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Quantum Mechanics by General Relativity

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Abstract

In the framework of General Relativity we explain the creation of all particles, ordinary and anti, in two chiral directions, with multiple generations, as well as electromagnetism and the strong nuclear force. Quantum mechanics is well-known to have its foundational problems revolving around the wave-particle duality, which actually has an exact solution, viz., a diagonal spacetime manifold that admits any particle of energy coupled with its wave *of energy co-existing at the same spacetime* $(t + it, x + iy, y + iz, z + ix)$. I.e., a photon can travel along $x = ct$ with its associated electromagnetic wave spinning from y to z in circular motion as $(y = \cos t, z = \sin t) \equiv e^{it}$. The construct of diagonal manifold, seemingly artificial, is fundamental in differential topology as it leads to the Euler characteristic. That Nature is inherently of duality cannot have a more evident example than that of the complex number $x + iy$, where 1 implies a linear motion in $\mathbb{R}$ and $i = e^{\frac{\pi}{2}i}$ implies a circular motion along S^1. That the quantum wave *itself* possesses energy can be argued simply as: wave = probability = frequency = energy by Planck's formula. By assigning energy entirely to particle, quantum mechanics has missed an entire copy of the Universe (the wave universe treated as the quantum vacuum).

Keywords: dark matter energy, quantum entanglement, anti-particle asymmetry, neutrino parity, 720-degree rotation

1. Introduction

1.1 The Failure of Quantum Mechanics to Explain Gravity

The success of quantum mechanics builds on the Hilbert-space setup, where an operator operates on a wavefunction with the eigenvalues being the possible states of the particle, thereof both the particle and the wave nature of an energy entity are recognized. However, the wave is probability not energy (for a recent critique of quantum mechanics, see Becker, 2018), for if it is energy, where does one locate this energy? The answer is: At the same spacetime as the particle, i.e., a diagonal $4 - manifold$ that contains $\{(particle, its\ electromagnetic\ wave)\}$ with energy possessed by both entries. Not recognizing the fundamental construct of diagonal manifold in differential topology, quantum mechanics has had no choice but interpreting wave as probability (for modeling difficulties in pilot wave theories, see Shtanov, 1996) and using particle to explain all physical phenomena, in particular graviton to explain gravity, which however has never been found. In the same vein, dark matter and dark energy have eluded an understanding. In our view the economic resources allocated in such pursuits will prove to be misdirected, as dark matter and dark energy exist in the wave universe, analogous to a situation where two identical stamps are glued together with the bottom stamp containing dark matter and dark energy.

1.2 Methodological Problems in the Standard Model

Two glaring analytical problems stand out in the Standard Model: [1] The pervasive practice of setting the speed of light $c = 1$, which is the inverse of the square-root of the product of permittivity and permeability constants, implies an alteration of the above constants, too; then Ampere's law, Maxwell equations and electromagnetism all break down. [2] The electroweak unification, where the Higgs boson is represented by a vector of the Higgs's wavefunction ϕ along with 0 and is multiplied by the Weinberg's matrix to re-distribute the energy of ϕ to the Z boson entirely, hence leaving photon without rest mass, works only if $(\phi, 0)^T$ is aligned as such; by reversing to $(0, \phi)^T$ both Z and photon are to receive rest masses, invalidating the electroweak unification (see Quigg, 2013, p. 125). Otherwise, the principle of symmetry has been relied upon to a fault (cf. Hossenfelder, 2018); consider the fundamental force of electromagnetism, where electricity and magnetism are *not* symmetric, the former radial and the latter sideways. The logic is: while electromagnetism implies electromagnetic waves, the converse is *Not* true. Overall relegating the complex number i to a mere symbol (Wong, 2001) instead of interpreting it as rotation in physical space (the Lorentzian manifold) has made quantum mechanics a mathematical cult, scattered with disjointed mystic enigmas, such as quantum entanglement, which along with the double-slit experiment and action-at-distance is simply a manifestation of the quotient topology of the wave universe, succinctly put,

