

## Zero Point Energy, Star Gates & Warp Drive

Notes on “The Casimir Effect  
Physical Manifestations of Zero Point Energy”  
K A Milton, World Scientific (2001)  
Under Construction

“When in doubt, integrate out.”<sup>1</sup>

By Jack Sarfatti

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<sup>1</sup> “Roger Rabbit Goes To College” ;-)

## Abstract

This paper contains original important discoveries not found anywhere else. It addresses and answers the following questions:

**Why classical curved spacetime at all? (Sakharov, 1967)**

**What is the “dark energy” that is most of the mass of the universe invisible to electromagnetic detectors yet detectable gravitationally?**

**Why is the universe’s expansion rate speeding up rather than slowing down?**

**What is Kip Thorne’s “exotic matter” needed to keep traversable wormholes open?**

**Is vacuum propulsion of unconventional flying objects<sup>2</sup> possible in principle?<sup>3</sup>**

In the course of answering these questions I derive the detailed nature of the coherence mechanism of the zero point energy vacuum fluctuations. What we have is an electrically neutral spin 0 Bose-Einstein condensate<sup>4</sup> of mainly virtual electron-positron pairs. I derive explicit formulas for the parameters of the effective potential of this condensed phase of quantum vacuum without which classical gravity could not even come into being. These formulas show implicitly how the quantum phase transition leading to inflation happens. They also suggest how to control the inflation process on a small scale. The implications of such a development are, of course, profound.

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The first obvious fact from this book by K. A. Milton is that the widespread claim by the New Age “Cargo Cult”<sup>5</sup> Alternative Energy and UFO Disclosure Movement that the theories of Hal Puthoff mainly, also Bernie Haisch and Alfonso Rueda secondarily, are some kind of panacea breakthrough already here for world energy problems is “not even wrong”<sup>6</sup> without any scientific foundation. Casimir force effects are very tiny. Their most immediate applications would be to tiny nanometer scale machines. The UFO explanation by Eric Davis at MUFON 2001 is completely bogus, although the alleged phenomena cited in his paper may not be.<sup>7</sup>

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<sup>2</sup> Book by Paul Hill a USG aeronautical engineer in 40’s and 50’s is reliable.

<sup>3</sup> In the sense of Alcubierre’s warp drive on a free float timelike geodesic without harmful g-forces.

<sup>4</sup> Classical curved spacetime is supported by a giant coherent quantum wave (or qubit field) inside the physical vacuum.

<sup>5</sup> Richard Feynman’s famous talk at Cal Tech on “Cargo Cult Pseudoscience”.

<sup>6</sup> Wolfgang Pauli’s nasty comment on bad physics.

<sup>7</sup> [http://198.63.56.18/pdf/davis\\_mufon2001.pdf](http://198.63.56.18/pdf/davis_mufon2001.pdf)

## Connection of zero point energy to intermolecular Van der Waals forces.

The interaction Hamiltonian between two electric dipoles is

$$H_{\text{electric-dipole-dipole}} = -\vec{d}_1 \cdot \vec{E}_{12} = -\vec{d}_2 \cdot \vec{E}_{21} = \frac{\vec{d}_1 \cdot \vec{d}_2 r^2 - 3\vec{d}_1 \cdot \vec{r} \vec{d}_2 \cdot \vec{r}}{r^5} \quad (1.1)$$

For a paraelectric randomly oriented ensemble of dipoles the quantum expectation value of the coupling energy from first order time independent perturbation theory vanishes.

$$\langle H_{\text{electric-dipole-dipole}} \rangle = 0 \quad (1.2)$$

In second order perturbation theory, the effective *static* dipole-dipole potential energy is

$$V_{\text{eff}}^{(2)} = \sum_{n \neq 0} \frac{\langle 0 | H_{\text{electric-dipole-dipole}} | n \rangle \langle n | H_{\text{electric-dipole-dipole}} | 0 \rangle}{E_0 - E_n} \sim \frac{1}{r^6} \quad (1.3)$$

Where  $|0\rangle$  is the “vacuum”. Including time delay retardation gives  $\sim r^{-7}$  at larger distances between the dipoles. The polarizability  $\alpha$  is defined by

$$\vec{d} = \alpha \vec{E} \quad (1.4)$$

At absolute zero temperature

$$V_{\text{eff}}^{(2)} \sim \frac{\alpha_1 \alpha_2 \hbar c}{r^6 r} \quad (1.5)$$

The general mainstream zero point energy computational situation is murky because of the ambiguities of renormalization of subtracting two infinities to get a finite number. True, the procedure empirically works to fantastic accuracy in quantum electrodynamics, but it is one of the mysteries why it does.<sup>8</sup> The Green’s function method seems to require the outgoing far field radiation boundary condition that appear to exclude nonradiating near fields? The Casimir force for parallel plates is attractive, but it is repulsive for a conducting neutral sphere (Timothy Boyer). Attempts to compute zero point energy effects of confined strong gluons in the microscopic hadron bag model are inconclusive. Applications to extra Kaluza-Klein space dimensions are also in a sorry state. When it comes to cosmology,

“Significant issues arise when we consider gravitation, because the absolute scale of energy presumably is now meaningful as the source of gravity. In particular, one might

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<sup>8</sup> See Feynman’s popular books especially the one on “Quantum Electrodynamics” with all the little arrows.

think that the cosmological constant would have its origins in quantum fluctuations of the gravitational and other fields, yet naïve estimates give far too large a value.” p. 201 (Milton).

I solve this problem in this paper. I should give some credit to Giovanni Modanese whose work with real superconductors, not the virtual one in the superfluid quantum vacuum, gave me one of the key ideas for this solution. Another key idea was Hagen Kleinert’s “solid state” formalism for general relativity in terms of a “world crystal lattice” with curvature and torsion as string topological defects of disclination and dislocation respectively. I also should give credit to Hal Puthoff and Bernie Haisch whose suggestions on the zero point origin of inertia and gravity seemed so silly and wrong headed to me that I decided to solve the Sakharov problem that motivated them correctly. Basically none of the Pundits, not just Hal and Bernie, had the correct qualitative picture of the actual quantum vacuum although fragments like QCD gluon condensates were in the air pointing in the right direction. No one, until me, realized how to use Bohm’s quantum realism to derive Einstein’s 1915 geometrodynamics from the phase modulation of the vacuum virtual Bose-Einstein condensate with the quintessent  $\Lambda(x)$  field from its amplitude modulation.

## Quintessence as finite renormalization?

The factor  $\hbar c/r$  is a quantum zero point fluctuation term. I suggest for Popper falsification, the completely new original empirical rule for  $L_p^2 \equiv \hbar G/c^3 \sim 10^{-66} \text{ cm}^2$

$$\frac{\hbar c}{r} \rightarrow \frac{\hbar c L_p^2 \Lambda(\vec{r}, t)}{r} = \frac{\hbar c}{r} \left( 1 - L_p^3 |\Psi(\vec{r}, t)|^2 \right) \quad (2.1)$$

where  $\Lambda(\vec{r}, t)$  is the local quintessent field and  $\Psi(\vec{r}, t)$  is the local order parameter of the physical vacuum describing the Bose-Einstein condensate of virtual off mass shell Goldstone “tachyons” with

$$M^2 < 0, \beta > 0 \quad (2.2)$$

in the infrared

$$|\vec{k}| \ll Mc/\hbar \quad (2.3)$$

where

$$\omega^2 \neq (kc)^2 - |Mc^2/\hbar|^2 \quad (2.4)$$

The local macroscopic quantum phase coherent vacuum order parameter obeys the spacetime + gauge covariant Landau-Ginzburg Bit From It equation

$$D^\mu D_\mu \Psi + \left(\frac{Mc}{\hbar}\right)^2 \Psi + \frac{\beta}{\hbar^2} |\Psi|^2 \Psi = 0 \quad (2.5)$$

where

$$\begin{aligned} \Psi(x) &= |\Psi(x)| e^{i\theta(x)} \\ |\Psi(x)| &\equiv \sqrt{\frac{1}{L_p^3} (1 - L_p^2 \Lambda(x))} \\ \lim_{\Lambda \rightarrow 0} |\Psi(x)| &\rightarrow \sqrt{\frac{1}{L_p^3}} \neq 0 \\ \lim_{\Lambda \rightarrow 1/L_p^2} |\Psi(x)| &\rightarrow 0 \end{aligned} \quad (2.6)$$

Note that the completely incoherent locally random hugely would be antigravitating vacuum<sup>9</sup> of Flat World indeed has  $\Lambda \approx L_p^{-2} \approx 10^{66} \text{ cm}^{-2}$ .

