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On the Fundamental Physical Constants: I. Phenomenology

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Abstract

The fundamental physical constants (FCs) are parametrized. The results reveal that: 1) FCs are field coupling constants. With the exception of ratio of identities such as $\mu = m_p/m_e$, there are no dimensionless constants – all FCs, including α and π, are dimensional. 2) The constant k = 1.6022 x 10^{-19} implicates: i) atomic unit of torque, it causes matter's intrinsic rotation on all (atomic to cosmic) scales; ii) motion of unrestricted bodies through free space and random thermal (Brownian) motion in condensed matter; iii) superluminal space expansion, i.e., Hubble effect is not an acceleration but tangential velocity (πc) of free space; and iv) common parametric definition of radioactivity and stellar explosion/supernova. 3) Newtonian gravitation comprises two potentials, a spherical pneumatic torque field G_1 acts to inflate the gravitational envelope and a combination of force fields G_2 impacts an acute hydrostatic pressure on the individual and common envelopes of the gravitating bodies; the two contrary force fields function to create a coherent rigid system in dynamic equilibrium. 4) The bosonic unit mass gravitational acceleration constant, g_w = 7.9433 x 10^{59} m s^{-2} kg^{-1} is associated with the strong nuclear force (SNF), it binds matter on all (atomic to cosmic) scales. 5) Although the classical electron radius (CER) formulation $r_e = e^2/m_ec^2$ yields correct value, it is nonetheless fortuitous as m_e deviates from the theoretical value by twenty orders of magnitude and theory does not link spatial dimension to electrostatics charge quantum. 6) Successful evaluation of r_e by three alternative methods implies that an attempt to relegate the CER as currently obtains in the Standard Model seeks to re-engineer reality. 7) Electron bosonic radius identifies with the astronomical unit, it accounts for "spooky" action at a distance and "entanglement" effects. 8) Planck length fails to relate to atomic spatial dimension indicating that Planck space does not refer to the atom. 9) Electric, magnetic and gravitational effects are all motivated by torque but its magnitude differs according to the order: electrical (N m) > magnetic $(N\ m)^{0.75}$ > gravitational $(N\ m)^{0.25}$. It is submitted that even if the atom degraded with cosmological epoch, values of the FCs would remain fixed because they are parametric relative quantities.

Keywords: Dimensional analysis, Fundamental constants, Gravitation mechanism, Nuclear binding force, Parameterization

1. Introduction

Two papers, one by Max Born (1935) and the other by Paul Dirac (1937) were particularly instrumental to subsequent development of theories of the fundamental constants (FCs) including some current centre stage cosmological models that claim space and time variability. The quanta of investments in this area of physical research in virtually all developed and emerging nations underline the global importance attached to the subject, Srinivasan (2016), Ubachs et al. (2015); indeed, it seems there must be much more to unraveling the FCs than meets the eye. Research findings are, of course, varied; there are tenable cases for variable constants, Barrow & Webb (2014), Duff (2004), Webb et al. (2001), however, current majority findings would support cosmologically invariant constants within the course of accessible history of spacetime evolution, Ade et al. (2014), Varshalovich et al. (1996), Varshalovich, Ivanchik, and Potekhin (1999), Bogdonaite et al. (2014), Godun et al. (2014), Ubachs et al. (2015). The underlying factors remain elusive, while the values are uncannily specific, existing theories yield no clue regarding their origin, Srinivasan (2016), Ubachs (2015). Wilzeck (2007) aptly summarizes the existing scenario: "The multiplicity and variety of fundamental constants [particularly in the Standard Model] are esthetic and conceptual shortcomings in our present understanding of foundational physics". Here, we consider the classical foundations of some of the most widely researched fundamental physical constants.

1.1 Fine Structure Constant, α

Following Sommerfeld's definition of α with a combination of other physical constants $\alpha = 2\pi e^2/hc$, recorded contemplation on the theoretical basis began effectively with Born's (1935) address to the Southern India Academy of Science. His contribution to existing knowledge of α is invaluable, it touches upon virtually all aspects of the electromagnetic (e-m) field and much more. He makes far reaching deductions, many of which inform current notions of e-m interactions, behavior of the electron in an e-m environment and even α's "importance for appearance of the physical world and our method to describe it. It makes it possible to separate atoms from the surrounding fields and to ascribe to them stationary states". It is hard to fathom that speculation could accommodate so much affirmation but, quite unintended, his approach, although firmly grounded on well established classical foundations, would seem to have influenced subsequent supremacy of aesthetic beauty over and above visualizability and cognizance. He would seem to regard α well above whatever might have given rise to it or indeed nature's fundamental building block when he avers that: "The great value 1/α =137 is the decisive factor for the order of magnitude of all physical phenomena when reduced to electronic units … the number 137 is the dominant factor for all natural phenomena", only to submit to the inescapable fact that the constant "… is not explained by existing theories. This is a very unsatisfactory situation". Several brilliant contributions have been made to build upon Born's foundation and deepen our understanding of α, Berkenstein (1982), Feynman (1985), Berkenstein (2002), Gabrielse et al. (2006), Schonfeld and Wilde (2012), Springer (2013), Kirakosyan (2015), Consiglio (2016), however, as with all other constants, the causality appears intractable.

1.2 Planck Constant, h

A most visible mainstream effort to develop a theoretical framework for h is reported by Lipovka (2014). However, given the rigor and sophistry of the standard procedure, his final result makes very interesting comparison with the apparently dismissible mundane classical approach reported by Schreiber (2006). As usual, the standard approach takes a dizzy tour through the gamut of details of the familiar formalism to arrive "… from the geometry of our universe" at the estimate

$$(R - 4\Lambda)\frac{c^3 a_o}{16\pi G} \approx h \quad (1)$$

where the parameters are traditionally defined. The approach, of course, retrieves the established value $h = 6.67\,x\,10^{-27}\,[erg\ s]$. Schreiber, however, simply uses classical dimensional analysis to submit that, if the classical mass formula is right, h must be an atomic constant defined with the expression:

$$h = 2mrc \quad (2)$$

where m, r and c are respectively atomic (rest) mass, radius and speed of light in vacuum. Given $m_{e(w)} = 7.373\,x\,10^{-51}\,kg$, and $r_{e(w)} = 1.5\,x\,10^{8}\,m$, see Obande (2016a), we have $h = 6.62607\,x\,10^{-34}\,Js$. The coefficient of eq. (2) doubles for condensed matter and given particulate electron's $m_{e(p)} = 4.8828\,x\,10^{-7}\,kg$, $r_{e(p)} = 9.1312\,x\,10^{-15}\,m$ with $c^o = 3.71535\,x\,10^{-14}$ m/s, we get $h = 6.62609\,x\,10^{-34}$ J s. Thus, without evoking cosmological parameters, the classical procedure effortlessly reproduces h's familiar value. The literature has never lacked proposals for theoretical derivation of h, see for instance van der Togt (2009).

1.3 Speed of Light, c

The classical mass formula $m = h\vartheta/c_o^2$ constrains variability of the vacuum speed of light c_o as it would entail atomic mass variability, Obande (2016b).

1.4 Proton/Electron Mass Ratio, μ

CODATA 2014 gives $m_p/m_e = \mu = 1838.683661$, the value, of course, indicates quite a margin between m_p and m_e. Existing theories fail to account for this margin and the subject continues to occupy considerable research attention. In his famous lecture, Born (1935) noted that an account of the "enormous difference… has been suggested by Pryce. He started from the experimental fact that both kinds of particles, … have the same angular momentum. As the spin is not connected with an accumulation of energy, the state 0+½ with no electromagnetic momentum (ℓ = 0) should have only electrostatic energy, whereas the state 1-½ which has a finite electromagnetic momentum (ℓ = 1) has an additional electromagnetic energy, which might explain the great mass difference". A recent attempt seeks explanation in relative abilities of p+ and e^- to couple to the "Planck vacuum state", Daywitt (2014).

A quantitative framework for μ is the subject of some active research programs, Hansson (2014), Kritov (2015), Weinberg (1983), however, as observed by Kirakosyan (2015), "Researchers are mostly looking to link α [indeed, every constant] to other known constants (physical or mathematical) to deduce it theoretically. This reduces to another version of calculating its value because α will be expressed by other experimentally known constants, remaining as cognitively unclear as before". Variability of μ has been extensively investigated and majority findings would seem to support invariability, Ubachs et al. (2015), Duff (2004), Varshalovich (1999), Bagdonaite et al. (2014), Godun et al. (2014), Kirakosyan (2015), Consiglio (2016), Gabrielse (2006), Berkenstein (1982), Berkenstein (2002).

1.5 Electron Charge, e-

In view of space we shall present results of investigation of phenomenology of electric charge in a separate report. Briefly, our finding supports much of the positions of Belyakov (2010), Filho (2015) and Weng (2016). Specifically, we share Belyakov's position that charge relates to momentum and note that the same conclusion has all along been evident from Goudsmit and Uhlenbeck's (1926) formalization of spin.

1.6 Newtonian Gravitation, G

Recorded contemplation on the causality of gravitation dates back to the Greeks, Renn (2007); the philosophy informed Victorian classical quantum Zero-Point Field (q-ZPF) as encapsulated in deductions from thermodynamics' third law, Kragh (2002). It would seem General Relativity (GR) modifies classical q-ZPF to carve itself an independent identity and advance the Standard Model (SM) concept of fluctuating quantum zero-point field (fq-ZPF); modern gravitation theories must now derive from this concept, Haisch et al. (1997), Cole et al. (2001). We observe an emerging tendency to revive Wilson's (1921) original concept linking gravitation to electromagnetism, Rabounski (2005), Marquet (2013), Stavroulakis (2008), Cameron (2015), Casey (2016). The subject of G's invariability was among the first to be considered settled in the follow up activities to establish Dirac's cosmological G(t) model, Copi, Davis & Krauss (2004), however, modern versions reclaiming variability continue to engage considerable research attention, Barrow & Webb (2014), Duff (2004), Webb et al. (2001).

1.7 Fundamental Length

1.7.1 Planck Length, First Bohr Orbit, Compton Wavelength and Classical Electron Radius

Planck's energy quantization translates naturally to space and time quantization and informs Planck scale dimensions (PSD); these days the subject admits of far reaching conjectures, Amelino-Camelia (2001), Amelino-Camelia (2003), Aloisio et al. (2005), Amelino-Camelia (2007); it retrieves with the expression:

$$\ell_p = \sqrt{\mathrm{hG}/2\pi\mathrm{c}^3} \tag{3}$$

Born (1935) reasons from first principles to argue that Sommerfeld's fine structure constant,

$$\alpha = 2\pi e^2/hc \tag{4}$$

"is a brilliant proof, simultaneously of Einstein's principle of relativity and Planck's quantum theory" and proceeds to relate α to atomic dimensions thus,

$$a_1 = a_o/\alpha^2 = (137)^2 a_o = 18770\ a_o \tag{5}$$

where a_1 is first orbit of H-atom and $a_o = r_{e(p)} = 2.8179403226\ x\ 10^{-15}\ m$ is classical electron radius (CER), i.e.,

$$r_e = \frac{1}{4\pi\varepsilon_o}\frac{e^2}{m_e c^2} \tag{6}$$

and

$$\frac{a_o}{\lambda_c} = \frac{e^2}{hc} = \frac{\alpha}{2\pi} \tag{7}$$

where λ_c is electron Compton wavelength. Equations (3) to (7) form the theoretical bases of prevailing notions of atomic and electronic units of space.

1.7.2 The Geometric Constant Pi, π

Recent attempts to probe π beyond its geometrical meaning would include the reports of: Pasamentier and Lehmann (2004); Arndt and Haenel (2006); Friedman and Hagen (2015), and Boeing (2016)]. Pasamentier & Lehmann's allusion to π as "the World's Most Mysterious Number", and Boeing's ultimate attribution, "The World is Pi" simultaneously underline the constant's over-riding ubiquity and relevance. Nonetheless, it is doubtful if, apart from their aesthetic beauty, these theoretical frameworks have added to unraveling π.

