Universal Quantum Computing: Anticipatory Parameters Predicting Bulk Implementation

Part I – Philosophical Foundations for the Formalism

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Abstract
We introduce an anticipatory approach to Universal Quantum Computing (UQC) utilizing a variety of extended theoretical parameters.
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1. Introduction – Overview of New Fundamental Parameters

Quantum Computing (QC) has remained elusive beyond a few qbits. Feynman's recommended use of a "synchronization backbone" for achieving bulk implementation has generally been abandoned as intractable; a conundrum we believe arises from limitations imposed by the standard models of Quantum Theory (QT) and Cosmology. It is proposed that Feynman's model can be utilized to implement Universal Quantum Computing (UQC) with valid extensions of QT and cosmology. Requisite additional degrees of freedom are introduced by defining a relativistic basis for the qbit (r-qbit) in a higher dimensional (HD) conformal invariant context and defining a new anticipatory based cosmology (cosmology itself cast as a hierarchical form of complex self-organized system) making correspondence to 12D symmetries in the F-Theory incarnation of M-Theory. The causal structure of these conditions reveal an inherent new "action principle" driving self-organization and providing a basis for applying Feynman's synchronization backbone principle.

Operationally a new set of transformations (beyond the standard Galilean / Lorentz-Poincaré) ontologically surmount the quantum condition, $\Delta x \Delta \rho \cong \hbar$ (producing decoherence during both initialization and measurement) by an acausal energyless topological interaction. Utilizing the structural-phenomenology of the HD regime requires new commutation rules and corresponding I/O techniques based on a coherent control process of cumulative interaction to manipulate applicable harmonic modes of HD spacetime manifolds such as those described by the genus-1 helicoid "parking garage" structure as a spin-exchange continuous-state spacetime resonance hierarchy. Finally it is suggested that this UQC model takes the same form as the mind-body interaction – that of conscious quantum computing.

The basis of an anticipatory approach for the ontological realization of bulk or Universal Quantum Computing (UQC) is introduced conceptually utilizing an axiomatic approach to facilitate delineating the philosophy for the formalism. The theoretical model requires a new cosmology based on an extension of Quantum Theory (QT) or vice versa depending on whether ones view is top-down or bottom-up. Both the new cosmology and extension of QT are anticipatory because they take the form of complex self-organized hierarchical systems [1-7]. The extended QT is derived from a combined relativistic extension of Cramer's Transactional Interpretation [8], based on the Wheeler-Feynman Absorber Theory of Radiation [9], and an HD extension of the de Broglie, Bohm, Vigier Causal Interpretation of QT where $m_\gamma \neq 0$ [10,11]. The cosmology is that of a 12D Holographic Anthropic Multiverse (HAM) making correspondence to the F-Theory [12] iteration of String Theory as developed by the 1st author [1-4,6,7,13]. Why does UQC require an anticipatory approach cast in new QT and HAM cosmology? Salient reasons discussed are: 1. Causal conditions, 2. New Symmetry relations, 3. Utilization of Feynman's suggestion, and 4. Coherent control methods of operation. Interestingly the self-organized parameters of the cosmology entail an inherent synchronization backbone, amounting to getting half the UQC for free!

2. The Causal Separation of Phenomenology from Ontology

Because of the recent jump from Newtonian Mechanics to Quantum Mechanics most physicists believe we live in a quantum universe. The logical progression of this line of reasoning would suggest we live in a Unitary Universe once a unified field is empirically delineated. This is an erroneous conclusion. A better assumption based on anticipatory properties inherent in 12D HAM cosmology suggests that the universe is a continuous-state interplay of all three modes [1-4]. Because we only observe the Euclidian component of this world view, we assume reality is a complex virtual standing wave with the present a continuously created subspace of HD future-past parameters [1-9]. Our task is to demonstrate an ontological methodology for surmounting the inherent uncertainty conditions of Copenhagen regime phenomenology with a new set of transformations that utilize an "energyless topological switching" to exchange information [14].

Reality as locally observed, (Fig. 1a) is Euclidian, E_3 or 3(4)D Minkowskian, $\hat{M}_4$ depending on whether time is introduced in the Newtonian or Einstein sense. In Fig. (1b) the 3D cube is shown unfolded into a cross in the 2D plane with arbitrary loss of the z direction. Fig. (1c) shows a 4D tesseract that includes the 4th dimension designated as w. In a manner analogous to Fig. (1b) the 4D tesseract is unfolded into a 3D cross as shown in Fig. (1d). Loss of the w direction makes it easier for the human mind to visualize a hypercube. For simplicity we use the 3(4)D cross to illustrate how '12' is the minimum number of dimensions required to describe *eternity* (defined as causal separation from E_3) and conceptually reveal how to overcome the limitations of the quantum principle inherent in Copenhagen uncertainty; i.e. since the phenomenology of Copenhagen action produces uncertainty by definition - choose instead an ontological process that does not discretize the z field commutator as in Eq. (2).

To illustrate, assume the translucent *central* cube (Fig. 1d) represents local E_3 reality as a subspace surrounded by six *adjacent* HD cubes that are components of the 4D tesseract in Fig. (1c). The eighth cube, the *satellite*, is arbitrarily attached to the *y* direction adjacent cube. Let the central cube hold a standard quantum state. A primary assumption of continuous-state noetic cosmology is that all eight 4D cubes (4096 in 12D) contain the information of the central cube's state by superposition (an inherent property of the conformal invariance [15,16] of HD Relativistic Quantum Field Theory (RQFT)). This is a fundamental symmetry condition of the Superspace of HAM cosmology [1-4]. The satellite cube is periodically *causally free* of the E_3 / M_4 central cube because of the relativistic transformation. This continuous-state topological transformation of the standing-wave modes is the inherent synchronization backbone in the backcloth of spacetime itself; as if half of the QC is obtained for free. In this context QC operations are ontological (if putatively performed in a specific manner described by the new noetic transform) without phenomenological collapse of the wave function with respect to quantum information contained in the central E_3 cube. This metaphor performed rigorously in a 12D context is able to surmount the uncertainty relation!

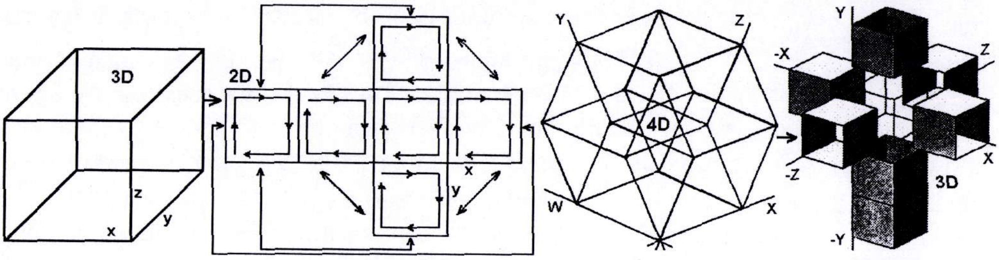

Figure 1. Geometry of space in 3 & 4D. (a,b) A 3D cube unfolds into the 2D plane. This metaphor aids the visualization of HD space. (c,d) A 4D hypercube unfolds into 8 component 3D cubes as in (1b). If a 5D hypercube were unfolded the 8 cubes forming the 3D cross (d) would be 4D hypercubes (tesseracts as in (c). The translucent cube, called the *central cube*, represents observed reality, E_3. This central cube is surrounded by six *adjacent cubes*. The 8th cube, called 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'.

3. Review of Angular Momentum and Pauli-Dirac Spin Matrices

The Schrödinger equation is invariant under Galilean but not the Lorentz transformation and therefore incompatible with the principle of relativity and all phenomena relating to the interaction of light and matter leading to the concept of 2[nd] quantization [17]. Our 12D extension of QT goes beyond the usual Klein-Gordon and Dirac models of RQFT. This is an issue of the observers cosmology with an inherent complementarity between 1[st] and 2[nd] quantization much like wave-particle duality. This is a continuous-state property [1-4] readily described by methods similar to that attributed to Dirac spherical rotation of the electron [1].

Separation of the Schrödinger equation into spherical coordinates reveals the Hamiltonian

$$H = \frac{1}{2m}\left(p_r^2 + \frac{L^2}{r^2} \right) + V(r), \tag{1}$$

where p_r is the radial momentum $(m\dot{r})$ and L the angular momentum vector. As well known, the three components of angular momentum, derived from each other by cyclic permutation, are $L_z = xp_y - yp_x$ $L_x = yp_z - zp_y$ $L_y = zp_x - xp_z$ $L = r \times \rho$ where the total angular momentum $L^2 = L_x^2 + L_y^2 + L_z^2$ has commutation rules $L \times L = i\hbar L$ [17-21]. SO(3) rotation generators l_1, l_2 and l_3 satisfy $l_1 l_2 - l_2 l_1 = l_3$, $l_2 l_3 - l_3 l_2 = l_1$, $l_3 l_1 - l_1 l_3 = l_2$; related quantum mechanically to angular momentum components L_1, L_2, L_3 with $L_x = i\hbar l_1, L_y = i\hbar l_2, L_z = i\hbar l_3$ about Cartesian axes giving commutation rules $L_x L_y - L_y L_x = i\hbar L_z$, $L_y L_z - L_z L_y = i\hbar L_x$ $L_z L_x - L_x L_z = i\hbar L_y$. Angular momentum refers to intrinsic spin about a massive particles center of mass and its magnetic moment by SO(3) Lie algebra which is non-Abelian so the elements do not all commute. The Pauli matrices satisfy these commutation rules when acting on two component spinor wavefunctions $\{\psi_0(x), \psi_1(x)\} \equiv \Psi_A$; but by the uncertainty relation, $\Delta x \Delta \rho \cong \hbar$ only one set of these operators may commute at a time. Non-relativistic Fermi spin $1/2\hbar$ particles with spin angular momentum operator $S = 1/2\hbar\sigma$ can be expressed as the three anticommuting Pauli *2 x 2* spin matrices Eq. (2) satisfying $\sigma_x \sigma_y = -\sigma_y \sigma_x = i\sigma_z$ as derived empirically from the Stern-Gerlach experiments [17,19]

$$L_x = \frac{\hbar}{2}\sigma_x = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \quad L_y = \frac{\hbar}{2}\sigma_y = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}, \quad L_z = \frac{\hbar}{2}\sigma_z = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}. \tag{2}$$

Here we demonstrate a complex HD geometric-micromagnetic [14] method where all commutator relations can periodically simultaneously commute like the Casimir-like 'total spin' operator, $\mathbf{J}^2 = L_x^2 + L_y^2 + L_z^2$ commutes with all three components of L in 3D [22-24]. This is possible in HD because E^3 (Fig. 1) in HAM cosmology has the same properties as the Dirac spherical rotation of the electron [1,4]. The topology of these boundary conditions is described by HD expansion of the noetic field equation, $F_n = E / R$ [25]; F_N is the cyclic noetic force, E the continuous-state Lagrangian and R the complex coherence length [26].

