Empirical Protocol for Measuring Virtual Tachyon / Tardon Interactions in a Dirac Vacuum

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Abstract. Here we present discussion for the utility of resonant interference in Calabi-Yau mirror symmetry as a putative empirical test of the existence of virtual tachyon / tardon interactions in a covariant Dirac polarized vacuum

INTRODUCTION - MULTIDIMENSIONAL GEOMETRY AND CLOSED TIME-LIKE LOOPS

It appears that a resolution of the problem of closed time-like loops (CTL) lies in developing a model in terms of a space of higher dimensionality, HD. What appears to be a closed loop in 4D spacetime may in fact *not* have an intersection in an HD space [1].. Normal macroscopic causality demands that no point in the forward lightcone is connected to another point outside the forward lightcone; that is, all signals are time-like [2]. Real events involve simultaneity which is defined by signals that do not exceed the velocity of light, $v \leq c$ where v is the velocity of propagation and c is the velocituy of light. Causality conditions for superliminal signals in constructing a Lorentz invariant quantum field theory are given in [3,4]. Tipler examines the problem of CTLs in general relativity for a rapidly rotating gravitational field [5]. The relationship of causality and locality conditions is dicussed in [6].

- First, the case in which there is no connection of past and future is represented, i.e., there is no causal connection.
- Second, the usual Minkowski diagram for a single valued present. In quantum mechanical terms, the collapse of the wave function describing the system under consideration allows only one world line.
- Third, the present or 'now' condition is not single valued. The event wave function no longer collapses to a point, localized region of spacetime, and more than one world line can represent the present.

In fact, for point-like events, one could conceivably have an infinite number of world lines passing through the present. Everett, Graham and Wheeler have examined the quantum mechanical implications of a multi-valued universe theory [7]. More detail is presented in [6]. Information about a future event may then be traced back to the present via another world line and that actual time sequencing experienced is associated with the first world line or possibly a third world line. Of course one of the major problems of a theory containing multivalue solutions is the difficulty in defining a reasonable and useful causal relationship. The 4-space description gives us CTL which yield difficulties in describing prior and post event occurrences [5]..

Intuitively, considering HD geometric models appears to reconcile the problem of CTL. For example, a helical world line in a 3-space would be single valued but would appear to contain multiple intersections if viewed at a 45° angle to the vertical helical axis as represented in a 2D space. This representation would contain multiple intersections even with a large pitch to the perpendicular to axis radius and hence act like a CTL [8].

A number of HD geometries (Fig. 1) have been examined, in terms of reconciling complex anticipation and precognition-like signaling and causality as well as their possible relationship to superluminal signals [9,10]. In particular we have examined some 5D and 6D geometries where the additional dimensions, XD are space-like and time-like. In [11], instead of hypothesizing a model which involves energy transmission and associated problems of energy conservation, we chose to develop a model in which remote information is accessed in 4-space as though it was not remote in a HD geometry. The relativity theory formally describes the relationship of macroscopic events in spacetime and, in particular, their causal connection is well specified. HD geometries appear to reconcile anticipation or precognition and causality and define a formalism in which the spatial and temporal separation of events in 4-space appear to be in juxtaposition in the HD geometry. This model can well accommodate information and perhaps energy transmission cond-itions as we will discuss in more detail in this volume.

There appears to be a reasonable relationship between these complex spaces and real 4, 5 and 6D spaces. The generalized causal relations in the complex space are consistent with the usual causality conditions, and exclude the CTL paradox. Multidimensional models appear to reconcile Maxwell's equations with the structure of general relativity in the weak gravitational field limit having some quantum mechanical features such as quantum nonlocality.

We introduce a complex 8D matrix in which the real components comprise the usual 4-space of three real space components and a real time component and four imaginary components composed of three imaginary space components and one imaginary time component [6,11].

Hansen and Newman [12] and Rauscher [6,11,13,14] developed the properties of a complex Minkowski space and explored the properties of this geometry in detail. The formalism involves defining a complex space $Z^m = X^m_{\text{Re}} + iX^m_{\text{Im}}$ where the metric of the space is obtained for the line element $ds^2 = g_{mn} dZ^m dZ^{*n}$ where indices m and n run 1 to 4.

In defining conditions of causality for $ds^2 = 0$ for the metrical form we have the usual 4-space Minkowski metric with signature (+++-)

$$ds^2 = g_{mn} dx^m dx^n \qquad \text{(1a)}$$

using units $c = 1$ and $dx_1 = dx,\ dx_2 = dy,\ dx_3 = dz$ and $dx_4 = cdt$ where the indices m and n run 1 to 4; where also

$$g_{mn} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{bmatrix} \qquad \text{(1b)}$$

which is a sixteen element mattrix where the trace, $tr = 2$.

In complex 8D space, we have for our differential line element with coordinates labeled $dZ^m = dX^m_{\text{Re}} + idX^m_{\text{Im}}$ (in which dZ is complex and dX_{Re} and dX_{Im} are themselves real), with a complex matric where h_{in} is analogous to g_{mn} such that

$$ds^2 = h_{mn} dZ^m dZ^{*m} \qquad \text{(.2)}$$

so that, for example, $dZ^m dZ^{*m} = (dX^m_{\mathrm{Re}})^2 + (dX^m_{\mathrm{Im}})^2$. We can write in general for real and imaginary space and time components:

$$\begin{aligned} ds^2 &= \left(dx^2_{\mathrm{Re}} + dx^2_{\mathrm{Im}}\right) + \left(dy^2_{\mathrm{Re}} + dy^2_{\mathrm{Im}}\right) \\ &+ \left(dz^2_{\mathrm{Re}} + dz^2_{\mathrm{Im}}\right) - c^2\left(dt^2_{\mathrm{Re}} + dt^2_{\mathrm{Im}}\right) \end{aligned} \tag{3}$$

In [11] we represent the three real spacial components, dx_{Re}, dy_{Re}, dz_{Re}, as dX and the three imaginary spacial components, dx_{Im}, dy_{Im}, dz_{Im} as dX_{Im} and similarly for the real time component $dt_{\mathrm{Re}} \equiv dt$ and $dt_{\mathrm{Im}} = dt$. We then introduce complex spacetime-like coordinates as a space-like part $x_{\mathrm{Im}} = c$ and a time-like part $t_{\mathrm{Im}} = t$ as imaginary parts of *X* and *t*.