$\sin(\omega t + 2k\pi) \equiv \sin \omega t$, with an equivalence class representatives $[0, 2\pi)$ of length 2π. To be sure, if gravitational interaction were not instantaneous, then the center of masses would become indeterminate, and if electromagnetic interaction were not instantaneous (Hoyle & Narlikar,1995), then the fine-structure constant α regulating quantum electrodynamics would have to be a function of distance. We do note, however, that the familiar acausal nature as associated with any circular spacetime does not apply in the diagonal manifold $(t + it, x + iy, y + iz, z + ix)$, where the linear structure (t, x, y, z) containing all the dynamics gets superimposed onto (it, iy, iz, ix).

1.3 Hypotheses underlying the Proposed Diagonal Manifold

We hypothesize "*H1*:" There existed a spacetime manifold $\mathcal{M}^{[2]}$ that contained electromagnetic waves ("EMW") of Planck length

$$\begin{aligned} \lambda_P &= \frac{c}{\nu_P} = 5 \times 10^{-35}\,(m)\,, \text{ with} \\ \nu_P &= \sqrt{\frac{c^5}{1.6Gh}} = 6 \times 10^{42}\,(1/s)\,, \end{aligned} \tag{1}$$

without particle representations. Then any particular EMW was (is) a traveling spinning wave ball

$$\begin{pmatrix} x(t) \\ y(t) \\ z(t) \end{pmatrix} = \begin{pmatrix} \rho\lambda_P + ct \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \cos\omega t \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \sin\omega t \end{pmatrix}, \tag{2}$$

with $r \in [0, 1]$, $\rho \in \left[-\frac{1}{2}, \frac{1}{2}\right]$, $\lambda_P k \equiv 2\pi$, $t \in (-\infty, \infty)$, and dark energy

$$h\left(\nu_P + \frac{1}{\nu_P\,(s^2)}\right), \tag{3}$$

where the second term = the uncertainty energy (note that throughout this paper we freely state our previously derived and published results as collected in Light, 2016).Then a collision with an EMW of the opposite direction and spin at $t = 0$ would lead to

$$\begin{aligned} &\begin{pmatrix} \rho\lambda_P + ct \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \cos\omega t \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \sin\omega t \end{pmatrix} \\ &+ \begin{pmatrix} \rho\lambda_P - ct \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \cos(-\omega)\,t \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \sin(-\omega)\,t \end{pmatrix} \\ = \;& 2\begin{pmatrix} \rho\lambda_P \\ r\,\|\mathbb{E}_{\max}\| \cos\rho\lambda_P k\ \cos(-\omega)\,t \\ 0 \end{pmatrix}, \end{aligned} \tag{4}$$

stopping being an EMW and entailing no favored velocity direction that could be accounted for by physical laws, hence a dark matter of rest mass

$$2\left(\frac{h}{c^2}\right)\left(\nu_P + \frac{1}{\nu_P\,(s^2)}\right). \tag{5}$$

H2: The gravitational constant $G^{[2]}$ of $\mathcal{M}^{[2]}$ was (is)

$$G^{[2]} = \frac{c^5\left(s^2\right)}{1.6h} \approx 10^{85} G^{[3]}, \text{ where} \tag{6}$$

$$G^{[3]} = \frac{G^{[1]}G^{[2]}}{G^{[1]} + G^{[2]}} \approx G^{[1]}, \tag{7}$$

with $G^{[3]} \equiv$ the Newton constant G of the post-Big Bang universe $\mathcal{M}^{[3]}$ and $G^{[1]} \equiv$ the gravitation constant of the post-Big Bang particle universe $\mathcal{M}^{[1]}$.