Possibility 1: singularities are real.

$$-\infty \leq L_p^2 \Lambda(x) \leq 1 \quad (2.7)$$

If this is how the universe works then we have a singularity when

$$\lim_{\Lambda \rightarrow -\infty} |\Psi| \rightarrow \sqrt{\frac{|\Lambda|}{L_p^3}} \rightarrow +\infty \quad (2.8)$$

Possibility 2: singularities are an illusion.

$$-1 \leq L_p^2 \Lambda(x) \leq 1 \quad (2.9)$$

This means that if  $L_p$  is an absolute universal cut off for all continuum based local quantum field theories

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<sup>9</sup> This is a counter-factual definite statement used in quantum theory. See Roger Penrose's popular books. Example, "I would if I could, but I am not able." (Pirates of Penzance) Something that might have happened, but didn't, would have been definite if it did. This is no joke, e.g. Elitzur-Vaidman land mine tester p. 268 Penrose, "Shadows of the Mind".

$$|\Psi|_{\max} = |\Psi|_{\Lambda=-1/L_p^2} = \sqrt{\frac{1}{L_p^3} \left(1 + \frac{L_p^2}{L_p^2}\right)} = \sqrt{2} |\Psi|_{\Lambda=0} \quad (2.10)$$

That is, the maximal possible Goldstone virtual tachyon Bose-Einstein density is only twice the corresponding density at the Einstein limit of 1915 where  $\Lambda = 0$ . It's beginning to look like all the infinities of renormalizable quantum field theories can be made finite using the local quintessent field  $\Lambda(x)$ . I make this as a conjecture.

## “It From Bit” + Bit From It = “Universe as a Self-Excited Circuit”<sup>10</sup>

Einstein's classical curved spacetime metric field obeys the deBroglie-Bohm-Josephson gauge covariant “phase lock” between “It” particle and “qubit” pilot wave<sup>11</sup>

$$g_{\mu\nu}(x) = \frac{1}{2} L_p^2 \{ \tilde{D}_\mu, \tilde{D}_\nu \} \Theta(x) = \frac{1}{2} L_p^2 [ \tilde{D}_\mu \tilde{D}_\nu + \tilde{D}_\nu \tilde{D}_\mu ] \Theta(x) \quad (3.1)$$

where

$$\tilde{D}_\mu \Theta \equiv \left( \frac{\partial}{\partial x^\mu} - \frac{e}{\hbar c} A_\mu \right) \Theta \quad (3.2)$$

$$\begin{aligned} \vec{D}\Psi &\equiv \left( -i\vec{\nabla} - \frac{e}{\hbar c} \vec{A} \right) \Psi \quad \& \quad D_0\Psi = \left( \frac{i}{c} \frac{\partial}{\partial t} - \frac{e}{\hbar c} A_0 \right) \Psi \\ D_\mu &\approx -i_{(\mu)} \frac{\partial}{\partial x^\mu} - \frac{e}{\hbar c} A_\mu + \Gamma \dots \\ i_{(1)} &= i_{(2)} = i_{(3)} = i, i_{(4)} = -i \end{aligned} \quad (3.3)$$

There is a perennial tension between classical Einstein relativity and quantum theory. For example

- Locality of classical relativity vs. quantum nonlocality
- Non-renormalizability of quantum gravity

Here we have the requirement of classical relativity's local covariance in tension with the Hermitian operators in qubit space requiring real eigenvalues for quantum observables

<sup>10</sup> John Archibald Wheeler

<sup>11</sup> This is the elastic-plastic strain tensor of Hagen Kleinert's 4-Dim “World Crystal Lattice” of scale  $L_p$  for the unit cell. 1-Dim string defects of disclination are the curvature of gravity. 1-Dim string defects of dislocation are the torsion gaps breaking “graviton” closed strings in Curve World into “gauge boson” open strings in local Flat World and vice versa.

like the momentum and energy of a real particle<sup>12</sup> (quantum). This requires using the signature operator  $i_{(\mu)}$  to maintain the Minkowski local light cone structure in  $\theta \approx p^\mu x_\mu / \hbar = (\vec{p} \cdot \vec{x} - Et/c) / \hbar$  that demands  $\vec{p} \rightarrow \hbar \vec{\nabla} / i, E \rightarrow i \hbar \partial / \partial t$ , otherwise we would be in the Euclidean spacetime from a Wick rotation<sup>13</sup>. There is no summation convention between the signature operator and the ordinary partial derivative in (3.3) and the  $\Gamma$  term is context dependent on the rank of the tensor operand. For example, for the scalar field  $\Psi(x)$  there is no  $\Gamma$  term. However.

$$D_\nu D_\mu \Psi = i_{(\nu)} \frac{\partial}{\partial x^\nu} D_\mu \Psi - \frac{e}{\hbar c} A_\nu D_\mu \Psi - \Gamma_{\mu\nu}^\sigma D_\sigma \Psi \quad (3.4)$$

The fully covariant D'Alembertian back-action BIT FROM IT<sup>14</sup> "wave propagation" term is then

$$\begin{aligned} D^\mu D_\mu \Psi &= i_{(\mu)} g_\sigma^\mu \frac{\partial}{\partial x^\sigma} D_\mu \Psi - \frac{e}{\hbar c} g_\sigma^\mu A_\sigma D_\mu \Psi - \Gamma_{\mu}^{\mu\sigma} D_\sigma \Psi \\ &= i_{(\mu)} g_\sigma^\mu \frac{\partial}{\partial x^\sigma} \left( -i_{(\mu)} \frac{\partial}{\partial x^\mu} - \frac{e}{\hbar c} A_\mu \right) \Psi - \frac{e}{\hbar c} g_\sigma^\mu A_\sigma \left( -i_{(\mu)} \frac{\partial}{\partial x^\mu} - \frac{e}{\hbar c} A_\mu \right) \Psi \\ &\quad - \Gamma_{\mu}^{\mu\sigma} \left( -i_{(\sigma)} \frac{\partial}{\partial x^\sigma} - \frac{e}{\hbar c} A_\sigma \right) \Psi \end{aligned} \quad (3.5)$$

Note the virtual condensate-virtual photon couplings. Every  $i_{(\mu)} \partial / \partial x^\mu$  operator is a virtual Bose-Einstein interaction part. When multiplied with a  $A_\nu$  it's an interaction with virtual photons, when multiplied by a  $\Gamma$  it's an interaction with the classical geometrodynamical connection field that is the smooth collective emergent Curve World<sup>15</sup> mode from a spontaneous broken Goldstone symmetry in Flat World. This is the solution to Andre Sakharov's problem of 1967. One never need directly quantize the gravitational field! It is a misconception to try to do so. That's why quantum gravity is not renormalizable in the global Flat World sense. It is not supposed to be! Hal Puthoff's attempt to solve this problem is "too cheap".<sup>16</sup>

Furthermore, the Curve World Levi-Civita connection for parallel transport of tensors along world lines in terms of the gauge force covariant Flat World derivatives is

$$\Gamma_{\mu\nu\sigma} \equiv \frac{1}{2} \left( \tilde{D}_\nu g_{\mu\sigma} + \tilde{D}_\sigma g_{\nu\mu} - \tilde{D}_\mu g_{\nu\sigma} \right) \quad (3.6)$$

<sup>12</sup> On the mass shell, i.e. pole of Feynman propagator in complex energy plane of underlying Flat World.

<sup>13</sup> Stephen Hawking makes frequent use of this formal trick in quantum cosmology.

<sup>14</sup> This is what John Archibald Wheeler left out of his "IT FROM BIT", "LAW WITHOUT LAW" Demiurge Platonic Vision of the "UNIVERSE AS A SELF-EXCITED CIRCUIT" (illustrated in Escher's "Drawing Hands").

<sup>15</sup> I will *try* to use "World" for 4-Dim spacetime and "Land" for 3-Dim spacelike slice of spacetime.

<sup>16</sup> What Albert Einstein allegedly initially told David Bohm in 1951 on seeing his pilot wave theory.

The gapless (massless) Goldstone-like bosons<sup>17</sup> are from the small oscillations in the  $\Theta$  quantum phase field around the *minimum* of the effective potential  $V(\Psi^*, \Psi)$  of the virtual infrared tachyonic physical vacuum superfluid. The massive Higgs-like bosons with  $m^2 > 0$  are from the small oscillations of the amplitude  $|\Psi|$  again at the *minimum* of the effective potential  $V(\Psi^*, \Psi)$  where<sup>18</sup>

$$\begin{aligned} V(\Psi^*, \Psi) &\equiv Mc^2\Psi^*\Psi + \frac{\beta}{M}(\Psi^*\Psi)^2 \\ \frac{M}{\hbar^2} \frac{\delta}{\delta\Psi^*} V(\Psi^*, \Psi) &= \left(\frac{Mc}{\hbar}\right)^2 \Psi + \frac{\beta}{\hbar^2}(\Psi^*\Psi)\Psi \\ D^\mu D_\mu \Psi + \frac{M}{\hbar^2} \frac{\delta}{\delta\Psi^*} V(\Psi^*, \Psi) &= 0 \end{aligned} \quad (3.7)$$

The limit of Einstein's 1915 theory of gravity is when  $\Lambda \rightarrow 0$ . This requires a large quantum vacuum tachyonic Bose-Einstein condensate  $|\Psi| \rightarrow \sqrt{1/L_p^3}$  for the more stable lower energy density physical vacuum that permits classical curved spacetime  $g_{\mu\nu}(x)$  to come into being from the phase field  $\Theta(x)$  of the new coherent order that is locally nonrandom and smooth.<sup>19</sup> This is "Curve World". The locally random false vacuum "Flat World"<sup>20</sup> is the Haisch-Puthoff-Rueda theory in which  $\Psi = 0$  and  $\Lambda \rightarrow 1/L_p^2 \sim 10^{66} \text{ cm}^{-2} \gg 0$ . The quantum vacuum corrected local "IT FROM BIT"<sup>21</sup> Einstein field equation is generally

$$G_{\mu\nu}(x) + \Lambda(x)g_{\mu\nu}(x) = -8\pi \frac{G}{c^4} T_{\mu\nu}(x) \quad (3.8)$$

In which  $\Lambda(x) > 0$  is Kip Thorne's universally antigravitating "exotic matter" needed to accelerate the expansion rate of the universe, keep traversable wormhole "Star Gates" open and keep timelike geodesic free float "warp drives" working. The other case of  $\Lambda(x) < 0$  is universally gravitating "dark energy" that is the "missing mass" of the universe. These important empirical results come from the covariant equation of state of the quantum vacuum energy, which is

$$\rho(qmvac)c^2 + p(qmvac) = 0 \quad (3.9)$$

<sup>17</sup> In this new original context I have here created.

