Redshift/CBR as Intrinsic Blackbody Cavity-QED Absorption/Emission Equilibrium Dynamics

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Alternative interpretations for the two main pillars of Big Bang cosmology are formally introduced. A redshift / CBR complementarity is delineated as complex blackbody equilibrium conditions intrinsic to the Cavity-QED resonance dynamics of the spin exchange coupling inherent in extended spacetime hyperstructure oscillations rotating relativistically within the topology of a higher dimensional (HD) form of a covariant polarized Dirac vacuum, with correspondence to the usual asymptotically flat Einstein/Minkowski energy-dependent spacetime metric, $\hat{M}_4$. In this frame a Vigier style dissipative redshift mechanism is described as absorption and Cosmic Microwave Background Radiation (CBR) as emission within the context of an extended de Broglie-Bohm-Vigier causal interpretation of quantum theory that includes extended EM theory and photon mass anisotropy.

> *The microwave 'background' makes more sense as the limiting temperature of space heated by starlight than as the remnant of a fireball.* - Sir Arthur Eddington [1].

> *Cosmologies that do not include the Big Bang have not produced any plausible alternative interpretation of the background radiation.* - J. Silk [2].

1. Introductory Cosmological Parameters

Historically the Vigier vacuum-induced dissipative redshift mechanism has been considered the most highly developed and viable alternative to the Doppler recessional velocity model. What remains to complete it is to introduce a more sophisticated delineation of the vacuum mechanics and a coupling to the Cosmic Microwave Background Radiation (CBR) emission process. Astrophysicists empirically claim that the CBR represents a near perfect blackbody spectrum. Most age of the universe measurements have been performed utilizing Hubble's Law interpreted through a Doppler expansion of the universe. Most recently age of the universe measures have been calculated utilizing data from the Wilkinson Microwave Anisotropy Probe (WMAP) satellite launched in 2001 to measure CBR temperature. The WMAP data age of the universe is 13.37 billion years, for a cosmos composed of 4.6% ordinary baryonic matter; 23% dark matter and 72% dark energy.

If the Hubble radius, H_R instead represents an observational limit based on a 'tired-light' photon energy attenuation by vacuum coupling in a static universe one would obtain the exact same result by calculations based on the same Hubble distance relation stemming from a Hubble constant of 70.1 ± 1.3 km·s^{-1}·Mpc^{-1}. Therefore, the existing 'über-bias' for one interpretation over the other is myopic and unscientific. It is true that until now a sufficiently pragmatic understanding of the nature of the photon, electromagnetic (EM) field theory, quantum theory, gravitation and vacuum structure have been elusive making the 'alternative' interpretation difficult to rigorously delineate. One cannot therefore be too 'über-critical' in exchanging one bias for another other than to complain of the puerility of human nature.

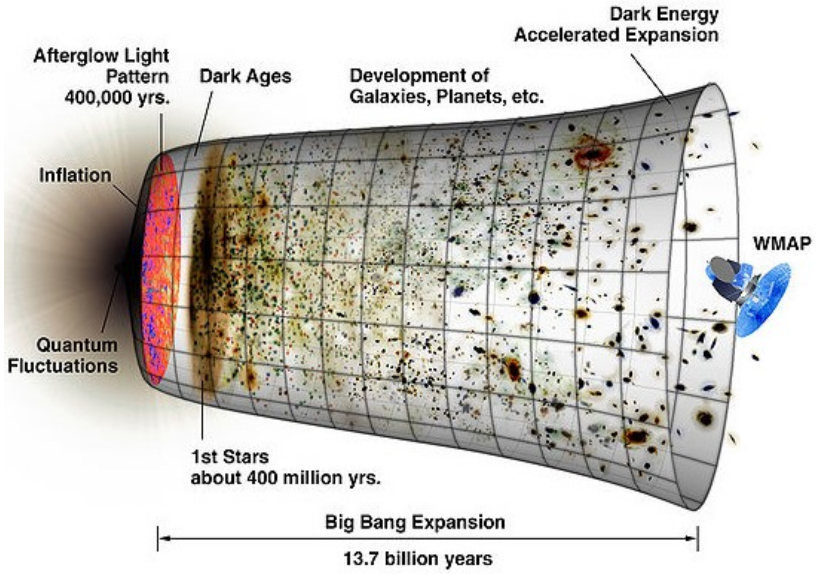

Figure 1. Interpretation of data from the 2001 Wilkinson Microwave Anisotropy Probe (WMAP) satellite, a follow-up to the 1992 COBE satellite from a Big Bang perspective. Figure courtesy of NASA.

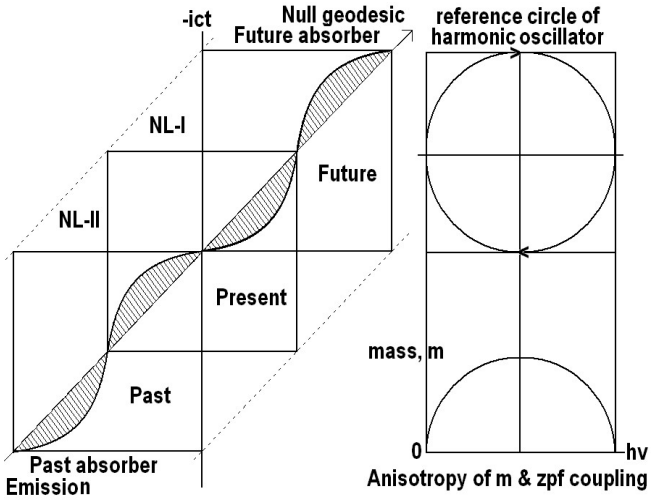

Figure 2. a) 2D drawing of a 3D view of a 4D hyperstructure. A Minkowski spacetime diagram of the electric vector only in terms of a present moment of 'tiled' Planck units utilizing the Wheeler-Feynman theory of radiation. The vertices represent absorption & emission. The observable present is represented by bold lines, and nonlocal components by standard line. Each event is a hyperstructure of Past, Present, and Future interactions, ultimately governed by the quantum potential. b) In the reference circle photon mass and energy fluctuate harmonically during propagation of the wave envelope (wave) and internal rotation of the ZPF during coupling (particle).

The expression 'the temperature of space' is the title of chapter 13 of Sir Arthur Eddington's famous 1926 work [1]. Eddington calculated the minimum temperature any body in space would cool to, given that it is immersed in the radiation of distant starlight. With no adjustable parameters, he obtained $3^{\circ}K$ (later refined to $2.8^{\circ}K$), essentially the same as the observed, so-called 'background,' temperature [3]." Instead of being a relic of an initial hot, dense, primordial singularity, a putative model of

CBR/Redshift as blackbody emission/absorption equilibrium is predicted to occur in the context of the de Broglie-Bohm-Vigier Causal Interpretation of quantum theory where the wave function, ψ describing individual quantum particles is not a mathematical artifice as often considered in the standard Copenhagen Interpretation, but represents physically real elements piloted within a real chaotic ether by a quantum potential [4-6]. Cramer's Transactional Interpretation [7], based on the Wheeler-Feynman absorber theory of radiation [8,9] claims that any present instant [10] is a standing-wave 'transaction' of advanced-retarded future-past elements that are also physically real [7]. See Figs. 4 below and 10.2, and 10.3.

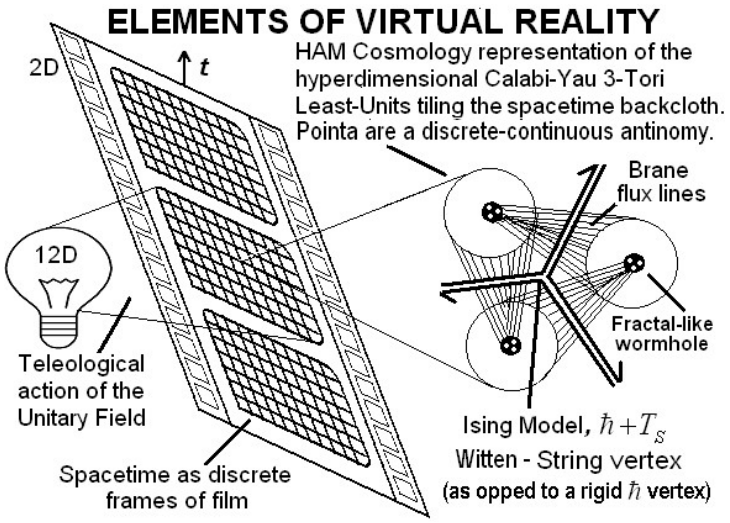

Figure 3. Spacetime is virtual in HAM cosmology and the least cosmological units tiling its backcloth are driven by a teleological anthropic action principle. Each 'point' is a continuous-discrete antinomy.

Although quantum theory itself is silent on the matter [11]; the theory of wave-function collapse is well known; that any measurement or interruption of it's evolution results in collapse or production of a new wave-function. In HAM cosmology reality itself is a continuous wave-function collapse of HD elements. For reality and the arrow of time, the topology of this virtual standing-wave structure of an event for any instant of the eternal present [10] is extended to include hyperdimensional SUSY symmetry breaking dynamics to complete the general framework as seen especially below. At the time of writing no formal evidence for supersymmetry exists and no Standard Model superpartners have been found, suggesting supersymmetry is a broken symmetry with heavy 'sparticles'. However, we postulate this theoretical projection is a result of Gauge Theory being only an approximation and therefore ultimately in reality neither large mass superpartners (a conundrum for microscopic Kaluza-Klein dimensions postulated not to apply to large-scale brane dimensions), or graviton will be found, as the regime of integration is with the unified field, not a quantum field! Supersymmetry is possible in additional dimensionality because spinor properties vary with dimensionality. In N dimensions, the size of a spinor is approximately $2^{N/2}$ or $2^{(N-1)/2}$. The maximum number of supersymmetries is 32, so that the largest dimensionality for supersymmetry is eleven. What we hope to show is that brane tension and coupling mechanisms in some form of extended Wheeler wormhole model provides the fundamental origin of mass. The best indicia for this concept of course is the Dirac spherical rotation electron model.

In the Big Bang scenario redshift and CBR arise in a straight forward manner – Doppler expansion and cool down from a hot initial singularity. In the HAM cosmological model, the basis relies on numerous open questions and entirely new concepts such an *eternal present* [10] that is a complex self-organized standing-wave of a unique form of SUSY *future-past,* [10,12] continuous-state symmetry

breaking parameters. In this context one must look for an inherent Cavity-QED (C-QED) spacetime topology within the covariant polarized Dirac vacuum [13,14] where the Planck Blackbody spectrum can be described as an equilibrium condition of cosmic redshift, as absorption and CBR, as emission. In order for Redshift to be non-Doppler, i.e. not signifying an expanding universe, the next challenge is to rely on the implications of extended Electromagnetic Theory [15,16] especially the Proca equation, $\Box A^{\nu} - \partial^{\nu}\left(\partial\mu\partial^{\mu}\right) + m^2 A^{\nu} = j^{\nu}$ [17] that allows one to introduce a relativistic massive spin 1 particle, in this case the photon is suggested to have a small finite mass, m_{γ} purported to arise by internal motion dynamics of the $B^{(3)}$ longitudinal *EM* field [18-20]. Maxwell's equations are known to cut off at the vacuum; what the Proca equation is all about is to make them continuous into the vacuum [21] – the Dirac polarized vacuum we have been considering. In order to put all this together into a complete model we have extend the so-called 'tired light' mechanism developed by Vigier. In the tired-light model a massive photon couples to this Dirac covariant polarized vacuum through harmonic oscillation of its internal motion [22-24], a wave-particle duality mass anisotropy effect, where $0 \leftrightarrow m_{\gamma} \leftrightarrow 10^{-65}$ g respectively.

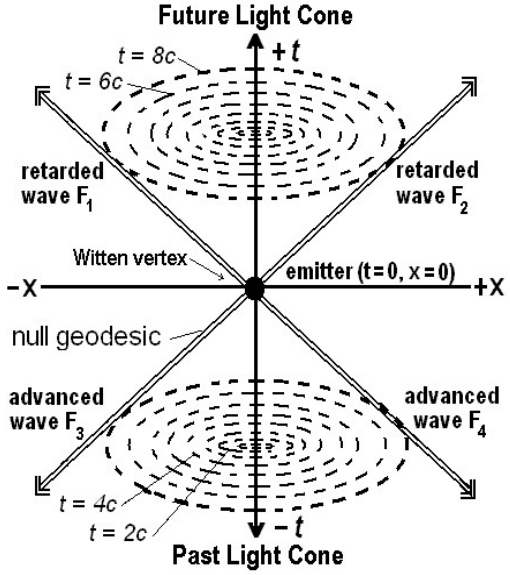

Figure 4 4D Minkowski light-cone of advanced and retarded waves (Eq. 1) emitted from a locus at $(x,t) = (0,0)$. Adapted from concepts of Cramer [7].

$$\text{Retarded:} \qquad F_1 = F_0 e^{-ikx} e^{-2\pi ift}, \quad F_2 = F_0 e^{ikx} e^{-2\pi ift} \qquad (1a)$$

$$\text{Advanced:} \qquad F_3 = F_0 e^{-ikx} e^{2\pi ift}, \quad F_4 = F_0 e^{ikx} e^{2\pi ift} \qquad (1b)$$

As part of the symmetry breaking process the continuous-state spin-exchange compactification dynamics of the vacuum hyperstructure is shown to gives rise naturally to a $2.735^{\circ} K$ degree Hawking type radiation from the topology of Planck scale (albeit a whole new consideration of how the Planck regime operates) micro-black hole hypersurfaces. All prior considerations of 'tired-light mechanisms have been considered from the perspective of 4D Minkowski space [25-34]. This new process arises from a richer *open* (non-compactified) Kaluza-Klein dimensional structure of a continuous-state cosmology in an M-Theory context with duality-mirror symmetry; also supporting the complex standing-wave postulate of the model.