Now we have the invariant line elements as

$$s^2 = |x'|^2 - c|t'|^2 = |x'|^2 - |t'|^2 \tag{4}$$

again where we choose units where $c^2 = c = 1$ and

$$x' = X_{\mathrm{Re}} + iX_{\mathrm{Im}} \tag{5}$$

and

$$t' = t_{\mathrm{Re}} + it_{\mathrm{Im}} \tag{6}$$

as our complex dimensional component [15]. We use

$$x'^2 = |x'|^2 = X^2_{\mathrm{Re}} + X^2_{\mathrm{Im}} \tag{7}$$

and

$$t'^2 = |t'|^2 = t^2_{\mathrm{Re}} + t^2_{\mathrm{Im}}. \tag{8}$$

Recalling that the square of a complex number is given as the modulus

$$|x'| = x'x'^* = \left(X_{\mathrm{Re}} + iX_{\mathrm{Im}}\right)\left(X_{\mathrm{Re}} - iX_{\mathrm{Im}}\right) \tag{9}$$

for X_{Re} and X_{Im} real. The fundamental key to this set of calculations is that the modulus of the product of complex numbers is real. Therefore, we have the 8-space line element.

$$\begin{aligned} s^2 &= x^2_{\mathrm{Re}} - c^2 t^2_{\mathrm{Re}} + x^2_{\mathrm{Im}} - c^2 t^2_{\mathrm{Im}} \\ &= x^2_{\mathrm{Re}} - t^2_{\mathrm{Re}} + x^2_{\mathrm{Im}} - t^2_{\mathrm{Im}} \end{aligned} \tag{10}$$

Causality is defined by remaining on the right cone, in real spacetime, as

$$s^2 = x^2_{\mathrm{Re}} - c^2 t^2_{\mathrm{Re}} = x^2_{\mathrm{Re}} - t^2_{\mathrm{Re}} \tag{11}$$

using the condition c = 1. Then generalized causality in complex spacetime is defined by

$$s^2 = x^2_{\mathrm{Re}} - t^2_{\mathrm{Re}} + x^2_{\mathrm{Im}} - t^2_{\mathrm{Im}} \tag{12}$$

in the $x_{\text{Re}}, t_{\text{Re}}, x_{\text{Im}}, t_{\text{Im}}$ generalized light cone 8D space.

Let us calculate the interval separation between two events or occurrences Z_1 and Z_2 with real separation $\Delta x_{\text{Re}} = x_{2\text{Re}} - x_{1\text{Re}}$ and imaginary separation $\Delta x_{\text{Im}} = x_{2\text{Im}} - x_{1\text{Im}}$. Then the distance along the line element is $\Delta s^2 = \Delta(x_{\text{Re}}^2 + x_{\text{Im}}^2 - t_{\text{Re}}^2 - t_{\text{Im}}^2)$ and it must be true that the line interval is a real separation. Then

$$\begin{aligned}\Delta s^2 &= (x_{2,\text{Re}} - x_{1,\text{Re}})^2 + (x_{2,\text{Im}} - x_{1,\text{Im}})^2 \\ &\quad -(t_{2,\text{Re}} - t_{1,\text{Re}})^2 - (t_{2,\text{Im}} - t_{1,\text{Im}})^2\end{aligned} \tag{13}$$

or

$$\begin{aligned}\Delta s^2 &= (x_{2,\text{Re}} - x_{1,\text{Re}})^2 + (x_{2,\text{Im}} - x_{1,\text{Im}})^2 \\ &\quad -(t_{2,\text{Re}} - t_{1,\text{Re}})^2 - (t_{2,\text{Im}} - t_{1,\text{Im}})^2\end{aligned} \tag{14}$$

Because of the relative signs of the real and imaginary space and time components and in order to achieve the causality connectedness condition between the two events, or Δs^2, we must "mix" space and time. That is, we use the imaginary time component to effect a zero space separation. We identify $(x_{1,\text{Re}}, t_{1,\text{Re}})$ with one spacetime event causally correlated with another spacetime event, $(x_{2,\text{Re}}, t_{2,\text{Re}})$ [16].

By introducing the imaginary time component, one can achieve a conditon in which the apparent separation in the real physical plane defined by x_{Re}, t_{Re} is zero, given access to the imaginary time, t_{im}, or the x_{Re}, t_{im} plane yielding spatial nonlocality.

The lightcone metric representation may imply superluminal signal propagation between an event A transmitter and even in the four real subset space by the event B (receiver) or two simultaneously remotely connected events. Separation will not appear superluminal in the 8-space representation. The causality conditions, which do not contain closed time-like loops, are for the complex 8-space geometry, where 4-space is a cut through the 8-space [11]. Newton examines causality conditions in 4-space with superluminal signals [4] and the problem of closed time-like loops posed by Feinberg's classic "Tachyon" paper [3]. These problems appear to be resolved by considering spaces of higher (>4D) dimensions and are consistent with subliminal and superliminal signals [9].

In a later section we will discuss the relationship between subliminal, time-like, and superliminal, space-like, interpretation of the remote connectedness phenomena, such as the nonlocality test of Bell's theorem.

LORENTZ CONDITION IN COMPLEX 8-SPACE AND TACHYONIC SIGNALING

In order to examine as the consequences of the relativity hypothesis that time is the fourth dimension of space, and that we have a particular form of transformation called the Lorentz transformation, we must define velocity in the comple space. That is, the Lorentz transformation and its consequences, the Lorentz contradiction and mass dielation, etc., are a consequence of time as the fourth dimension of space and are observed in three spaces [17,18]. These attributes of 4-space in 3-space are expressed in terms of velocity, as in the form $g = \left(1 - b^2\right)^{-1/2}$ for $b \equiv v_{\text{Re}} / c$ where c is always taken as real.

If complex 8-space can be projected into 4-space, what are the con-sequences? We can also consider a

4D slice through the complex 8D space. Each approach has its advantages and disadvantages. In projective geometries information about the space is lost. What is the comparison of a subset geometry formed from a projected geometry or a subspace formed as a slice through an XD geometry? What does a generalized Lorentz transformation "look like"? We will define complex derivatives and therefore we can define velocity in a complex plane [11].

Consider the generalized Lorentz transformation in the system of x_{Re} and t_{Im} for the real time remote connectedness case in the $x_{\mathrm{Re}}, t_{\mathrm{Im}}$ plane. We define our substitutions from 4-to 8-space before us,

$$\begin{aligned} x &\rightarrow x' = x_{\mathrm{Re}} + i x_{im} \\ t &\rightarrow t' = t_{\mathrm{Re}} + i t_{im} \end{aligned} \tag{15}$$

and we represented the case for no imaginary component of x_{Re} or $x_{\mathrm{Im}} = 0$ where the $x_{\mathrm{Re}}, t_{\mathrm{Re}}$ plane comprises the ordinary 4-space plane.

Let us recall that the usual Lorentz transformation conditions defined in four real space. Consider two frames of reference, Σ, at rest and Σ' moving at relative uniform velocity *v*. We call *v* the velocity of the origin of Σ' moving relative to Σ. A light signal along the *x* direction is transmitted by $x = ct$ or $x - ct = 0$ and also in Σ' as $x' = ct'$ or $x'-ct' = 0$, since the velocity of light in vacuo is constant in any frame of reference in 4-space. For the usual 4D Lorentz transformation, we have as shown in Eq. (2.16), $x = x_{\mathrm{Re}}, t = t_{\mathrm{Re}}$ and $v_{\mathrm{Re}} = x_{\mathrm{Re}} / t_{\mathrm{Re}}$.

$$\begin{aligned} x' &= \frac{x - vt}{\sqrt{1 - v^2/c^2}} = g\left(x - vt\right) \\ y' &= y \\ z' &= z \\ t' &= \frac{t - \left(v/c^2\right)x}{\sqrt{1 - v^2/c^2}} = g\left(t - \left(\frac{v}{c^2}x\right)\right) \end{aligned} \tag{16}$$

for $g = (1 - b^2)^{-1/2}$ and $b = v/c$. Here *x* and *t* stand for x_{Re} and t_{Re} and *v* is the real velocity.