H3: In $\mathcal{M}^{[2]}$ an amount of mass/energy $M^{[2]}$ equal to about 20 times the visible energies of $\mathcal{M}^{[3]}$ became confined in a radius of 10^{108} meters at $T = 0$. Then a black hole **B** formed in $\mathcal{M}^{[2]}$, by the Schwarzschild formula

$$\begin{aligned} R_{Sch} &= \frac{2G^{[2]}M^{[2]}}{c^2} \approx 10^{108}\,(m) \\ &> \; > 10^{26}\,(m) = \text{the present-day} \\ &\quad\; \text{radius of } \mathcal{M}^{[3]}, \end{aligned} \tag{8}$$

with its interior composed of equivalence classes of spacetime lengths equal to the square-root of $-g_{11}$ in *Einstein Field Equations ("EFE").* Since General Relativity is predicated on the principle of equivalence and the construct of center of mass, all the *EMW's* in **B** were necessarily cast in the same equivalence class - - the smallest being of length

$$r_* = \frac{c}{\sqrt{-g_{11}(\lambda_P)}} \approx 10^{-63}\,(m)\,. \tag{9}$$

H4: The smallest indivisible unit of distance at $T = 0$ was (is)

$$\begin{aligned} d_* &= \frac{\pi}{6}\frac{\lambda_P}{2} \approx 0.26 \times 5 \times 10^{-35}\,(m) \\ &= 1.3 \times 10^{-35}\,(m)\,. \end{aligned} \tag{10}$$

Then $d_* >> r_*$ and **B** blew up at its center, resulting in a hole $\mathcal{M}^{[1]}$ of diameter λ_P, along with it a diagonal 4-manifold $\mathcal{M}^{[1]} \times \mathbf{B} = \mathcal{M}^{[3]}$ containing (particle p, $EMW(p)$)'s and $(0, EMW)$'s, where p and $anti - p$ of the same handedness were created by 2 (coincidental) (*photon*, EMW)'s via altering their 360-degree spins to 180 degrees along 2 semi-circles separated by $180, 90, 60, 30$, or 0 degrees, resulting in *photon*, *electron*, *up quark u*, *down quark d*, or *neutrino* ν, with generation m given by the multiple of full spins before the "re-combination" - - the scheme to all particles. By Feynman's analysis on electromagnetic mass (see Feynman, 1963, II: 28-3), we claim the energy distribution over $(p, EMW(p))$ being $(3/4, 1/4)$. The particle's rest mass comes from the spin-stop at the intersection of the 2 semi-circles - - a discontinuity also causing a spacetime curvature producing electric charge so that with an energy-momentum tensor constructed from the Poynting vector, *EFE* explains electromagnetism as well as gravity. Thus, any electrically charged particle p punctures $\mathcal{M}^{[1]}$ with a mini black hole b of radius $1/e$ of that of $EMW(p)$, so large that it explains nuclear binding. The ratio $1/e$ derived from the fact that at the Big Bang any photon appeared within its wave length λ_P with probability 1; re-parametrizing $s \in [0, 1]$ for $s \cdot \lambda_P$ to $e^s \in \left[e^0, e^1\right] = [1, e]$, one then has $\int_1^e \frac{1}{r} dr = 1$, where the factor $\left(\frac{1}{r}\right)$ is contained in the formula for the metric tensor g_{11}. This ratio $1/e$ applies to the sizes of the mini black holes of all $(p, EMW(p))'s$ of electric charges, where the point p punctures a mini black hole of radius $r_{Sch}(p)$ in $\mathcal{M}^{[1]}$ accounting for $3/4$ of the mass and $EMW(p)$ resides in the annular volume of $(e-1)\, r_{Sch}(p)$ accounting for $1/4$ of the mass. Note that all particles p_n with electric charge = 0 coulomb have their Schwarzschild radii $r_{Sch}(p_n)$ (attributed to their masses alone) $<< d_*$ so that by construction $r_{Sch}(p_n) = 0$; i.e., $(p_n, EMW(p_n))$ has $p_n \in \mathcal{M}^{[1]}$, as a point, and $EMW(p_n) \in \mathbf{B}$, as a ball minus p_n. Also note that p_n includes photons as well since all photon wave lengths after the Big Bang $> \lambda_P$ by spacetime inflation.

