"Buckaroo Banzai Across the 8th Dimension"
A Strategic Assault on the Dimensional Barrier

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Abstract. Additional dimensions (XD) have been proposed for a hundred years; recently synthetic/artificial XD have been discovered in quantum Hall graphene bilayers, suggesting empirical discovery is imminent. With current supercollider technology the CERN LHC proposes a series of experiments called 'gravities rainbow' to detect compact dimensions; it is suspected however that the LHC will not be sufficiently powerful. The Chinese have proposed a collider twice the size of CERNs; however, Nobelist C N Yang suggested tis would be a waste of money, for which he was criticized. We agree with Yang in principle, but not in detail; we propose a low-energy tabletop device putatively taking a higher dimensional cross section.

> *It is sensible and prudent…to think about alternatives to the standard model, because the evidence is not all that abundant…and we do know that the standard cosmological model is pointing to another surprise…because* (it) *traces back to a singularity.* P.J.E Peebles [1].

1. Introduction

Currently three avenues exist for experimentally demonstrating, the existence of, or in our model for accessing, additional dimensionality (XD) beyond restrictions produced by the inherency of the quantum uncertainty principle limiting the 4D Standard Model. 1) Enhancements to the CERN LHC or proposed Chinese supercolliders double the size of the LHC by 'gravity's rainbow' mini-black hole theory or other means. 2) Exploration of topological pumping in Quantum Hall symmetry mirroring of novel topological phases in higher dimensions (HD) or the rash of similar formats, already with proof of XD concept in 2017. These protocols are cryogenic. 3) The table-top room temperature Amoroso-Vigier Tight-Bound State (TBS) protocol surmounting the Uncertainty Principle by rf-pulsed Sagnac Effect resonance parameters acting on the Dirac polarized vacuum. With Dubois incursive oscillator parameters added, a QED cavity opens penetrating XD/LSXD topology *discovering* additional HD TBS spectral lines. Kaluza in 1919, proposed a 5D classical unified field extension of general relativity, followed by Klein's improvement to a quantum interpretation in 1926, which are considered the major precursors to String Theory having tenuous origins in the late 1960s. Discrepancies in QED going back to about 2000 are attributed to researchers like Chantler, who finally obtained results at the sigma-5 level in 2012; although theory has sallied forth, not until 2017 has direct experimental evidence for additional dimensions (XD) appeared in relation to Quantum Hall effects in graphene bilayers. Pertinent aspects of string theory necessary for developing the parameters of the TBS model are reviewed. The main task of the paper then presents development of the topological phase transitions required to perform the experiment and enhance theoretical development.

Can Yang-Mills (YM) Kaluza-Klein (KK) correspondence (equivalence) drive the future of particle physics and provide an empirical path extending the Standard Model of particle physics? Although it is generally known that YM-KK theories define equivalence on principle fiber bundles; specific conditions for equating their Lagrangians have not been rigorously specified. Since the origin of KK Theory virtually all corresponding extensions of the Standard Model (SM) rely on a profusion of additional dimensionality (XD); a conundrum that clearly can only be resolved experimentally. In contrast to ongoing QED violation and CERN LHC SUSY XD experiments, this work explores a radical new low energy-tabletop Unified Field Mechanical (UFM) approach surmounting uncertainty.

2. Introduction to the Conundrum

A putative protocol for utilizing YM-KK equivalence as a path for demonstrating additional dimensionality (XD) beyond the Standard Model (SM) is outlined in preliminary form [2-4]. For example, Riemannian KK manifolds, M with horizontal and vertical subspaces in the tangent bundle (M = X x G) defined by the YM connection are orthogonal with respect to the KK metric, where X is a 4D spacetime and G an arbitrary gauge Lie group; and for the corresponding YM theory, M is a trivial principle G-bundle [5]. This suggests putative orthogonal extensions of dimensionality beyond the 4D utilized by the SM requiring a fundamental change in the meaning of the concept of dimensionality [6]. A novel protocol has been found for empirically testing the model; which if successful could have far reaching consequences for validating M-Theory and provide tabletop-low energy Unified Field Mechanical (UFM) 'cross section' alternatives for 'viewing' putative SUSY partners (or alternative brane topologies) in a trans-dimensional 'slice' rather than the TeV, PeV supercollider techniques utilized/proposed to produce standard cross section particle sprays in the highly successful 100 year history of high energy collision physics.

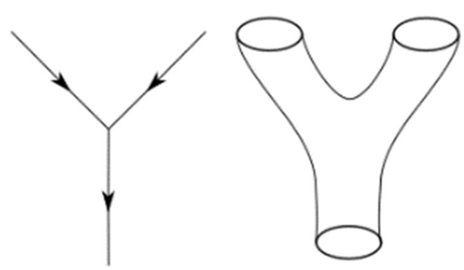

Fig. 1. Quantum interactions: a) Standard Model 0D Fermionic point particle world line. b) M-Theory world sheet with 1D string; extended to $M_{12} = M_4 \times C_8$ brane topology in our model where ($C_8 = \pm C_4$).

Two special processes emerge for modelling XD: 1) Duality, where the dimensions are fundamentally different in character, and 2) Anti-commutativity, where they are fundamentally the same [6]. The unique complex quaternionic Clifford algebra revealing how to operate the experimental design is under development [7]. Rather than the current iteration of String/M-Theory this work is based on a radical extension of the original hadronic form of the theory because of corresponding key elements such as virtual tachyon/tardon interactions (allowing more than one temporal dimension [8,9]) and a variable concept of string/brane tension, T_S yielding experimental design parameters for accessing additional dimensionality [2,4].

The KK formalism appeared as the first suggestion of the utility of XD as a tool in unification procedures. It is generally known that KK modeling makes correspondence to the SM through YM Gauge Theory [9-11]. Decades later the concept of Higher Dimensionality (HD) became associated with String Theory; now extended to an 11D M-Theory with Calabi-Yau mirror symmetric brane topology [12]. M-Theory has been severely criticized until now by the inability to perform experimental tests [13].

A salient feature of YM-KK correspondence as a path for extending the SM is the utility of the additional degrees of freedom allowed by dimensionality beyond the 4D of the SM. That a mathematical YM-KK correspondence exists is reasonably obvious [5,9-17] and not under overt dispute; what is questioned is whether or not extended real physical correlations exist. The debate has continued for at least ninety years. For a modicum of completeness we initially list a couple formulations briefly here:

- A correspondence path to unified theory began in 1919, but not until the 1940's was KK theory completed. Kaluza's 1921 invariant 5D line element is $ds^2 \equiv \tilde{g}_{ab}dx^a dx^b = g_{\mu\nu}dx^\mu dx^\nu + \phi^2\left(A_\nu dx^\nu + dx^5\right)^2$ where $\tilde{g}_{ab}$ is the 5D metric and $g_{\mu\nu}$ the 4D spacetime metric; ϕ is the associated scalar field at a 5th diagonal, and A the Electromagnetic (em) vector potential from which the equations of both General Relativity (GR) and em can be derived [18,19].

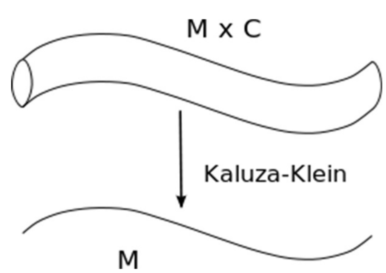

Fig. 2. KK space, *M x C* is compactified over set *C*; KK decomposition produces a field theory over *M*. The tangent bundle of M (M = X x G) defined by the YM connection is orthogonal with respect to the KK metric.

- It is possible to have supersymmetry in alternate dimensions because spinor properties change dramatically with dimensionality. For example, in d dimensions, spinor size is ~ $2^{d/2}$ or $2^{(d-1)/2}$. The maximum supersymmetries is said to be 32; thus the greatest number of dimensions in which a supersymmetric theory can exist is 11D. An SU(3) x SU(2) x U(1) gauge symmetry group can describe all known particle interactions. Following Witten, [16,17] the minimum number of dimensions of a manifold with this symmetry is 7D. Gauge fields arise in SU(3) x SU(2) x U(1) group symmetry in a gravitational field as components of more than 4D. This forms a reality of at least four non-compact and seven compact spacetime dimensions, $M^4 \times S^7 = 11\text{D}$, which Witten [16] calls a '*remarkable numerical coincidence*' because this 11D supergravity maximum is the minimum for SU(3) x SU(2) x U(1) symmetry which for symmetry reasons observed in nature is in practicality the largest group one could obtain from KK theories in seven XD.

- Following Sundrum [20] for 5D GR the Einstein action is $\ni \partial_\mu$ or $\partial_5 Gr^0_{MN}(x) \to 0$ for XD fluctuations $ds^2 \ni Gr_{55}(dx^5)^2 = Gr_{55}R^2 d\theta^2 \Rightarrow \; Gr^{(0)}_{55}(x) \equiv$ dynamical XD radius. Randall and Sundrum [21] found an HD method for solving the hierarchy problem utilizing 3-branes with opposite tensions, $\pm\sigma$ residing at the orbifold fixed points which together with a finely tuned cosmological constant form sources for 5D gravity.

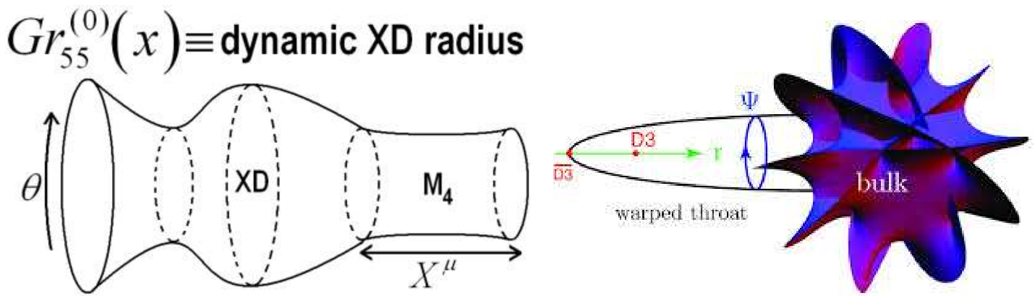

Fig. 3. Two views of the Randall-Sundrum model of dynamic GR radius for LSXD fluctuations, where X^μ are the Lorentz coordinates. Redrawn from [20]. b) With warped throat.

The various Randall-Sundrum models utilize a 5D warped geometry to describe reality as an anti-de Sitter (AdS^5) space with elementary particles (except for the graviton) residing on a localized 3 + 1 4D brane (the Planck brane) and an additional separated gravity brane.

3. Dimensional Physicality Only Resolved by Experiment

Because of the numerous unresolved attempts at finding rigorous realistic XD model building one is justified in claiming the issue can only be resolved by experiment. Three putative empirical avenues are currently being explored:

1. CERN - LHC: Search for LSXD predicted by 'leaking' of gravity between HD branes as in the Randall-Sundrum model [20,21] where the visible, 4D universe is restricted to a brane inside an HD space called the "bulk"(Fig. 4). If true one claim is to be suggestive of mini black holes (MBH) the energy of which is calculated in terms of what theorists call 'gravity's rainbow' [22-25]. The detection of MBH suggests existence of LSXD. No results so far at LHC energies of 5.3 TeV. Proponents believe 9.5 TeV is required for detecting 6D and 11.9 TeV for 10D. Absence of results so far is suggested as an "*indication of a suppression of higher dimensional black hole production due to Planckian deformation of quantum gravity*

which was not taken into account" [22]. 'Using gravity's rainbow, it was found that the energy needed to form black holes is larger than the energy scale of the LHC, but proposed to be within reach of the next generation of particle colliders' [23-25].

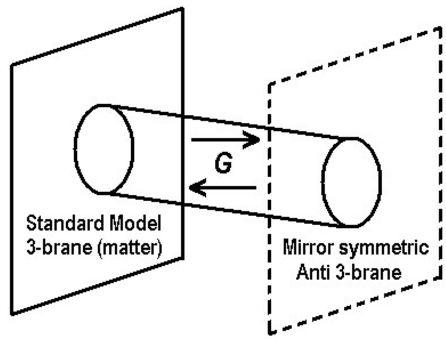

Fig. 4. D-brane model of 4D SM on a 3-brane with *G* in 10D able to pass through the HD bulk by mirror symmetric brane-antibrane topological interactions.

2. QED Violation Experiments: Experimental tests of Quantum Electro Dynamics (QED) have recently discovered a range of anomalies. Tests are often based on X-ray spectroscopic measurements. Recent results along these lines comes from a program by Chantler [26,27]. Numerous tests of several forms over the last 10 to 15 years have produced myriad possible discrepancies in QED theory; but interpretation problems and critical views of possible experimental error have generally left these results ignored by the physics community. This changed in 2012 with a more sophisticated experiment and more dramatic results performed by Chantler's team [27]. The new QED test $(Z > 20)$ was for the $w\left(1s2p^1P_1 \rightarrow 1s^{21}S_0\right)$ x-ray resonance line transition energy in trapped Helium-like Titanium $\left(\mathrm{Ti}^{20+}\right)$ ions which had a statistical significance on the coefficient that rose to the level of 5 standard deviations; one of the most statistically significant discrepancies from QED theory to date for the $\left(1s2p^1P_1 \rightarrow 1s^{21}S_0\right)$ transition energy which significantly could help establish Hydrogen-like lines of highly charged ions as a new class of transfer standards in x-ray spectroscopy [28,29]. Continued improvements remain promising.