We consider the $x_{\mathrm{Re}}, t_{\mathrm{Im}}$ plane and write the expression for the Lorentz conditions for this plane (Fig. 2.1). Since again t_{Im} like t_{Re} is orthogonal to x_{Im} and t'_{Im} is orthogonal to x'_{Im} we can write

$$\begin{aligned} x' &= \frac{x - ivt_{\mathrm{Im}}}{\sqrt{1 - v^2/c^2}} = g_v\left(x - vt_{\mathrm{Im}}\right) \\ y' &= y \\ z' &= z \\ t' &= \frac{t - \left(v/c^2\right)x}{\sqrt{1 - v^2/c^2}} = g_v\left(t - \left(\frac{v}{c^2}x\right)\right) \end{aligned} \tag{17}$$

where g_v represents the definition of g in terms of the velocity *v*; also $b_{v\mathrm{Im}} \equiv v_{\mathrm{Im}} / c$ where *c* is always taken as real [19] where *v* can be real or imaginary.

In Eq. 2.17 for simplicity we let x', x, t' and t denote $x'_{\mathrm{Re}}, x_{\mathrm{Re}}, t'_{\mathrm{Re}}$ and t_{Re} and we denote script v as v_{Im}. For velocity, v is $v_{\mathrm{Re}} = x_{\mathrm{Re}} / t_{\mathrm{Re}}$ and $v = v_{\mathrm{Im}} = i_{\mathrm{Im}} / it_{\mathrm{Im}}$; where the *i* drops out so that

$v = v_{\mathrm{Im}} = x_{\mathrm{Im}} / t_{\mathrm{Im}}$ is a real value function. In all cases the velocity of light c is c. We use this alternative notation here for simplicity in the complex Lorentz transformation.

The symmetry properties of the topology of the complex 8-space gives us the properties that allow Lorentz sonditions in 4D, 8D ans ultimately 12D space. The example we consider here is a subspace of the 8-space of $x_{\mathrm{Re}}, t_{\mathrm{Re}}, x_{\mathrm{Im}}$ and t_{Im}. In some cases we let $x_{\mathrm{Im}} = 0$ and just consider temporal remote connectedness; but likewise we can follow the anticipatory calculation and formulate remote, nonlocal solutions for $x_{\mathrm{Im}} \neq 0$ and $t_{\mathrm{Im}} = 0$ or $t_{\mathrm{Im}} \neq 0$. The anticipatory case for $x_{\mathrm{Im}} = 0$ is a 5D space as the space for $x_{\mathrm{Im}} \neq 0$ *and* $t_{\mathrm{Im}} = 0$ is a 7D space and for $t_{\mathrm{Im}} \neq 0$ as well as the other real and imaginary spacetime dimensions, we have our complex 8D space.

It is important to define the complex derivative so that we may define velocity, v_{Im}. In the $x_{\mathrm{Re}}t_{\mathrm{Im}}$ plane then, we define a velocity of $v_{\mathrm{Im}} = dx/dit_{\mathrm{Im}}$. In the next section we detail the velocity expression for v_{Im} and define the derivative of a comple x function in detail [3].

For $v_{\mathrm{Im}} = dx / idt_{\mathrm{Im}} = -idx / dt_{\mathrm{Im}} = -iv_{\mathrm{Re}}$ for v_{Re} as a real quantity, we substitute into our $x_{\mathrm{Re}}, t_{\mathrm{Im}}$ plane Lorentz transformation conditions as

$$
\begin{aligned}
x' &= \frac{x_{\mathrm{Re}} - v_{\mathrm{Re}} t_{\mathrm{Im}}}{\sqrt{1 + v_{\mathrm{Re}}^2 / c^2}} \\
y' &= y \\
z' &= z \\
t'_{\mathrm{Im}} &= \frac{t_{\mathrm{Re}} - v_{\mathrm{Re}} x_{\mathrm{Re}}}{\sqrt{1 + v_{\mathrm{Re}}^2 / c^2}}
\end{aligned}
\qquad (18)
$$

These conditions will be valid for any velocity, $v_{\mathrm{Re}} = -v$.

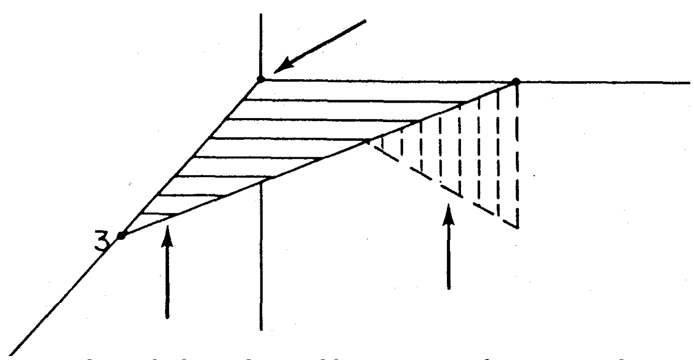

Figure 1. We illustrate an example in which a real space-like separation of events P_1 and P_2 appears to be contiguous by the introduction of the complex time, $t_{x\mathrm{Re}} + it_{x\mathrm{Im}}$ such that from the point of view of event P_3, the time-like separation between $(x_2(P_2) - x_1(P_1))$ appears to be zero.

Let us examine the way this form of the Lorentz transformation relates to the properties of mass dilation. We will compare this case to the ordinary mass dilation formula and the tachyonic mass formula of Feinberg [3] which nicely results from the complex 8-space. See Fig. 1.

In the ordinary $x_{\mathrm{Re}} t_{\mathrm{Re}}$ plane then, we have the usual Einstein mass relationship of

$$m = \frac{m_0}{\sqrt{1 - v_{\mathrm{Re}}^2 / c^2}} \quad \text{for} \quad v_{\mathrm{Re}} \le c \tag{19}$$

and we can compare this to the tachyonic mass relationship in the *xt* plane

$$m = \frac{m_0^*}{\sqrt{1 - v_{\mathrm{Re}}^2 / c^2}} = \frac{im_0}{\sqrt{1 - v_{\mathrm{Re}}^2 / c^2}} = \frac{m_0}{\sqrt{v_{\mathrm{Re}}^2 / c^2 - 1}} \tag{20}$$

for v_{Re} now $v_{\mathrm{Re}} \ge c$ and where m^* or m_{Im} stands for $m^* = im$ and we define m as m_{Re},

$$m = \frac{m_0}{\sqrt{1 + v^2 / c^2}} \tag{21}$$

For m real (m_{Re}), we can examine two cases on v as $v < c$ or $v > c$, so we will let v be any value from $-\infty < v < \infty$, where the velocity, v, is taken as real, or v_{Re}.