Relativistic spin $1/2\hbar$ particles are described by Dirac's formalism for the wave equation which has been expressed by a number of notations such as $E\psi + c(\alpha \cdot p)\psi + mc^2\beta\psi = 0$; or $i\hbar\frac{\partial \psi}{\partial t} - i\hbar c\alpha \cdot grad\psi + mc^2\beta\psi = 0$ [27] which when expressed by Dirac's σ matrices can be expanded in the following *4 x 4* matrices:

$$\beta = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix} \quad \alpha_x = \begin{bmatrix} 0 & \sigma_x \\ \sigma_x & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

$$\alpha_y = \begin{bmatrix} 0 & 0 & 0 & -i \\ 0 & 0 & i & 0 \\ 0 & -i & 0 & 0 \\ i & 0 & 0 & 0 \end{bmatrix} \quad \alpha_z = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{bmatrix} \tag{3}$$

which are Hermitian and readily seen to contain the *2 x 2* Pauli matrices (2) as in the center of matrix α_x for example [28]. An interesting point developed below is that in cases where $m = 0$ (or for high E where any massive particle behaves like $m = 0$) only three anticommuting matrices instead of four are required. This means the Pauli matrices will suffice and the spinor needs only 2 components which relates to the Wehl or chiral representation [29].

In another popular notation the Dirac equation is represented as

$$E + mc^2 + \frac{ke^2}{r} = \phi c + imc^2 = \vec{\phi} c + imc^2 \quad where \quad E \to -\frac{\hbar}{i}\frac{\partial}{\partial t}; \vec{\phi} \to \frac{\hbar}{i}\vec{\nabla} \tag{4}$$

which has the general solution $\frac{\hbar c}{i}\left(\gamma_1 \frac{\partial}{\partial x} + \gamma_2 \frac{\partial}{\partial y} + \gamma_3 \frac{\partial}{\partial z} + \gamma_0 \frac{\partial}{\partial ict} + \right)\psi - mc^2\psi = 0$

which is easily shorthanded to $\left(\gamma^\mu \partial_\mu + i\frac{mc^2}{tc}\right)$. There are two non-relativistic limits; the first is the Klein-Gordon equation, $\left(E + mc^2 + ke^2/r\right)^2 = (\phi c)^2 + \left(mc^2\right)^2$, the second the Schrödinger equation, $E + mc^2 + ke^2/r$ = $\sqrt{(\phi c)^2 + (mc^2)^2} \cong mc^2\left[1 + \frac{1}{2}\left(\frac{\phi c}{mc^2}\right)^2 + \ldots\right] \cong mc^2 + \frac{\phi^2}{2m} + \ldots$ thus becoming

$E = \frac{\phi^2}{2m} - \frac{ke^2}{r}$, the Schrödinger equation. In this notation the matrices in Eq. (3)

$\alpha_x, \alpha_y, \alpha_z, \beta_{ict}$ correspond to $\gamma_1, \gamma_2, \gamma_3, \gamma_0$, respectively and ψ to the matrix $\psi = \begin{pmatrix} \psi_{e\uparrow} \\ \psi_{e\downarrow} \\ \psi_{\phi\uparrow} \\ \psi_{\phi\downarrow} \end{pmatrix}$.

4. Noumenal Reality Versus the Phenomenology of Quantum Theory

Feynman has shown that reality can be considered incompatible with QT [30]. If we let *A,B,C* represent the three observables *a,b,c*, their values *P(a,b)*, *P(b,c)*, *P(c,a)*, their transition probabilities $a \to b, b \to c, c \to a$ and $\phi(a,b), \phi(b,c), \phi(c,a)$ the corresponding quantum mechanical amplitudes; the transition probabilities *P(x,y)* (*x,y* = *a,b,c*) are measurable empirically by the classical rules of probability leading to

$$P(a,c) = \sum\nolimits_b P(a,b) \cdot P(b,c) \tag{5}$$

with the summation taken over all values of observable *B* [30,31].

Measuring *P(x,y)* in a case where the relative frequency of *x* is an ensemble prepared so that *y* is realized with certainty, the identity equation (6) can be shown to be wrong because the difference (called the interference term) between the right and left sides of (6) is found to be some orders of magnitude larger than the experimental error. If one calculates the interference terms according to the rules of QT from the empirically correct formula

$$\phi(a,c) = \sum\nolimits_b \phi(a,b)\phi(b,c) \tag{6}$$

and utilizing the connection between probability and amplitude

$$|\phi(x,y)|^2 = P(x,y); \quad x,y = a,b,c \, [30]. \tag{7}$$

This contradiction between the classical probability identity (5) and the results of the Copenhagen interpretation (6) have been elucidated by Feynman:

> ...Looking at probabilities from a frequency point of view (5) simply results from the statement that in each experiment giving *a* and *c, B* had some value. The only way (6) could be wrong is the statement, "*B* had some value", must sometimes be meaningless. Noting that (7) replaces (6) only under the circumstance that we make no attempt to measure *B*, we are led to say that the statement, "*B* has some value", may be meaningless whenever we make no attempt to measure *B*" [30].

Feynman's statement delineates Schrödinger's cat paradox. He states regarding the interference term that if we say "*B* had some value" when we make no attempt to measure it is true we have a contradiction with experiment because there is a contradiction between objective reality and the validity of QT in the orthodox Copenhagen interpretation. For our purposes here we resolve this paradox by abandoning the notion of a local absolute objective reality by stating that the observer's 3(4)D reality is virtual and that the 11(12)D HAM anticipatory reality is physically more complete. This is a key foundational element of our UQC model because we postulate firstly that the very existence of the observer discretizes reality and secondly that the application of the arbitrary *z*-field discretizes *L* such that it does not universally commute. This is of course experimentally demonstrated as the standard interpretation of QT and is the basis for its formalism. This scenario avoided in the 12D anticipatory model of UQC is not possible by "law" if Copenhagen is applied. We demonstrate a model with zero commutator for all values of L where state evolution can be manipulated ontologically (from a position of causal separation) rather than the standard phenomenology of wave function collapse producing the uncertainty relation, $\delta x \delta \rho_x \geq 1/2\hbar$.

5. Justification for the Incursive Noetic Model

If M-theory/F-Theory subsumes the standard model of particle physics and cosmology, strings will represent the primary physical element; and $\hbar$ will no longer be considered a fundamental constant. First let's consider the continuous-state compactification of noetic superspace. The 12[th] D (hyperplane of Fig. 10 is an absolute space signifying the geometric limit of our reality from which a 9 to 11D manifold drops out (site of unitary field) as the 1[st] continuous-state compactification of the harmonic superspace delineated as

$$x_N = x_N + 2\pi R_N \tag{8}$$

where $N \rightarrow$ from 1 to 8D and R the periodic radius of space N goes from $\hbar$ to ∞. This condition exists because unit strings are not related to $\hbar$ = 1, but to string tension, denoted simplistically $T_s = 1/\pi$ [32,33]. Fields on this periodic space therefore satisfy

$$\phi(x) = \phi(x + 2\pi r) \tag{9}$$

which means the field ϕ can be power expanded periodically with eigenfunctions

$$\phi(x) = \sum_k \phi_k e^{ipx} \tag{10}$$

where $p = k / R$ and k is an arbitrary integer so that the momentum conjugate x is quantized in integers, a feature of all compactifications. Note for our purposes that compactification of a dimension quantizes the momentum corresponding to the compactified coordinate [12].

This has immediate repercussions for the anticipatory UQC model. For Copenhagen, only the z component of the angular momentum vector of a particle on a Riemann sphere is considered well defined. The Dirac equation, usually formulated in 4D, must be recast in the 11(12)D superspace [34] to include additional causal action in the symmetry of advanced–retarded potentials and heterotic splitting of the 8D resonant tower (Figs. (3,4,5) where the wave function and all off diagonal elements are physically real and therefore accessible as in Cramer's transactional interpretation [8]. A transaction is represented as a form of standing wave both of which support the energy dependent nature [1] of the periodic 12D continuous-state Superspace. The separation of these parameters in terms of de Broglie's fusion model [35,36] is used for ontological manipulation of the harmonic tier.

It is suggested that continuous compactification of noetic superspace in this framework produces a singularity (a cyclic wave-particle) which is the observed E_3 reality itself; and the eight-form factorizes into two four-forms $N_8 \rightarrow X_4 \wedge X_4$, i.e. the advanced – retarded components of an HD extension of a Cramer transaction [8].

Because M_4 is Einstein's energy-dependent spacetime metric, $\hat{M}_4$ where strings are susceptible to *EM* charges, (p, q); the tension of these heterotic strings becomes

$$T_{p,q} = pe^{-\phi} + qe^{\phi} \quad (11)$$

which can be used to demonstrate that string tension, T vanishes at the singularity E_3 [12].