1.8 Convergence of Standard Model (SM) and Classical (CM) Quantum Philosophies

Parametrization reveals that the FCs derive specificity equally from the atomic bosonic and fermionic e-m fields. In order to demonstrate "oneness" or doublet nature of the two fields, it is relevant to demonstrate convergence of the SM and CM world views as juxtaposed in Table 1. Notably, CM recognizes the boson field as the cosmic vacuum field and sees this field and each of the three "mass generation" fermion fields as independent yet interactive ref. frames or universes working in perfect harmony with one another to define a common experience of reality. Notably, the two fields do not interact to jointly define a given constant and, in cases where a common parametric coupling defines the same constant, its fermionic value is usually several orders of magnitude higher than the corresponding bosonic value. Although it recognizes the distinction between the boson and the fermion, the SM is yet to appreciate that the two fields are integral forms of the atom, see Obande (2016a), (2016b). Here, we show that observational value of the FC derives from independent linear correlation of atomic fermionic and bosonic field parameters.

2. Procedure

The procedure is described in detail in an earlier brief report on causalities of gravitation, electricity and magnetism, Obande (2015a); here, we present a broader horizon of the subject. Basically, we assume that the atom is an e-m harmonic oscillator comprising doublet wave (bosonic) and particle (fermionic) components and proceed to evaluate the respective simple harmonic motion (SHM) parameters. Value of the FC obtains from analysis of self-interactions (couplings) of the following field parameters: rest mass m, radius r, density ρ, angular speed ω, centripetal force F, elastic modulus ϵ, longitudinal stress σ, and strain rate τ. Each parameter is correlated with every other one in a log-log plot and, following a set of simple rules, the correlation coefficient (coupling constant) yields the FC, while the exponent indicates the couple's geometry, Obande (2015a), (2017).

We recommend familiarization with the earlier report as it would greatly facilitate readability of this one; indeed, the raw data for the present investigation are contained in Table 2 therein.

3. Results and Discussion

The results are presented in nine sets of eight equations in Tables 2 and 3 for the fermion and boson fields respectively. Each set describes interactions of a chosen independent parameter with eight others that constitute the dependent variants, a snapshot of the entire results is presented in Table 4. The equation is numbered according to its position in the table, for example, eq. (2A(vii)) refers to Table 2, set A, item (vii). A list of notations and some general comments are provided in the Appendix; the details are presented.

3.1 The Fine Structure Constant, Alpha $\boldsymbol{\alpha}$

A log-log plot of the atom's fermionic transverse field ϑ_p vs. stress, σ_p gives the correlation coefficient,

$$\vartheta_p/\sigma_p^{0.25} = 7.46449\,x\,10^{-3}\,(N/m^2)^{-0.25}\,s^{-1} \qquad \text{(2A(vii))}$$

the value 7.4645 x 10^{-3} compares favorably with current CODATA's $\alpha = 7.2974\,x\,10^{-3}$. Direct evaluation from electron's $\vartheta_{e(p)} = 2.034\,s^{-1}$ and $\sigma_{e(p)} = 5.5625\,x\,10^9\,N/m^2$ (see Table 2 Obande (2015a)) gives $\alpha = 7.4479\,x10^{-3}\,(N/m^2)^{-0.25}\,s^{-1}$. Dimensional analysis gives $\alpha = 0.3355(\vartheta v/m)^{0.25} = 7.4498\,x\,10^{-3}$ (m s^{-2}/kg)$^{0.25}$, i.e., α is dimensional, it is fermionic field's intrinsic tendency to tangential acceleration per unit mass. With c^o = 3.71535229 x 10^{-14} m/s, the innate tendency of condensed matter to tangential acceleration is, of course, imperceptible for most practical purposes, however, the property might be responsible for precession of large objects in circular motion.

The same coupling that gives α in the fermion causes electrical effect in the boson field, i.e.,

$$\vartheta_w/\sigma_w^{0.25} = 1.9953\,x\,10^{14}\,(N/m^2)^{-0.25}\,s^{-1} \qquad \text{(3A(vii))}$$

Use of bosonic electron parameters gives 2.006 x 10^{14}, the value reflects CODATA's eV = 2.417989 x 10^{14} Hz. This result is particularly interesting, the value traces to inverse fermion transverse field, i.e., $2.36\pi/c^o = 1.995\,x\,10^{14}\,m^{-1}\,s$, where $c^o = 3.71535229\,x\,10^{-14}\,m\,s^{-1}$. No natural e-m oscillation exceeds nine orders of magnitude (Obande (2015b)), a simple analysis that refutes the eV-Hz assignment to 10^{14} Hz follows shortly. In reality, coefficient of (3A(vii)) points to a much needed parametric bridge between the microcosmic (boson) and macrocosmic (fermion) fields uncannily reminiscent of Born's (1935) "…α's importance for appearance of the physical world …". In other words, $\vartheta_w/\sigma_w^{0.25}$ indicates a bosonic wave process that converts absolute to relative atomic mass values, it awaits further investigation.

The analysis reveals as follows:

i. Alpha α is an exclusive condensed matter atomic constant, it is the fermion field frequency-stress coupling constant. The same parametric coupling that manifests α in the fermion would seem responsible for evolution of condensed matter from the microcosm.
ii. Alpha α is not dimensionless as empiricism presumes, theory reveals the dimension $(m\,s^{-2}/kg)^{0.25}$, i.e., particulate matter's intrinsic tendency to tangential acceleration per unit mass.
iii. We have shown severally that the electron e is first element of nature's chemical periodicity, Obande (2016a), (2016b), (2015a); here, we find it sharing common parametric ratios with all other elements, i.e., in line with Born (1935), e is not a point charge, it is "extended".
iv. We find no hint of literature's claim to ubiquity of α in e-m field interactions; besides, eq. (4) is a mathematical construct nonetheless faulted because theory does not link α directly to e, h or c.

3.2 Planck Constant, h

The classical mass formula, $h = mc^2/\vartheta$, simply defines h an invariant atomic field energy/frequency quotient and CODATA gives $h = 6.626070\,x\,10^{-34}\,J\,s \;= 4.13567\,x\,10^{-15}\,eV\,s$. The following fermionic field couplings are indicative, eqs.: a) (2A(viii)), $m_p\tau_p = 5.8884\,x\,10^{-14}$; and b) (2C(vi)), $r_p\epsilon_p^{0.333} = 5.0119 \times 10^{-16}$. The literature value (eV s) retrieves with 5.8884 x $10^{-14}/1.4415\pi^2$ and (b)'s coefficient is in line with $h/2\pi = 6.58212\,x\,10^{-16}\,eV\,s$. In addition to these expressions, fermionic flux density couples with frequency to give,

$$\rho_p/\vartheta_p^4 = 1.7783\,x\,10^{34}\,kg\,m^{-3}\,s^{-4} \tag{2D(i)}$$

it yields $h = 1.1937\pi^2/1.7783\,x\,10^{34} = 6.625\,x\,10^{-34}J\,s$ which compares favorably with the CODATA value. Direct calculation reproduces the graphical value: $\rho_p/\vartheta_p^4 = 3.1\,x\,10^{35}/2.03^4 = 1.9\,x\,10^{34}\,kg\,m^{-3}s^{-4}$.

Only two bosonic field parametric couplings implicate h:

$$m_w = 1.1221\,x\,10^{-34}\,\epsilon_w^{0.333}\,kg \tag{3B(vi)}$$

where the coefficient compares well with CODATA's $h/2\pi = 1.0545718\,x\,10^{-34}\,J\,s$, and

$$\omega_w = 1.2589\,x\,10^{15}\,\sigma_w^{0.25}\,rad\,s^{-1} \tag{3E(vii)}$$

where $h/2\pi = 0.2637\pi/1.2589\,x\,10^{15} = 6.59285\,x\,10^{-16}\,eV\,s$. Notably, dimensional analysis gives $h = m_w/\epsilon_w^{0.333} = (m/\omega)^{0.667} = 1.0698\,x\,10^{-34}$, almost identical to CODATA's h/2π.

The results summarize as follows:

i. Planck constant is retrievable as a coupling constant; the fermionic couplings $m_p\tau_p$ and $r_p\epsilon_p$ indicate $h/eV\,s$, while ρ_p/ϑ_p yields a value from which $h/J\,s$ easily obtains.
ii. Only two bosonic field couplings implicate h, m_w/ϵ_w yields a value quite close to empirical h/2π (J s) and ω_p/σ_w gives a figure that readily yields h/2π (eV s)
iii. Given our earlier results, we infer that parametric differences between boson and fermion field definitions of h reflect corresponding differences in processes that produce matter in absolute and relative atomic mass forms, see Obande (2016a).

*3.3 Proton/Electron Mass Ratio, **μ***

Theoretically, we have the following mass values: i) proton: $m_{P(p)} = 1.0\,x\,10^{-3}\,kg/u$ and $m_{P(w)} = 1.51\,x\,10^{-47}\,kg/atom$; electron: ii) $m_{e(p)} = 4.883\,x\,10^{-7}kg/u$ and $m_{e(w)} = 7.37\,x\,10^{-51}\,kg/atom$, divergence of this value from CODATA's $m_{e(w)} = 9.10\,x\,10^{-31}\,kg$/u has been explained, Obande (2015a). The following field oscillation values are also relevant: i) proton: $\vartheta_{P(w)} = 2048\,Hz$; $\vartheta_{p(p)} = 4166\,Hz$; ii) electron: $\vartheta_{e(w)} = 1.0\,Hz$; $\vartheta_{e(p)} = 2.034\,Hz$. With these values we obtain the respective μ values from ratios of the rest masses and transverse fields, i. e.,

$$\mu_w = m_{p(w)}/m_{e(w)} = 1.5099\,x\,10^{-47}/7.3725\,x\,10^{-51} = 2048.016$$

$$\mu_p = m_{p(p)}/m_{e(p)} = 1.0\,x\,10^{-3}kg/4.8828125\,x\,10^{-7}\,kg \;= 2048$$

$$\mu_{\vartheta(w)} = 2048/1.0 \;= 2048;\; \mu_{\vartheta(p)} = 4166.52511/2.034436 = 2048$$

thus, theoretically, $\mu = m_p/m_e = 2048$. We have noted previously that the empirical value 1836.15267389 results from prevailing theoretical and experimental limitations, Obande (2016a).

We deduce as follows from the result:

i. Theoretical values of proton and electron atomic masses calculated from the classical mass formula for the boson and fermion fields yield a constant ratio μ = 2048. The value reflects invariability of atomic mass values. A voluminous and growing literature exists on μ, Ubachs et al. (2015); notably, the question of spatial and temporal cosmological evolution remains unsettled Varshalovich (1999), Webb et a. (2001);

we present here with compelling quantitative evidence that μ is a universal field invariant. The argument for atomic mass degradation on cosmological time scale would seem to ignore key pertinent fundamental issues: a) μ is a relative quantity, therefore, its variability would require a random atomic mass degradation process; b) a random atomic mass phenomenon of any kind would engender abnormal entropy changes and disrupt the harmonic resonances constituting the stable equilibrium that sustains a timeless cosmos.

ii. No immediate reason is found for the special significance attached to μ value; indeed, relative atomic mass $m_r = m_E/m_H$ is a "μ" of sort, since invariance of m_r is taken for granted, it is hard to see why quotient of the proton/electron mass would be expected to vary given that H and e are very stable species; the situation is attributable to non-recognition of the elemental electron, Grimes & Adams (1979), Dye (2003). Mu μ is m_r, i.e., proton atomic mass relative to e's value.

iii. The large divergence between m_p and m_e reflects presence of 22 chemical elements occurring between e and p in the natural periodicity of the chemical elements, Obande (2016a). At the moment these elements are empirically inaccessible but they are implicated in imprecise location of H in conventional (Mendeleev) periodicity.