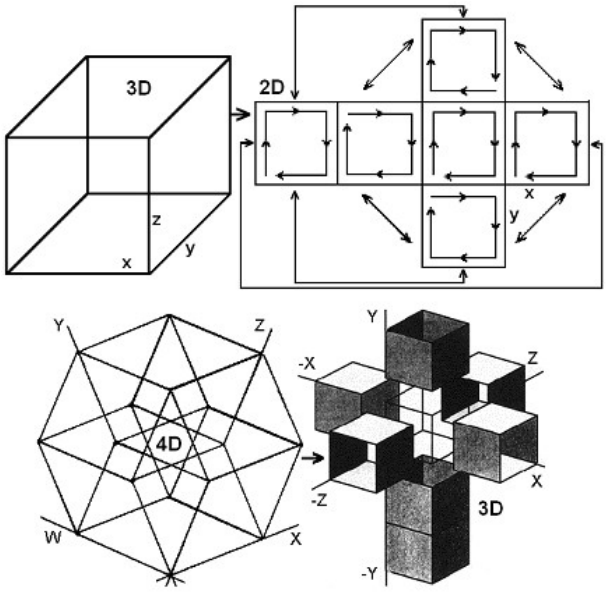

Figure 5 2D view of the HD geometry of space conceptualized in unfolded 3D & 4D views to aid visualization.

An additional note to keep in mind for the global nature of this cosmology: The Einstein-Hubble 3-sphere in HAM cosmology is a self-organized complex system; one of an infinite number of nested Hubble spheres, each with their own fine-tuned laws of physics. The $360^\circ - 720^\circ$ Dirac spinor rotation of the electron by covariance also reflects the continuous-state transformation of HD spacetime itself as the basis for our 'virtual reality'. Each H_R is closed and finite in time, but open and infinite in the bulk of the multiverse. Complex systems are driven by an external force [35-37]; this allows the putative anthropic principle to drive the evolution (a super quantum potential) of each nested H_R.. What we are trying to emphasize is that this covariant scale-invariant structure applies to the microscopic C-QED structures we wish to model for BB equilibrium complementarity.

In Fig. 4a & b a 3D cube unfolds into the 2D plane, aiding the visualization of HD space. In Fig. 4c,d a 4D hypercube unfolds into 8 component 3D cubes as in 4b. If a 5D hypercube were unfolded the 8 cubes forming the 3D cross (4d) would be 4D hypercubes (tesseracts as in Fig. 4c). The translucent cube in the center of 4d, called the *central cube*, represents observed Euclidian reality, E_3. This central cube is surrounded by six *adjacent cubes*. The 8th cube, the *satellite cube*, is placed arbitrarily on any adjacent cube. Carried to 12D the central cube and 12D satellite causally separate as a 'mirror image of a mirror image' is separated from the initial object.

If this 'reality transformation' of HAM cosmology (Fig. 4) is carried to a 12D superspace, 12D can be said to describe 'eternity' because 12D is the minimum number of dimensions to be causally free of the virtual E_3/M_4 complex HD 'standing-wave' present, $\hat{M}_4 \pm C_4$ [35-38]. This is commensurate with some type of dual Calab-Yau 3-forms which in the Wheeler-Feynman formalism can be simplistically written (as adapted from Narlikar [39]) in unexpanded form as

$$F^{S^N}_{symM_4} = \frac{1}{2}\left[R^{S_N}_{retC_4} + R^{S_N}_{advC_4} \right] \qquad (2)$$

This 3-torus cosmological least-unit [40] singularity structure of the *advanced-retarded future-past*

standing-wave dynamics is a foundational principle of the continuous-state anthropic multiverse.

The Big Bang can be obviated by invalidating Einstein-Friedman universes upon which it is based. The field equations of General Relativity (GR) allow for singularities, the existence of which has been used to predict black holes and Big Bang inflationary origins of a temporal universe; but both GR and quantum theory (QT) are known to be incomplete. The Big Bang although highly successful cannot claim logical consistency. This was the state of Newtonian mechanics before it was superseded by quantum mechanics and GR. It is not possible for an event to initialize inflation from an era of infinite entropy without violating the law of conservation of energy. Therefore, a scientific justification for a Big Bang era is not possible [41,42]. Many other inconsistencies with the Big Bang interpretation are passionately debated in the literature [3]. The standard Big Bang model is founded on strong observational data; prompting many to accept it unconditionally. While the empirical data are correct; the interpretation relies on an incorrect metaphysical basis. The crisis facing scientific epistemology has come full circle to a similitude of Galileo's time when the logic of sound philosophical deduction failed deduce natural law. Einstein's refinement of Newtonian gravitation will be repeated for General Relativity (GR) by post-quantum anthropic cosmology, requiring inflationary models of the universe to be critically reevaluated. This paper introduces a radical new view of compactification dynamics for a Dirac vacuum hyperstructure utilizing spin-spin coupling to build on the 'tired-light' model developed by Vigier [34].

2. Origin of Redshift in Nonzero Restmass Photon Anisotropy in Photon Propagation and the Vigier Tired-Light Hypothesis

The self-referential flavor of GR's equivalence principle induced conformal map between a curved Einstein-Riemannian 4-space and a locally conformally flat Lorentzian spacetime manifold shelved the propagation problem inherent in a 'Maxwellian ether' after the null results of the Michelson-Morley experiment; but Einstein said relativity did not compel us to exclude the possibility of an ether – namely spacetime itself. Since GR endows space with physical qualities; "space without ether is unthinkable" [43]. Photon anisotropy requires vacuum zero-point coupling, and its propagation can no longer be considered independent of the Dirac vacuum [44]. The fluctuation of the vacuum zero-point field is consistent with the Sakharov-Puthoff model of gravitation [45,46].

Einstein, Schrödinger, and de Broglie have attested to the significance of nonzero photon rest mass. Frequency dependent anisotropy results from a putative $10^{-65} g$ periodic nonzero photon restmass according to

$$E = h\nu - mc^2\left[1 - v^2/c^2\right]^{-1/2} \text{ [35]}. \qquad (3)$$

Of critical importance to our utility of the Dirac vacuum is the consequences non-zero photon mass, $m_\gamma \neq 0$ has for quantum electrodynamics where it becomes possible to split the corresponding EM spin 1 waves into transverse, $J_3 = \pm 1$ and longitudinal $J_3 = 0$ parts [34,47-49] where the latter relates to a decoupled Yukawa action-at-a-distance scalar potential that replaces the Coulomb field [34]. This field of course vanishes when the mass of the photon is zero. This photon polarization condition has also been noticed by Sundrum in relation to a 5D string vacuum where the 3rd polarization of $m_\gamma \neq 0$ adds an additional degree of freedom allowing a form of vacuum superconductivity [49].

The Wheeler-Feynman absorber theory of radiation [8] refined by Cramer [7] and by Chu [9] is utilized for our refinement of the Vigier Dirac vacuum conductivity model because the symmetry conditions of the emitter-absorber transaction is logically consistent with both C-QED requirements of HAM cosmology and our extension of the de Broglie, Bohm, Vigier causal stochastic interpretation of quantum theory which provides a vacuum model with the inherent physical existence of these vacuum

displacement currents. The dissipative mechanism is also related to general relativity. The fluctuation in photon mass although tiny is sufficient to create an oscillation in spacetime curvature which as we shall see later creates a deficit angle in the parallel transport of vacuum charge allowing the coupling and uncoupling process to operate, i.e. according to general relativity and action and reaction occurs between the $g_{\mu\nu}$ field and particles moving in the Dirac medium characterized by the energy momentum distribution $T_{\mu\nu}$ because

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R + \Lambda g_{\mu\nu} = 8\pi G\left(T_{\mu\nu} + g_{\mu\nu}\rho_{vac}\right) \qquad (4)$$

meaning that photon propagation is modified by the $g_{\mu\nu}$ medium and the $g_{\mu\nu}$ medium is modified by photon propagation [50].

Dissipative redshift mechanisms have remained *ad hoc* curiosities because of little empirical support and conflict with the apparent strident success of the standard Big Bang model Most physicists today believe the photon is massless because a massive photon would destroy the mathematics of gauge theories and would violate Einstein's theory of special relativity because mass would go to infinity since $u = c$.

$$M = M_0 \frac{1}{\sqrt{1 - \mu^2 / c^2}} \qquad (5)$$

However the existence of light pressure which has been known for a long time [51] a function of irradiance I over c ($p = I/c$ for absorbed photons and $2I/c$ for reflected photons) suggests that photons carry linear momentum and energy which can readily be calculated using Einstein's mass energy relation, $h\nu = mc^2$. The de Broglie wavelength relationship for massive particles, taking the accepted value for R applied to the Vigier mass, m_γ of the photon is:

$$m_\gamma = \frac{h}{\lambda c} \qquad (6)$$

taking $\lambda = R \approx 10^{28} cm$ for the de Broglie wavelength, λ of the photon then $m_\gamma \approx 2.2 \times 10^{-65} g$

which is the value for photon restmass obtained by a number of researchers [34,52]. Where R is the radial size of the universe; and by the uncertainty relation this is the smallest possible photon mass. Further $m \to 0$ only if $R \to \infty$. The de Broglie hypothesis was verified by [53,54] for the wavelength of a material particle. A photon mass of $10^{-65} g$ is in total agreement with Vigier's tired-light hypothesis [34].

From the redshift-distance relation, $z = f(d)$ (for static or expanding universe models) following [33] photons with restmass, m_γ interact with vacuum particles of mass, m_{vac} with acceleration

$$\int \frac{d^2 y}{dt^2} dt = -\frac{2\lambda\rho\omega}{y\left[\left(\frac{1}{2}\right)^2 + y^2\right]^{1/2}}. \qquad (7)$$

The momentum transfer per vacuum particle, m_{vac} is

$$\int m_{vac}\frac{d^2y}{dt^2}dt = -\frac{2m_{vac}m_\gamma\omega}{y\left[\left(\frac{1}{2}\right)^2+y^2\right]^{1/2}} \tag{8}$$

with t the time, y the coordinate intersecting the path, ω.

Producing a 'tired-light' redshift-distance law

$$\frac{\Delta v}{v} = e^{kd} - 1, \tag{9}$$

where k is determined by m_γ estimated to have a value of $10^{-65}g$ [34,52,55], m_{vac} which is currently unknown and may not be completely relevant other than the putative fact that vacuum coupling occurs.

It is inherently obvious that the photon is annihilated when brought to rest; therefore, it is suggested that the photon has a rest mass with a half life on the order of the Planck time of 10^{-44} s, which would still preserve gauge in the domain of the standard model of elementary particles and allow for anisotropic vacuum zero-point coupling of the photon which if it also occurs in the limit of the Planck time can be a virtual interaction.

3. Weak-Field Gravitational Approach of a Finite Light-Pencil and Derivation of the Gravitational Field of Radiation

For the linearized Weak-Field Approximation (WFA) approach [56] assume $m_\gamma = 0$, is point-like and the usual notation $c = G = 1$. Then for Einstein's field equations:

- $R_{ik} = (1/2)g_{ik}R = 8\pi T_{ik}$ and
- $g_{ik} = \eta_{ik} + 2h_{ik}$,
- $\eta_{ik} = diag(1,-1,-1,-1)$, and
- $\left(h_{ik}\right)^2 = 0$ yield the linearized field equations:

$$\Box\psi^{ik} = 8\pi T^{ik}, \quad \psi^{ik} = -\frac{1}{2}\eta^{ik}h^l_l \tag{10}$$

The mass of the photon proposed by Vigier [34] is derived here utilizing the Tolman, Ehrenfest, Podolsky (TEP) [50] model of spacetime curvature induced by a finite light pencil. The TEP equations are summarized below; and include Einstein's weak field approximation (WFA) applied to a mass-free radiation field. Accordingly, the WPA is linear, deviating only to first order in the Galilean case suggesting that the model is local, i.e., describing spacetime curvature induced by the light pencil in its immediate vicinity. The notation used is within the context of classical GR theory.