6. Essential Properties of Complex Noetic 12 Space

The UQC model relies on a new 12D Absolute Space (AS) (ultimate arena of reality) from which properties of a Wheeler geon [38] or 'ocean of light' (the unitary noetic field) emerge. The noetic AS is an atemporal, highly ordered and symmetric harmonic superspace from which all other space relative to an Earth observer is a composite subspace. The geon domain (9 to 11D) is the first compactification regime; and because of coherence of the unitary field, railroad tracks would not recede but remain parallel. A set of null lines (complex arrow of time), a loci of eternal points, remains hidden from local observed reality as an eternal present. This is part of the complex, $\pm C_4$ Wheeler-Feynman-Cramer duality of the future-past standing-wave comprising the continuous state present: "a relativistic spin-exchange dimensional reduction compactification process" which represents a new set of transformations beyond Galilean and Lorentz/Poincairé to describe the inherent dynamics of this unitary domain and create the arrow of time [39]. This condition results in our E^3-M^4 domain being a subspace of eternity (Fig. 1); and the essential process for producing the 'synchronization backbone' inherent in the backcloth of HAM cosmology [2-4].

As in special relativity where c remains constant and independent of the velocity of the source; the 12D AS remains static and absolute whether matter is stationery or in relativistic motion. In this context there is a duality in terms of conservation laws, annihilation/creation, advanced/retarded potentials or between space and energy including an asymmetry between the future-past. The new set of transformations makes correspondence with M-Theory and is conceptually considered a higher dimensional extension of Dirac Spherical Rotation [4,40-42]. Thus issues of the historical controversy between relational and AS are pushed to the new 12D domain. Within the Classical limit the former 3D Euclidean AS remains relative to the eternal present [43] of the subjective observer. Einstein demonstrated that the application of special relativity to a 3(4)D Minkowski/Riemann manifold makes space relational. The new relational space extends Einstein's view from four to eleven dimensions. In the 12D noetic superspace, S_N the 11D unitary noetic field (and the local 3(4)D $B^{(3)}$ component of the *EM* field [44]) translates longitudinally, but the space (as in water waves) remains fixed because the wave bumps against the close-packed spheres or least units [7,45] (like the water molecules) allowing only transverse displacement while the wave is locally present. This wave cyclically undergoes $m_\gamma = 0$ and $m_\gamma \neq 0$ plus $B^{(3)}$ for certain polarizations.

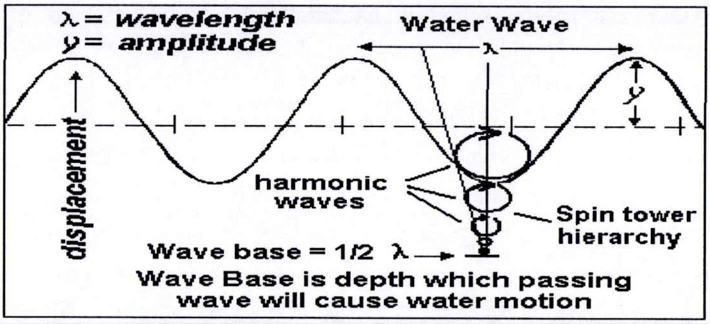

Figure 2. Symbolic representation of a 12D Ocean (Dirac sea) of Light (unitary field) modeled after the Wheeler Geon. The "ocean" provides a practical metaphor for 12D space in that polarization of the Dirac sea is said to have properties like water waves.

Current thinking on the topology of space takes three general forms: 1) The most commonly accepted 3(4)D Minkowski/Riemann spacetime manifold; and two putative HD superspace additions, 2) Calabi-Yau space preferred by M-Theory and 3) Dodecahedral space. Nature of the true vacuum remains an open question. The 3D absolute space of Newton became the 3(4)D relational spacetime of Einstein. The 12th D of Noetic cosmology represents a new form of absolute space, a periodic superspace where the eternal twelfth dimension has a Wheeler Geon [38] or ocean of 'light' (the unified field) as its $9 \Leftrightarrow 11$D subspace. The relational 3(4)D Minkowski/Riemann spacetime manifold is a continuous state standing wave subspace of the 12D noetic superspace; it acts as a topological cover of an eternal present [43] which is not observed and continuously decays into spacetime (Fig. 11).

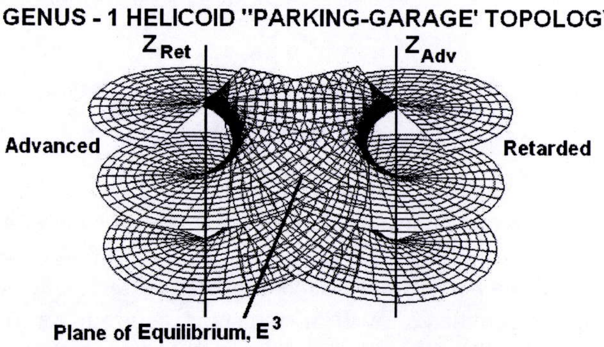

Figure 3. The Helicoid, a minimal embedded surface [46], is swept out by a line rotating about and moving down the *z* axis. Here a double Genus-1 Helicoid is joined into a "parking garage" ramp structure representing the future-past hierarchical topology of noetic space. An ordinary 2D plane can be twisted into a helicoid. Also see [15].

"Space quantization" or the quantization of orientation of atomic systems observed empirically primarily by Stern-Gerlach [17] and secondarily in other phenomena like the Zeeman Effect in an inhomogeneous magnetic field led to the basis for representing spin ½ fermions as a uniform Dirac spherical rotation through a 720° cycle [4,40-42] and the commutation relation for angular momentum in quantum theory. We explore extending these properties to twelve dimensions, 12D as required for UQC ontological operations.

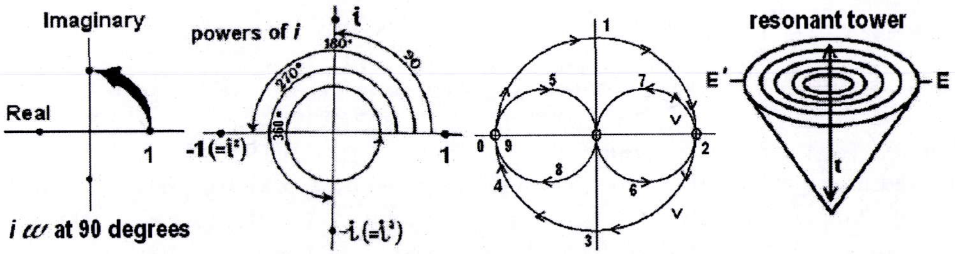

Figure 4. (a) Complex dimension at 90° from the real axis. (b) Powers of *i* from 90° to 360°. (c) Power of *i* at 720°. (d) Resonant hierarchy comprised of powers of *i* in conjunction with the topology of the Genus-1 helicoid "parking-Garage" of the string vacuum with either Ising model, logarithmic spiral or cyclotron resonance hierarchy parameters for applying ladder operators of the resonant modes required to ontologically operate the UQC model.

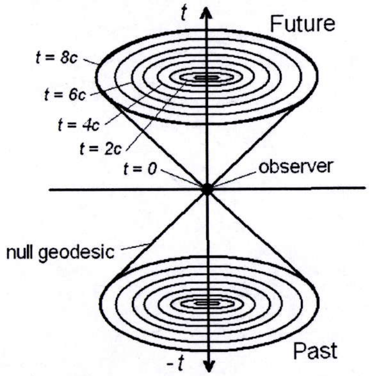

Figure 5. Minkowski light cone with parameters for hierarchical conditions.

If the noetic space water wave conception is correct, the continuous state compactification process contains a tower of spin state Lie groups from spin 0 to spin 4. Spin 4 represents the unified field and makes cyclic correspondence with spin 0 where Ising lattice spin flips [14,37] create dimensional jumps through the helicoids topology (Fig. 3). Spin 0, 1/2, 1, & 2 remain in standard form. Spin three is suggested to relate to the orthogonal properties of atomic energy levels and space quantization. Therefore the spin tower hierarchy precesses through 0, 720°, 360°, 180°, 90° & 0 (∞) as powers of *i* as conceptually illustrated in Fig. 4.

An instant t, for position $r \equiv (x,y,z)$ or for the light cone (Fig. 5) $r = xdt$, defines a point or event $d = \sqrt{x^2 + y^2 + z^2}$ in ordinary spacetime coordinates, a pseudo-Euclidian metric tensor [47] representing the sixteen points of a 4-sphere (Fig. 1c)

$$G_{\mu\nu} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix} . \tag{12}$$

In summarizing the observers relationship to the *Cosmological Principle* (that the universe is homogeneous and isotropic on average in the large-scale) [48,49] events are idealized instants in spacetime defined by arbitrary time and position coordinates *t, x, y, z*, written collectively as x^μ where μ runs from 0 to 3. The standard line element is

$$ds^2 = \sum_{\mu\nu} G_{\mu\nu} dx^\mu dx^\nu = G_{\mu\nu} dx^\mu dx^\nu , \tag{13}$$

where the metric tensor

$$G_{\mu\nu}(x) = G_{\mu\nu}(x) \tag{14}$$

is symmetric [47]. In local Minkowski form all first derivatives of g_{ij} vanish at the event and equation (13) takes the form

$$ds^2 = cdt^2 - dx^2 - dy^2 - dz^2 . \tag{15}$$

The Cosmological Principle generally suggests that the clocks of all observers are synchronized throughout all space because of the inherent homogeneity and isotropy. Because of this synchronization of clocks for the same world time *t*, for commoving observers the line element in (15) becomes

$$ds^2 = dt^2 + G_{\alpha\beta} dx^\alpha dx^\beta = dt^2 - dl^2 , \tag{16}$$

where dl^2 represents special separation of events at the same world time *t*. This spatial component of the event dl^2 can be represented as an Einstein three-sphere

$$dl^2 = dx^2 + dy^2 + dz^2 + dw^2 \tag{17}$$

which is represented by the set of points (*x, y, z, w*) at a fixed distance *R* from the origin:

$$R^2 = x^2 + y^2 + z^2 + w^2 \tag{18}$$

where

$$w^2 = R^2 - r^2 \quad \text{and} \quad r^2 = x^2 + y^2 + z^2 \tag{19}$$

finally we may write the line element of the Einstein three-sphere from equation (9) as

$$dl^2 = dx^2 + dy^2 + dz^2 + \frac{r^2 dr^2}{R^2 - r^2} \text{ [50].} \tag{20}$$

By imbedding Einstein's model of the three-sphere in a flat HD space, specifically as a subspace of a new complex 12D superspace, [1-4,6] new theoretical interpretations of standard cosmological principles are feasible.