3.4 Fundamental Charge, e^-

The literature gives F = 96,485.3251 C and e- = 1.6021766208 x 10^{-19} C to create a whopping 23 orders of magnitude divergence between p+ and e-; interestingly, physicists seem satisfied with this huge divergence but quite agitated with the three order difference between m_p and m_e. It signals a patent cognition crisis in the notion of "charge" particularly as it relates to (rest) mass. We highlight the e- vs. F contradiction with simple examination of quantitative expressions for μ.

$$\mu = m_{p(MeV)}/m_{e(MeV)} = m_{p(u)}/m_{e(u)} = m_{p(C)}/m_{e(C)} \tag{8}$$

Substituting literature values in (8) we get, 931.4940958/0.511 = 1.01/5.485799 x 10^{-4} = 96, 485.3253/x, giving x = m_e = 52.54755 C; notably, the empirical value e- = 52.5476 C compares well with the theoretical value. Theoretically, F = 96,383.383 C and e- = 47.062 C in line with the universal proton/electron mass ratio μ = $F/e^- = 96383.383/47.062 = 2048$, Obande (2016a). It raises the questions: if literature e- is not charge what is it, and why is it so successful in several quantitative approaches? We address these questions with detailed examination of field couplings that yield $|e^-| = 1.6022\ x\ 10^{-19}$.

The following fermionic field couplings are relevant:

$$\rho_p = 2.0893\ x\ 10^{-19}\ \tau_p^4 \tag{2D(viii)}$$

$$F_p = 3.5481\ x\ 10^{-19}\ \vartheta_p^2 \tag{2F(i)}$$

dimensional analysis gives

$$\rho_p/\tau_p^4 = (3m/4\pi r^3)/(\Delta r/r)^4 = 3mr/4\pi(\Delta r)^4 = k_1 mr \tag{9}$$

$$F_p/\vartheta_p^2 = m\omega_p^2 r/\vartheta^2 = mr(2\pi\vartheta)^2/\vartheta^2 = 4\pi^2 mr = k_2 mr \tag{10}$$

Similarly, two bosonic field couplings are relevant,

$$\rho_w = 8.5114\ x\ 10^{-19}\ \sigma_w \tag{3D(vii)}$$

$$\rho_w = 5.2481\ x\ 10^{-76}\ \vartheta_w^4 \tag{3D(i)}$$

and dimensional analysis gives:

$$\rho_w/\sigma_w = (3m/4\pi r^3)(\pi r^2)/(m\omega^2 r) = 3/4(\omega r)^2 = k_3/v^2 \tag{11}$$

where $v = \omega r = \pi c_o$ is the tangential vacuum field , i.e., velocity *not* speed of light, Obande (2016b).

$$\rho_w/\vartheta_w^4 = 6m_w\vartheta_w^3/\pi c^3\vartheta^4 = 3m_w/\omega_w c^3 = k_4 m/\omega \tag{12}$$

Substituting e's values in eqs. (9) to (12) gives the following field coupling constants:

Eq.(9): $\frac{\rho_p}{\tau_p^4} = \frac{2x3mr}{4\pi(\Delta r)^4} = \frac{(2x3\ x\ 4.88\ x10^{-7}x\ 9.13\ x\ 10^{-15})}{12.566x0.3183^4} = 2.0739\ x\ 10^{-19}\ N\ m$

Eq.(10): $\frac{F_p}{\vartheta_p^2} = k_2 mr = 2x4\pi^2 mr = 78.957\ x\ 4.459\ x\ 10^{-21} = 3.521\ x\ 10^{-19}\ N\ m$

Eq.(11): $\frac{\rho_w}{\sigma_w} = 3/(r_w\omega_w)^2 = 3/(6.28\ x\ 1.499x10^8)^2 = 3.3819\ x\ 10^{-18}\ (m/s)^{-2}$

Eq.(12): $\frac{\rho_w}{\vartheta_w^4} = 3m/\omega c^3 = \frac{3\ x\ 7.37\ x\ 10^{-51}}{6.28\ x\ (2.9979\ x\ 10^8)^3} = 1.30645\ x\ 10^{-76} = k_5;$

$$(k_5)^{0.25} = 1.0691\,x\,10^{-19}\,N\,m/(m\,s^{-1})^3\,rad\,s^{-1}$$

Earlier, we reasoned that the 20 orders of magnitude divergence between empirical and theoretical e- values is accountable if we assume "that an external field above some threshold voltage drastically suppresses, or indeed nullifies intrinsic atomic spin that creates charge…", Obande (2016a). Here, it reveals │e-│ an atomic reality that relates to values of the atom's diverse parametric self-interactions. Observe that the quotients of (9) to (12) are each $\sim 10^{-19}$ except (11) which is an order higher. It turns out that │e-│$\sim 1.6 \times 10^{-19}$ is among the most decisive determinants of spacetime characteristics on atomic to cosmic scales.

The eV-J quotient normally retrieves as 1eV = $2.418\,x\,10^{14}\,Hz$ x $6.626\,x\,10^{-34}\,J\,s = 1.6022\,x\,10^{-19}\,J$ but theory faults this value. The error traces to wrong Hz/eV quotient; theory reveals no natural e-m oscillation above $\sim 10^9$ Hz, Obande (2015b, 2016b). Theoretically, m_e = 0.0455 MeV (i.e., empirical 0.511 MeV) and $\vartheta_{e(p)}$ = 1.0172 Hz, therefore, 1eV = 2.2356×10^{-5} Hz = 1.4813×10^{-38} J, ~│e-│^{2}, a much lower value than empiricism suggests. To cross-check: 1.4813×10^{-38} J/eV x 6.623×10^{43}/u = 0.981 MeV/u, the theoretical equivalent of empirical 981.494MeV. Notably, empirical 1 eV= $1.6021766 \times 10^{-19}$ J unwittingly equates eV to C as in 1 eV x 1.6022 x 10^{23}/u = 96,483 C/u; an independent account is in view. Here, we account for │e-│ within its several parametric definitions in (9) to (12).

i. Equations (9) and (10) describe parametric couplings realizing │e-│~ 10^{-19} in the fermion field, the unit mr indicates torque, its magnitude kmr varies only slightly with the couple's specifics. It reveals that: a) matter is intrinsically subject to a universal invariant torque that causes the atom's innate spin; b) the conversion factor 1eV = $1.60217662 \times 10^{-19}$ J is in error, theoretically 1eV = 1.4813×10^{-38} J.

ii. Equation (11), $3/v_w^2 = 3.3819\,x10^{-18}(m/s)^{-2}$ gives $v_w = 9.418467565\,x\,10^8\,m\,s^{-1} = \pi c_o$; in other words, the bosonic field coupling constant $\rho_w/\sigma_w \sim 10^{-19}$ traces to light's tangential velocity, it indicates superluminal expansion of vacuum space, i.e., the Hubble effect is not an acceleration, space expands (radiates) at a constant superluminal velocity $v = \pi c\,ms^{-1}$, Nielsen, Guffanti & Sakar (2016). Notably, it is indicated here that the effect is *measurable* as a fixed vacuum field flux density/stress quotient ρ_w/σ_w = $8.5114\,x\,10^{-19}kgm^{-3}/Pa$; thus, if tensile parameters of the vacuum field were accessible, the Hubble effect would register with the herein ρ_w/σ_w value.

iii. Equation (12), $\rho_w/\vartheta_w^4 = 3m/\omega c^3 = 1.0691\,x\,10^{-19}Nm/\{(m/s)^3 rad\,s^{-1}\}$ describes an effect in which the torque field imposes an accelerated bulk compression that couples with angular speed to impact an aggressive hydrostatic pressure on the bosonic envelope. It implies that in order to maintain vacuum isotropic and isostasic invariance, the torque field transforms from planar to a spherical envelope to constitute a tremendous pneumatic pressure field. We deduce as follows: a) on atomic scale, the device couples with an increase of ω with Z value to effect spontaneous radioactivity at Ac, ω = 2×10^{10} rad s^{-1}, Obande (2015c); b) on stellar and galactic scales, the effect is likely responsible for stellar explosion/supernova. We refrain from stating the well-known technological implications of eq. (12).

iv. Equation (9) allows to evaluate strain rate Δr imposed on particulate matter's fermionic envelope to effect observational electromotive force fields, we simply equate $\Delta r/r = \tau_{e(p)}$ = 3.486×10^{13}, given $r_{e(p)}$ = 9.1312×10^{-15} m, $\Delta r = 0.3183$ or 31.83%. It identifies with $1/r_{photon}$ = 1/π = 0.3183, Obande (2016b). Expectedly, it reveals that strain on the wave results from the 180° amplitude oscillation that manifests propagation.

3.5 Gravitation

3.5.1 Newtonian Gravitational Constant G

CODATA (2014) gives $G = 6.67407\,x\,10^{-11}\,m^3\,kg^{-1}\,s^{-2}$. The investigation reveals that Newtonian gravitation is an exclusive bosonic field effect, two bosonic field parametric couplings are implicated:

$$G_1 = r_w\rho_w^{0.25} = 2.2909\,x\,10^{-11} \quad (3C(iii))$$

$$G_2 = \rho_w/\epsilon_w^{1.333} = 2.7542\,x\,10^{-11} \quad (3D(vi))$$

Dimensional analysis gives,

$G_1 = r_w\rho_w^{0.25} = (3r_w m_w/4\pi)^{0.25} = 2.2664\,x\,10^{-11}(Nm)^{0.25}$; it retrieves the CODATA value as $G_2 = 2.266\,x10^{-11}\,x\,0.937\pi = 6.674\,x\,10^{-11}$; $G_2 = \rho_w/\epsilon_w^{1.3} = 3/4\pi r^3 m^{0.3}\omega^{2.67}$= $2.61\,x\,10^{-11}\,(mr^2\omega\,)^{-0.3}\,(m/s)^{-2.3}$. Notably, both G_1 and G_2, implicate bosonic flux density in Newtonian gravitation.

3.5.2 Universal Unit of Gravitational Acceleration, the Galilean, g

Universal gravitational acceleration unit (gal) $g = 1.0\,x\,10^{-6}\,m\,s^{-2}$, Emiliani (1995), the subject is normally omitted in CODATA lists; the following field parametric couplings are implicated:

$$g_1 = r_p\rho_p^{0.25} = 6.7920\ x\ 10^{-6} \quad (2C(iii))$$

$$g_2 = F_p/m_p^2 = 1.5311\ x\ 10^{-6} \quad (2F(iii))$$

$$g_3 = \epsilon_w/\sigma_w^{0.75} = 2.3496\ x\ 10^{-6} \quad (3G(vii)$$

Dimensional analysis gives:

$$g_1 = 3^{0.25}m_p^{0.25}r_p/(4\pi r_p^3)^{0.25} = (3m_pr_p/4\pi)^{0.25} = 5.7119\ x\ 10^{-6}\ (N\ m)^{0.25}$$

$$g_2 = m_p\omega_p^2 r_p/m_p^2 = r\omega^2/m = v\omega/m = 3.0558\ x\ 10^{-6}\ m\ s^{-1}\ rad\ s^{-1}\ kg^{-1}$$

$$g_3 = m_w\omega_w^2(\pi r)^{0.75}/(m_w\omega_w^2)^{0.75} = \pi^{0.75}m_w^{0.25}\omega_w^{0.5}r_w^{0.75} = 2.348\ x\ 10^{-6}\ (N\ m)^{0.25}\ (m/s)^{0.5}$$

In other words, Newtonian and Galilean gravitational effects arise from very interesting couplings of e-m force fields details of which would require an elaborate account; here, we highlight only a few key points:

i. The equality $G_1 = g_1 = r\rho\ (N\ m)^{0.25}$(see also eqs. (2C(iii)) and (3C(iii)) reveals that both Newtonian and Galilean gravitation involve a pneumatic (centrifugal) force field identified here with torque. The torque field is three dimensional in the vacuum, therefore, spherical; its strength, of course, increases with an increase in the gravitating body's mass and distance from the centre thus, it is strongest at the equator and least at the poles.

ii. Theory reveals two Newtonian gravitational potentials: the one arising from the pneumatic torque field defined by $G_1 = r\rho(N\ m)^{0.25}$ and the other a combination of reversed spherical angular momentum and accelerated tangential velocity defined by $G_2 = (mr^2\omega)^{-0.333}\ (m/s)^{-2.333}$ both directed inwards to consolidate structural integrity of individual gravitating bodies and secure their common envelope. Clearly, G_2 manifests gravitational "pull" effect; thus, theory reveals an intense hydrostatic pressure that pulls the bodies together to counteract the outward push of the pneumatic torque field G_1 and achieve a rigid solid system in dynamic equilibrium.

iii. Galilean gravitation is an exclusive fermionic wave phenomenon, it comprises contributions from three parametric interactions: the interaction g_1 is an intrinsic torque field whose strength depends, of course, on the body's mass, radius and angular speed; g_2 comprises the body's combined tangential and angular motion, while g_3 implicates an additional torque field in translational potential. With respect to condensed matter's tangential motion potential, marginal value of the transverse field forecloses perceivable translation, however, translational tendency would bear strongly on precession; amongst other effects, the tendency would account for: a) perpetual tangential (translational) motion of unrestricted bodies through free space and b) random (thermal) motion of condensed matter down to constituent atoms of the molecule.