<sup>18</sup>  $m_p = \sqrt{\hbar c/G} = 2.18 \times 10^{-5} \text{ gm}$

<sup>19</sup> This was the problem posed by Andre Sakharov in 1967, but not solved properly until now by me.

<sup>20</sup> "Flat, stale and unprofitable" Hamlet, Shakespeare

<sup>21</sup> Because of macro-quantum  $\Psi$  dependence via quintessent  $\Lambda$ .



where  $\rho(qmvac)$  is the effective “zero point” mass density of the quantum vacuum, and  $p(qmvac)$  is the effective “zeropoint” quantum pressure of the vacuum. In fact

$$t_{00}(qmvac) \equiv \rho(qmvac)c^2 = \frac{\hbar c}{L_p^2} \Lambda(x) \quad (3.10)$$

The active gravity mass-energy density that, for example pumps cosmic inflation in Einstein’s theory, is  $\rho(qmvac)c^2 + 3p(qmvac)$ . The factor of 3 is crucial. When  $\Lambda(x) > 0$ , then  $\rho(qmvac)c^2 + 3p(qmvac) < 0$ , i.e. the active gravity mass-energy density is negative which means universal antigravity, i.e. Kip Thorne’s exotic matter. Similarly,  $\Lambda(x) < 0$ , i.e. the active gravity mass-energy density is positive which means gravitating “dark energy” that is invisible electromagnetically, but not gravitationally because it is a nonclassical phase of the physical vacuum.

## Local Conservation of Stress-Energy Density Currents

When  $\Lambda$  is constant, and there is zero torsion<sup>22</sup>, and metricity<sup>23</sup> the two Bianchi identities combine to give a vanishing spacetime covariant divergence to the Einstein tensor, i.e.

$$\begin{aligned} G_{\mu\nu}{}^{;\nu} &= 0 \\ \Lambda g_{\mu\nu}{}^{;\nu} &= 0 \end{aligned} \quad (4.1)$$

Therefore,

$$T_{\mu\nu}{}^{;\nu} = 0 \quad (4.2)$$

This is no longer true when we have a local quintessent field. Assuming still zero torsion and metricity, gives at the very least

$$T_{\mu\nu}{}^{;\nu}(x) = -\frac{c^4}{8\pi G} \frac{\partial \Lambda(x)}{\partial x^\nu} g_{\mu\nu}(x) \neq 0 \quad (4.3)$$

This is an equation of the “vacuum propeller”<sup>24</sup> type. Torsion and nonmetricity from the universe’s “unseen dimensions” would, if present, give further terms for “propellantless propulsion”.

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<sup>22</sup> Lower indices of connection  $\Gamma_{\mu\nu}^\sigma$  for parallel transport of vectors along paths in Curve World are symmetric.

<sup>23</sup> Spacetime covariant derivative of metric tensor vanishes.

<sup>24</sup> Roger Coolidge (private communication).

## Is the quantum vacuum's virtual superfluid charged?

Tony Smith wonders if the infrared virtual tachyon macroscopic quantum vacuum superfluid (Bose-Einstein condensate) whose local phase modulation gives the classical Einstein field, and whose local amplitude modulation gives the quintessent field for both antigravity exotic matter and gravitating dark matter, is charged? That is, is there a new U(1) internal symmetry (hyperspace) group with spontaneous broken local gauge invariance in the vacuum? Is this simply the "axion"? What about the other charges like electro-weak-strong charges (12 altogether)?

I have been rather cavalier on this important detail focusing for the nonce on the delicious results i.e. a unified simple explanation for

1. Why classical curved spacetime at all?
2. Why Einstein's 1915 field equation with zero cosmological constant works so well?
3. Why the universe is accelerating and exotic matter for star gates and warp drive are the same thing on different scales.
4. What the "dark energy" missing mass of the universe really is.

The key new feature is the quantum vacuum coherence factor

$$\Psi(x) = \sqrt{\frac{1}{L_p^3} (1 - L_p^2 \Lambda(x))} e^{i\Theta(x)} \quad (5.1)$$

If  $\Psi(x)$  were an absolutely charge neutral giant "wave function" for the macroscopic Bose-Einstein condensate we would not be that well off because we would have no hope of locally controlling it to fly away in our saucers through star gates to other worlds of promise, hope and glory. We would be stuck on this small planet only to all die from ecological catastrophe, perhaps quite soon, as many people have described with strange gusto. This is because, we recall (3.1), Einstein's local field for Curve World is

$$g_{\mu\nu}(x) = \frac{1}{2} L_p^2 \{ \tilde{D}_\mu, \tilde{D}_\nu \} \Theta(x) = \frac{1}{2} L_p^2 [ \tilde{D}_\mu \tilde{D}_\nu + \tilde{D}_\nu \tilde{D}_\mu ] \Theta(x) \quad (5.2)$$

where  $L_p^2 = hG/c^3 = 10^{-66} \text{ cm}^2 =$  area of one quantum gravity Bekenstein BIT of Shannon entropy-Brillouin information (depending how you look at it).

"Area" is fundamental to the "world hologram" of my old Cornell chum Lenny Susskind and to "loop quantum gravity" of Ashtekar et-al as a non-perturbative Diff(4) invariant strategy unlike superstring theory with hyperspace which seems to be stuck in perturbation theory, except perhaps for various "dualities"?

If  $\tilde{D}_\mu$  is simply a partial derivative in global Flat World, The Capital City of Special Relativity, we do not have much hope of becoming Super Heroes like Buckaroo Banzai, <http://jerseyguy.com/bonzai.html> rock star (will a Gilbert and Sullivan tenor do?) genius physicist leaping across the 11 dimensions of Super Cosmos. It would be time for me to take off my Captain Video ring that I got at the US Army Quarter Masters Lab in 1950 in lower Manhattan near the John Wanamaker Building.

To make the problem simpler without losing the essence: start in quantum Flat World. Assume Feynman's quantum electrodynamics is a complete description of Flat World. We have only spin 1-boson photons and spin 1/2 fermionic electrons and positrons. An electron of negative energy moving backward in time is a positron of positive energy moving forward in time.

The second quantized electron-positron local field operator  $\hat{\psi}_\sigma(x)$  breaks into a positive frequency and a negative frequency part.

$$\begin{aligned} \hat{\psi}_\sigma &= \hat{\psi}_\sigma^+ + \hat{\psi}_\sigma^- \\ \sigma &= \uparrow, \downarrow \end{aligned} \tag{5.3}$$

The negative frequency part  $\hat{\psi}_\sigma^-(x)$ , let us say, destroys an electron  $e^-$  at spacetime point event  $x$  or creates a positron  $e^+$ , both of positive energy moving forward in time. Therefore, the positive frequency part  $\hat{\psi}_\sigma^+(x)$  creates an electron or destroys a positron. These fermions also have two spin states and the electron-positron complex is described by a 4-component Dirac spinor, which at low energies limits to a 2-component Pauli spinor describing only the electron. I mean here, of course, real quanta on the mass shell!

Is the virtual tachyon superfluid inside the physical quantum vacuum a composite of virtual photons and virtual electron-positron pairs?

