

Intuitive Notes on Mathematical Physics

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Einstein: “Physics should be as simple as possible, but not simpler than is possible.”

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1. Maxwell’s Classical Electromagnetic Field Equations

No magnetic monopoles, i.e. $\rho_m = 0$.

$$\vec{\nabla} \cdot \vec{B} = 0 \tag{1.1}$$

Faraday's law of electric induction by changing magnetic flux.

$$\vec{\nabla} \times \vec{E}(\vec{r}, t) + \frac{\partial \vec{B}(\vec{r}, t)}{\partial t} = 0 \quad (1.2)$$

(1.1) and (1.2) are the “first pair” of Maxwell's equations.

Gauss's law of electric flux from electric point monopole

$$\vec{\nabla} \cdot \vec{E}(\vec{r}, t) = \rho_e(\vec{r}, t) \quad (1.3)$$

$$\rho_e(\vec{r}, t) \rightarrow q\delta(\vec{r} - \vec{r}_e(t)) \quad (1.4)$$

Ampere's law of magnetic induction by real electric current plus Maxwell's time-changing electric field (“displacement current”).

$$\vec{\nabla} \times \vec{B}(\vec{r}, t) - \frac{\partial \vec{E}(\vec{r}, t)}{\partial t} = \vec{j}_e(\vec{r}, t) \quad (1.5)$$

$$\vec{j}_e(\vec{r}, t) \rightarrow \rho_e(\vec{r}, t) \frac{d\vec{r}_e(t)}{dt} \quad (1.6)$$

(1.3) and (1.5) are the “second pair” of Maxwell's equation.

“e” is a source charge at a source point, “q” is a test charge at the field point (\vec{r}, t) . The classical 3-vector polar electric and axial magnetic force fields $\vec{E}(\vec{r}, t), \vec{B}(\vec{r}, t)$ are complicated time-delayed (advanced) integrals over source charge distributions. In terms of special relativity, the influence of source event on force field event is “contact” in 4-dimensional spacetime, i.e. zero proper time between source and force along both past and future light cones (Wheeler-Feynman).

Lorentz force law

$$\vec{F}_q = q \left(\vec{E}(\vec{r}, t) + \frac{d\vec{r}_q(t)}{dt} \times \vec{B}(\vec{r}, t) \right) \quad (1.7)$$

Radiation Reaction (self-force) from the self-field of an electric point charge

$$\vec{F}_q \approx m \frac{d^2 \vec{r}_q(t)}{dt^2} - \frac{2e^2}{3c^2} \frac{d^3 \vec{r}_q(t)}{dt^3} \quad (1.8)$$

Classical vacuum electromagnetic duality

$$\rho_e(\vec{r}, t) = 0 \quad (1.9)$$

$$\vec{\Xi} \equiv \vec{E} + i\vec{B} \quad (1.10)$$

The classical vacuum Maxwell equations are then

$$\begin{aligned} \vec{\nabla} \cdot \vec{\Xi} &= 0 \\ \vec{\nabla} \times \vec{\Xi} &= i \frac{\partial \vec{\Xi}}{\partial t} \end{aligned} \quad (1.11)$$

The duality transformation

$$\vec{\Xi} \rightarrow \vec{\Xi}' \equiv -i\vec{\Xi} \quad (1.12)$$

Is a formal symmetry of Maxwell's classical vacuum equations, i.e.

$$\begin{aligned} \vec{\nabla} \cdot \vec{\Xi}' &= 0 \\ \vec{\nabla} \times \vec{\Xi}' &= i \frac{\partial \vec{\Xi}'}{\partial t} \end{aligned} \quad (1.13)$$

In components this classical electromagnetic vacuum symmetry is equivalent to

$$\begin{aligned} \vec{B} &\rightarrow \vec{E} \\ \vec{E} &\rightarrow -\vec{B} \end{aligned} \quad (1.14)$$

This duality symmetry would only work in the presence of sources if there were magnetic monopoles. Like quarks, none have yet been observed in a free state.

Hodge star duality operator formalism

Maxwell's equations with sources¹ can be elegantly written as

$$\begin{aligned} dF &= 0 \\ *d^*F &= J \end{aligned} \quad (1.15)$$

These symbols from Cartan's forms will be defined below.

¹ The first line is the first topological pair of Maxwell's equations, i.e. no magnetic monopoles and Faraday induction. The second line is the second metrical pair of Maxwell's equations, i.e. Ampere's law and Gauss's law.

Einstein and the crackpots.

Maxwell's classical local force field equations with sources are automatically covariant² under the global flat space time Lorentz transformations. Indeed, it was the conflict between Newton's particle mechanics and Maxwell's electromagnetic field equations that led Einstein in 1905 to special relativity. It is completely crackpot³ to say that Einstein's classical special relativity and general relativity are wrong within their proper limited domains of relevance that have been battle tested by many experiments.

