AWARENESS: PHYSICAL COSMOLOGY OF THE FUNDAMENTAL LEAST UNIT

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"Time and space are modes by which we think and not conditions in which we live." -- Albert Einstein, 1941

Abstract. Awareness is introduced as a fundamental physical quantity. The context for defining awareness is an advanced form of Einstein's model of a static universe, called the Continuous State Conscious Universe (CSCU). The new cosmology is based on principles of the Wheeler-Feynman absorber theory of radiation extended to the topology of a periodic 12D spacetime. The fundamental *least unit of awareness* is shown to be a scale invariant complex cosmological system. Time arises naturally as a 'beat frequency' in the translating boundary conditions of a spin exchange 'continuous state' dimensional reduction compactification process. A new set of Noetic transformations beyond the Galilean and Poincare-Lorentz are called for to show how the macroscopic nature of awareness arises from microscopic action principles inherent in the Dirac polarized vacuum. The inherent topology of the Noetic transformations are derived by coupling superluminal Lorentz boosts with noncompactified Kaluza-Klein theory in the context of an energy dependent spacetime metric.

Keywords: Awareness, Consciousness, Kaluza-Klein theory, Superluminal boosts

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1. Introduction

The standard model for a living system, biological mechanism, presumes that life can be completely described by parameters of chemistry and physics. In general this biological naturalism is described by quantum theory which deals with the mechanics of atomic and related systems. Quantum theory is described formally by the Schrodinger equation which takes myriad forms, but simply equation (1)

$$ih(\partial\psi / \partial t) = H\psi \tag{1}$$

describes the action of a particle on a manifold. But the founding fathers of quantum theory said the standardized Copenhagen interpretation was incapable of describing biological systems. Therefore the bulk of this paper is devoted to developing the proper cosmological framework for introducing a fundamental definition of awareness.

1.1 EUCLIDIAN / MINKOWSKI GEOMETRY AS THE BASIS FOR REALITY

The Euclidian line is assumed to be the real line [1] because it is what is observed. Logical reasons from supersymmetry and supergravity suggest there are a number of additional unobserved dimensions [2] leaving the issue of dimensionality as an open question. Euclidian space in classical Newtonian terms is a continuous 3D absolute space with time an independent parameter.

Einstein's theories of relativity provided a discrete 3(4)D transmutable relational spacetime manifold. The debate between absolute space or substantivism and relational space still continues. Utilizing the standard definition of a straight line as the intersection of two rigid planes, measurements could be taken to observe whether the angles of a triangle add up to 180°; but settling the question definitively would require astronomical scale measurements where it appears physically impossible to apply the concept of a rigid body or to define a straight line in terms of a light ray by stellar parallax because of the effects of general relativity. Therefore all physics knows with certainty at the present time is that observed space is approximately Euclidian as is Minkowski space [1, 36].

According to the proof of Schoenflies theorem [10] there can be no topological knots in a plane. Therefore there can be no torsion in a 2D reality; thus the real line must be at least 3D Euclidian where the standard Pythagorean line element is

$$ds^2 = dx_1^2 + dx_2^2 + dx_3^2 \tag{2}$$

This assumption that the Euclidian line is the real line is intuitive. Currently there is no known method of empirical proof; and since the Euclidian line is what the Human mind apprehends it remains the formal basis for all scientific fact [1, 23]. But this assumption remains profoundly problematical with issues stemming from both the foundations of mathematics and the nature of physical theory itself concerning the fundamental basis for sets, discreteness versus continuity, geometry and topology, and the relationship of real numbers to rational numbers for example [1].

In general, the class of theories unifying gauge and gravitational fields by utilizing extra dimensions is called Kaluza-Klein theories. In these theories spontaneous symmetry breaking by coordinate transformation in five dimensions is a product of the standard four-dimensional transformation and a local U(1) gauge group arising in basic form in a general relativistic framework of five dimensions described according to the Einstein-Hilbert action

$$A = \int d^5 x \sqrt{g} R. \tag{3}$$

Where instead of postulating a five-dimensional Minkowski space M^5 as the ground state, the ground state is taken to be the product $M^4 \times S^1$ where the circle S^1 is a U(1) group of rotations [2]. In conventional supersymmetry models the radius of circle S^1 is considered to be microscopically small on the order of the Planck scale $(10^{-33} cm,\ 10^{-43} s)$, very short and very fast, explaining why these extra dimensions are not observed. This will be discussed in more detail below where Planck's constant is recalculated utilizing the Larmor radius as it relates to non-compactified Kaluza-Klein theory.

An SU(3) x SU(2) x U(1) gauge symmetry group can be used to describe all known particle interactions. Following Witten, [2] the minimum number of dimensions of a manifold with this symmetry is seven. In this SU(3) x SU(2) x U(1) symmetry group gauge fields arise in the gravitational field as components of more than four dimensions. This yields a dimensionality for our reality of at least four non-compact and seven compact spacetime dimensions, $M^4 \times S^7 = 11D$, which Witten [2] calls a remarkable numerical coincidence since this eleven dimensional maximum for supergravity is the minimum for SU(3) x SU(2) x U(1) symmetry which also for symmetry reasons observed in nature is in practicality the largest group one could obtain from Kaluza-Klein theories in seven additional dimensions.

This gauge group for gravitational field components is insufficient to describe nature; for a complete theory quarks and leptons plus a Higgs type mechanism triggering symmetry breaking must be added to the Kaluza-Klein framework. In attempting to complete the theory, the gauge coupling constants are determined by calculating the Einstein action over the compact dimensions. This scales at a high power of $1/(M_p R)$, where M_p is the Planck length and *R* is the radius of the extra dimensions showing that *R* must actually be in the $10^{-33} cm$ range for these standard model gauge theories. If one adds the Lagrangian of a cosmological constant Witten finds one can form a reasonable theory [2].

Although only introduced in a preliminary form here, a different view is required by noetic theory because the Einstein gauge is both classical and incomplete. Noetic cosmology like any new theory must however bear correspondence to the established Einstein gauge. The existing derivation of Planck's constant represents classical mathematical limits only and are not actual physical limits in CSCU cosmology. Since the Higg's mechanism also arises from the Einstein gauge it must also be called into question and be replaced by another mechanism when the noncompactified form of Kaluza-Klein theory is utilized.

1.2 SPACE: RELATIONAL VS ABSOLUTE

The conceptual disparity regarding the fundamental nature of space arises in terms of correspondence between the Newtonian worldview of a continuous Absolute Space (AS) that is in opposition to the current Einsteinian view of discreteness of the spacetime manifold. This debate about the nature of space has continued at least since Aristotle. Einstein in his last published statement regarding the nature of space and time said:

> "The victory over the concept of absolute space or over that of the inertial system became possible only because the concept of the material object was gradually replaced as the fundamental concept of physics by that of the field...The whole of physical reality could perhaps be

represented as a field whose components depend on four space-time parameters. If the laws of this field are in general covariant, then the introduction of an independent (absolute) space is no longer necessary. That which constitutes the spatial character of reality is then simply the four-dimensionality of the field. There is then no 'empty space', that is, there is no space without a field." [18].

Einstein's view is a form of the *relational theory* of space introduced initially by Leibniz and Huygens [31,32]. Relationalism is in opposition to *substantivalism* which gives space the ontological status of an independent reality as a kind of *substance* [31]; the Newtonian concept of absolute space being the prime example.

Finding the founding fathers of quantum theory credible in their declaration that the standard model is incapable of describing biological systems; means awareness can only be defined adequately by extending all the standard models since they are so intertwined. This means that:

- The standard cosmological model - the Bigbang is insufficient.
- The standard mechanistic model of biological naturalism is inadequate.
- The standard Turing model of computation is inadequate.
- The standard model of gravitation is insufficient.
- The standard Copenhagen phenomenological model of quantum theory is inadequate.
- The standard model of electromagnetism is inadequate.
- The standard cognitive model of neuroscience is also insufficient.

