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The Emergence of Quantum Mechanics from General Relativity Electromagnetism and Charge Quantization

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ABSTRACT

Based on the concept of the Big Bang of the universe being governed by the principles of Minimization of Action and Minimization of rate of Entropy production in a the Very Early Universe, where the expansion of Spacetime was superluminal, both QM (Quantum Mechanics) and electrodynamics can be seen to be emergent rather than foundational with both being a consequence of electric charge quantization and electromagnetism in an expanding spacetime. Postulating the appearance of the "Electrically Entangled" electron charge quanta, which are identified as 5th dimensional vectors in a Kaluza-Klein mathematical framework, both plus and minus, at very Early times in the Big Bang, plus the existence of electromagnetic fields around those charges, the superluminal expansion of spacetime prevents electrodynamics and thus EM radiation. This epoch is postulated to end with the formation of the proton in the Hadron Epoch, with its three quarks forming, with the electron, a Minkowski four vector, and the highly entropic dynamics of the quarks within the proton giving rise to entropy in the EM field under cosmic isothermal conditions with a temperature defined by Electrodynamics of the quarks interior to the proton rather than electrodynamic scattering between widely separated subatomic particles. The appearance of a larger unit of action h, thus mirrors the appearance of a larger unit of stable rest mass, the proton. This correlation is confirmed by the central place of the proton/electron mass ratio in the highly accurate formula derived for α. The emergent character of the quanta of action is suggested to explain the unfeasibility of quantization of GR (General Relativity) to higher orders and with GR and EM with charge quantization being the foundation on which QM is built.

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Introduction

We live in a universe with three spatial coordinates and a time coordinate, making up 4- dimensional Minkowski spacetime. However, unlike the spatial coordinates, we are not free to travel in time freely, but must move relentlessly forward in a "local now". This is the great "Arrow of time" launched in the Big Bang [1]. Its direction is best represented in the present Cosmos is by the Hubble Expansion, considered to be the continuation of the Big Bang process. Locally, it is seen on one's table top as the 2nd Law of Thermodynamics, where your coffee cools to room temperature, increasing entropy in your kitchen. Therefore, it can be said that time's arrow is a property of ensembles of particles and their dynamics, who, especially in the case of Cosmically predominant hydrogen, consisting of electrons and protons, appear to exist in a timeless state. Accordingly, time began with the Big Bang because it was the birth of an ensemble of particles and fields around them, emerging from the vacuum. Time and its advance thus began with the Big Bang and the expansion of the universe, which continues to this day.

Two great puzzles presently confront theoretical physics, one is the apparent "Cosmic Twin Photon Paradox" where it is observed that the Planckian Temperature of photons from opposing halves of the sky are nearly identical, suggesting that thermal equilibration occurred in the Early Universe by FTL (faster than light) phenomena (2) as it expanded. The second great mystery is the fact that GR (General Relativity) has resisted all attempts at quantization to anything beyond lowest orders.

While the TPP (Twin Photon Paradox), along with the Cosmic Flatness problem, has been partially resolved mathematically by invoking "Cosmic Inflation" (3) no consensus exists on the detailed physical mechanisms of this phenomena, or how Cosmic thermal equilibration occurred in the VEU (Very Early Universe) before the Inflationary Epoch occurred. In general, the VEU had conditions so different that those seen anywhere in our present cosmic epoch, that testable hypotheses are very difficult formulate.

In the case of the failure of full quantization of GR, in the sense that QED (Quantum Electro Dynamics) exists as a quantum theory good to all orders, no QGR (Quantum General Relativity) theory has been formulated despite the labors of many great scientists over many decades.