2. Relevant mathematical concepts applied to physics

Topological spaces, manifolds, Einstein's EEP & hyperspace

I will not be rigorous on these background details of manifold mathematics. One defines a topology on open sets. The intersection and union of open sets are open. The complement of an open set is a closed set. The set of open sets of a topological space is the topology of the manifold. Given a point of the manifold, and open set that contains it is called a neighborhood of the point. A function is a mapping from one topological space to another, or even a self-mapping. A continuous function is the opposite of classical mechanical chaos. That is, nearby points are mapped to nearby points. One uses the topology of open sets to make this notion rigorous. Details not important for physicists as yet. A manifold is covered by overlapping coordinate patches. This is important for physicists. Indeed, this is precisely where Harold Puthoff makes a serious mathematical error leading to false physical conclusions in his use of "isotropic coordinates" in his so called "PV" challenge to Einstein's theory of gravity.⁴ Each

² Form-invariant.

³ There have always been large numbers of crackpots of varying levels of competence irrationally attacking Einstein's physics from the very beginning. This is a form of anti-Semitism coupled with weak intellect and lack of proper education in mathematics and physics.

⁴ For example, in Einstein's theory for a spherically symmetric static mass source, radially oriented meter sticks shrink locally relative to identical meter sticks oriented along latitudes and longitudes in the LNIF non-geodesic frames. This purely 3-dimensional spatial anisotropy in the LNIF frames is locally detectable in principle. In contrast, in Puthoff's PV challenge to Einstein's GR (<http://xxx.lanl.gov/ftp/gr-qc/papers/9909/9909037.pdf>), this *local* spatial anisotropy is not there because of Puthoff's misuse of isotropic coordinates. Einstein also had isotropic coordinates, but when properly used they show the local spatial anisotropy. Puthoff attempts to replace this local spatial anisotropy in the LNIF gravitational warping with an irrelevant global warping. This local spatial anisotropy is illustrated in Fig P.3 on p. 31 of Kip Thorne's "Black Holes and Time Warps" (Norton, 1994) in which the circumference $C < 2\pi R$ for radius R even locally for a small angular section of a circular annulus along the radial direction from the source mass. This locally observable distortion in a small neighborhood coordinate patch is missing from Puthoff's theory. Therefore, Puthoff's claim that his theory asymptotically limits to Einstein's is false. Note that a small circle entirely in the latitude-longitude plane perpendicular to the radial direction (think spherical polar coordinates) obeys $C = 2\pi R$. In contrast, a small latitudinal (or longitudinal) angular section, of an annulus of inner radius R and outer radius $R + dR$ as measured by the non-geodesic LNIF meter sticks, will locally show the spatial anisotropy missing in Puthoff's theory. The coincident geodesic LIF meter sticks and clocks are undistorted. There is no way for Puthoff to describe the latter feature of Einstein's theory that comes from the EEP. Consequently, Puthoff's theory violates the EEP and should be rejected on that ground alone. Puthoff wrongly alleges that his theory is consistent with the EEP. However, in my opinion his allegation is based on inconsistent reasoning. Note, that one can say that the non-geodesic meter sticks and clocks are distorted by the electrical reaction forces making them take non-

coordinate patch U_i is an open set. The topology of open sets U_i covers the topological space to form a manifold is their set union is all of the topological space which is then a manifold. A local coordinate chart is a continuous function mapping of U_i into the set of N real numbers for a real manifold of N dimensions. The inverse mapping also exists and is also continuous. Ultimately this formal idea is needed for Einstein's physical principle of equivalence (AKA "EEP") in which there is a bi-continuous *tetrad* mapping between timelike non-geodesic LNIF observers that feel "weight" and whose meter sticks and clocks "distort", and momentarily near coincident weightless "free float" LIF observers on timelike geodesics that fuzzily intersect the timelike non-geodesics. The experience of "weight" is from non-gravitational electrical reaction forces that cause a deviation of the path of the object off a timelike LIF geodesic to a timelike LNIF non-geodesic in 4-dim curved spacetime. Strictly speaking there is no such thing as a gravitational force in Einstein's theory of gravity. The geodesic path equation is really the generalization of Newton's first law of inertial motion from globally flat spacetime to locally variably curved spacetime

$$\vec{F} = 0 \quad (2.1)$$

The bosonic hyperspace of Kaluza-Klein in the 1920's is to take this same idea of Einstein's geometrodynamics elimination of Newton's gravity force to the electrical force by invoking a compactified 4-th dimension of space rolled up like a tiny tube of radius

$$R_{Kaluza-Klein} \sim \frac{L_p}{\sqrt{\alpha}} = \sqrt{\frac{\hbar G/c^3}{e^2/\hbar c}} = \sqrt{\frac{\hbar^2 G}{e^2 c^2}} = \frac{\hbar}{ec} \sqrt{G} \sim 10^{-32} \text{ cm} \quad (2.2)$$