This criticism does not mean these seven models are wrong; only that they go part way. The focus here is primarily on the cosmological model as it is the core of the problem. The required parameters of the post Bigbang universe will be stated axiomatically for simplicity. The domain of the Bigbang is defined in terms of the Hubble radius for the large-scale structure of the universe and the Planck scale for the microscopic. The large-scale observational limit according to Bigbang philosophy is caused by the Doppler effect on light propagation due to the recessional velocity of expansion of the universe. This observational limit occurs where light becomes attenuated by the redshift.

The Hubble radius remains an observational limit in Continuous State Conscious Universe (CSCU) cosmology also but is not caused by the Doppler effect. It is due to a minute non-zero rest mass for the photon [4,5]. As a photon propagates it couples to the polarized Dirac vacuum and loses energy also attenuating to zero observability; but if one were able to travel to the Hubble limit observation would extend for another Hubble radius ad infinitum. Thus a critical difference in interpretation of redshift – a physical limit for the Bigbang and an observational illusion in CSCU cosmology.

Einstein by the introduction of special and general relativity replaced the absolute 3D Newtonian continuum with a discrete 3(4)D relational spacetime manifold. This space can still be interpreted as a potential Bigbang space terminating at the impenetrable Planck backcloth of stochastic foam. Noetic cosmology changes the interpretation of this limit. The Planck barrier is a virtual mathematical barrier to Fermions as the present recedes into the past.

The CSCU [5] is a megaverse with the potential for an infinite number of nested Hubble spheres in causal separation and thus with their own laws of physics [16]. In the Bigbang the extra dimensions laid down at the beginning of time are curled up at the Planck scale as a compactified subspace. In the Noetic CSCU cosmology the opposite is true. A new form of HD Absolute Space (AS) projects a periodic 11(12)D space. The standard observed relational Einstein reality, 3(4)D M^4, is a subspace of the 11(12)D space projected from this new AS. An extension of the Wheeler-Feynman absorber theory of radiation [20] is utilized to define an eternal *present* as a standing wave of the *future-past* that is 'covered' at each level of scale by a HD Wheeler Geon (Wheeler, 1955) or ball of light. This HD Noetic light field filling the immensity of subspace is the unified field that acts as gravitation, the vital force, and light of the mind. As will be derived below this action principle can be described by a simple fundamental Noetic equation $F_{(N)}$ = E / R [5,21,28]. This complex least unit explains the utility of the 12D space. All this will be discussed in detail in ensuing sections.

The world lines of relational space are virtual extensions created and recreated harmonically by the torsion of the continuous compactification process. Therefore instead of a rigid impenetrable Planck barrier covered by a stochastic foam of particle creation and annihilation, CSCU cosmology has an ordered / open spacetime with a complex hyperstructure that is closed and finite in time for fermions, but open and infinite atemporally for bosons. In the CSCU, stochasticity, i.e. string or brane dynamics, arises in the wake of unitary graviton propagation guiding the dynamics of the continuous state. The Noetic graviton, is a quadrupole photon complex confined to the spacetime metric like quarkonium and described elsewhere [12]. The Planck singularity $(10^{-33}\,cm),\ 10^{-43}\,s$ is *virtual*, a geometric orientation that arises as the present recedes into the past [5].

1.3 OVERVIEW OF THE FORMALISM FOR NOETIC COSMOLOGY

Noetic Cosmology is cast in a 12D harmonic superspace $S_N = S_0 + S_1 + S_2$ in the context of an extended Wheeler/Feynman absorber theory [15] where standard Minkowski space M_4 is a 'standing wave' of the future-past. This takes the general form

$$R^{S_{N0}}_{symM_4} = \frac{1}{2}\left[R^{S_{N1}}_{retC_4} + R^{S_{N2}}_{advC_4}\right] \tag{4}$$

or simplistically stated the 12D noetic superspace S_N represents a complex Minkowski metric $M_4 + C_8$ (or $\pm C_4$). S_N thus combines the standard M_4 four *real* dimensions (D) plus 8 imaginary D representing a *retarded* and *advanced* complex hyperspace topology which adapts the complex ($M_4 + C_8$) Minkowski metric from the standard stationary form to a periodic form. $S_0 = M_4$ represents the noetic 3(4)D 'standing wave' Minkowski 'present' spacetime; $S_1 = -C_{4(ret)}$ represents the past component and $S_2 = +C_{4(adv)}$ represents the future for complex correspondence to the standard 4 real dimensions utilizing 8 imaginary dimensions. The 8 imaginary dimensions, while not manifest generally (locally) on the Euclidean real line, are nevertheless 'physical' in the CSCU and can be represented by complex coordinates

$$X = \pm(x + i\xi), Y = \pm(y + i\eta), Z = \pm(z + i\zeta) \quad \text{and} \quad t = \pm(t + i\tau)$$

designating correspondence to real and retarded/advanced continuous spacetime transformations. For symmetry reasons the standard Minkowski line element metric $ds^2 = g_{ij}dx^i dx^j$ is expanded into periodic *retarded* and *advanced* topological elements fundamental to relational space 'extension' giving Noetic Superspace S_N its continuous state dimensional reduction standing wave periodicity. This is illustrated conceptually in Fig. 1 below.

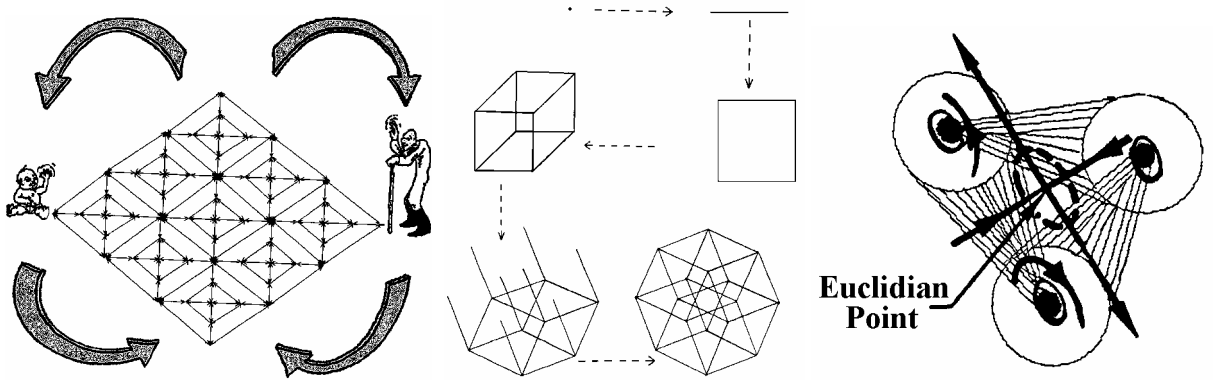

Figure 1. Basic topological premises of Noetic Cosmology shown by three different conceptual views representing the least cosmological unit: a) The baby and old man represent the *relational* periodic basis of spacetime by applying extended Wheeler/Feynman absorber theory where the present is a standing wave of the future/past. b) The 12D harmonic superspace translates in a continuous state dimensional reduction compactification process. c) A 3-torus illustrating a virtual standing wave 'creation' of a discrete virtual Euclidian point; a different conceptual view of figure 1a and 1b. This Noetic 'least unit' represents a Wheeler/Feynman future/past periodicity and a continuous cycling of *classical* $\rightarrow$ *quantum stochasticity* $\rightarrow$ *fundamental unitary* ($R_C \rightarrow R_Q \rightarrow R_U$) in the D reduction compactification $D_s \rightarrow D_t \rightarrow D_E$ transformation process [5].