First, what about virtual photons forming Bose-Einstein condensates, will that do? NO! Why? Because those are what real detectable classical near induction electric and magnetic fields from motors and transformers etc already are. They are "zero" in the complete vacuum, unless we mean by "vacuum" the electron vacuum? The electron quantum vacuum is an electrically neutral plasma of locally random virtual electron-positron fluctuations. If the spin 0 boson tachyon condensate is composite and not a fundamental field on its own, then it must be a Bose-Einstein condensate of nonlocally connected or "entangled" Einstein-Podolsky-Rosen-Bohm (EPRB) virtual electron-positron pairs like in a BCS superconductor. Yes, that's what it is all right. That is we have a huge macroscopic density of  $|\psi(x)|^2 = L_p^{-3} [1 - L_p^2 \Lambda(x)]$  virtual electron positron pairs all occupying the same small phase space volume, the same nonlocally entangled pair state. What is the  $x$  in the local order parameter  $\psi(x)$ ? It is the center of mass coordinate of the virtual electron-positron pair. How many of these virtual pairs? Starting with Einstein's 1915 local field equation for the shape of Curve World:

$$G_{\mu\nu}(x) + \Lambda(x) g_{\mu\nu}(x) = -8\pi \frac{G}{c^4} T_{\mu\nu}(x) \quad (5.4)$$

$$\Lambda(x) \rightarrow 0$$

Implies  $\psi(x) \neq 0$ , i.e. Curve World is the smooth locally nonrandom macroscopic coherent quantum "classical looking" final state from the initial discontinuous locally random microscopic incoherent zero point virtual electron-positron pair vacuum fluctuations. What we have here is a second order phase transition of Goldstone's spontaneous broken symmetry from Flat World to Curve World in which the latter is a smooth nonrandom modulation of the former random carrier channel. Flat World is intrinsically "exotic" with a huge antigravity that will not support ordinary spacetime geometry and matter as we know it.

We then have for  $\Lambda \rightarrow 0$  to first approximation

$$|\psi|^2 \approx \frac{1}{L_p^3} \approx 10^{99} \text{ cm}^{-3} \quad (5.5)$$

virtual electron-positron pairs all occupy the *same* entangled pair state in phase space. Use the non positive definite Wigner phase space "wavelet" density  $W(x, p)$  whose marginal integrals give  $|\psi(x)|^2$  and its Fourier transform  $|\tilde{\psi}(p)|^2$  both positive definite.

Each quantum has 4 space-time degrees of freedom and 4 momentum degrees of freedom (tangent fiber bundle). The dimension of phase spacetime is 32 including the 2 spin polarizations for each quantum. However, we will focus on the local center of mass degrees of freedom in 3-space, not the relative degrees of freedom of separation of one fermion from the other in the nonlocally entangled state. The volume of this phase space cell for the center of mass only is  $\sim 2\hbar^3$ , where  $\hbar \sim 10^{-27}$  erg-seconds. Therefore, we have  $\sim 10^{99}$  virtual electron-positron pairs per cubic centimeter of spacelike surface all squeezed into this single "Prospero's Cell" in order to maintain the Curve World in which we move like fish swim in water.

When the density of virtual pairs gets too large we have gravitating electromagnetically invisible "dark energy", i.e. the missing mass of the universe. When the density of virtual pairs gets too small we have antigravitating electromagnetically invisible "exotic matter" (Kip Thorne) needed to accelerate the universe, hold open star gates like Hercules supporting the world and zip around in flying saucers like Buckaroo Banzai and his gang!

<http://stardrive.org/cartoon/coffee.html>

Consider a nonlocal pair entanglement operator<sup>25</sup>

$$\langle 0 | \frac{1}{\sqrt{2}} [\hat{\psi}_{\uparrow}^+(x) \hat{\psi}_{\downarrow}^-(x') + \hat{\psi}_{\uparrow}^-(x) \hat{\psi}_{\downarrow}^+(x')] | 0 \rangle = \frac{1}{\sqrt{2}} [e_{\uparrow}^-(x) e_{\downarrow}^+(x') + e_{\uparrow}^+(x) e_{\downarrow}^-(x')] \quad (5.6)$$

There is nothing unique about this particular choice of a nonlocal entanglement e-bit pattern because we do not need to consider the electron and the positron identical in the sense of the Pauli exclusion principle. Also, in this case they are in different spin states and can occupy the same event  $x$  even if they were identical. This particular choice gives an electrically neutral spin zero complex even on the mass shell for a real electron-positron pair. We will stay off the mass shell. Imagine, for example,  $10^{99}$  of such pairs all Bose-Einstein condensed into this same pair state in each cubic centimeter of classically empty space. To be more precise we need to focus on the center of mass coordinate  $X$  of a single pair. All the center of mass coordinates of all the pairs inside the Bose-Einstein condensate are phase-locked together by the phase field  $\theta(X)$  of the local, but long-range phase coherent, quantum vacuum order parameter  $\Psi(X)$

$$\begin{aligned} X &\equiv \frac{x + x'}{2} \\ \chi &\equiv x - x' \end{aligned} \quad (5.7)$$

The inverse transformation is

$$\begin{aligned} x &= X + \frac{\chi}{2} \\ x' &= X - \frac{\chi}{2} \end{aligned} \quad (5.8)$$

$$\begin{aligned} \frac{\partial}{\partial x} &= \frac{\partial X}{\partial x} \frac{\partial}{\partial X} + \frac{\partial \chi}{\partial x} \frac{\partial}{\partial \chi} = \frac{1}{2} \frac{\partial}{\partial X} + \frac{\partial}{\partial \chi} \\ \frac{\partial}{\partial x'} &= \frac{\partial X}{\partial x'} \frac{\partial}{\partial X} + \frac{\partial \chi}{\partial x'} \frac{\partial}{\partial \chi} = \frac{1}{2} \frac{\partial}{\partial X} - \frac{\partial}{\partial \chi} \end{aligned} \quad (5.9)$$

$$\frac{\partial}{\partial x} + \frac{\partial}{\partial x'} = \frac{\partial}{\partial X} \quad (5.10)$$

Note the cancellation of the relative nonlocal separation in (5.10).

The virtual off mass shell electrons and positrons are certainly charged and they require gauge covariant derivatives in Flat World. That is, we need the local quantum operators

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<sup>25</sup> This is one member of a “Bell basis” used in quantum computing, cryptography and teleportation in the Menage a Trois “voyeur” games that Alice, Bob and Eve play with each other in Liaisons Dangerous. ;-)

$$-i\vec{\nabla} - \frac{e}{\hbar c} \vec{A}(x) \& i \frac{\partial}{\partial t} - \frac{e}{\hbar c} A_0(x) \quad (5.11)$$

Classically the total momentum of an electron in an EM field is  $p_\mu - (e/c)A_\mu$  where  $-(e/c)A_\mu$  is the EM field momentum “stuck” to the electron. However, in quantum mechanics  $\vec{p} \rightarrow (\hbar/i)\vec{\nabla}$  &  $E \rightarrow i\hbar\partial/\partial t$  as noted above.

The *nonlocal* nonrelativistic<sup>26</sup> quantum Schrodinger equation in configuration space for two charged particles in an external classical electromagnetic field is

$$\begin{aligned} & i\hbar \left\{ \left( \frac{\partial}{\partial t} - \frac{e}{\hbar} A_0(x) \right) + \left( \frac{\partial}{\partial t} - \frac{e}{\hbar} A_0(x') \right) \right\} \psi(x, x') \\ & = \left\{ -\frac{\hbar^2}{2m} \left[ \left( \vec{\nabla}_x - \frac{e}{\hbar c} \vec{A}(x) \right)^2 + \left( \vec{\nabla}_{x'} - \frac{e}{\hbar c} \vec{A}(x') \right)^2 \right] \right\} \psi(x, x') \end{aligned} \quad (5.12)$$

Where  $\psi(x, x')$  is the Einstein-Podolsky-Rosen-Bohm nonlocally entangled pair state.

What we want to do, quite obviously, is to separate out the center of mass degree of freedom of this single pair. We then have  $10^{99}$  virtual electron-positron pairs per cubic centimeter Bose-Einstein condense, i.e. occupy this same center of mass wave packet spread through ordinary Curve World. The center of mass quantum phase is then coherently locked in step. This is an obvious violation of local gauge invariance, which means that the quantum phases at different events  $x$  in Curve World are not tightly locked together. That we have smooth classical Curve World at all would not be able to happen were it not for this phase locking spontaneous broken U(1) symmetry of the virtual off mass-shell electron-positron pairs in a spin-zero electrically neutral macroscopically occupied pair state at the above enormous density if the Planck scale  $L_p$  is really as small as  $10^{-33}$  cm. My theory here works even if  $L_p$  is larger as it is in some versions of O Brane New World of M-Theory.<sup>27</sup> Bill Page has cited a paper that large Planck scales from large extra compactification scales in the bosonic Kaluza-Klein sector of the hyperspace of Super Cosmos would conflict with data on proton decay. I am not sure about that.

The rule in Curve World’s *configuration space* is therefore

$$D_\mu \rightarrow D_\mu(x) + D_\mu(x') \quad (5.13)$$

<sup>26</sup> Galilean relativity with Newtonian absolute simultaneity time  $t$ .

<sup>27</sup> August 2000 Scientific American, “The Universe’s Unseen Dimensions” and Stephen Hawking’s “The Universe in a Nutshell”.

