}^*/m_{w(H)}^* = v_{w(E)}^*/v_{w(H)}^*$, where particulate matter's light speed $c^o = 3.7154 \times 10^{-14} \text{ m s}^{-1}$ (actually, rad s^{-1}) and indices E and H denote 'element' and 'hydrogen' respectively. In the generalized symbol m_p^x , index 'x' specifies the phase or universe. Notably, as c_o is a *vacuum-field* invariant so also is c^o a *matter-field* invariant in all three matter-worlds, U_p^*, U_p^o, U_p' .

Column 8: m_p^o – Relative Atomic Mass (visible matter)

With reference to elemental bi-atomic molecular species such as H_2 , O_2 , Cl_2 , et cetera, the term molar mass seems clear and unambiguous but, it easily becomes capable of losing clarity when applied to atomic species such as H, O, C, Fe, Al, et cetera. From He onwards, mass values of the elements (col. 8) are conventionally associated with atomic mass; however, the present study, summarized in Table 3, cols. 13, 14 and 15, accord with *molar* mass, i.e., $m_p^o = 2m_p^* = h\nu_p^o/c^{o2}$. The observation would call for a review of elemental atomic/molar mass dichotomy from the fundamentals. Each of the actions: $m_p^* = m_w^*/m_{w(H)}^*$, $2m_p^*/m_{p(H)}^*$, in general, m_E^x/m_H^x , is equally capable of precipitating visible molecular matter from the vacuum field; however, coefficient of the graphical correlation ω_p^x/τ_p^x yielding the matter-field constant or light speed $c^o = 3.7153 \times 10^{-14} \text{ m/s}$, Obande (2017a, p.54), would suggest dominance of the generalized action $m_p^x = h\nu_p^x/c^{o2}$; observe that $c^o/10 = 3.72 \times 10^{-13} = 1.1826 \times 10^{-13}\pi \cong r_p^o \omega_p^o \text{ m/s}$.

Column 9: m_p' – Relative Atomic Mass (dark matter II)

Material stuff of the two invisible p-matter worlds U_p^* and U_p' constitute what is generally identified with 'dark matter'. To an observer on Earth the three matter worlds are arranged in the order: U_p^* outermost, U_p' intermediate, U_p^o innermost, Obande (2017c); in view of this arrangement we tag U_p^* level I (deeper) 'dark matter' and U_p' level II (shallower) dark matter. The fact that masses of atoms of the dark matter worlds can be evaluated with the CMF is a significant confirmation of universality of the laws of physics thus, in general, we can write, $m_p^x = h\nu_p^x/c^{o2}$ where index x denotes a given universe U_w^*, U_p^*, U_p' or U_p^o provided the correct e-m frequency and light speed are used. The evidence would suggest that the dark matter worlds U_p^* and U_p' comprise only charged species, however, their invisibility from our ref. frame and whether or not they comprise exclusively charged atoms, or molecular stuff, or a combination of both forms remains an open question.

Column 10: ν_p^o - E-m Field of the Visible Atom

The parameter ν_p^o refers to e-m oscillation of the visible atom. Although c^o is invariant in all three matter worlds, the causal oscillation varies according to $\nu_p^* = \nu_p' = 0.5\nu_p^o = 1.0172 \text{ Hz}$. It turns out that c^o makes an exciting subject for investigation, for instance, $Kc^o = 6.62\pi r_p^o \omega_p^o = 2.429 \times 10^{-12} = \lambda_c$, where the geometric constant $K = 6.62\pi$; thus, a tangential *velocity field* is conventionally associated with *spatial dimension*, the Compton wavelength λ_c . It reveals that, λ_c is a matter field $\omega_p^x r_p^x$ correlation coefficient, a velocity field, $v = r\omega \text{ m/s}$, Obande (2017a, 2016b, 2016c, 2015c)).