The Kaluza-Klein model utilized is set in a noncompactified D = 12 harmonic Noetic Superspace S_N since it is the foundation of a conscious universe. For symmetry reasons shown in the text this superspace is comprised of an 11D

hypersurface in a 12D universe, giving it theoretical correspondence to 10D superstring theory and 11D supergravity and providing a context to solve the disparity between them. The general appeal of the Kaluza-Klein model is that physics seems simplified in HD, especially integration of the electromagnetic (EM) and gravitational field.

Kaluza's initial demonstration of gravity in 5D, ${}^5G_{AB} = 0$ with *AB* running from 0 to 4 contained 4D General Relativity with an EM field ${}^4G_{\alpha\beta} = {}^4T^{EM}_{\alpha\beta}$, with α, β running from 0 to 3 [3]. The currently less common non-compactified Kaluza-Klein model is utilized by Noetic Cosmology where also dependence on the extra D is required; this yields the same result for Einstein's equations ${}^5R_{AB} = 0$ except that the *EM* energy momentum tensor ${}^4T^{EM}_{\alpha\beta}$ is replaced by a general one ${}^4T_{\alpha\beta}$ instead [3].

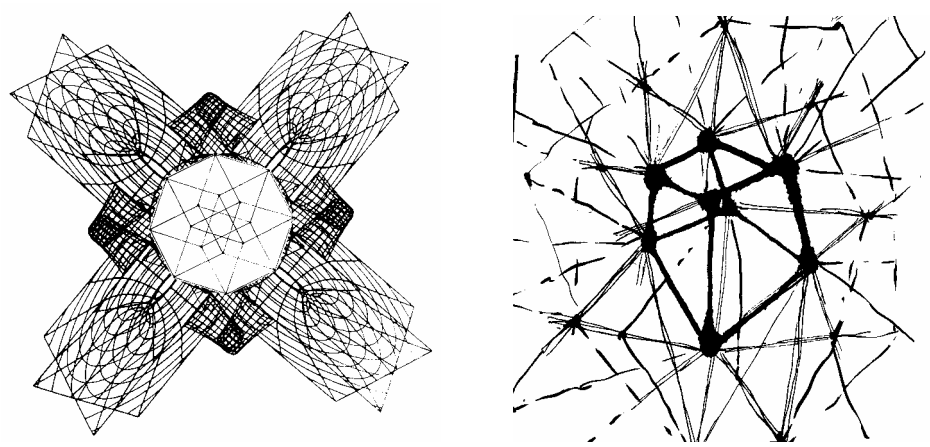

Figure 2. Two additional conceptual views of Fig. 1. a) represents a snapshot in time. The central hypersphere represents the atemporal hidden HD covering the standing wave present. The larger peripheral tubes represent open orientation toward the future; and the narrower coupled tube forming a square represents a phase of recessional compactification toward the past, the final phase of which would end up like that of Fig. 1c – a virtual Planck scale singularity. This figure hints at why the Planck constant needs to be recalculated. Related to the past – the resultant of measurement, the Planck constant apples as usual. In the *eternal now*, the Planck constant takes the form of the Larmor atomic radius and is an unbounded component of the unitary field in the future orientation. Fig. 2. b) conceptualizes the relational nature of Minkowski space emerging from the polarized vacuum.

Periodic Noetic superspace S_N entails a continuous state of dimensional reduction that operates under transformations beyond the Poincaire / Lorentz where spatial dimensions D_S through superluminal boosts are transformed in to temporal dimensions D_t and further in terms of a noncompactified Kaluza-Klein model [2,3] into energy dimensions D_E by $D_S \to D_t \to D_E$. This requires the properties of an energy dependent spacetime metric first developed by Einstein where standard Minkowski space M_4 is a topologically invariant homeomorphic manifold of an energy dependent spacetime metric $\hat{M}_4$

$$f : M_4 \to \hat{M}_4 \tag{5}$$

According to the principle of relativity a spacetime region which is a 'perfect vacuum' (no matter and no fields) must be isotropic and covariant in the Lorentz sense [15]. The deformed region $\hat{M}_4$ of S_N and the symmetry of S_N itself reduces to the Einstein relativistic metric and is assumed compatible with a polarized Dirac vacuum.

1.4 TRANSFORMATION OF SPACE INTO TIME

It is well known that Superluminal Lorentz Transformations (SLT) change real quantities into imaginary ones. Following Cole [22] and Rauscher [17] we illustrate the transformation of complex spatial dimensions into temporal dimensions by orthogonal superluminal boosts (SLB). For example an SLB in the *x* direction with velocity $v_x \pm \infty$

the SLT is $x' = \pm t,\ y' = -iy,\ z' = -iz,\ t' = x.$ In complex Minkowski space the coordinates are $z^u = x^u_{\mathrm{Re}} + ix^u_{\mathrm{Im}}$ where z is complex and x_{Re} and x_{Im} are real and the index u runs over 0,1,2,3. Using classical notation for simplicity

$$t = t_{\mathrm{Re}} + it_{\mathrm{Im}},\ x = x_{\mathrm{Re}} + ix_{\mathrm{Im}},\ y = y_{\mathrm{Re}} + iy_{\mathrm{Im}},\ z = z_{\mathrm{Re}} + iz_{\mathrm{Im}}. \tag{6}$$

To clarify the meaning of imaginary quantities in an SLT it is helpful to represent time as a 3D vector $t_x,\ t_y,\ t_z$; therefore time is defined as $t = t_x\hat{x} + t_y\hat{y} + t_z\hat{z}$ where

$$t_x = t_{x\,\mathrm{Re}} + it_{x\,\mathrm{Im}},\ t_y = t_{y\,\mathrm{Re}} + it_{y\,\mathrm{Im}},\ t_z = t_{z\,\mathrm{Re}} + it_{z\,\mathrm{Im}} \tag{7}$$

Finally for the SLB for velocity $v_x \pm \infty$ along x the transformations are

$$\begin{aligned} &x'_{\mathrm{Re}} + ix'_{\mathrm{Im}} = t_{x\,\mathrm{Re}} + it_{x\,\mathrm{Im}},\ y'_{\mathrm{Re}} + iy'_{\mathrm{Im}} = y_{\mathrm{Im}} - iy_{\mathrm{Re}},\ z'_{\mathrm{Re}} + iz'_{\mathrm{Im}} = z_{\mathrm{Im}} - iz_{\mathrm{Re}} \\ &t'_{x\,\mathrm{Re}} + it'_{x\,\mathrm{Im}} = x_{\mathrm{Re}} + ix_{\mathrm{Im}},\ t'_{y\,\mathrm{Re}} + it'_{y\,\mathrm{Im}} = t_{y\,\mathrm{Im}} - it_{y\,\mathrm{Re}},\ t'_{z\,\mathrm{Re}} + it'_{z\,\mathrm{Im}} = t_{z\,\mathrm{Im}} - it_{z\,\mathrm{Re}} \end{aligned} \tag{8}$$

where the SLT in x of M_4 spacetime transforms real components into imaginary and imaginary complex quantities into real quantities as one major property of the periodic nature of Noetic CSCU spacetime [17, 22].

1.5 ENERGY DEPENDENT SPACETIME METRIC

Einstein originated the concept of an energy dependent spacetime for explaining temporal rate change in the presence of a gravitational field by generalizing the special relativistic line element (compare equation 2)

$$ds^2 = (1 + 2\phi / c^2)c^2dt^2 - dx^2 - dy - dz^2 \tag{9}$$

with the introduction of time curvature [14] where ϕ is the Newtonian gravitational potential. This utilizes the deformed Minkowski metric $\hat{M}_4$ (introduced above by eq. 5) which is imbedded in the periodic HD Noetic space chosen axiomatically for CSCU cosmology to take the form of a noncompactified Kaluza-Klein theory [2,3].