The problem here in Curve World is that curvature<sup>28</sup> and torsion<sup>29</sup> introduce non-integrable path-dependences needing the connection fields. The world line one takes in parallel transport matters. However, here in Quantum World we are in a configuration space and at this point the anholonomies of local Curve World do not yet impede the progress of your Journey with me along the straightest hyperspace geodesic through Dante's Inferno on the Path of Enlightenment to Paradiso and the City of the Mind of God.<sup>30</sup> ☺

$$\{D_\mu(x) + D_\mu(x')\} \psi(x, x') = \left\{ -i_{(\mu)} \frac{\partial}{\partial x^\mu} - \frac{e}{\hbar c} A_\mu(x) - i_{(\mu)} \frac{\partial}{\partial x'^\mu} - \frac{e}{\hbar c} A_\mu(x') \right\} \psi(x, x') \quad (5.14)$$

$$\{D_\mu(x) + D_\mu(x')\} \psi(x, x') = \left\{ -i_{(\mu)} \frac{\partial}{\partial X^\mu} - \frac{e}{\hbar c} \left[ A_\mu \left( X + \frac{\chi}{2} \right) + A_\mu \left( X - \frac{\chi}{2} \right) \right] \right\} \psi'(X, \chi) \quad (5.15)$$

I now make the usual Ansatz of separability. This needs more rigor of course, but I leave that for the mopping up by future grad students doing dissertations at Star Fleet Academy in San Francisco's Presidio.

$$\psi'(X, \chi) = \Psi(X) \psi(\chi) \quad (5.16)$$

Therefore

$$\begin{aligned} \{D_\mu(x) + D_\mu(x')\} \psi(x, x') &\rightarrow \left\{ D_\mu \left( X + \frac{\chi}{2} \right) + D_\mu \left( X - \frac{\chi}{2} \right) \right\} \Psi(X) \psi(\chi) \\ &= \left\{ -i_{(\mu)} \frac{\partial}{\partial X^\mu} - \frac{e}{\hbar c} \left[ A_\mu \left( X + \frac{\chi}{2} \right) + A_\mu \left( X - \frac{\chi}{2} \right) \right] \right\} \Psi(X) \psi(\chi) \end{aligned} \quad (5.17)$$

Next, make a Taylor series expansion on the electromagnetic 4-potentials  $A_\mu$ . Symbolically and *very* non-rigorously this is

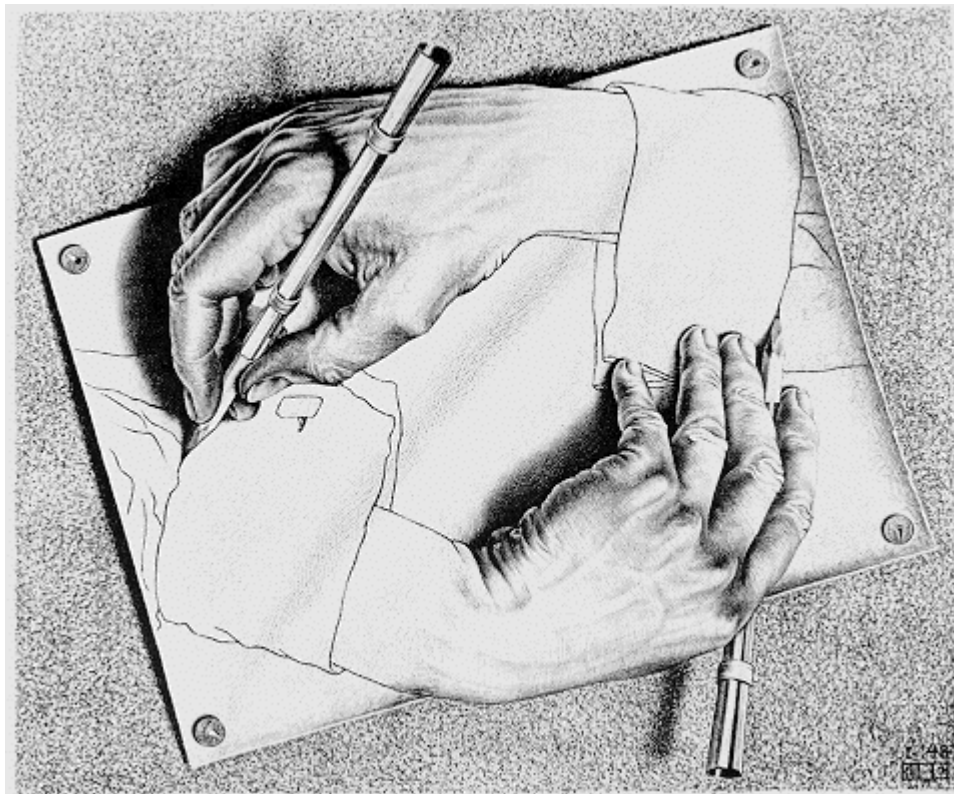
$$A_\mu \left( X \pm \frac{\chi}{2} \right) \approx \sum_{n=0}^{\infty} \frac{(\pm 1)^n}{n!} \left( \frac{\chi}{2} \right)^2 \left( \frac{d}{dX} \right)^n A_\mu(X) \quad (5.18)$$

<sup>28</sup> Disclination string defects in the World Crystal Lattice of Hagen Kleinert.

<sup>29</sup> Dislocation string defects breaking closed paths into open paths with a gap in the local Curve World <-> Flat World "tetrad map" that is Einstein's local principle of equivalence, i.e. explain gravity by locally eliminating gravity in the free float weightless local inertial frames (LIF) of Flat World tangent fiber space. Frames of reference stuck in Curve World are non-inertial, i.e. non-geodesic with "weight" from non-gravity electrical reaction forces. For example, standing on the surface of the Earth is a noninertial frame in Curve World. Weightless free float on the Space Shuttle in orbit with engines off is an LIF frame with zero gravity.

<sup>30</sup> See end of Hawking's "A Brief History of Time".

This is really a multiple Taylor expansion of course since each variable is a set of 4 variables. What we have here is essentially an electromagnetic multipole expansion. We are concerned here with the post-quantum back action BIT FROM IT covariant Landau-Ginzburg equation for the deformation of the Bose-Einstein condensate by Curve World given that Curve World itself is an emergent coherent collective order<sup>31</sup> from the phase modulation of the Bose-Einstein condensate itself. What we have here is illustrated in Maurice Escher's "Drawing Hands"



Note that the odd multipoles cancel out of the center of mass motion equation. For now, restrict the pair separation  $\chi$  to be small compared to local radii of spacetime curvature. If the Landau-Ginzburg equation were linear the  $\psi(\chi)$  function would cancel out. But it is nonlinear, hence it does not cancel out. Thus we must also take the difference

$$\left\{ D_{\mu}(x) - D_{\mu}(x') \right\} \psi(x, x') \rightarrow \left\{ D_{\mu} \left( X + \frac{\chi}{2} \right) - D_{\mu} \left( X - \frac{\chi}{2} \right) \right\} \Psi(X) \psi(\chi) \quad (5.19)$$

$$\left\{ -2i_{(\mu)} \frac{\partial}{\partial \chi^{\mu}} - \frac{e}{\hbar c} \left[ A_{\mu} \left( X + \frac{\chi}{2} \right) - A_{\mu} \left( X - \frac{\chi}{2} \right) \right] \right\} \Psi(X) \psi(\chi)$$

<sup>31</sup> P.W. Anderson's "More Is Different".



Now it is the even multipoles that cancel out. The complete nonlinear BIT FROM IT post-quantum backaction partial differential equation will be a set of two coupled equations in which the center of mass motion and the internal motion of the pair state are mutually interdependent.

We really want an equation only for the center of mass of the pair with the effective potential of (3.7) above. When in doubt, integrate out!

What we want to do is to take 3-dimensional spacelike integrals over the relative separation  $\chi$ . This is like integrating over unobserved particles in the reduced density matrix formalism of many-particle physics. In particular look at the nonlinear and nonlocal potential terms of the Landau-Ginzberg equation in the configuration space of the virtual pair. Imagine that the basic equation in Curve World virtual particle-antiparticle configuration space is

$$D^\mu(x, x') D_\mu(x, x') \psi(x, x') = 0 \quad (5.20)$$

That is,

$$D^\mu(X, \chi) D_\mu(X, \chi) \Psi(X) \psi(\chi) = 0 \quad (5.21)$$

Take the symmetric form,

$$\begin{aligned} D(X, \chi)_s &\equiv D\left(X + \frac{\chi}{2}\right) + D\left(X - \frac{\chi}{2}\right) \\ &= -i_{(\mu)} \frac{\partial}{\partial X^\mu} - \frac{2e}{\hbar c} \left[ A_\mu\left(X + \frac{\chi}{2}\right) + A_\mu\left(X - \frac{\chi}{2}\right) \right] \end{aligned} \quad (5.22)$$

Next, form the symmetric wave propagation operator in pair configuration space<sup>32</sup>

$$\begin{aligned} D(X, \chi)^\mu_s D(X, \chi)_{\mu s} &\approx \\ g^{\mu\sigma}(X) &\left\{ -i_{(\sigma)} \frac{\partial}{\partial X^\sigma} - \frac{2e}{\hbar c} \left[ A_\sigma\left(X + \frac{\chi}{2}\right) + A_\sigma\left(X - \frac{\chi}{2}\right) \right] \right\} \left\{ -i_{(\mu)} \frac{\partial}{\partial X^\mu} - \frac{2e}{\hbar c} \left[ A_\mu\left(X + \frac{\chi}{2}\right) + A_\mu\left(X - \frac{\chi}{2}\right) \right] \right\} \end{aligned} \quad (5.23)$$

Now integrate all  $\chi$ -dependent terms in the wave operator with respect to a spacelike slice of spacetime. The basic conditional probability integral operator for these terms is

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<sup>32</sup> We can leave out the Curve World  $\Gamma$  terms since they do not contribute to the effective potential for the order parameter  $\Psi(X)$ .

$$\iiint d^3 \chi |\psi(\vec{\chi}, \chi_0)|^2 \dots \quad (5.24)$$

Obviously the pure center of mass differential operator terms  $-i_{(\sigma)} \frac{\partial}{\partial X^\sigma}$  are not affected.