3.5.3 The Strong Nuclear Force

Equation (2F(iii)) inspires association with g the equivalent bosonic field coupling

$$F_w/m_w^2 = 7.9433\ x\ 10^{59} \quad (3F(iii))$$

it reveals an incredibly over-bearing bosonic field unit mass gravitational (radial) acceleration:

$$g_w = a_r = F_w/m_w^2 = 7.9433\ x\ 10^{59}\ m\ s^{-2}\ kg^{-1} \quad (13)$$

Dimensional analysis gives $g_w = m_w^{-1}\omega_w^2 r_w = 8.0269\ x\ 10^{59}\ m\ s^{-1} rad\ s^{-1}\ kg^{-1}$. We consider two extreme cases of elements of the chemical periodicity e, and At, e marks onset of the natural periodicity and At marks onset of spontaneous radioactivity, Obande (2015c). Electron bosonic (F_w) and fermionic (F_p) field unit mass centripetal (gravitational) forces are:

$$F_{e(w)} = (7.3725\ x\ 10^{-51})^2 x\ 7.9433\ x\ 10^{59} = 4.3175\ x\ 10^{-41}\ N/atom \quad (13a)$$

$$F_{e(p)} = (4.8828\ x\ 10^{-7})^2\ x\ 1.5311\ x\ 10^{-6} = 3.6504\ x\ 10^{-19}\ N/u \quad (13b)$$

For astatine we have $m_{At(w)} = 7.4214\ x\ 10^{-42}\ kg$ and $m_{At(p)} = 0.210\ kg$ giving,

$$F_{At(w)} = (7.4214\ x\ 10^{-42})^2\ x\ 7.9433\ x\ 10^{59} = 4.3749\ x\ 10^{-23}\ N/atom \quad (13c)$$

$$F_{At(p)} = 0.21^2\ x\ 1.5311\ x\ 10^{-6} = 6.7522\ x\ 10^{-8}\ N/u \quad (13d)$$

We deduce as follows from these results:

i. $F_w = 7.9433\ x\ 10^{59}\ m_w^2\ N$ would identify with the strong nuclear force (SNF), it is a bosonic unit mass centripetal force field holding matter together on atomic to cosmic scales, Obande (2015a). Increase of F_w with mass and g_w with radial distance would account for increase of gravitational potential from the centre of mass, i.e., the further you remove a composite (say, a nuclide or payload) from the centre of mass (nucleus), the tougher the process gets.

ii. Molar, N_A = 6.643 x 10^{43} (Obande (2015b)) multiples of $F_{e(w)} = 4.3175\,x\,10^{-41}\,N$ yield a respectable 2.8681 x 10^3 N/u holding together bosonic molar e; the value balloons to molar particulate e's $F_{e(p)} = 2.4250\,x\,10^{25}\,N/u$; it would account for inordinately high energy requirement to split the atom. The present finding might inform lower bound energy profile of next generations of smashers that aim at real sub-atomic (i.e., sub-electron) species. However, such a smasher would likely yield no more than the conjugate right and left handed angular momentum vector fields (atomic electrons and positrons) that constitute the neutral molar electron, i.e., $e^-_{atom} + e^+_{atom} = 2e_{mol.}$, plus a myriad of energy packets that constitute the glue field which binds the two counter-rotating vortices.

iii. Equation (13b) raises a possibility that e-'s experimental procedure might be probing its centripetal force, $F_{e(p)}$ = 3.6504 x 10^{-19} N, not charge; the subject calls for further investigation.

3.6 Atomic Spatial Units

Here, we consider values of the classical electron radius, electron Compton wavelength and Planck space.

3.6.1 Classical Electron Radius (CER)

Literature gives,

$$r_e = e^2/m_e c^2 = 2.81794\,x\,10^{-13}\,cm \tag{14}$$

with $e = 4.80\,x\,10^{-10}\,esu, and\ c = 2.99792458\,x\,10^{10}\,cm/s$. Unless we are in error, (14) would seem to raise key fundamental issues: i) theoretically, $m_e = 7.3725\,x\,10^{-48} g$, certainly *not* $9.11\,x\,10^{-28}\,g$; CODATA currently calls the theoretical value "hertz – kilogram relationship" despite literature to the effect that it is e's absolute (bosonic) atomic mass, Amsler et al. (2008), Pai (2015); ii) identification of e- with torque implicates electromotive rather than electrostatic effect and, indeed, eq. (14) bears this out in the empirical unit $g^{1/2} cm^{3/2} s^{-1}$, i.e., $(gf\ cm)^{½}\ cm\ s^{-1}$. The Standard Model introduces a further dimension in rejecting the order of magnitude to assign a value that makes $10^{-15}\ m$ appear colossal.

Quantitatively, fundamental length traces to mass/density ratio, i.e.,

$$r = \sqrt[3]{3m/4\pi\rho} \tag{15}$$

With $m_{e(p)} = 4.883\,x\,10^{-7}\,kg/u$ and $\rho_{e(p)} = 3.062\,x\,10^{35}\,kg\,m^{-3}$, we get $r_{e(p)} = 7.248\,x\,10^{-15}\,m$ in reasonable agreement with the graphical $9.131\,x\,10^{-15}\,m$, Obande (2015a) and CER values. The key issue with (14) resides in constructing a theoretical framework to link magnitudes of length and charge, it resolves immediately e- identifies with electromotive (velocity) rather than electrostatics (mass) effect. We examine the phenomenon of r_e.

It turns out that r_e is implied in only one parametric coupling of the fermion field, i.e.,

$$F_{e(p)} = 5.0118\,x\,10^{-16}\,\epsilon^{0.667}_{e(p)} \quad ((2F(vi))$$

Theoretically, $r_{e(p)} = F/\epsilon = F_{e(p)}/(\epsilon^{0.667}_{e(p)} x\,\epsilon^{0.333}_{e(p)}) = (5.0118\,x\,10^{-16})/\epsilon^{0.333}_{e(p)}$= 5.0118 x 10^{-16}/(1.5957 x $10^{-4})^{0.333}$ = 9.2374 x 10^{-15} m. Alternatively, $r = \lambda/2 = c/2\vartheta$; for condensed matter $c^o = 3.7154\,x\,10^{-14}\,m\,s^{-1}$, $\vartheta_e = 2.034\,s^{-1}$, i.e., $r_e = 3.71535229\,x\,10^{-14}/4.068$ = 9.1331 x 10^{-15} m. The three approaches concur with $r_e \sim 10^{-15}$, therefore, an attempt to relegate this value, such as obtains in the Standard Model, seeks to re-engineer observational reality. Notably, with $r_{e(w)} = c_o/2\vartheta$ and $\vartheta_{e(w)} = 1.0\,Hz$, electron bosonic radius $r_{e(w)} = 1.499\,x\,10^8\,m$ identifies with the astronomical unit A.U., it is informative. The parameters ϑ and c in $h\vartheta = mc^2$ refer respectively to oscillation and angular speed, Obande (2016b), in other words, the electron does not translocate, its oscillation ϑ_e spans the imponderable expanse of the cosmic vacuum field; furthermore, λ_e encloses λ values of all other elements. Thus, if the e is disturbed in an experiment, the effect is instantaneously transmitted throughout the entire cosmos; it lists among "spooky" action at a distance and "entanglement".

3.6.2 Pi, π

In the course of this project we investigated the photon and to our surprise π turns out a photonic dimensional parameter appearing in the expression of *velocity* (not speed) of light, i.e., $v = r\omega = \pi c$ it identifies with wavelength of a non-matter photonic envelope Obande, (2016b). Here, we present its phenomenology.

Table 2 gives two fermionic field parametric interactions and their inverses indicative of π, i.e.,

$$r_p \omega_p / c^o = \pi \quad (2C(iv))$$

$$\omega_p / \vartheta_p = 2\pi \quad (2E(i))$$

Dimensional analysis gives π = 9.1312 x 10^{-15} m x 12.783 rad s^{-1}/(3.71535229 x 10^{-14}) m s^{-1} = 3.141670574 radians; notably, same parametric coupling defines π regardless of e-m field specifics. Observe that eqs. (2C(iv)) and (2E(i)) inform that π is encoded in the primitive e-m field interactions that create matter; indeed, "*Die Welt ist Pi*", Boeing (2016).

3.6.3 Electron Compton Wavelength λ_c

The value $\lambda_c = 2.426310\,x\,10^{-12}\,m$ is retrievable from the fermionic field coupling,

$$r_{e(p)} = 1.1749\,x\,10^{-13}/\omega_{e(p)} = \pi c^o/\omega_{e(p)} \quad (2C(iv))$$

It gives $\lambda_c = 1.1749\,x\,10^{-13} x\,2.092\pi^2 = 2.42613\,x\,10^{-12}\,m$ and reveals that λ_c traces to the cosmic background radiation CMB, i.e., $\lambda_c = 2.106\pi^3 c^o$ where c^o = 3.71535229 x 10^{-14} m/s is electron's contribution, to the CMB, Obande (2015b).

3.6.4 Planck Length, ℓ_P

Results of this investigation present no evidence in Table 2 or 3 of a field coupling suggestive of atomic spatial dimension of the order ~ 10^{-35} m. Interactions whose order of magnitude come within range such as $m_{w/}\epsilon_w^{0.333} = 1.122\,x\,10^{-34}$, eq. (3B(vi)) and $m_w/\sigma_w^{0.25} = 1.1479\,x\,10^{-36}$, eq. (3B(vii)), refer to electromotive force not length; furthermore, lowest atomic radii values are ten orders of magnitude higher than ℓ_P, and belong to trans-U elements, see Table 2 of Obande (2015a). We deduce, therefore, that ℓ_P is not an atomic parameter; indeed, same argument applies to all Planck scale dimensions, they fail to locate in theoretical analyses of e-m fields of the atomic wave-particle composite.

It raises the important question: "is speculation constructing a subjective reality or is it truly probing objective reality?". Results of our investigation so far would support speculation construction of a subjective universe that compellingly claims objectivity, Daywitt (2014), Amelino-Camelia (2001), Amelino-Camelia (2003), Alioso et al. (2005), Amelinno-Camelia (2007). Irreconcilable results of attempts to evaluate the cosmological constant with Planck scale parameters notify that objective reality refutes Planck scale dimensionality, Obande (2016c).

3.7 Electromagnetism

3.7.1 Magnetic Flux Density B

CODATA 2014 gives B = 2.067834 x 10^{-15} Wb; the parametric coupling indicative of this value is

$$m_p/\rho_p^{0.25} = 1.3183\,x\,10^{-15} \quad (2B(iii))$$

Dimensionally we have,

$$m_p/\rho_p^{0.25} = 2\,x\,(0.75\pi)^{0.25}(m_p r_p)^{0.75} = 1.3520\,x\,10^{-15}\,(N\,m)^{0.75} \quad (16)$$

direct evaluation gives $B = 1.3128\,x10^{-15}(Nm)^{0.75}$; the CODATA value retrieves with $B = 1.3250\,x\,10^{-15}\,x\,0.4868\pi = 2.06765\,x10^{-15} Wb$.