The motion of an electric charge would then be a timelike hyperspace geodesic in 5-dimensional spacetime, which looks like a timelike non-geodesic in the projection down to the 4-dimensional spacetime of Einstein's local geometrodynamics theory of gravity (AKA GR for "general relativity"). In this way, the idea is to eliminate all forces as hyperspace timelike geodesics. A geodesic is the straightest path between two points in a curved space. In Euclidean curved space without light cones, as in Hawking's "imaginary time", the length of the geodesic is a minimum compared to lengths of all nearby paths with the same end points. In contrast in locally Lorentzian curved spacetime, with relatively tilted light cones, the length of the geodesic is a maximum. This explains why the twin on the timelike non-geodesic is younger than the twin on the timelike geodesic

geodesic paths. There is no inconsistency with Einstein's theory in saying that. This is the Lorentz-Fitzgerald type of interpretation. In other words, one can attribute "curvature" gravitational distortion of meter sticks and measuring rods to electrical reaction forces needed to create the non-geodesic LNIF frames within Einstein's geometrodynamics. There is no need at all to take the steps Haisch and Puthoff take in their wrong attempt to explain inertia from purely random incoherent zero point far field transversely polarized zero point fluctuations. Indeed, the origin of inertia is from the macro-quantum coherence of virtual electron-positron pairs that lowers the physical zero point energy vacuum density by the formation of a virtual bound state that is macroscopically occupied to form a virtual superfluid Bose-Einstein condensate. This is the real "PV" (Polarized Vacuum) theory of gravity along the lines of Andre Sakharov in 1967. Indeed, Puthoff's wrong attempt at this can be called "PV without PV" since there is no quantum physics, no \hbar in his PV model.

when the former returns in the flying saucer with warp drive like in the movie “Close Encounters of the Third Kind” when the WWII pilots return.

An N-dimensional manifold is a topological space equipped with an atlas of local overlapping coordinate charts. For example, the isotropic coordinates correspond to a local chart that does not cover the entire manifold for a spherically symmetric static mass-energy source. One of Puthoff’s many mistakes in his PV theory is to falsely assume that the isotropic coordinates cover the entire manifold. This leads him to his false conclusion that there are no black holes in his theory. This ancient widespread confusion was settled by David Finkelstein, Martin Kruskal and others almost 40 years ago but Puthoff seems unaware of this citing wrong papers written from before the turning point in general relativity in the early 1960s. Note that these considerations are topological much deeper⁵ and independent of any particular action principle leading to a particular set of local dynamical classical field equations. One needs *transition functions* to analytically continue⁶ from one chart to another to form the atlas.

Vector fields of arrows

The key idea is that of the directional derivative of a function.⁷

$$vf \equiv v^\mu \partial_\mu f \equiv v^1 \frac{\partial f}{\partial x^1} + \dots v^N \frac{\partial f}{\partial x^N} \quad (2.3)$$

A vector field of arrows on a manifold is a tangent vector field.⁸ The set of local differential operators $\{\partial_\mu\}$ form the standard linearly independent “holonomic” basis of the local tangent vector space at each point of the manifold. A path, or curve $\gamma(t)$, through the manifold is a function from the real line to the manifold that depends smoothly on a parameter t that you can loosely think of as the non-unique length of the path. The tangent vector $\vec{\gamma}(t)$ to that path at a point is a function from the manifold to the real line that sends any function f to its directional derivative $df(\gamma(t))/dt$ along the path $\gamma(t)$.

Let ϕ be a function from manifold M to manifold N . Imagine now a second function f from manifold N to the real line. One now uses the first function ϕ to pull back the second function f to a third function $f \circ \phi$ from M to the real line. That is,

⁵ In the sense of Felix Klein’s “Erlanger Program” of 1872 of layers of geometry from a partially ordered lattice of subgroups. One breaks symmetry in going from a group to a subgroup. A topological space has more symmetry than a metric space, for example. The metric space geometry is from a subgroup of the group of the topological space. There are intermediate cases, projective, affine, conformal.

⁶ Not in the exact sense of “analytic continuation” of functions of a complex variable, but in an analogous sense.

⁷ For details of these mainstream tools go to standard texts like “Gauge Fields, Knots and Gravity” by Baez & Muniain, and “Geometrical methods of mathematical physics” by Schutz.

⁸ I follow the Baez book here.

$$f \circ \phi \equiv \phi^* f \quad (2.4)$$

This *pullback* operation ϕ^* is associated with the convention of calling functions on manifolds *contravariant* objects. In contrast tangent vectors are *covariant* objects from a *pushforward* operation of v by the same ϕ . That is, the tangent vector $\vec{\gamma}(t)$ to a curve $\gamma(t)$ on manifold M is pushed forward by ϕ to a tangent vector $\phi_*\vec{\gamma}(t)$ to an image curve $\phi \circ \gamma(t)$ on manifold N .⁹

Flows and Lie bracket commutator of vector fields

Think of the flow of a fluid. Let a particle in the fluid move on a path¹⁰ $\gamma(t)$ with parameter t as “time”. This gives a velocity vector field. The vector field of arrows is integrable only if all the integral curves are defined for all t . This condition breaks down in general for timelike geodesics in Einstein’s theory of gravity in the Penrose-Hawking classical theory of spacetime singularities of black holes and big bangs.