Although the Newton and Coulomb potentials have similar forms the two theories have developed separately. For our purposes, following the Sakharov-Puthoff conjecture [51], that gravity is a product of fluctuation of the zero point field; we unify them with the Amoroso-Vigier methods [52,53] where both fields are represented by 4-vector field densities A_μ. Both phenomena are considered different types of motion within the same real physical field in flat spacetime as two different vacuum types of collective perturbations carried by a single vacuum field (unified). See (Fig. 7a). Maxwell's equations traditionally describe only transverse elements that 'cut-off' at the vacuum. Here for HAM cosmology extended electromagnetic theory is utilized where the Einstein-de Broglie relation, $E = \hbar \nu = mc^2$ allows additional degrees of freedom such as longitudinal components $B^{(3)}$ and polarized vacuum conditions where $m_\gamma \neq 0$ suggests that the photon is piloted. These conditions suggest the need for both the standard *EM* field and extended $\mu\nu$ field coordinates; an understanding of which will be seen to be required for the ontological UQC operations.

In our original integration of *G* and *EM* we chose to fix the $\mu\nu$ field coordinates [52,53]. Here we go a step further. Dirac himself suggested by the rule of coordinate law that the pilot wave and the photon decouples [54]. The two sets of coordinates *EM* or $\mu\nu$ would normally be considered independent of each other. We integrate them in the topology of the Dirac polarized sea and alternate the fixing and decoupling of $\mu\nu$ and *EM* coordinates as an inherent 'leapfrogging' (Fig. 6) of the nonlocal-supralocal continuous-state standing-wave present [1-4,6]. Like wave-particle duality of matter, HAM cosmology $EM - \mu\nu$ duality extends to spacetime itself in that the unified field harmonically discretizes into spatial boundary conditions of an Ising model Euclidian point (Fig. 7b).

Two types of computer animation in terms of 'figure' and 'ground' illustrate this. First, the animated figure crosses (arrow of time) the stationery background from left to right, disappears off the screen and reappears cyclically with an inherent frame rate. Each L-R cycle can be considered as one discrete spacetime least-unit quantum to the external observer. However as well known, our so-called quantum is actually comprised of a number of discrete frames that appear continuous to the external observer because of the refresh rate. This could be considered as the properties of quantum phase space and that material Fermi surfaces appear smooth because of the relativistic velocity of the surface electrons.

In the second case, the animated figure remains permanently fixed in the center of the screen and the background moves continuously from left to right (Arrow of time again) across the screen. For the sake of the metaphor one can say this latter case is introspective relative to the observer and the first case is objective (quantum) or external to an observer.

Neither of these two views offer a complete description of reality; as noted above, a third case of simultaneity is required. The apparent separateness of the two views; i.e. 'we live in a quantum universe' is the root of the problem because as proposed here we live in a continuous-state universe that is classical, quantum and unitary depending on perspective. The challenge here is to show that by adopting this view a model of Universal Quantum Computing with an inherent spacetime synchronization backbone can be delineated.

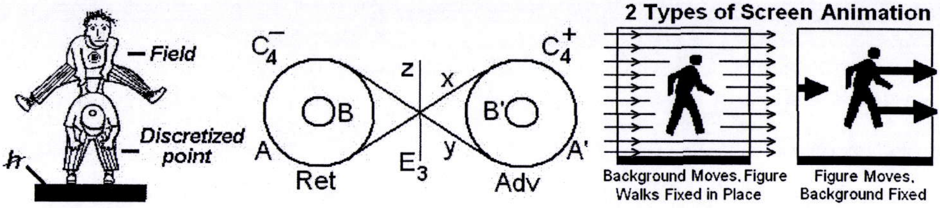

Figure 6. (a) Leapfrog metaphor of virtual reality. (b) This metaphor adds Ising properties to the future-past transaction. The central Euclidian point, E_3 is created and annihilated as a standing wave harmonic oscillator within the boundaries (denoted by A:B; A:'B') of two complex 4D tori. (c) The leapfrog duality of the $EM-\mu\nu$ metric also includes to two types of spin exchange coupling-decoupling background–foreground interactions.

Noetic Space "leapfrogs" from holographic unitarity to discretized reality. This simplifies the boundary conditions and variables needed for UQC operations. The 12D Multiverse surface is considered a new form of Absolute Space (AS) and our observed Euclidian E_3 is a pseudo-AS or subspace of this regime. Because of the leapfrogging which I suppose is a fancy form of Witten's Ising flip [37] of the covariant string vertex (Fig. 7b). The E_3 pseudo-AS is a periodic discretization or 'frozen moment' of one 4D set of the 12D parameters (when time is included). This gives the least unit of the superspace the geometry of a torus; or in our Wheeler-Feynman future-past model considered as two 4D advanced-retarded tori. This suggests the boundary conditions A:B; A':B' (Fig. 6b) are HD boundary conditions of a harmonic oscillator allowing coherent control of the UQC to be operated with 4D parameters. As well known the usual form of Maxwell's equations in vacuum with $m_\gamma \neq 0$ and $B^{(3)} = 0$ has infinite families of boundary free exact solutions with the Lorentz gauge vector potential $A_\mu = 0$; but in the noetic case with $m_\gamma \neq 0$ where Maxwell's equations do not cut off at the vacuum, there is only one family and one set of boundary conditions, a model justified empirically by existence of the Casimir and Zeeman effects [17,22-24]. *EM* theory implies the effects of the *EM* vector four-potential A_μ on the phases, S of quantum mechanical waves

$$\Delta S = \frac{q}{h}\int \phi dt - \frac{q}{hc}\int \vec{A}\cdot d\vec{S}. \qquad (21)$$

For the continuous-state integration the mass term m_γ is introduced into Maxwell's equations. One may also describe gravity with a four-vector density A_μ^g so that the Newton and Coulomb potentials take the same form but with different coupling constants suggesting both are different aspects of the same fundamental (unified) field with $A_\mu A_\mu \to 0$ where A_μ denotes the total four-potential in a covariant polarized Dirac vacuum.

From the EM vector potential $A^{\mu}(x)$ where $F_{\nu\mu} = A_{\nu,\mu} - A_{\mu,\nu}$, the components of E and B form second rank dual antisymetric spacetime field strength tensors $F^{\mu\nu}$ (Adv), ${}^{*}F^{\mu\nu}$ (Ret) defined as $F^{\mu\nu} = \partial^{\mu} A^{\nu} - \partial^{\nu} A^{\mu}$ and ${}^{*}F^{\mu\nu} = \frac{1}{2}\varepsilon \exp \mu\nu\rho\sigma\ F_{\rho\sigma}$ respectively as matrices

$$F^{\mu\nu} \equiv \begin{pmatrix} 0 & -E^{x} & -E^{y} & -E^{z} \\ E^{x} & 0 & -B^{z} & B^{y} \\ E^{y} & B^{z} & 0 & -B^{x} \\ E^{z} & -B^{y} & B^{x} & 0 \end{pmatrix}, \quad {}^{*}F^{\mu\nu} \equiv \begin{pmatrix} 0 & -B^{x} & -B^{y} & -B^{z} \\ B^{x} & 0 & E^{z} & -E^{y} \\ B^{y} & -E^{z} & 0 & E^{x} \\ B^{z} & E^{y} & -E^{x} & 0 \end{pmatrix} \quad [55,56]. \qquad (22)$$

If properties of the Dirac vacuum are expanded to conform with noetic cosmology Fig. 7a graphically represents the integration of Eqs. (12) and (13) on the top of the Dirac sea where the central point is a space-like radial four-vector $A_{\mu} = r_{\mu}\exp(iS/\hbar)$ with frequency $\nu = m_{\gamma}c^{2}/\hbar$. The oppositely rotating dipoles $\pm e$ correspond to gravity and EM with each individual sub-element four-momentum $\partial_{\mu}S$. For detailed discussion see [52,53]. Fig. 7(b) represents one close-packed noetic hypersphere least-unit just below this regime which is the vertex at 0 where further unification to the unitary field occurs

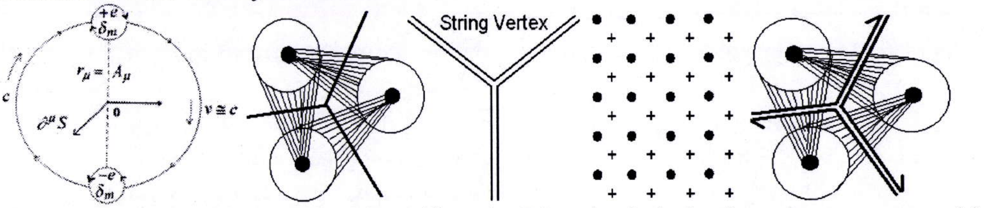

Figure 7. Models of least-unit points tiling the Dirac backcloth of noetic superspace. (a) Conceptualization of two oppositely charged vacuum subelements rotating at $v \cong c$ around a central point behaving like a dipole (+ *e*) *EM* 'bump' and (-*e*) *G* 'hole' on the topological surface of the covariant polarized Dirac vacuum. (b) Least cosmological unit with a classical discrete $\hbar$ vertex. (c) Continuous vertex of string theory able to undergo Ising flips (d) as in string theory. (e) Triune nature of Ising least-units.