3.7.2 Electron Magnetic Moment μ_e

CODATA gives $\mu_e = 9.284765\,x\,10^{-24}\,J\,T^{-1}$, it is interesting to find a specific bosonic parametric field coupling that replicates this value, i.e.,

$$F_w/\tau_w^2 = 9.7724\,x\,10^{-24} \quad (F(viii))$$

Dimensional analysis gives,

$$F_w/\tau_w^2 = m_w\omega_w^2 r_w/(\Delta r_w/r_w)^2 = 9.6755\,x\,10^{-24}\,N\,m\,(rad\,s^{-1})^2 \quad (17)$$

Evaluation from e_w parameters gives $\mu_e = 4.3628\,x\,10^{-41}/(2.1235\,x\,10^{-9})^2 = 9.6752\,x\,10^{-24}$, i.e., the three methods give same results.

Equation (17) affords evaluation of Δr_w, i.e., magnetic effect causal strain rate on the bosonic field; we simply equate $\Delta r_w/r_w = \tau = 2.1235\,x\,10^{-9}$, i.e., $\Delta r_w = 31.83\%$. It gives an identical value obtained above for electric field effect causal strain rate; eqs. (9) and (17) thus provide additional evidence in support of common causality of electric and magnetic fields.

3.7.3 Magnetic (Permeability) Constant μ_o

The CODATA value is $\mu_o = 12.56637\,x\,10^{-7}\,N\,A^{-2}$, it is an exclusive bosonic field effect with the indicative parametric coupling

$$r_w \sigma_w^{0.25} = 7.4817 \; x \; 10^{-7} \tag{3C(vii)}$$

Dimensional analysis gives,

$$\mu_o = (r_w \omega_w)^{0.5} (m_w r_w/\pi)^{0.25} = 7.4741 \; x \; 10^{-7} \; v^{0.5} \; (N \; m)^{0.25} \; (m \; s^{-1})^{0.5} \tag{18}$$

Use of electron parameters and dimensional analysis give similar results with the graphical value; the literature value retrieves as $\mu_o = 7.4741 \; x \; 10^{-7} \; x \; 0.535\pi = 12.5621 \; x \; 10^{-7} \; N \; A^{-1}$, observe in (18) that the unit suggests a torque field in perpetual motion through space at √πc c.f. g_3, eq. (3G(vii)).

3.7.4 Electric (Permittivity) Constant ε_o

CODATA gives $\varepsilon_o = 8.854187817 \; x \; 10^{-12} \; F \; m^{-1}$, it is a bosonic field coupling constant defined with

$$F_w/\sigma_w^{0.5} = 1.7783 \; x \; 10^{-12} \tag{3F(vii)}$$

dimensional analysis gives,

$$\varepsilon_o = F_w/\sigma_w^{0.5} = m\omega^2 r(\pi r^2)^{0.5}/(m\omega^2 r)^{0.5} = v(\pi m r)^{0.5}$$
$$= 1.755 \; x \; 10^{-12} \; (N \; m)^{0.5} \; m \; s^{-1} \tag{19}$$

The literature value retrieves with $1.606\pi \; x \; 1.755 \; x \; 10^{-12} = 8.85412179 \; x \; 10^{-12} \; F \; m^{-1}$. Observe that eq. (19)'s unit suggests a torque field in superluminal motion through space at πc; thus, ε_o and μ_o share common units - torque fields in tangential motion; notably, ε_o's unit is square μ_o's. The results are summarized:

i. Magnetic flux density is an exclusive fermionic field effect, it is the fermion field mass-density coupling constant; notably, the unit of magnetic force $(N \; m)^{0.75}$ makes interesting comparison with $(N \; m)^{0.25}$ for gravitation and $(N \; m)$ for electricity.

ii. Electron magnetic moment μ_e is a bosonic field phenomenon, it is centripetal force-strain rate coupling constant; the unit $N \; m \; (rad/s)^2$ denotes electrical effect, a torque field in accelerated angular speed.

iii. Magnetic permeability constant μ_o and electric permittivity constant ε_o result from a common bosonic parametric coupling, they differ only with respect to magnitude of the unit, ε_o's unit is square μ_o's.

iv. It is instructive that magnetic flux density **B** is a fermionic phenomenon while μ_e, μ_o and ε_o are bosonic phenomena; a detailed investigation of the subject might reveal as yet unknown relationship between matter and space on the one hand and electrical and magnetic effects on the other.

4. Summary and Conclusion

The report presents an attempt to demystify the fundamental physical constants with unambiguous identification of the underlying causalities. Based on an earlier submission that the atom is an e-m harmonic oscillator comprising intrinsic wave-particle doublet, the procedure evaluates the oscillator's boson (wave) and fermion (particle) fields' tensile parameters; coefficient of linear correlation (coupling) of one parameter with another reproduces accurate value of the fundamental constant. Dimensional analysis of the constant enables far reaching insight into details of the physical processes involved; the key findings are highlighted.

i. The fine structure constant α is fermionic field frequency-stress coupling constant; same bosonic field coupling indicates a process of formation of condensed matter from the vacuum field. Dimensional analysis yields the value $7.4645 \text{ x } 10^{-3}$ m s^{-2}/kg in line with literature's $7.2974 \text{ x } 10^{-3}$; notably, α is *not* a dimensionless constant, it identifies with condensed matter's intrinsic tendency to tangential acceleration and would account for precession of bodies in rotational motion.

ii. Planck constant h retrieves as a universal atomic field invariant. Bosonic field's atomic mass couples with field modulus to yield h/J s and angular speed couples with stress to yield h/eV s; similarly, a number of fermion field parameters couple to yield h/eV s directly; specifically, density couples with frequency to give a coefficient from which h/J s readily obtains.

iii. Theoretically, proton/electron mass ratio μ = 2408; reference is made to an earlier report to argue that the huge value reflects presence of twenty two inaccessible elements occurring between p+ and e- in the complete (natural) chemical periodicity. It is explained that e is an element, therefore, μ is relative atomic mass m_r, i.e., proton mass relative to electron's value; hence μ's variability would imply m_r variability across the periodicity. It is, however, argued that even if atomic mass values degraded with cosmological epoch, it would do so uniformly and still leave m_r, hence μ, an invariant.

iv. Proton/electron mass quotient is invoked in different atomic mass units to demonstrate that the empirical value e- = $1.6022 \text{ x } 10^{-19}$ refers to electromotive *not* electrostatics unit, in the latter unit e- = 47.062 C. It is, therefore, recommended that atomic unit of charge (i.e., elementary charge) should read F_e = 47.062

C in line with F_P = 96, 485 C; in other words, F (the Faraday) should denote charge, F_e and F_p its atomic and natural units respectively.

v. The magnitude │e-│ ~10^{-19} implicates: a) atomic unit of intrinsic torque (N m) responsible for rotation of matter on all (atomic to cosmic) scales; b) causalities of: i) tangential motion of unhindered bodies through free space; ii) random thermal motion in condensed matter; iii) spontaneous radioactivity of the chemical element and stellar explosion/supernova; c) space expansion at πc, i.e., in line with Nielsen et al. (2016), the Hubble effect is not an acceleration, it is superluminal expansion of space.

vi. Newtonian gravitation is an exclusive bosonic field phenomenon, two potentials are implicated: a pneumatic torque field with constant G_1 acts to inflate the common spatial envelope of the gravitating bodies and a spherical vector field G_2 comprising combined reversed angular momentum and accelerated tangential velocity exerts a superlative hydrostatic pressure on the individual bodies and their common envelope to counteract the effect of G_1 and achieve dynamic equilibrium of the system. Thus, gravitation turns out not a simple mutual pull of two or more bodies but an elaborate balance of contrary forces in dynamic equilibrium.

vii. Universal unit of (Galilean) gravitational acceleration, UGA, defines with three potentials, the potential g_1 shares common parametric combination with G_1, i.e., $G_1 = g_1 = r\rho = r\omega^2 = v\omega = a_r$. For condensed matter it results in an orthogonal planar 2-D equatorial gravitational envelope which transforms in the vacuum field to a spherical envelope; g_2 is a combined tangential and angular motion while g_3 is yet another torque field in translational potential.

viii. The bosonic equivalent of the UGA g_1, i.e., $g_w = F_w/m_w^2 = 7.9433 \ x \ 10^{59}$ is interpreted to indicate the strong nuclear force (SNF) binding matter together on all scales from the atom to the cosmos. The values $F_{e(w)} = 2.7 \times 10^3$ N and $F_{e(p)} = 5 \times 10^{25}$ N were found binding together molar bosonic and fermionic electron respectively, $F_{e(p)}$ would account for high energy profiles to disintegrate the atom.

ix. Investigation of atomic spatial dimensions revealed as follows: a) the empirical expression $r_e = e^2/m_e c^2$ is faulted on account of wrong m_e value, it is twenty orders of magnitude higher than the theoretical value. b) Based on concordance of r_e values calculated with three alternative methods, it is submitted that an attempt to relegate the classical electron radius $r_e = 2.8179 \times 10^{-15}$ m as in the Standard Model seeks to re-engineer physical reality. c) Electron bosonic radius $r_{e(w)} = 1.499 \times 10^8$ m coincides with the astronomical unit AU, it would account for "spooky" action at a distance and "entanglement" effects. d) Planck length is not implicated in parametric couplings that give atomic spatial dimensions, its reference to the atom (and nature) is, therefore, refuted. e) Pi π turns out an e-m field coupling constant, it expresses in rad unit (inclination), therefore, *not* a dimensionless constant.

x. Magnetic permeability μ_o and electric permittivity ε_o constants have identical units, however, magnitude of ε_o's unit is square of μ_o's. Electrical, magnetic and gravitational effects have torque (N m) as a common causality, however, its order of magnitude differs according to: (N m) > $(N\ m)^{0.75}$> $(N\ m)^{0.25}$; it justifies research efforts seeking to link the three, e.g., Wilson (1921), Rabounski (2005), Stavroulakis (2008), Marquet (2013), Cameron (2015).

xi. Analyses of seventy two linear correlations that cover the usual set of tensile properties each for the atomic boson and fermion e-m fields (Tables 1 and 2) strongly suggest that, with the exception of ratio of identities such as μ, there are no dimensionless fundamental physical constants, furthermore, FCs are field parametric quotients, therefore, strictly invariant.

In conclusion, we note that the above constitutes only a sketchy analysis of the voluminous data contained in Tables 1 and 2, adequate analysis would be bulky and require a non-peer review outlet. Although the presentation merely broaches the topic, it is forwarded nonetheless for wider scrutiny with hope to motivate independent investigation and, perhaps, attract much better informed contribution. It is clear from our series of investigations that classical (Newtonian) physics offers arguably the most powerful tool for probing the atom. The approach facilitates visualization, cognition and conceptualization of the atom's nature, its "dance steps" and their perceivable outcomes; it has distinguished itself by reproducing accurate values of observational properties of the atom and of reality, all of which were hitherto absolutely inaccessible, Obande (2015) to (2016). Notably, results of the present investigation would suggest that accessibility of tensile properties of the vacuum field could engender unprecedented revolutions in theoretical physics and technological innovation. We remain convinced that physics has, for quite a long while, had in its firm grips the "Theory of Everything", it is none other than the Planck-Einstein-de Broglie classical mass formula $h\vartheta = mc^2$; its simplicity hides its awesome analytical power as a tool for probing the atom and the cosmos. An observational theory of nature is now conceivable and it should inform speculation which, left unredeemed, can mislead irretrievably.