Kaluza's initial demonstration of gravity in 5D, ${}^5G_{AB} = 0$ with *AB* running 0,1,2,3,4 contained 4D General Relativity with an EM field ${}^4G_{\alpha\beta} = {}^4T^{EM}_{\alpha\beta}$, with α, β running 0,1,2,3 [17]. The currently less common non-compactified Kaluza-Klein model is utilized by Noetic Cosmology where also dependence on the extra D is required; this yields the same result for Einstein's equations ${}^5R_{AB} = 0$ except that the *EM* energy momentum tensor ${}^4T^{EM}_{\alpha\beta}$ is replaced by a general one ${}^4T_{\alpha\beta}$ instead [17]. Sections 1.6 & 1.7 demonstrate the feasibility of an energy domain pervading HD spacetime with properties similar to Wheeler's Geon proposal discussed in section 1.6 below. In a generalized deformed spacetime metric $\hat{M}_4$, spacetime is fixed by the energy and has the metric

$$\eta(E) = diag.(a(E),\ -b(E),\ -c(E),\ -d(E)). \tag{10}$$

1.6 THE WHEELER GEON CONCEPT

Wheeler [20] postulated a photonic mass of sufficient size to self cohere into a spherical ball of light. In Wheeler's notation the Geon is described by three equations. The first (11) is the wave equation, followed by two field equations the first (12) of which gives a mass distance relationship and the second (13) variation of the factor *Q*:

$$d^2 f / d\rho^{*2} + [1-(l^* Q/\rho)^2 (1-2L/\rho)] f = 0 \tag{11}$$

with circular frequency $c\Omega$ related to the dimensionless radial coordinate $\rho = \Omega r$
such that $d\rho^*$ is the abbreviation for $d\rho^* = Q^{-1}(1-2L/\rho)^{-1} d\rho$

$$dL/d\rho^* = (1/2Q)[f^2 + (df/d\rho^*)^2 + (l^* Qf/\rho)^2 (1-2L/\rho)] \tag{12}$$

$$dQ/d\rho^2 = (\rho - 2L)^{-1}[f^2 + (df/d\rho^*)^2] \tag{13}$$

L and *f* are mass and field factors respectively; *Q* is a scale correction factor. The factor *l* relates to a family of modes with distinct frequencies associated with the well known completeness theorem of spherical harmonics. HD extended modes of *l* are key elements in propagation of the noetic field; discussed in future works but alluded to in [5, 6]. Wheeler states that these equations permit change of distance scale without change of form [20] which is compatible with the Noetic action principle F_N = E/R derived in section 6 [12,28, 38].

1.7 THE HYPER-GEON DOMAIN OF CSCU FIELD THEORY

As summarized in 1.6 above Wheeler defined the Geon as theoretical classical spacetime construct not yet observed in nature. A complex Hyperdimensional Geon is postulated to *cover* our observed 3(4)D relational spacetime. This is described by a new set of Noetic transformations for CSCU cosmology [28,38]; acting on all levels of scale from the Einstein/Hubble radius to the Planck scale. Because of its contact with the megaverse it relates also to the cosmological constant Λ and is the dark energy responsible for the missing dark matter effecting galaxy rotation [5]. It also forms the lower energy boundary of a projected 12D space making it synonymous with the unified field. This unitary Noetic field is the origin of the teleological action principle [5,28]. This coalesced region of nonlocal photon-gravitons – The hyper-geon cover acts as:

- Gravitation (The graviton in CSCU cosmology is a confined quadrupole photon $\hat{M}_4$ complex; thus teleological action of the unified field orders the large scale structure of the universe – which is a non-Darwinian guided evolution)
- Causal action of the quantum potential or pilot wave (An additional causal action principle pertinent extended quantum theory)
- *Élan vital* or life force (The long sought vital principle required to legitimize dualism / interactionism)
- "light' of the mind (Bosonization of the Eccles psychon as it couples to dendrons etc to become qualia)

2.0 The Complementarity Of Physical Time And Conscious Time

Now that some cosmological properties are worked out it is easier to show the relationship of physical time to conscious time. All arrows of time reduce to the spacetime topology of the polarized vacuum [6]. From within the microscopic action of the complex hierarchical cosmology of the least unit of awareness, macrophysical phenomena, which include thermodynamic processes, appear asymmetric because of a complementarity of boundary conditions related to human awareness and other physical conditions. There is no preferred temporal direction in the microphysical laws of physics. When this atemporality is reduced to the temporal domain (when it becomes a subspace) many parameters are subtracted out through the symmetry breaking of the spin exchange compactification process occurring at the speed of light. But this microscopic annihilation governed by teleological causality produces an orthogonal summation creating the macroscopia of perception. The velocity *c* of the reduction / compactification receding from the present has a discrete microscopic beat frequency which we perceive macroscopically as continuous.

First we will clarify the conceptual suggestion by Franck [24] that an eternal now occupies the center of awareness. Similar to physical concepts like 'charge' we assume that awareness is a fundamental physical principle [28,30] which is associated with the concept of the 'least unit' in CSCU cosmology developed in section 1. The Noetic *least unit* is a microcosm of the whole universe where the Noetic Transform is in continuous operation.

Information passes from M_4 through SLT-Kaluza-Klein boosting into the 12D Hyper-Geon domain in both directions in the context of the extended Wheeler-Feynman future/past.

If we utilize the metaphor of a movie theater to describe the structural phenomenology of the mind / body and apply Huygen's principle of wave train addition in a manner similar to how sunlight shines through discrete raindrops summating into the smooth image of a rainbow, we can begin to understand the human psychosphere [37,39]. The psychosphere is the standing wave light cone surface of human awareness impinged by qualia. It is not confined to the brain; but occupies the total boundary conditions of the human mind-body that extends from the Euclidian brain occupying M_4 to the limits of the HD Noetic Geon. There is a complementarity between these two domains of the human psychosphere. Fermi-Dirac statistic describe the temporal dynamics in the M_4 brain / body region and Einstein-Bose statistics describe the atemporal HD domain applicable to the Noetic hyper-geon. This is the CSCU view of Franck's 'eternal now'. The two domains are mediated by the noeon of the unitary noetic field.

2.1 RASTER OF CONSCIOUSNESS – A JACOB'S LADDER MOVIE THEATER

The M_4 domain is described by the phenomenological Copenhagen interpretation of quantum theory where collapse of the wave function applies. However the HD region is governed by an ontological view of quantum theory where noncomputable noncollapse processes occur. The electromagnetic arrow of time originates at the juncture of the M_4 and the HD regions and is a 'beat frequency' inherent in the translation of their complementary relationship bounded as a least unit as described above. This is the origin of the EM and thermodynamic arrow.

The exchange particle of the Noetic unified field, the noeon, follows preferred paths within the continuous spin exchange dimensional reduction compactification process. It is reminiscent of a traveling arc or *Jacob's ladder* where the 'charge' enters with a harmonic *holophote action* at the bottom (Planck scale) and travels to the HD region where it is released or reabsorbed cyclically as the *eternal present* remains a continuous state of the future-past topology. This is the movie theater metaphor where discrete frames of film pass over the projector bulb (Planck scale holophote noeon emission into every point in spacetime and atom) propagating *up* the Jacob's ladder (psychosphere light cone surface) to the *screen* (smooth continuous raster of awareness) as qualia.