Only the non-zero components of the energy momentum tensor, T^ν_μ are those in energy density, ρ. Since the line element integral diverges for an infinitely-long light pencil, (L_p) and energy density, ρ, the pencil length is taken to a finite value L_p with ρ also finite. Then the expression for the Galilean deviation yields an elementary function: $h^\nu_\mu := \delta^{\nu\alpha}h_{\mu\alpha}$ with for a $h := h^\alpha_\alpha$ for a L_p traveling along the positive axis of an orthogonal Lorentzian 3-sphere. The linearized WFA from [56] is:

$$\left[h_\mu^\nu - \frac{1}{2}\delta_\mu^\nu h\right](x,y,x,t) = -4\iiint \frac{\left[T_\mu^\nu\right](\bar{x},\bar{y},\bar{z},t-r)}{r} d\bar{x},d\bar{y},d\bar{z} \quad (11)$$

Which coupling the metric distribution of matter and energy taken over all elements of spatial volume $d\bar{x}d\bar{y}d\bar{z}$ for time *r*.

To determine the gravitational field of light the momentum energy tensor of an electromagnetic radiation field is formulated in natural coordinates and in Weyl's form in this manner [57]

$$T_1^1 = \frac{1}{2}\left(X^2 + Y^2 + Z^2\right) + \frac{1}{2}\left(\alpha^2 + \beta^2 + \gamma^2\right) \quad (12)$$

$$T_1^2 = XY + \alpha\beta \quad (13)$$

$$T_1^4 = \beta Z + \gamma Y \quad (14)$$

$$T_4^4 = \frac{1}{2}\left(X^2 + Y^2 + Z^2\right) + \frac{1}{2}\left(\alpha^2 + \beta^2\gamma^2\right) \quad (15)$$

For pure electromagnetic radiation all other components of *T* vanish. Here *X, Y* and *Z*; and α, β and γ are components of the electric and magnetic field strength respectively at (*XYZ*).

Using the above WFA solution for the energy momentum tensor, T_μ^ν for incoherent electromagnetic radiation (polarized or nonpolarized) for a L_p parallel to the positive *x*-axis, in natural coordinates with constant linear energy density, the only density components, ρ in (6) reduces to

$$T_1^1 = -\rho, \quad T_4^4 = \rho, \quad T_1^4 = -\rho, \quad T_4^1 = \rho, [56] \quad (16)$$

where effects at the beam boundary are neglected. Substituting $T_1^1 = -\rho$ into (2) gives

$$\begin{aligned} h_1^1 - \frac{1}{2}h &= 4\int \frac{[\rho]dV}{r} \\ h_2^2 - \frac{1}{2}h &= 0 \\ h_3^3 - \frac{1}{2}h &= 0 \\ h_4^4 - \frac{1}{2}h &= -4\int \frac{[\rho]dV}{r} \\ h_1^4 - h_4^1 &= 4\int \frac{[\rho]dV}{r} \end{aligned} \quad (17)$$

Solving $h_1^1 - \frac{1}{2}h = 4\int \frac{[\rho]dV}{r}$ for $h_{\mu\nu}$ gives

$$h_{11} = h_{44} = -h_{14} = -h_{41} = 4\int \frac{[\rho]dV}{r} \qquad (18)$$

The values of $h_{\mu\nu}$ in (18) fixes the form of the line element due to pure electromagnetic radiation traveling along the X-axis of a system of natural coordinates.

4. Gravitational Action of a Light-Pencil

The gravitational field in the neighborhood of a finite L_p with constant linear energy density ρ passing along the *x* axis between a source at *x* = 0 and an absorber at *x* = l [7-9,56]; contributes to the radiation by

$$4\int \frac{[\rho]dV}{r} = -h_{11} = -h_{44} = h_{14} = h_{41} = \qquad (19)$$

$$4\rho \log \frac{\left[(l-x)^2 + y^2 + z^2\right]^{1/2} + l - x}{\left[x^2 + y^2 + z^2\right]^{1/2} - x}$$

Equation (19) describes the gravitational contribution only in L_p neglecting any contribution from the source or absorber [56] also any internal conditions, vacuum zero point coupling, or other spin exchange which also effect propagation.

Finally, for the acceleration of a test particle towards the L_p along the negative *y* direction determined by a geodesic originating midway between the two ends of the pencil, [56] arrive at the simple result in 4.4. This is significant because the equivalency of the gravitational and inertial mass of a L_p justifies the application of the de Broglie relationship in (3.2) to the photon verifying the Vigier hypothesis of $m_\gamma = 10^{-65} g$!

$$-\frac{d^2y}{dt^2} = \frac{2pl}{y\left[(l/2)^2 + y^2\right]^{1/2}} \quad . \qquad (20)$$

The de Broglie relationship applied above in equation (2) determine the Vigier mass, m_γ of $10^{-65} g$. The important characteristic achieved is that conservation of momentum is preserved because as expected the acceleration is exactly twice that calculated from Newtonian theory by taking the equivalence of gravitational and inertial mass!

5. Internal Motion Structure of the Photon

All these fifty years of conscious brooding have brought me no nearer to the answer to the question, 'What are light quanta?' Nowadays every Tom, Dick and Harry thinks he knows it, but he is mistaken. ... I consider it quite possible that physics cannot be based on the field concept, i.e., on

> *continuous structures. In that case, nothing remains of my entire castle in the air, gravitation theory included, [and of] the rest of modern physics.* - Albert Einstein [57]

According to Einstein rest mass results from external or internal structural motion of a particle. Vigier has also discussed this extensively in terms of the causal-stochastic interpretation of quantum theory [6]. Unlike Fermi materials that are localized in all spatial dimensions and maintain a well developed internal kinetic structure even when at rest, photons immediately release their more open spin structure when brought to rest and immediately dissipate their energy. For photons this internal transformation oscillates We postulate the photon rest mass fluctuates harmonically in a manner like $0 \Leftrightarrow \sim 10^{-65} g$ which signifies according to $E = mc^2$ a change in energy from inward reflection and interaction with the Dirac polarized vacuum to outward displacement through space. We believe if this were not so the speed of light would be infinite; and that this variance is key to the fine-tuning of each nested Hubble sphere, $H_{R\alpha}, H_{R\beta}, H_{R\chi} ... H_{Rn}$. Fluctuation in mass-energy is not mysterious as it is generally known that inertial and gravitational masses are an aspect of this movement. At the DESY laboratory recent experimental results have shown that the photon has extra layers of activity [58]. This is represented in Fig. 1.

> In other words, the transformation of 'matter' into 'energy' is just a change from one form of movement (inwardly, reflecting, to & fro) into another form, e.g. outward displacement through space. The possibility for objects of zero rest mass exists provided that they are moving at the speed of light. For if rest mass is 'inner' movement, taking place even when an object is visibly at rest, it follows that something without 'rest mass' has no such inner movement, and *all* its movement is outward, in the sense that it is involved in displacement through space. So light does not have the possibility of being 'at rest' since it does not poses any such inner movements [59].

This does not preclude a massive photon, only points out the difference in structure between Bosons and Fermions. It has been suggested that the definition of restmass be refined [60] or perhaps some sort of a photon 'lifetime' related to frequency could be considered.

6. Introduction to Spin Exchange Compactification Dynamics

Photon mass anisotropy is a major requirement of the model. Our C-QED BB theory is based on the fundamental premise that the energetic interplay of mass, inertia, gravitation and spacetime topology is based on a unified symmetry of internal spin-spin coupling and spin exchange compactification with a 'super quantum potential' ultimately being the action and control principle. Spin exchange symmetry through the interplay of a unique topological package orders compactification providing a template from which superstring or twistor theory could be clarified. One purpose of compactification dynamics is to allow the 3- sphere of temporal reality to stochastically 'surf' on the superstructure of HD eternity creating our virtual reality and the perceived arrow of time allowing nonlocal interactions not possible in a Newtonian absolute space or completely described by Copenhagen quantum theory. Stated another way, the domain of quantum uncertainty stochastically separates the classical regime from the unitary regime. This allows the subspace of temporal reality to surf as it were on the face of eternity.
The localized appearance of compactification has been interpreted as a structure fixed in an early Big Bang era, but spin-exchange delocalizes compactification in a rich dynamic HD hyperstructure of continuous spacetime symmetry transformation of constant N-Dimensional collapse to the 3-sphere of Minkowski space for the reality of the observer. If we apply Mach's principle[1,2] [61,62] to the

[1] Local physical laws are determined by the large-scale structure of the universe.
[2] "inertia originates in a kind of interaction between bodies" - Einstein [61].

perspective of HAM cosmology we consider the inertial force and Einstein's equivalence principle to be the same and can be applied as a quantum space density of space waves combined from all particles in the universe to every space point:

$$\text{Mach density} \propto mc^2 = hf \propto \sum_1^N \left[\frac{\Phi_n}{r_n}\right]^2 \text{ [62].} \qquad (21)$$

The continuous-state compactification process contains a central inherent hysteresis loop that entails an inertial drag; the oscillating boundary conditions of which determine the speed of light, *c*. This is its fine tuning and the reason $c \equiv c$ and is not infinite. The continuous-state acceleration parameters of which balances the gravitational potential which along with the Stoney modulated Planck's constant, $\hbar + T_0$ and the SUSY modulated cosmological constant, Λ together balance dark energy and the minute oscillation of the curvature of spacetime orders the arrow of time. This form of inertial drag is compatible with the Sakharov-Puthoff model of gravitational theory [45,46,63,64] which are compatible with a Dirac ether model.

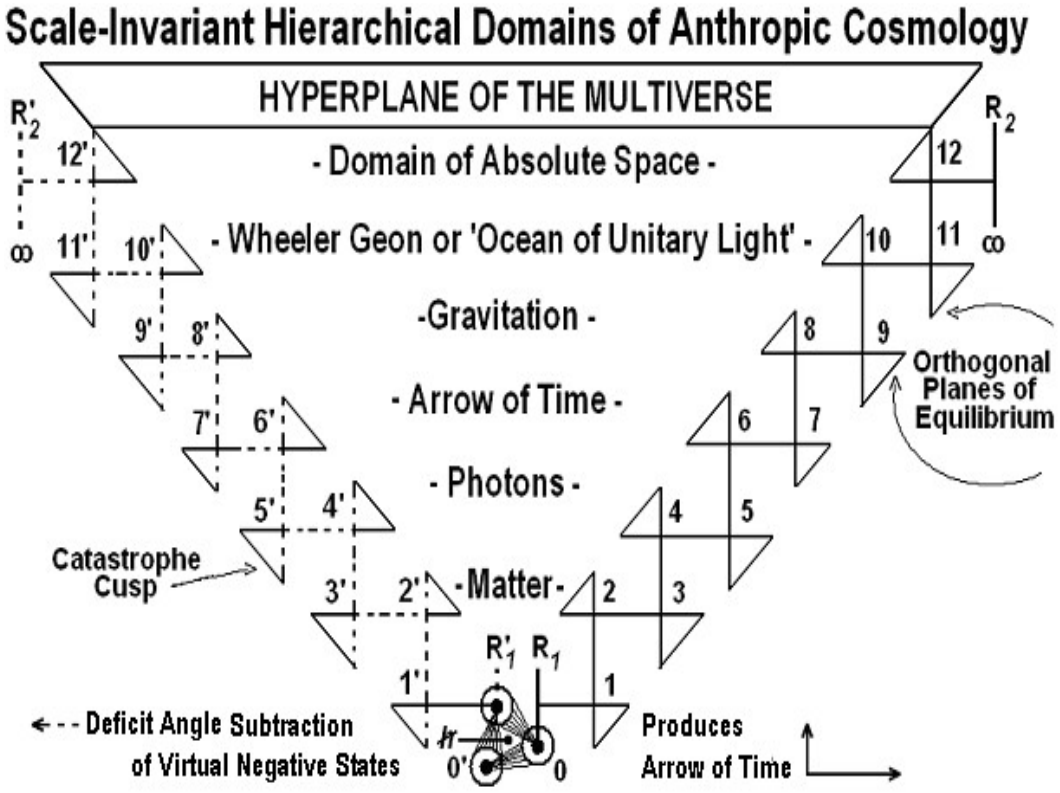

Figure 6. Conceptualization of the covariant scale-invariant hierarchical structure and function of HAM dimensionality from zero to 12D.

Considering the structural-phenomenology of the array of least cosmological units tiling the spacetime backcloth to be BB cavities, an inherent inertial force in the hysteresis loop of the continuous-state compactification dynamics is the determinant of the perceived arrow of time. This pertains to the photon and quadrupole photon-graviton complex and the HD 'ocean of unitary light' it originates in, structure not observed when enfolded in HD reality.

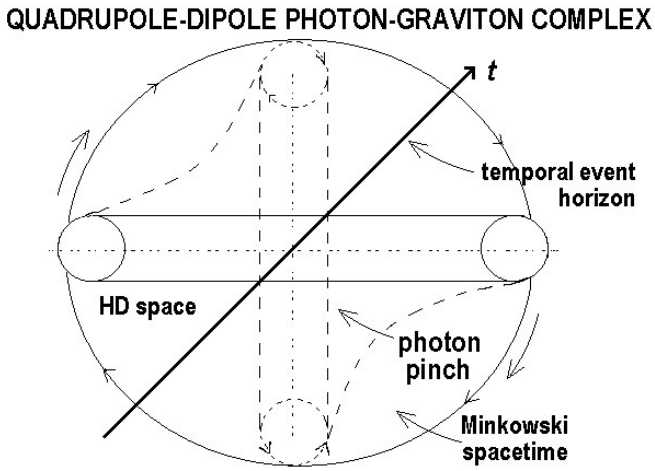

Figure 7 Conceptualized view of the HD quadrupole photon-graviton complex for $quadrupole \Leftrightarrow dipole$ interactions as elements of the unitary field and the event horizon of the Minkowski spacetime leading lightcone singularity and inherent arrow of time for an Earth observer. Compare Fig. 11.