Given two vector fields, their Lie bracket is

$$[\vec{v}, \vec{w}] \equiv \vec{v}\vec{w} - \vec{w}\vec{v} \quad (2.5)$$

A non-vanishing Lie bracket is the failure of mixed directional derivatives of functions to commute. The condition of integrable holonomy for ordinary partial derivatives is

$$[\partial_\mu, \partial_\nu] = 0 \quad (2.6)$$

Indeed,

$$[\vec{v}, \vec{w}] \equiv \vec{v}\vec{w} - \vec{w}\vec{v} \neq 0 \quad (2.7)$$

Is analogous to a *torsion gap*. That is, the little parallelogram for the flows in the two possible sequences do not go to the same place. Similarly, in the case of torsion, with the parallel transport of tangent vectors leaving a parallelogram that does not close. Einstein’s 1915 geometrodynamics is torsion free. Einstein, in his later years played with torsion in his unified field theories, but did not, it appears, get any interesting results.¹¹

⁹ P. 33 Baez

¹⁰ “integral curve” containing $p \equiv \gamma(0)$

¹¹ Jim Corum of the Institute of Software Research in West Virginia seems to think otherwise. We, at ISSO in 1999, investigated Gennady Shipov’s torsion theory without any reaching any definite conclusions with regard to propellantless vacuum propulsion.

Cartan's differential forms

Functions f are 0-forms. Gradients of functions are examples of 1-forms. The curl of a vector field is an example of a 2-form, and the divergence of a vector field is an example of a 3-form. Use the exterior differential operator d . In the space of real numbers of dimension $N \geq 2$. Recall the gradient operator $\vec{\nabla}$ of vector calculus in globally flat space. The directional derivative of the function f along a direction given by vector \vec{v}

$$\vec{v}f \equiv \vec{\nabla}f \cdot \vec{v} \quad (2.8)$$

The topological 1-form df generalizes this to any manifold which need not have a metric structure of lengths and angles. This is a deeper differential structure of manifolds than the specialized application to Einstein's geometrodynamics of gravity physics. However, we need a metric to give meaning to the dot product in (2.8) for example. d applied to an n form yields an $n + 1$ form. This chain ends at N the integer dimension of the space, without going to fractal spaces on non-integer dimension. The basis set¹² of natural one forms $\{dx^\nu\}$ spanning the linear co-tangent space are dual to the basis set of natural tangent vectors $\{\partial_\mu\}$ spanning the linear tangent vector space. That is,

$$\begin{aligned} dx^\nu \partial_\mu &= \delta_\mu^\nu \\ &= 1, \mu = \nu \\ &= 0, \mu \neq \nu \end{aligned} \quad (2.9)$$

Think of the quantum wave-particle duality. The ∂_μ are like particle lines and the dx^ν is a little stack of iso-phase fragments of wave fronts along the eigen-directions of the local frame of reference. That is, the co-tangent 1-forms are like pilot wave-fronts and the tangent vectors like particle paths of Bohm's hidden variable in that particular intuitive picture of the meaning of quantum physics at the single-particle un-entangled level. The larger df is, the closer together the wave front peaks are. The real number $df(\vec{v})$ is how many peak wave fronts cross the direction of \vec{v} for a given df in the neighborhood of a given point in the manifold. Note that this real number is the directional derivative of the function at the point in the manifold in the given direction. That is,

$$df(v) \equiv \vec{v}f \rightarrow \vec{\nabla}f \cdot \vec{v} \quad (2.10)$$

The *tensor* convention is that cotangent vectors or 1 forms are contravariant, and tangent vectors are covariant. The formal details of this in the books referenced give me dyslexia and I will not dwell on it.

¹² A local frame of reference

The map is not the territory

This phrase from Alfred Korzybski is one of Einstein's key ideas of physical objectivity in the classical theories of relativity. It underlies the symmetry theory of groups of transformations between local frames of reference of all kinds with local frame independent invariants that give the true objective structure of the world. The notion of locality needs to be generalized to configuration space for entangled quantum systems in which the non-mechanical organic quantum whole is greater than the pre-assigned mechanical sum of its parts. This gives the form-dependent/intensity-independent context dependence of quantum systems that shows up as regions of phase space in which the Wigner density is negative in violation of classical probability theory. The Wigner density is like a Gabor windowed transform¹³ generalization of the Fourier transform¹⁴ that needs further generalization to the scaled wavelet transform.¹⁵ Classical gravity physics is an emergent collective phenomenon from a Bose-Einstein condensation of virtual fermion-antifermion pairs. That is macro-quantum phase coherence of the zero-point vacuum polarization (PV) dampening down random incoherent zero point fluctuations of all fields, fermion and boson, allows smooth classical curved spacetime to come into being on the macro scale of low energy phenomena. *Random locally incoherent* fermion zero point vacuum polarization fluctuations makes attractive "dark matter" gravity and *random locally incoherent* boson zero point fluctuations makes repulsive "exotic matter"¹⁶ anti-gravity as two *opposing phases* of the physical macro-quantum vacuum depending the relative balance between virtual fermions and virtual bosons mediated by the local coherent macro-quantum PV order parameter. Entanglement of the virtual fermions beyond the pair level is suppressed in our actual macroscopic universe.