3. LSXD Tight Bound States (TBS) in Hydrogen: Atomic physics conventionally treats electromagnetic interactions other than Coulomb spin-orbit or spin-spin couplings as perturbations with small corrections to the energy levels. Coulomb's electrostatic inverse square law is, $|F_C| = k_e\left(|q_1, q_2|/r^2\right)$, where k_e is the Coulomb constant and *r* is the Bohr radius. Seminal work by Vigier and colleagues proposed the creation of strong magnetic interactions at small distances and the creation of anti-Born-Oppenheimer states corresponding to rapid motion of the heavy particles around essentially fixed electrons. Although these terms in the Hamiltonian with distances at $\sim r^{-3}$ and $\sim r^{-4}$ are very small compared to atomic scale Coulomb terms, they are comparable or even much higher at shorter distances. Vigier suggested that 'in principle there is a possibility that magnetic interactions at short distances give rise to new

phenomena not currently explained by perturbative treatment' [30]. This theoretical view seems to correlate with Chantler's. The SM is inherently an incomplete theory; it does not yet adequately explain gravity/graviton, is incompatible with GR, it does not explain dark matter/dark energy, neutrino mass or matter-antimatter asymmetry. At the time of writing CERN-LHC experiments on supersymmetry or additional dimensionality (XD or LSXD) have failed; but additional tests are being developed. As noted above Chantler's experimental result does occur at the "5σ" level considered to be the 'threshold of discovery' in particle physics; however, because of a variety of issues, although this work has finally gained some notoriety it has not yet received general acceptance. These three models are the prime candidates for empirical tests of physics beyond the SM.

4. Tight Bound State (TBS) Modeling

Recently TBS due to electromagnetic interactions at small distances below the lowest Bohr orbit have been postulated for the Hydrogen atom [30-34]. We begin summarizing seminal work of Vigier - In the usual understanding of atomic physics spin-orbit and spin-spin coupling perturbations for example give rise to only small corrections to classic Bohr energy levels. However, with distances in the $1/r^3$ and $1/r^4$ range these interaction terms, until now overlooked, could be much higher than the Coulomb term at distances much less than the Bohr radius - predicting new physics [31,32]. Corben [33] was first to notice that motion of a point charge in a magnetic dipole field at rest is highly relativistic with orbits of nuclear dimensions. Further investigation undertaken by [30-32,34] represented an extension of the Pauli equation to a two-body system as defined by the Hamiltonian

$$H = \frac{1}{2m_1}\left(\vec{P}_1 - e_1\vec{A}(\vec{r}_1)\right)^2 + \frac{1}{2m_2}\left(\vec{P}_2 - e_2\vec{A}(\vec{r}_2)\right)^2 + \frac{1}{4\pi\varepsilon_0}\frac{e_1e_2}{|\vec{r}_1 - \vec{r}_2|} + V_{dd} \tag{1}$$

where, m_i is mass, $\vec{P}_i$ momentum, e_i charge, $\vec{r}_i$ position of the particles ($i = 1,2$), $\vec{A}$ is the electromagnetic vector potential and V_{dd} the dipole-dipole interaction term:

$$V_{dd} = -\left(\frac{\mu_0}{4\pi}\right)\vec{\mu}_1\vec{\mu}_2\delta(\vec{r}_1 - \vec{r}_2) + \left(\frac{\mu_0}{4\pi}\right)\left[\frac{\vec{\mu}_1\vec{\mu}_2}{|\vec{r}_1 - \vec{r}_2|^3} - \frac{3\left[\vec{\mu}_1(\vec{r}_1 - \vec{r}_2)\right]\cdot\left[\vec{\mu}_2(\vec{r}_1 - \vec{r}_2)\right]}{|\vec{r}_1 - \vec{r}_2|^5}\right] \tag{2}$$

In the center-of-mass frame and with a normal magnetic moment, $\vec{\mu} = (e/m)\vec{S}$ the Hamiltonian (2) becomes:

$$\begin{gathered} H = \frac{1}{2m_1}p^2 - \left(\frac{\mu_0}{4\pi}\right)\frac{e_1e_2}{m_1m_2}\frac{\vec{S}\vec{L}}{r^3} + \left(\frac{\mu_0}{4\pi}\right)^2\frac{e_1^2e_2^2\hbar^2}{4m_1m_2m}\frac{1}{r^4} + \\ \frac{1}{4\pi\varepsilon_0}\frac{e_1e_2}{r} - \left(\frac{\mu_0}{4\pi}\right)\frac{e_1e_2}{m_1m_2}\vec{s}_1\vec{s}_2\delta(\vec{r}) + \left(\frac{\mu_0}{4\pi}\right)\frac{e_1e_2}{m_1m_2}\left[\frac{\vec{s}_1\vec{s}_2}{r^3} - \frac{3(\vec{s}_1\vec{r})\cdot(\vec{s}_2\vec{r})}{r^5}\right] \end{gathered} . \tag{3}$$

where $r, p, \vec{S}, \vec{L}$ relate to relative motion and m is a reduced mass. The usual Pauli approximation producing (3) is improved by keeping an energy term in the Hamiltonian since m is of the resonant energy order of interest. This new Hamiltonian depends on energy through the effective mass, m^* as in, $m^* = m + (E/8c^2)$ [30-32].

In terms of total spin angular momentum the self-consistent Hamiltonian of the Barut-Vigier model is:

$$H = \frac{1}{2m^*}p^2 + \frac{1}{4\pi\varepsilon_0}\frac{e_1 e_2}{r} - \left(\frac{\mu_0}{4\pi}\right)\frac{e_1 e_2}{8\left(m^*\right)^2}\frac{\vec{J}^2 - \vec{L}^2 - 2\vec{S}^2}{r^3} + \left(\frac{\mu_0}{4\pi}\right)^2 \frac{e_1^2 e_2^2 \hbar^2}{16\left(m^*\right)^3}\frac{1}{r^4} - \left(\frac{\mu_0}{4\pi}\right)\frac{4\pi e_1 e_2}{8\left(m^*\right)^3}\left(\vec{S}^2 - \frac{3}{2}\hbar^2\right)\delta\left(\vec{r}\right) - \left(\frac{\mu_0}{4\pi}\right)\frac{3e_1 e_2 \hbar^2}{8\left(m^*\right)^2}\frac{Q}{r^3} \quad (4)$$

with operator $Q = \left(1/\hbar^2\right)\cdot\left(\left(\vec{S}\vec{r}\right)^2/r^2\right)$ [31,34].

Continuing to follow Vigier [30-32], the possibility of TBS physics as derived from Hamiltonian (4) is shown by important spin channel resonance phenomena, $S = 1$, $L = 1$ and $J = 0$ because attractive spin interactions are strongest with an effective potential appearing in the radial Schrödinger equation (5) and simplified form (6) when limited to spherical terms:

$$\frac{d^2u}{dr^2} - \left[\frac{2m^*}{\hbar^2}\frac{1}{4\pi\varepsilon_0}\frac{e_1 e_2}{r} + \frac{2}{r^2} + \left(\frac{\mu_0}{4\pi}\right)\frac{e_1 e_2}{4\left(m^*\right)}\frac{6}{r^3} + \left(\frac{\mu_0}{4\pi}\right)^2\frac{e_1^2 e_2^2}{8\left(m^*\right)^2}\frac{1}{r^4} - \left(\frac{\mu_0}{4\pi}\right)\frac{e_1^2 e_2^2}{8\left(m^*\right)^2}\frac{\delta\left(r\right)}{r^2} - \frac{2m^*E}{\hbar^2}\right]\mu\left(r\right) = 0 \quad (5)$$

$$\frac{d^2X}{dr^2} + \frac{2m}{\hbar^2}\left[E - V\left(r\right)\right]X = 0 \quad (6)$$

which contains a form for the effective potential in the inverse power law:

$$V\left(r\right) = \frac{A}{r^4} + \frac{B}{r^3} + \frac{C}{r^2} + \frac{D}{r}. \quad (7)$$

At large distances this potential is an attractive Coulomb tail with a repulsive core at small distances due to the A/r^4 term [30]. For proper values of potential (5) its coefficients could have another potential well in addition to the one at distances of the order of the Bohr radius where new physics is suggested to be 'located'. Additional theoretical details on the seminal development of TBS by Vigier can be found in [30-34].

5. Radical Divergence from Current Thinking, Justified?

It is possible to make theoretical correspondence between the three empirical paths we have used as salient examples; however, doing so would be counterproductive to our penultimate goal of introducing a paradigm shift. We suspect, but not sufficiently to calculate, that von

Neumann's postulate suggesting a 'speed of collapse' of the quantum wavefunction [35] could explain the marked improvement between Chantler's prior two decades experiments on hydrogen and the 2012 NIST experiment on Helium-like titanium with 5 statistical standard deviations improvement [26,27]. Is it possible that the difference in radius of electron orbits between hydrogen and single electron titanium atoms could play a part in the QED violation effect or provide indicia of hidden XD/LSXD? Von Neumann's conjecture is not sufficiently understood to postulate especially in conjunction with controversy regarding physicality of components of the wavefunction in relation to the mathematics of the Schrödinger equation.

MANIFOLD of UNCERTAINTY (MOU)

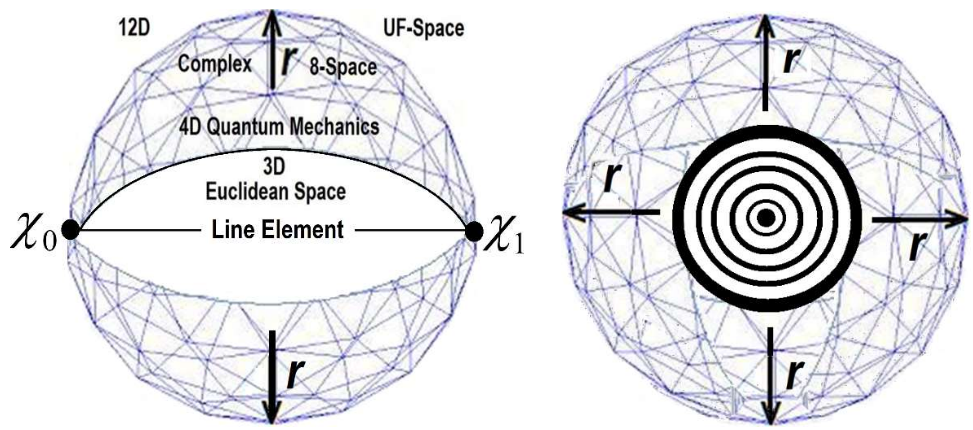

Fig. 5. a) Proposed 2XD to 6XD conceptualized Manifold of Uncertainty (MOU) of finite radius on the Riemann sphere, *r* beyond which LSXD are postulated. Partial hyperspherical view. b) Riemann sphere Manifold of uncertainty. Central concentric circles mean to conceptualize the warped-throat hypertube view of Fig. 3 looking in.

STANDARD HYPERVOLUMES

n	*V*(*n*,1)	
0	0	0
1	2	2
2	π	$\approx$ 3.1416
3	$4/3\pi$	4.1888
4	$1/2\pi^2$	4.9348
5	$8/15\pi^2$	5.2638
6	Degenerate ?	∞

Table 1: Standard Hypervolume values for increasing *n*-dimensionality of MOU radius, *r* for unit sphere or *n*-ball equal to 1. If LSXD exist, degeneracy would occur at the limit of *r* discovered in the same manner the outermost energy level of an atom is detected when an outer electron acquires sufficient energy to escape to infinity.

More saliently the Chantler and putative CERN experiments can at best only produce subtle indicia of QED violation or XD/LSXD respectively because of the 4D limit of the SM and the observational limit inherent in the uncertainty principle. In contrast, our proposed experiment if successful promises unfettered low energy complete access to a 3rd UFM regime of reality [2-4,7,21,30,36-40].

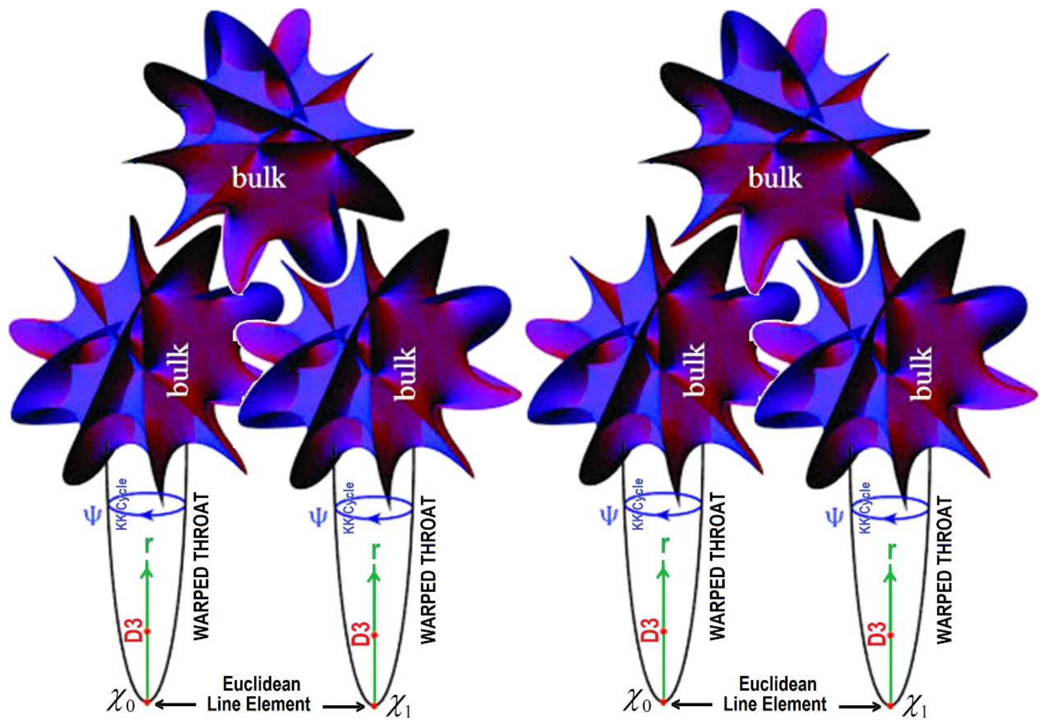

Fig. 6. Propagating Line Element χ_0 to χ_1 in *t*. 0D points, warped-throat D3 branes to semi-quantum limit at the KK limit to Calabi-Yau bouquet florets in the UFM bulk.