Consider the case of v as imaginary (or v_{Im}) and examine the consequences of this assumption. Also we examine the consequences for both v and m imaginary and compare to the above cases. If we choose v imaginary or $v^* = iv$ (which we can term v_{Im}) the $v^{*2} / c^2 = -v^2 / c^2$ and $\sqrt{1 + v^{*2} / c^2}$ becomes $\sqrt{1 - v^{*2} / c^2}$ or

$$m = \frac{m_0}{\sqrt{1 - v_{\mathrm{Re}}^2 / c^2}} \tag{22}$$

We get the form of this normal Lorentz transformation if v is imaginary $(v^* = v_{\mathrm{Im}})$

If both v and m are imaginary, as $v^* = iv$ and $m^* = im$, then we have

$$m = \frac{m_0^*}{\sqrt{1 + v^{*2} / c^2}} = \frac{im_0}{\sqrt{1 - v^2 / c^2}} = \frac{m_0}{\sqrt{v^2 / c^2 - 1}} \tag{23}$$

or the tachyonic condition.

If' we go "off" into x_{Re} t_{Re} t_{im} planes, then we have to define a velocity "cutting across" these planes, and it is much more complicated to define the complex derivative for the velocities. For subliminal relative systems Σ and Σ' we can use vector addition such as $W = v_{\mathrm{Re}} + iv_{\mathrm{Im}}$ for $v_{\mathrm{Re}} < x$, $v_{\mathrm{Im}} < c$ and $W < c$. In general there will be four comp lex velocities. The relationship of these four velocities is given by the Cauchy-Riemann relations in the next section.

These two are equivalent. The actual magnitude of v may be expressed as $v = [vv^*]^{\frac{1}{2}} \hat{v}$ (where $\hat{v}$ is the unit vector velocity) which can be formed using either of the Cauchy-Riemann equations. It is important that a detailed analysis not predict any extraneous consequences of the theory. Any possibly new phenomenon that is hypothesized should be formulated in such a manner as to be easily experimentally testable.

Feinberg suggests several experiments to test for the existence of tachyons [20]. He describes the following experiment – consider in the laboratory, atom A, at time, t_0 is in an excited state at rest at x_1 and atom B is in its ground state at x_2. At time t_1 atom A descends to the ground state and emits a tachyon in the direction of B. Let E_1 be this event at t_1, x_1. Subsequently, at $t_2 > t_1$ atom B absorbs the tachyon and ascends to an excited state; this is event E_2, at t_2, x_2. Then at $t_3 > t_2$ atom B is excited and A is in its ground state. For an observer traveling at an appropriate velocity, $v < c$ relative to the laboratory frame, the events E_1 and E_2

appear ro occur in the opposite order in time. Feinberg describes the experiment by stating that at $t_2^{'}$ atom *B* spontaneously ascends from the ground state to an excited state, emitting a tachyon which travels toward *A*. Subsequently, at $t_1^{'}$, atom *A* absorbs the tachyon and drops to the ground state.

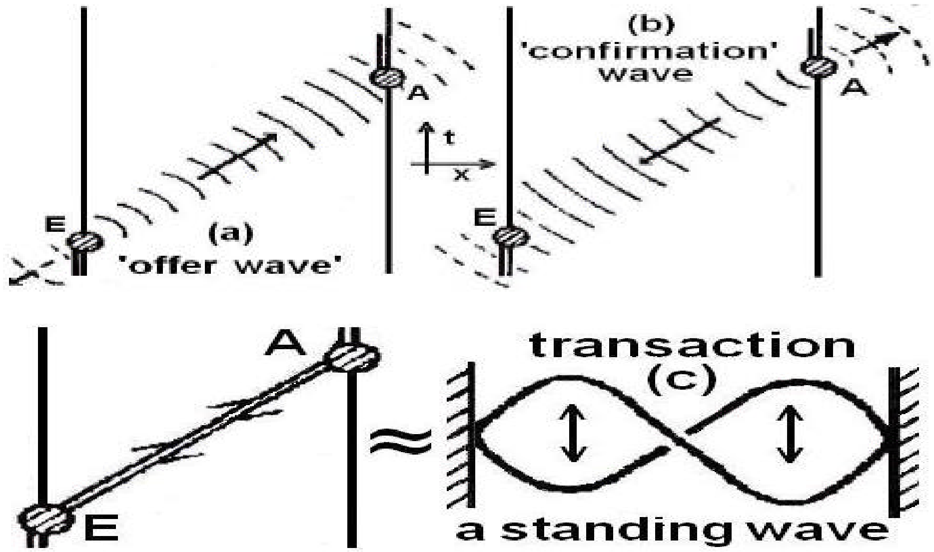

Figure 2 Transactional model. a) Offer-wave, b) confirmation-wave combin-ed into the resultant transaction c) which takes the form of an HD future-past advanced-retarded standing or stationary wave. Figs. Adapted from Cramer [21].

It is clear from this that what is absorption for one observer is spontaneous emission for another. But if quantum mechanics is to remain intact so that we are able to detect such particles, then there must be an observable difference between them: The first depends on a controllable density of tachyons, the second does not. In order to elucidate this point, we should repeat the above experiment many times over. The possibility of reversing the temporal order of causality, sometimes termed 'sending a signal backwards in time' must be addresses [22]. Is this cause-effect statistical in nature? In the case of Bell's Theorem, these correlations are extremely strong whether explained by $v > c$ or $v = c$ signaling.

In [23], Bilaniuk, et al formulated the interpretation of the associtin of negative energy states with tachyonic signaling. From the different frames of reference, thus to one observer absorption is observed and to another emission is observed. These states do not violate special relativity. Acausal experiments in particle physics have been suggested by a number of researchers [24,25]. Another approach is through the detection of Cerenkov radiation, which is emitted by charged particles moving through a substance traveling at a velocity, $v > c$. For a tachyon traveling in free space with velocity, $v > c$ Cerenkov radiation may occur in a vacuum cause the tachyon to lose energy and become a tardon [26].

In a prior joint volumes [27,28] in discussions on the arrow of time we have developed an extended model of a polarized Dirac vacuum in complex form that makes correspondence to both Calabi-Yau mirror symmetry conditions which extends Cramer's Transactional Interpretation [21] of quantum theory to cosmology. Simplistically Cramer models a transaction as a standing wave of the future-past.

However in the broader context of the new paradigm of Holographic Anthropic Multiverse (HAM) cosmology it appears theoretically straight forward to 'program the vacuum' The coherent control of a Cramer transaction can be resonantly programmed with alternating nodes of constructive and destructive interference of the standing-wave present. It should be noted that in HAM cosmology the de Broglie-Bohm quantum potential becomes an eternity-wave, $\aleph$ or super pilot wave or force of coherence associted with the unified field ordering the reality of the observer or the locus of the spacetime arrow of time.