Spacetime is quantized as a discontinuous Planck scale raster determined by the fundamental constants *c, G & h.* This comprises a basic unit of the Dirac polarized vacuum with the properties like a rotating microcosmic Klein bottle with properties like a Planck scale black hole. The Planck constant *h* is a product of the uncertainty principle; a complement of the Planck length, l_{pl} and Planck time, t_{pl} comprising the virtual event horizon of nonlocality.

Compactification appears as localized scalar potentials to standard quantum measurement, but nonlocally, in the Wheeler-Feynman-Cramer-HAM model [7-9,12], are a continuous transformation of QED or SED hyperdimensional mirror symmetry Calabi-Yau 3-tori cavities in blackbody equilibrium. Delocalized compactification dynamics produce a periodic mass equivalency by oscillations of the gravitational potential (GP) providing the action principle for absorption and emission (see section 7). Theoretical feasibility of Planck scale black holes has long been demonstrated [65-67]. Thus, the CBR could be considered a form of Hawking radiation [66-68] from the hypertiling of covariant polarized Dirac sea microcavities. Planck scale black hole microcavities have been criticized as unphysically hot, but this would not be the case in continuous-state cosmology because the inherent spin exchange SUSY breaking mechanism makes any heat buildup impossible because of the constant roiling of the energy in the hysteresis looping.

The HAM is modeled as a type of dynamically transforming hyperdimensional Klein bottle, topologically representative of Kant's antinomy of an open/closed spacetime [69] with near-field far-field photon mass anisotropy leap-frog conditions; the hypergeometry of which translates in a metric of commoving Birkhoff spheres [70] where $\dot{R} = c$ is preserved through all levels of scale [71,72]. This is part of the continuous-state future-past advanced-retarded dimensional reduction standing-wave spin-exchange compactification process. Taking the Hubble sphere as the arbitrary radius of the temporally finite observable universe, the Gravitational Potential is opposed within the 3-sphere, not by inflation but by a nonlocal equivalence to the Gravitational Potential, i.e *dark energy* of the bulk of the multiverse [12] which appears in the large scale as Einstein's cosmological constant, Λ and in the small scale as the new string tension, T_S modulated Planck constant, $\hbar$. Both the cavity-QED CBR-emission and Redshift-absorption arise from an 'electromotive torque', an inertia in the hysteresis loop of the temporal-eternal antinomy of the continuous state process that arises as the stochastic background wake of photon-graviton propagation [12,35,36] as a duality between a phenomenal 'semi-quantum limit' and the ontological unified field. This is the ontological flux of the unitary field; and the source of

Mach's principle. The unified field exchange mediator in this model has been dubbed the noeon [12,35,36]. The exchange is performed by topological switching [73] and therefore is an energyless ontological process. Wheeler said 'charge is topology'. This process is where this 'virtual charge' comes from. It's quote-unquote 'force' arises in the variance of the curvature of the topology, during the continuous-state, i.e. it is a force of coherence which is the great attractor of the anthropic principle guiding evolution, a super quantum potential, as described by the fundamental noetic equation, $F_{(N)} = E/R$. As introduced below we relate the Gravitational Potential equivalent acceleration of the continuous-state translation of these co-moving topologies of higher and lower fluctuating flat-curved spacetime dimensions as fundamentally equivalent to a Planck scale black body exciplex hypersurface [44].

7. Blackbody Exciplex Radiation - Cosmological Constraints

Employing to the tensor field equations of Einstein's general relativity, $G_{\mu\nu} + \Lambda g_{\mu\nu} = \left(8\pi G / c^4\right) T_{\mu\nu}$, especially for the Schwarzchild line element,

$$ds^2 = -\left(1 - \frac{2M}{r}\right) dt^2 + \frac{dr^2}{1 - 2M/r} + r^2\left(d\theta^2 + \sin^2\theta d\phi^2\right), \quad (22)$$

a gravitational interaction between a domain wall and a black hole might be valid when the symmetry breaking scale of the scalar field is near the Planck scale, but the assumption is the effects of gravity cab be ignored near the black hole horizon and we would essentially ignore any consideration of Planck scale black bodies. The boundary conditions of a black body cavity radiates at every possible frequency and is dependent only on the temperature of the walls of the cavity. In thermodynamic equilibrium the amount of energy, $U(\nu)$ depends only on temperature and is independent of the material of the walls or shape of the container. The crux of the matter is that the radiation field and boundary conditions behave like a collection of simple harmonic oscillators that can arbitrarily be chosen to have a set of boundary conditions of dimension L [40,74] which is repeated periodically through spacetime with spherical symmetry in all directions. These boundary conditions will yield the same equilibrium radiation as any other boundary conditions, and with this result no walls are actually required because the walls thermodynamically only serve in the conservation of energy [59]; allowing the putative feasibility of our C-QED exciplex model for BB CBR /redshift equilibrium to be compatible with natural law. This seems to relate somehow to Birkhoff's theorem [70] for the gravitational potential in a spherical universe (the Einstein-Hubble 3-sphere); it seems to be this theorem that allows the 'container' and its walls to be essentially irrelevant especially in terms of the symmetry of the covariant scale invariance. Perhaps it may be better said as a nothing-everything configuration of infinite potentia. This is the background setting with parameters providing delicate balanced equilibrium conditions. It would appear that emissions is the simpler of the two conditions – an internal or external 'bump or hole' (Fig. 13) coupling-uncoupling allows a boundary condition change facilitating emission. Dirac hole theory and Bohr-Summerfield conditions may have some relevance. In any case this is all governed by the boundary conditions described by noetic field equation, $F_N = E/R$ as illustrated in Fig. 7

Defining the observable universe as an Einstein 3-sphere, any spherical distribution of matter of arbitrary size (according to the general theorem developed by Birkhoff [70]) maintains a uniform contribution of the GP with any particle in the volume. Metaphorically the Wheeler-Feynman-Cramer-HAM model [7,8] defines the radius of the universe, R in terms of a comoving Hubble sphere with the topology of a hyper-Klein bottle (dual mirror symmetry Calabi-Yau 3-tori). This relation maintains itself through all levels of scale. Therefore, Birkhoff's theorem [70] can apply hyperdimensionally to all matter in the multiverse. This can explain the origin of the cosmological constant [75], why space appears universally flat and why 3-sphere dark matter is not required to explain galactic rotation since

in HAM cosmology [12], it is instead balanced by a multiversal *dark energy* from the 'infinite number of causally separated nested Hubble spheres.

This arbitrary cavity putatively modeling the structure of the universe, as drawn from current astrophysical data, is generally accepted to be a perfect BB radiator of $2.735^{\circ} K$. Einstein introduced the cosmological constant to balance the GP in a *static universe*. Which he then retracted when Hubble discovered what was erroneously thought to be a Doppler recessional redshift, which Einstein apparently thought obviated the need for a cosmological constant. Further Einstein postulated the existence of singularities derived from the field equations of general relativity; from which Friedman suggested that the universe itself originated in a temporal singularity giving rise to the Big Bang model of recent history.

It turns out there is a temporal singularity but it relates to continuous-state parameters of string tension and recession of the advanced mode of the Planck constant as it recedes into the past from the stationery locus of the eternal present [10]. It has been shown in [55] that redshift is intrinsic to photon mass anisotropy; suggesting that recession is an observational illusion of 'tired light' rather than a physically real Doppler recessional velocity indicative of a Big Bang effect.

> Let us assume that photons of rest mass, m_p interact with the vacuum particle, having mass m_o. There is, along the interaction path, w, a transfer of energy and momentum from the traveling photon to the vacuum particles which gives the vacuum particles a motion toward the trajectory (a pinch effect). The loss of photon energy and of photon momentum can be computed...The effect has a perfect geometrical symmetry, being in essence the result of an interaction between a photon along its trajectory with a strictly symmetrical potential. The redshift-distance law is obviously a 'tired-light' [33].

8. Blackbody Microcavity-QED Constraints

Specialized Dirac vacuum C-QED boundary conditions are taken to represent the walls of Birkhoff black body – black hole microcavities comprised of a tiled stochastic hyperstructure of Planck scale, S_N phase cells with the lower limit of dimensional size determined by the Heisenberg uncertainty principle with the cavity volume defined by $\delta x\delta y\delta z\delta t\delta p_x\delta p_y\delta p_z = |h|^3$ and the energy for each coordinate defined by $\sum_{S_N} \delta E_N \delta t \sim h$ [44]. But now we know from string theory that the string tension factor modulates the size of the cavity. During the continuous cycles of dimensional reduction (different than popular M-Theory with one fixed compactification rather than our continuous stepwise compactification cycle[3]), the energy, E is parallel transported by an *energyless Topological Switching*[4] of higher to lower dimensionality, $D-(\delta E_x \delta t)$ without distorting the smoothness of perceived macroscopic realism because of the standing wave spin exchange process. Although in HAM reality the Planck backcloth is a 11(12)D hypertiling of topologically comoving hyperstructures, not a rigid tiling of 3D cubes with primal fixed compactification as in Big Bang theory.

9. CBR Energy Damping by Vacuum Conductivity

Planck's radiation law for a harmonic oscillator is energy per unit time per unit volume. An order of

[3] Continuous-state compactification is merely a form of Kaluza-Klein cyclicality for > 5D brane dynamics.

[4] *Topological Switching* refers to the optical illusion occurring when fixating on a face of a Necker cubes where a background vertex switches to a foreground vertex; here utilized as a metaphor of how parameters of a higher dimensional topology may interplay harmonically by parallel transport into lower dimensional structures.

magnitude calculation for the energy of a single transverse CBR cavity wave mode for the energy density is $\omega = \tfrac{1}{2}\varepsilon_0 E^2 + \tfrac{1}{2}\mu_0 B^2 \approx \varepsilon_0 E^2$. According to Lehnert & Roy [21] energy, $E = E_0\left(r - c_0 t\right)\cdot\exp\left(-\tfrac{1}{2}R\sigma r\right)$ where R is radius of the universe and r is direction of propagation. This implies that the energy density has an *e*-folding decay length, $L_{decay} = 1/r\sigma$ where $\sigma \equiv$ conductivity of the vacuum because the conductivity is extremely small. The corresponding energy decay time (damping time for E to decay from original value) would be $t_{decay} = L_{decay}/c = 1/R\sigma c \equiv$ absorption time of the 'tired light' redshift absorption effect [21]. This applies to all waves where R is radius of universe.

Lakes found an interesting way to measure photon mass using a form of Cavendish balance [76]. See Fig. Below. His experimental design evaluated the product of photon mass squared, m_γ^2 and the energy density of the ambient cosmic magnetic vector potential, A not the usual measurement of the magnetic field. His apparatus is more sensitive than in other experiments because it measures large-scale cosmic magnetic fields associated with huge vector potentials [76].

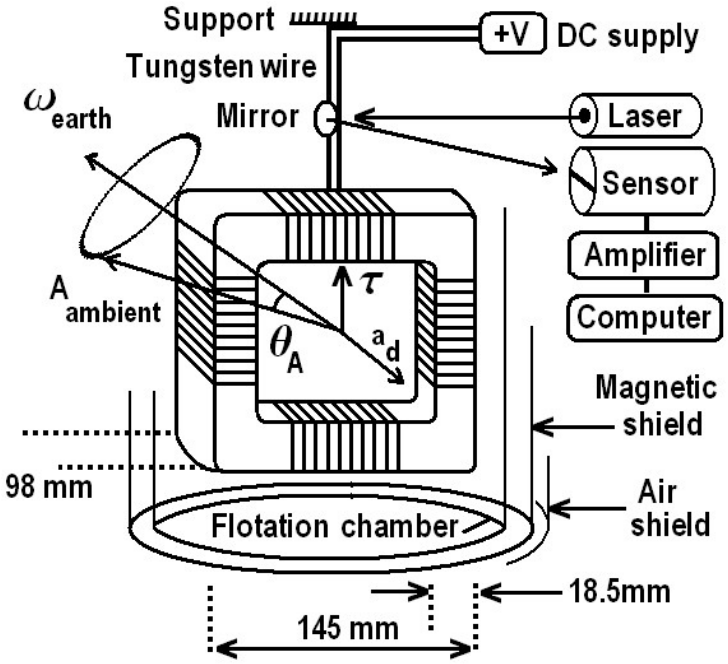

Figure 8. An electric current in a toroid produces a dipole field which interacts with the ambient vector potential producing a torque on the toroid which varies with the Earth's rotation. Fig. redrawn from [76].