Column 11: ν_p' – E-m Field of Invisible Analogue of the Visible Atom

The expression $\nu_p' = m_p' c^{o2}/h$, of course, yields accurate values of any of the parameters, however, prior to evaluating c^o graphically, m_p' had to be obtained originally through an arithmetic procedure that utilizes empirical m_p^o , Obande (2013).

TABLE 2: Energy Ratio, $m_p^x c^2/h\nu_p^x$

The parameters comprising Table 2 are described and explained in Table 1. In essence, Table 2 is a rather emphatic way of showing that the identity $h\nu = mc^2$ holds strictly only in the vacuum U_w^* and visible U_p^o worlds. The visible particulate atom is not only the

least massive, Obande (2015a, 2013), it is also the lightest of atoms of the three tangible-matter worlds, Obande (2019a); in effect, the visible universe is actually floating in a cosmic pool of invisible condensed matter. Investigation reveals that to effect this scheme nature reduces value of the dark atom's radius relative to the corresponding visible atom's value.

TABLE 3: Mass of the atom's wave and particulate forms in kg/atom, MeV, C and u

Columns 1 to 6 are explained in the presentation of Table 1. Observe that in Table 3 Z_n , col. 4, is juxtaposed with conventional electronic structure CES, col. 16, to register the point that, in spite of its apparent success in describing observational reality, the CES is totally subjective.

Column 7: m_w^*/MeV – Absolute Atomic Mass in Electron Volts

It is the waveform atomic mass in eV, graphical τ vs ω/r correlation gives, $m_w^*/MeV = 1.0372 \quad x^{-5} m_w^*/kg \text{ atom}^{-1} (rad/s \text{ m}^{-1})^{0.5}$ where the calculated coefficient $k_w = 1.0753284 \times 10^{-5}$ is cosmic vacuum field atomic mass unit, i.e., waveform amu/eV; it derives from the expression $\tau_w^* = k_w/(\omega/r)^{0.5}$, Obande (2016a); thus, the atomic waveform amu writes, $amu_{(w)}/eV = k_w = \tau_w^*/(\omega_w^*/\tau_w^*)^{0.5}$.

Column 8: m_w^*/C – Absolute Atomic Mass in Coulombs

The waveform atomic mass in Coulombs is, $m_w^*/C = m_{w(E)}^*/m_{w(H)}^*$, where $m_{w(H)}^*/MeV = 1.567 \times 10^{-52}$ is, of course, H atom's waveform mass in eV.

Column 9: m_p^x/u – Relative Atomic Mass in kg/u

In general, $m_p^x/u = hv_p^x/c^{x^2} = m_{w(E)}^x(kg \text{ atom}^{-1})/m_{p(H)}^x(eV)$, for the visible universe the mass ratio reduces to $m_{w(E)}^0(kg \text{ atom}^{-1})/1.510 \times 10^{-47}$; notice that the value retrieves equally from the element's v reduced to H atom's value thus we equally have, $m_p^x/u = v_{p(E)}^x/v_{p(H)}^x$ which, for our universe, is $m_p^0 = v_p^0/2048$. Notably, particulate atomic electron evaluates to $m_{p(e)}^0 = 4.8828 \times 10^{-4} g/u$ which compares favorably with literature's empirical $5.4866 \times 10^{-4} g/u$.

Column 10: m_p^x/MeV – Relative Atomic Mass in Electron Volt

The condensed atom's atomic mass eV unit expresses as, $m_p^x/eV = k_p = \tau_p^x/(\omega_p^x/r_p^x)^{0.5} = 9.31494 \times 10^5$ in MKS units. In general, $m_p^x/MeV = m_p^x(kg \text{ u}^{-1})/m_{p(H)}^x(MeV)$, the visible atom gives $m_p^0/MeV = 9.31494 \times 10^5 m_p^0/u$, Obande (2016); notably, particulate electron's calculated value, $m_{p(e)}^0 = 0.455 MeV$, compares reasonably well with empirical 0.511 MeV; we may observe that the calculated mass constant $9.31494 \times 10^5 MeV$, would seem 3 orders of magnitude lower than empirical value.