It seems obvious to me that we will pull out the effective potential of (3.7) in this process in which the parameter  $M^2$ , which can be positive or negative, comes from the  $\chi$  integrations (5.24) over the gauge force multipole expansion of (5.18), and  $\beta$  comes from the  $\chi$  integrals in the screened Hartree-Fock Coulomb static field approximation. This screened field potential will be repulsive. Why? There are three contributions of essentially equal strength in the virtual electron-positron charge neutral plasma that is the quantum vacuum of the Dirac field. They are electron-electron, positron-positron, and electron-positron. That is two repulsive vs. one attractive interaction, hence repulsion dominates which is exactly what we want. The center of mass densities;

$(\Psi^*(X)\Psi(X))^2$  are outside the  $\chi$  integrals in the screened Hartree-Fock Coulomb static field computation. Therefore,

$$\left(\frac{Mc}{\hbar}\right)^2 = \left(\frac{2e}{\hbar c}\right)^2 g^{\mu\sigma}(X) \iiint d^3 \chi \left[ A_\sigma\left(X + \frac{\chi}{2}\right) + A_\sigma\left(X - \frac{\chi}{2}\right) \right] \left[ A_\mu\left(X + \frac{\chi}{2}\right) + A_\mu\left(X - \frac{\chi}{2}\right) \right] \quad (5.25)$$

$$-\infty < M^2 < +\infty \quad (5.26)$$

$$\frac{\beta}{\hbar^2} (\Psi^*(X)\Psi(X))^2 \approx e^2 \iiint d^3 \chi \left\{ \frac{\left[ \rho_1\left(X + \frac{\chi}{2}, X + \frac{\chi}{2}\right) \rho_1\left(X - \frac{\chi}{2}, X - \frac{\chi}{2}\right) + 2\rho_1\left(X + \frac{\chi}{2}, X - \frac{\chi}{2}\right)^2 \right]}{|\vec{\chi}|} \right\} \quad (5.27)$$

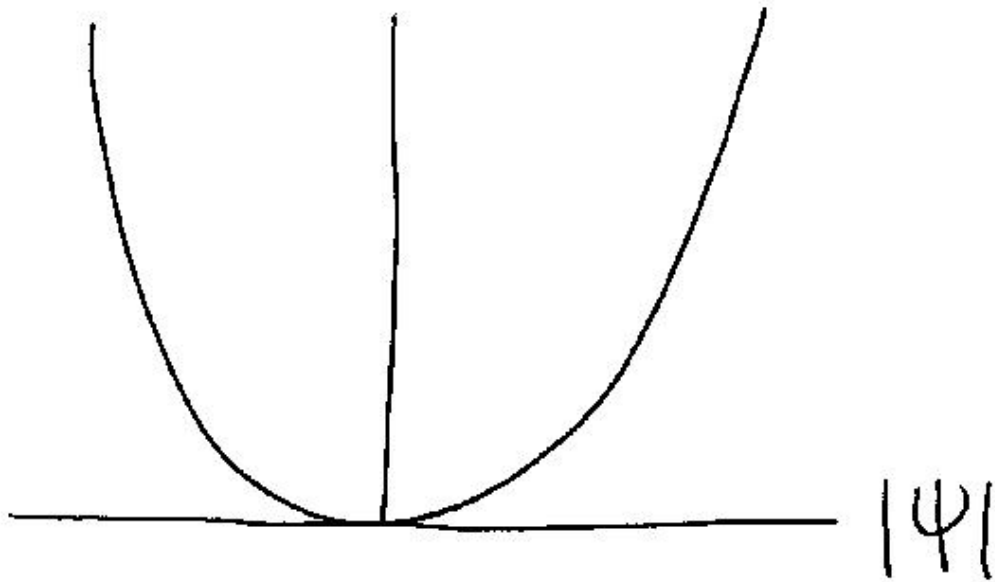
Using the reduced density matrix formalism. The off-diagonal term is the quantum mechanical Heisenberg, in this case repulsive, Coulomb exchange interaction between virtual electrons with virtual electrons on different pairs, and also between virtual positrons with virtual positrons on different pairs. The Coulomb attraction between virtual electrons with positrons in the same pair and on different pairs cancel out. There, is of course, no exchange interaction in that case since they are not to be treated as identical particles in the sense of the Pauli exclusion principle.

$$\begin{aligned} \rho_1\left(X + \frac{\chi}{2}, X + \frac{\chi}{2}\right) &\equiv \iiint d^3 x' |\psi(x, x')|^2 \\ \rho_1\left(X - \frac{\chi}{2}, X - \frac{\chi}{2}\right) &\equiv \iiint d^3 x |\psi(x, x')|^2 \end{aligned} \quad (5.28)$$

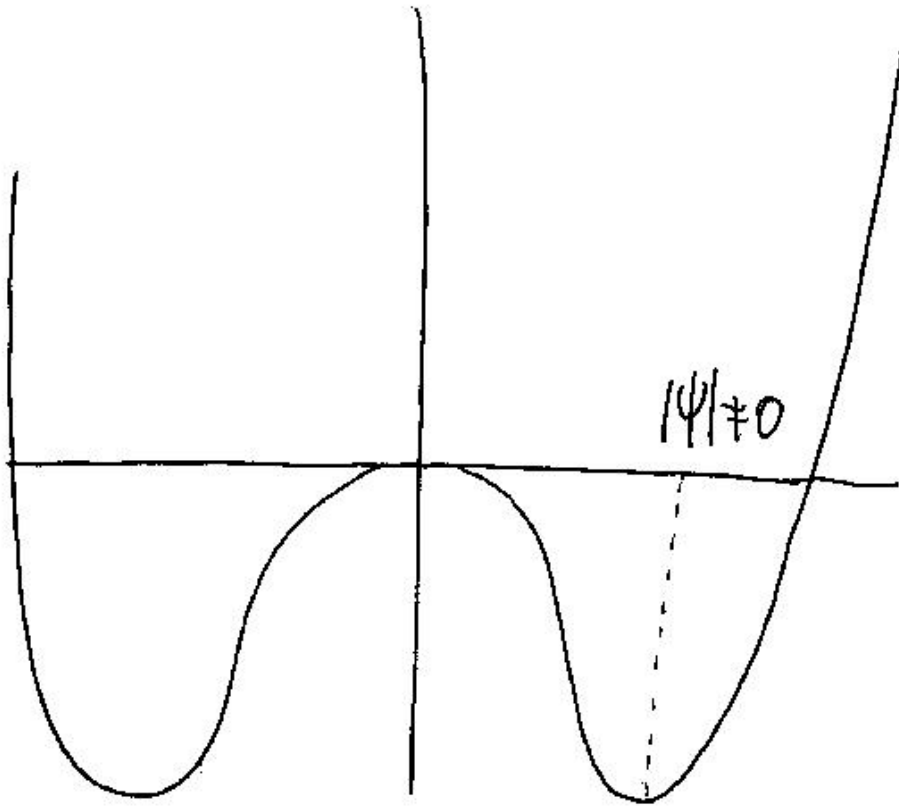
$$\rho_1\left(X + \frac{\chi}{2}, X - \frac{\chi}{2}\right) \equiv |\psi(x, x')|^2 \quad (5.29)$$

The effective potential for the quantum vacuum order parameter  $\Psi(X)$  whose coherent phase modulation is Einstein's classical curved spacetime geometrodynamics field  $g_{\mu\nu}(x)$  is

$$V(\Psi^*(X), \Psi(X)) = Mc^2\Psi^*(X)\Psi(X) + \frac{\beta}{M}(\Psi^*(X)\Psi(X))^2 \quad (5.30)$$