The TPP problem is inherent in GR cosmology even it its simplest form, which must begin with an initial singularity. This is easily seen from Einstein Equations of GR:

$$G_{\mu\vartheta} + \Lambda g_{\mu\vartheta} = \kappa T_{\mu\vartheta} \qquad (1)$$

The Big Bang solutions for this are the Freidman Equations, which for the simple case of a cold fluid, in a space with no background curvature, and Cosmological Constant Λ=0,

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{\kappa c^4}{3}\rho \qquad (2a)$$

$$2\frac{\ddot{a}}{a} + \left(\frac{\dot{a}}{a}\right)^2 = 0 \qquad (2b)$$

Where a(t) is the scale factor, and we have a mass density $\rho \propto 1/a^3$ and has the simple solution

$$a(t) = a_o t^{2/3} \qquad (3)$$

This yields for the expansion rate of the scale size a(t)

$$\dot{a}(t) = \frac{2}{3} a_o t^{-1/3} \qquad (4)$$

Which is obviously singular at t=0, giving an infinite expansion rate of spacetime between particles. This leads to the "horizon problem", where the particles of the VEU are separating from each other much faster than light, and thus cannot interact. If they possess a temperature it cannot equilibrate across even small parts of the sky, much less opposite halves. Various theories have been proposed, besides Inflation have been proposed to solve this problem, including the early proposal of a singularity in the speed of light in the VEU by Dicke [2,3]. By definition, the t=0 event is the beginning of time and its advance. Because it also begins with particles, with EM and Gravity fields surrounding them, the singularity of appearance in these fields at t=0 means a finite bandwidth in frequency as they expand with spacetime, which defines field entropy. Therefore, it can be said that at t=0 entropy was born along with time and its advancement. In this brief article we present a new theory that attempts to answer these two questions: the birth of electrodynamics and the birth of quantum mechanics. The question of Cosmic Flatness, while interesting, will be addressed in later discussions. We will then summarize the theory and briefly discuss its physical implications.

Minimization of Action and Entropy Production Rate in the Big Bang

We begin our discussion by considering the primordial physics that governed the Big Bang during the VEU when it is believed the foundation of the physical laws we observe now were established. We consider here that the Big Bang in its very Early Stages was governed by two foundational laws that operate in our present Cosmic epoch: the Minimization of Action, and the Principle of Minimum Entropy Production rate.

Minimization of action, is an overarching law of physics from which most of Physics can be derived and gives us the fundamental quantum h found by Planck in his derivation of the Black-Body radiation spectrum. However, another fundamental quantum is also present, that of the charge of the electron e. If one assumes that charge quantization and Maxwell's Equations governed the VEU along with minimization of action then then one would expect that the action quanta e2/c would appear first as the laws of physics were being established, followed by the larger action quanta h. In other words, the Universe would start with the smallest increments of action possible and these are electric charge quanta.

As shown by the Freidman Equations, even in the simplest models of the Big Bang, the VEU is superluminal in its expansion rate. This can be physically visualized as an ensemble of stationary charged subatomic particle with the spacetime between them undergoing FTL expansion. Because the expansion is superluminal in the VEU the charged particles do not exert forces on each other, and since it is these dynamics which create entropy, it can be said that entropy is nonzero, but in the VEU is constant.

Time in EM theory is full reversable until particle-particle dynamics occurs with acceleration of charges. If we imagine the VEU consisted of a lattice of nearly evenly spaced particles then the advent of subliminal expansion will result in a shock acceleration of the particles leading immediately to radiation fields being excited globally. This can be equated to a blast of "White Noise." Since would expect this scenario, being a singularity, to occur with maximum entropy, even if its value was small, then this radiation field would be quasi-Planckian at some temperature defined by the physics involved. Thus, the epoch of no dynamics, will end when the rate of spacetime expansion between particles drops to luminal then subluminal.

However, we would expect by the principle of minimum entropy change with time, that this would result in a subluminal expansion at a constant nonzero entropy similar to the melting of an ice cube: a basically rigid lattice becoming a plasma of freely moving charged particles with a Planckian spectrum of photons. What are the physical details of this change of state with resultant appearance of a nonzero entropy rate of increase?