Column 11: $M_p^0(\tau_{p(E)}^x/\tau_{p(H)}^x)$ – Molar Mass in Coulomb

Candidate interactions manifesting the particulate atom would include: $m_p^0/u = hv_p^0/c^{0.2} = m_w^*/m_{w(H)}^* = 2m_p^*/u = \tau_{p(E)}^x/\tau_{p(H)}^x$, Obande (2016a); until our procedures and resulted are faulted, there is no immediate reason to suggest preference for a particular expression, each would readily give mass of the atom accurate to three or more significant figures. Unlike others, the quotient $\tau_{p(E)}^x/\tau_{p(H)}^x$ is a most interesting expression of atomic mass action, it directly yields molar mass values thus providing a tool for an *observational theory of elemental molar mass*. Unless we are quite uninformed, in terms of modular value, we see no distinction between atomic mass quantum expressed in gravimetric units kg/u or in C. It would imply that the coupled (*neutralized*) charge quantum and gravimetric mass quantum differ only in concept not in substance; if correct, the finding would be eye opening.

Column 12: M_p^0/MeV - Molar Mass in eV

The atom's molar mass value in Coulomb, col. 11, converts to eV, col. 12, through multiplication by the mass constant; i.e., $M_p^x/MeV = 931.494 \tau_p^x/\tau_p^x$, where the letter M distinguishes the molar from atomic mass m. The expression provides some crucial information on atomic and molar mass phenomenology, it re-casts the classical molar mass formula CMolF purely in terms of the radial stress imposed on the atom's e-m transverse radiation thus, we have, $M_{p(E)}^x/u = \tau_{p(E)}^x/\tau_{p(H)}^x$.

Columns 13 & 15: $MeV/1863$ – Molar mass in u

Division of the element's eV molar mass by H's eV value, of course, yields the element's atomic mass in u, i.e., $m_p^x/u = M_{p(E)}^x(MeV)/M_{p(H)}^x(MeV)$, which for the visible atom, is $M_{p(E)}^x/1863$, see cols. 9 and 13.

Column 14: $2MeV/1863$ – Molar mass action

The column results from summation of values in cols. 13 and 15, values in 13 are duplicated in 15 to register

the point that the *molar quantum forms from coupling of two oppositely charged quanta*, e.g., molar electron results from coupling of ‘electron’ and ‘positron’, i.e., $M_{p(e)}^o = M_{p(e-)}^* + M_{p(e+)}^* = 2 \times 7.3725 \times 10^{-51} = 1.475 \times 10^{-50} \text{ kg/u}$; in general, $E = A^- + A^+$, where the symbol E denotes element and A its atom, the subject is slightly more involved but exceedingly interesting.

Column 16: Electronic structure

The juxtaposition of nature’s mass numbering, col.4, and conventional electronic structure, col. 16, shows unambiguously that, at best, the latter is indeed relative, this is in line with expectation. More importantly, it reveals that physical reality can be reasonably evaluated from a ‘relative’ perspective; furthermore, it raises disturbing questions regarding the basis of conventional physical fundamentals.

TABLE 4: Atomic Physical Properties

It comprises the following Tables: 4A – Atomic waveform vacuum field U_w^* ; 4B – Particulate component U_p^* of the atomic waveform vacuum field U_w^* ; and 4C – The visible atom U_p^o . Each comprises eleven columns: the first four – atom, mass no. Z_n , e-m field v , and mass m – are defined in Table 1, the rest present expressions for the following e-m harmonic oscillation parameters: radius r , density ρ , rotational speed ω , centripetal force F , elastic (Young’s) modulus ϵ , transverse stress σ and radial strain τ . Two or more expressions are usually valid for evaluating a given property, however, one of them would normally prove easier to use for either the atom’s particulate- or wave-form, the details have been reported, Obande (2015b, 2015c); columns 5 to 11 are presented.