The author's team originally had little interest in the 1998-2000 Vigier TBS model as additional orbits below the lowest Bohr orbit seemed illogical and of unlikely physicality; but now parallels between the Chantler and CERN LHC protocols seem evident. What surprised us, looked at again a decade later in 2012 after developing a holographic multiverse Big Bang alternative [36,37], was profound new insights [2-4,38,39]. Firstly, the term TBS (orbits below the lowest Bohr orbit) needs to be redefined and clarified in terms of a paradigm shift to the 3rd regime of UFM with a duality of a 'semi-quantum limit', a compact 2 to 5 XD manifold and a LSXD UFM regime providing a putative clear link between the new UFM regime system and the associated semi-quantum and quantum approximations which the Chantler and forthcoming LHC results would thus appear to be.

Now a reasonable theoretical TBS definition can be offered. The general *n*-volume equation is $V(n,r)=\pi^{\frac{n}{2}}r^{n}/\Gamma\left(\frac{n}{2}+1\right)$ where $V_{n,r}$ is volume per number of dimensions, *n* of radius *r* and Γ a factorial constant. We relate these n-volume equations to volumetric properties of the MOU for calculating putative HD QED semi-quantum cavity volumes. Preliminarily TBS additional spectral line predictions for hidden MOU QED cavities utilizing 4D and 5D hyperspherical volumes could be easily calculated. The lowest Bohr orbit occurs at ~.5Å and the 2nd at ~2Å. We choose not to do this yet since theoretically:

- We are not sure yet if degeneracy occurs at 6D or 9D depending on how we utilize M-Theoretic mirror symmetry or its possible duality. But still by the updated TBS definition additional TBS Bohr orbits should putatively appear between the standard ~.5Å and ~2Å orbits depending on any restrictions yet to be theorized!
- How to close-pack the new hyperspherical Least Cosmological Unit (LCU) tessellating space because of its unique properties like a Semi-Quantum Limit (SQL) UFM duality.
- String tension, T_S is a fixed string-theoretic addition to the Planck constant, $\hbar + \Delta T_S$. Since we utilize the original hadronic form of variable T_S, TBS cavity volumes may have critical restrictions affecting the wavelength of the TBS spectral line. See Fig. 7.

Very much UFM is beyond the limits of this paper and a 'can of worms' best not opened too far here [40,41] however, for the record if success occurs, some parameters are worth noting before proceeding to final sections summarizing the TBS experimental design theory. A major shift from current thinking is that gravity is most likely not quantized!

> "...maybe we should not try to quantize gravity. Is it possible that gravity is not quantized and all the rest of the world is? ... Now the postulate defining quantum mechanical behavior is that there is an amplitude for different processes. It cannot be that a particle which is described by an amplitude, such as an electron, has an interaction which is not described by an amplitude but by a probability...it seems that it should be impossible to destroy the quantum nature of fields. In spite of these arguments, we should like to keep an open mind. It is still possible that quantum theory does not absolutely guarantee that gravity has to be quantized" [42].

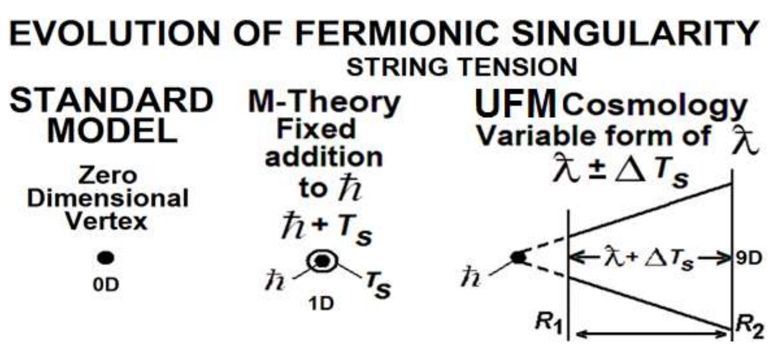

Fig. 7. Evolution of fermionic singularity: a) standard consideration, to b) current fixed string tension, T_S model in String/M-Theory Theory and finally to c) Multiverse UFM model of variable T_S. with 'continuous-state compactification'; the 'length' varies from virtual $\hbar$ (Stoney, $\lambda\!\!\!^{-}$) to the Larmor radius of the Hydrogen atom.

Here we develop the radical assumption that ‘Feynman’s Conjecture’ is dramatically correct! Calabi-Yau mirror symmetric branes may have a form of ‘topological charge’ with information transfer that is not quantized [37,77]. Continued KK to M-Theoretic development over the past ~ 90 years, based on well-tested theory that reality is fundamentally quantum, is that XD provides the basis for a Quantum-Gravity integration; indeed, this has been the prime directive of String/M-Theory. We make a case (as Feynman subtly hints) that G is not quantized and that a 3rd physical regime of UFM provides the arena for unification of G with the other forces of nature. Just as we know that Classical Theories are limited, so now we must prepare to accept that QM is also not fundamental. Historically just as infinities in the Rayleigh-Jeans Law [43] pointed the way to Quantum Mechanics, now infinities in Renormalization of quantum field theory [44, 45] similarly point the way to another regime of UFM [40,41]! The problem of infinities initially arose in the classical electrodynamics of point particles later inspiring renormalization procedures in quantum field theory. For the em mass of a point particle as a charged spherical shell of radius r_e the mass-energy of the field is $m_{em} = \int 1/2\left(E^2 dV\right) = \int_{r_e}^{\infty} 1/2\left(q/4\pi r^2\right)^2 4\pi r^2 dr = q^2/8\pi r_e$ becoming infinite as $r \to 0$. It is a radical redefinition of the point particle with a semi-quantum UFM dual LCU cyclicality that allows experimental supervening of the uncertainty principle and any putative hope whatsoever of experimentally finding LSXD [2-4,37-39]. A new set of transformations beyond the Galilean-Lorentz-Poincaré is also required, but that will not be addresses here.

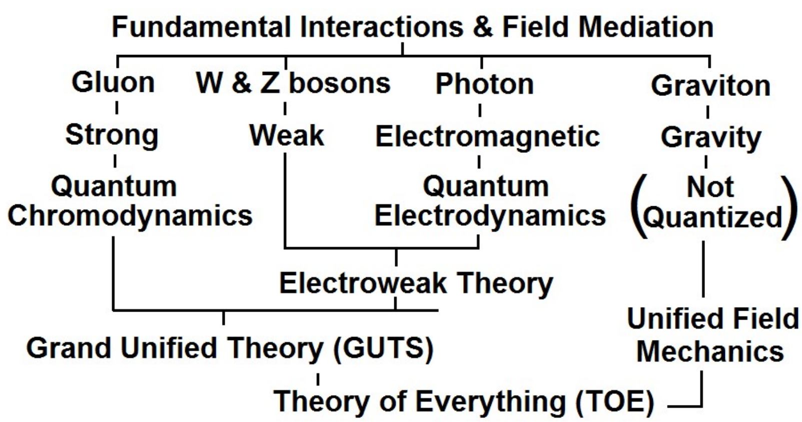

Fig. 8. The new UFM 3rd regime paradigm shift predicts that of the four known forces only the electromagnetic (em), and strong and weak nuclear forces are phenomenological and that gravity is not quantized. ‘Holographic’ information is exchanged ontologically (energyless) by the ‘topological switching’ of brane information called ‘topological charge.

This requires a radical new direction for some aspects of M-Theory; a paradigm shift hard to accept initially since it is in opposition to long accepted thinking. It appears however that the toolbox of string theory already provides sufficient components for the transition requiring only variant application of certain parameters. Salient features are:

1) Continuous/cyclic spin-exchange dimensional reduction compactification process rather than one unique compactification to the SM Minkowski-Riemann Gauge [37].

2) Variable String Tension, T_S that facilitates continuous compactification by providing a unique background independent string vacuum [37] with
3) Postulate that matter resides on a local 3-brane with *G* free to pass [21]; explains why force of *G* is comparatively weak leading to a non-quantized model of the 'graviton' in conjunction with the 'energy-less' ontological exchange unit of the Unified Field, U_F [37].

All elementary interactions are Gauge Theoretic interactions' as empirically well-tested for the three phenomenologically mediated field interactions; however, we now find the putative existence of new physics beyond the SM. Since graviton discovery continues to fail, is it possible as Feynman suggests that the gravitational interaction is not quantized? No *a priori* reason exists for a quantum-gravity. The obvious candidate for a nonlocal force, mass-energy, has nothing to do with discreteness; it is a continuous distribution throughout the entire universe suggesting correspondence to Mach's Principle. Quantum calculations are performed for local forces between isolated particles mediated by boson exchange; perhaps we should be looking for something nonlocal between elements in a continuous distribution in which boson exchange has no part. We attempt to show that such a radical approach is now timely, introduce new theoretical parameters and review a UFM protocol for empirical tests of XD parameters in putative M-Theoretic Calabi-Yau mirror symmetric brane topology with a proposed duality of a 'semi-quantum limit' with a non-quantized UFM regime of large-scale dimensionality beyond [97].

> *If [all physicists] follow the same current fashion in expressing and thinking about electrodynamics or field theory, then the variety of hypotheses being generated ... is limited. - a direction obvious from an unfashionable view of field theory - who will find it? Only someone who sacrifices himself ... from a peculiar and unusual point of view, one may have to invent for himself* – R.P. Feynman, Nobel Prize lecture.

6. Resolving the SM Conundrum Regarding Point Particles / Singularities

SM experimental evidence suggests that fermions have no size. They are singularities in 3-space. Physics assumes that we can define dynamic physical objects ('particles' or fermions) as existing 'in space'. It is not obvious what this means, notwithstanding the concept of space is inconceivable without matter, 3D space has no mechanism within itself for constructing the physical singularities that make up material particles. This suggests something needs to be added to ordinary space to include extended UFM modelling of fundamental particles. In the 3D limit of the SM for particle physics an elementary particle has no known composite subparticles. Mathematical idealizations of elementary particles are often called 'point particles or point charges' lacking spatial extension (0D) which perhaps arose because in a mathematical coordinate context size can be considered irrelevant. The nature of a point particle has remained an open question in physics [46]. Recent *avant-garde* work by Rowlands extends our understanding of this conundrum:

> "Physics at the fundamental level can be effectively reduced to an explanation of the structures and interactions of fermions. Fermions appear to be singularities rather than extended objects, but there is no obvious way of creating such structures within the 3-

dimensional space of observation. However, the algebra associated with the Dirac equation appears to suggest that the fermion requires a double, rather than a single, vector space, and this would seem to be confirmed by the double rotation required by spin ½ objects, and the associated effects of *zitterbewegung* and Berry phase shift. Further investigation of the second 'space' reveals that it is, in effect, an 'antispace', which contains the same information as real space but in a less accessible form. The two spaces effectively cancel to produce a norm 0 (nilpotent) object which has exactly the mathematical structure required to be a fermionic singularity" [46].

Continuing to follow Rowlands we further note that fermions as singularities exist in their own multiply-connected space requiring double rotations to return to their starting position. Fermions also undergo the quantum process of *zitterbewegung* continually switching between real space and a complex vacuum space. The double circuit in real space is required because fermions only exist in this space for half their existence. It is not coincidental that fermion algebra (gamma matrices) requires a commutative combination of two vector spaces for a full mathematical representation. Thus it becomes obvious that constructing a physical 'singularity' requires a dual space [6,7,46].

While the Rowlands' nilpotent space-antispace model brilliantly extends our understanding of the nature of a fermionic singularity in terms of the SM, elegant quaternionic algebra is not necessarily tantamount to a penultimate description of nature. What we mean suggestively, is even though the theoretical elements of Rowlands' model are *avant garde* to the SM they are not sufficiently radical to satisfy the needs of UFM [7,36,37,40,41,47]; but it does provide an inspired basis for making correspondence to the profoundly unique 'singularity' under development in UFM [36,37,40,41,47,48].

Before we define the UFM singularity let's briefly review some discrepancies in contemporary theory: Interactions of extended objects can appear point-like. A spherical object in Euclidean space described by the inverse square law can behave like its mass was concentrated in a geometric center. According to Coulomb's law the electric field associated with a classical point charge increases to infinity as the distance from the point charge decreases towards zero making energy-mass of point charges infinite. In Newtonian gravity and classical em, a field outside a spherical object is identical to a point particle located at the center of the sphere. In quantum mechanics, the nature of a point particle is complicated by the Heisenberg uncertainty principle where neither elementary nor composite particles are spatially localized, i.e. elementary particles with no internal structure occupy a nonzero volume. A point charge is an idealized model of a particle with 0D. However, the particle wavepacket always occupies a nonzero volume. For example, the electron is an elementary particle, but its quantum states form 3D patterns. Good reason remains to call an elementary particle a point particle. Even if an elementary particle has a delocalized wavepacket, the wavepacket is in a quantum super-position of quantum states localizing the particle. For example, a 1*s* electron in a hydrogen atom occupies a volume of $\sim 10^{-30}$ m^3. Fermions appear to be singularities rather than extended objects in the 4-space limit of the SM which is only the 'tip of the iceberg' relative to the additional LSXD structure in UFM [76]; but beyond space limitations of this paper to detail.

7. Derivation of Unique 'Continuous-State' M-Theoretic Vacuum

The greatest shift from the current M-Theoretic search for a single unique compactification from HD to the 4D Minkowski-Riemann Gauge of the SM is the introduction of a 'continuous compactification process' [36,37] wherein compactification occurs from 12D to 0D (virtual Planck) continuously with a left-right symmetry dimensional reduction compactification process repeating cyclically (see Fig. 7); a scenario originally derived as a parameter of a Holographic Multiverse alternative to Big Bang cosmology [36,37] bearing some semblance to an extended form of Einstein's original Static Universe Model. The continuous-state process is a key feature of 3rd regime UFM cosmology as it is critical to designing and performing the experiment to surmount the Quantum Uncertainty Principle [2-4]. The energy of Expansion, Inflation and Quintessence instead of being Doppler is alternatively internalized as a form of 'gravitational freefall'. Note that Hubble discovered cosmological 'redshift' not a Doppler expansion of the universe [36,37].