Hierarchical Harmonic Oscillator Parameters	
classical	$X = A\cos(\omega t)$
quantum	$\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2}+\left(E-\frac{kx^2}{2}\right)\psi=0$
annihilation creation	$x(t)=x_0\left[a\exp(-i\omega t)+a^{\dagger}\exp(i\omega t)\right]$
future-past retarded-advanced	$F_1=F_0e^{-ikx}e^{-2\pi ift}$, $F_2=F_0e^{ikx}e^{-2\pi ift}$, $F_3=F_0e^{-ikx}e^{2\pi ift}$, $F_4=F_0e^{ikx}e^{2\pi ift}$
incursive	$\frac{dx(t+\Delta t)}{dt}-v(t)=0, \frac{dv(t+\Delta t)}{dt}+\omega^2=0$

Figure 3 Basic mathematical components of the applied harmonic oscillator: classical, quantum, relativistic, transactional and incursive are required in order to achieve coherent control of the cumulative resonance coupling hierarchy in order to produce harmonic nodes of destructive and constructive interference in the spacetime backcloth.

To perform a simple experiment to test for the existence of Tachyons and Tardons and atom would be placed in a QED cavity or photonic crystal. Utilizing the resonant hierarchy illustrated in Fig. 2.18, through interference the reduced eternity wave, $\aleph$ is focused constructively or destructively as the experimental mode may be and acording to the paramters illustrated by Feinberg above temporal measurements of emission are taken.

VELEOCITY OF PROPAGATION IN COMPLEX 8-SPACE

In this section we utilize the Cauchy-Riemann relations to formulate the hyperdimensional velocities of propagation in the complex plane in various slices through the hyperdimensional complex 8-space. In this model finite limit velocities, $v > c$ can be considered. In some Lorentz frames of reference, instantaneous signalling can be considered. In Fig. 1 is displayed the velocity connection between remote nonlocal events, and temporal separated events or anticipatory and real time event relations.

It is important to define the complex derivative so that we can define the velocity, vy_{Im}. In the *xit* plane then, we define a velocity of $v = dx/d\,(it)$. We now examine in some detail the velocity of this expression. In defining the derivative of a complex function we have two cases in terms of a choice in terms of the differential increment considered. Consider the orthogonal coordinates *x* and it_{Im}; then we have the generalized function, $f(x,t_{\mathrm{Im}}) = f(z)$ for $z = x + it_{\mathrm{Im}}$ and f(z) = $u(x,t_{\mathrm{Im}}) + iv(x,t_{\mathrm{Im}})$ where $u(x,t_{\mathrm{Im}})$ and $v(x_{\mathrm{Im}},t_{\mathrm{Im}})$ are real functions of the rectangular coordinates *x* and t_{Im} of a point in space, $P(x,t_{\mathrm{Im}})$. Cooose a case such as the origin $z_0 = x_0 + it_{0\mathrm{Im}}$ and consider two cases, one for real increments $h = \Delta x$ and imaginary increments $h = i\Delta t_{\mathrm{Im}}$. For the real increments $h = \Delta t_{\mathrm{Im}}$ we form the derivative $f\,'(z_0) \equiv df(z)\,/\,dz_{z_0}$ which is evaluated at z_0 as

$$f' = \lim \Delta x \to 0 \left\{ \frac{u(x_0 + \Delta x, t_{0\text{Im}}) - u(x_0, t_{0\text{Im}})}{\Delta x} + \right. \qquad (2.24a)$$

$$\left. i\frac{v(x_0 + \Delta x, t_{0\text{Im}}) - v(x_0, t_{0\text{Im}})}{\Delta x} \right\}$$

$$f'(z_0) = u_x(x_0, t_{0\text{Im}}) + iv_x(x_0, t_{0\text{Im}}) \text{ for}$$

or

$$u_x \equiv \frac{\partial u}{\partial x} \text{ and } v_x \equiv \frac{\partial v}{\partial x}. \qquad (2.24b)$$

Again $x = x_{\text{Re}}$, $x_0 = x_{0\text{Re}}$ and $v_x = v_{x\text{Re}}$.

Now for the purely imaginary increment, $h = i\Delta t_{\text{Im}}$ we have

$$f'(z_0) = \lim \Delta t_{\text{Im}} \to 0 \left\{ \frac{1}{i} \frac{u(x_0, t_{0\text{Im}} + \Delta t_{\text{Im}}) - u(x_0, t_{0\text{Im}})}{\Delta t_{\text{Im}}} + \right. \qquad (2.25a)$$

$$\left. \frac{v(x_0, t_{0\text{Im}} + \Delta t_{\text{Im}}) - v(x_0, t_{0\text{Im}})}{\Delta t_{\text{Im}}} \right\}$$

and

$$f'(z_0) = -iu_{t\text{Im}}(x_0, t_{0\text{Im}}) + v_{t\text{Im}}(x_0, t_{0\text{Im}}) \qquad (2.25b)$$

for $u_{\text{Im}} = u_{t\text{Im}}$ and $v_{\text{Im}} = v_{t\text{Im}}$ then

$$u_{t\text{Im}} \equiv \frac{\partial u}{\partial t_{\text{Im}}} \text{ and } v_{t\text{Im}} \equiv \frac{\partial v}{\partial t_{\text{Im}}}. \qquad (2.25c)$$

Using the Cauchy-Reimann equations

$$\frac{\partial u}{\partial x} = \frac{\partial v}{\partial t_{\text{Im}}} \text{ and } \frac{\partial u}{\partial t_{\text{Im}}} = -\frac{\partial v}{\partial x} \qquad (2.26)$$

and assuming all principle derivations are definable on the manifold and letting $h = \Delta x + i\Delta t_{\text{Im}}$ we can use

$$f'(z_0) = \lim h \to 0 \quad \frac{f(z_0 + h) - f(z_0)}{h} = \frac{df(z)}{dz}\bigg|_{z_0} \qquad (2.27a)$$

and

$$u_x(x_0, t_{0\text{Im}}) + iv_x(x_0, t_{0\text{Im}}) - \frac{\partial u(x_0, t_{0\text{Im}})}{\partial x} + i\frac{\partial v}{\partial x}(x_0, t_{0\text{Im}}) \qquad (2.27b)$$

with v_x for x and t_{Re} that is $u_{\text{Re}} = u_{x\text{Re}}$, with the derivative form of the charge of the real space increment with complex time, we can define a complex velocity as,

$$f'(z_0) = \frac{dx}{d(it_{\text{Im}})} = \frac{1}{i}\frac{dx}{dt_{\text{Im}}} \qquad (2.28a)$$

we can have $x(t_{\text{Im}})$ where x_{Re} is a function of t_{Im} and $f(z)$ and using $h = i\Delta t_{\text{Im}}$, then

$$f'(z_0) = x'(t_{\text{Im}}) = \frac{dx}{dh} = \frac{dx}{idt_{\text{Im}}}. \qquad (2.28b)$$

Then we can define a velocity where the differential incrrement is in terms of $h = i\Delta t_{\mathrm{Im}}$. Using the first case as $u(x_0, t_{0\mathrm{Im}})$ as and obtaining $dt_{0\mathrm{Im}} / \Delta x$ (with i's) we take the inverse. If u_x which is v_x in the $h \to i\Delta t_{\mathrm{Im}}$ case have both u_x and v_x, one can be zero.