Column 5: Radius, r

Several expressions are equally valid provided they are chosen consistently. In other words, the most suitable expression for the particulate atom’s parameter might prove problematic for use to evaluate same parameter of the waveform; the details are provided in Obande (2015c, Section 2, p. 86). For atomic radius we have, of course, (i) $r = \lambda/2 = c/2v$; (ii) $r = (3m/4\pi\rho)^{1/3}$; (iii) $r = F/\epsilon$. While (i) readily applies to the waveform, (ii) is more convenient with the condensed atom and (iii) is equally applicable to both forms provided due diligence is observed to avoid confusing ‘bulk’ (empirical) with ‘atomic’ (theoretical) parameter.

Column 6: Density, ρ

Atomic density retrieves with any of the usual expressions: (i) $\rho = m/v = 3m/4\pi r^3$; (ii) $\rho = 6mv^3/\pi c^3$; of course, while (i) more readily applies to the particulate atom (ii) fits better with the atomic waveform.

Column 7: Rotational speed, ω

We have, of course, $\omega = 2\pi v$; observe the difference in denotation, $\omega_w^* = 2\pi v_w^*$ and $\omega_p^o = 2\pi v_p^o$ for the waveform and the visible atom respectively.

Column 8: Centripetal Force, F

The familiar expression is, of course, (i) $F = m\omega^2 r$; its quantum waveform transcription is (ii) $F = 8\pi^2 m v^3 / c$, Obande (2022, 2019b, 2017a, 2015c).

Column 9: Elastic Modulus, ϵ

The established expression for particulate matter is (i) $\epsilon = m\omega^2$, it transcribes to (ii) $\epsilon = 4\pi^2 m v^2$ for direct evaluation from the wave.

Column 10: Transverse stress, σ

The traditional expression is (i) $\sigma = F/\pi r^2$ for particulate matter, it rewrites (ii) $\sigma = 8\pi m v^3 / c$ for the wave.

Column 11: Axial Strain, τ

The 180° electromagnetic field oscillation motivating light speed c_o in vacuum and c^o in condensed matter imposes significant axial strain τ on the transverse radiation. Quantitatively, $\tau = \Delta r/r$, where r is atomic radius and $\Delta r = 1/\pi = 0.3183$, a familiar universal constant normally expressed as percentage otherwise, it loses its beauty to the less meaningful value $\Delta r = 31.83 \cong 10/\pi$, Obande (2017a). Conventionally, (i) $\tau = \sigma/\epsilon$, its waveform transcription reads, (ii) $\tau = 2v/\pi c = \omega/\pi^2 c$.

3. SOURCES OF ERROR

Accuracy of results of the entire project depends on accuracy of value of the atom’s specific e-m oscillation frequency v ; as already noted, the values, Table 1 col. 5, are calculated from clues provided in R & R (1981, pp. 31, 39). Possible sources of error would include: (i) confusion with frequency of the noble gas and elements of its period. Assignment of frequencies of the noble gas and its period’s elements are easily prone to confusion as would seem the case with assignments of: Ne 32,728 Hz to Be (8,192Hz); Ar 262,144 to Mg (65,536Hz); Fe 2,097,152 to Ca (524,288), Zr 16,777,216 to Sr (8,388,608) and Rn 1,073,741,824 to Ra (2,147,483,648 Hz); however,

some of the assignments help to elaborate the periodicity; (ii) we could not avoid reproducing ν_w^* value of the noble gas of a given period to obtain frequency of the adjoining alkali metal that starts the next period. The procedure is questionable but

4. HIGHLIGHTS

From the perspective afforded by the present results, everything in the universe looks so very simple, neatly packaged in predictable sequences and hierarchies that it makes one wonder how physics could possibly have missed it. In one publication we wrote: “So far we are yet to find an attempt that uses an existing property of nature to cogently explain all other [observational] causes and effects. ... the phenomenon which assigns to each atom its mass holds the key to unraveling the atom and the cosmos.”, Obande (2015a, p.79). The present compilation attests to that view; a firm handle on actions that manifest mass is all that is required to account for much of reality; we highlight only a few aspects of a very wide subject.