The Emergence of Action Quanta h from Electric Charge Quanta Electron Plus Quarks as a Four Vector in the GEM (Gravity Electro-Magnetism) Unification Theory

If we assume the appearance of charges in a KK (Kaluza-Klien) Theory framework, i.e. as an orthogonal 5th dimension then the appearance of charge quanta, is as a compact dimension, as is assumed in the GEM Unification theory the charge quanta must appear in charge balance, to give zero displacement in the 5th dimension in the Big Bang [4,5]. Also, the requirement of action minimization requires [5] that the electron, quark elementary charge system form a Minkowski 4 vector with the condition:

$$q_0^2 - q_1^2 - q_2^2 - q_3^2 = 0 \qquad (5)$$

Together with global charge neutrality this condition can be satisfied with the Standard Model assigned values: $q_0 = -e$, $q_1=-e/3$, $q_2= 2e/3$, and $q_3= 2e/3$. The charges deploy, in an "Inflationary Manner," as the 5th dimension deploys to full size as $r_o = e^2/(m_o c^2)$ where $m_o = (m_p m_e)^{1/2}$ where m_p and m_e are the mass of proton and the electron respectively.

In brief, the GEM theory is based on two postulates: 1. that gravity fields are equivalent to an array of ExB drifts familiar from plasma physics. 2. That the cosmos began with a Planckian vacuum with one force field and one particle-anti particle species, of the Planck mass $M_P = (\hbar c/G)^{1/2}$ and split apart in a Big bang expansion, with the appearance and "inflationary" deployment [2] of a hidden 5th dimension from the Planck length $r_P = (G\hbar/c^3)^{1/2}$ into the coupled coupled appearance of two long-range force fields Gravity and EM (Electro-Magnetism) and two stable particles, electrons and protons of masses m_e and m_p respectively. These particles with electric charges ±e, came to be in this process from what will become the Planck charge $\pm(\hbar c)^{1/2}$.

We can explore the physical/mathematical models associated with each postulate. For the first postulate it is easy to see that all charged particles will assume the same drift velocity of magnitude

V_d in the same direction in crossed E and B fields. The velocity magnitude will be (in cgs) for uniform crossed E and B fields. Here we will assume the fields lie in the x and y directions, leading to motion in the z direction.

$$V_d = \frac{cExB}{B^2} \qquad (6)$$

For constant B=B_o but varying E in the z direction we will have an acceleration affecting all charges particles identically (see Figure 1)

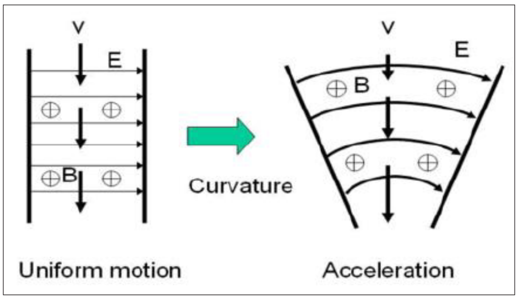

Figure 1: The ExB Drift Model of Gravity

$$a = V_d \frac{dV_d}{dz} = \frac{c^2}{2B_o^2}\frac{dE^2}{dx} \qquad (7)$$

Following the form of the relativistic metric $g_{44} = (1+2\psi)$ where ψ is the Newtonian gravity potential we obtain for g_{44}

$$g_{44} = \left(1 + E^2/B_o^2\right) \qquad (8)$$

For E/B<<1, this can be generalized to the relativistic form, where we assume a nearly flat space metric $\eta_{\mu\nu}$ results, in a form of the metric tensor where the zero-point fields will be seen to "self censor."

$$g_{\alpha\beta} = \frac{4(F_\alpha^\gamma F_{\gamma\beta})}{F^{\delta\varepsilon}F_{\delta\varepsilon)}} \cong \eta_{\alpha\beta} \qquad (9)$$