Table 1. Comparison of Classical and Std. Model world views

Bosons	u up	c charm	t top	g gluon	Higgs Boson
	d down	s strange	b bottom	γ photon	
Quarks	e electron	μ muon	τ tau	z boson	
Leptons	υ_e electron neutrino	υ_μ muon neutrino	υ_τ tau neutrino	W boson	
Classical Ref. Frames	$\mathbf{U^o_r}$ visible	U'_r Invis. Analog.	U^*_r Invis. Compnt.	U^*_{abs} Invisible Absolute	

Table 2. Atomic fermionic (U^*_r, U^o_r, U'r) field parametric coupling coefficients

	A. Frequency ϑ/s	E. Rot. speed ω rad/s	
Parametric Equation	Candidate Constant	Parametric Equation	Candidate Constant
(i) $\vartheta/m = 4.8084 \times 10^{-7}$	$m_{e(p)} = h\vartheta_o/c^{o2} = 4.8828E\text{-}7$ kg	(i) $\omega/\vartheta = 6.2806$	$2\pi = 6.2832$
(ii) $\vartheta r = 1.8621 \times 10^{-14}$	$\lambda^o_p = c^o/\vartheta_p = 1.8266 \times 10^{-14}$ m	(ii) $\omega/m = 1.3062 \times 10^{7}$	$2.03\pi/m_e = 1.3061E7$ kg^{-1} Hz
(iii) $\vartheta/\rho^{0.25} = 2.7353 \times 10^{-9}$	$\mu_N/3.6686\pi = 2.7353 \times 10^{-9}$ eV/T	(iii) $\omega r = 1.1749 \times 10^{-13}$	$\lambda_C/1.0462\pi = 1.1749 \times 10^{-13}$ m^{-1}
(iv) $\vartheta/\omega = 0.1592$	$0.0507\pi = 0.1592$	(iv) $\omega/\rho^{0.25} = 1.7219 \times 10^{-8}$	$\mu_N/0.583\pi = 1.7212 \times 10^{-8}$eV/T
(v) $\vartheta/F^{0.5} = 1.6827 \times 10^{9}$	$\mu_B/2.6476\pi = 1.6827E9$ Hz T^{-1}	(v) $\omega/F^{0.5} = 1.0471 \times 10^{10}$	$0.238\pi\mu_B = 1.0465 \times 10^{10}$ Hz/T
(vi) $\vartheta/\varepsilon^{0.333} = 37.4073$	$\gamma_n/2\pi = 37.409$ MHz T^{-1}	(vi) $\omega/\varepsilon^{0.667} = 235.505$	$0.547\pi/\alpha = 235.49$ kg s^2/m
(vii) $\vartheta/\sigma^{0.25} = 7.4645 \times 10^{-3}$	$\alpha = 7.2974E\text{-}3$ m s^{-2}/kg	(vii) $\omega/\sigma^{0.25} = 4.69 \times 10^{-2}$	$0.583\pi\mu_N = 4.689 \times 10^{-2}$ m^{-1} T^{-1}
(viii) $\vartheta/\tau = 5.8884 \times 10^{-14}$	$h/0.4426\pi = 5.8880 \times 10^{-14}$ J	(viii) $\omega/\tau = 3.71535 \times 10^{-13}$	$\lambda_C/2\pi = 3.8616 \times 10^{-13}$ m
B. Mass m/kg		F. Centripetal force F/N	
(i) $m/\vartheta = 4.8084 \times 10^{-7}$	$m_{e(p)} = h\vartheta_o/c^{o2} = 4.8828E\text{-}7$	(i) $F/\vartheta^2 = 3.5481 \times 10^{-19}$	$0.705\pi e = 3.5486 \times 10^{-19}$ C
(ii) $mr = 8.9125 \times 10^{-21}$	$10.388\pi P_{nu} = 8.912E\text{-}21$ kg m/s	(ii) $Fr = 1.2303 \times 10^{-46}$	$\Gamma_p = 1.2149 \times 10^{-46}$ N m
(iii) $m/\rho^{0.25} = 1.3183 \times 10^{-15}$	$\Phi_o/0.5\pi = 1.3164 \times 10^{-15}$ Wb	(iii) $F/m^2 = 1.53109 \times 10^{-6}$	$g \cong 1.0 \times 10^{-6}$ m s^{-2}
(iv) $m/\omega = 7.656 \times 10^{-8}$	$0.3425\pi/F_{au} = 7.6568E\text{-}8$ eV T^{-1}	(iv) $F/\rho^{0.5} = 2.6302 \times 10^{-36}$	$0.47\pi eV = 2.6322 \times 10^{-36}$ kg
(v) $m/F^{0.5} = 809.1$	$0.684\pi Z_o = 809.5\ \Omega$	(v) $F/\omega^2 = 8.9125 \times 10^{-21}$	$10\pi P_{nu} = 8.5794 \times 10^{-21}$ kg m/s
(vi) $m/\varepsilon^{0.333} = 1.803 \times 10^{-5}$	$\mu_B/1.022\pi = 1.8028E\text{-}5$ eV T^{-1}	(vi) $F/\varepsilon^{0.667} = 5.0118 \times 10^{-16}$	$r_{e(p)}/5.8\pi = 5.0113 \times 10^{-16}$ m
(vii) $m/\sigma^{0.25} = 3.581 \times 10^{9}$	$\mu_B/1.244\pi = 3.5813E9$ Hz T^{-1}	(vii) $F/\sigma^{0.5} = 1.9953 \times 10^{-23}$	$0.3424\pi\mu_{au} = 1.9952 \times 10^{-23}$ J/T
(viii) $m/\tau = 2.8184 \times 10^{-20}$	$e/1.81\pi = 2.8177 \times 10^{-20}$ C	(viii) $F/\tau^2 = 1.2022 \times 10^{-45}$	$3.15\pi\Gamma_p = 1.2022 \times 10^{-45}$
C. Radius r/m		G. Young's modulus ε/Pa	
(i) $r\vartheta = 1.8621 \times 10^{-14}$	$\lambda^o_p = c^o/\vartheta_p = 1.8266 \times 10^{-14}$ m	(i) $\varepsilon/\vartheta^3 = 1.8967 \times 10^{-5}$	$\mu_B/0.972\pi = 1.8956 \times 10^{-5}$ eVT^{-1}
(ii) $rm = 8.9126 \times 10^{-21}$	$10.388\pi P_{nu} = 8.912E\text{-}21$ kg m/s	(ii) $\varepsilon/m^3 = 1.6982 \times 10^{14}$	$eV/0.4532\pi = 1.698 \times 10^{14}$ Hz
(iii) $r\rho^{0.25} = 6.7920 \times 10^{-6}$	$g \cong 1.0 \times 10^{-6}$ m s^{-2}	(iii) $\varepsilon r^3 = 1.232 \times 10^{-46}$	$\Gamma_p = 1.2149 \times 10^{-46}$
(iv) $r\omega = 1.1749 \times 10^{-13}$	$\lambda_C/1.0462\pi = 1.1749 \times 10^{-13}$ m	(iv) $\varepsilon/\rho^{0.75} = 3.8904 \times 10^{-31}$	$\mu_{au}/6.937\pi = 3.890 \times 10^{-31}$ C m^2
(v) $rF^{0.5} = 1.1220 \times 10^{-23}$	$2\mu_B = 1.1220 \times 10^{-23}$ J T^{-1}	(v) $\varepsilon/\omega^3 = 7.6559 \times 10^{-8}$	$F_{au}/0.3425\pi = 7.6568 \times 10^{-8}$ N
(vi) $r\varepsilon^{0.333} = 5.0119 \times 10^{-16}$	$h/0.418\pi = 5.0123 \times 10^{-16}$ eV s	(vi) $\varepsilon/F^{1.5} = 8.9121 \times 10^{22}$	$2.9193\pi E_\Delta = 8.912 \times 10^{22}$ Vm^{-2}
(vii) $r\sigma^{0.25} = 2.5119 \times 10^{-12}$	$2.071\pi\lambda_c = 2.5124 \times 10^{-12}$ m	(vii) $\varepsilon/\sigma^{0.75} = 7.9433 \times 10^{-12}$	$\lambda_C 6.5476\pi = 7.9433 \times 10^{-12}$ m
(viii) $r\tau = 0.31842$	$1/\pi = 0.31831$	(viii) $\varepsilon/\tau^3 = 3.8018 \times 10^{-45}$	$10\pi\Gamma_p = 3.8167 \times 10^{-45}$ N m
D. Density ρ/(kg m^{-3})		H. Longitudinal stress σ/Pa	
(i) $\rho/\vartheta^4 = 1.7783 \times 10^{34}$	$3.75\pi/h = 1.7780 \times 10^{34}$ (J s)$^{-1}$	(i) $\sigma/\vartheta^4 = 3.2434 \times 10^{8}$	$0.3859\pi\gamma_p = 3.2433 \times 10^{8}$ s^{-1} T^{-1}
(ii) $\rho/m^4 = 3.1131 \times 10^{59}$	$2.27\pi^2/\mu_E^2 = 3.113 \times 10^{59}$ C m	(ii) $\sigma/m^4 = 6.0256 \times 10^{33}$	$1.3\pi/h = 6.1636 \times 10^{33}$ J^{-1} s^{-1}
(iii) $\rho r^4 = 2.1379\ 10^{-21}$	$2.5\pi P_{nu} = 2.145E\text{-}21$ kg m s-1	(iii) $\sigma r^4 = 3.8904 \times 10^{-47}$	$\Gamma_p/\pi = 3.867 \times 10^{-47}$ N m
(iv) $\rho/\omega^4 = 1.1485 \times 10^{31}$	$\alpha/h = 1.1013E31$ kg/m^3 (rad/s)$^{-4}$	(iv) $\sigma/\rho = 1.8197 \times 10^{-26}$	$0.4106\pi\mu_p = 1.8196 \times 10^{-26}$ JT^{-1}
(v) $\rho/F^2 = 1.4125 \times 10^{71}$	Γ_p^-0.49π= 1.5E71/kgm^3(rad/s)^2	(v) $\sigma/\omega^4 = 2.0797 \times 10^{5}$	$3.832\pi/\mu_B = 2.0798 \times 10^{5}$ m^{-1}
(vi) $\rho/\varepsilon^{1.333} = 3.4674 \times 10^{40}$	μ_{quad}^-0.328$\pi = 3.38 \times 10^{40}$ C m^2	(vi) $\sigma/F^2 = 2.5704 \times 10^{45}$	$0.1\pi/\Gamma_p = 2.586 \times 10^{45}$ N^{-1} m^{-1}
(vii) $\rho/\sigma = 5.954 \times 10^{25}$	$0.715\pi n_o = 5.9561 \times 10^{25}$ m^{-3}	(vii) $\sigma/\varepsilon^{1.333} = 6.3096 \times 10^{14}$	$1.834\pi/r_{e(p)} = 6.3099 \times 10^{14}$ m^{-1}
(viii) $\rho/\tau^4 = 2.0893 \times 10^{-19}$	$0.415\pi e = 2.0889 \times 10^{-19}$ C	(viii) $\sigma/\tau^4 = 3.8019 \times 10^{-45}$	$10\pi\Gamma_p = 1.2149 \times 10^{-45}$
		I. Strain rate τ	
(i)$\tau/\vartheta = 1.6982 \times 10^{13}$	$eV/4.532\pi = 1.6983 \times 10^{13}$ Hz	(iv) $\tau/\omega = 2.6915 \times 10^{12}$	$E_\rho/0.7924\pi = 2.692 \times 10^{12}$ Cm^{-3}
(ii) $\tau/m = 3.5481 \times 10^{19}$	$1.8095\pi/e = 3.5481 \times 10^{19}$ C^{-1}	(v) $\tau/F^{0.5} = 2.8840 \times 10^{22}$	$0.945\pi E_\Delta = 2.8849 \times 10^{22}$ Vm^{-2}
(ii) $\tau r = 3.1842$	$10/\pi = 3.1831$	(vi) $\tau/\varepsilon^{0.333} = 6.3096 \times 10^{14}$	$0.83\pi eV = 6.305 \times 10^{14}$ Hz
(iii) $\tau/\rho^{0.25} = 4.6774 \times 10^{4}$	$0.85\pi/\mu_B = 4.6133 \times 10^{4}$ eV^{-1} T	(vii) $\tau/\sigma^{0.25} = 1.2589 \times 10^{11}$	$0.227\pi\gamma_e = 1.2557 \times 10^{11}$ s^{-1} T^{-1}
1. $\tau/(\omega/r) = 931E5$ (rad/s/m)^{½}	u = 931.494054 MeV	2.$(\omega/r)/\tau = 931E5$ rad/s/m)^{½}	amu = 931.494054 MeV