4.1 The Wave Function

Electromagnetic oscillation frequencies ν that define the chemical elements are listed in Table 1 col. 5, the same values, accurate at least to the tenth decimal place, are appended to the online article, Obande (2021). Only one unaware of existence of these values would hold onto the view that the wave function was statistical. Starting from the element cesium and moving step-wise up to americium we have, Obande (2021, p. 54), this intriguing symmetry (coding?) in the eighth to tenth decimal place: Cs to La: 0,0,0; La to Yb: 0,5; 1,6; 2,7; 2,8; 3,9; 4,9; 5,0; Lu to Pb: 0,1,2,3,4,5,5,6,7,8,9,0 then, 0,0,0... up to Am. At the moment we are in no position to fathom these rhythmic notes in the atom's e-m oscillation at the *tenth decimal* position, suffice to observe that the rhythmic sequence closely resembles typical rhythmic sequences of *whole number* frequencies of atoms of the chemical periods, Obande (2018). Thus, in specifying the ‘late-stage’ transition elements, nature redefines the lanthanides and actinides with a tag that replicates, in fractional values, the original periodic positioning of the wave (whole) number. The implication is yet unknown and would seem deeply embedded; certainly, the

absolutely unavoidable as long as theoretical atomic mass framework remained elusive, our re-assurance is in the fact that the procedure leads to highly accurate calculated observational relative atomic mass values, Obande (2016a, 2015a, 2013).

observation totally nullifies a statistical interpretation of the wave function.

4.2 The Transverse e-m Radiation, Light

4.2.1 Spatial Dimension

Published studies on light would make a sizeable library in its own right; yet, we may not claim a secured handle on the subject of light. It is established that light manifests mass, the present compilation makes important distinctions between the following variants of the element's atomic mass: i) invisible, intangible: $m_w^* = h\nu_w^*/c_o^2$; ii) invisible, tangible: $m_p^* = h\nu_p^*/c^{*2}$; iii) invisible, tangible: $m_p' = m_p'/c'^2$; and, iv) visible, tangible: $m_p^o = m_p^o/c^{o2}$. Nature achieves this differentiation by tinkering with the atom's e-m oscillation parameters; thus, the electron's corresponding e-m frequency varies as: $\nu_{w(e)}^* = 1.000 \text{ Hz}$; $\nu_p^* = 1.0172 \text{ Hz}$; $\nu_p' = 1.0172 \text{ Hz}$ and $\nu_p^o = 2.0344 \text{ Hz}$. Associated with these subtle frequency variants is a simple device that also tinkers with the wavelength. Give the premier quantum packet the imponderable value $\lambda_{w(e)}^* = 1.49896 \times 10^8 \text{ rads}$, you find that unit-time rotation, (i.e., $\nu_{w(e)}^* = 1.0000 \text{ Hz}$, of this ‘mega python’, gives the characteristic vacuum radiation associated with light speed $c_o = 2.9979246 \times 10^8 \text{ rad s}^{-1}$.

A little digression might not be out of place here. Perhaps, for historical reasons the speed of light has all along been expressed in linear measure, metres/second m/s; this has caused untold challenges in our conception of electrodynamics action EA and especially of space itself. If, from the onset of formalization of physics, it had been recognized that EA is not linear (Euclidean) but curvilinear, i.e., elliptic (Riemannian), what great energy, resources, pain and time physics would have saved itself and humanity at large! The correct expression and unit of light speed are, $c_o = \omega_{e-} = 2\pi\nu_{e-} = 2.9979 \times 10^8 \text{ rad/s}$ while *velocity* of light is, $r_{e-}\omega_{e-} = \pi c_o = 9.4183 \times 10^8 \text{ m/s}$. One would wish the community took notice.