The second postulate is that a KK hidden dimension appears and in an inflationary manner deploys to a constrained size, allowing separate EM and Gravity fields as in KK theory. The deployment occurs in a manner coupled to the separation of the electron and proton from the Planck masses, to form a new mass and charge scale as opposed to the Planck scale quantities of charge, mass, and length, respectively (here we can substitute the action e^2/c for $\hbar$ without loss of generality, as will be discussed later)

$$q_P^2 = \hbar c \qquad (10a)$$

$$M_P = \sqrt{q_P^2/G} \qquad (10b)$$

$$r_P = \sqrt{G\hbar c/c^4} \qquad (10c)$$

Where we can define the ratio of the Planck charge to the newly appeared electronic charge, as the square root of the fine structure constant

$$\alpha^{1/2} = \sqrt{e^2/\hbar c} \qquad (11)$$

We now assume the inflationary deployment of the new KK 5th dimension from the Planck scale, to a new scale, which we will call the "mesoscale". This has the physical effect of producing a new charge-to-mass scale, e/m_o, which is in contrast to $G^{1/2}$, which also has units of charge-to-mass $G^{1/2} = q_P/M_P$.

We assume this new charge, mass, and length scale appears as the KK 5th dimension deploys in an inflationary manner, e, r_o and m_o, so that the "fine structure constant $\alpha = e^2/\hbar c$ goes from being unity to becoming approximately 1/137. We will call the final hidden dimension size r_o, or the mesoscale length, where the new length scale represents new information in the cosmos being composed of new quantities e and m_o, the mesoscale mass, which is $m_o = (m_p m_e)^{1/2}$

$$r_0 = e^2/(m_o c^2) \qquad (12)$$

We then posit the equation, defining the parameter $\sigma = (m_p / m_e)^{1/2} \cong 42.8503\ldots$, the square root of the proton-electron mass ratio, so that the deployment of the mesoscale is coupled to the separate appearance of protons and electrons from the particle-antiparticle system of the Planck mass particles.

$$\ln(r_o/r_P) = \sigma - 1/\sigma^2 \qquad (13)$$

where the $1/\sigma^2$ term is only of importance near the Planck scale where $\sigma \to 1$. The ratio of the mesoscale size and the Planck length, is not only a geometric ratio but also an important parameter of the relative strengths of quantum mediated forces of Gravity and EM between a proton and an electron.

$$r_o/r_P = \sqrt{\alpha e^2/(Gm_p m_e)} \qquad (14a)$$

Alternatively, since we believe, h, the quantum of action and Quantum Mechanics do not exist before the deployment of the KK 5th dimension we can write

$$r_o'/r_s = \sqrt{\alpha e^2/(Gm_p m_e)} \qquad (14b)$$

Here $r_s = (Ge^2/c^4)$, the Stoney length, defined before the development of Quantum Mechanics, and

$$r'_0 = e^2/(m'c^2) \qquad (14c)$$

Here, m' ≅(m_o m_q)1/2 where m_q =3000MeV which lies between the closely paced masses of the η_c meson 2984MeV and the J/Psi meson at 3097MeV. So that QM does not exist at the fundamental level of the Universe but appears with the appearance of the proton. The right side of expression of Eq. 14b thus remains unchanged.

When Eq. 13 is inverted to find an expression for G, the gravitation constant we obtain the result for the everyday scale

$$G = \alpha \frac{e^2}{m_p m_e} exp(-2\left(\left(\frac{m_p}{m_e}\right)^{\frac{1}{2}} - \frac{m_e}{m_p}\right)) \qquad (15)$$

We can easily recover the MKS expression for G with the substitution $e^2 = e^2/(4\pi\varepsilon_o)$. Using 2018 CODATA values for all physical constants this yields, in MKS, G_{gem}= 6.67539 x 10^{-11}