A new type of scaling applicable to a variety of physical parameters in the universe is proposed utilizing a relation linking the fundamental masses and fundamental constants in nature. An axiomatic approach is developed for the relations between microscopic and macroscopic originally found by Eddington and Dirac relating to the changing of the scale of the universe. The possibility of multiple interpretations is challenging. Putative variation of the fundamental constants or LCU continuous-state transformations can lead to a cosmological arrow of time in the present universe as well as scale-invariant relationships linking all scales. All lengths in the universe are proportional to the scale of the universe R, and similar relations exist for other physical parameters.

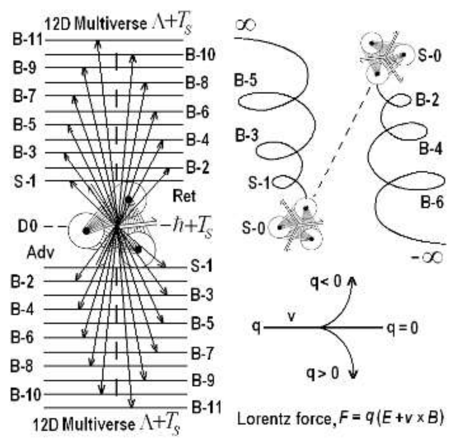

Fig. 9. Conceptualized string (S) and brane (B) couplings in Advanced-Retarded mirror symmetric Calabi-Yau spacetime arising from Least-Cosmological Unit (LCU) translations. a) String-brane duality couplings from 0 to 12D for odd-even HD brane topologies. b) Ising model spin-glass rotations which may be driven by an internal Lorentz-like UFM force of coherence or applied external resonances for vacuum engineering technologies.

Although we propose radical changes for M-Theory it still provides the best hope for a

Theory of Everything (TOE). String theory is currently aligned with the Copenhagen interpretation of quantum theory and Big Bang cosmology which have led to the quest for a putative 'quantum gravity'. In UFM cosmology neither of these ideas form the correct basis for a UFM producing M-Theory and need to be replaced by considerations that include a new cosmological perspective with an HD completed form of the de Broglie-Bohm-Vigier causal stochastic interpretation of quantum theory [78,79] compatible with the Transactional Interpretation of quantum theory [80] because this formulation of Calabi-Yau dual mirror symmetry not only fulfills the charge of finding a unique string vacuum but leads to the continuous-state LCU tessellation required for surmounting uncertainty yielding experimental access to the 3rd regime of UFM.

Regarding TOE search, recently well-known scientists like Hawking and Dyson have suggested that a TOE is impossible according to Gödel's incompleteness theorem [81] which simplistically states that 'nothing can be described in terms of itself because by definition that would be too limited a view; a complete description must come from outside the boundaries of a principle to be fully understood'. An apparent philosophical conundrum, but from the UFM perspective; it is possible to Gödelize beyond the SM. The TOE is essentially about unifying the four fundamental forces completing particle physics with a connection between quantum theory and gravitations in a proper cosmological context. An anthropic cosmology by supposition is a complex self-organized system with associated properties such as incursion, hierarchy and an inherent external (nonlocal) action principle driving its self-organization. By applying Kant's antinomies [82] the Hubble sphere, H_R is closed and finite temporally, but open, infinite and causally separated 'atemporally'. Such a Multiverse has 'room for an infinite number of nested Hubble spheres each with their own fine-tuned laws of physics' [83]. Such a TOE sufficiently developed for our Einstein-Hubble sphere allows experimental access to the LSXD holographic Multiverse beyond it - compatible with Gödel's incompleteness theorem.

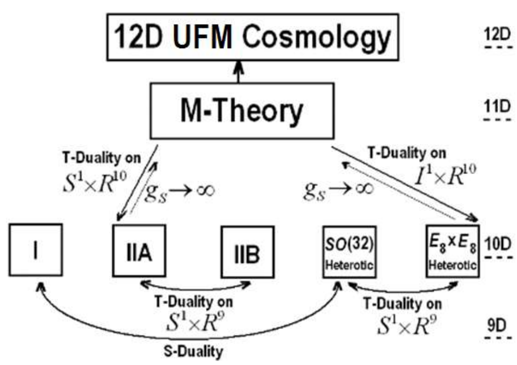

Fig. 10. Mirror/duality transformations relating the 5 superstring theories to each other and the anthropic principle of HAM cosmology. Adapted from [84].

Every Calabi-Yau manifold with mirror symmetry or T-duality admits a hierarchical family of supersymmetric toroidal 3-cycles. It is currently undefined theoretically whether the attempt to formalize this compactification–boost 'continuous-state structure' should follow a KK spin tower, logarithmic or golden ratio spiral, cyclotron resonance hierarchy, genus-1 helicoid 'parking-garage' or some other HD topological structure [37]. We currently find the Genus-1 helicoid intellectually appealing because of its ability to incorporate Kahler manifolds compatible with M-Theory parameters. Also of note is that the heterotic SO(32) Bosonic string introduces a tachyon which we do not consider anomalous but part of the internal field coupling of a Lorentz vacuum contraction. Type IIA & Type-IIB open/closed strings are cast in odd/even string/brane dimensionality which we postulate is an inherent part of the Ising model rotation of the Riemann sphere for 'genus-1 parking-garage helicoid' raising-lowering indices of the continuous-state dimensional reduction compactification process [37]. These complex UFM constructs can only be adequately worked out with a move away from a Big Bang cosmology and limits imposed by Copenhagen-Gauge approximations.

It is well known that it is possible to have supersymmetry in alternate dimensions. Because the properties of spinors change dramatically with dimensionality; each dimension has its own characteristics. In *d* dimensions, the size of spinors is roughly $2^{d/2}$ or $2^{(d-1)/2}$. Since the maximum number of supersymmetries is 32, the largest number of dimensions a supersymmetric theory can have is 11D. It is possible to have multiple supersymmetries and also have supersymmetric XDs.

If we accept the postulate of M-Theory that matter resides on the 3-brane along with the associated boundary conditions underlying the spinor elements of matter; along with duality/mirror symmetry this satisfies spatiality to 6D. UFM cosmology is cast in 12D – a temporal 3D and an additional 3D of UFM control parameters for 'piloting' (like an ontological super quantum potential) or driving (coherent control) the continuous-state evolution of spacetime. UFM cosmology is built on the premises of extended em theory [99-103], a covariant polarized Dirac vacuum [93-95] with photon mass anisotropy [104,105] giving the photon an internal motion coupling it to the vacuum. Since photons are not fermions its brane dynamics is different (simpler). Further we posit the photon as a periodic temporal 'pinch' of the continuous coherent unified field – a Wheeler geon-like or 12D 'ocean of light' [106]. This could be one of the greatest contributions when properly understood.

Cosmological theories and theories of fundamental physics must ultimately not only account for the structure and evolution of the universe, the physics of fundamental interactions but also lead to an understanding of why this particular universe follows the physics that it does. Such theories must lead to an understanding of the values of the fundamental constants themselves. Moreover, the understanding of universe has to utilize experimental data from the present to deduce the state of the universe in distant regions of the past and also account for certain peculiarities or coincidences observed.

The prevalent view today in cosmology is the Big Bang, inflationary evolutionary model. Although certain nagging problems have remained, e.g. the need to postulate cold, dark matter in amounts much larger than all the observable matter put together, dark matter not detected so far in the laboratory or the recent need to re-introduce the cosmological constant, Big Bang cosmology has, nevertheless, achieved impressive results [49].

In this paper we take a different approach than the usual evolutionary picture where the physics itself is assumed invariable. We study some numerical relations among fundamental constants starting from relationships first proposed by Weinberg [50], which turn out to be equivalent to the relations found by Dirac [51], and explore a new scaling hypothesis relating the speed of light c and the scale of the universe R. We then develop an axiomatic approach which results in an apparent expanding universe, yielding the same successes as present big bang cosmology but without the need to postulate inflation, cold dark matter, cosmological constant or any of the artificialities of current theory. The “coincidences” of Dirac [51] and Eddington [52] concerning large numbers and ratios of fundamental constants are not to explained, rather they are accepted and in the process yield a fundamentally different view of the cosmos. The fundamental constants can be assumed to vary with time and this variation leads to an apparent expansion of the universe. The variations of the fundamental constants lead to a changing universe, e.g. the number of nucleons varies, etc. The increase of the number of nucleons appears to be related to an arrow of time as perceived by an observer in the present universe. Possible implications of this new approach are discussed.

7.1 *Fine-Tuning Implied by Cosmological Observations*

There are a number of observations which must be applied in any cosmological theory which attempts to explain the observed structure of the universe:

1. The universe appears to be quite flat, in other words the density of the universe is close to the so-called closure or critical density,

$$r_{\text{crit}} = 2\times10^{-29}\left(H_0 \big/ 100\ \text{km s}^{-1}\ \text{Mpc}^{-1}\right)^2 g_r\ \text{cm}^{-3} \tag{8}$$

where H_o is the Hubble constant defined as the ‘apparent’ rate of expansion with distance, $\dot{R}/R$ and where R is the scale of the universe. In big bang cosmology, this so-called “constant” is actually a function of cosmic time, i.e. a variable. Its present-day value seems to be ~ 75 km $s^{-1}Mpc^{-1}$. The universe appears to be an asymptotically flat, Euclidean, Einstein-de Sitter state as indicated by (8); but it is still not clear what the geometry of the universe is. Is it exactly flat (which would be required by the inflationary scenario); open (yielding a forever-expanding, negatively curved space-time); or closed (yielding a maximum expansion and a positively curved space-time) [53-55]? Hubble discovered redshift, not a Doppler expansion of the universe [36,37] as our holographic multiverse cosmology model suggests.

It remains difficult to know the fundamental polyhedron (topology/geometry) of our cosmology made from observations within it; and astrophysicists continue to struggle with this problem [53-55]. Preliminary data from WMAP has supported an Anti de Sitter ($AdS_5 \times S^5$) Poincaré Dodecahedral ‘wrap-around’ model but more precise Planck satellite data will take several more years as the 2013 data released was not taken at the required frequencies. For example, space appears infinitely flat or Euclidean, but there are numerous observationally flat topologies that are not actually flat. The simplest shape for our reality is a 3-sphere with positive curvature. When we draw tori they appear curved only because we embed them in 3-space. A flat torus can be made from a square with its edges wrapped around to join seamlessly. The criterion is that the angles of a triangle add up to 180°. If our observed Hubble sphere, H_R is a flat torus; observations in certain directions allow one to see oneself in the distance [53-56].

This is compatible with the topology of a Big Bang 3-sphere postulated to be like a 3D expanding balloon; one with a 12 to 15 billion light year radius where light hasn't had sufficient time to cross yet. If the symmetry of curvature is not broken there are three possibilities - 3-sphere topologies with positive, negative and zero curvature. But a 3D flat torus (cube with opposite faces joined) has zero curvature. There are also hyperbolic 3D spaces with negative curvature. In a finite 3-space like the H_R purported self-observations in various directions would allow us to work out the curvature and shape of our H_R which is considered closed and finite in UFM cosmology; but open and infinite in the LSXD it is embedded in.

The spatial region observed from any local point is a circular disk increasing in size with time. When it grows to the same size as the H_R it begins to overlap. At this moment because of relativity it would be possible to observe the same object in many directions in the overlapping portions of space. Age of the universe predictions form Big Bang cosmology suggest that if the H_R is a 3-sphere overlapping should have begun and that these overlaps would form large circles in the sky, circles because the intersection of two 3-spheres is a circle [56]. Recent WMAP and Planck satellite observations have observed these putative circles in initial support of Poincaré Dodecahedral Space (PDS) [53-59].

2. If one is to assume that the universe followed an inflationary period in the distant past, then the universe must be exactly flat to one part in 10^{50} near the time of big bang. This is the so-called *flatness problem*: This is such a remarkable requirement that the usual interpretation proposed in the early 80's is that early on, the universe was in an inflationary state, washing out any departures from flatness on time scales of 10^{-35} sec. The inflationary model proposed by Guth [60] has been developed in various forms to account for the flatness of the universe and also is proposed to solve the horizon problem, or apparent homogeneity of the 2.73 K black body radiation seen by COBE [61]. The latter problem involves the observation that although the 2.73 K radiation was emitted $\sim 10^5$ years after the beginning, opposite sides of the sky at that time were out of causal contact, separated by $\sim 10^7$ light years. Other structures involving largescale correlations in the universe exist such as very large structures in the distribution of matter [62]. These structures may be progressively hierarchical all the way to the scale of the universe itself.

3. If the universe is indeed flat, observations indicate that baryons (and luminous matter) can only contribute at most ~ 0.05 of the closure density at present. We should ultimately be able to detect the other 90% or more of the matter required to give closure density, presumed to be in the form of cold dark matter [63]. Nevertheless, attempts to detect such exotic matter in the laboratory have, so far, failed. Moreover, the recent realization that the cosmological constant Λ may have to be re-introduced [1] has also led to the probability of Λ itself varying and other similar notions [64]. Without though some direct laboratory verification or overwhelming requirements imposed by particle theory (neither of which presently exists), the nature of dark matter remains elusive. This is clearly a very unsatisfying situation.