Now, vary ν in such a way as to achieve quantized evolution of values while ensuring that the product

$\lambda\nu = c_0$ remained invariant across board, you get a periodicity that gives each quantum packet the freedom of independent tailoring. It allows specification of the wave packet's e-m parameters such as: i) precise angular speed specification and *spin orientation*, the latter *manifests charge*; ii) *geodynamic spatial distribution* of angular speed, it *manifests valency*. An examination of this very brief account already indicates that $\lambda_{w(e)}^*$ value is necessarily endowed with such imponderable value in order to accommodate condensed matter universes; notably, size of the cosmos measures in units of $\lambda_{w(e)}^*$, in other words, the cosmic envelope resides within continuous series of electron waveform packets!

4.2.2 Tangible Matter

A precisely measured reduction in λ value causes the quantum wave-packet to miniaturize and become dense at corresponding rotational speeds; its size, of course, decreases with an increase in rotational speed. Having set oscillation of the premier quantum unit at $\nu_p^* = 1.0172 \text{ s}^{-1}$, if now you diminish its size to $\lambda_p^* = 1.82624 \times 10^{-14} \text{ rad}$, you get the drastically reduced marginal transverse radiation $c^o = 2\lambda\nu = 3.715352291 \times 10^{-14} \text{ rad s}^{-1}$; the effect freezes the wave packet causing the atom to congeal and precipitate out of the vacuum field. In some cases, such as the noble gases and halogens, the effect is insufficient to cause bulk solidification, these remain gaseous at standard conditions; yet, in others the element remains, at STP, in a state intermediate between solid and liquid such as we find with the alkali metals. Upon emergence from the vacuum field, tangible matter evolves through physical and chemical interactions; subsequent gravity-aided coalescences give rise to our visible and the invisible matter worlds.

We must quickly note that the above in no way represent a full account of the dynamic factors that determine physical states of the elements at STP. The account simply considers only wave function related causal factors. It is hoped that in the foreseeable future knowledge of the subject shall have advanced to the stage where physical characteristics of the elements, including in particular, Tc and Hg would be fully accounted for purely from theory.

As stated in the presentation of Table 3, col. 11, intrinsic tension τ of the vacuum field, motivated by light's causal π radians oscillation, amazingly precipitates *molecular matter*, what is more intriguing here is that the process is universally invariant, calculations show that it is true for both the visible and invisible worlds. Quantitatively, $\tau = \Delta r/r$ where, of course, radius of the quantum e-m packet, $r = \lambda/2$ and the universal invariant $\Delta r = 1/\pi = 0.3183 \text{ rad}^{-1}$; thus, we have $M_E^x = \tau_E^x/\tau_H^x$, where M stands for molar mass of the element E in a given universe x. Of course, tension-motivated evolution of matter is by no means least among actions that precipitate tangible matter out of the vacuum field, however, τ 's implication in molecularity would make an interesting subject for investigation. The action reveals that molar mass of an element is inversely proportional to atomic radius, hydrogen's radius turns out the universal constant of proportionality; in other words, we have $M_E = \lambda_H/r_E$, where $\lambda = 2r$, where r is, of course atomic radius. Nothing faults the statistical wave-function interpretation more acutely than this rather surprising finding that molar mass is emergent also from spatial dimension. From our perspective, the mass-radius (M-R) relation marks an important turning point, a major milestone, in the course of our 'Classicalization Project', CP, Obande, (2022), an on-going programme that investigates the atom with classical physics formalism. The M-R relation tells us that, *given established empirical relative atomic mass values, it is possible, in principle, to reproduce i.e., simulate, observational reality*; our original goal is thus achieved.