2.2 PERIPHERAL PHYSICAL PROPERTIES

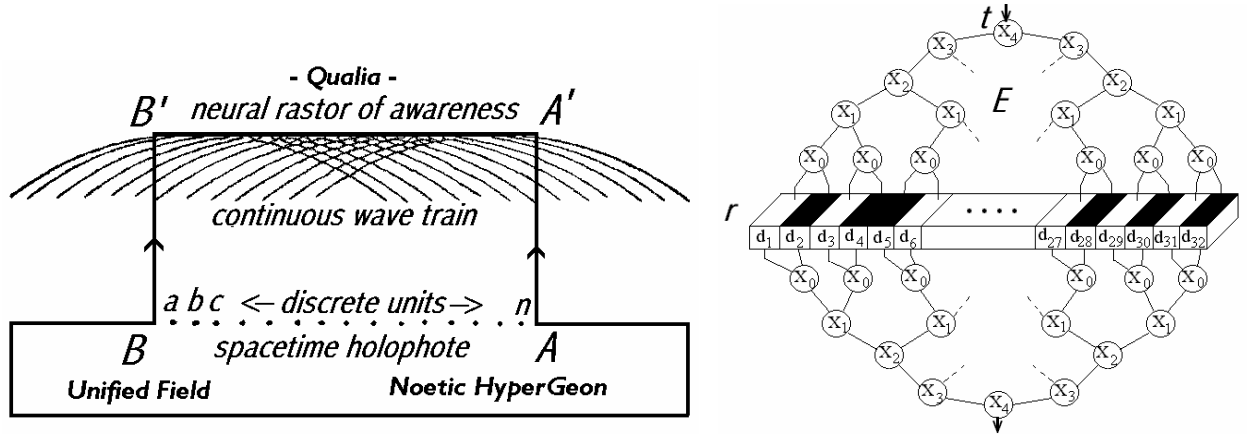

Figure 2. *Movie theater* views of the *psychosphere* light cone boundary. All *D* suppressed except one extended spatial element *B' – A'* or *r*. a) Classical view: Noeons (exchange particles of the Noetic Unified Field) propagate within the discrete Planck scale backcloth of the polarized Dirac vacuum, not in free space, but confined to the metric of the HD fabric like quarks. Noeons represent both the *elan vital* and *light of consciousness*. They propagate with an inherent *beat frequency* along preferred paths of the *Jacob's ladder* holophote by the Noetic transform (SLT-Kaluza-Klein to Geon light boosts). The *smoothness of awareness* is the oscillating leading edge of the lightcone kept in phase by a Huygen's like principle of wave train addition. b) More sophisticated Quantum view of the same process. Several imbedded actions: 1. Quantum foam background. 2. Unitary Noeons evanesce into temporality by quasiparticle transitions [39] into neural networks and other elements of the dendritic microprocess as qualia are produced [34,35,39]. *r* represents a relational unit of standing wave spacetime extension maintained by the energy of the discrete X_N fundamental units according to the noetic action formalism $F_N = E / R$ as derived in section 4 below.

3. The Vacuum Origin Of Thermodynamics And Entropy

Temporal asymmetry is a fundamental problem because the microscopic laws of physics are time reversible. The macroscopic arrow of time arises from translation of the complex boundary conditions of consciousness, which ultimately is a property of the unified field. Although this is a perceptual phenomenology it is still physical. The most fundamental basis, more fundamental than for quantum interactions of matter is the unified electromagnetic-gravitational arrow; from which the thermodynamic and all other arrows arise. The continuous state dimensional reduction compactification process within the topological structure of the polarized Dirac vacuum has a *beat frequency* associated with the inherent *Jacob's ladder-holophote* of least unit translation.

Entropy increase in thermodynamic systems can be accounted for by vacuum radiation; and this interaction of vacuum radiation with matter is time-reversible. Therefore whether entropy increase in thermodynamic systems can be considered to produce an arrow of time depends on what controls the vacuum photons. Both cases are consistent with quantum mechanics. Position and momentum perturbation on particles by vacuum zero-point radiation is limited by uncertainty to

$$\langle \delta x^2 \rangle^{1/2} \langle \delta p_x^2 \rangle^{1/2}$$

where the first root mean square value is position and the second momentum respectively Burns [14,29]. According to Zeh, [13]

$$< \delta x^2 >^{1/2} = (\hbar t / m)^{1/2},$$

(where m is particle mass), can be obtained both from classical SED and the stochastic interpretation of quantum mechanics. Substituting the result into the uncertainty principle yields a fractional change in momentum coordinates,

$< \delta p_x^2 >^{1/2} / p$, p is the total momentum, $2^{-3/2} (\hbar / Et)^{1/2}$, E is the kinetic energy.

As vacuum radiation interacts with particles, momentum is exchanged. When an initial fractional change $< \delta p_x^2 >^{1/2}$ in momentum is amplified by the lever arm of molecular interaction,

$$< \delta p_x^2 >^{1/2} / p \geq 1$$

it becomes greater than one in only a few collision times [13, 14, 29]. Therefore the momentum distribution of a collection of interacting particles is randomized in that time, and the action of vacuum radiation on matter can account for entropy increase in thermodynamic systems; i.e. it can be related to the atemporal / temporal : microscopic / macroscopic cosmology of fundamental awareness.

Dynamical interactions occurring at the molecular level are time-reversible, but thermodynamic processes associated with entropy increase, like diffusion and heat flow, only proceed unitarily in time. Entropy increase appears to be only a macroscopic phenomenon, appearing when a coarse-grained average is taken of microscopic processes. No averaging of time-reversible processes has been shown to account for temporally irreversible phenomena [13]. The reduced or temporal subspace nature of human perception filters out half of the microscopic action by the continuous dimensional reduction process. This action occurs at the speed of light and explains perspective – narrowing of the railroad tracks into the distance; which would not occur for a HD atemporal observer like God.

In the standard model (utilizing only the positive set of Maxwell's equations) electromagnetic waves emanate from a source to infinity only, and do not converge from infinity to a source. Collapse of the wave function is a one-way process.[40] Burns [14, 29] has shown that entropy increase in thermodynamic systems is produced by the interaction of vacuum radiation with matter. This interaction is time reversible. Whether an arrow of time is ultimately involved in entropy increase depends on how vacuum radiation is produced. In Noetic cosmology which utilizes an extension of the Wheeler / Feynman absorber theory of radiation EM waves from infinity do converge with the standing wave source. There are extended quantum domains without collapse of the wave function where noncomputable ontological superpositions occur; and vacuum radiation is governed by teleological cosmological action principles inherent in the HD vacuum topology [33].

4. Derivation of The Universal Noetic Field Equation

The teleological and local action of consciousness is not a 5th fundamental force but an integration of the electromagnetic and gravitational force [12] as it is confined to the 12HD spacetime metric $S_N = M_4 \pm C_4$ [5]. It appears to be synonymous with the unitary field. In this section we derive the general action principle for the Continuous State Conscious Universe (CSCU) [5]. Newton's second law of motion $F = ma$ is the fundamental action principle of M_4 spacetime reality and derivation of the basic formalism for noetic theory begins at the same place. It is interesting to note that the Schrodinger equation $ih(\partial\psi / \partial t) = H\psi$ central to quantum theory has correspondence to $F = ma$ as does Newton's law of gravitation $F = Gm_1m_2 / r^2$ and likewise Einstein's law of gravitation $G = 8\pi T - \Lambda g$. These are not chosen as the starting place because they don't represent the correct form of gravitation and also contain an undesired constant of dimensionality. Whereas $F = ma$ is dimensionless and primary. Einstein's mass energy relation $E = mc^2$ can also be shown to reduce to Newton's second law. The Schrodinger equation is also not the place to look for mental action because as stated it describes particles on a manifold and does not encompass sufficient degrees of freedom to apply to biological systems.

To derive the fundamental Noetic action principle $F_{(N)}$ first we substitute Einstein's mass energy relation $E = mc^2$ into Newton's second law $F = ma$ and obtain:

$$F_{(n)} = E / c^2 a \tag{14}$$

Where $F_{(n)}$ is the noetic force and E represents the energy of the self-organized unified field that is scale invariant from the largest scale of the supralocal Megaverse, as a hyperdimensional Wheeler Geon [20] filling all space to the Planck scale covering the pertinent subspace at each level of dimensional reduction. Next the noetic equation is further generalized for CSCU cosmology by utilizing boundary scaling principles from the work of Kafatos [16].