4. As we saw, present-day approximate flatness yields to an exact flatness in the distant past (this was one of the main reasons why the inflationary scenario was introduced to begin with). The alternative is to accept fine tuning in the universe. In fact, the flatness of the universe is

not the only fine tuning. In considering other fundamental observed facts, the universe appears to be extremely fined tuned. It was Eddington [52,65] and Dirac [51] who noticed that certain cosmic “coincidences” occur in nature linking microscopic with macroscopic quantities [66]. A most unusual relationship is the ratio of the electric forces to gravitational forces; this ratio is presumably a constant in an expanding universe where the physics remains constant (and also constant in our ‘internalized’ Mach’s Principle continuous-state gravitational ‘free-fall’), or

$$e^2/Gm_em_p \sim 10^{40} \tag{9}$$

while the ratio of the observable size of the universe to the size of an elementary particle, or

$$R/(e^2/m_ec^2) \sim 10^{40} \tag{10}$$

where in the latter relationship the numerator is changing as the universe expands because the scale of the universe R is constantly changing in an expanding universe. Dirac formulated the so-called Large Number Hypothesis which simply states that the two ratios in (9) and (10) are in fact equal for all practical purposes and postulates that this is not a mere coincidence. Various attempts were made to account for the apparent equality: A possibility that constants such as the gravitational constant may be varying was proposed by [51] himself and others [67]. Other ratios such as the ratio of an elementary particle to the Planck length,

$$\frac{e^2 / m_e c^2}{\left(\hbar G / c^3\right)^{1/2}} \sim 10^{20} \tag{11}$$

can also be constructed [68] yielding to the conclusion that fine-tuning may be prevalent in the universe. These relationships may be indicating the existence of some deep, underlying harmonies involving the fundamental constants and linking microcosm to macrocosm. Physical theory has not, however, accounted for these in a self-consistent way, waiting perhaps the anticipated unification of all physical forces at the unified field mechanical or superstring levels.

5. Although other, less traditional ways, such as the Anthropic Principle [69] have been proposed to account for fine-tuning properties of the universe, there may be other approaches involving quantum-like correlations [70] or UFM approaches [40,41,47].

7.2 *Numerical Relations and the Concept of Scaling*

The critical density of the universe in (8) is defined as

$$r_{\text{crit}} = \frac{3H_0^2}{8\pi G}. \tag{12}$$

Let N_p be the number of nucleons in the universe, then

$$m_p = \frac{M}{N_p} = \frac{R\dot{R}^2}{2GN_p} \tag{13}$$

where m_p and M are the mass of the nucleon and mass of the universe, respectively.

Weinberg [50] noticed a relationship linking the masses of elementary particles to the Hubble constant and other fundamental constants

$$m_p \sim \left(\frac{8\hbar^2 H_0}{Gc} \right)^{1/3} \tag{14a}$$

and correspondingly,

$$m_e \sim \left(\frac{\hbar e^2 H_0}{\left(8^\pi\right)^3 Gc^2} \right)^{1/3} \tag{14b}$$

where, m_p and m_e are the pion and electron masses, respectively. These relations can be rewritten as

$$m_p \sim c_{pp} \left(\frac{8\hbar^2 \left(\dot{R}/R \right)}{Gc} \right)^{1/3} \quad \text{with } c_{pp} = \frac{m_p}{m_\pi}$$

and (15)

$$m_p \sim c_{pe} \left(\frac{\hbar e^2 \left(\dot{R}/R \right)}{Gc^2 \left(8\pi\right)^3} \right)^{1/3} \quad \text{with } c_{pe} = \frac{m_p}{m_e} \cdot$$

From (13) and (14a) one easily gets

$$G^2 \hbar^2 c^{-1} \sim c_{pp}^{-3} N_p^{-3} \frac{R^4 \dot{R}^5}{64} \, . \tag{16}$$

We also have

$$m_p = c_{p*} \sqrt{\hbar c / G} \tag{17}$$

where $c_{p*} = m_p / m_*$, m_* is the Planck mass and the suffix * indicates Planck quantities.

Combining (17) and (13), yields

$$cG\hbar \sim 1/4 N_p^{-2} c_{p*}^{-2} R^2 \dot{R}^4 \, . \tag{18}$$

Similarly, from (16) and (17)

$$c \sim 2^{2/3} N_p^{-1/3} c_{p*}^{-4/3} c_{pp} \dot{R} . \tag{19}$$

The multiplier factor in (19) is equal to $2^{2/3} N_p^{-1/3} c_{p*}^{-4/3} c_{pp} \dot{R}$, and is ~ 1. Conversely, if we choose to set $2^{2/3} N_p^{-1/3} c_{p*}^{-4/3} c_{pp} = 1$, one gets the simple relationship linking the speed of light to $\dot{R}, c = \dot{R}$ with $N_p \sim 3.7 \text{ x } 10^{79}$, which is a good estimate of the number of particles in the current universe. The relationship $c = \dot{R}$ could be interpreted as the Hubble Law $\dot{R} \sim c$. We emphasize that this relationship in no way implies that expansion is taking place; and indeed, our most important postulate, key to our UFM multiverse is that this energy (instead of expansion, inflation or quintessence) is 'internalized' nonlocally-holographically as a Mach's Principle 'continuous-state process [71]. Similar considerations occur if one choses to apply the relations to electrons. If we start by assuming the heuristic relation

$$c \equiv \dot{R} \tag{20}$$

i.e. the speed of light is *identical* to the (virtual) rate of change of the scale of the universe, we construct an axiomatic approach equivalent to Hubble's Law. This axiomatic approach can be considered as an alternative to the mysterious coincidences of Eddington and Dirac which Weinberg called "*so far unexplained... a real though mysterious significance."* It can be further shown that all lengths, such as the Planck length, 1_*, the classical electron radius, r_e, etc., are also proportional to

$$R, 1_*, r_e, \sim (...) R . \tag{21}$$

For example,

$$1_* \sim \left(2^{-7/3} N_p^{-1/3} c_{p*}^{5/3} c_{pp}^{-2}\right) R . \tag{22}$$

Similar relations can be found for r_e and r_p where r_e and r_p are the electron and proton radii. Combining (18) with (21) we obtain

$$G\hbar = \frac{R^2 \dot{R}^3}{4} N_p^{-2} c_{p*}^{-2} \sim 3.4 \times 10^{-122} R^2 \dot{R}^3 . \tag{23}$$

A relationship linking the gravitational and Planck's constants to R and $\dot{R}$, and where the last relationship in (23) holds for the current values of $N_p^{-2} c_{p*}^{-2}$ in the universe. Let us now set the following initial conditions, i.e.,

$$\mathbf{N} R \rightarrow 1_* \tag{24}$$

$$\dot{R} \rightarrow \frac{1_*}{t_*} = c \tag{25}$$

where 1_* and t_* are the Planck length and Planck time, respectively. Then $N_p^{-2}\chi_{p*}^{-2}/4 \to 1$ at those initial conditions, while for the present universe the value of this quantity is ~ 3.4 x 10^{-122}.

The limit $N_p \to 1$ indicates that in our model "in the beginning" there was only one bubble-like object or a "cosmic egg" [72]. Moreover, $R \to 1_*$ and $N_p \to 1$ imply that $c_p \to 1$ as well (similarly for all ratios of masses, *c*'s), which in turn indicates that the masses of all particles were equal to each other at these initial conditions. Also, "in the beginning", $R/\left(e^2/m_ec^2\right) \sim \left(e^2/m_ec^2\right)/\left(\hbar G/c^3\right)^{1/2} \sim 1$, rather than the large values of 10^{40} and 10^{20} which these ratios are equal to respectively, today. "In the beginning" all lengths were equal, all masses were equal and there was only one particle or cosmic egg. Today, these ratios are not unity, there is a very large number of particles in the universe and *R* is equal to ~ 10^{28} cm. However, scale-invariant relationships such as $c \equiv \dot{R}$; all lengths are proportional to each other, etc. still hold.

In other words, $c \equiv \dot{R}$, at the "initial time" when $N_p \to 1$ and all *c*'s = 1, and this relationship remains invariant even at the present universe (eqs. (19) and (21)). The self-consistency is obtained by calculations for the value of N_p from (19) and (23). This relation is a type of a scaling law and connects the microcosm and the macrocosm.

Now if irrespective (and it is even immaterial) of whether there is expansion of the universe or not, if *R* itself is changing from the Planck scale to the size of the observable universe, then the fundamental constants like *G*, $\hbar$ and *c* also *all* are changing. Note, however, that we cannot deduce the actual variation or the initial value of *c* and other constants from observations: The relationship $c \equiv \dot{R}$ is not enough to tell us the actual variation or even over "how long" it takes place. It is a scale invariant relationship. If we re-write it as a scale-invariant relationship, $c(t_*)/c(t_0) = \dot{R}(t_*)/\dot{R}(t_0)$ where t_* and t_0 could be conveniently taken as the Planck time and the present "age" of the universe, then this relationship is not enough to give us the evolution of $\dot{R}$ or even the values of t_* and t_0. Hence it cannot tell us how *c* itself is varying or even if it is varying. If we wanted to insist that *c is constant*, then all the other "constants" like *G* and $\hbar$ *are really constant* as well. But if *c* is not constant, then all the other "constants" are varying as well. In both cases, however, the number of particles is changing, the ratios of masses are changing and the ratios of scales or lengths are also changing. An arrow of cosmological time could therefore, be introduced. In this picture, invariant relationships hold and from unity, there is evolution into diversity. One cannot though conclude how the variations are taking place, over what timescales they are taking place or even how old the universe is. The universe could be 10^{10} years old or 5 x 10^{-44} sec (the Planck time) old, or any time in between. Time *is strictly a parameter* that can be introduced in the scale-invariant relationships. It has no meaning by itself. The universe appears to be evolving as the number of particles and ratios are varying.

7.3 *Peremptory Perspective*

The existence of horizons of knowledge in cosmology, indicate that as a horizon is approached, ambiguity for a unique view of the universe sets in. It was precisely these circumstances that apply at the quantum level, requiring that complementary constructs be employed [73]. At the *initial time*, which could be conveniently taken as the Planck time, if we set the conditions like $c \equiv \dot{R}$, as proposed in this paper, we can axiomatize the numerical relations connecting the microcosm and the macrocosm. One then has scale-invariant relationships. During the *evolutionary* (virtual) process of the universe, the fundamental constants are changing or they may be constant. In the former case, we don't know how or even over what timescales they are changing. In the latter case, one gets the usual evolutionary universe. This is a clear case where complementarity applies.

In other words, as N_p is changing from the initial value of 1 (unity) to the present large value of ~ 10^{80} (diversity), more particles are created as R and all length scales as well as all masses are changing. This could be interpreted by an observer as an "expansion of the universe" (as happened in Big Bang cosmology). An observer, who is inside the universe will perceive an "arrow of time" and an (virtual) "evolving universe". But equivalently, as the "constants" change (in contrast to previous works, they would all have to be changing), or even if they are truly constant, there appears to be an evolution. As $N_p \to 10^{80}$, the present number of the nucleons in the universe, the fundamental "constants" achieve their present values.

Recapitulating, the cosmological arrow of time can be related to a kind of complementarily between two constructs, i.e., the fundamental "constants" *are truly constant*, on one hand; and the fundamental "constants" *are changing*, on the other hand.

In summary, we found that adopting Weinberg's relationship (equivalent to Dirac's relationships (9) and (10) when the latter are equated to each other), we can obtain a relationship linking the speed of light, c to the rate of change of the scale of the universe. In fact, the proportionality factor is ~ 1 if one substitutes for values of fundamental quantities like the present number of particles in the universe, etc. The next step assumes that the relationship linking c and R is an identity, i.e. $\dot{R} \equiv c$ (for example, at the Planck time, one observes that this relationship still holds if the ratios of all masses $\to 1$ and the number of particles also $\to 1$). As such, it is possible (but not necessary) to state that *all* the fundamental constants are changing and not just one of them as was assumed in past works. It is interesting that, recently, the possibility of the cosmological constant, Λ itself changing [64] has been suggested (we prefer minutely oscillating). As such, what we are suggesting here as a framework for the universe is a natural extension of previous ideas. Therefore, as N_p changes from an initial value of 1 to the present value of 10^{80} $(1 \to 10^{80})$, the universe would appear to be evolving to an observer inside it or if an arrow of time is introduced. Finally, the outcomes of this prescription are not just that an arrow of time is introduced and the mysterious coincidences of Dirac and Eddington now can be understood as scale-invariant relationships linking the microcosm to the macrocosm; but in addition, all scales are linked to each other and what one calls, e.g. *fundamental length*, etc. is purely a convention. In the same way, time itself is not as fundamental as the scale-invariant relationships linking the microcosm to the macrocosm. The most critical point is that when the perceived 'Doppler energy of expansion' is instead internalized and correlated with Mach's Principle [71] as a nonlocal 'holographic' continuous-state process [36,37] one arrives at a 3rd regime of UFM [40,41,47] and a dramatic paradigm shift in the definition of the fermionic singularity or Least Cosmological Unit (LCU) tessellating space-spacetime in a 'semi-quantum UFM M-Theoretic Calabi-Yau brane mirror symmetry without a quantum gravity scenario [74].

8. A New UFM Singularity – Introducing the Least Cosmological Unit (LCU)

An SM Least Cosmological Unit (LCU) has been postulated in the past for SM cosmology [48]. The UFM Multiverse LCU is compounded in that there is a duality in the composition of HD. As suggested, there are not simply either Planck scale KK XD or LSXD as Randal-Sundrum suggest but a complementarity of continuous-state semi-compactified XD at the MOU 'semi-quantum limit' and infinite size LSXD beyond (like Euclidean 3D) in the 3rd regime of UFM [40,41]!

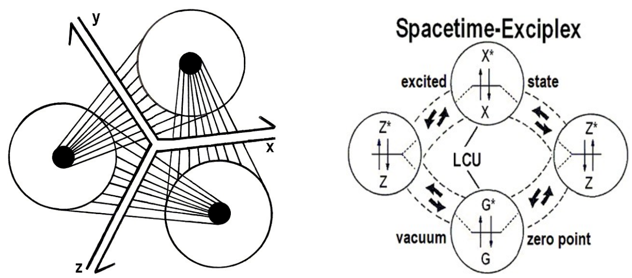

Fig. 11. 10a**.** Triune structure of a solitary least unit that like an isolated quark does not exist in nature. The central parallel lines are the Witten string vertex with properties of a complex Riemann sphere able to continuously rotate from zero to infinity. The field lines represent the 'super quantum potential' coherent control of the unified field, U_F. 10b. Least Unit (LCU) Exciplex Composite. The spacetime exciplex complex is comprised of an array of least cosmological units tessellating space that act in HD as a brane topology gating mechanism for entry of unified field control parameters to operate on the continuous evolution of the resultant Minkowski 4-space.