4.2.3 Physical Properties of Matter

With regard to mechanical properties of matter, it is of utmost relevance to take cognizance of Lorentz's long-standing position on the subject; he says, "... I believe every physicist feels inclined to the view that all the forces exerted by one particle on another, all molecular actions and gravity itself, are transmitted in some way by the ether [now called 'vacuum'], so that the tension of a stretched rope and the elasticity of an iron bar must find their explanation in what goes on in the ether between the molecules. Therefore, since we can hardly admit that one and the same medium is capable of transmitting two or more actions by wholly different mechanisms, all forces may be regarded as connected more or less intimately with those which

we study in electromagnetism. ... Indeed, one of the most important of our fundamental assumptions must be that the ether not only occupies all spaces between molecules, atoms or electrons, but that it pervades all these particles. We shall add the hypothesis that, though the particles may move, *the ether always remains at rest*. We can reconcile ourselves with this, at first sight, somewhat startling idea, by thinking of the particles of matter as some local modifications [interactions *not* 'excitations'] in the state of the ether. These modifications may of course very well travel onward while the volume-elements of the medium in which they exist remain at rest." Lorentz (1952 pp. 45, 11). One is completely short of words to describe these uniquely insightful positions of an all-time physics luminary. As long as mainstream physics chose to discountenance overwhelming lines of evidence in support of the material vacuum and persisted inexplicably to embrace the untenable view of its non-existence so long shall a hope of regaining lost time within the foreseeable time frame remain an illusion.

The vacuum field is the sole source, i.e., origin, of force; the reason is simple, it is the field of the most active electrodynamic actions; of course, matter field partakes also of e-m actions but, its actions are comparatively dead. A case in point may suffice, compare the value of vacuum speed of light with its corresponding value in matter; the ratio reads, $\alpha = c_o/c^o = 2.99792 \times 10^8 / 3.71535 \times 10^{-14} = 8.069 \times 10^{21}$; in order words, in matter light takes 8×10^{21} seconds to cover the distance it covers in one second in the waveform!

Wheeler is on record for saying *inter alia*, "Empty space is not empty, it is the seat of the most violent [i.e., most active] physics", a view which resonates with that expressed decades earlier by Lorentz. Graphical correlation of the atom's harmonic parameters gives a most interesting result. 1) Numerical coefficient of log-log plot of any two parameters yields a fundamental physical constant; our limited knowledge of the diverse subjects notwithstanding, we were able to assign less than half or thereabout of the coefficients to established fundamental physical constants; certainly, there must

be many more unassigned physical constants out there. 2) Analysis of the correlation exponents indicated geometry of the coupled co-ordinate space, we call it symmetry group SG. Notably, the correlations, totalling 72 for particulate matter and 72 for the waveform, produced only four SGs excluding, of course, their mirror images, Obande (2017b). We reason that the parameters exist as lattice elements arranged in specific geometric forms that seamlessly inter-weave and interpenetrate into a complex spherical latticed e-m force field envelope. The envelope constitutes internal structures of the particulate atom and waveform, i.e., the *vacuum field*. Thus, space comprises intricate 3D grid of e-m force fields, the parameter space couple to manifest observational e-m effects notably electrical and magnetic constants and gravitation. We think Fibonacci lattices would give an excellent geometric representation of the e-m force fields grid residing within the atom and in the vacuum of space; our view is informed by the finding that parametric correlation coefficients give exclusively conical sections, Obande (2021, 2015c).

It may be relevant to mention in conclusion that our understanding of the material vacuum has facilitated successful investigation of the following erstwhile intractable subjects: universal gravitation fundamentals, Obande (2022); causality of observational drift in value of the Hubble Constant, Obande (2021); cosmic mass and energy densities and the cosmological lambda, Obande (2019a, 2016b); spontaneous rotation of matter, Obande (2019b); cosmic roles of the active galactic nucleus, Obande (2018); causality of natural radioactivity and stellar supernova, Obande (2017a); Vacuum field mass actions, Obande (2016a); common causality of gravitation, electricity and magnetism, Obande (2015c); accounts of particle generations and identity of dark matter, Obande (2013) plus others listed in the references.

CONCLUSION

Quantitative analysis reveals observational reality classically Newtonian; *all* its actions are described directly or indirectly with the expression which equates atomic mass to wave energy.

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