Taking the axiomatic approach to cosmological scaling that all lengths in the universe are scale invariant, we utilize the heuristic relation that

$$c \equiv \dot{R} \quad \text{or} \quad \dot{R} = l / t = c$$

where $\dot{R}$ represents the rate of change of scale in the universe. This corresponds to the Hubble relation for perceived expansion of the universe where

$$H_0 = \dot{R} / R \quad \text{and} \quad a = \dot{R} \times H_0 \quad \text{or substituting} \quad a = \dot{R}^2 / R$$

Returning to (8) 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:

$$F_{(n)} = E / R \tag{15}$$

Which is the formalism for fundamental action in the complex space of CSCU cosmology as opposed to Newton's $F = ma$ which represents classical action of particles in M_4 space. It should be noted that R is a complex rotational length and could also be derived in terms of a topological string theory or spacetime spinors at higher levels closer to domains described by more conventional theory. But the derivation above is much simpler and more fundamental. The point being that the noetic formalism could be derived and related to any level of 'conscious reality' and as will

be shown elsewhere expanded forms of the formalism can be used to describe intentionality, computation in biological systems and the origin of redshift and the CMBR [21]. It may seem on first glimpse that these concepts do not relate to each other; but in a universe with consciousness fundamental, it will soon become obvious that they do. The close connection of light and space relates to the superluminal boosts in the Noetic transform [6].

5. The Noetic Spacetime Transformation

Noetic CSCU cosmology implies that so-called 'real space' is a relational standing wave subspace of an absolute HD space, where a continuous state dimensional reduction compactification process is central to the scale invariant periodic geometric structure. It is useful to initiate the description by introducing a toy model of the lower *D* space and build it up to the actual HD space.

Maintaining the extended Wheeler-Feynman property of the present as a function of the future-past (Figs. 1&2; equation 4) we begin by describing a discrete Einstein type point in the relational spacetime manifold. Since points are defined as singularities where dimensionality breaks down, a dimensionless point cannot be 'covered'. This property will be shown to be a valuable criteria as a 'hole' for oriented orthogonal superluminal boosts in the noetic transformation. This also contrasts the nature of continuity (Absolute space) with discreteness (relational space); points are not absolute because the universe turns out not to be a Newtonian continuum.

5.1 THE 1D CASE

Therefore we begin the construction of dimensionality with the 1D scalar case. Assuming an arbitrary, discrete, infinitesimal, oriented least unit $h = \Delta x$, an entourage of additional HD's are required to 'cover' or confine each subspace level. Usually the entourage has one more D than its subspace. The least unit *h* on coordinate *x* can be covered by a 2-torus when the orthogonal generating circle *A,* of radius *r* is located at distance $R > h_{\Delta x}$ from x_0 and not on *h,* is rotated through dimension *y* into a plane *x, y*. Thus a 2D flat torus covers the least unit $h_{\Delta x}$ with an *x, y* plane. The rotation through y (of growing importance later) may occur in counterpropagating directions. Finally the 1D case utilizes a $\pm 2D$ covering for the $h = \Delta x$ unit of extension which may wink in and out of existence since it is a complementarity of 0D and 1D.

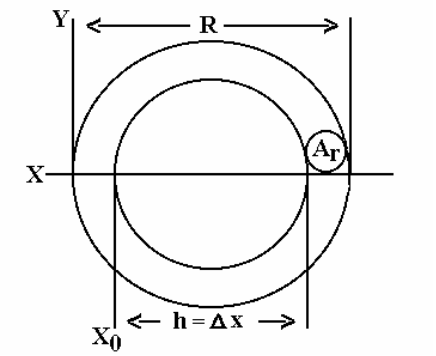

Figure 4. The 2-torus appearing as a donut slice acts as a covering of an infinitesimal 1D topological least unit $h = \Delta x$. A point of *h = 0* is dimensionless and cannot be covered (or confined). But $h = \Delta x$, acting as a transient 1D unit of extension, may be covered by a 2-torus. One additional dimension is required to cover the next lower D space.

5.2 THE 2D CASE

Covering the least unit of a plane $h = \Delta x, \Delta y$ uses a method similar to the 1D case except that two modes of covering are allowed:

Type 1. Energy –Time. An intermediate covering of region *h* by a $\pm 2D$ flat torus in the plane *x, y* as in the 1D case which leaves room for access of a 3rd energy or time coordinate utilizing either the spin exchange dimensional reduction process or superluminal boost into HD.

Type 2. Spatial. Region $h = \Delta x, \Delta y$ is completely covered by a 3-torus. This occurs by rotating a generating circle orthogonal to *x, y* through the *z* direction. This covering represents the lower limit of standard M_4 space with the addition of time.

There is no need to develop the toy model further at present as it sufficiently illustrates pertinent aspects of the noetic transformation that show how boundary conditions transform the dimensionality of space and time along with the energy covering of the unified field by $D_S \rightarrow D_t \rightarrow D_e$. The unified field governing gravitation, and the quantum potential guides the action of translation along certain allowed pathways. For example if either *l*, *w* or *h* is removed from a cube the object collapses to a plane. Removing a dimension from the plane causes compactification to a line and so on. The released space is not initially empty. At the first stage of D reduction space transforms into time; and at the second stage into the energy that couples with the energy governing it as compactification is completed for that particular unit.

5.3. THE PERMUTATION OF DIMENSIONS IN THE NOETIC TRANSFORMATION

Only certain pathways for parallel transport by spin exchange dimensional reduction (*D* down scaling) and superluminal boosting (*D* up scaling) are allowed by the Wheelere-Feynman symmetry breaking relations in the continuous maintenance of the standing wave present.

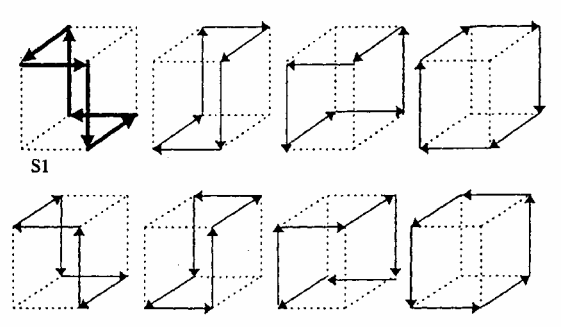

Figure 5. The figure shows the four counter-propagating circular permutations of the vertices of a cube that represent parallel transport about each of the diagonals. These allowed paths and orientations constrict the dimensional reduction of the entourage of associated spaces into symmetry breaking pathways according to strict rules. This diagram is a modification of a trajectory model describing a Schrodinger particle [26].

It is useful to clarify the utility of the dual covering modes in terms of parallel transport and the Regge equations relation to the Bianchi identity of a boundary of a boundary being equal to zero $(\partial \circ \partial \equiv 0)$ [25].

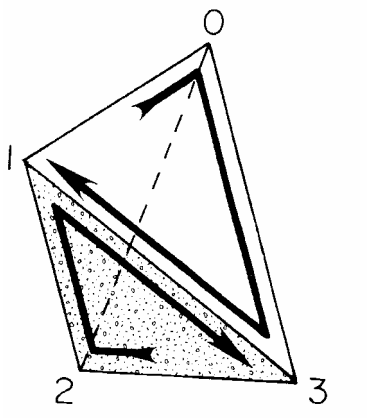

Figure 6. Ordering the vertices as shown in the figure induces an orientation on the tetrahedrons two dimensional boundary, which consists of four oriented triangles by $\partial(0123) =$ (012) - (013) + (023) - (123). This in turn induces an orientation on the edges of the one dimensional boundaries $\partial(012) =$ (01) - (02) + (12). Summing the dimensional boundaries cancels them in pairs [(01) - (01) = 0]. This is the Bianchi identity $\partial \circ \partial = 0$ described by the Regge equations for parallel transport where the boundary of a boundary is zero. Or suggesting the tetrahedron is edgeless because the 1D boundary of the 2D boundary of the 2D region is zero [25].