In the next section, we present a brief discussion of $n > 4$D geometries. Like the complex 8D space, the 5D Kaluza-Klein geometries are subsets of the supersymmetry models. The complex 8-space deals in extended dimensions, but like the TOE models, Kaluza-Klein models also treat $n > 4$D as compactified on the scale of the Planck length, 10^{-33} cm [27].

In 4D space (Fig. 1) event point, P_1 and P_2 are spatially separated on the real space axis as $x_{0\mathrm{Re}}$ at point P_1 and $x_{1\mathrm{Re}}$ at point P_2 with separation $\Delta x_{\mathrm{Re}} = x_{1\mathrm{Re}} - x_{0\mathrm{Re}}$. From the event point P_3 on the t_{Im} axis we move in complex space from event P_1 to event P_3. From the origin, $t_{0\mathrm{Im}}$ we move to an imaginary temporal separation of t_{Im} to $t_{2\mathrm{Im}}$ of $\Delta t_{\mathrm{Im}} = t_{2\mathrm{Im}} - t_{0\mathrm{Im}}$. The distance in real space and imaginary time can be set so that measurement along the t_{Im} axis yields an imaginary temporal separation Δt_{Im} subtracts out, from the spacetime metric, the temporal separation Δx_{Re}. In this case occurrence of events P1 and P2 can occur simultaneous, that is, the apparent velocity of propagation is instantaneous.

For the example of Bell's Theorem, the two photons leave a source nearly simultaneously at time, $t_{0\mathrm{Re}}$ and their spin states are correlated at two real spatially separated locations, $x_{1\mathrm{Re}}$ and $x_{2\mathrm{Re}}$ separated by $\Delta x_{\mathrm{Re}} = x_{2\mathrm{Re}} - x_{1\mathrm{Re}}$. This separation is a space-like separation, which is forbidden by special relativity; however, in the complex space, the points $x_{1\mathrm{Re}}$ and $x_{2\mathrm{Re}}$ appear to be be contiguous for the proper path 'traveled' to the point.

We design our tachyon measurement experiment by initially considereing Bohr's starting point for the development of quantum theory, i.e. the emission of photons by atoms from quantum jumps between stable Bohr orbits. We do this from the point of view of the de Broglie-Bohm causal stochastic interpretation in order to take into consideration new laser experimental results described by Kowalski [29]. As one knows light emitted from atoms during transitons of electrons from higher to lower energy states takes the form of photon quanta carrying energy and angular momentum. Any causal description of such a process implies that one adds to the restoring force of the harmonic oscillator an additonal radiation (decelerating) resistance associated (derived from) with the electromagnetic (force) field of the emitted photon by the action equal reaction law. Any new causal condition thus implies that one must add a new force to the Coulomb force acting at random and which we suggest is related to ZPF vacuum resonant coupling and motions of the polarized Dirac aether. We assume that the wave and particle aspects of electrons and photons are built with real extended spacetime structures containing internal oscillations of point-like electromagnetic topological charges, $e^{\pm}$ within an extended form of the causal stochastic interpretation of quantum mechanics. Kowalski's interpretation drawn from recent laser experiments [29] showing that emission and absorbtion between Bohr atomic states take place within a time interval equal to one period of the emitted-absorbed photon wave, the corresponding transition time is the time needed for the orbiting electron to travel one full orbit aroound the nucleus.

- This suggests that electrons (like all massive particles) are not point-like but must be considered as extended spacetime topological structures imbedded in a real physical Dirac aether [30].
- These structures contain internal oscillations of point-like quantum mechanical charges around coresponding gravitational centers of mass, Y_m so that individual electrons have different centers of mass and electromagnetic charge in the particle's and piloting fields.
- The Compton radius of mass is much larger than the radius of the charge distribution [30,31].
- The centers of charge, X_m rotates around the center of mass, Y_m with velocity near the velocity of light, c so that individual electrons are real oscillators with Broglian internal oscillations [32].
- Individual photons are also extended spacetime structures containing two opposite point-like

charges, $e^{\pm}$ rotating with the nearly the velocity of light, $v \simeq c$ at opposite sides of a rotating diameter, with a mass, $m_g \simeq 10^{-65}$gm. and an internal oscillation, $E = mc^2 = \hbar$. (Fig. x)

- The real aether is a covariant polarized Dirac-type stochastic distribution od such extended photons which carry electromagnetic waves built with sets of such extended photons beating in phase amd thus constituting subluminal and superluminal collective electromagnetic fields detected in the Casimir Effect so that a Bohr transition with one photon absorption occurs when a non-radiating Bohr orbital electron collides and beats in phase with an aether photon. In that case a photon is emitted and Bohr electron's charge e^- spirals in one rotation towards the lover level (Exceplex)

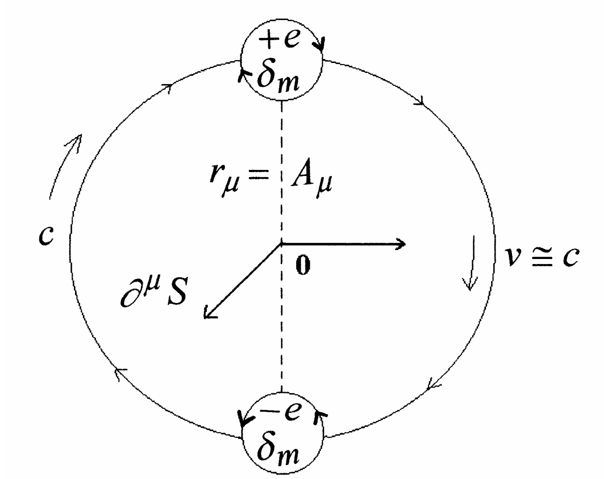

Figure 4. Diagram conceptualizing two oppositely charged sub-elements rotating at v$\cong c$ around a central point 0 behaving like a dipole bump and hole on the topological surface of the covariant polarized Dirac vacuum.

POSSIBLE NEW CONSEQUENCES OF THE MODEL

Since such models evidently imply new testable properties of electromagnetic and gravitational phenomena we shall conclude this work with a brief discussion of the points where it differs from the usual interpretations and implies new possible experimental tests.

If one considers gravitational and electromagnetic phenomena as reflecting different behaviors of the same real physical field i.e. as different collective behavior, propagating within a real medium (the aether) one must start with a description of some of its properties.

We thus assume that this aether is built (i.e. describable) by a chaotic distribution $r(x_m)$ of small extended structures represented by four-vectors $A_m(x_a)$ round each absolute point in I_0. This implies

- the existence of a basic local high density of extended sub-elements in vacuum
- the existence of small density variations $dr(x_m)A_a(xm)$ above $dr > 0$ for light and below $(dr < 0)$ for gravity density at x_m .
- the possibility to propagate such field variations within the vacuum as first suggested by Dirac [33].