The HD are not curled up at the Planck scale because they are invisible; they are Large-scale XD (LSXD) because of subtractive interferometry of the C_4^+ - M_4 - C_4^- Cramer-like sanding-wave modes that operates like a movie theatre where discrete frames of film moving through the projector at a few cm/sec appear continuous on the screen. For UFM virtual reality exchange quanta of the U_F is relativistically 'pumped' through discrete holographic-like LCUs tiling the raster of spacetime to produce cyclical virtual images of a Minkowski space present continuously created, annihilated and recreated producing a 'beat frequency' in the emergent cycle of spacetime hidden behind the 'manifold of uncertainty (Fig. 5). Behind this virtual veil is a continuous-state cycle from $0 \Leftrightarrow \infty$ [84].

8.1 *Possibility of Cavity-QED Emission from Continuous Spacetime Compactification*

Exciplex properties of spacetime and matter also suggest 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 (26) 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 LCU spacetime exciplex are:

$$\begin{aligned} &G^* + G^* \Leftrightarrow Z^*; \quad Z^* + m_\gamma \Leftrightarrow X^* \\ &X^* - m_\gamma \xrightarrow{emission} Z^* \quad or \quad G^* \\ &X^* + m_\gamma \rightarrow Z^* \quad or \quad G^* \end{aligned} \tag{26}$$

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 LCU 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 [85].

A torus is generated by rotating a circle about an extended line in its plane where the circles become a continuous ring. According to the equation for a torus, $\left[\left(\sqrt{x^2}+y^2\right)-R\right]^2+z^2=r^2$, where *r* is the radius of the rotating circle and *R* is the distance between the center of the circle and the axis of rotation. The volume of the torus is $2\pi^2Rr^2$ and the surface area is $4\pi^2Rr$, 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 multiverse [37]. Summarizing pertinent aspects of UFM 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 Cramer-Transactional models where the present is continuously recreated out of the *future-past*. Singularities in the UFM are not point like, but dynamic wormhole-like objects able to transmute 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 a 9D mirror symmetric brane with the observed 3(4)D Minkowski spacetime package as the resultant.

During the spin-exchange process of dimensional reduction by topological switching there are 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 virtual 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 virtual Planck scale asymptote 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 UFM 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 aether or during the *torque moment* of excess energy during the continuous-state 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-locked mode acting like an atomic volume. A conceptualization of a Planck scale cavity during photon emission is represented in Figs. 10a,b with 9D suppressed.

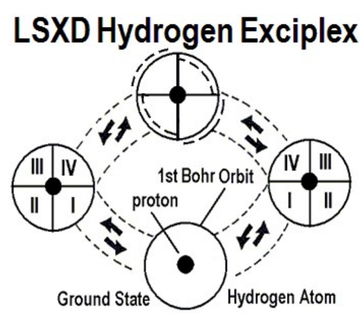

Fig. 12. LSXD Exciplex complex with conformal scale-invariant properties revealing operation of TBS cyclicality in the hydrogen atom mediated by the fluctuating form of Planck's constant varying from asymptotic virtual Planck to the Larmor radius of the hydrogen atom. This is a variable cavity-QED representation whereby new spectral lines will appear at various periodic nodes in the continuous-state LSXD cycle. Nonlocal/HD parts not drawn to scale.

In early spectroscopy the orbital series associated with Rydberg states was proportional to the difference between the two terms of an energy level transition which became known as sharp, principle, diffuse and fundamental, so the designators *s, p, d, f* were used to represent orbital angular momentum states of an atom.

Quantized energy levels result from the relation between a particle's energy and its wavelength. For a confined particle such as an electron in an atom, the wave function has the form of standing waves. Only stationary states with energies corresponding to integral numbers of wavelengths can exist; for other states the waves interfere destructively, resulting in zero probability density. Elementary examples that show mathematically how energy levels come about are the particle in a box and the quantum harmonic oscillator.

The energies of Rydberg states are sensitive to the geometrical structure of the molecular ion core. Rydberg states with low quantum numbers are conveniently accessed using multi-photon excitation via valence states, providing spectra with intensity distributions that depend sensitively on the molecular isomeric form. This discovery opens up the possibility of using Rydberg states to fingerprint the shapes of molecules. Because of the large size of the Rydberg orbitals, the Rydberg fingerprint methodology can have applications in the characterization of biological and nanoscale structures [86].

9. Review of Atomic Theory - Elements of Atomic Structure

Atoms and molecules have Intrinsic orbital state energy levels - specifically, here for the case of a hydrogen atom with a single proton nucleus and a one electron orbital, the energy of state is primarily determined by the electrostatic interaction of the negatively charged electron with the positively charged proton. The energy levels of an electron around a nucleus are given by $E_n = -\hbar c R_\infty (Z^2 / n^2)$ where R_∞ is the Rydberg constant, Z the atomic number and n the principle quantum number. For the hydrogen atom Rydberg levels depend only on the principal quantum number, n (the only Bohr model quantum number).

- Electron Energy, The 1st term is kinetic and the 2nd potential $E = \frac{1}{2}mv^2 - \frac{e^2}{r}$
- Bohr Radius $r = \alpha_0 n^2$
- Centripetal Force $F^2 = \frac{e^2}{mr} \Rightarrow E = \frac{1}{2}m\left(\frac{e^2}{mr}\right) - \frac{e^2}{r} = -\frac{e^2}{2r} = -\frac{e^2}{2\alpha_0 n^2}$
- Rydberg Energy $E_R = \frac{e^2}{2\alpha_0} \Rightarrow E = -\frac{E_R}{n^2}$ for $\begin{cases} n = 1 \;\; E = -E_R \\ n = \infty \;\; E = 0 \end{cases}$

For our process the periodic presence of a larger continuous-state QED cavity (LSXD) will shift the energy level structure in the TBS hydrogen atom, thereby altering the frequency of the emitted radiation. According to atomic theory the duration of this influence is much longer than the lifetime of the emission process thus providing a sufficient period for the putative experimental effect to occur. The Zeeman and Stark effects could help explain or act as an aid in setting up the LSXD TBS experiments.

The Zeeman Effect describes splitting a spectral line into a number of components in the presence of a static magnetic field. It is analogous to the Stark effect, the shifting and splitting of spectral lines of atoms and molecules into several components in the presence of an external electric field. When the spectral lines are absorption lines, the effect is called inverse Zeeman Effect. The Stark effect can lead to splitting of degenerate energy levels. For example, in the Bohr model, an electron has the same energy whether it is in the 2s state or any of the 2p states. However, in an electric field, there will be quantum superpositions of the 2s and

2p states. Where the electron tends to be to the left it will acquire a lower energy; in other hybrid orbitals where the electron tends to be to the right it will acquire a higher energy. Therefore, the formerly degenerate energy levels will split into slightly lower and slightly higher energy levels. Since an atom is a collection of point charges (electrons and nuclei) dipole conditions apply. The interaction of atom or molecule with a uniform external field is described by the operator, $V_{\text{int}} = -F \cdot \mu$.

10. TBS Experimental Theory

Traditionally spectral emission/absorption lines provide information characteristic of the internal structure of an atom by, $E = \hbar\nu = \hbar c / \lambda$ or by the wave number, $\sigma \equiv 1/\lambda = E/\hbar c$ such that each atom has discrete characteristic wavelengths confirmed by monochromatic *x*-ray bombardment. Every atom has a variety of possible energy levels; the lowest called the ground state. From the excited state of energy, E_2 decay may occur to a lower state, E_1 with the energy difference occurring as a photon of energy, E_2 - E_1 with frequency, ν, wavelength, λ and wave number, $E_2 - E_1 = \hbar\nu = \hbar c/\lambda = \hbar c\sigma$ with a perfectly definite value for a monochromatic spectrum [87].

The Born-Oppenheimer (BO) approximation [88,89] which is based on the fact that within molecular systems fast-moving electrons can be distinguished from slow-moving nuclei allows the wavefunction of a molecule to be broken into its electronic and nuclear (vibrational, rotational) $\Psi_{\text{Total}} = \psi_{\text{Electronic}} \times \psi_{\text{Nuclear}}$ components for easier calculation. The assumption is made that if non-adiabatic coupling terms are negligibly small then the upper electronic surfaces have no effect on the nuclear wave function of the lower surface. This assumption is not considered dependent on the systems energy.

However, the ordinary BO approximation was also employed for cases where these coupling terms are not necessarily small, assuming that the energy can be made as low as required. The justification for applying the approximation in such a case is that for a low enough energy the upper adiabatic surfaces are classically forbidden, implying that the components of the total wave function related to these states are negligibly small. As a result, the terms that contain the product of these components with the nonadiabatic coupling terms are also small, and will have a minor effect on the dynamical process.

The protocol will test for both the existence of TBS and also for large scale XD. UFM Cosmology predicts novel HD cavities in the brane topology of Calabi-Yau mirror symmetry. Simplistically a tunable NMR device acts on a vial of hydrogen over a range of de Broglie wavelengths set for specific Cavity-QED resonances to probe the lowest Bohr orbit for TBS. If our cosmological model is correct there will be novel resonances that cannot correspond to either classical wave mechanics or Copenhagen modes. One might suspect C-QED to detect nodes in the Dirac spherical rotation of the electron (cyclical pattern of Klein bottle open-closed modes). Critics might say this is just a 4D effect Dirac effect of the putative Klein bottle symmetries in the electron's spinor rotation. But our XD cosmology predicts a much richer Calabi-Yau mirror symmetry within the higher 9D brane topology so there "should" be a cycle of novel TBS resonances in the Calabi-Yau symmetry. Likewise, these resonance nodes would have de Broglie wavelengths different than any higher Bohr orbit excitation in Hydrogen. It may be possible to predict the de Broglie wavelengths in the resonance hierarchy if the topology can be determined or if a clear C-QED resonance hierarchy appears the topological structure of higher dimensions may be revealed. Vigier discussed using deuterium; it is an open question if that would make a qualitative difference in success or results in such an experiment.

In an earlier work [4,90] we designed a tachyon measurement experiment by initially considering 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 did 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 [91,92]. As one knows light emitted from atoms during transitions 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 additional 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 [91,92] showing that emission and absorption 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 around the nucleus. We note that the same Lorentz conditions denoted in the tachyon measurement experiment apply directly to the TBS experiment with slight phase control alterations in the Cramer-like standing-wave oscillation of the HD Calabi-Yau mirror symmetries.

- 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 [39,93-95].
- These structures contain internal oscillations of point-like quantum mechanical charges around corresponding gravitational centers of mass, Y_μ 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_μ rotates around the center of mass, Y_μ with velocity near the velocity of light, c so that individual electrons are real oscillators with Broglian internal oscillations [37].
- 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, $m_\gamma \simeq 10^{-65}$gm. and an internal oscillation, $E = mc^2 = \hbar$.(Fig. 12)
- The real aether is a covariant polarized Dirac-type stochastic distribution of such extended photons which carry electromagnetic waves built with sets of such extended photons beating in phase and 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 lower level (Exciplex).

10.1 *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 complex space. That is, the Lorentz transformation and its consequences, the Lorentz contraction and mass dilation, etc., are a consequence of time as the fourth dimension of space and are observed in three spaces [90]. These attributes of 4-space in 3-space are expressed in terms of velocity, as in the form $\gamma = \left(1-\beta^2\right)^{-1/2}$ for $\beta \equiv v_{\mathrm{Re}} / c$ where c is always taken as real.

If complex 8-space can be projected into 4-space, what are the consequences? 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 [90].

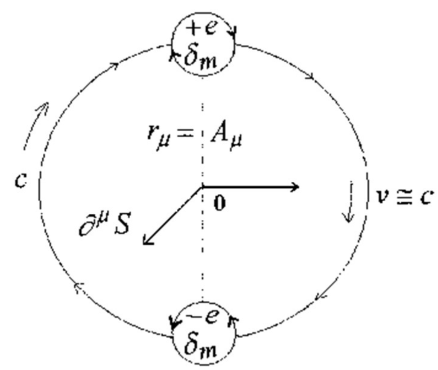

Fig. 13. Diagram conceptualizing two oppositely charged sub-elements rotating at $v \cong c$ around a central point 0 behav2ng like a dipole bump and hole on the topological surface of the covariant polarized Dirac vacuum.

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,

$$x \to x' = x_{\mathrm{Re}} + ix_{im}$$
$$t \to t' = t_{\mathrm{Re}} + it_{im} \tag{27}$$

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

Let us recall that the usual Lorentz transformation conditions is defined in 4D 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. (28), $x = x_{\text{Re}}, t = t_{\text{Re}}$ and $v_{\text{Re}} = x_{\text{Re}} / t_{\text{Re}}$.

$$\begin{aligned} x' &= \frac{x - vt}{\sqrt{1 - v^2 / c^2}} = \gamma\left(x - vt\right) \\ y' &= y \\ z' &= z \\ t' &= \frac{t - \left(v / c^2\right)x}{\sqrt{1 - v^2 / c^2}} = \gamma\left(t - \left(\frac{v}{c^2}x\right)\right) \end{aligned} \tag{28}$$

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

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

$$\begin{aligned} x' &= \frac{x - ivt_{\text{Im}}}{\sqrt{1 - v^2 / c^2}} = \gamma_v\left(x - vt_{\text{Im}}\right) \\ y' &= y \\ z' &= z \\ t' &= \frac{t - \left(v / c^2\right)x}{\sqrt{1 - v^2 / c^2}} = \gamma_v\left(t - \left(\frac{v}{c^2}x\right)\right) \end{aligned} \tag{29}$$

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

In Eq. (29) for simplicity we let x', x, t' and t denote $x'_{\text{Re}}, x_{\text{Re}}, t'_{\text{Re}}$ and t_{Re} and we denote script v as v_{Im}. For velocity, v is $v_{\text{Re}} = x_{\text{Re}} / t_{\text{Re}}$ and $v = v_{\text{Im}} = i_{\text{Im}} / it_{\text{Im}}$; where the *i* drops out so that $v = v_{\text{Im}} = x_{\text{Im}} / t_{\text{Im}}$ 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 conditions in 4D, 8D and ultimately 12D space. The example we consider here is a subspace of the 8-space of $x_{\text{Re}}, t_{\text{Re}}, x_{\text{Im}}$ and t_{Im}. In some cases we let $x_{\text{Im}} = 0$ and just consider temporal remote connectedness; but likewise we can follow the anticipatory calculation and formulate remote, nonlocal solutions for $x_{\text{Im}} \neq 0$ and $t_{\text{Im}} = 0$ or $t_{\text{Im}} \neq 0$. The anticipatory case for $x_{\text{Im}} = 0$ is a 5D space as the space for $x_{\text{Im}} \neq 0$ *and* $t_{\text{Im}} = 0$ is a 7D space and for $t_{\text{Im}} \neq 0$ as well as the other real and imaginary spacetime dimensions, we have our complex 8D space.