An open set U in the real manifold M has non-unique local coordinates. A chart is a 1-1 diffeomorphism from the open set in the manifold M to the real vector space \mathbb{R}^N . A function can be written in terms of these local chart coordinates as $f(x^1, \dots, x^N)$. A tangent vector field decomposed into components relative to the natural holonomic basis¹⁷ is described by

$$\vec{v} \rightarrow v^\mu (x^1, \dots, x^N) \partial_\mu \quad (2.11)$$

Similarly for the dual co-tangent vector 1-forms of Cartan

$$\omega^{(1)} \rightarrow \omega_\mu^{(1)} (x^1, \dots, x^N) dx^\mu \quad (2.12)$$

¹³ Of the Weyl-Heisenberg group with algebra $[p, x] \sim -i\hbar$.

¹⁴ Of the translation group.

¹⁵ Of the conformal group of translations and dilations in which we map from phase space to spacetime-scale space. The dilations determine the scale of the physical phenomena.

¹⁶ For star gate wormhole time machines and weightless warp drives.

¹⁷ Sum over repeated pairs of upper and lower component indices.

Local frame transformations leave the intrinsic tangent vectors and co-vectors invariant. A local frame transformation at a fixed event P in the open set U of the manifold is

$$\begin{aligned}\partial_\mu &\rightarrow \partial'_\nu \\ \partial_\mu &= T_\mu^\nu(P) \partial'_\nu \\ T_\mu^\nu(P) &= \left. \frac{\partial x'^\nu}{\partial x^\mu} \right|_P\end{aligned}\tag{2.13}$$

The objectively real invariance of the territory $\vec{v}(P)$ in terms of the two alternative maps (local frames of reference, or local mariner's charts) is

$$\vec{v}(P) = v'^\mu(P) \partial'_\mu = v^\mu(P) \partial_\mu\tag{2.14}$$

Substitute (2.13) into (2.14) for the tangent vector components

$$v'^\nu(P) \partial'_\nu = v^\mu(P) \left. \frac{\partial x'^\nu}{\partial x^\mu} \right|_P \partial'_\nu \rightarrow v'^\nu(P) = v^\mu(P) \left. \frac{\partial x'^\nu}{\partial x^\mu} \right|_P\tag{2.15}$$

This is general, but in particular it can be used in the EEP tetrad transformation from a timelike geodesic LIF local frame to a coincident at P timelike non-geodesic LNIF frame. In that special subclass of possible physical situations

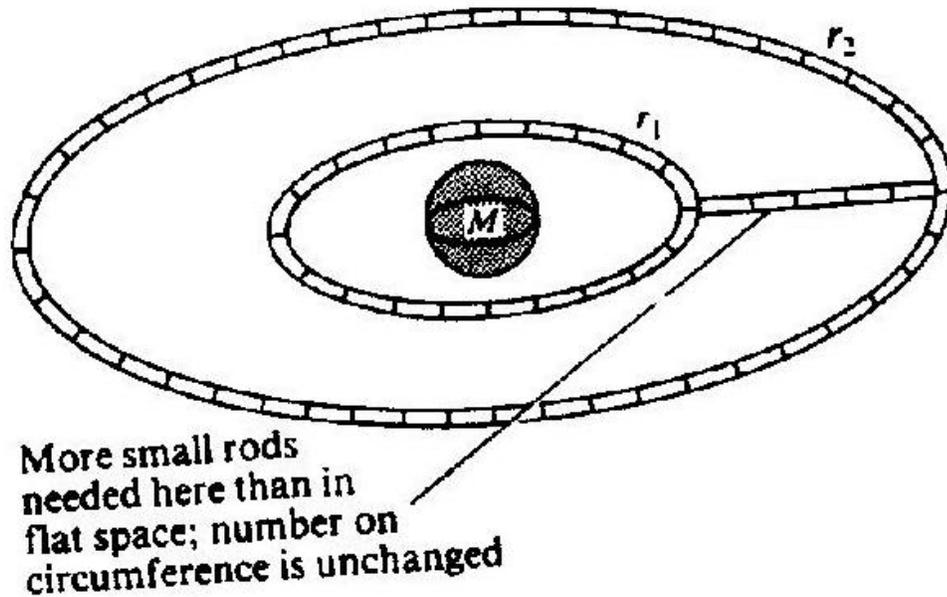
$$\begin{aligned}\left. \frac{\partial x'^\nu}{\partial x^\mu} \right|_P &\rightarrow e_\mu^a(P) \\ v^a(P) &= e_\mu^a(P) v^\mu(P) \\ a &\equiv LIF \\ \mu &\equiv LNIF\end{aligned}\tag{2.16}$$

Physical meaning of the local tetrad LIF frames.