H5: $EMW(p)$ = probability wave, hence quantum mechanics.

2. Method and Results

In the sequel we will proceed in the mode of deductive logic as based on the above five hypotheses so that conclusions necessarily follow as results. For our previously accumulated results (*Sections 2.1* through *2.7*, we will deliver a sharpened integrated rendition; for our new findings concerning the nuclear strong force in this paper (for some of the foundational problems in QCD, see, e.g., Chýla, et al., 1993, Nussinov, & Shrock, 2010), we will present the analytic details (*Section 2.8*). Section 2.1 will analyze the interior of **B** that resulted in the Big Bang and thereof: 2.2 - - the emergence of photons, 2.3 - - pair creation of electron and positron, 2.4 - - anti-particle asymmetry, 2.5 - - intrinsic spin, 2.6 - - quarks, neutrino, and generations of fermions, and 2.7 - - rest mass and electric charge. *Section 2.8* will first explain the inseparableness of quarks and then the nuclear overall binding.

2.1 The Interior of **B** *and the Big Bang*

First

$$\begin{aligned} 1i\,meter &\equiv 1m \cdot e^{\frac{\pi}{2}i} \\ &\equiv \text{rotating } 1m \text{ by } \frac{\pi}{2} radians, \end{aligned} \tag{11}$$

implying a circle of circumference = $2\pi m$ so that

$$\begin{aligned} & 1i \text{ second refers to a circular distance} \\ = \;& 3 \times 10^8 \times 2\pi m \\ = \;& \text{the length of an equivalence class representatives} \end{aligned} \tag{12}$$

(for how the literature has treated the "imaginary time *it*," see. e.g., Jackiw,1977). We now illustrate $g_{11}^{[2]} < 0$ with two examples:

Example 1

Consider

$$\begin{aligned}\left(\frac{t_0^{[2]} si}{t_0^{[1]} s}\right)^2 &\approx 1-\frac{2G^{[2]}M^{[2]}}{rc^2} \equiv 1-\frac{R_{Sch}}{r} \\ \text{at } r &= \frac{1}{5}R_{Sch};\text{ then} \\ \frac{t_0^{[2]} si}{t_0^{[1]} s} &= \frac{2si}{s}, \end{aligned} \tag{13}$$

so that the length of an equivalence class representatives at $r = \frac{1}{5}R_{Sch}$ is $\frac{1}{2} \times 3 \times 10^8 \times 2\pi m$ in frame [1]. A passing but worthy note here is that frame [1] is by no means obligated to use the "real calendar linear time second;" in fact one can re-express the above proper-time ratio as

$$\begin{aligned}\left(\frac{t_0^{[2]} si}{t_0^{[1]} si}\right)^2 &= \frac{R_{Sch}}{r}-1 \\ &= \left(\frac{t_0^{[2]}}{t_0^{[1]}}\right)^2 = 4, \end{aligned} \tag{14}$$

so that for each half-second in frame [1], frame [2] completes one spacetime cycle.

Example 2

Now consider $r = \frac{\lambda_P}{2} \approx 10^{-143} R_{Sch}$; then

$$\frac{t_0^{[2]} si}{t_0^{[1]} s} = \frac{10^{72} si}{1s}, \tag{15}$$

so that the length of an equivalence class representatives at $r = \frac{\lambda_P}{2}$ equals $10^{-72} \times 3 \times 10^8 \times 2\pi m \approx 10^{-63} m$. Since the center of mass must be averaged over masses of the same equivalence class, this common equivalence class must be the smallest, $10^{-63} m$. By *H4* this is unattainable and **B** blew up, i.e., the Big Bang.