$m^3/(kg\ s^2)$ and is within 0.015% of the presently accepted value of GCODATA =6.67430 x 10^{-11} $m^3/(kg\ s^2)$ We also have the mass formula for protons and electrons

$$m = m_o exp(\pm\frac{q}{e}ln\sigma) \qquad (16)$$

Where the charge state of the particle determines its mass, producing protons for positive charge and electrons for negative charge. Where we have also for m_o

$$m_o = M_P exp(\left(-\alpha^{-\frac{1}{2}} - \alpha - 1\right)ln\sigma) \qquad (17)$$

Where $\alpha^{-1/2}$ is the Planck charge normalized to e, and α is a QED correction term, important near the Planck scale as is the $1/\sigma 2$ in the formula for G. This term must be included to give the proper limiting behavior near the Planck scale where we assume both σ and $\alpha \rightarrow 1 + \varepsilon$, where we assume $\varepsilon << 1$ near the Planck scale so that the product of the ratios of masses and lengths will go to unity to second order in ε as the Planck scale is approached, making it a local extremum

$$\frac{M_P r_p}{r_o m_o} = \frac{1 - 3\varepsilon \ldots}{1 - 3\varepsilon \ldots} \rightarrow 1 \qquad (18)$$

This gives a formula for the mass of the proton

$$m_p = M_P exp(\left(-\alpha^{-\frac{1}{2}} - \alpha\right)ln\sigma) \qquad (19)$$

Using 2018 CODATA values for all physical constants this yields m_{pgem}= 1.6664 x10^{-27} kg and is within 0.37% of the presently accepted value of m_p (CODATA) = 1.67262 x10^{-27} kg

The splitting of the positive electronic charge into 3 unequal parts which undergo dynamics in a small spherical volume of radius $r_c = e^2/(2m_e c^2) \cong 1.4$ fm creates "instant entropy" and, as determined by the proton mass $m_p/m_e = 6\pi^5$ determines a triune Planckian gluon field, with temperature equal to the rest mass of the neutral pion [5]. Thus the formation of protons in the "Hadron Epoch" of the VEU creates both entropy and temperature that are shared everywhere in the fireball as a consequence of the physics of Minkowski spacetime, Maxwell's equations, and electric charge quantization. This also determines the central number of the GEM Unification theory: σ, defined as $m_p/m_e = \sigma^2$ where, σ = 42.8503…

The TPP, the uniform temperature of the CBR is thus due to shared physics of identical systems, not temperature equilibration, just as the shared red color of Maple leaves in Fall is due to identical system responses to changes of season, not shared root networks. Borne with this common temperature and entropy is the quantum of action h.

Thus, the appearance of the proton-electron mass ratio, with the primordial fireball now blossoming with the formation of protons, freeing heat of formation as EM thermal radiation. The protons, in model, are objects of the same size as an electron $rc= e^2/(2m_e c^2)$ but full of 3 Planckian modes, corresponding to the quark/gluon fields and of temperature corresponding to the rest mass energy of the neutral pion, is what determines the universal temperature of the Primordial fireball in the Hadron Epoch, and fixes its temperature as then expands as a hydrogen plasma, the neutron component then decaying into hydrogen as well, so that one second after the Big Bang, the fireball plasma is in excess of 90% hydrogen plasma. These assumptions lead to the Lenz relation for the mass ratio of the proton to the electron $m_p/m_e = 6\pi^5$, where the π^5 come directly from the expression for the Steffan-Boltzmann constant.

Accordingly, in this model the quantum of action h, much larger than e^2/c, the electric action, mirrors the appearance of the proton mass scale in the Hadron Epoch, much larger than the electron/lepton mass scale existing earlier. Thus, we would expect the relationship of h, to e^2/c, to depend of the mass ratio of proton to the electron.

Spacetime as a Tesseract (4-cube)

Before proceeding to a discussion of the value of the ratio of η to e^2/c, it is important to understand the role of geometry in our interpretation of the mathematics of this important ratio of actions.