There is no gravity distortion of the LIF rods and clocks at P , whilst there is gravity distortion of the LNIF rods and clocks at the “same” event P . “Same” means that the actual separations between the instruments of the two observers Alice in the LIF and Bob in the LNIF are small compared to the 4 principal radii of curvature at event P . It has been suggested that the term “gravity distortion” is misleading since, the argument goes, the actual physical cause of the LNIF distortions of the clocks and measuring rods are the electrical reaction forces making the LNIF objects deviate away from the free float weightless timelike geodesic for ordinary real matter inside the local light cone.¹⁸

¹⁸ This argument, first suggested by Fitzgerald for the length contraction and time dilation of special relativity, is suspect because of the universality of the gravitational distortion. It seems to require an unlikely conspiracy between electricity and gravity. The electrical reaction forces causing the gravity distortions would have to come from the vacuum itself, i.e. from the Bose-Einstein condensate of virtual

Furthermore, in the special case of a spherically symmetric static spacetime manifold, the LNIF rods oriented radially to the source center really do objectively shrink relative to the identically constructed rods oriented anywhere in the local tangent plane perpendicular to the unique radial direction through P. This territory is independent of the choice of coordinate map whether “isotropic” or “Schwarzschild”.



From “A Short Course in General Relativity”, J. Foster & J.D. Nightingale, Springer-Verlag, 1995

Puthoff’s PV theory in this case lacks this essential objectively real local spatial anisotropy. Therefore, in no physically significant sense really can it be said to limit to Einstein’s theory. Note that a LNIF clock runs slower than a LIF clock coincident with it. That is, the rates of the clocks depend on the kinds of paths they are on. This does not appear to be the case in Puthoff’s PV theory. The local metric of the timelike geodesic LIF clock at event P is that of special relativity so that there is zero gravity potential for it. In contrast, the local metric for the timelike non-geodesic LNIF clock is warped with an effective gravity potential in the weak field limit. Therefore, a light signal sent from the LNIF clock “at rest” relative to the source mass to the almost coincident¹⁹ freely

electron-positron pairs as in my new original theory of how Einstein’s geometrodynamics emerges from the micro-quantum gauge foam in a symmetry breakdown to the smooth macro-quantum vacuum in which Einstein’s geometrodynamics field of curved spacetime is a coherent macro-quantum phase modulation effect with the quintessence Λ field as an amplitude modulation effect. Puthoff does not appear to understand this in his tables I & II for the distortion of rods and clocks. He seems to think of the undistorted rods and clocks as in a far away from P asymptotically flat event P’. This misses the whole point of Einstein’s EEP that classical physics is simple when it is local at the same point P and that one explains gravity at P by approximately locally eliminating gravity at P by hopping off a LNIF into LIF. Indeed there are spacetime manifolds that are not asymptotically flat.

¹⁹ Both the LIF and the LNIF clocks are in the same small neighborhood of event P.

falling gravity-free LIF clock, also instantaneously at rest relative to the LNIF clock²⁰, will show the same gravity red shift as is seen by a very distant LNIF clock also “at rest” relative to the source mass. This is subtle and rather tricky. Also it may be pragmatically very difficult to do these gedankenexperiments. For example, a light signal sent from the LIF clock momentarily coincident with and instantaneously at rest relative to the LNIF clock at common event P will show the same gravity red shift at distant event P’ in the asymptotically flat region as the light signal from the LNIF clock. In both cases the real photons from either the LIF or the LNIF clocks have to take essentially the same lightlike zero proper time geodesic path connecting emission events at the P neighborhood to absorption events at P’ neighborhood. Let’s make this gedankenexperiments event more specific thinking of the famous Pound-Rebka experiment at the tower at Harvard University that measured the gravity redshift through a height of 22.5 meters²¹ using recoilless 14.4 keV gamma ray emission from the Mossbauer effect in crystals with Fe⁵⁷. We imagine 6 clocks, 3 LIF and 3 LNIF in pairs at three point event neighborhoods A, B and C. A is at the base of the Harvard tower with static gravity potential energy per unit test mass $U(A)$. B is at the top of the Harvard tower with gravity potential $U(B)$ and C is out in space far from the Earth with gravity potential $U(C) \sim 0$, i.e. $r_C \rightarrow \infty$. We neglect the influence of the Sun and other large objects. The pairs of clocks LIF A(B,C) and LNIF A(B,C) are momentarily almost coincident at A(B,C) and instantaneously relatively at rest at each of the 3 events A, B, C respectively.²² Let’s make a table. The columns are the emitters and the rows are the absorbers of real photon light signals along zero proper time lightlike geodesics connecting the emissions and absorptions. These lightlike geodesics are determined by the curved spacetime metric of the objectively real warped geometry territory independent of the local coordinate chart maps. For simplicity I use the weak field approximation for the gravity light frequency shifts in a stationary static spherically symmetric spacetime. Each real photon in the light signal is also a physical

²⁰ To eliminate extraneous relative motional Doppler shifts.