One can have internal variations: i.e. motions within these sub-elements characterized by internal motions associated with the internal behavior of average points (i.e. internal center of mass, centers of charge, internal rotations: and external motions associated with the stochastic behavior, within the aether, of individual sub-elements. As well known the latter can be analyzed at each point in terms of average drift and osmotic motions and A_m distribution. It implies the introduction of non-linear terms.

To describe individual non-dispersive sub-elements within I_0, where the scalar density is locally constant and the average A_m equal to zero, one introduces at its central point $Y_m(q)$ a space-like radial four-vector $A_m = r_m \exp(iS/\hbar)$ (with $r_m r^m$ = a^2 = constant) which rotates around Y_m with a frequency $n = m_g c^2 / h$. At both extremities of a diameter we shall locate two opposite electric charges e^+ and e^- (so that the sub-element behaves like a dipole). The opposite charges attract and rotate around Y_m with a velocity $\cong c$. The +e and –e electromagnetic pointlike charges correspond to opposite rotations (i.e $\pm \hbar/2$) and A_m rotates around an axis perpendicular to A_m located at Y_m, and parallel to the individual sub-element's four momentum $\partial_m S$.

Assuming electric charge distributions correspond to $dm > 0$ and gravitation to $dm < 0$ one can describe such sub-elements as holes ($dm < 0$) around a point 0 around which rotate two point-like charges rotating in opposite directions as shown in Figure 6.1 below.

These charges themselves rotate with a velocity c at a distance $r_m = A_m$ (with $r_m r_m$ = Const.). From 0 one can describe this by the equation

$$? \ A_m - \frac{m_g^2 c^2}{\hbar^2} \cdot A_m = \frac{\left[[](A_a^* A_a) \right]^{1/2}}{(A_a^* A_a)^{1/2}} \cdot A_m \tag{31}$$

with $A_m = r_m \cdot \exp[iS(x_a)/\hbar]$ along with the orbit equations for e^+ and e^- we get the force equation

$$m \cdot w^2 \cdot r = e^2 / 4pr^2 \tag{32}$$

and the angular momentum equation:

$$m_g \cdot r^2 \cdot w = \hbar / 2 \tag{33}$$

Eliminating the mass term between (31) and (33) this yields

$$\hbar w = e^2 / 2r \tag{34}$$

where $e^2/2r$ is the electrostatic energy of the rotating pair. We then introduce a soliton-type solution

$$A_m^0 = \frac{\sin \cdot K \cdot r}{K \cdot r} \cdot \exp\left[i(\mathrm{cot} - K_0 x)\right] \tag{35}$$

where

$$K = mc/\hbar, \quad w = mc^2/\hbar \quad and \quad K_0 = mv/\hbar \tag{36}$$

satisfies the relation (31) with $r = ((x - vt)^2 \cdot (1 - v^2 / c^2)^{-1} + y^2 + z^2)^{1/2}$ i.e.

$$? \ A_m^0 = 0 : \tag{37}$$

so that one can add to A_m^0 a linear wave, A_m (satisfying ? $A_m = (m_g^2 c^2 / \hbar^2) A_m$) which describes the new average paths of the extended wave elements and piloted solitons. Within this model the question of the interactions of a moving body (considered as excess or defect of field density, above or below the aether's neighboring average density) with a real aether appears immediately[1].

As well known, as time went by, observations established the existence of unexplained behavior of light and some new astronomical phenomena which led to discovery of the Theory of Relativity.

In this work we shall follow a different line of interpretation and assume that if one considers particles, and fields, as perturbations within a real medium filling flat space time, then the observed deviations of Newton's law reflect the interactions of the associated perturbations (i.e. observed particles and fields) with the perturbed average background medium in flat space-time. In other terms we shall present the argument (already presented by Ghosh et al. [34]) that the small deviations of Newton's laws reflect all known consequences of General Relativity

The result from real causal interactions between the perturbed local background aether and its apparently independent moving collective perturbations imply absolute total local momentum and angular momentum conservation resulting from the preceding description of vacuum elements as extended rigid structures.

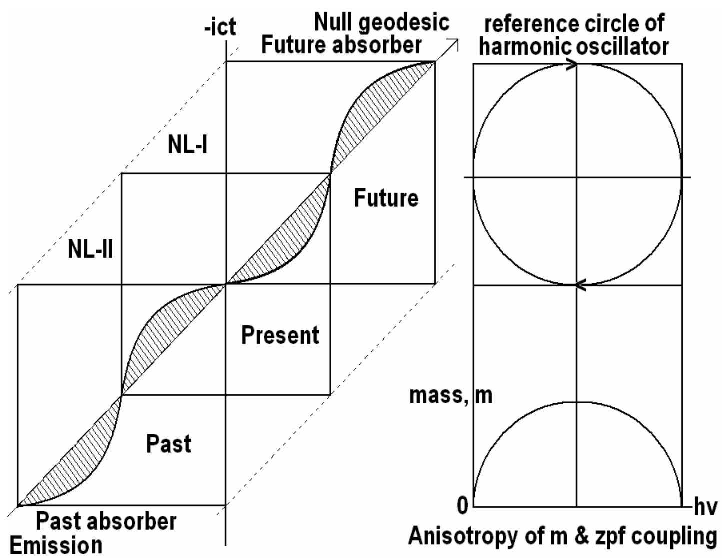

Figure 5 a) 2D drawing of a 3D view of a 4D hyperstructure. A Minkowski spacetime diagram of the electric vector only in terms of a present moment of 'tiled' Planck units utilizing the Wheeler-Feynman theory of radiation. The vertices represent absorption & emission. The observable present is represented by bold lines, and nonlocal components by standard line. Each event is a hyperstructure of Past, Present, and Future interactions, ultimately governed by the quantum potential. b) In the reference circle photon mass and energy fluctuate harmonically during propagation of the wave envelope (wave) and internal rotation of the ZPF during coupling (particle).

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[1] According to Newton massive bodies move in the vacuum, with constant directional velocities, i.e. no directional acceleration, without any apparent relative friction » or drag» term. This is not true for accelerated forces (the equality of inertial and gravitational masses are a mystery) and apparent absolute motions proposed by Newton were later contested by Mach.

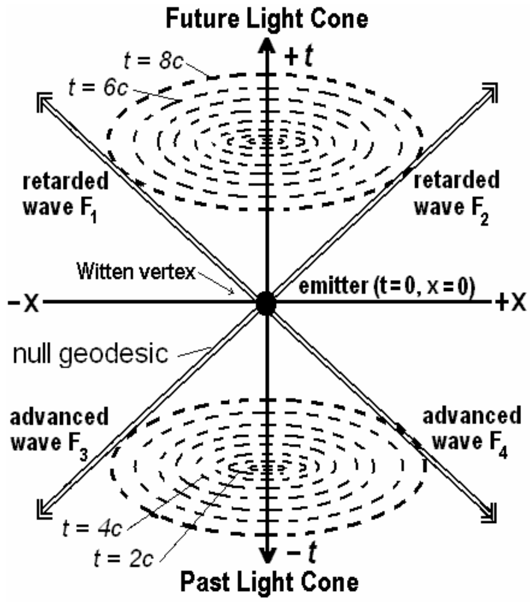

Figure 6 4D Minkowski light-cone of advanced and retarded waves (Eq. 1) emitted from a locus at (x,t) = (0,0). Adapted from concepts of Cramer [21].