Perhaps laser trapping techniques could be utilized to enhance the energy baseline and improve the accuracy by several orders of magnitude. Lake states: "nonzero photon mass would give rise to a wavelength dependence of the speed of light in free space, the possibility of longitudinal electromagnetic waves, a leakage of static electric signals into conductive enclosures, and a more rapid falloff … of magnetic dipole fields with distance than the usual inverse cube dependence" [76]. We have noticed a naturally occurring case of 'leakage of static electric fields'. We have been told numerous times by automotive and marine battery distributors over the years than they cannot store them on the floor of they are damaged quickly.

We postulate an 'exciplex' C-QED black body tiling of the Dirac polarized vacuum such that redshift and CBR are absorption-emission equilibrium conditions. The functionality of this model is facilitated

by the Vigier Causal Interpretation of quantum theory and extended electromagnetic theory described by the Proca equation which includes photon mass. "The conventional form of Maxwell´s equations in the vacuum, with a vanishing electric field divergence, leads to the vanishing parameters spin, rest mass and longitudinal magnetic field of the individual photon. With a nonzero photon mass such divergence in the vacuum state, and with the requirement of Lorentz invariance, all these parameters become nonzero. For the phase and group velocities of a photon wave packet still to remain close to the experimental value of the velocity of light, and for the spin to have its experimentally determined value, the rest mass and the longitudinal magnetic field component then must become very small but nonzero. Thus, the rest mass of the photon does not have to be included ad hoc and occurs from the beginning in the basic Maxwell-Proca field equations [17], but comes out from the nonzero electric field divergence. This is one of the results of my revised quantum electrodynamic theory" [15,16,21,77-79].

10. Possible Black Hole Considerations for Discussion

Any number of bosons may cohere in a phase cell while Fermions must have energy to occupy the same domain because of the Pauli exclusion principle and therefore must be degenerate in black holes. These Planck volumes considered as the boundary conditions of the cavity ground state, cohere stochastically to embody any required energy configuration. The general expression for BB radiation derived by Planck takes the form:

$$M_{\lambda}^{b} = 2\pi hc^{2}\lambda^{-5}\left(e^{hc/\lambda kT}\right)^{-1} \qquad (23)$$

where $M_{\lambda}^{b}(T)$ is spectral emittance, and k is the Boltzmann constant. Hawking found a similar relationship for the hypersurface of a black hole [66,67]. The topology of the Planck backcloth has been considered to be a latticework of micro black holes by some researchers; but perhaps a better postulate would that the backcloth tiling a form of Calabi-Yau Wheeler wormholes. The best indicia for such a scenario is the Dirac $360^{\circ} - 720^{\circ}$ spinor rotation of the electron; it appears such a could only occur in a topology with some form of Klein-bottle hyperstructure. The thermodynamic relationship between black hole area and entropy $E_{\deg raded} = \left(\sum Area/16\pi\right)^{1/2} = \left(\sum M_{tired}^{2}\right)^{1/2}$ and emittivity [66-68,80,81] found to occur at the hyperstructure surface of a black hole is putatively developed here as one possible example for similar emittivity for CBR black body emission intrinsic to the C-QED features of spacetime topology.

11. Size Temperature Relationship of Kerr Black Holes

Bekenstein, [80] suggested a relationship between the thermodynamics of heat flow and the surface temperature of a BH, which led Hawking, 1974a to the finding that all BH's can radiate energy in BB equilibrium because the entropy of a black hole, S_{bh} is related to the surface area, A of its event horizon, where k is Boltzmann's constant, $S_{bh} = M^{2}2\pi[kcG/(h/2\pi)]$ [74]. This leads to the expression for the surface temperature of a black hole:

$$T(^{\circ}K) = (h/2\pi)D/[32\pi hM(M - 1/2Q^{2})/M + D] \qquad (24)$$

where $D = (M^{2} - Q^{2} - L^{2}/M^{2})^{1/2}$ Q = charge, and L = momentum [74]. This shows that the BB temperature of a BH is the inverse of its mass, which for a typical Kerr BH represents a temperature of

one $^{\circ}K$ for a BH a little larger than the moon or for each 10^{26} g.

Accordingly the Beckenstein - Hawking relationship, while a stellar mass BH has the expected fractional degree temperature, the predicted temperature for microcavity Planck scale BH would be about $1.9x10^{31\,\circ}K$. Therefore the additional physics of the Wheeler-Feynman-Cramer-HAM spin exchange dynamics must be added to account for the difference in the compressed geometry of a black hole having a fixed internal singularity structure with a lifetime of billions of years and a Planck scale black hole with an open singularity that [12,44] by rotating at the speed of light, *c* with a Planck time lifetime of 10^{-44} sec and therefore able to dissipate this heat if its theoretical prediction were otherwise true.

So, while a micro-BH might be considered to have a temperature of billions of degrees Kelvin if the nature of its internal singularity and total entropy is derived through the predictions of GR and Big Bang cosmology; because according to GR a singularity occupies no volume and has infinite energy density. But GR breaks down and is known to be incomplete at the quantum level; requiring new physics to describe spacetime quantization. Further, although Einstein said 'spacetime is the ether' [43] radiation was still considered to be independent of the vacuum, which is now known not to be the case [55].

12. Temperature Relationship of Dirac QED Cavity 'Black Holes'

In the transition from the Newtonian Euclidian continuum to quantum theory, what still remains to be properly addressed is the ultimate nature of a discrete point. The infinite density Einstein singularity is still too classically rooted. In terms of the Wheeler-Feynman-Cramer-Chu-HAM model the energy density is delocalized in terms of the equivalent GP of compactification dynamics. Planck scale black body cavities are topologically open nonlocally and spin exchange entropy through a continuous flux of energy; and are not scalar compactified singularities originating in a Big Bang, but continuously transform or accelerate toward an open propagating ground that is never reached nonlocally as if swimming upstream with the same velocity as the flow so that the swimmers position is in stasis relative to a point on the shore. The inertia inherent in this dynamic results in the intrinsic $2.75^{\circ}K$ CBR.

13. Spin Exchange Parameters of Spacetime-Photon Coupling

Starting with the Hawking radiation modification of the Planck BB relationship as applied to BH surface dynamics, the requirement for application to a quantum BB C-QED cavity generally defined as the phase space of $|h_c|^4$ in (25) is the addition of spin exchange parameters, where

$$\sum_{i}^{Z^a Z_a} N_i \left|P_l / P_t\right|^4 = \left|h_c\right|^4 \Leftrightarrow C_\gamma \ . \tag{25}$$

N is the complex sum of Planck hyperunits comprising one BB C-QED microcavity. Spin dynamics can be readily described using the density matrix formalism. Spin states are represented as linear combinations of α and β states corresponding to the spin eigenvalues; and can be used in terms of the wave function to determine the value of spin characteristics *Q*.

$$Q = \left|S_{c1}\right|^2 Q_{\alpha\alpha} + S_{c1}S_{c2}^* Q_{\alpha\beta} + S_{c1}^* S_{c2} Q_{\beta\alpha} + \left|S_{c2}\right| Q_{\beta\beta}$$

$$\rho = \begin{bmatrix} \left|S_{c1}\right|^2 & S_{c1}^* S_{c2} \\ S_{c1}S_{c2}^* & \left|S_{c2}\right|^2 \end{bmatrix} \tag{26}$$

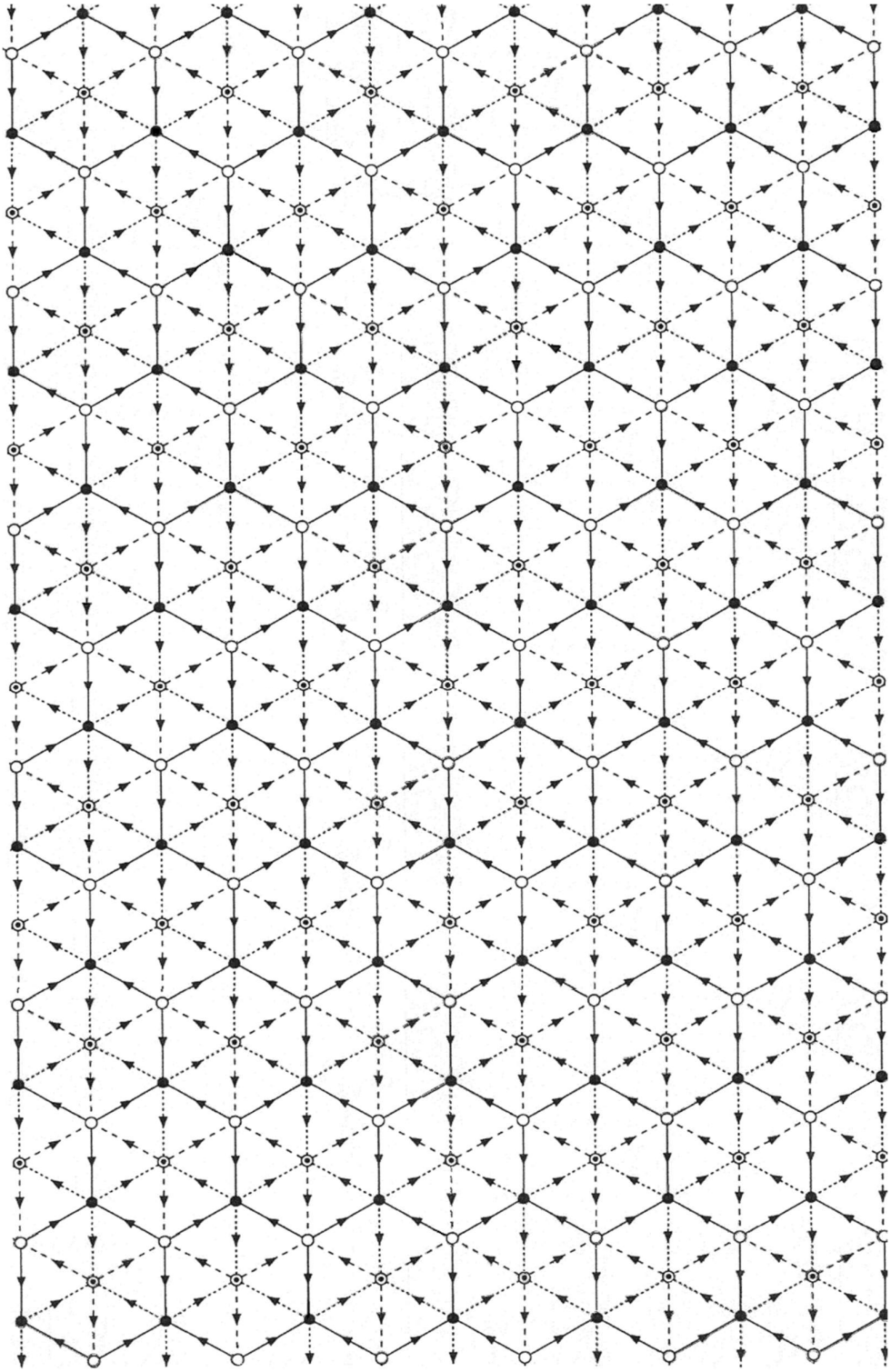

Figure 9. Least-unit exciplex C-QED backcloth able to accommodate any geometry and any transform by topological switching. Fig. adapted from [73].

The density matrix ρ is made up of the spin coupling coefficients S_{c1} and S_{c2}. The diagonal elements correspond to real local spin orientations, and the non-diagonal elements correspond to complex quantities representing spin projection on planes perpendicular to axes of quantization. For the purposes of discussion any arbitrary axis may be chosen as an axis of quantization; but in the spin exchange process the geometry of the complex topology of the Argand plane transforms from real to complex in the retiling of compactification dynamics. The variance in the diagonal elements effects the longitudinal spin polarization along the axis of quantization; and the non-diagonal variances effect transverse spin polarizations. It is the phase of the elements that determine the angle of spin coupling with each dimensional axis. This relates CBR emission/absorption to the cycle of torque moments.

The mass equivalent inertial properties comprising the linear and angular momentum components of spin exchanged in the nonlocal continuous compactification structure allow the Dirac vacuum to maintain perfect BB equilibrium inside the scale invariant Hubble Birkhoff sphere.

14. Spontaneous CBR Emission by Spacetime Cavity-QED

This preliminary model for continuous spontaneous emission of STCBR directly from C-QED dynamics of the stochastic properties of the Dirac sea, obviates CBR origin as the relic of an initial state Big Bang cosmology as the standard model has predicted. In this model we make one speculative new assumption that is not based on the published body of empirical data for C-QED. Spontaneous emission by atomic coupling to vacuum zero-point fluctuations of the Dirac sea is already an integral part of C-QED both in the laboratory and theory; here we postulate that a similar process can occur in free space. In classical electrodynamics the vacuum has no fluctuation; by contrast quantum radiation can be viewed as partly due to emission stimulated by vacuum zero-point fluctuations.