²¹ 74 feet

²² Note I consider the spherically symmetric stationary/static spacetime from a source mass M in Einstein's GR modeling the actual Pound-Rebka experiment Fig. 38.1 p. 1057 of section 38.5 of MTW. I consider 3 events A at bottom of Harvard tower, B at top of Harvard tower, and C far far away on the radial line connecting A to B, assumed to point accurately enough to center of gravity of the Earth -- ignoring its rotation and orbital motion and inhomogeneities as an ideal gedankenexperiment. I consider 6 local frames of reference. LNIF(A,B,C) all along the same radial line are all "at rest" relative to the source mass M. One can do this in a stationary-static geometry. Later I will amplify on all these measurement issues in more detail. The 3 remaining "tetrad" LIF's (A,B,C) are specially chosen so that, for example, LIF A is not only approximately coincident with LNIF A but is also instantaneously at rest relative to it. This eliminates extraneous motional Doppler shifts that obscure the warp distortion we are interested in. Similarly, for B and C. Of course, LIF C and LNIF C in the asymptotic flat region are "degenerate", i.e. essentially identical. The 6x6 Table shows all the relative gravity shifts both red and blue, in color, for all possible roles of each of the 6 local frames as emitters and detectors of real photon signals. One sees, for example, on how precisely LIF A as a detector of a light signal from LNIF A is equivalent to LIF C = LNIF C as a detector etc.. That is the LIF tetrad frame is globally equivalent to a distant LIF frame. Actually testing the 36 possible experiments as a practical matter would be a real challenge of course. The actual Pound-Rebka experiment only tested 2 of the 36 possibilities i.e. LNIF A and LNIF B with dual roles as emitters and detectors. Actually of the 36 possible gedankenexperiments showing the physical meaning of the local tetrad LIF timelike geodesic frames, 8 are trivial. This leaves only 28 non-trivial tests. And of these there are only 4 independent gravity redshifts and 4 independent gravity blue shifts that each show up in several possible experiments.

clock in addition to the real electrically charged particles of the emitters and absorbers that are also physical clocks. The relative gravity frequency shifts are labeled z . Since $\nu\lambda = c$ for real photons in classical vacuum, we have for z

$$z \equiv \frac{\Delta\lambda}{\lambda} = \frac{\lambda_{\text{absorbed}} - \lambda_{\text{emitted}}}{\lambda_{\text{emitted}}} = \frac{\frac{1}{v_{\text{absorbed}}} - \frac{1}{v_{\text{emitted}}}}{\frac{1}{v_{\text{emitted}}}} = \frac{v_{\text{emitted}}}{v_{\text{absorbed}}} - 1 \quad (2.17)$$

$$= \frac{v_{\text{emitted}} - v_{\text{absorbed}}}{v_{\text{absorbed}}} \approx \frac{U_{\text{absorbed}} - U_{\text{emitted}}}{c^2} \approx \frac{GM}{c^2} \left(\frac{1}{r_{\text{emitted}}} - \frac{1}{r_{\text{absorbed}}} \right)$$

The z 's are shown as the “matrix element” table entries below.²³ The point here is that the local LIF frames have effective flat metrics as in special relativity.²⁴ We further choose that subclass of LIF frames instantaneously at rest relative to an instantaneously coincident LNIF frames relatively at rest to the source mass M .²⁵ Note that $r_A < r_B < r_C \rightarrow \infty$ for same polar latitude θ and same azimuthal longitude ϕ .

²³ A positive z is gravity redshift and a negative z is a gravity blueshift

²⁴ This is a physical realization of the local tetrad frame transformation at least in principle as a gedankenexperiments. Einstein's “strong” EEP is: “In a freely falling (nonrotating) laboratory occupying a small region of spacetime, the laws of physics are the laws of special relativity.” (p.2, Foster & Nightingale, “A Short Course in General Relativity” Springer-Verlag, 1995. That is, the local metric for these frames is that of special relativity $ds^2 = c^2 dt_{LIF}^2 - dr_{LIF}^2 - r_{Schwarzschild}^2 (d\theta^2 + \sin^2 \theta d\phi^2)$ to a good approximation in a small enough (compared to the 4 principal radii of curvature) spacetime neighborhood of a point P in the curved manifold that is still large enough so that locally random quantum gravity metric zero point Heisenberg uncertainty noise fluctuations $\Delta g_{\mu\nu}(P) \sim L/L_p \ll 1$.

²⁵ We are allowed to do this for these special asymptotically flat spherically symmetric stationary static spacetime warps. We can't do it in general spacetime warps. “Stationary” means a timelike Killing vector field. “Static” means the timelike Killing vector field is locally orthogonal to a foliation of 3-dim spacelike hyper surfaces. Then we can make a global definition of what it means for a distant object to be at rest relative to the source mass M . If the spacetime is stationary there are coordinates in which the metric is time independent. The travel coordinate time in them is independent of the time of emission and the interval of *coordinate time* between successive wave crests emitted at A is the same at that for the detections at B. i.e. $\Delta t_A = \Delta t_B$. Furthermore, if the spacetime is static there is no Lense-Thirring 3-vector potential like Ray Chiao needs for his “gravity radio”, e.g. <http://stardrive.org/Jack/berry.pdf>, i.e.