It is important to define the complex derivative in order to define velocity, v_{Im}. In the $x_{\text{Re}}t_{\text{Im}}$ plane then, we define a velocity of $v_{\text{Im}} = dx/dit_{\text{Im}}$. In the next section we detail the velocity expression for v_{Im} and define the derivative of a complex function in detail [90].

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

$$\begin{aligned} x' &= \frac{x_{\text{Re}} - v_{\text{Re}} t_{\text{Im}}}{\sqrt{1 + v_{\text{Re}}^2 / c^2}} \\ y' &= y \\ z' &= z \\ t'_{\text{Im}} &= \frac{t_{\text{Re}} - v_{\text{Re}} x_{\text{Re}}}{\sqrt{1 + v_{\text{Re}}^2 / c^2}} \end{aligned} \tag{30}$$

These conditions are valid for any velocity, $v_{\text{Re}} = -v$.

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 [90] which nicely results from the complex 8-space.

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

$$m = \frac{m_0}{\sqrt{1 - v_{\text{Re}}^2 / c^2}} \quad \text{for} \quad v_{\text{Re}} \leq c \tag{31}$$

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

$$m = \frac{m_0^*}{\sqrt{1 - v_{\text{Re}}^2 / c^2}} = \frac{im_0}{\sqrt{1 - v_{\text{Re}}^2 / c^2}} = \frac{m_0}{\sqrt{v_{\text{Re}}^2 / c^2 - 1}} \tag{32}$$

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

$$m = \frac{m_0}{\sqrt{1 + v^2 / c^2}} \tag{33}$$

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

$$m = \frac{m_0}{\sqrt{1-v_{\text{Re}}^2/c^2}} \tag{34}$$

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

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

$$m = \frac{m_0^*}{\sqrt{1+v^{*2}/c^2}} = \frac{im_0}{\sqrt{1-v^2/c^2}} = \frac{m_0}{\sqrt{v^2/c^2-1}} \tag{35}$$

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 $W = v_{\text{Re}} + iv_{\text{Im}}$ for $v_{\text{Re}} < x$, $v_{\text{Im}} < c$ and $W < c$. In general, there will be four complex 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 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 [90]. 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 to 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.

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 addressed [8]. 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.

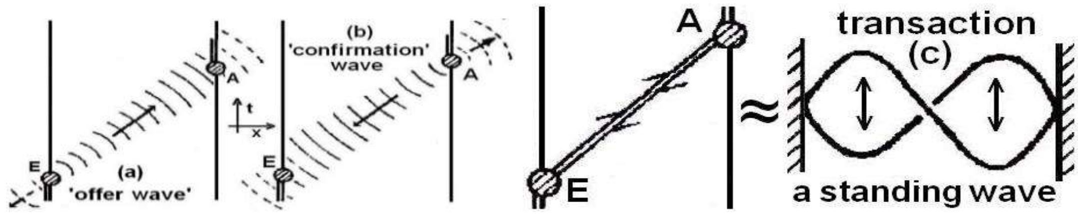

Fig. 14. Cramer's Transactional Interpretation model. a) Offer-wave, b) confirmation-wave combined into the resultant transaction c) which takes the form of an HD future-past advanced-retarded standing or stationary wave. Figs. Adapted from Cramer [79].

Bilaniuk, et al formulated the interpretation of the association of negative energy states with tachyonic signaling [90]. 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 [8]. 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 [90].

In prior volumes [37,90] 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 [37,79] of quantum theory to cosmology. Simplistically Cramer models a transaction as a standing wave of the future-past (offer wave-confirmation wave).

However, in the broader context of the new paradigm of Holographic Anthropic Multiverse (UFM) 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 UFM cosmology the de Broglie-Bohm quantum potential becomes an eternity-wave, ℵ or super pilot wave or force of coherence associated with the U_F ordering the reality of the observer or the locus of the spacetime arrow of time.

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 through interference the reduced eternity wave, ℵ is focused constructively or destructively as the experimental mode may be and according to the parameters illustrated by Feinberg above temporal measurements of emission are taken.

10.2 *Velocity 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 signaling can be considered. It is 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 $v = dx / d(i\tau)$. 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, $f(x, t_{\text{Im}}) = f(z)$ for $z = x + it_{\text{Im}}$ and f(*z*) = $u(x, t_{\text{Im}}) + iv(x, t_{\text{Im}})$ where $u(x, t_{\text{Im}})$ and $v(x_{\text{Im}}, t_{\text{Im}})$ are real functions of the rectangular coordinates x and t_{Im} of a point in space, $P(x, t_{\text{Im}})$. Choose a case such as the origin $z_0 = x_0 + it_{0\text{Im}}$ and consider two cases, one for real increments $h = \Delta x$ and imaginary increments $h = i\Delta t_{\text{Im}}$. For the real increments $h = \Delta t_{\text{Im}}$ we form the derivative $f'(z_0) \equiv df(z) / dz_{z_0}$ which is evaluated at z_0 a

$$f' = \lim \Delta x \to 0 \left\{ \frac{u(x_0 + \Delta x, t_{0\text{Im}}) - u(x_0, t_{0\text{Im}})}{\Delta x} + i\frac{v(x_0 + \Delta x, t_{0\text{Im}}) - v(x_0, t_{0\text{Im}})}{\Delta x} \right\} \tag{36a}$$

or

$$f'(z_0) = u_x(x_0, t_{0\text{Im}}) + iv_x(x_0, t_{0\text{Im}}) \text{ for } u_x \equiv \frac{\partial u}{\partial x} \text{ and } v_x \equiv \frac{\partial v}{\partial x}. \tag{36b}$$

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

$$f'(z_0) = \lim \Delta t_{\text{Im}} \to 0 \left\{ \frac{1}{i} \frac{u(x_0, t_{0\text{Im}} + \Delta t_{\text{Im}}) - u(x_0, t_{0\text{Im}})}{\Delta t_{\text{Im}}} + \frac{v(x_0, t_{0\text{Im}} + \Delta t_{\text{Im}}) - v(x_0, t_{0\text{Im}})}{\Delta t_{\text{Im}}} \right\} \tag{37a}$$

and

$$f'(z_0) = -iu_{t\text{Im}}(x_0, t_{0\text{Im}}) + v_{t\text{Im}}(x_0, t_{0\text{Im}}) \tag{37b}$$

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

$$u_{t\text{Im}} \equiv \frac{\partial u}{\partial t_{\text{Im}}} \text{ and } v_{t\text{Im}} \equiv \frac{\partial v}{\partial t_{\text{Im}}}. \tag{37c}$$

Using the Cauchy-Riemann equations

$$\frac{\partial u}{\partial x}=\frac{\partial v}{\partial t_{\mathrm{Im}}} \text{ and } \frac{\partial u}{\partial t_{\mathrm{Im}}}=-\frac{\partial v}{\partial x} \tag{38}$$

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

$$f'(z_0)=\lim h\to 0 \quad \frac{f(z_0+h)-f(z_0)}{h}=\frac{df(z)}{dz}\Big|_{z_0} \tag{39a}$$

and

$$u_x(x_0,t_{0\mathrm{Im}})+iv_x(x_0,t_{0\mathrm{Im}})-\frac{\partial u(x_0,t_{0\mathrm{Im}})}{\partial x}+i\frac{\partial v}{\partial x}(x_0,t_{0\mathrm{Im}}) \tag{39b}$$

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

$$f'(z_0)=\frac{dx}{d(it_{\mathrm{Im}})}=\frac{1}{i}\frac{dx}{dt_{\mathrm{Im}}} \tag{40a}$$

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

$$f'(z_0)=x'(t_{\mathrm{Im}})=\frac{dx}{dh}=\frac{dx}{idt_{\mathrm{Im}}}. \tag{40b}$$

Then we can define a velocity where the differential increment is in terms of $h=i\Delta t_{\mathrm{Im}}$. Using the first case as $u(x_0,t_{0\mathrm{Im}})$ 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.

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 $n > 4D$ as compactified on the scale of the Planck length, 10^{-33} cm [90].

In 4D space 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 complex space, the points $x_{1\text{Re}}$ and $x_{2\text{Re}}$ appear to be contiguous for the proper path 'travelled' to the point.

10.3 *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) [93-96] 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 $\rho(x_\mu)$ of small extended structures represented by four-vectors $A_\mu(x_\alpha)$ 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 $\delta\rho(x_\mu)A_\alpha(x\mu)$ above $\delta\rho > 0$ for light and below $(\delta\rho < 0)$ for gravity density at x_μ.
- the possibility to propagate such field variations within the vacuum as first suggested by Dirac [95].

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_μ distribution. It implies the introduction of non-linear terms.

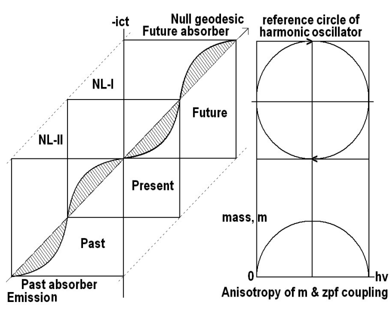

Fig. 15. a) 2D drawing of a 3D view of a 4D hyperstructure. Minkowski spacetime diagram of the electric vector only in terms of a present moment of 'tiled' Planck units for the Wheeler-Feynman theory of radiation. Vertices represent absorption & emission. The observable present is represented by bold lines, and nonlocal components by standard line. Each event is a hyperstructure of Past, Present, Future interactions, governed by an HD de Broglie-Bohm super-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).

To describe individual non-dispersive sub-elements within I_0, where the scalar density is locally constant and the average A_μ equal to zero, one introduces at its central point $Y_\mu(\theta)$ a space-like radial four-vector $A_\mu = r_\mu \exp(iS/\hbar)$ (with $r_\mu r^\mu$ = a^2 = constant) which rotates around Y_μ with a frequency $\nu = m_\gamma c^2/h$. 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_μ with a velocity $\cong c$. The +e and –e electromagnetic pointlike charges correspond to opposite rotations (i.e $\pm\ \hbar/2$) and A_μ rotates around an axis perpendicular to A_μ located at Y_μ, and parallel to the individual sub-element's four momentum $\partial_\mu S$.

Assuming electric charge distributions correspond to $\delta m > 0$ and gravitation to $\delta m < 0$ one can describe such sub-elements as holes ($\delta m < 0$) around a point 0 around which rotate two point-like charges rotating in opposite directions as shown in Figure 12.

These charges themselves rotate with a velocity *c* at a distance $r_\mu = A_\mu$ (with $r_\mu r_\mu$ = Const.). From 0 one can describe this by the equation

$$\Box A_\mu - \frac{m_\gamma^2 c^2}{\hbar^2} \cdot A_\mu = \frac{\left[\Box(\mathrm{A}_\alpha^* \mathrm{A}_\alpha)\right]^{1/2}}{(A_\alpha^* A_\alpha)^{1/2}} \cdot A_\mu \tag{41}$$

with $A_\mu = r_\mu \cdot \exp[iS(x_\alpha)/\hbar]$ along with the orbit equations for e$^+$ and e^- we get the force equation

$$m \cdot \omega^2 \cdot r = e^2/4\pi r^2 \tag{42}$$

and the angular momentum equation:

$$m_\gamma \cdot r^2 \cdot \omega = \hbar/2 \tag{43}$$

Eliminating the mass term between (41) and (43) this yields

$$\hbar\omega = e^2/2r \tag{44}$$

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

$$A_\mu^0 = \frac{\sin \cdot K \cdot r}{K \cdot r} \cdot \exp[i(\cot - K_0 x)] \tag{45}$$

where

$$K = mc/\hbar, \quad \omega = mc^2/\hbar \quad and \quad K_0 = mv/\hbar \tag{46}$$

satisfies the relation (43) with $r = ((x - vt)^2 \cdot (1 - v^2/c^2)^{-1} + y^2 + z^2)^{1/2}$ i.e.

$$\Box A_\mu^0 = 0: \tag{47}$$

so that one can add to A_μ^0 a linear wave, A_μ (satisfying $\Box A_\mu = (m_\gamma^2 c^2 / \hbar^2) A_\mu$) 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. 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.

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. [90]) 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.

$$\textbf{Retarded:} \quad F_1 = F_0 e^{-ikx} e^{-2\pi ift}, \quad F_2 = F_0 e^{ikx} e^{-2\pi ift} \tag{48a}$$

$$\textbf{Advanced:} \quad F_3 = F_0 e^{-ikx} e^{2\pi ift}, \quad F_4 = F_0 e^{ikx} e^{2\pi ift} \tag{48b}$$

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. This new process arises from a richer *open* (non-compactified) KK 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.

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

An excimer is defined as 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.

An Exciplex is an electronically excited complex of definite stoichiometry, 'non-bonding' in the ground state. For example, a complex formed by the interaction of an excited molecular entity with a ground state counterpart of a different structure. When it hits ground a photon is emitted as a Quasiparticle soliton.