2.2 The Emergence of Photons That Carry EMW's

As soon as **B** came into being, the center of all the contained masses gave birth to a diagonal $4-manifold$ of radius $\lambda_P/2$ (which was to inflate to today's $10^{26} m$). A fraction of the pre-Big Bang $EMW's$ became $(photon, wave)'\, s$ with energy re-distributed in the ratio of $\left(\frac{3}{4}, \frac{1}{4}\right)$ (following Feynman's analysis on the electromagnetic mass).

2.3 Pair Creation of Electron and Positron

For easy visualization we set:

$$\begin{aligned} E &\equiv (1,0,0), W \equiv (-1,0,0); \\ N &\equiv (0,1,0), S \equiv (0,-1,0); \\ T &\equiv (0,0,1), B \equiv (0,0,-1). \end{aligned} \tag{16}$$

Consider $(photon, EMW)_1$ spin as

$$W \to N \to E \to S \to W \tag{17}$$

and $(photon, EMW)_2$ spin as

$$E \to T \to W \to B \to E. \tag{18}$$

Then a combination of the two results in

$$W \to N \to E \to T \to W \tag{19}$$

as a left-handed electron, and

$$E \to S \to W \to B \to E \tag{20}$$

as a left-handed positron.

We note that the above motions such as that of a left-handed electron is (i) logically implied by Pauli matrices, which in turn is (ii) logically implied by the "mass-shell equation" from Einstein: (i) The first columns of σ_x, σ_z,and σ_y,represent respectively the linear momenta N, E, and T in the semi-circular motions $W \rightarrow N \rightarrow E \rightarrow T$. (ii)

$$\begin{aligned} E^2 &= \left(m_0c^2\right)^2 + (pc)^2 \\ &= \left(m_0c^2 + ipc\right)\left(m_0c^2 - ipc\right) \end{aligned} \tag{21}$$

yields

$$\pm\, ipI_3 = \pm\hbar kI_3 = \pm\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}\begin{pmatrix} 0 & \hbar k & 0 \\ \hbar k & 0 & 0 \\ 0 & 0 & -\hbar k \end{pmatrix}, \tag{22}$$

representing the three possible angular momenta (in two senses corresponding to electron and positron), where k converts meter into radians so that i refers to the rotation of the three possible planes corresponding to the three angular momenta. Set

$$\tilde{\sigma}_x \equiv \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix} \text{ and} \tag{23}$$

$$R \equiv \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & -1 \\ -1 & 0 & 0 \end{pmatrix}; \tag{24}$$

then

$$R\tilde{\sigma}_x = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & 0 \end{pmatrix} \equiv \tilde{\sigma}_z \text{ and} \tag{25}$$

$$-R^2\tilde{\sigma}_x = \begin{pmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ 1 & 0 & 0 \end{pmatrix} \equiv \tilde{\sigma}_y. \tag{26}$$

Projecting the first two columns of $\tilde{\sigma}_x$, $\tilde{\sigma}_z$, and $\tilde{\sigma}_y$ onto (x, y), (x, z), and (y, z) planes respectively, we arrive at Pauli matrices.

2.4 Anti-Particle Asymmetry

Section *2.3* showed the left-handed positron e^+_Las $E \rightarrow S \rightarrow W \rightarrow B \rightarrow E$. Consider a (physical) motion of e^+_L,

$$(x, y, z) \mapsto (-x, y, -z) \mapsto (-x, -z, -y)\,; \tag{27}$$

then

$$\begin{aligned} & [E \rightarrow S \rightarrow W \rightarrow B \rightarrow E] \\ & \text{changes into} \\ & [W \rightarrow T \rightarrow E \rightarrow N \rightarrow W]\,, \\ & \text{a right-handed electron; i.e.,} \\ e^+_L &= e^-_R. \end{aligned} \tag{28}$$

2.5 "Intrinsic Spin"

Consider rotating an electron wave ball (i) from T to B along the $x - axis$, (ii) then from E to W along the $z - axis$, (iii) then from B to T along the $x - axis$, and finally (iv) from W to E along the $z - axis$; after such $4 \times 180°$ semi-circular rotations the electron returns to its beginning state, where of course the motion of $2 \times 180°$ is precisely what has been derived in Section *2.3*.