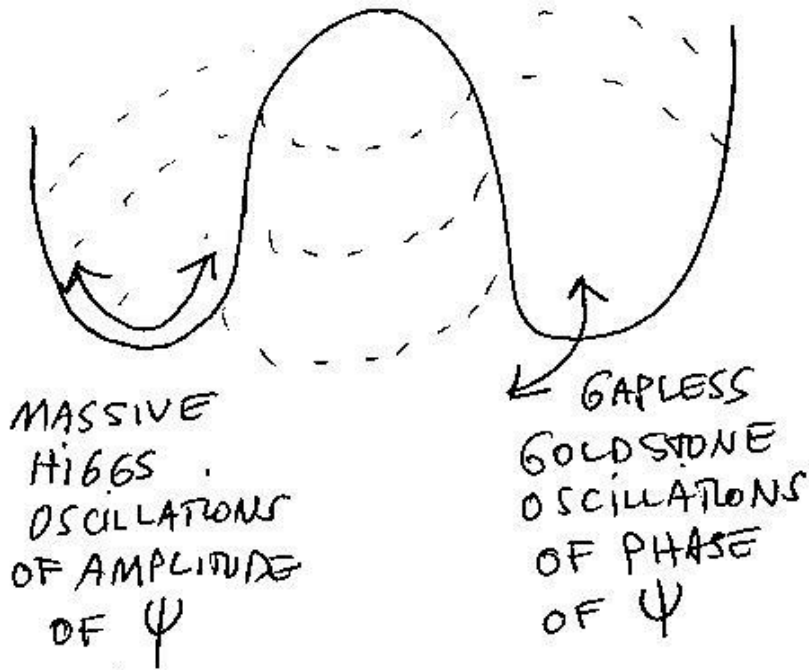


FALSE VACUUM  
 OF FLAT WORLD  
 $M^2 > 0, \beta > 0$



TRUE VACUUM  
OF CURVE WORLD  
 $M^2 < 0, \beta > 0$

### EFFECTIVE POTENTIAL



$\Psi$  = VIRGUAL TACHYON  
BOSE-EINSTEIN CONDENSATE  
EINSTEIN'S GRAVITY IS FROM  
MODULATING PHASE OF  $\Psi$   
THE BASE IS THE COMPLEX PLANE

$$\begin{aligned} \frac{M}{\hbar^2} \frac{\delta V(\Psi^*, \Psi)}{\delta \Psi^*} &= \left( \frac{Mc}{\hbar} \right)^2 \Psi + \frac{\beta}{\hbar^2} |\Psi|^2 \Psi \rightarrow 0 \\ |\Psi|^2 &= -\frac{(Mc)^2}{\beta} \\ M^2 &< 0 \end{aligned} \quad (5.31)$$

Is the more stable vacuum at the minimum of the effective potential. The zero root is now an unstable vacuum of higher energy density. Use equations (5.25) and (5.27), symbolically

$$\begin{aligned} \frac{(Mc)^2}{\beta} &= \frac{\left( \frac{2e}{c^2} \right)^2 g^{\mu\sigma}(X) \iiint d^3\chi \left[ A_\sigma \left( X + \frac{\chi}{2} \right) + A_\sigma \left( X - \frac{\chi}{2} \right) \right] \left[ A_\mu \left( X + \frac{\chi}{2} \right) + A_\mu \left( X - \frac{\chi}{2} \right) \right]}{|\Psi|^4 e^2 \iiint d^3\chi \left\{ \frac{\left[ \rho_1 \left( X + \frac{\chi}{2}, X + \frac{\chi}{2} \right) \rho_1 \left( X - \frac{\chi}{2}, X - \frac{\chi}{2} \right) + 2\rho_1 \left( X + \frac{\chi}{2}, X - \frac{\chi}{2} \right)^2 \right]}{|\vec{\chi}|} \right\}} \\ &= -|\Psi|^2 \end{aligned} \quad (5.32)$$

$$\begin{aligned} |\Psi|^2 &= \left[ \frac{-\left( \frac{2e}{c} \right)^2 g^{\mu\sigma}(X) \iiint d^3\chi \left[ A_\sigma \left( X + \frac{\chi}{2} \right) + A_\sigma \left( X - \frac{\chi}{2} \right) \right] \left[ A_\mu \left( X + \frac{\chi}{2} \right) + A_\mu \left( X - \frac{\chi}{2} \right) \right]}{e^2 \iiint d^3\chi \left\{ \frac{\left[ \rho_1 \left( X + \frac{\chi}{2}, X + \frac{\chi}{2} \right) \rho_1 \left( X - \frac{\chi}{2}, X - \frac{\chi}{2} \right) + 2\rho_1 \left( X + \frac{\chi}{2}, X - \frac{\chi}{2} \right)^2 \right]}{|\vec{\chi}|} \right\}} \right]^{\frac{1}{3}} \\ &= \frac{1}{L_p^3} [1 - L_p^2 \Lambda(X)] \end{aligned} \quad (5.33)$$

The local quintessent field  $\Lambda(X)$  is, therefore, determined implicitly in terms of quantum electrodynamics since it is essentially a coherence of virtual electron-positron pairs. The algebra is complicated and non-intuitive so I have to check to make sure I have not left out an explicit dependence on the spacetime connection  $\Gamma$ . Remember this is the first time, on this planet, at least, that ideas like this have ever been written down. I am rather amazed at what I am doing myself. This was unexpected even two days ago, but was cosmically triggered by a query from Tony Smith on which U(1) I meant. I mean electromagnetic U(1). Note also I do not need torsion, nor do I need large extra-space dimensions to explain key mysteries about our universe in a simple way. The ideas are simple, only the algebra is a bit complicated but with Math Type who cares? ;-). However, I can add torsion and extra large space dimensions rather easily, but so far no need.

## Star Gate Time Travel Metric

Kip Thorne's toy static<sup>33</sup> spherically symmetric metric for a nonsingular traversable wormhole time machine has the generic form<sup>34</sup>

$$ds^2 = -e^{+2\phi_{\pm}(r)} c^2 dt^2 + \frac{1}{\left\{1 - \frac{b_{\pm}(r)}{r}\right\}} dr^2 + r^2 d\Omega \quad (6.1)$$

$\phi_{\pm}(r)$  are the two redshift functions since we will need two separate coordinate patches for the two mouths or portals of the Star Gate. The two mouths may be in the same universe (3-brane) at same or different global cosmic times<sup>35</sup>, or they may connect parallel universes separated from each other in the hyperspace of Super Cosmos<sup>36</sup>.

When

$$\phi_{+}(\infty) \neq \phi_{-}(\infty) \quad (6.2)$$

We have a time machine. Moving through the Star Gate one way takes you to the future. Moving the opposite way takes you to the past. Stephen Hawking has a "chronology protection conjecture" that says you will be burned to a crisp by hard blue shifted radiation as soon as this time travel condition emerges. I think Hawking is wrong because his argument is based on flimsy "renormalization" arguments that Feynman called a

<sup>33</sup> "static" = time independent (stationary) and nonrotating, symmetric under time reversal & global Killing vector field that is hypersurface orthogonal and timelike in limit of spacelike infinity. Lie dragging derivative of metric along Killing vector field vanishes by definition (isometry).

<sup>34</sup> Matt Visser and John Peacock use different GR sign conventions that may cause me to make a sign error.

<sup>35</sup> Measured by absolute temperature of the black body thermal radiation from the end of the Big Bang.

<sup>36</sup> "Universe in a Nutshell" by Stephen Hawking, "Hyperspace" by Michio Kaku, "The Universe's Unseen Dimensions" August 2000, Scientific American. Tiny proton decay rate may make big hyperspace compactification scale impossible? (Bill Page e-mail).

“scandalous shell game” even though he was one of its main inventors. I suspect my new quintessent field  $\Lambda(x)$  will show the error in Hawking’s argument. I could be wrong here of course. But damn the torpedoes, let’s see what we get if we do not live in the boring universe Hawking leaves us with.

$b_{\pm}(r)$  is the shape function<sup>37</sup> of the traversable wormhole with no event horizon where time comes to a stop and no black hole spacetime singularity behind the event horizon to stretch and squeeze us to death, even our atoms out of existence in the Devil’s Rack!

$$b_{\pm} \equiv b_{\pm}(\infty) = \frac{2GM_{\pm}}{c^2} \quad (6.3)$$

Using the quintessent field for a pure exotic quantum vacuum engineered Star Gate

$$M_{\pm} = -\frac{\Lambda(R_{\pm})c^2 R_{\pm}^3}{2G} \quad (6.4)$$

Where  $R_{\pm}$  is the scale of the Star Gate “entrance-exit” or “doorway” Ad Astra<sup>38</sup> and Beyond in the Secret Passage to the New India, the fabled land of “Magonia”. I make the approximation that the quintessent field  $\Lambda(R_{\pm})$  is uniform over the scale of the wormhole mouth in each parallel universe<sup>39</sup>, or in the two entrance and exit events of the same universe as the case may be.

For this simple toy model Star Gate from Cal Tech, the Einstein tensor components are few and have the generic form

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<sup>37</sup> We are using Schwarzschild coordinates. The radial derivatives of both the redshift and shape functions match at the minimum of the throat of the wormhole. Details in Visser 11.2 of “Lorentzian Wormholes”.

<sup>38</sup> “To The Stars” Royal Air Force motto in the Battle of Britain in WWII against Hitler and Goring’s Luftwaffe. Today we have “The Axis of Evil”, al Qaida.