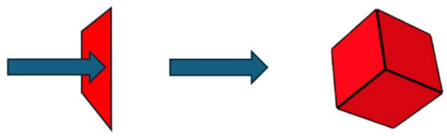

Figure 2: A Moving Square Sweeps Out 3-Cube in Time

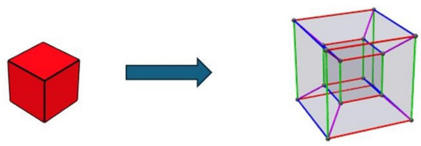

Figure 3: A Moving 3-Cube Sweeps Out a 4 Cube (Terreract) in Time. Surface Area of Cube of Side λ is $S = 6\lambda^2$

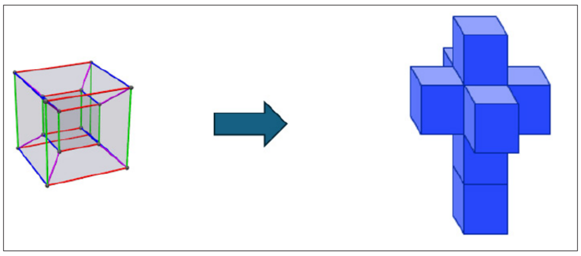

Figure 4: The "Surface Volume" of a Tesseract of Side $\lambda = 8 (V')^{3/4} = 8\lambda^3$

Derivation of the Wyler Formula for α from the T^4 Radiation Law

We expect the SB law for radiated power per unit area of a hot condensed matter material PSB at an interface with a vacuum to be approximately [6]

$$F_{SB} \cong 2\varepsilon' P'_L n' \delta' \cong \frac{2}{15}\pi^5 c \frac{(kT)^4}{(hc)^3} \qquad (20)$$

Where the factor of two represents the inclusion of both polarizations, P'_L is Larmor classical radiated power per thermally agitated electron, perturbed by collective effects due the fact that the electrons are surrounded by other perturbed electrons, which also move when one electron moves. In the physical model we will adopt, the effective radiating density n' represents the density of electrons free to move, absorb energy in electron-electron collective interactions and then radiate it, in classical manner, being an overlapping population of free and loosely bound electrons in the condensed matter. In contrast the effective skin thickness □' represents the layer thickness of the condensed matter where radiation from the interface with a vacuum occurs, due to a slightly different density of electrons, which we will call n'', which participate in the radiation near the interface, by quantum electron-photon events. We will consider the electron-electron radiation active density n' to be approximately similar to the density quantum active density n'' of electrons in this model so that n'≈n'' even though their dynamics are different in this model.

The electrons move more sluggishly in condensed matter than in isolation, leading to less radiated power per electron. This effect will be treated in our modeling by assigning an effective mass, $m_{eff} \cong m_e$ to the electrons in their dynamics. As will be seen, this effect can be included as a factor on the Larmor classical radiated power per electron with, which scales as the acceleration of the electrons squared, which will be reduced by a factor $C_{eff} > 1$ due to a larger effective mass of the electrons $m_{eff} > m_e$.

$$\left(\frac{3\pi}{80\alpha}\right)^{4/3} c\frac{(kT)^4}{(hc)^3} = \frac{2}{15}\pi^5\ c\frac{(kT)^4}{(hc)^3} = \sigma_{SB}T^4 \qquad (21)$$

This can be written, defining the Stefan Boltzmann constant, σ_{SB}, as $F_{SB} = \sigma_{SB}$ T4 where σ_{SB} = 5.670374e-08 W m^{-2} K^{-4} (CODATA).

Our physical model calculation gives the value σ_{SB} = 5.670370E-08 W m^{-2} K^{-4}. So this is within 1 ppm of the CODATA value.