The triune geometry of Fig. 7e represents the point 0 in 7a shown as an Ising lattice array in 9d. This is similar to the vertex in string theory (Fig. 7c) able to topologically undergo spin flips of the Riemann sphere from zero to infinity (Fig. 13b). In these continuous-state points the Ising vertices as governed by the super quantum potential (unified field) as described by the noetic field equation [25]. There is a foreground and background duality as illustrated in Fig.6 where the *EM* and metrics continuously "leapfrog" in the spacetime backcloth. These factors are imposed on spacetime geometry by the symmetry conditions of noetic cosmology. Traditionally parallel transport of a vector or spinor around a closed path P,Q,R (Fig. 8a) or P,Q,R,S (Fig. 8b) generally results in a deficit angle, a mass deficit that signifies the amount of curvature at that vertex when the Riemann tensor is $\neq 0$ [29,57,58].

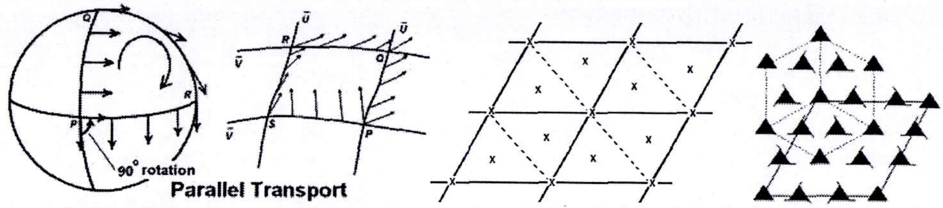

Figure 8. Parallel transport of a vector or spinor around closed paths generally results in a deficit angle, a mass defect where the vector doesn't return to the original position *P*.

Tiny loops approximated by a parallelogram of two tangent vectors $\vec{\mu}$ and $\vec{\nu}$ close (no deficit) if $[\vec{\mu},\vec{\nu}]=0$; then the curvature operator is the commutator of covariant derivatives along $\vec{\mu}$ and $\vec{\nu}$, $R(\vec{\mu},\vec{\nu})=\left[\nabla_{\vec{\mu}},\nabla_{\vec{\nu}}\right]$ [29]. If $[\vec{\mu},\vec{\nu}]\neq 0$, $\left[\nabla_{\vec{\mu}},\nabla_{\vec{\nu}}\right]$is subtracted from the commutator, the parallelogram doesn't close and the Riemann tensor is $\neq 0$.

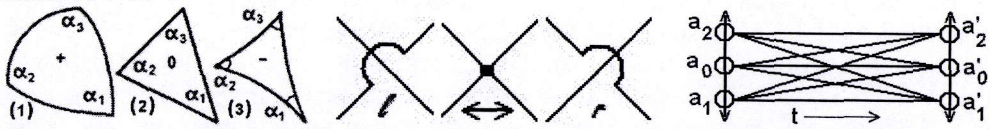

Figure 9. (a) Three types of geodesic triangles with Gaussian curvature. 1) Circumsphere with positive curvature, sum of internal angles$>\pi$. 2) Mesosphere, E^3 with zero curvature. 3) Insphere, internal angle sum$<\pi$ so curvature is negative. (b) Chiral properties of a vertex where the coordinate basis topologically switches from fixed to ℓ or r open. (c) Triune elements of an HD transaction in noetic terms where the elements of a least-unit are tertiary.

In Fig. 9, the sum of the three internal angles minus π is the Gaussian curvature integral $(\alpha_1+\alpha_2+\alpha_3)-\pi\int KdA$ where K is the Gaussian curvature. Taking Fig. 9 triangle (a) on a sphere of radius r with $\alpha_1=\alpha_2=\alpha_3=\pi/2$ the area of the triangle is $\left(4\pi r^2\right)/8$ and the Gaussian curvature would be $K=1/r^2$ which is positive [29].

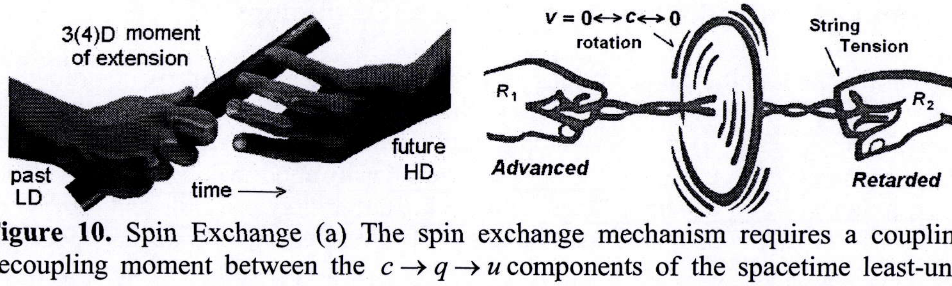

Figure 10. Spin Exchange (a) The spin exchange mechanism requires a coupling-decoupling moment between the $c\rightarrow q\rightarrow u$ components of the spacetime least-units like the passing of a baton in a relay race. (b) The spinning disk toy further illustrates elements of the continuous-state. Imagine an array of disks. The spin-exchange hierarchy process has many components.

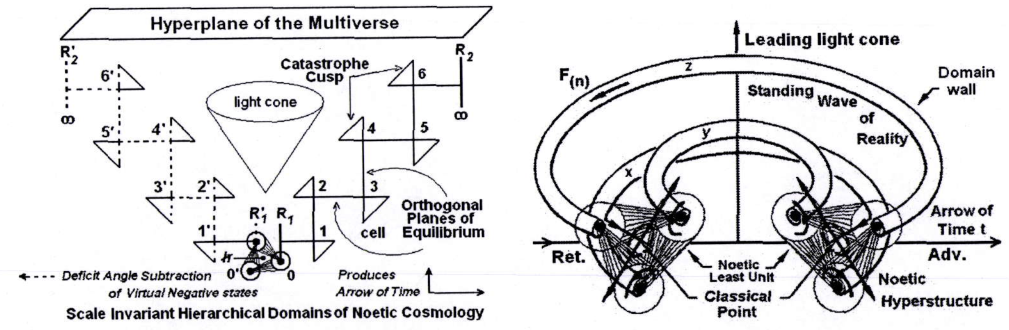

Figure 11. (a) Scale invariant hyperplane domains in the hierarchy of noetic superspace. (b) A single future-past, retarded-advanced domain where the properties interplay to produce the observed macroscopic arrow of time.

The dominant view among cosmologists regarding extra dimensions is that if they exist they must be microscopic because they are not observed. In noetic cosmology extra dimensions are macroscopic and take part in the creation and recreation of spacetime, the arrow of time and observed macroscopic reality (Fig. 11). This scenario arises during the inherent 'continuous-state spin-exchange dimensional reduction compactification process' by parallel transport (Fig. 8) within the additional context of a dual Dirac spherical rotation of the least-unit topology (Fig. 7) of subspace elements producing deficit angles during decoupling-coupling allowing relativistic subtraction of supralocal-nonlocal domain components (Figs. 8,9,10&11) producing the arrow of time. The scaling process begins in the microscopic backcloth without a physical arrow of time and ramps up the helicoid hierarchy (Fig. 3) to the virtual standing-wave macroscopic present. Because of its relativistic nature the 'baton' passing (coupling-decoupling) between domains appears smooth to the observer. Fig. 11 is meant to be synonymous with the lightcone rings of Fig. 5 where the leapfrogging domain frequency provides the context for assigning coupling parameters required for utilizing the synchronization backbone for the UQC.

7. Geometric Introduction to the Noetic QC Ontology

What are the topological conditions required to achieve a commutative ontology for UQC? Newton's 2nd Law of motion says position and velocity completely determine an observables 'state', (p, q) at an instant in time. Quantum mechanically an observable has a probabilistic distribution of values (P, Q), with quantization making correspondence between the two [59]; conditions that delineate the uncertainty principle and provide no framework for a pragmatic absolute ontology. In HAM cosmology neither spacetime nor stochasticity is considered fundamental. This is not a different basis than the concept of Heisenberg's potential; so what is required is a new process. Spacetime is a continuous harmonic state comprised of the Amoroso-Vigier dual *EM*□ $\mu\nu$ metric [52,53] comprised of conventional transverse '*EM*' elements described by Maxwell's traditional equations plus longitudinal $\mu\nu$ elements with additional degrees of freedom derived from the Einstein-de Broglie relation $E = h\nu = mc^2$ (with $m = m_0(1 - v^2/c^2)^{-1/2}$) such that Maxwell's equations do not 'cut off' at the vacuum. Evidence for such a metric is implied by the Casimir, Zeeman & Aharonov-Bohm effects [60]. These two sets of coordinates $EM + \mu\nu$ would generally be exclusive and independent. The aim here is to reveal a framework for their 'continuous-state' integration, not in 4D as previously done [52,53] but in 12D where integration is completed to unitarity.

The close-packed least unit hypersphere tiling of this noetic superspace is a complex self-organized scale invariant anticipatory system. While beyond the scope of this paper, operational interplay of the parameters of the fundamental least unit is discretized macroscopically into perceived reality. Normally local application of an observational *RF* pulse in the *z* direction discretizes the uncertainty relations of microscopic quantum states for particles. To avoid production of these uncertainties inherent in the quantum principle, a new set of Noetic transformations beyond the Galilean-Lorentz-Poincairé must be implemented by a cumulative interaction methodology to allow a 'coherent control' transformation of the phenomenology of discretization into an ontological superposition of the information.

To illustrate we apply general mechanical principles for 'pure rolling contact' [61] to the transmission of angular momentum translating through the topology of this HD spin tower (Figs. 3,10), the relative motion of consecutive elements propagate successively in proper order with the elements of parallel axes in the corresponding topological surface. These motions may be ± coupled combinations relative to the center of mass and components of angular momentum that are singular (degenerate), linear, circular, cylindrical, spherical and hyperspherical. This reveals the richness of the cosmological least unit as it undergoes continuous-state spin-exchange (rolling contact) compactification (past orientation) and Ising dimensional flip (future orientation) in quantifiable stages of dimensional jumps from 12D to 0D by superluminal Lorentz boosts [1,62] in cyclic progression $\mathrm{S} \rightarrow \mathrm{t} \rightarrow \mathrm{E}$ and $\mathrm{C} \rightarrow \mathrm{Q} \rightarrow \mathrm{U}$ (space to time to energy; classical to quantum to unitary).