<sup>39</sup> I mean “parallel universe” in the classical material IT sense of Bohm’s hidden variable system point moving on the mental qubit pilot wave landscape or BIT in sense of Wheeler’s IT FROM BIT. David Deutsch’s multiverse, is something else. It refers to the different BIT valleys, or attractor basins for IT the not so Hidden Variable “system point”, on the grand mental landscape of Super Cosmos i.e. Hawking’s “Mind of God”.



$$\begin{aligned}
 G_{\pm tt}(r) &= \frac{1}{r^2} \frac{\partial b(r)_{\pm}}{\partial r} \\
 G_{\pm rr}(r) &= -\frac{b(r)_{\pm}}{r^3} + 2 \left\{ 1 - \frac{b(r)_{\pm}}{r} \right\} \frac{1}{r} \frac{\partial \phi(r)_{\pm}}{\partial r} \\
 G_{\pm \theta\theta}(r) &= G_{\pm \varphi\varphi}(r) = \left\{ 1 - \frac{b(r)_{\pm}}{r} \right\} \left[ \frac{\partial^2 \phi(r)_{\pm}}{\partial r^2} + \frac{\partial \phi(r)_{\pm}}{\partial r} \left( \frac{\partial \phi(r)_{\pm}}{\partial r} + \frac{1}{r} \right) \right] \\
 &\quad - \frac{1}{2r^2} \left[ \frac{\partial b(r)_{\pm}}{\partial r} r - b(r)_{\pm} \right] \left( \frac{\partial \phi(r)_{\pm}}{\partial r} + \frac{1}{r} \right)
 \end{aligned} \tag{6.5}$$

My approximate field equation by passing the spacetime stiffness barrier of 1 fermi<sup>40</sup> bend per 4 billion metric tons equivalent applied external electromagnetic energy density<sup>41</sup> is,

$$G_{\mu\nu} = -\Lambda g_{\mu\nu} \tag{6.6}$$

Define

$$\begin{aligned}
 \rho(r) &\equiv \frac{\Lambda c^2}{8\pi G} g_{tt}(r) = -\frac{\Lambda(r)c^2}{8\pi G} e^{+2\phi_{\pm}(r)} \\
 -\tau &\equiv \frac{\Lambda c^2}{8\pi G} g_{rr} = \frac{\Lambda c^2}{8\pi G} \frac{1}{\left\{ 1 - \frac{b_{\pm}(r)}{r} \right\}} \\
 p &\equiv \frac{\Lambda c^2}{8\pi G} g_{\theta\theta} \equiv \frac{\Lambda c^2}{8\pi G} g_{\varphi\varphi} = \frac{\Lambda c^2}{8\pi G}
 \end{aligned} \tag{6.7}$$

Substitute (6.1) and (6.5) into (6.6) to get the IT FROM BIT equations:

<sup>40</sup> One thousandth of a one billionth of one centimeter! (fermi)

<sup>41</sup> This is why it is completely foolish of Eric Davis and Hal Puthoff to use a theory of UFOs limited by such a barrier. There is a way around it as I think I am showing here.

$$\begin{aligned}
 G_{\pm tt}(r) &= \frac{1}{r^2} \frac{\partial b(r)_{\pm}}{\partial r} = \Lambda(r) e^{+2\phi_{\pm}(r)} \\
 G_{\pm rr}(r) &= -\frac{b(r)_{\pm}}{r^3} + 2 \left\{ 1 - \frac{b(r)_{\pm}}{r} \right\} \frac{1}{r} \frac{\partial \phi(r)_{\pm}}{\partial r} = -\frac{\Lambda(r)}{\left\{ 1 - \frac{b_{\pm}(r)}{r} \right\}} \\
 G_{\pm \theta\theta}(r) &= G_{\pm \varphi\varphi}(r) = \left\{ 1 - \frac{b(r)_{\pm}}{r} \right\} \left[ \frac{\partial^2 \phi(r)_{\pm}}{\partial r^2} + \frac{\partial \phi(r)_{\pm}}{\partial r} \left( \frac{\partial \phi(r)_{\pm}}{\partial r} + \frac{1}{r} \right) \right] \\
 &\quad - \frac{1}{2r^2} \left[ \frac{\partial b(r)_{\pm}}{\partial r} r - b(r)_{\pm} \right] \left( \frac{\partial \phi(r)_{\pm}}{\partial r} + \frac{1}{r} \right) = -\Lambda(r)
 \end{aligned} \tag{6.8}$$

This is only half the story of course; we still have the BIT FROM IT post-quantum back-action Landau-Ginzberg equation and Maxwell's field equations in Curve World to deal with. I never promised you a Rose Garden. It will probably take supercomputing to get engineering results unless some young genius comes along with simple analytical models?

## What do the UFOs do?

<http://www.broadwaymidi.com/down/Camelot-WhatDoTheSimpleFolkDo.mid>

Eric Davis in [http://198.63.56.18/pdf/davis\\_mufon2001.pdf](http://198.63.56.18/pdf/davis_mufon2001.pdf)

makes a big deal that Hal Puthoff's PV theory explains the alleged property of real UFO's described as "fiction" in Fastwalker by Jacques Vallee and Tracy Torme (Mel's son) writer producer of TV series Sliders on parallel universes.

<http://www.nidsci.org/bios/vallee.html>

This is no big deal.

In <http://stardrive.org/Jack/Casimir.pdf> <sup>42</sup>

One sees that the effective potential per unit mass of the quantum vacuum in the weak field limit obeys the Poisson equation<sup>43</sup>

$$\nabla^2 V = -4\pi G(\text{effective mass density} + 3 \text{ pressure}/c^2)$$

with the quantum vacuum equation of state

<sup>42</sup> This is a self-referential Godel "strange loop" (Hofstadter) which is not hard to understand in hypertext.

<sup>43</sup> A positive active gravitational mass is attractive, a negative one is repulsive.

effective mass density + pressure/c<sup>2</sup> = 0

And

effective mass density =  $\Lambda(x) c^2/8\pi G$

$\Lambda(x)$  is the local quintessence field from the amplitude of the order parameter of the Bose-Einstein condensate of virtual electron-positron pairs whose quantum phase variation gives Einstein's classical geometrodynamics field  $g_{\mu\nu}(x)$  of 1915 GR (e.g. Hagen Kleinert's web page for background).

OK take a flying saucer whose outer edge has a hollow ring of square cross section  $a^2$  of radius  $R$  for a total volume of  $2\pi Ra^2$ .

There are control induction EM *nonradiating near fields* inside the ring vacuum chamber. The effective active gravitational mass of the quantum vacuum in the ring is then

$$M_{vac} \equiv -\frac{\Lambda(R)c^2 Ra^2}{2G} \quad (7.1)$$

Redshift  $z$  is

$$z \equiv \frac{\lambda_o - \lambda_e}{\lambda_e} \equiv \frac{\Delta\lambda}{\lambda_e}$$

$$\Delta\nu = \Delta\left(\frac{c}{\lambda_e}\right) = -\frac{c}{\lambda_e^2} \Delta\lambda \quad (7.2)$$

$$\frac{\Delta\nu}{\nu_e} = -z$$

A positive  $z$  is a redshift, a negative  $z$  is a blueshift, subscript "e" is the emission event. Similarly, "o" is the observation event. Roughly, for these non-classical vacua

$$z = -\frac{\Delta\nu}{\nu_e} = \frac{\nu_e - \nu_o}{\nu_e} \approx \frac{\Lambda(R)Ra^2}{2} \left[ \frac{1}{(R+r)} - \frac{1}{R} \right] \quad (7.3)$$

$$\frac{1}{(R+r)} - \frac{1}{R} < 0$$

In the near field  $r/R < 1$ , the limit of small  $r$  is obviously zero

$$\begin{aligned} \frac{1}{(R+r)} - \frac{1}{R} &= \frac{1}{R\left(1+\frac{r}{R}\right)} - \frac{1}{R} \\ &= \frac{1}{R} \sum_{n=0}^{\infty} (-1)^n \left(\frac{r}{R}\right)^n - \frac{1}{R} = \sum_{n=1}^{\infty} (-1)^n \left(\frac{r}{R}\right)^n \end{aligned} \quad (7.4)$$

In the far field  $R/r < 1$

$$\begin{aligned} \frac{1}{(R+r)} - \frac{1}{R} &= \frac{1}{r\left(1+\frac{R}{r}\right)} - \frac{1}{R} \\ &= \frac{1}{r} \sum_{n=0}^{\infty} (-1)^n \left(\frac{R}{r}\right)^n - \frac{1}{R} = \frac{1}{r} \sum_{n=1}^{\infty} (-1)^n \left(\frac{R}{r}\right)^n - \frac{1}{R} \\ &\rightarrow -\frac{1}{R} \end{aligned} \quad (7.5)$$

Therefore,

$\Delta v/v_e$  is a blue shift when  $\Lambda > 0$

$\Delta v/v_e$  is a redshift when  $\Lambda < 0$

It is assumed that  $\Lambda = 0$  at the detector which is ordinary as distinct from exotic vacuum.

This quintessent quantum spectral shift is a much bigger effect than one gets from the  $(G/c^4)T_{\mu\nu}$  term!

That's what UFOs if real do!

So they say.

Note that

$$\Lambda L_p^2 = 1 - L_p^3 |\psi|^2$$

Where  $|\psi|^2 = 10^{99}$  Bose-Einstein condensed virtual electron-positron spin zero electrically neutral pairs per cubic centimeter.

So what spectral shift do you want Bhubba?

"We spectres are a jollier crew than you, perhaps, suppose." Ruddygore G & S

[http://math.boisestate.edu/gas/ruddigore/html/night\\_wind\\_howls.html](http://math.boisestate.edu/gas/ruddigore/html/night_wind_howls.html)

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