The fact that we can derive a highly accurate expression for the Stefan-Boltzmann radiation law based on simple but physical models, which are themselves based on physically reasonable assumptions, is profoundly meaningful. It suggests that quantum electrodynamics and collective classical electrodynamics, i.e. plasma physics, are intimately connected and cannot be separated. It also suggests that quantization of action is intimately connected with quantization of electric charge. Accordingly, (6) since it is possible to write $\alpha^{-1} = h/(2\pi e^2)$

$$\left(\frac{3\pi}{80\alpha}\right)^{4/3} = \frac{2}{15}\pi^5 \qquad (22)$$

$$\alpha^{-1} = \frac{80}{3\pi}\left(\frac{2}{15}\pi^5\right)^{3/4} = 137.0361 \text{ vs } 137.035999 \text{ (CODATA)} \qquad (23)$$

Which is a formula first prosed by Wyler [7]

EM and GR as the Foundation from which and Quantum Mechanics Emerges

General Relativity defines the Big Bang, and the underlying unity of EM and Gravitation, through a KK 5th dimension, in turn, gives rise to both the arrow of time and Quantum Mechanics. Both entropy and QM are based on the loss of information about the state of a system, and while being fundamental laws that govern reality, are also shadows on the side of Plato's cave, not to be confused with a more complex reality occurring outside it. This can be seen from the following analysis.

$$\left({m_p}/{m_e}\right) = 6\pi^5 \text{ (to 17ppm)} \qquad (24)$$

$$\sqrt{\left({m_p}/{m_e}\right)} = \sigma \cong 42.8503\ldots \qquad (25)$$

$$\hbar = 8\frac{10}{3\pi}\left(\frac{6}{45}\pi^5\right)^{3/4}\frac{e^2}{c} \qquad (26)$$

Since both 10/3π and σ /45 are close to unity, we can simplify and obtain the simple expression.

$$\hbar c \cong 8\,\sigma^{3/4}\,e^2 \qquad (27)$$

This means that Quantum Mechanics is a lower dimensional projection of a higher dimensional reality like the 8 cubes that are the unfolding of a Tesseract or a photograph of a star.

Summary and Implications

Based on the assumptions of minimum action and minimum entropy production rate in the Early Big Bang, the beginning of time, plus the presence of quantized electric charge and Maxwell's equations in the Early epoch, one is strongly led to believe the action of e^2/c due to the existence of charge quanta preceded and underlies the appearance of h, the quanta of action which is the basis of Quantum Mechanics. Quantum Mechanics was thus emergent. Quantum Mechanics is therefore, like the 2nd Law of Thermodynamics, fundamental but not foundational. Quantum Mechanics appeared, based on this analysis, with the birth of the proton, given the internal dynamics of the quarks, in the Hadron Era of the Big Bang, and determined its temperature and entropy, and consequently the uniform temperature of the CBR. Accordingly, it can be said that the appearance of Quantum behavior, fundamental like the Second Law of Thermodynamics, was emergent from the Big Bang expansion of space time and presence of electromagnetism with charge quantization. There, the appearance of the quantum of action h, so much larger than the electric action e^2/c, mirrors the appearance of the higher mass proton from the much lighter quark-electron system and its dynamics. For this reason, the value of ratio of h to e^2/c, contains the proton/electron mass ratio.

The most important consequence of this concept of emergent Quantum Mechanics is that it explains the failure to perform in-depth quantization of GR, despite the finest minds on Earth laboring on this task for nearly a century. If Dick Feynman could not figure out how to do it, despite his genius and aggressive creativity, it is most probably not feasible. This does not mean that like sound waves in crystal, quantization to low orders of GR are not possible or useful, merely that it must include high frequency cutoffs that bar the way to high order analysis. General Relativity is thus like massive stone formation, upon which is founded a house made of brick. One can make bricks from the surface rock, but its fundamental nature is an immense continuum. Put differently, QM emerges from the spacetime defined by GR , rather than QM giving rise to GR spacetime.

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