12D, the minimum to describe eternity or escape from the temporal bounds of uncertainty is a result of the dimensional tower where time and E_3 / M_4 is a standing wave subspace of eternity. This structure whether Calabi-Yau, dodecahedral, or some M-Theory, F-Theory combination entails a reciprocal spiral topology. In this context we utilize logarithmic, helicoid or cyclotron resonance spirals (Fig. 11) to illustrate new angular momentum commutators. The future/past asymmetry has a Doppler relationship (Fig. 8) (relative only to the perception of the 4D observer). *E* & *E'*, (Fig. 4) therefore represent equal Wheeler-Feynman future/past symmetries. The Doppler effect arises because of inherent *E-E'* boosts and compactifications. In this picture the Wheeler-Feynman-Cramer elements [8,9] may be understood conceptually by pairs of logarithmic spirals (Fig. 12a) of equal obliquity rolling on a common tangent, *ed* where each coupled point signifies a present spacetime moment; the locus of which (*ed*) is the arrow of time.

A radiant of the spiral, r is

$$r = ae^{b\theta} \tag{23}$$

with a the value of r if $\theta = 0$, e base of the Naperian logarithms and $b = 1/\tan\phi$, with ϕ the constant angle between the tangent to the curve and radiant to the point of tangency [63]. If the value of θ takes uniform increase (quantized values) the radiants, r will be $ct = 0,1,2,3....n$ in geometric progression relative to the hierarchal topology of the space (Fig. 5).

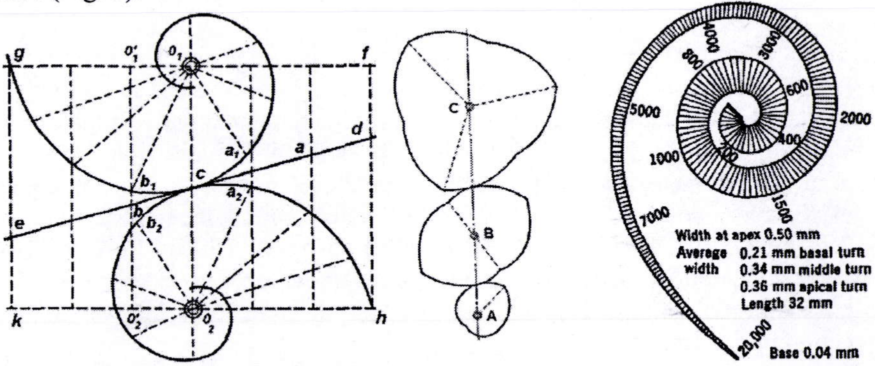

Figure 12. (a) Two logarithmic spirals illustrating perfect rolling contact (no slip) that cannot be continuous because of boundary limits. (b) Continuous rolling contact by 1, 2 & 3 lobed spheres (segments of (a)) illustrating how HD hierarchy nodes may be formed. (c) The basilar membrane of the ear is tapered (like radiants) roughly like a logarithmic spiral beginning at a Planck point and widening to the Larmour radius of an atom. Each width is frequency dependent causing sound input of specific frequencies to vibrate more in the location where the radius has the same characteristic resonant frequency.

These log curves are not closed; to adapt to continuous motion, pairs must be utilized. Joining corresponding sections of the spiral form symmetrical unilobed wheels. While sectors needn't be equal or symmetrical, the 'wheels' must be paired with sectors of equal obliquity in contact for pure rolling motion to occur. Wheels may also be bilobed or trilobed etc. up to ND to illustrate the Superspace. A tier of three symmetrical wheels is illustrated in Fig. 12b.

The mechanical concept of rolling contact is used to geometrically illustrate the ontological framework for the new noetic commutation rules of angular momentum. A logarithmic spiral coupled to another of the same obliquity undergoes perfect rolling motion (no slippage and constant touching) as long as arcs of the same obliquity coincide. This system of spirals reaches a limit that could be said to be points of Ising flip; but the rotation is not continuous. To make the rolling continuous one must take 2 sections of the logarithmic spiral (fig 12a) and join them into a spheroid. Then continuous motion may occur. As in Fig. 12b this single lobed gear may be made bilobed or trilobed, again for continuous or perfect rolling motion proper obliquity must be maintained. So here as in the ear metaphor the points of contact correspond to frequencies.. If the point of contact corresponds to the z axis we have moments of commutation of angular momentum. Leaving one gear set (the spin tower of frequencies) we have a system of close packed spheres of least cosmological units undergoing the noetic mantra (spin-exchange, dimensional reduction, compactification) which means that there are HD moments of commutation in the 12D structure. Since angular momentum is the resultant of the atomic magnetic moment and (center of mass) harmonic frequencies (as in the cyclotron frequencies of synchrotron radiation) should make these other (x & Y) components of angular momentum accessible, In any given discretized (composite) E_3 frame only the z axis will commute as per standard quantum theory; but in the complex HD space the E_3 non-commutative parameters commute periodically on rotation through mirror tangent nodes of proper obliquity in the continuous state topology; i.e. in considering all HD hyperplanes, there are periodic simultaneous moments where commutation may be accessible by RF pulses of the proper harmonic cyclotron frequency.

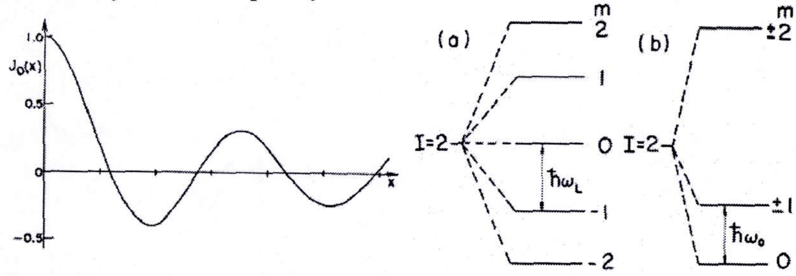

Figure 13. (a) Graph of Bessel function $J_0(x)$ showing how J_0 oscillates as x increases. (b) Nuclear energy splitting of substates for total spin 2 in a magnetic field and (c) axially symmetric electric field with quadratic energy splitting, ω is the spin precession frequency.

Bessel functions could be used to manipulate the complex cavity resonance modes. For example in a generalized Cramer event cavity (between future-past topological boundaries) the magnitude of a uniform applied electric field with E_0 constant can be taken as $E = E_0 e^{i\omega t}$. If the frequency increases the electric field flux through any loop Γ_1 produces an oscillating magnetic field $B = i\omega r / 2c^2 \cdot E_0 e^{i\omega t}$ proportional to r, the radius of the cavity. This varying magnetic field, proportional to the rate of change of E and thus ω, effects the electric field so it can no longer be uniform by Faraday's Law and also changes with r [64]. This requires corrections to our original uniform field E_1 such that the corrected field must now be $E = E_1 + E_2 + E_3 ... E_n$ which is best described by the Bessel function J_0 with $x = \omega r / c$

$$J_0(x) = 1 - \frac{1}{(1!)^2}\left(\frac{x}{2}\right)^2 + \frac{1}{(2!)^2}\left(\frac{x}{2}\right)^4 + \frac{1}{(3!)^2}\left(\frac{x}{2}\right)^6 + \dots \qquad (24)$$

such that E is now

$$E = E_0 e^{i\omega t} J_0\left(\frac{\omega r}{c}\right). \qquad (25)$$

8. Microphysical Computation Limits: The Case for Relativistic Qbits

In the conventional consideration of quantum computing a quantum bit or qbit is any two-state quantum system defined as a superposition of two logical states of a usual bit with complex coefficients that can be mapped to the Riemann sphere by stereographic projection (Fig. 13). Formally a qbit is represented as: $\Psi = \xi|0\rangle + \eta|1\rangle$ with each ray $\xi, \eta \in C$ in complex Hilbert space and $\|\Psi\|^2 = \xi\overline{\xi} + \eta\overline{\eta} = 1$, where $|0\rangle$ corresponds to the south or 0 pole of the Riemann sphere and $|1\rangle$ corresponds to the opposite or north or ∞ pole of the Riemann complex sphere. The conventional qbit maps to the complex plane of the Riemann sphere as:

$$\xi\overline{\eta} + \eta\overline{\xi} \to X, \quad \xi\overline{\eta} - \eta\overline{\xi} \to iY, \quad \xi\overline{\xi} - \eta\overline{\eta} \to Z. \qquad (26)$$

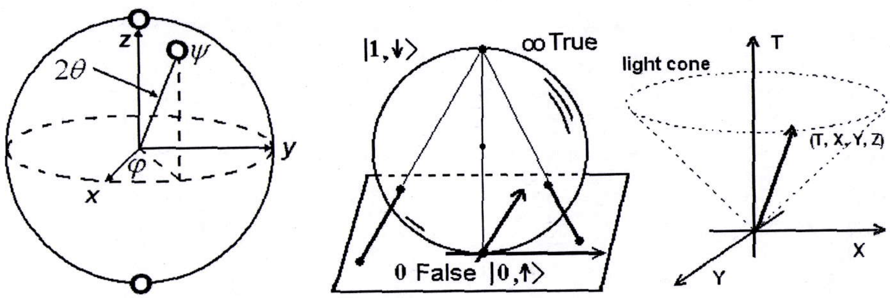

Figure 14. The qbit. (a) Block Sphere representation of a qbit, a geometrical representation of the pure state space of a two-level quantum mechanical system. Alternately, it is the pure state space of a 1 qubit quantum register. (b) Stereographic projection model of a qbit on a complex Riemann sphere. (c) Relativistic model of a qbit with interacting quantum fields.

Unitary transformations of a qbit correspond to 3D rotations of the Riemann sphere. Following Vlasov [65] for relativistic consideration of a qbit (r-qbit) an additional 4D parameter is added to equation (24):

$$\xi\overline{\eta} + \eta\overline{\xi} \to X, \quad \xi\overline{\eta} - \eta\overline{\xi} \to iY, \quad \xi\overline{\xi} - \eta\overline{\eta} \to Z, \quad \xi\overline{\xi} + \eta\overline{\eta} \to T \qquad (27)$$

In cartography and geometry, the stereographic projection is a mapping that projects each point on a sphere onto a tangent plane along a straight line from the antipode of the point of tangency (with one exception: the center of projection, antipodal to the point of tangency, is not projected to any point in the Euclidean plane; it is thought of as corresponding to a "point at infinity"). One approaches that point at infinity by continuing in any direction at all; in that respect this situation is unlike the real projective plane, which has many points at infinity.