2.6 Quarks, Neutrino, and Generations of Fermions

By *H4* The smallest indivisible unit of distance at $T = 0$ was

$$d_* = \frac{\pi}{6}\frac{\lambda_P}{2} \approx 0.26 \times 10^{-35}\,(m)\,.$$

As such, the pair-creation from two $(photon, EMW)'\,s$ could (can) result in exactly four possible intersection angles: 90° (electron), 60° (up quark), 30° (down quark), and 0° (neutrino). In the case of 0°, the motion being $W \to N \to E \to N \to W$ yields only the "left-handed" neutrinos. Further, depending on the multiple of $360^\circ - cycles$ of the two $(photon, EMW)'\,s$ before their recombination, multiple generations of fermions can result.

2.7 Rest Mass and Electric Charge

As all non-photon particles result from pair-creation via the above-stated angles, any semi-circular motion must stop at the intersecting angle before changing to a different angular momentum, and hence rest mass results. At the same time the intersecting angles per se serve as sources of spacetime curvatures; i.e., electric charges play the same role as energies in General Relativity and previously we derived an extended Einstein Field Equations

$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = -\frac{8\pi G}{c^2}T\mu\nu, grav \mp \frac{16\pi G}{\left(1-\gamma^{-2}g_{11,grav}\right)c^5}T^{att;rep}_{\mu\nu,em}. \tag{29}$$

Because of the added term of $T^{att;rep}_{\mu\nu,em}$, the mini black hole punctured by the point particle proton is as large as $1/e$ of its radius and as such nuclear binding can be explained in the framework of General Relativity, as shown in the next *Section 2.8*.

2.8 The Strong Nuclear Force

The strong nuclear force includes (i) the inseparableness of quarks and (ii) the overall binding of the nucleus. For (i) the combination of three quarks for proton p or neutron n is about a superpostion of three coincidental fields of the same size as p or n, so that they cannot be separated. For p_L the superposition is

$$\begin{aligned} u_L + u_L + d_L &= -60^\circ - 60^\circ + 30^\circ = -90^\circ, \\ &\quad \text{in contrast with } e_L \text{ of } 90^\circ; \end{aligned} \tag{30}$$

for n_L, it is

$$u_L + d_L + d_L = -60^\circ + 30^\circ + 30^\circ = 0^\circ. \tag{31}$$

For (ii) we proceed in three steps: (a) Use the extended Einstein Field Equations to show

$$\frac{\text{proton's electric strength}}{\text{its gravitational strength}} \approx 10^{39}. \tag{32}$$

(b) Use (a) to establish proton's mini black hole size $r_{Sch}(p)$. (c) Substitute $r = r_{Sch}(p) + d_*$ into

$$\left(\frac{t_0^{[2]}}{t_0^{[1]}}\right)^2 = 1 - \frac{r_{Sch}(p)}{r} \text{ to arrive at} \tag{33}$$

$$\left(\frac{t_0^{[2]}}{t_0^{[1]}}\right) \approx 10^{-10}, \tag{34}$$

where $d_* = \frac{\pi}{6}\frac{\lambda_p}{2}$ (the idea here is to separate a neutron n that has been tangent to the mini black hole of a proton p by the least indivisible unit of distance) and the base point (i.e., the denominator) is set at $r = 0$ (i.e., at the point particle proton p as in the Newtonian framework, where the passive gravitational mass cancels out with its inertial mass so that

$$\mathbf{a}_{passive\ mass} = -\frac{Gm(p)_{active}}{r^2} \cdot \frac{\mathbf{r}}{||\mathbf{r}||}, \tag{35}$$

with $r = 0$ set at p; note that this is a switch of the base point from $r = \infty$ as in the framework of General Relativity, which corresponded to a flat spacetime). Then $\left(\frac{t_0^{[2]}}{t_0^{[1]}}\right) \approx 10^{-10}$ implies

$$\frac{G\left(10^{10}m(p)\right)\left(10^{10}m(n)\right)}{(10^{-10}r)^2} = 10^{40} \cdot \frac{Gm(p)\,m(n)}{r^2}, \tag{36}$$

the strong nuclear force. Now the three steps:

(a) A rest proton has its mass $\approx 1.67 \times 10^{-27} kg$ with Lorentz factor $\gamma = 1$, so that

$$\begin{aligned} 1 - \gamma^{-2} g_{11,grav} &= 1 - g_{11,grav} && (37) \\ &= 1 - \left(1 - \frac{\hat{r}_{Sch,grav}(p)}{r}\right) \\ &= \frac{G \times 1.67 \times 10^{-27}}{rc^2}, && (38) \end{aligned}$$

where $g_{11} \approx 1 - \frac{GM}{rc^2}$ is due to

$$\begin{aligned} g_{11} &= 1 - \frac{2GM}{rc^2} + \left(\frac{GM}{rc^2}\right)^2 + \text{ higher-order terms} && (39) \\ &\approx 1 - \frac{2GM}{rc^2} \text{ for } r \to \infty, && (40) \\ &\approx 1 - \frac{GM}{rc^2} \text{ for } \frac{GM}{rc^2} \approx 1, \text{ which is the case here,} && (41) \end{aligned}$$

$$\hat{r}_{Sch,grav}(p) = \frac{G \times 1.67 \times 10^{-27}}{c^2} = 1.24 \times 10^{-54} (m) \quad (42)$$

denotes the Schwarzschild radius of p due to its mass alone, and $r =$ the radius of p so that the factor $\left(1 - \gamma^{-2} g_{11,grav}\right)$ as a whole measures the inertial mass of p that counters another proton's exerted electromagnetic force. To be proved shortly,

$$r = 10^{-15} e \ meters. \quad (43)$$

Thus,

$$1 - \gamma^{-2} g_{11,grav} = \frac{G \times 1.67 \times 10^{-27}}{10^{-15} e \times 9 \times 10^{16}} \approx 0.46 \times 10^{-39}, \quad (44)$$

and

$$\begin{aligned} \left(\frac{T^{att}_{11,em}}{T_{11}, grav}\right) &= \frac{1 \cdot J/\left(sm^2\right)}{1 \cdot kg/m^3} && (45) \\ &= \frac{1 \cdot kgc^2/\left(c^{-1} m^3\right)}{1 \cdot kg/m^3} \\ &= c^3, \end{aligned}$$

so that

$$\begin{aligned} & \frac{16\pi G T^{att}_{11,em}}{0.46 \times 10^{-39} c^5} \cdot \frac{c^2}{8\pi G T_{11}, grav} && (46) \\ = & \frac{2}{0.46} \times 10^{39} = 4.35 \times 10^{39} \\ = & \frac{\|EM(p)\|}{\|Grav(p)\|}. \end{aligned}$$

(b) Denote a tentative Schwarzschild radius of p by

$$\begin{aligned} \tilde{r}_{Sch}(p) &\equiv \hat{r}_{Sch,grav}(p) \times 4.35 \times 10^{39} && (47) \\ &= 1.24 \times 10^{-54} \times 4.35 \times 10^{39} \\ &= 5.4 \times 10^{-15} (m), \end{aligned}$$

which however contains an added uncertainty distance. Here we *assume* that in the process of measuring the rest mass of p the following theoretical relations are involved:

$$m(p) = \frac{E}{c^2} = \frac{\hbar \nu}{c^2}, \quad (48)$$

where $\nu \equiv \frac{c}{\lambda}$ has been "rounded upward" to the next integer frequency as in the division algorithm, $bq+r = f < b(q+1) =$ a rounded integer value that overstates f by $(b-r)$. We thus are to remove Δx from $\tilde{r}_{Sch}(p) = 5.4 \times 10^{-15}\,(m)$ by invoking the following Heisenberg relation,

$$\begin{aligned} \Delta momentum \cdot \Delta x &= \frac{h}{2}, \text{ or} \qquad (49) \\ \left(1.67 \times 10^{-27}\right) \cdot \frac{\Delta \nu}{c} \cdot \Delta x &= \frac{h}{2c}. \end{aligned}$$