The literature on C-QED is rich in descriptions of the nature of spontaneous emission of radiation by atoms in a cavity [82-84]. We begin development by choosing, for historical reasons, the upper limit of the number of atoms in the vacuum of space to the figure of one atom per cubic centimeter as derived by Eddington, [85]. This figure could be considered arbitrary, but for our purposes it is sufficient to note that *there are sufficient free atomic particles moving in space for spontaneous* C-QED CBR emission.

> Charged particles are coupled to the electromagnetic radiation field at a fundamental level. Even in a vacuum, an atom is perturbed by the zero-point field, and this coupling is responsible for some basic phenomena such as the Lamb shift and spontaneous radiative decay [86].

Recent developments in C-QED have included descriptions of emission by Rydberg atoms in microwave cavities that include optical frequencies [87-95]. The Rydberg formula for atomic spectra is related to the binding energy of an electron by:

$$R = \mu_0{}^2 m e^4 c^3 / 8h^3 \qquad (27)$$

where μ_0 is the magnetic permeability which is the ratio of the magnetic flux density, B of an atom to an external field strength, H. $\mu = B/H$ which is also related to the permeability of free space, μ_0, the Coulomb constant k and the magnetic constant k_m by

$$c = \sqrt{\frac{k}{k_m}} = \frac{1}{\sqrt{\mu_0/\varepsilon_0}} = 3\times10^8 m/s \qquad (28)$$

where ε_0 is the vacuum permittivity of free space; *m* and *e* are mass and charge of an electron respectively, *c* the speed of light and *h* Planck's constant. In the non-perturbative regime strength of the dipole coupling is larger than the dissipation rate and quantum mechanical effects have been shown to include multi-photon resonance, frequency shifts and atomic two state behavior at vacuum Rabi resonance, the latter of which will be of most interest in our discussion [89].

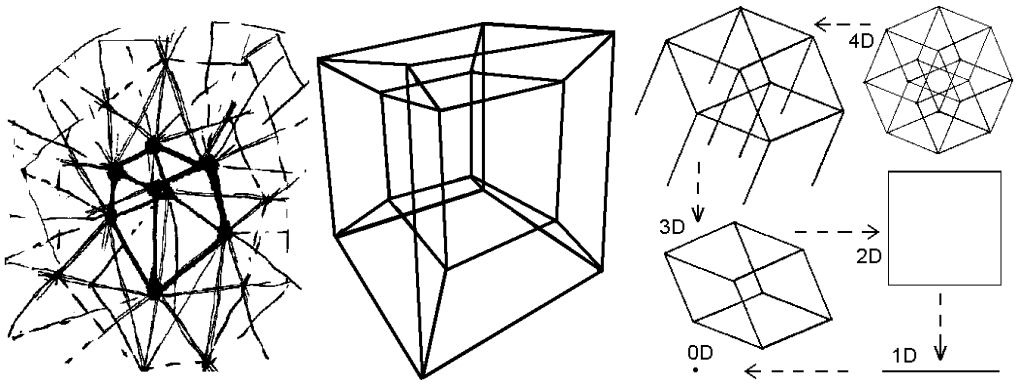

Figure 10 a) A CBR photon emission from the Planck C-QED backcloth *exciplex torque modes* of the *future-past* compactification cycle. b) In HAM cosmology Euclidian space is a subspace of complex HD space (The reverse of Big Bang theory); such that each 3(4)D scale invariant 'cell' is covered by the hyper-geon of the unified field and it's associated action. c) Illustration of continuous D reduction; Not observable from a Euclidian orientation because it is imbedded in complex space $\left(\pm C_4\right)$.

Spontaneous emission requires only a single quantum so the internal state of the atom-vacuum coupled cavity system may be described by the simple quantum basis

$$\left|0\right\rangle\left|-\right\rangle,\left|0\right\rangle\left|+\right\rangle,\left|1\right\rangle\left|-\right\rangle \tag{29}$$

where $\left|0\right\rangle$ and $\left|1\right\rangle$ are the Fock photon states and $\left|-\right\rangle$ and $\left|+\right\rangle$ are two states of the Rabi/Rydberg atom. Momentum operators *x*(*p*) an d *y*(*p*) relate center of mass and atom ground state $\left|-\right\rangle$ dynamics where a master equation can describe the two state atom interacting with the mode of the vacuum cavity momentum distribution after spontaneous emission and the emission spectra [89,96].

$$\begin{aligned}\dot{\rho} &= \left(1/i\hbar\right)\left[\hat{H},\rho\right] + K\left(2\hat{a}\rho\hat{a} - \hat{a}\hat{a}\rho - \rho\hat{a}\right) + \\ &\left(\gamma_I/2\right)\left(2\hat{\sigma} - \rho\hat{\sigma}_+ - \hat{\sigma}_+\hat{\sigma}_-\rho - \rho\hat{\sigma}_+\hat{\sigma}_-\right)\end{aligned} \tag{30}$$

where the *a*'s are the boson creation and annihilation operators and the sigma's the raising and lowering operators for the atom [89].

We assume that the atom acts classically as a free wave-packet where $\rho_{\text{int}}(t)$ describes the internal state of the system which can be described by

$$\rho_{\text{int}}(t) = w(t)(\left|0\right\rangle\left|-\right\rangle)(\left\langle-\right|\left\langle 0\right|) + \left|E_{\text{int}}(t)\right\rangle\left\langle E_{\text{int}}(t)\right|, \tag{31}$$

with

$$\left|E_{\text{int}}(t)\right\rangle = x(t)\left|1\right\rangle\left|0\right\rangle + y(t)\left|0\right\rangle\left|+\right\rangle, \tag{32}$$

where

$$\frac{dx}{dt} = -(\kappa + i\omega_0)x + g \quad \cos(\Omega t + \Phi)y, \tag{33}$$

and

$$\frac{dy}{dt} = -\left(\gamma_I / 2 + + i\omega_0\right) y - g \quad \cos(\Omega t + \phi)x, \tag{34}$$

In addition to the atoms classical motions as a free wave-packet, the vacuum coupled system when excited, has two harmonic potentials related to the atoms motion and spontaneous emission process as in the following from Carmichael [89].

$$|\mu\rangle = \left(1/\sqrt{2}\right)\left(|0\rangle|+\rangle + i|1\rangle|-\rangle\right) \tag{35}$$

$$|l\rangle = \left(1/\sqrt{2}\right)\left(|0\rangle|+\rangle - i|1\rangle|-\rangle\right) \tag{36}$$

Vacuum Rabi atomic orbital splitting is the normal mode splitting of the coupled harmonic oscillators; one mode describing the atomic dipole and the other the cavity field mode. This system of coupled harmonic oscillation is extremely versatile and can be applied to describe Dirac vacuum cavity QED emission of the CBR when driven by the vacuum quantum mechanical stochastic field. Our application to the CBR is based on the work of Agarwal, 1991 and Carmichael, 1993 on the nature of stochastic driving fields in C-QED.

Starting with the Hamiltonian for a coupled harmonic oscillator

$$H(t) = \tfrac{1}{2}\left(p_A^2 + p_C^2\right) + \tfrac{1}{2}\omega_0^2\left(q_A^2 + q_C^2\right) + 2\omega_0 g\cos\left(\Omega t + \phi\right) q_A q_C, \tag{37}$$

where q_A, q_C, p_A, p_C are the coordinates and momenta of the one-dimensional oscillator; with the subscripts *A* and *C* referring to atomic dipole and cavity modes respectively of the Rabi/Rydberg atom in free space. The oscillator coupling is modulated by the Doppler frequency Ω,with phase ϕ modulating the dipole coupling constant for atomic motion; the equations of which take the form of equations (12) [89]. This has been a non-perturbative formalism much simpler to interpret than a QED perturbative expansion deemed sufficient for this stage of development.

15. Possibility of Blackbody Emission From Continuous Spacetime Compactification

It is also suggested that further development of the C-QED model of CBR emission could be extended to include spontaneous emission from the continuous dimensional reduction process of compactification. This would follow from modeling spacetime cavity dynamics in a manner similar to that in atomic theory for Bohr orbitals. As well-known photon emission results from electromagnetic dipole oscillations in boundary transitions of atomic Bohr orbitals. Bohr's quantization of atomic energy levels is applied to the topology of Spacetime C-QED boundary conditions in accordance with equation (1) where spacetime QED cavities of energy, E_i undergo continuous harmonic transition to a higher state, $E_j\left(> E_{iH}\right)$ (redshift-absorption mode) or to a lower state $E_k\left(< E_{iL}\right)$ (CBR-emission) according to the relation $h\nu = E_j - E_{iL} = E_{iH} - E_k$. Thus, we postulate that boundary conditions inherent in continuous standing-wave spacetime spin exchange cavity compactification dynamics of vacuum

topology also satisfy the requirements for photon emission. In metaphorical terms, periodic phases or modes in the continuous spacetime transformation occur where *future-past exciplex*[5] *states* act as *torque moments* of CBR/Redshift BB emission/absorption equilibrium.

In reviewing atomic theory Bohm, [59] states:

> *Inside an atom, in a state of definite energy, the wave function is large only in a toroidal region surrounding the radius predicted by the Bohr orbit for that energy level. Of course, the toroid is not sharply bounded, but* ψ *reaches maximum in this region and rapidly becomes negligible outside it. The next Bohr orbit would appear the same but would have a larger radius confining* ψ *and propagated with wave vector* $k = \rho / h$ *with the probability of finding a particle at a given region proportional to* $|\psi|^2 = |f(x,y,z)|^2$ *. Since* f *is uniform in value over the toroid it is highly probable to find the particle where the Bohr orbit says it should be* [59].

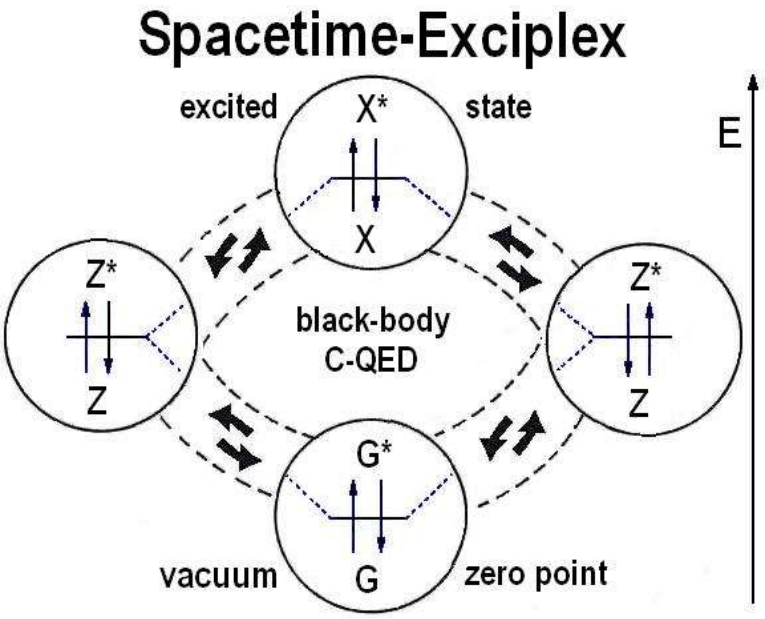

Figure 11. Geometric model for a spacetime C-QED black body Exciplex for red-shift-CBR absorption-emission equilibrium dynamics.

The general equations for a putative spacetime exciplex are:

[5] An exciplex (a form of excimer- short for excited dimer), usually chemistry nomenclature, used to describe an excited, transient, combined state, of two different atomic species (like XeCl) that dissociate back into the constituent atoms rather than reversion to some ground state after photon emission. An excimer is a short-lived dimeric or heterodimeric molecule formed from two species, at least one of which is in an electronic excited state. Excimers are often diatomic and are formed between two atoms or molecules that would not bond if both were in the ground state. The lifetime of an excimer is very short, on the order of nanoseconds. Binding of a larger number of excited atoms form Rydberg matter clusters the lifetime of which can exceed many seconds. Exciplex, an electronically excited complex of definite stoichiometry, 'non-bonding' in the ground state. For example, a complex formed by the interaction of an excited molecular entity with a ground state counterpart of a different structure. When if hits ground photon emitted Quasiparticle soliton

$$G^* + G^* \Leftrightarrow Z^*; \quad Z^* + m_\gamma \Leftrightarrow X^*$$

$$X^* - m_\gamma \xrightarrow{emission} Z^* \quad or G^* \tag{38}$$

$$X^* + m_\gamma \rightarrow Z^* \quad or \quad G^*$$

where G is the ZPF ground, Z black body cavity excited states and X the spacetime C-QED exciplex coupling. The numerous configurations plus the large variety of photon frequencies absorbed allow for a full black body absorption-emission equilibrium spectrum. We believe the spacetime exciplex model also has sufficient parameters to allow for the spontaneous emission of protons by a process similar to the photoelectric effect but from spacetime C-QED spallation rather than from metallic surfaces.

A torus is generated by rotating a circle about an extended line in its plane where the circles become a continuous ring. According to the equation for a torus, $\left[\left(\sqrt{x^2} + y^2\right) - R\right]^2 + z^2 = r^2$, where r is the radius of the rotating circle and R is the distance between the center of the circle and the axis of rotation. The volume of the torus is $2\pi^2 Rr^2$ and the surface area is $4\pi^2 Rr$, in the above Cartesian formula the z axis is the axis of rotation.