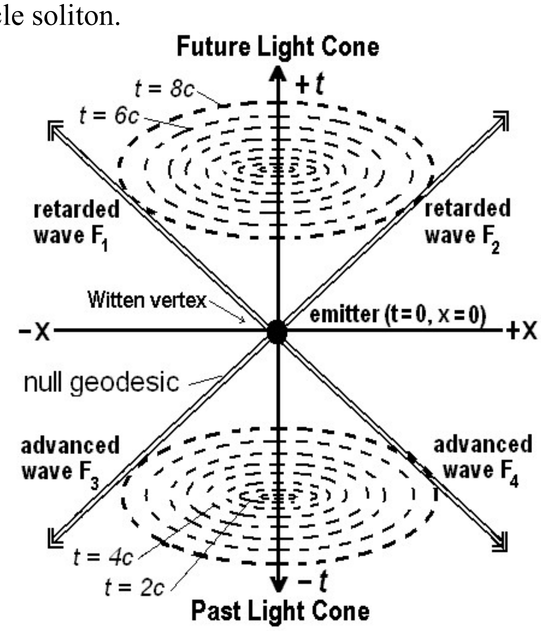

Fig. 16. 4D Minkowski light-cone of advanced and retarded waves (Eq. 1) emitted from a locus at $(x,t) = (0,0)$. Adapted from concepts of Cramer [79].

In reviewing atomic theory Bohm states:

"Inside an atom, in a state of definite energy, the wave function is large only in a *toroidal region* surrounding the radius predicted by the Bohr orbit for that energy level. Of course the toroid is not sharply bounded, but ψ reaches maximum in this region and rapidly becomes negligible outside it. The next Bohr orbit would appear the same but would have a larger radius confining ψ and propagated with wave vector $k = \rho / h$ with the probability of finding a particle at a given region proportional to $|\psi|^2 = |f(x,y,z)|^2$. Since f is uniform in value over the toroid it is highly probable to find the particle where the Bohr orbit says it should be" [96].

11. Experimental Design and Procedure

The main purpose of this work is to propose an empirical protocol for testing additional dimensionality without the need for supercollider physics, creating a new field of particle physics able to test and manipulate the structure of matter with low energy table top devices. This experiment potentially opens the door to a new regime of UFM in the continuation - Classical Newtonian Mechanics to Quantum Mechanics and now to UFM [40,41,47].

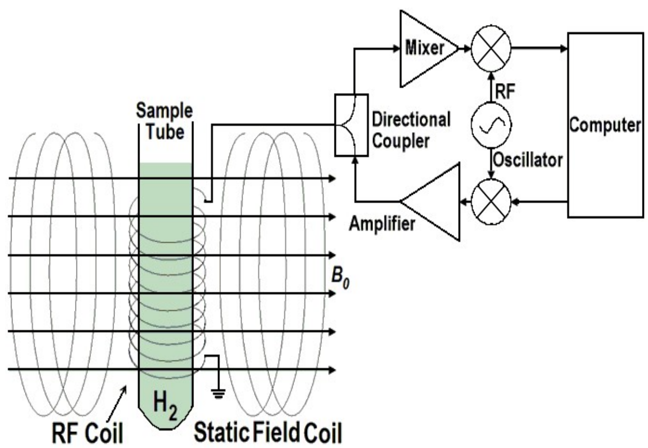

Fig.17. Simplified experimental NMR-like resonance apparatus for putative LSXD C-QED ionization of TBS in hydrogen. The Fig. only shows possible details for rf-modulating TBS QED resonance, not the spectrographic recording and analysis components.

Some experimental evidence has been found to support this view showing the possibility that the interaction of these extended structures in space involve real physical vacuum couplings by resonance with a subquantum Dirac aether. Because of photon mass the CSI model, any causal description implies that for photons carrying energy and momentum one must add to the restoring force of the harmonic oscillator an additional radiation (decelerating) resistance derived from the em (force) field of the emitted photon by the action-equal-reaction law. Kowalski showed that emission and absorption between atomic states take place within a time interval equal to one period of the emitted or absorbed photon wave.

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

The purpose of this simple experiment is to empirically demonstrate the existence of LSXD utilizing a new model of TBS in the hydrogen atom until now hidden behind the veil of the uncertainty principle. For illustration, we assume new TBS spectral lines occur between the *s* and *p* orbitals of a hydrogen atom by the possibility of heretofore unknown CQED volume possibilities arising from cyclical fluctuations in large XD Calabi-Yau mirror symmetry dynamics hidden behind the veil of uncertainty. This is in addition to the Vigier Coulomb TBS model.

As in the perspective of rows of seats in an auditorium, rows of trees in an orchard or rows of headstones in a cemetery, from certain positions the line of sight is open to infinity or blocked. This is the assumption we make about the continuous-state cyclicality of HD space in relation to surmounting the quantum uncertainty principle [2-4]. Then if the theory has a basis in physical reality and we propose that at certain nodes in the cycle we would discover HD cavity volumes in the MOU. Three Putative XD cavity modes like 'phase locked loops' depending the cycle position - maximal, intermediate and minima are proposed. UFM cosmology suggests that there is a Feynman synchronization backbone with an inherent beat frequency in the continuous-state spacetime backcloth. If we trap a hydrogen atom in a specific continuous-state CQED mode; we may manipulate it with an rf-pulsed resonance hierarchy in the context of Kowalski's Lorentz transform [91,92].

12. Summary – Conclusions and Further Considerations

A brief review of the status of current thinking for the empirical search for physics beyond the SM was presented. A radical new theoretical and experimental alternative has been introduced. John Archibald Wheeler stated, "*In any field find the strangest thing and then explore it*" [97]. During the 2015 'Conference on 60 Years of Yang-Mills Gauge Field Theories' at the Nanyang IAS in Singapore Nobelist David Gross commented "… *Some crazy experiment* …". Let not the reader be myopically dissuaded as history has shown that bolder new ideas present greater challenge of initial acceptance; especially as this theory (as history demonstrates for rigorous theory) is not only empirically testable but passes the 'pre-test' of being 'logically coherent, internally consistent and having broad explanatory power'!

The new UFM theory does not stand alone in proposing LSXD. It does however represent a paradigm shift in the progression: Newtonian Classical Mechanics $\rightarrow$ Quantum Mechanics $\rightarrow$ UFM and is thus fraught with a plethora of detail hard to swallow on 1st bite. The model is essentially a String/M-Theory albeit with radically different utility of some parameters based more generally on the original Hadronic form with inherent virtual tachyon/tardon parameters and variable rather than fixed string/brane tension, T_S lost in current iterations of fixed T_S. An alternative derivation of T_S uncovered a putative discovery of the Holy Grail of M-Theory, i.e. a unique string vacuum [37].

Most salient UFM postulates include:

- An HD manifold of quantum uncertainty (MOU) of finite radius with a complementary LSXD Bulk beyond.
- Resonance hierarchy for experimentally surmounting uncertainty possible because of a beat frequency inherent in the cyclicality of Continuous-State LCU cosmology.
- New TBS spectral lines in hydrogen between the 1st Bohr orbit at .5Å and 2Å
- QM is no longer considered fundamental and not the regime of integration with GR, rather the 3rd regime of UFM.
- Of greatest importance - The Continuous-State process is a key feature of 3rd regime

cosmology as it provides critical understanding for designing and performing the experimental protocol for surmounting the Quantum Uncertainty Principle. Its mantra is: A 'continuous-state Calabi-Yau mirror symmetric spin-exchange dimensional reduction compactification process' hidden until now behind the 'veil of uncertainty'. The LCU UFM Continuous-State cycle appears to correspond to Mach's Principle, giving theoretical injunction that gravity is not quantized.

12.1. Gravity's Rainbow and String/M-Theory

The complete fundamental brane content of string/M-theory raises the question whether the super-Minkowski spacetimes themselves arise as central extensions. Huerta proves that they do. He starts from the simplest possible super-Minkowski spacetime, the superpoint, which has no Lorentz structure and no spinorial structure, we give a systematic process of repeated "maximal invariant central extensions", and show that it discovers the super-Minkowski spacetimes that contain superstrings, culminating in the 10- and 11-dimensional super-Minkowski spacetimes of string/M-theory and leading directly to the brane bouquet.

This raises an evident question: Might there be a precise sense in which all dimensions of spacetime originate from the condensation of some kind of 0-branes in this way? Is the brane bouquet possibly rooted in the superpoint? Such that the ordinary super-Minkowski spacetimes, not just extended super-Minkowski spacetimes such as string and m2brane, arise from a process of 0-brane condensation "from nothing"? To appreciate the substance of this question, notice that it is clear that every super-Minkowski spacetime is some central extension of a superpoint [107,108] the super-2-cocycle classifying this extension is just the super-bracket that turns two supercharges into a translation generator.

In summary, Theorem 14 shows that the brane bouquet, and with it at least a fair chunk of the structure associated with the word "M-theory", has its mathematical root in the superpoint, and Proposition 6 adds that as the superspacetimes grow out of the superpoint, they consecutively discover their relevant Lorentzian metric structure and spinorial structure, and finally their supergravity equations of motion.

The ***proposed Chinese supercollider***, at 34 miles in circumference, would be double the size of the LHC, which will soon be obsolete.

The next LHC experiment was considered to be a game changer. Mir Faizal, on the team of physicists behind the experiment, said: "Just as many parallel sheets of paper, which are two dimensional objects can exist in a third dimension, parallel universes can also exist in higher dimensions". "We predict that gravity can leak into extra dimensions, and if it does, then miniature black holes can be produced at the LHC." "Normally, when people think of the multiverse, they think of the many-worlds interpretation of quantum mechanics, where every possibility is actualized. "This cannot be tested and so it is philosophy and not science. "This is not what we mean by parallel universes. What we mean is our real universes built with extra dimensions. "As gravity can flow out of our universe into the extra dimensions, such a model can be tested by the detection of mini black holes at the LHC.

"We have calculated the energy at which we expect to detect these mini black holes in 'gravity's rainbow' [a new scientific theory]. "If we do detect mini black holes at this energy, then we will know that both gravity's rainbow and extra dimensions are correct." When the

LHC is fired up the energy is measured in TeV (trillion), electron Volts. So far, the LHC has searched for mini black holes at energy levels below 5.3 TeV. But the latest study says this is too low. Instead, the model predicts that black holes may form at energy levels of at least 9.5 TeV in 6D and 11.9 TeV in 10D.

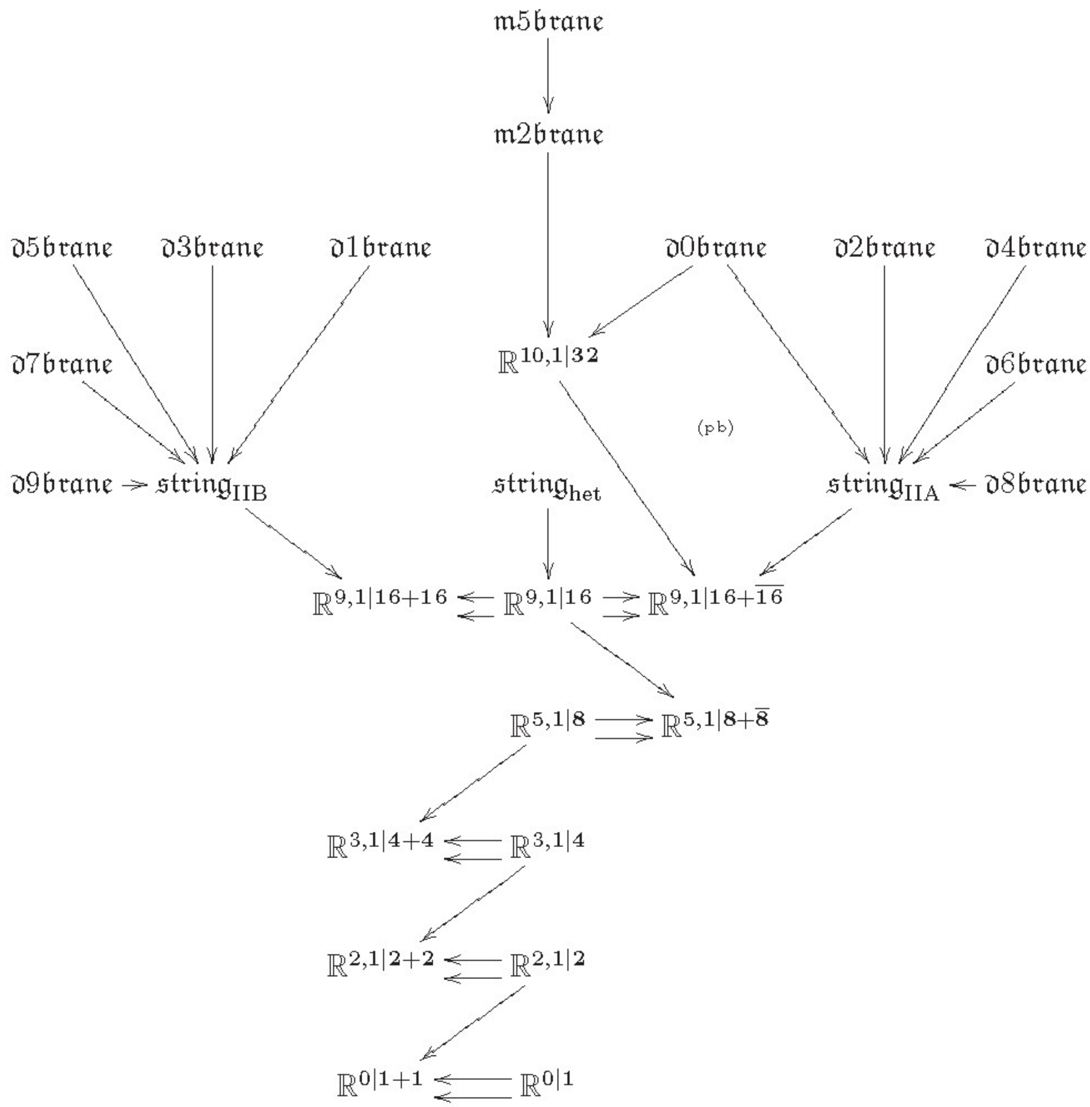

Figure 18. Brane bouquet, adapted from Huerta [107].

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