Recalling that the semi-circular wave motions must stop at the intersection points, we *assume*

$$\frac{\Delta \nu}{c} = 0.15, \text{ which then implies} \qquad (50)$$

$$\Delta x = 4.4 \times 10^{-15}\,(m). \qquad (51)$$

As such,

$$\begin{aligned} r_{Sch}(p) &= \tilde{r}_{Sch}(p) - \Delta x \\ &= 10^{-15}\,(m). \qquad (52) \end{aligned}$$

(c) Then

$$\begin{aligned} \left(\frac{t_0^{[2]}}{t_0^{[1]}}\right)^2 &= 1 - \frac{r_{Sch}(p)}{r} \\ &= 1 - \frac{r_{Sch}(p)}{r_{Sch}(p) + \frac{\pi}{6}\frac{\lambda_P}{2}} \qquad (53) \\ &\approx \frac{1.3 \times 10^{-35}}{10^{-15}} \\ &= 1.3 \times 10^{-20}, \end{aligned}$$

which incidentally is in near perfect agreement with the result from a totally independent derivation as from the numerical identity

$$\frac{Gh}{c^3} = 1.64 \times 10^{-70}\left(m^2\right). \qquad (54)$$

Since

$$\frac{\pi}{6}\frac{\lambda_P}{2} \Leftrightarrow \frac{12}{\pi}\nu_P \approx 3.8\nu_P,$$

we have

$$\frac{Gh\,(3.8\nu_P)/c^2}{10^{-15}c^2} \qquad (55)$$

$$= \frac{3.8 \times 6 \times 10^{42}}{3 \times 10^8} \times 1.64 \times 10^{-70+15} \qquad (56)$$

$$= 1.25 \times 10^{-20}$$

(with uncertainty energy $\frac{h}{3.8\nu_P} \approx 0$).

Thus we have established the mini black hole engendered by proton has a radius $10^{-15}m$ and therefore proton itself has a radius $10^{-15}e\ m$. By contrast neutron without electric charge has a negligible mini black hole that reduces to a single point (Equation (10)) and hence a radius of $10^{-15}m$. A concern here might be whether such sizes can be accommodated by a nucleus. Thus let each neutron n be tangent to the mini black of a proton p (where the overlapping fields of n and p, being the sum of two smooth fields, maintains smooth continuity across the intersection); then an alignment of

$$n \cup p \cup n \cup p \cup n \cup p \cup n \cup p \cup n \cup p$$

would entail a distance of

$$2 \times \left(10^{-15} + 10^{-15}e\right) \times 5 \approx 32 \times 10^{-15}\,(m) \qquad (57)$$

along the $x - axis$, so that a volume of

$$\left(3.2 \times 10^{-14}\right)^3 \tag{58}$$

could contain 1000 nucleons.

3. Discussion

(1) If one is to give the duality of $(particle, wave)$ parallel recognition, then the spacetime geometry has to be our hypothesized diagonal $4 - manifold$.

(2) Our model implies that electron has four states in a cycle of 720°, which is testable by a Stern-Gerlach type of experiment.

(3) We interpret the complex number i as rotation in real $3 - space$, hence altering the foundation of quantum mechanics.

(4) Our work shows that all matter have their invisible wave copies, which then must have implications in medical science.

(5) The quest for dark matter or dark energy will prove to be in vain.

(6) Quantum entanglement is a matter of course; the impediment is the existence of competing waves, which we surmise having to do with entropy.

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