Electron charged particle spherical domains fill the toroidal volume of the atomic orbit by their wave motion. If a photon of specific quanta is emitted while an electron is resident in an upper more excited Bohr orbit, the radius of the orbit drops back down to the next lower energy level decreasing the volume of the torus in the emission process.

We suggest that these toroidal orbital domains have properties similar to QED cavities and apply this structure to *topological switching* during dimensional reduction in the continuous state universe (HAM) model [12,35]. To summarize pertinent aspects of HAM cosmology:

- Compactification did not occur immediately after a big bang singularity, but is a continuous process of dimensional reduction by *topological switching* in view of the Wheeler-Feynman absorber model where the present is continuously recreated out of the *future-past*. Singularities in the HAM are not point like, but dynamic wormhole like objects able to translate extension, time and energy.

- The higher or compactified dimensions are not a subspace of our Minkowski 3(4)D reality, but our reality is a subspace of a higher 12D multiverse of three 3(4)D Minkowski spacetime packages.

During the spin-exchange process of dimensional reduction by topological switching two things pertinent to the discussion at hand:

- There is a transmutation of dimensional form from *extension to time to energy*; in a sense like squeezing out a sponge as the current Minkowski spacetime package recedes into the past down to the Planck scale; or like an accordion in terms of the *future-past* recreating the present.

- A tension in this process (string tension, T_0 in superstring theory) allows only specific loci or pathways to the dimensional reduction process during creation of the transient Planck scale domain. Even though there are discrete aspects to this process it appears continuous from the macroscopic level (like the film of a movie); the dynamics of which are like a harmonic oscillator.

With the brief outline of HAM parameters in mind, the theory proposes that at specific modes in the periodicity of the Planck scale pinch effect, cavities of specific volume reminiscent of Bohr toroidal atomic orbits occur. It is proposed rather speculatively at present that these cavities, when energized by

stochastically driven modes in the Dirac ether or during the *torque moment* of excess energy during the continuous compactification process, or a combination of the two as in standard C-QED theory of Rabi/Rydberg spontaneous emission, microwave photons of the CBR type could be emitted spontaneously from the vacuum during *exciplex* torque moments. This obviously suggests that Bohr atomic orbital state reduction is not the only process of photon emission; (or spacetime modes are more fundamental) but that the process is also possible within toroidal boundary conditions in spacetime itself when in a phase mode acting like an atomic volume. A conceptualization of a Planck scale cavity during photon emission is represented in figure 1c with nine dimensions suppressed.

16. New Background Conditions of the Dirac Vacuum

If one assumes in conjunction with the de Broglie-Bohm-Vigier Causal Stochastic Interpretation (CSI) of quantum theory [4,6,22,97] that de Broglie matter-waves describe a wave-particle duality built up with real extended space structures with internal oscillations of particle-like spin, it is possible to justify Bohr's physical assumptions and predict new properties of a real Dirac covariant polarized vacuum [6,13].

Bohr's major contribution to modern physics was the model of photon emission-absorption in Hydrogen in terms of random energy jumps between stable quantum states and atomic nuclei. This discovery was one of the starting points for the Copenhagen Interpretation of quantum theory. We suggest this structural-phenomenology by general covariance applies equally as well to the symmetry conditions of the Dirac vacuum backcloth also; but as one knows the purely random description of quantum jumps suggested by Bohr is obviated by the CSI of quantum mechanics [4,6,22,98] suggesting this interaction is piloted. We feel the CSI interpretation is required for our exciplex model to work because it is the internal motion of a massive photon that enables coupling to the Dirac vacuum.

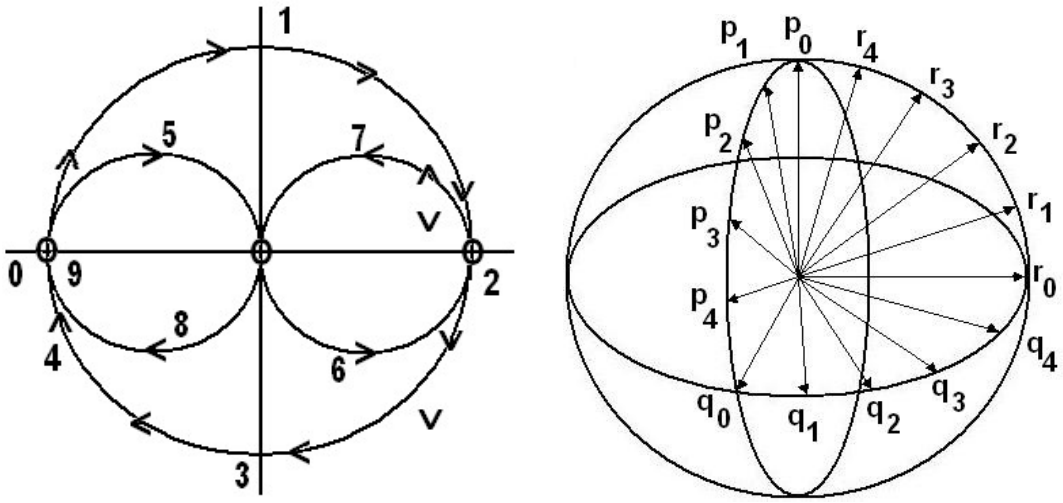

Figure 12. a) 2D simplistic view of 3D Dirac rotation map. b) 2D rendition of 4D view of Dirac hyperspherical rotation for raising and lowering the topological annihilation-creation vectors.

Some experimental evidence has been found to support this view [98,99] showing the possibility that the interaction of these extended structures in space involve real physical vacuum couplings by resonance with the subquantum Dirac ether. Because of photon mass the CSI model, any causal description implies that for photons carrying energy and momentum one must add to the restoring force of the harmonic oscillator an additional radiation (decelerating) resistance derived from the EM (force) field of the emitted photon by the action-equal-reaction law. Kowalski has shown that emission and

absorption between atomic states take place within a time interval equal to one period of the emitted or absorbed photon wave. The corresponding transition time corresponds to the time required to travel one full orbit around the nucleus. Individual photons are extended spacetime structures containing two opposite point-like charges rotating at a velocity near *c*, at the opposite sides of a rotating diameter with a mass, $m_\gamma \simeq 10^{-65} g$ and with an internal oscillation $E = mc^2 = h\nu$. Thus, a new causal description implies the addition of a new component to the Coulomb force acting randomly and may be related to quantum fluctuations. We believe this new relationship has some significance for our model of vacuum C-QED blackbody absorption/emission equilibrium.

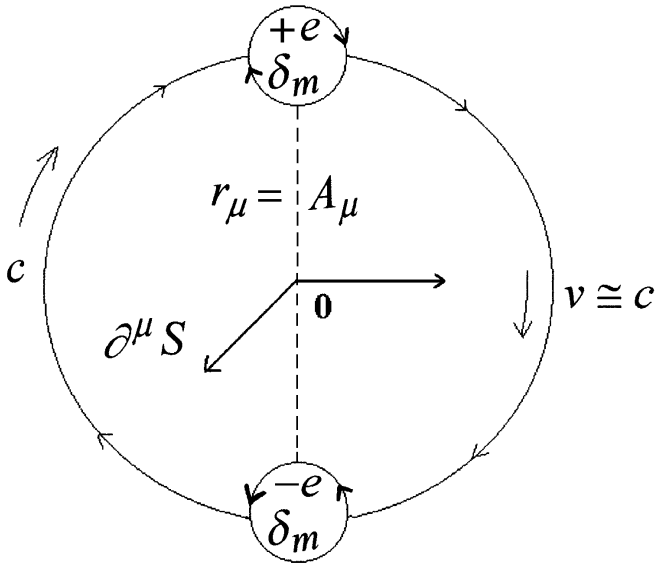

Figure 13 Rotating surface charges (Bumps and Holes) on the surface of the polarized Dirac ether signifying the integration EM and G. Compare Fig. 7.

The real ether has a covariant Dirac type stochastic surface regime with a distribution of extended photons which carry EM waves built with sets of such extended photons beating in phase; thus constituting subliminal and superluminal collective EM fields detected in the Casimir effect, so that a 'Bohr transition' with one photon absorption occurs when a nonradiating Bohr orbital electron collides and beats in phase with an ether photon. In that case a photon is emitted and Bohr electron's charge e^- spirals in one rotation in an atom towards a lower level. (But for CBR-redshift the exciplex charge topology undergoes instead a Dirac spherical rotation of 720° which allows a 'piloting' mechanism to control the BB equilibrium C-QED domain). Kowalski's calculations from the laser experiments have demonstrated such an orbiting charge can emit or absorb a photon within the transition time corresponding to the time interval needed to travel one full orbit [98] in terms of the CSI of quantum theory where electrons and photons are considered to contain extended structures in space and their interactions within extended time intervals.

We could think in way of an illustrative example of the high energy interaction of the photon in HAM cosmology along the lines of the Kaivaranan bivacuum model [100] but in general we consider the photon dipole as an element of the photon-graviton complex of the unitary field. We include reference to the Kaivaranian model because we think it is a good example of the richness of vacuum structure still little understood especially as we continue to study its HD Dirac properties. Wheeler considered 'charge as topology' where lines of force in a wormhole can thread through a handle and emerge through each mouth to give the appearance of charge in an otherwise charge free spacetime [101]. We include it as a lead in to Sect. 18 where since charge is topology, following our recalculation

of the Planck constant a richer exciplex structure could be developed to show a format for Dirac vacuum exciplex proton spallation.

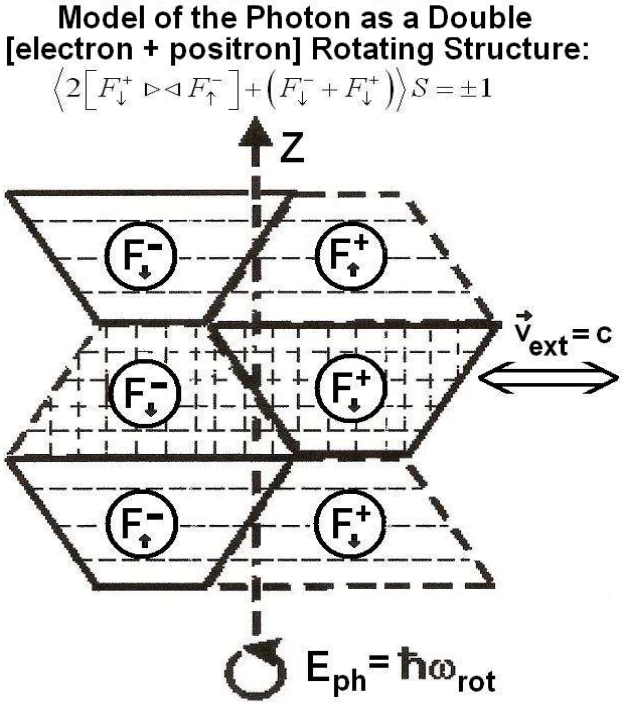

Figure 14. Model of the photon $\langle 2[F_{\downarrow}^{+} \rhd\lhd F_{\uparrow}^{-}]+(F_{\downarrow}^{-}+F_{\downarrow}^{+})\rangle S=\pm 1$, as result of fusion of electron and positron-like triplets of subelementary fermions. The resulting symmetry shift of such structure is equal to zero, providing the absence or very close to zero photon rest mass and its propagation in the vacuum with light velocity or very close to it in the asymmetric secondary Bivacuum [100]. Figure adapted from [100].

To summarize our conflict with the Copenhagen interpretation we reexamine Bohr's starting point for the emission and absorption of photons between jumps in stable atomic orbits in terms of the CSI to account for the recent experiments reviewed by Kowalski [98] which he interpreted to be based on extended structures in space and their interactions within extended time intervals with a real physical 'vacuum coupling' by resonance from a physically real Dirac aether which takes place during the time interval of orbit around the nucleus:

- That electrons like all other massive particles (including photons) are not point-like but extended spacetime structures in a physically real aether.
- That these structures contain internal harmonic oscillations of point-like quantum mechanical charges around the corresponding gravitational center of mass, Y_{μ} so that individual electrons or photons have different centers of mass and EM charge when particulate and piloted fields.
- That the Compton radius [102] of mass is significantly larger than the radius of the charge distribution.
- That the centers of charge, e, x_{μ} rotates around the center of mass, Y_{μ} with a velocity close to the velocity of light, *c* so that individual electrons (and photons) during the centroid anisotropic mass coupling moment – are real harmonic oscillators with de Broglie type internal oscillations. See Fig. 13.

- That individual photons are also extended spacetime structures containing two opposite point-like charges, $e^{\pm}$ rotating near the velocity of light, c at the opposite sides of a rotating diameter with a mass, $m_{\gamma} \simeq 10^{-65} g$ with an internal oscillation, $E = mc^2 = \hbar$.
- That the Dirac covariant polarized stochastic vacuum is a real aether distribution of these extended photons carrying EM waves built with sets of these extended photons oscillating in phase and thus constituting subluminal and superluminal collective EM fields detectable in the Casimir effect such that a Bohr transition with one photon absorption occurs when a non radiating Bohr orbital electron collides and beats in phase with an aether photon such that a photon is emitted and a Bohr electron's charge, e^- spirals in one rotation into the lower level.