6. Dirac Spherical Rotation Inherent To The Transformation Of The Fundamental Least Unit

Typically the Dirac dual (2π) spinor rotation applies to the observation that an electron undergoes 720° of rotation (not the usual 360°) before returning to the initial orientation. Traditional thinking has assumed this to be some property of matter. But the discovery of the complex structure of spacetime has shown that this is not a property fundamental to the electron; but rather to the superspace the electron is imbedded in and part of. Dirac spherical rotation as it is also called, is more fundamentally a primary property of space than it is matter. This is revealed in the complex hierarchical structure of the least unit discussed in the paper.

6.1 THE DIRAC STRING TRICK

Take a square and tie the four corners to another larger square by loose string as shown in the figure below (alternatively, tie the initial square to the four corners of the room). Now rotate the small square by 360 degrees about a vertical axis, that is, in a horizontal plane. The strings will become somewhat tangled, and it is not possible to untangle them without rotating the square.

If we rotate through another 360 degrees, for a total of 720 degrees; it is now possible to untangle the string without further rotation of the square by simply allowing enough space for the strings to be looped over the top of the square! You won't believe it unless you check it out for yourself. It is advisable for your experiments to use bulldog clips to attach the ribbons to the squares, so that it can be undone easily if it gets too tangled. A similar idea works for a rotation through 720 degrees about any axis.

Another version of the Dirac string trick is called the Philippine wine dance. A glass of water held in the hand can be rotated continuously through 720 degrees without spilling any water. These geometrical demonstrations are related to the physical fact that an electron has spin ½! A particle with spin 1/2 is something like a ball attached to its surroundings with string. Its amplitude changes under a 360 degrees (2π) rotation and is restored by rotation of 720 degrees (4π).

The formal description of such complex phenomena typically requires sophisticated mathematics (algebra, group theory, topology, quaternions...) since they are not part of everyday experience.

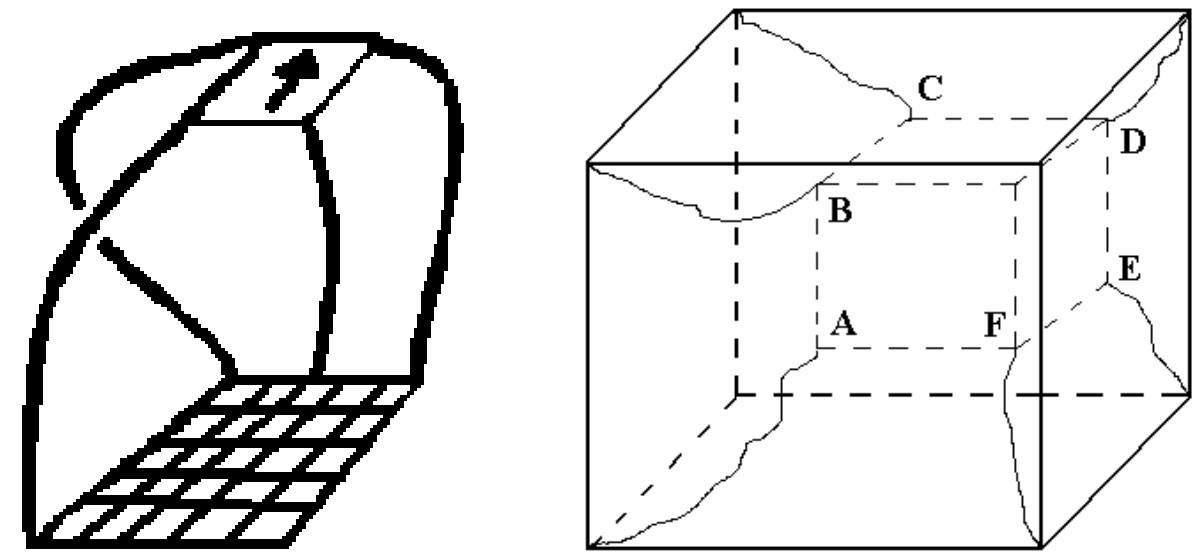

Figure 7. Two forms of demonstrating the Dirac string trick to illustrate how spin ½ particles like the electron must undergo 720 degrees of rotation instead of the usual expected 360 degrees [18].

7. Developing The Line Element For Noetic Superspace

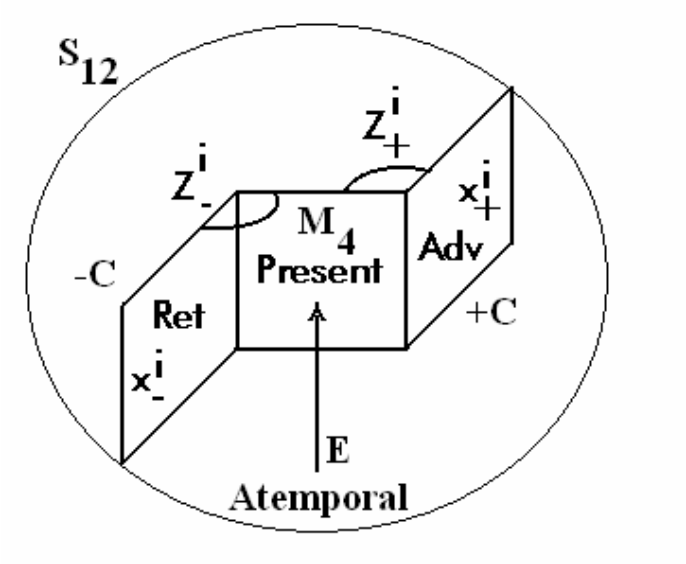

Figure 7. A 2D representation of the three four dimensional spacetime packages making up the 12D periodic noetic superspace of post Bigbang cosmology. M_4 is the Euclidian based Minkowski / Riemann standing-wave present with two higher dimensional complex spacetime packages $\mp C$ representing the four retarded and four advanced dimensions respectively which puts certain constraints on the description of the noetic line element.

The real parameters for the line element in standard Einstein-Minkowski space M_4 is

$$dS_0^2 = dx_1^2 + dx_2^2 + dx_3^2 - dt^2 \tag{16}$$

to which noetic superspace must make correspondence. We begin by developing the associated eight dimensional complex space of the future-past following work initiated by Amoroso [5] and Rauscher [17, 41], Cole [22] and Hansen and Newman [42] on complex Minkowski space.

For $X^j_{\mathrm{Re}} + iX^j_{\mathrm{Im}}$ with j = 1,4 and $X^k_{\mathrm{Re}} + iX^k_{\mathrm{Im}}$ also with k = 1,4 we set up the complex relation

$$Z^{jk} = [X^j_{\mathrm{Re}} + iX^k_{\mathrm{Im}}],\ [\overline{X}^j_{ret} + \overline{X}^k_{adv}] \tag{17}$$

again with j, k = 1,4 yielding (1, 1, 1, -1). Then for complex advanced space $+C_4$ we have the general relation $Z^{jk}_{adv} = X^{jk}_{\mathrm{Re}(adv)} + iX^{jk}_{\mathrm{Im}(adv)},\ \overline{X}^{jk}_{\mathrm{Re}(adv)} + \overline{X}^{jk}_{\mathrm{Im}(adv)}$ with j = 1, 4. For complex retarded space $-C_4$ the relation is $Z^{jk}_{ret} = X^{jk}_{\mathrm{Re}(ret)} + iX^{jk}_{\mathrm{Im}(ret)},\ \overline{X}^{jk}_{\mathrm{Re}(ret)} + \overline{X}^{jk}_{\mathrm{Im}(ret)}$ with k = 1, 4. Then the line element is

$$\Delta S^2 = \eta_{jk} dZ^{jk}_{adv} Z^{jk}_{ret} \tag{18}$$

with the further condition satisfied that $\eta_{jk} = \alpha_{jk} + i\beta_{jk}$ where

$$\alpha_{jk}(dx^j_- dx^k_p + dx^j_p dx^k_+) + \beta_{jk}(dx^j_- dx^k_+ - dx^j_p dx^k_p) = 0 \tag{19}$$