Retarded: $$F_1 = F_0 e^{-ikx} e^{-2p ift}, \quad F_2 = F_0 e^{ikx} e^{-2p ift} \tag{1a}$$

Advanced: $$F_3 = F_0 e^{-ikx} e^{2p ift}, \quad F_4 = F_0 e^{ikx} e^{2p ift} \tag{1b}$$

As part of the symmetry breaking process the continuous-state spin-exchange compactification dynamics of the vacuum hyperstructure is shown to gives rise naturally to a $2.735^\circ K$ degree Hawking type radiation from the topology of Planck scale (albeit a whole new consideration of how the Planck regime operates) micro-black hole hypersurfaces. All prior considerations of 'tired-light mechanisms have been considered from the perspective of 4D Minkowski space [27]. This new process arises from a richer *open* (non-compactified) Kaluza-Klein dimensional structure of a continuous-state cosmology in an M-Theory context with duality-mirror symmetry; also supporting the complex standing-wave postulate of the model.

or to a lower state $E_k\left(< E_{iL}\right)$ (CMBR-emission) according to the relation $h\nu = E_j - E_{iL} = E_{lH} - E_k$. Thus we postulate that boundary conditions inherent in continuous standing-wave spacetime spin exchange cavity compactification dynamics of vacuum topology also satisfy the requirements for photon emission. In metaphorical terms, periodic phases or modes in the continuous spacetime transformation occur where *future-past exciplex*[2] *states* act as *torque moments* of CMBR/Redshift BB emission/absorption equilibrium.

In reviewing atomic theory Bohm, [34] states:

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

Inside an atom, in a state of definite energy, the wave function is large only in a toroidal region surrounding the radius predicted by the Bohr orbit for that energy level. Of course the toroid is not sharply bounded, but y reaches maximum in this region and rapidly becomes negligible outside it. The next Bohr orbit would appear the same but would have a larger radius confining y and propagated with wave vector $k = r / h$ with the probability of finding a particle at a given region proportional to $|y|^2 = \left| f(x, y, z) \right|^2$. Since f is uniform in value over the toroid it is highly probable to find the particle where the Bohr orbit says it should be [34].

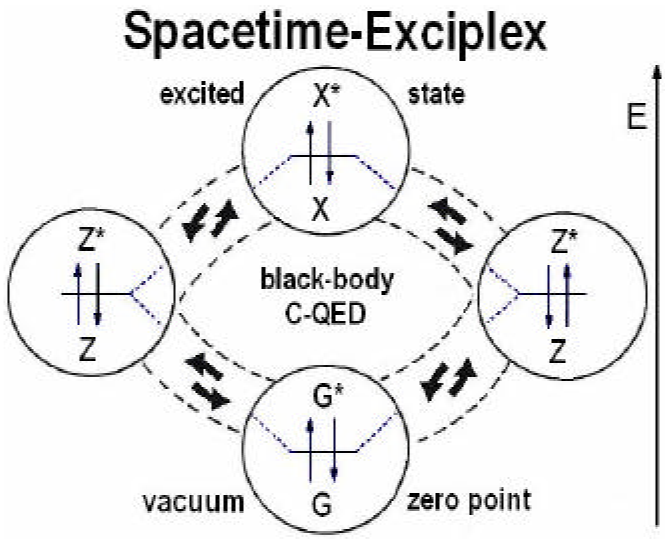

Figure 7 Geometric model for a spacetime GQED black body Exciplex for red-shift-CMBR absorption-emission equilibrium dynamics.

POSSIBILITY OF CAVITY QED EMISSION FROM CONTINUOUS SPACETIME COMPACTIFICATION

It is also suggested that further development of the C-QED model of CMBR emission could be extended to include spontaneous emission from the continuous dimensional reduction process of compactification. This would follow from modeling spacetime cavity dynamics in a manner similar to that in atomic theory for Bohr orbitals. As well known photon emission results from electromagnetic dipole oscillations in boundary transitions of atomic Bohr orbitals. Bohr's quantization of atomic energy levels is applied to the topology of Spacetime C-QED boundary conditions in accordance with equation (7.1) where spacetime QED cavities of energy, E_i undergo continuous harmonic transition to a higher state, $E_j\left(> E_{iH}\right)$ (redshift-absorption mode).

The general equations for a putative spacetime exciplex are:

$$G^* + G^* \Leftrightarrow Z^*; \quad Z^* + m_g \Leftrightarrow X^*$$
$$X^* - m_g \xrightarrow{emission} Z^* \quad or G^* \qquad (38)$$
$$X^* + m_g \rightarrow Z^* \quad or \quad G^*$$

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

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

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

We suggest that these toroidal orbital domains have properties similar to QED cavities and apply this structure to *topological switching* during dimensional reduction in the continuous state universe (HAM) model [27]. To summarize pertinent aspects of HAM cosmology:

- Compactification did not occur immediately after a big bang singularity, but is a continuous process of dimensional reduction by *topological switching* in view of the Wheeler-Feynman absorber model where the present is continuously recreated out of the *future-past*. Singularities in the HAM are not point like, but dynamic wormhole like objects able to translate extension, time and energy.
- The higher or compactified dimensions are not a subspace of our Minkowski 3(4)D reality, but our reality is a subspace of a higher 12D multiverse of three 3(4)D Minkowski spacetime packages.

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

- There is a transmutation of dimensional form from *extension to time to energy*; in a sense like squeezing out a sponge as the current Minkowski spacetime package recedes into the past down to the Planck scale ; or like an accordion in terms of the *future-past* recreating the present.
- A tension in this process (string tension, T_0 in superstring theory) allows only specific loci or pathways to the dimensional reduction process during creation of the transient Planck scale domain. Even though there are discrete aspects to this process it appears continuous from the macroscopic level (like the film of a movie); the dynamics of which are like a harmonic oscillator.

With the brief outline of HAM parameters in mind, the theory proposes that at specific modes in the periodicity of the Planck scale pinch effect, cavities of specific volume reminiscent of Bohr toroidal atomic orbits occur. It is proposed rather speculatively at present that these cavities, when energized by stochastically driven modes in the Dirac ether or during the *torque moment* of excess energy during the continuous compactification process, or a combination of the two as in standard C-QED theory of Rabi/Rydberg spontaneous emission, microwave photons of the CMBR type could be emitted spontaneously from the vacuum during *exciplex* torque moments. This obviously suggests that Bohr atomic orbital state reduction is not the only process of photon emission; (or spacetime modes are more fundamental) but that the process is also possible within toroidal boundary conditions in spacetime itself when in a phase mode acting like an atomic volume. A conceptualization of a Planck scale cavity during photon emission is represented in figure 7.1c with nine dimensions suppressed.

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