In Kowalski's calculations the orbiting electron can emit or absorb a photon in the interval of one rotation [98]. We hope this discussion is sufficient for the reader to see that if these same atomic CSI conditions are applied to C-QED exciplex parameters (Fig. 11) black body absorption-emission redshift-CBR equilibrium entails the same processes.

17. Deriving the Topological Action Principle for CBR Emission

Well known forms of the Schrödinger equation central to quantum theory have correspondence to Newton's second law of motion, $\sum f = ma$; which is also chosen as the formal basis for HAM CBR emission theory. A more rigorous defense of the logic for this choice will be given elsewhere. Here only the postulate that CBR emission is governed by a unified electro-gravitation action principle is stated. Neither Newtonian $F = Gm_1m_2 / r^2$ (although it was derived from $f = ma$) nor Einsteinian gravitation, $G = 8\pi T$ is utilized for deriving the *advanced/retarded* description of CBR emission because the related structural-phenomenological boundary conditions of the cavities topology has no relation to classical dynamics which both of these theories do. Newton's gravitation law also contains a constant of undesired dimensionality; whereas $f = ma$ is without dimensionality. For similar reasons Einstein's gravity is also not chosen.

Since relativistic energy momentum and not mass is required, first we substitute Einstein's mass energy relation, $E = mc^2$ into Newton's second law and obtain: $F_{(N)} = E / c^2 a$. Where $F_{(N)}$ will become the unitary emission/absorption force and E arises from the complex self-organized electro-gravitational 'Geon energy' related to S_N of the HAM complex energy dependent Minkowski metric, $\hat{M}_4 \pm C_4$ as defined in the basic symmetry premises of HAM theory [12,35] where, $S_0 = \hat{M}_4$, $S_1 = -C_{4(ret)}$ and $S_2 = +C_{4(adv)}$ for the triune 12D least unit:

$$S_N = S_0 + S_1 + S_2 \tag{39}$$

E is scale invariant through all levels of HAM cosmology beginning at the highest level in the supralocal 12D Multiverse as a hyperdimensional Wheeler Geon [103] or 'ocean of light' of the unitary field. According to Wheeler a Geon is a ball of photons of sufficient mass that it will self cohere through gravitational action. At the micro level the Geon becomes synonymous with the E term and quantized as a unit of *Einstein's* , the fundamental physical quantity defined as a 'mole or Avogadro number of photons'. Next the equation is generalized for the HAM as derived from the work of [71].

Taking an axiomatic approach to cosmological scaling, such that all lengths in the universe are scale invariant, we begin with the heuristic relation that $c \equiv \dot{R}$ or $\dot{R} = l / t = c$ where $\dot{R}$ represents the rate of change of scale in the universe [71]. This corresponds to the Hubble relation for perceived expansion

of the universe where $H_0 = \dot{R}/R$ and $a = \dot{R} \times H_0$ or substituting $\dot{R}^2/R$. So continuing for final substitution we have $F_{(N)} = E/c^2 a = E/c^2 \times \dot{R}^2/R$. Since $c \equiv \dot{R}$ the c^2 & $\dot{R}^2$ terms cancel and we are left with:

$$F_{(N)} = \pm E/R_t \qquad (40)$$

Which is the unexpanded formalism for the fundamental unitary anthropic action equilibrium conditions as delineated in terms of string tension, T_0. It should be noted that R_t is a complex rotational length and could also be derived in terms of angular momentum, spacetime spinors, Penrose twistors, SUSY branes and most importantly as a complementarity of static-dynamic Casimir boundary conditions for mirror symmetry/brane duality at higher levels closer to domains described by conventional theory. But the derivation above is more fundamental to HAM CBR. The Hubble Einstein 3-sphere, a subspace in HAM cosmology (or Calabi-Yau dual 3-tori), is *covered* by the scale invariant hyper-geon (unified) field. The spin exchange mechanism of continuous dimensional reduction-compactification dissipates the putative heat predicted by gauge theory for the Planck scale BH backcloth [65,74].

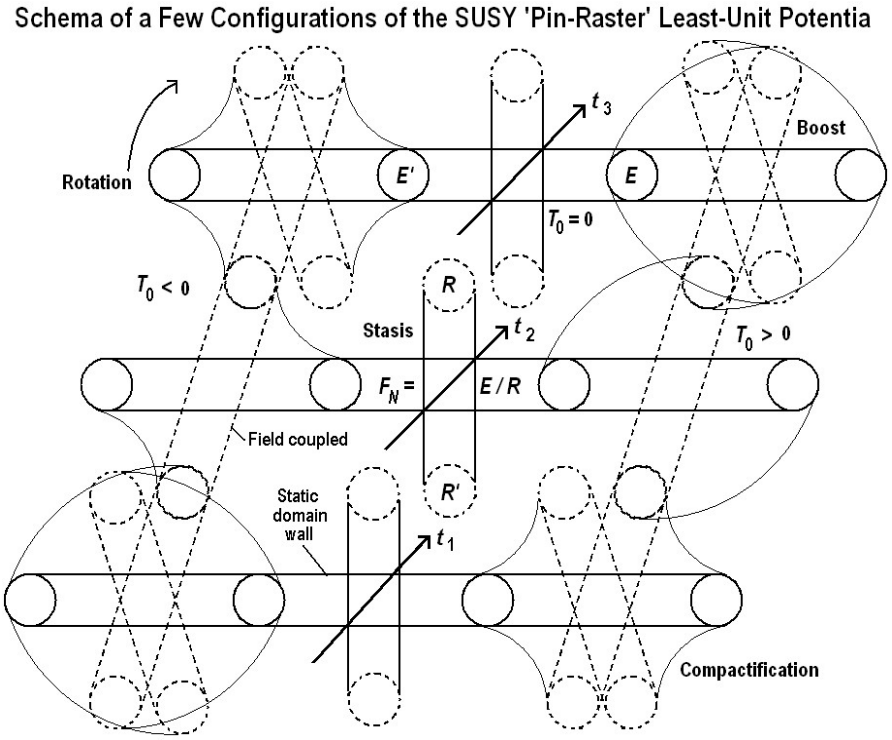

Figure 15. Geometric schema of the unexpanded noetic field equation. Where the central locus represents the x-axis. Loci where coupling is shown (superposed circles) would uncouple and recouple depending on whether the parallel transport mode of the cycle is at the deficit angle position or not.

The free energy for CBR emission during the periodic *exciplex* moment arises by parallel transport during continuous dimensional reduction. Spatial dimensions, by the boundary of a boundary = 0 condition (Bianchi identities) [104] , first parallel transport to temporal dimensionality, d_t [37] and then to noetic or anthropic unitary energy, $E_{(N)}$ [105] $d_s \rightarrow d_t \rightarrow E_{(N)}$ This boost concept is key to the completion of quantum theory and unifying geometrodynamics with unitarity.

18. A Putative Model of Exciplex Proton Nucleosynthesis

In recent decades four types of nucleosynthesis have been considered: 1) Big Bang nucleosynthesis during the putative first three minutes of creation, 2) Stellar fission/fusion nucleosynthesis, 3) Explosive Supernova nucleosynthesis and 4) Cosmic ray spallation against the interstellar medium of gas and dust mostly by high energy protons. Spallation is also known to occur in meteor rock, the Earth's atmosphere and lava [106-117]. Here we introduce a 5th form of gentle nucleosynthesis by spacetime exciplex spallation utilizing the Vigier causal stochastic interpretation of quantum theory because of its legitimacy in dealing with the internal motion and structure of matter [4,6,22]. 3/4 mass of universe is attributed to hydrogen. If the Big Bang is incorrect as we and a few other cosmologists propose, there must be a mechanism for the 'creation' of protons [117-119].

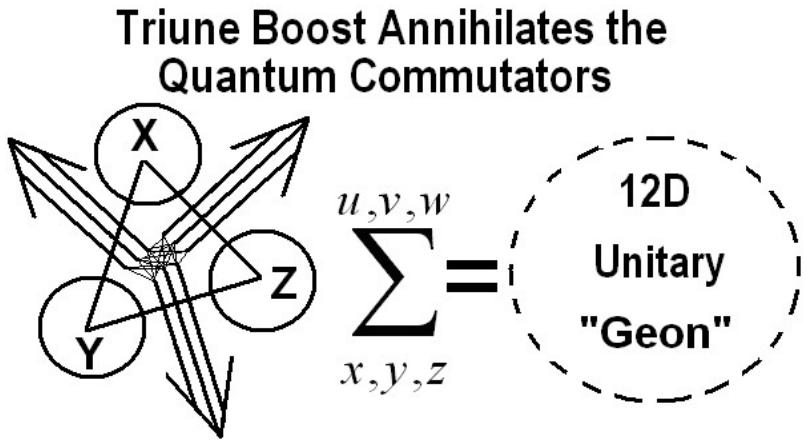

Figure 16. The continuous-state boost of $s \leftrightarrow t \leftrightarrow e$, signifying a new set of Noetic Transformations beyond the Lorentz-Poincairé where states that ordinarily do not commute are able to commute in the HD regime.

Chatterjee and Banerjee have developed an XD model for Hoyle and Narlikar's C-field cosmology [118]. Hoyle and Narlikar added an additional term to Einstein's field equations to introduce the C-field

$$R_{ik} - \frac{1}{2} g_{ik} R = -8\pi \left({}^{m}T_{ik} + {}^{C}T_{ik} \right) \qquad (41)$$

where ${}^{C}T_{ik}$ is the C-field term,

$${}^{C}T_{ik} = -f \left(C_i C_k - \frac{1}{2} g_{ik} C^{\alpha} C_{\alpha} \right), \qquad (42)$$

but Hoyle and Narlikar [119] formalized their C-Field with a negative energy density that drives expansion of the universe and is therefore not compatible with continuous-state HAM cosmology. For interest to HAM cosmology Chatterjee and Banerjee find a spontaneous compactification process in their HD derivation of C-field solutions utilizing the $\dot{R}$ scaling factor key to the continuous-state of HAM cosmology; but they also align their formalism with an expanding universe. Another point of interest of the Chatterjee and Banerjee model [118] is that introduction of the C-Field is not *ad hoc* as in the Gold and Bondi or Hoyle and Narlikar models by the compactification process that also allows for the HD conservation of matter. We do not have time to develop this model to a rigorous formalism for this volume, but we hope to or that other works will utilize the richness of the exciplex paradigm to complete the model. The other factor we have ignored in this discussion is that the oscillation of

Planck's constant up to the size of the Larmor radius of the hydrogen atom provides many additional C-QED parameters for this work especially when the plethora of SUSY parameters enter the picture. And don't forget the new noetic transform…

19. Summary and Conclusions

An anisotropic photon rest mass calculated from both the WFA of classical GR, and the Einstein-de Broglie relationship confirms the Vigier hypothesis of $m_\gamma \neq 0$. Photon zero-point coupling, as required by quantum gravity, has major cosmological implications obviating the big bang by removing the need for an initial singularity in time and still preserves gauge. The GP is equalized by compactification, enabling rigorous calculation of the cosmological constant revealing the arrow of time. Unitarity by its nature must provide pervasive application.

When the CBR was discovered it was interpreted as definitive proof that the Big Bang was the correct model of creation. However, the same observational data may be also interpreted in the manner here. HAM Gravity, which models compactification as a rich dynamic hyperstructure provides an inherent mechanism to balance the GP in a *static universe* where the CBR is not a remnant of adiabatic inflation but intrinsic to the equilibrium conditions of Planck scale spacetime CQED or CSED.

A preliminary formalism for CBR-emission and *tired-light* redshift-absorption as BB equilibrium from the continuous state topological dynamics of the Dirac vacuum in a HAM has been presented. This has taken two possible forms:

1. A stochastically driven C-QED effect on Eddington free space Rabi/Rydberg atoms coupled to vacuum zero-point field fluctuations.

2. A composite *exciplex* of advanced - retarded spacetime topological cavity modes which may act as an atom-cavity « molecule » formed on the basis of gravito-quantum coherence effects by unitary action of $F_{(N)}$. Both postulated by only two new theoretical concepts, from already observed CQED effects in the laboratory:

- A Dirac type vacuum coupling between the atom and vacuum cavities of the structure of spacetime itself, and

- CBR photon emission can also occur from the Bohr-type boundary conditions of spacetime topology without the presence of an atom with *E* transport by topological switching in D-reduction of $d_s \rightarrow d_t \rightarrow E_{(N)}$.

BH's have been demonstrated by Hawking to emit BB radiation in the quasiclassical limit, and the lower limit has been shown to be the Plank, mass providing a firm theoretical foundation for intrinsic vacuum emmitivity. A non-inflationary origin of CBR obviates the Big Bang requiring reinterpretation of the standard cosmological model with profound implications for the future of cosmological theory.

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