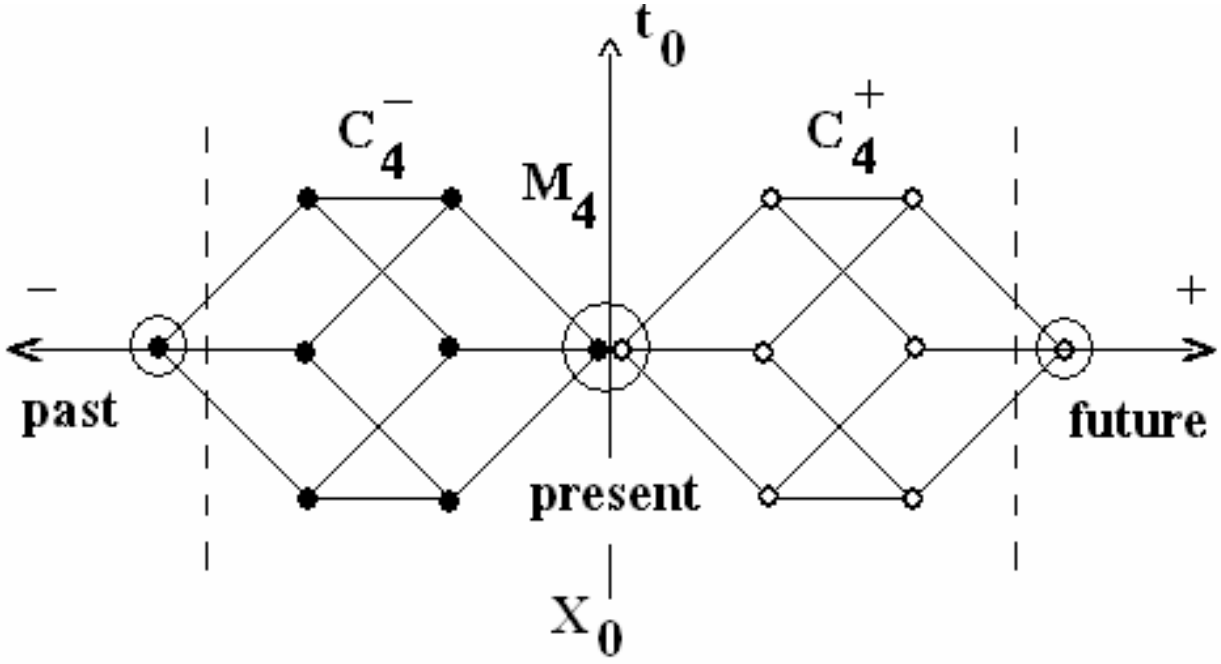

Figure 8. Conceptual view of the symmetry of a least unit in Noetic Superspace showing the relationship of its twelve dimensions here depicted as points. The larger circle in the center represents the Minkowski M_4 present comprised of the smaller circles at each end representing future/past components that comprise it. The twelve points labeled C_4 symbolize a conceptualization of the twelve dimensions comprising a fundamental least unit. The complex plane is suppressed for simplicity.

8. More On The Physical Cosmology of Time

The physics of time (thermodynamic processes, kaon decay etc) seems independent of psychological time. But in a *conscious universe*, all arrows of time are interrelated and arise from a central point in the hierarchy of unitary translation of the Noetic least unit. An understanding can be garnered by explaining the amplification of microscopic phenomena by processes inherent in fundamental awareness. Observation - synonymous with measurement is the obverse of the process of awareness. William James stated that 'there is no splitting of experience into consciousness and what the consciousness is of'. So between experience A and experience B there is no gap, no collapse of the wave function is observed in thought processes. If one attempts to bring a photon to rest it vanishes. This observed reduction of the wave function in the external world has confused conceptions of what occurs in the mind where there is no collapse. But the phenomenology of awareness takes place in a structural noumenon. The additive properties of a Huygens rainbow effect applies to produce a framework for awareness. The summation of the effect in each individual microscopic raindrop produces the macroscopic rainbow. The rainbow is the screen in the movie theater upon which qualia may be projected. For the purpose of illustration this process could be said to be described by equation (16). The summation of the individual coherence lengths must have one orientation (time) or they would cancel and remain microscopic and reversible. The laws of physics have two forms with one generally ignored. The set of equations ignored is the one not observed or sacrificed to produce the perception of macroscopia. The continuous spin exchange compactification dimensional reduction process occurs at the speed of light and thus are too fast and small to be seen. So we don't see these Planck scale gaps in the continuous state standing wave of perceived reality. This is the dimensional topology and geometric origin of time.

According to the Copenhagen interpretation all quantum measurements are associated with reduction of the wave function, a thermodynamically irreversible process. Only the final observed component of the ensemble is considered to be *real* [13] by

$$\sum_i c_i \psi_i \rightarrow \psi_i \ . \tag{20}$$

This action directly creates boundary conditions separating the fundamental reversible aspects of microscopic natural law into the perceptual macroscopia and an additional HD physical realm not perceived by neurophysiology. Noetic cosmology proposes that this temporal asymmetry is completely observer related and the ensuing boundary conditions delete essentially half of the systems information cosmology. Bohr stated from the beginning that the Copenhagen interpretation did not describe biological systems; therefore a full physical description must utilize extended de Broglie/Bohm ontological forms of quantum theory without state reduction and therefore loss of systems information. The big question then is what is the utility of the unobserved parameters of this cosmology?

Here is where the main utility of the Noetic least unit transform enters in. The complementary superluminal boosting of the 'standing wave' eternal present

$$D_s \to D_t \to D_E \;:\; R_U \to R_Q \to R_C \tag{21}$$

produces and maintains the perceptual macroscopic amplification of microscopic phenomena. The Noetic boosts reduce the flux of all physical fields at the boundary by absolute parallelism $\partial \circ \partial = 0$ where the boundary of a boundary equals zero facilitating this whole cosmological process. We begin with the description of the electromagnetic field. Following Kafatos and his collaborators [16] suggesting the importance of $\dot{R} \equiv C$ for universal boundary conditions which are also relevant to the velocity required for the observers mind to escape microphysics and become coupled to a macroscopia for EM by

$$\vec{c} = \frac{2\vec{E} \times \vec{B}}{\vec{E}^2 + \vec{B}^2} \tag{22}$$

where, according to Wheeler [27], velocity $\vec{c} = \vec{n} \tanh \alpha$ and the numerator is the Poynting flux and the denominator the energy density. This boost equation describes the reduction of the EM field to mutual parallelism which according to the Bianchi identity describes how the boundary of a boundary equals zero. Allowing half the universe to cancel into the resultant standing wave covering. The covering is piloted by the de Broglie wave-particle energy. Application of the Huygen's principle of wave addition produces the smooth feel of reality we observe by *surfing* as it were on the face of the discrete elements of atemporal microphysics!

9. Conclusions

A new model of the universe called the CSCU provides a fundamental framework for introducing a comprehensive dualist / interactionist model of mind and body for the first time in history. This noetic cosmology allows awareness to be defined as a fundamental scale invariant complex cosmological system representative of the structural phenomenology of the universe itself. The most important concept is the proposed origin of the unified field and the complex HD topology that facilitates its entry into every spacetime point and atom providing the necessary basis for dualism / interactionism – a quantum of action acting as the *élan vital* and providing a causal nature with sufficient degrees of freedom to explain intentionality. All the parameters of the conscious universe are governed by utilizing suitable expansion of the formalism for Noetic action $F_N = E/R$ derived from Newton's second law $F = ma$. An axiomatic approach was taken for the sake of brevity. Many controversial principles stated emphatically; but Noetic cosmology is empirically testable so it will now be possible to settle many of these questions experimentally.

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