Table 3. Bosonic (U^*_{abs}) field parametric coupling coefficients

A. Frequency ϑ/s		E. Rotational speed ω rad/s	
Parametric Equation	Candidate Constant	Parametric Equation	Candidate Constant
(i) $\vartheta/m = 1.3489 \times 10^{50}$	Kg/Hz $= 1.3564 \times 10^{50}$	(i) $\omega/\vartheta = 6.2806$	$2\pi = 6.2832$
(ii) $\vartheta r = 1.4962 \times 10^{8}$	$c_o/2 = 1.499 \times 10^{8}$ ms^{-1}	(ii) $\omega/m = 8.5114 \times 10^{50}$	1.9974πkg = 8.5114E50 Hz
(iii) $\vartheta/\rho^{0.25} = 6.61 \times 10^{18}$	1 J = 6.2415×10^{18} eV	(iii) $\omega r = 9.4189 \times 10^{8}$	$\pi c = v = 9.4183 \times 10^{8}$ m s^{-1}

(iv) $\vartheta/\omega = 0.1592$	$\pi/19.7336 = 0.1592$	(iv) $\omega/\rho^{0.25} = 4.0738 \times 10^{19}$	$2.075\pi/e = 4.0687 \times 10^{19}$/C
(v) $\vartheta/F^{0.5} = 1.5154 \times 10^{20}$	$E_{\Delta}/2.041\pi$ =1.5155E20 V m^{-2}	(v) $\omega/F^{0.5} = 9.3325 \times 10^{20}$	$E_{\Delta}/3.3144\pi$ = 9.3324E20 V m^{-2}
(vi) $\vartheta/\varepsilon^{0.333} = 1.4971 \times 10^{16}$	kg/1.911π = 1.4978×10^{16} J	(vi) $\omega/\varepsilon^{0.333} = 9.3325 \times 10^{16}$	0.331πkg = 9.3459×10^{16} J
(vii) $\vartheta/\sigma^{0.25} = 1.99 \times 10^{14}$	eV/0.3857π = 1.9955E14 Hz	(vii) $\omega/\sigma^{0.25} = 1.2589 \times 10^{15}$	$1/(h/2\pi) = 1.5193 \times 10^{15}$ eV^{-1} s^{-1}
(viii) $\vartheta/\tau = 4.6989 \times 10^{8}$	$\gamma_p = 4.6981 \times 10^{8}$ s^{-1} T^{-1}	(viii) $\omega/\tau = 2.9580 \times 10^{9}$	$\mu_B/1.506\pi$ = 2.9583E9 Hz T^{-1}
B. Mass m/kg		F. Centripetal Force F/N	
(i) $m/\vartheta = 7.4131 \times 10^{-51}$	$m_e = h\vartheta_e/c^2$ = 7.3725 E-51 kg	(i) $F/\vartheta^2 = 4.3652 \times 10^{-41}$	0.843πEγ = 4.366E-41 C^2 m^2 J^{-1}
(ii) $mr = 1.1220 \times 10^{-42}$	Eγ/4.6776π = 1.1E-42 C^2 m^2 J^{-1}	(ii) $Fr^2 = 1.0 \times 10^{-24}$	$\mu_{au}/5.904\pi = 1.00 \times 10^{-24}$ J T^{-1}
(iii) $m/\rho^{0.25} = 4.898 \times 10^{-32}$	14.978πP_{uv} = 4.9E-32 kgm^2rads^{-1}	(iii) $F/m^2 = 7.9433 \times 10^{59}$	F_g = 7.9433m^2E59 m s^{-2} kg^{-1}
(iv) $m/\omega = 1.1749 \times 10^{-51}$	$m_e/1.997\pi$ = 1.1751E-51 kg	(iv) $F/\rho^{0.5} = 1.9099 \times 10^{-2}$	$\mu_N/0.424\pi$ = 1.91E-2 m^{-1} T^{-1}
(v) $m/F^{0.5} = 1.1220 \times 10^{-30}$	$\mu_E/2.42\pi$ = 1.1152E-30 C m	(v) $F/\omega^2 = 1.1220 \times 10^{-42}$	Eγ/4.677π = 1.122E-42 $C^2m^2J^{-1}$
(vi) $m/\varepsilon^{0.333} = 1.122 \times 10^{-34}$	$h/2\pi = 1.0546 \times 10^{-34}$ J s	(vi) $F/\varepsilon^{0.667} = 9.9541 \times 10^{-9}$	$0.599\pi a_o = 9.9581 \times 10^{-9}$ m
(vii) $m/\sigma^{0.25} = 1.148 \times 10^{-36}$	eV/0.4943π = 1.1480E-36 kg	(vii) $F/\sigma^{0.5} = 1.7783 \times 10^{-12}$	$\varepsilon_o/1.5848\pi = 1.7784 \times 10^{-12}$ F m^{-1}
(viii) $m/\tau = 3.5481 \times 10^{-42}$	Eγ/1.4643π = 3.584E-42 c^2 m^2 T^{-1}	(viii) $F/\tau^2 = 9.7724 \times 10^{-24}$	$\mu_e = 9.2848 \times 10^{-24}$ J T^{-1}
C. Radius r/m		G. Young's modulus ε/Pa	
(i) $r\vartheta = 1.4962 \times 10^{8}$	$r_{e(w)} = \lambda_e/2$ = 1.499E8 m	(i) $\varepsilon/\vartheta^3 = 2.9512 \times 10^{-49}$	Γ_w^0.64π = 2.9E-49 kgm^3(rad/s)^2
(ii) $rm = 1.1220 \times 10^{-42}$	Eγ/4.6776π = 1.122E-42 C^2 m^2 J^{-1}	(ii) $\varepsilon/m^3 = 6.3096 \times 10^{101}$	$\varepsilon = 6.3096$ $m^3 \times 10^{101}$ Pa
(iii) $r\rho^{0.25} = 2.2909 \times 10^{-11}$	G/0.927π = 2.3E-11/kg m^3 s^{-2}	(iii) $\varepsilon r^3 = 1.0 \times 10^{-24}$	$\mu_{au}/5.904\pi = 1.00 \times 10^{-24}$ J T^{-1}
(iv) $r\omega = 9.4189 \times 10^{8}$	$\pi c_o = v = 9.4183 \times 10^{8}$ ms^{-1}	(iv) $\varepsilon/\rho^{0.75} = 8.4140 \times 10^{7}$	$v_{pho}/3.563\pi$ = 8.4140 E7 m s^{-1}
(v) $rF^{0.5} = 1.00 \times 10^{-12}$	$0.3442\pi/E\rho = 1.00 \times 10^{-12}$ C m^{-3}	(v) $\varepsilon/\omega^3 = 1.1749 \times 10^{-51}$	$m_e/2\pi = 1.1749 \times 10^{-51}$ kg
(vi) $r\varepsilon^{0.333} = 9.9541 \times 10^{-9}$	$0.5988a_o = 9.9548 \times 10^{-9}$ m	(vi) $\varepsilon/F^{1.5} = 1.0 \times 10^{12}$	$0.3442\pi/E\rho = 1.00 \times 10^{-12}$ C m^{-3}
(vii) $r\sigma^{0.25} = 7.4817 \times 10^{-7}$	$\mu_o/0.5346\pi$ = 7.4822E-7N A^{-2}	(vii) $\varepsilon/\sigma^{0.75} = 2.3496 \times 10^{-6}$	gal = 1×10^{-6} m s^{-1}
(viii) $r\tau = 0.3184$	$1/\pi = 0.3183$	(viii) $\varepsilon/\tau^3 = 3.0903 \times 10^{-23}$	$0.53\pi\mu_{au} = 3.0883 \times 10^{-23}$ J T^{-1}
D. Density ρ/(kg/m3)		H. Longitudinal stress σ/Pa	
(i) $\rho/\vartheta^4 = 5.2481 \times 10^{-76}$	ρ_w = 5.2258E-76ϑ^4_w kg m^{-3}	(i) $\sigma/\vartheta^4 = 6.3096 \times 10^{-58}$	μ_E^0.6263π = 6.3307E-58 C m
(ii) $\rho/m^4 = 1.5849 \times 10^{125}$	$\rho_w = 1.5849 m_w^4 \times 10^{125}$ kg m^{-3}	(ii) $\sigma/m^4 = 1.9953 \times 10^{143}$	$\sigma = 1.9953 m^4 \times 10^{143}$ Pa
(iii) $\rho r^4 = 2.6915 \times 10^{-43}$	Eγ/19.5π = 2.6914E-43 C^2 m^2 J^{-1}	(iii) $\sigma r^4 = 3.1623 \times 10^{-25}$	$\mu_e/9.346\pi$ = 3.1623E-25 J T^{-1}
(iv) $\rho/\omega^4 = 3.3884 \times 10^{-79}$	$\rho_w = 3.3884\omega_w^4 \times 10^{-79}$ kg m^{-3}	(iv) $\sigma/\rho = 1.1749 \times 10^{18}$	1 J/1.691π = 1.17489×10^{18} eV
(v) $\rho/F^2 = 2.7416 \times 10^{5}$	$B_{au} = 2.3505 \times 10^{5}$ T	(v) $\sigma/\omega^4 = 3.9811 \times 10^{-61}$	μ_E^0.662π = 3.3954E-61 C m
(vi) $\rho/\varepsilon^{1.333} = 2.7542 \times 10^{-11}$	G/0.771π = 2.76E-11 m^3 $kg^{-1}s^{-2}$	(vi) $\sigma/F^2 = 3.2359 \times 10^{23}$	0.4573πamu = 3.2358×10^{23} Hz
(vii) $\rho/\sigma = 8.5114 \times 10^{-19}$	$1.691\pi e = 8.5115 \times 10^{-19}$ C	(vii) $\sigma/\varepsilon^{1.333} = 3.1989 \times 10^{7}$	$\vartheta_{pho}/0.4748\pi$ = 3.1987E7 s^{-1}
(viii) $\rho/\tau^4 = 2.5704 \times 10^{-41}$	0.496πEγ = 2.569E-41 C^2m^2/J	(viii) $\sigma/\tau^4 = 3.0903 \times 10^{-23}$	$0.53\pi\mu_{au} = 3.0883 \times 10^{-23}$ J T^{-1}
		I. Strain rate τ	
(i) $\tau/\vartheta = 2.1281 \times 10^{-9}$	$a_o/1.493\pi = 1.1282 \times 10^{-9}$ m	(v) $\tau/\omega = 3.3806 \times 10^{-10}$	$2m_p = 3.00655 \times 10^{-10}$ J
(ii) $\tau/m = 2.8184 \times 10^{-41}$	0.543πEγ = 2.8127E-41 C^2 m^2 J^{-1}	(vi) $\tau/F^{0.5} = 3.1623 \times 10^{11}$	$E_\Theta = 3.1623 \times 10^{11}$ V m^{-1}
(iii) $\tau r = 3.1842$	$10/\pi = 3.1831$	(vii) $\tau/\varepsilon^{0.333} = 3.1989 \times 10^{7}$	$\vartheta_{pho}/0.4748\pi$ = 3.1987E7 s^{-1}
(iv) $\tau/\rho^{0.25} = 1.3804 \times 10^{10}$	$\mu_B = 1.3996 \times 10^{10}$ Hz T^{-1}	(viii) $\tau/\sigma^{0.25} = 4.2560 \times 10^{5}$	$0.5764\pi B_{au} = 4.2563 \times 10^{5}$ T
(1) $\tau/(\omega/r)^{0.5} = 1.0375 \times 10^{-5}$	$amu_{(w)} = 1.0375 \times 10^{-5}$ eV	**(2)** $(\omega/r)/\tau = 9.2897 \times 10^{9}$	$\mu_B/0.48\pi$ = 9.2815E9 Hz T^{-1}

Table 4. Causality and effect of atomic fermionic and bosonic waves' self-interaction