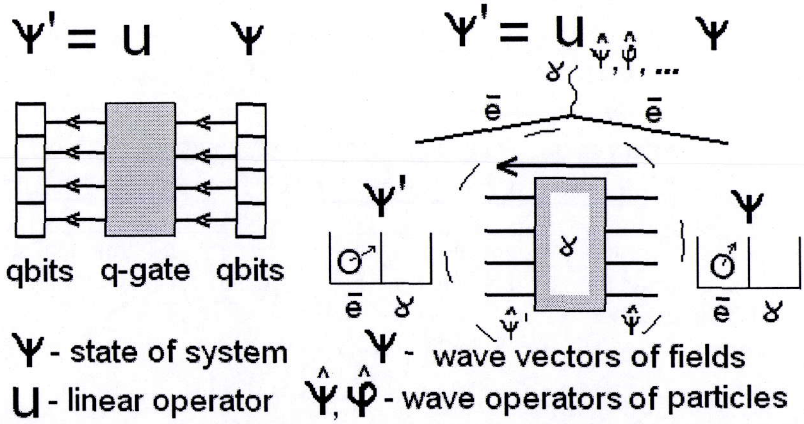

Figure 15. (a) Usual q-gate with constant number of states and particles. (b) Relativistic quantum bit (r-qbit) with constant particles but variable or infinite states.

9. Essential Parameters of the Dubois Incursive Oscillator (DIO)

The evolution of physical theory from Classical to Quantum changed the fundamental understanding of a point or point particle from continuous – represented in 3D Euclidian space, to discrete fuzzy units with wave-particle duality–represented in 3(4)D Minkowski/Riemann spacetime. As physical cosmology has evolved towards M-Theory it is now realized that neither of these contexts is sufficient or complete. In Multiiverse cosmology the nature of a vertex or point changes into a continuous-state 12D superspace. This means there are three regimes existing simultaneously/ individually: Classical, Quantum and Unity depending on mode of observation.

Motion of a one dimensional classical harmonic oscillator is given by $q = A\sin(\omega t + \varphi)$ and $p = m\omega A\cos(\omega t + \varphi)$ where A is the amplitude and φ is the phase constant for fixed energy $E = m\omega^2 A^2 / 2$. For state $|n\rangle$, with $n = 0,1,2...\infty$ and with Hamiltonian $E_n = (n+1/2)\hbar\omega$ the quantum harmonic oscillator becomes $\langle n|q^2|n\rangle = \hbar / 2m\omega\langle n|(a^\dagger a + aa^\dagger)|n\rangle = E_n / m\omega^2$ and $\langle n|p^2|n\rangle = 1/2(m\hbar\omega)\langle n|a^\dagger a + aa^\dagger = mE_n$ where a & $a^\dagger$ are the annihilation and creation operators, $q = \sqrt{\hbar / 2m\omega}(a^\dagger + a)$ and $p = i\sqrt{m\hbar\omega/2}(a^\dagger a)$. For the 3D harmonic oscillator each equation is the same with energies $E_x = (n_x + 1/2)\hbar\omega_x$, $E_y = (n_y + 1/2)\hbar\omega_y$ and $E_z = (n_z + 1/2)\hbar\omega_z$ [17,20].

In Dubois' notation the classical 1D harmonic oscillator for Newton's 2nd law in coordinates *t* and *x(t)* for a mass *m* in a potential $U(x) = 1/2(kx^2)$ takes the differential form

$$\frac{d^2x}{dt^2} + \omega^2 x = 0 \qquad where \qquad \omega = \sqrt{k/m} \tag{28}$$

which can be separated into the coupled equations (29)

$$\frac{dx(t)}{dt} - v(t) = 0 \qquad and \qquad \frac{dv(t)}{dt} + \omega^2 x = 0. \tag{29}$$

From incursive discretization, Dubois creates two solutions $x(t+\Delta t)$ $v(t+\Delta t)$ providing a structural bifurcation of the system which together produce Hyperincursion. The effect of increasing the time interval discretizes the trajectory [5,66-68]. This represents a background independent discretization of spacetime. Numerical simulation of the phase space trajectory of the Dubois *superposed incursive oscillator* based on coordinates and velocities

$$x_n = 1/2[x_n(1) + x_n(2)]$$
$$v_n = 1/2[v_n(1) + v_n(2)]$$

is shown in the Figure 5 of the Antippa and Dubois paper [5].

Each mode of a quantum harmonic oscillator is associated with cavity-QED dynamics, hexagon lattices of spacetime topology undergoing continuous transitions. *E* is the state of energy for *n* photons. For $n = 0$ the oscillator is in the ground state, but a finite energy $1/2\hbar\omega$ of the ground state, called the zero-point energy, is still present in the region of the cavity. According to Eq. (30), the quantum harmonic oscillator field energy of the photons undergo periodic annihilation and recreation in the periodic spacetime [69].

$$E_n = (n + \frac{1}{2})\hbar\omega \tag{30}$$

10. Ontological I/O by Superceding Quantum Uncertainty

The critical problem in applying conventional QT to the bulk implementation of QC lies in the accompanying theory of measurement [20]; variables observed change destructively in any interaction between particle and observing apparatus. This phenomenological *force of interaction* is mediated by particle exchange which modifies the Schrödinger equation. In conventional terms 'physical reality is irreducibly quantum' and a qbit resides at a Euclidian, E^3 or Minkowski, M^4 vertex. All attempts for bulk QC have failed in the Copenhagen regime because measurement destroys the quantum system being measured. To overcome this problem the Dirac equation is hyperdimensionalized utilizing an extension of Cramer's Transactional Model of QT where all off diagonal elements are physically real and conformally invariant. Bulk implementation of UQC requires a new superspace N^{12} without a real vertex where not only is the arbitrarily chosen *z*-axis of angular momentum accessible; but the x and y components are also real and accessible by a new anticipatory transformation law for ontological evolution utilizing topological switching. This is conceptually elucidated by unfolding a hypercube (Fig. 1). Relative to the subspace E_3 the extra square called a satellite is *causally free* of E_3 when carried to 12D unitarity.

During the HD continuous-state topological transformation of the cosmological form of Dirac spherical rotation, a pinch or twist occurs in the middle of the transform followed by an Ising flip [37] of the close-packed complex Riemann spheres which can be driven by the micromagnetic spintronics [14] of fractional and integer quantum Hall effects because of the highly symmetric topological parameters [1] of driven Micromagnetics [14]. This UQC can be implemented in any sufficient multi-state quantum system, whether solid, liquid, bubble, crystal, dot, network, trap, well, vacuum backcloth, comprised of atoms, molecules, ions, photons, spins, NMR, threads, lines, block walls, domain walls, lattices or arrays able to utilize coherent control of the synchronization backbone [30]. In order to avoid the Copenhagen limitations of collapse and dissipation [70] UQC requires utilization of the hierarchical and recursive properties of complex self-organization inherent in the *whole universe*, not just a portion of its observed parameters. The critical condition is the introduction of a model for evolution of the wave function making correspondence to a new non-collapse (ontological or energyless) version of RQFT. By a coherent control of Ising spin flips [37] of the noetic spacetime least-units (a topological switching of metrics [14]) domains of discretization ($\Delta x \Delta \rho \cong \hbar$) may be avoided by utilizing periodic nodes in the resonant hierarchy that are commutative because the Riemann curvature tensor equals zero [71]. E_3 is a discretization, a composite of future-past potentials. In HD where the parameters are separated one can manipulate commutative and noncommutative regimes. Another way to illustrate the intended use of coordinated RF sine wave π-pulses (Fig. 16) with the geometry of spatial rotations of a pair of common dice to show that some rotations commute, $a \otimes b = b \otimes a$ and others are noncommutative $a \otimes b \neq b \otimes a$.

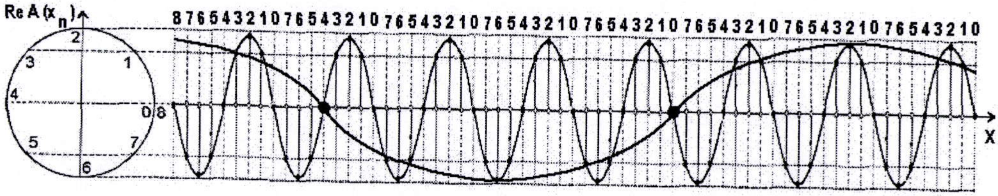

Figure 16. Depiction of 2π and 14π harmonic waves coinciding at 2 points on the x-axis corresponding to points 4 and 0,8 on the reference circle. The geometry of a reference circle (2D for simplicity, actually an HD hypersphere) is utilized to set up RF harmonic oscillator π-pulse parameters for phase alignment with the inherent Adv-Ret elements of the spacetime synchronization backbone. The periodicity of the phase points ϕ are aligned to manipulate symmetries of corresponding regimes of commutative and noncommutative modes.

11. A Twistor Approach to the UQC I/O Ontology

Because of the essential requirement of utilizing Dirac spherical rotation to access the inherent synchronization backbone in HAM cosmology it is suggested that a Penrose twistor approach provides the most efficient methodology for coupling to the resonant hierarchy.

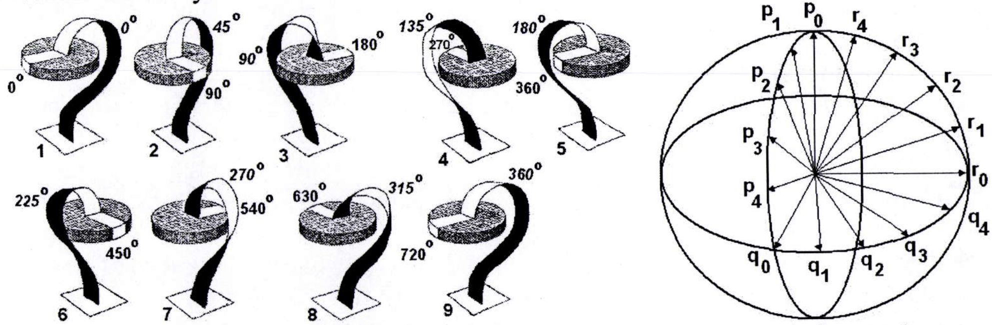

Figure 17. (a) Geometry of Dirac spherical rotation showing the 360° - 720° degree complementarity structure of spin ½ particles without the topological pinch. (b) Hyperspherical modeling for switching the coordination of phase angles.

Given worldline $y^a(s)$ and fundamental twistor relation $Z^\alpha = (\omega^A, \pi_{A'})$ following [72,73] we define $\xi^A(s) = \omega^A - iy^{AA'}(s)\pi_{A'}$. Then for the scalar field contours (Fig. 18) we define a twistor function $f(Z^\alpha)$ by

$$f(Z^\alpha) = \oint \frac{ds\,\alpha \cdot \beta}{(\alpha \cdot \xi)(\beta \cdot \xi)} \tag{31}$$

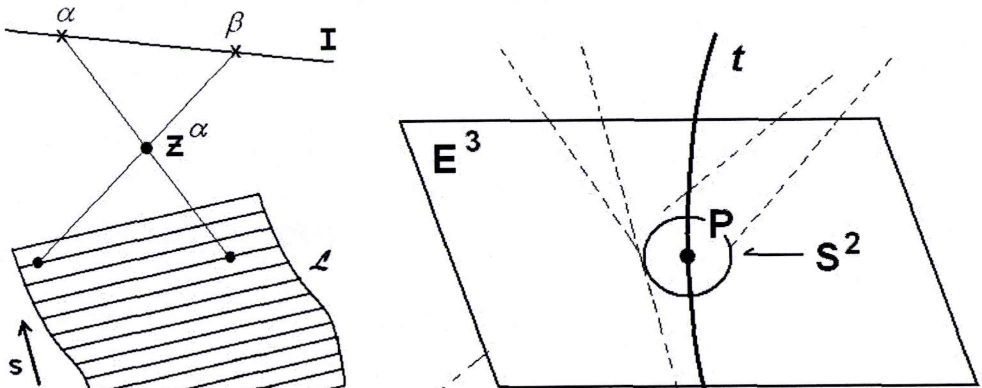

Figure 18. (a) A piece of ruled surface $\mathscr{L}$ for worldline $y^a(s)$ where each line on the surface represents a point on the complex worldline *I*. (b) Small sphere, S^2 surrounds E^3 worldline P with null twistors Z^α representing null lines meeting S^2.

where α_A and β_A are fixed spinors and $\alpha \cdot \beta = \alpha_A \beta^A$. In this regime the field produced by the unit charge has poles corresponding to advanced and retarded points on the worldline [72,73]. Taking an EM field potential $\Phi AA'(x)$ with left and right handed components given by $\phi A'B' = \nabla^{A}_{A'\Phi B'A}$ and $\phi AB = \nabla^{A'}_{A\Phi BA'}$ respectively [72,73].

Twistor functions describe relative cohomology classes in $\mathbb{PT}$ regions; but the same twistor functions may also be examined geometrically in M^4 [73]. The contour in Eq. (31) is a small loop around the $\alpha \cdot \xi = 0$ and $\beta \cdot \xi = 0$ poles (Fig. 19). There are two of these, one for advanced and one for retarded solutions. When a singularity is reached (Dirac pinch) one switches from $f(\alpha)$ to $f(\beta)$. In a small neighborhood U of $\mathfrak{L}$, U_α, U_β keeps away from the branching singularity of $f(\alpha)$, $f(\beta)$. The process of doing contour integrals gives a well defined field; choice of contour gives any linear combination of Adv. and Ret. solutions. The α and β spinors represent opposite directions in E^3 but not in the same regions. The contours move continuously from Ret to Adv [72,73].

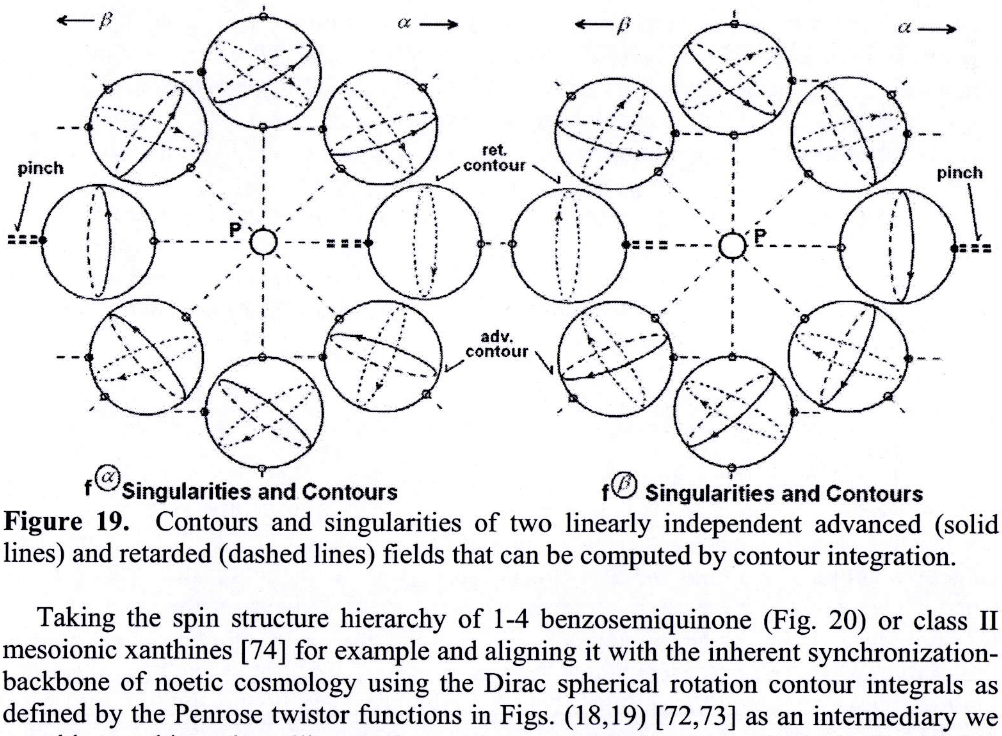

Figure 19. Contours and singularities of two linearly independent advanced (solid lines) and retarded (dashed lines) fields that can be computed by contour integration.

Taking the spin structure hierarchy of 1-4 benzosemiquinone (Fig. 20) or class II mesoionic xanthines [74] for example and aligning it with the inherent synchronization-backbone of noetic cosmology using the Dirac spherical rotation contour integrals as defined by the Penrose twistor functions in Figs. (18,19) [72,73] as an intermediary we are able to achieve the rolling motion contacts suggested metaphorically in Fig, 12. but in the Dirac spherical rotation manner of Fig. 17. Why? This is to achieve ontological topological switching with the satellite regime of Fig. 1. Noetic theory postulated that this path is only open in the continuous-state leapfrogging of the Vigier-Amoroso coordinates [52,53].

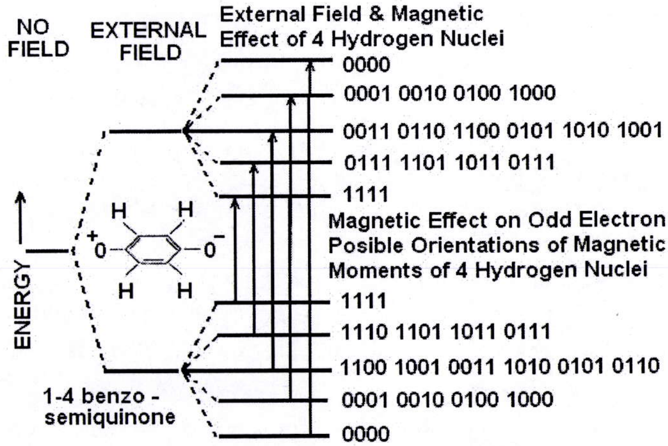

Figure 20. The spin states of 1-4 benzosemiquinone, a molecule suitable for testing QC parameters by application of RF fields.

This complexity arises because the Dirac pinch (illustrated in Figs. 4c,7b,11b) is a fundamental process of reality (not just the electron) since the eternal origin of the unitary field is causally separated from E^3. To comprehend one must hold Fig. 4c in ones mind while wrapping it around the context of Fig. 19 where the interplay of the three regimes (classical, quantum, unitary) occurs. In order for the I/O pulses to achieve coupling to the proper leapfrogging contours the resonance modes of the RF pulses must align precisely with the inherent beat frequency of the spacetime backcloth, i.e. without the coherent control [75] the inherent synchronization backbone provides there can be no cumulative interaction with the Dirac spherical rotation hierarchy and no ontological initialization or processing of the QC registers and the QC remains stuck at the ten qbit limit of the Copenhagen regime.

12. Conclusion

The debate over the completeness of quantum theory has raged for nearly one hundred years. Completing QT to find a method for empirically surmounting the uncertainty principle has been no easy task. We have stated that bulk QC cannot be achieved within the limits of Bigbang cosmology or the bounds described by the Copenhagen regime. Here we have produced a rudimentary path for the completion of QT through a model for the implementation of bulk QC. We doubt one can understand the ontology without comprehending the new cosmology and have perhaps overdone the metaphors in hoping to facilitate this. We can only guess how difficult it will be to build a prototype. One could like Edison try 10,000 filaments (multiphase concatenation of resonant hierarchy coupling modes) and expect to achieve success with sufficient effort. Two things remain to facilitate a clear path; rigorous work on the physical cosmology of the arrow of time and final formalizing of the basis for the noetic transform. We are working to complete both of these programs in other works and for part II of this paper.

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