S/No.	Effect	Fermionic wave Causality	Bosonic wave Causality
1	Rest mass	ϑ/m; m/ϑ; ω/m; τ/(ω/r); (ω)/τ	ϑ/m; m/ϑ; m/ω; ω/m; ϵ/ω; ω/ϵ; σ/F; τ/(ω/r)
2	Photon wavlngth., π	ϑ/ω; ω/ϑ; rτ; τr	ϑ/r; r/ϑ; ϑ/ω; ω/ϑ; rω; ωr; rτ; τr
3	Photon freq. ϑ_{pho}	-	ϵ/ρ; σ/ϵ; τ/ϵ
4	Energy /(J or eV)	-	ϑ/ρ; σ/ρ; σ/m
5	E. field grad. E_{Δ}	ϵ/F; τ/F	ϑ/F; ω/F; τ/F
6	Polarizability	-	m/r; r/m; m/τ; F/ϑ; τ/m; ρr; ρ/τ; F/ω
7	E. potential /V	τ/ϑ; ϵ/m; F/ρ; τ/ϵ	ϑ/σ; m/σ
8	E. dip. Moment	F/σ; ϵ/ρ	m/F; σ/ω
9	Electrostatics	F/ϑ; τ/m; m/τ; ρ/τ; τ/ω; ρ/m	rF; ρ/ω; ρ/σ; ω/ρ; ϵ/F
10	Permittivity	-	F/σ; τ/ω
11	Impedance	m/F	-
12	M. permeability	-	Rσ
13	Quadrpl. momt.	ρ/ϵ	-
14	Nucl.mag. moment	-	F/τ; σr
15	M. dipole momt.	Σρ	ϵ/τ; σ/τ; Fr; ϵr
16	M. flux density	m/ρ	ρ/F; τ/σ
17	Bohr magneton	ϑ/F; m/ε; m/σ;ϵ/ϑ; r/F; ω/F; τ/ρ; σ/ω	ω/τ; τ/ρ; (ω/r)/τ
18	Nucl. Magneton	ϑ/ρ; ω/σ; ω/ρ	F/ρ
19	Gyromag. Ratio	ϑ/ϵ; σ/ϑ; τ/σ	ϑ/τ
20	Unit of action	ϑr; ϑ/τ; rϑ; ρ/ϑ; rϵ	m/ϵ
21	Bohr radius	-	F/ϵ
22	Electron radius	F/ϵ	r/ϑ
23	Comptn. wavlgth.	rω; ωr; rσ; ω/τ;ϵ/σ	-
24	Newtonian G	-	rρ; ρϵ
25	Galilean g	F/m; rρ	F/m (Strong Nuclear Force); ϵ/σ
26	Fine structure	ϑ/σ; ρ/ω; ω/ε	-
27	No. densty n_o	ρ/σ	-
28	Force	m/ω; ϵ/ω	-
29	Torque	mr; rm; Fr; F/τ; ρ/F; σ/F; ε/τ; σ/τ; ϵr; σr	ϵ/ϑ

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Appendix

A. Notation

1. a_o = 5.291772×10^{-9} m – atomic unit a.u of length (Bohr radius)
2. α = 7.297353×10^{-3} m s^{-2}/kg – fine structure constant
3. $amu_{(p)}$ = 931.4940×10^{5} eV – amu - eV equivalent of fermionic atomic unit
4. $amu_{(w)}$† = 1.0375284×10^{-5} eV – amu - eV equivalent of bosonic atomic unit
5. B_{au}* = 2.350518×10^{5} T – a.u. of magnetic flux density
6. c_o = 2.99792458×10^{8} ‘m s^{-1}’ – vacuum (boson) speed of light: transverse vacuum radiation
7. c^o† = $3.715352291 \times 10^{-14}$ m s^{-1} – matter (fermion) speed of light, i.e., transv. Broglie radiation
8. e = 1.602177×10^{-19} C – a. u. of “charge” (theoretically: a. u of electric couple)
9. ε_o = 8.854188×10^{-12} F m^{-1} – electric (permittivity) constant
10. E_θ* = 5.142207×10^{11} V m^{-1} – a. u. of electric field
11. E_ρ* = 1.081202×10^{12} C m^{-3} – a.u. of electric charge density
12. E_Δ* (E_h/ea_o^2) = 9.717362×10^{21} V m^{-2} – a.u. of electric field gradient
13. E_∇* ($e^2a_o^2/E_h$) = 1.648777×10^{-41} C^2 m^2 J^{-1} – a.u. of electric polarizability
14. E_{nu}* (m_ec^2) = 8.238732×10^{-14} J – natural unit (n.u.) of energy
15. eV = 2.417989×10^{14} Hz – eV – Hz relationship (wrong; theory:1eV = 2.1978×10^{-5} Hz)
    = 1.782662×10^{-36} kg – eV – kg relationship (wrong; theory: 1eV = 1.07315×10^{-11} kg)
16. F_{au}* (E_h/a_o) = 8.238723 10^{-8} N – atomic unit (a.u.) of force
17. F$†_g$ = 7.943282×10^{59} m s^{-2} kg^2 – n.u of gravitational force (the Strong Nuclear Force)
18. gal ≅ 1×10^{-6} m s^{-2} - n.u. of universal (Galilean) gravitational acceleration
19. G = 6.67408×10^{-11} m^3 kg^{-1} s^{-2} Newtonian constant of gravitation
20. γ_e = 1.760860×10^{11} s^{-1} T^{-1} – electron gyromagnetic ratio
21. γ_p = 2.675222×10^{8} s^{-1} T^{-1} - proton gyromagnetic ratio
22. $\gamma_N/2\pi$ = 29.164693×10^{6} s^{-1} T^{-1} – neutron gyromagnetic ratio over 2 pi

23 Γ_{nu}† = 2.0739×10^{-19} N m – n.u of torque

23. Γ_p† = 1.21486×10^{-46} kg m^3 rad^2 s^{-2} – torque on the fermionic atomic wave
24. Γ_w† = 9.80272×10^{-25} kg m^3 rad^2 s^{-2} – torque on the bosonic atomic wave
25. h = 6.626070×10^{-34} J s – Planck Constant
26. h/2π = 6.582120×10^{-16} eV s – Planck Constant over 2 pi
27. J = 6.241509×10^{18} eV – J relationship (wrong; theory: 1J = 6.8638×10^{37} eV

28. kg = 8.987552 x 10^{16} J; = 4.524438 x 10^{41} m^{-1}; = 1.356393 x 10^{50} Hz

29. λ_C = 2.4263102376 x 10^{-12} m - Compton wavlgsth; $\lambda c/2\pi$ = 3.861593 x 10^{-13} m – n.u. of length

30. $m_{e(p)}$ = $h\vartheta_{e(p)}/c^{o2}$ = 4.8828125 x 10^{-7} kg – electron relative atomic mass

31. $m_{e(w)}$† = $h\vartheta_{e(w)}/c_o^2$ = 7.372495 x 10^{-51} kg – electron absolute atomic mass

32. amu = 2.252343 x 10^{23} Hz – amu –hertz equivalent (wrong, theory: 1 amu = 2048 Hz ≡ H atom)

33. μ_{au}*($2\mu_B$) = 1.854802 x 10^{-23} J T^{-1} – a.u. of magnetic dipole moment

34. μ_B = 13.966245 x 10^9 Hz T^{-1}; = 5.788382 x 10^{-5} eV T^{-1} – Bohr magneton

35. μ_e = 9.284765 x 10^{-24} J T^{-1} - electron magnetic moment

36 μ_E (ea_o) = 8.478354 x 10^{-30} C m – a.u. of electric dipole moment

37. μ_N = 3.152451 x 10^{-8} eV T^{-1}; = 2.542623 x 10^{-2} m^{-1} T^{-1} - nuclear magneton

38. μ_o = 12.566371 x 10^{-7} N A^{-2} – magnetic (permeability) constant

39. μ_{quad}* (ea_o^2) = 4.486551 x 10-^{40} C m^2 a.u. of electric quadrupole moment

40. μ_p = 1.410606 x 10^{-26} J^{-1} T^{-1} – proton magnetic moment

41. n_o = 2.686781 x 10^{25} m^{-3} Loschmidt Constant (amagat)

42. ϑ_{pho} (πc)† = 9.418578 x 10^8 m s^{-1} – velocity (*not* speed) of light

43. P_{au} = 1.992850 x 10^{-24} kg m s^{-1} – a.u. of momentum

44. P_{univ}† = 1.04082057 x 10^{-33} kg m^2 rad s^{-1} universal angular momentum of the isolated atom [56]

45. Φ_o (h/2e) = 2.067834 x 10^{-15} Wb – magnetic flux quantum

46. P_{nu}* (m_ec) = 2.730924 x 10^{-22} kg m s^{-1} – n.u. of momentum

47. $r_{e(p)}$† = 9.13116 x 10^{-15} m – classical electron radius (theoretical value)

48. Z_o (μ_oc) = 376.730313 Ω – impedance of vacuum

*Introduced in this investigation to facilitate tabulation.

†New atomic e-m constant evaluated in the course of our series of investigations.

B. Observations

i. Dimensional analysis

The results interpretation relied heavily on dimensional analysis, in particular, identity of the constant depended exclusively on arrangement of dimensions of interacting parameters, the choices will benefit from independent assessment. A few illustrations may suffice: a) The fine structure constant presents as fermion field frequency-stress correlation coefficient, $\alpha = \vartheta_p/\sigma_p^{0.25}$; normally, the unit should read s^{-1} $Pa^{-0.25}$, however, much is lost on the interaction dynamics if we stopped at that level. Further reduction of σ gives $\alpha = \vartheta/(F/\pi r^2)^{0.25} = \vartheta/(m\omega^2 r/\pi r^2)^{0.25} = \pi^{0.25}\vartheta r^{0.25}/m^{0.25}\omega^{0.5} = 0.335469(\vartheta v/m)^{0.25}$. It differentiates significantly between the two units, the former makes little sense while the latter details the coupling mechanism. b) Take also the case of e-/$(kg^{1/2}m^{3/2}s^{-1})$, it rearranges to $(kgf\ m)^{1/2}m\ s^{-1}$, i.e., $(N\ m)^{1/2}m\ s^{-1}$, a torque field in perpetual tangential motion, not evident without the rearrangement. Furthermore, re-arrangement of the familiar G/(m^3 kg^{-1} s^{-2}) to m s^{-2} m^2/kg or (m s^{-1})^2 m/kg, speaks familiar tunes.

ii. Nomenclature and notation

The investigation uncovers a major gap in link between nomenclature, symbol and notation of physical quantities. It became necessary to use the symbol E for electric constants and distinguish between types with improvised indices, e.g., E_θ, E_ρ, E_Δ, E_∇, E_{nu} hopefully differentiate electric: field, charge density, field gradient, polarization and natural unit of energy respectively. We used the (traditional) symbols μ and P for moment and momentum respectively and differentiate between types with appropriate indices. But, the situation is absolutely unsatisfactory. Physics cannot afford to have as many symbols/notations as there are researchers and/or authors, particularly in textbooks. The International Union of Pure and Applied Physics IUPAP should move to systematize physical nomenclature, symbols and notations, this is long overdue. Listings such as E_h/ea_o^2 and $e^2a_o^2/E_h$ passed for 'notations' for a.u. of field gradient and polarizability respectively highlight the urgency, these collections of symbols are clearly 'expressions' not notations.

iii. CODATA innovation

Current (2014) compilations define ε_o and μ_o as electric and magnetic constants respectively, it poses no problem for 'old school' physicists but easily capable of making teaching a little more challenging, simply because there are other constants of electricity and magnetism. The generic words in definitions of these terms are "permittivity" and "permeability", if removed the definitions lose their specificity and visualizability.

iv. New constants

The investigation uncovered a few new physical constants, most of these have been introduced, Obande (2015a), they are, however, included here for a holistic presentation; notably, they include: i) the bosonic field force of gravitational (centripetal) acceleration F_g attributed to the strong nuclear force; ii) universal angular momentum of the isolated atom, $P_{univ.}$, it is field invariant; iii) torque on the boson Γ_w and fermion Γ_p fields; iv) n.u of torque Γ_{nu} = 2.0739 x 10^{-19} N m, it manifests a wide range of effects.

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