$\vec{h} \equiv (g_{01}, g_{02}, g_{03}) = 0$. Therefore, the coordinate time needed for a light signal to go from A to B is the same as needed for it to return from B to A. This is not so when $\vec{h} \neq 0$ as when the source mass M is rotating. But when it is so we now have a global operational definition to test for simultaneity on the entire stationary static manifold between any two events in it using the principle of radar ranging. Thus A at coordinate time t_i sends a light signal to B that is detected there at coordinate time $t_B \equiv t_i + T$ and then reflected back to A where it is detected at coordinate time $t_f = t_i + 2T$. Therefore, the instant on the A world line simultaneous with the instant $t_B \equiv t_i + T$ on the B world line is

$t_A = (t_f + t_i)/2 = t_i + T = t_B$. Thus, when the spacetime is static, *without any possibility* of Chiao's “gravity radio” efficient transduction between far field gravity and electromagnetic radiation waves, the

absorb\emit	LIFA	LIF B	LIF C	LNIF A	LNIF B	LNIF C
LIF A	0	$-\left \frac{GM}{c^2}\left(\frac{1}{r_B}-\frac{1}{r_A}\right)\right $	$-\frac{GM}{c^2 r_A}$	$\frac{GM}{c^2 r_A}$	$-\left \frac{GM}{c^2}\left(\frac{1}{r_B}-\frac{1}{r_A}\right)\right $	$-\frac{GM}{c^2 r_A}$
LIF B	$+\left \frac{GM}{c^2}\left(\frac{1}{r_A}-\frac{1}{r_B}\right)\right $	0	$-\frac{GM}{c^2 r_B}$	$+\left \frac{GM}{c^2}\left(\frac{1}{r_A}-\frac{1}{r_B}\right)\right $	$\frac{GM}{c^2 r_B}$	$-\frac{GM}{c^2 r_B}$
LIF C	$\frac{GM}{c^2 r_A}$	$\frac{GM}{c^2 r_B}$	0	$\frac{GM}{c^2 r_A}$	$\frac{GM}{c^2 r_B}$	0
LNIF A	$-\frac{GM}{c^2 r_A}$	$-\left \frac{GM}{c^2}\left(\frac{1}{r_B}-\frac{1}{r_A}\right)\right $	$-\frac{GM}{c^2 r_A}$	0	$-\left \frac{GM}{c^2}\left(\frac{1}{r_B}-\frac{1}{r_A}\right)\right $	$-\frac{GM}{c^2 r_A}$
LNIF B	$+\left \frac{GM}{c^2}\left(\frac{1}{r_A}-\frac{1}{r_B}\right)\right $	$-\frac{GM}{c^2 r_B}$	$-\frac{GM}{c^2 r_B}$	$+\left \frac{GM}{c^2}\left(\frac{1}{r_A}-\frac{1}{r_B}\right)\right $	0	$-\frac{GM}{c^2 r_B}$
LNIF C	$\frac{GM}{c^2 r_A}$	$\frac{GM}{c^2 r_B}$	0	$\frac{GM}{c^2 r_A}$	$\frac{GM}{c^2 r_B}$	0

Note, for example, how LIF A is equivalent to LIF C relative to LNIF A. Of course, by construction LIF C and LNIF C are essentially identical because LNIF C is chosen to be at rest relative to the distant source, and LIF C is instantaneously at rest relative to LNIF C. The fate of the real photon signals is determined by the objectively real warping of spacetime independent of the state of motion of the detectors and emitters up to relative motional Doppler effects that I completely eliminate in this set of gedankenexperiments. I emphasize that experiments like these have not yet been attempted. For example, the Pound-Rebka experiment was only between LNIF A and LNIF B. To make a practical measurement of, say, the two LNIF B - LIF B entries²⁶ in the above table would be difficult to perform in practice, but not impossible in principle. The table here is what

frame-dependent coordinate time can be used to operationally define, in principle, a global foliation into spacelike hyper surfaces of simultaneity using radar ranging. On the other hand, real clocks do not tick off coordinate time in their rest frames, they tick off local frame invariant proper time

$\Delta\tau(E) \equiv \sqrt{g_{00}(E)}\Delta t \approx (1 - U(E)/c^2)\Delta t$ when $U(E)/c^2 \ll 1$. Therefore, in this very special SSS case, $\Delta\tau(A)/\sqrt{g_{00}(A)} = \Delta\tau(B)/\sqrt{g_{00}(B)}$ for the gravity time dilation. Note, for example, $g_{00}(LIFA) = 1$ because special relativity works for it locally according to the strong EEP. In contrast, $g_{00}(LNIFA) \approx 1 - 2U_A/c^2$. (ref. Wheeler & Ciufolini, "Gravitation and Inertia" p. 100, Princeton, 1995) No one ever said this stuff was easy, intuitive and commonsensible. I never promised you a rose garden. ©

²⁶ With reversed roles as emitter and absorber of the real photon signal.

Puthoff was unconsciously driving at in a confused way in his “Tables I and II” in his PV model.

Cartan forms again

Returning to the thread of the previous formal considerations. For the dual co-tangent vectors (AKA 1-forms of Cartan)

$$dx'^{\nu} = \left. \frac{\partial x'^{\nu}}{\partial x^{\mu}} \right|_P dx^{\mu} \quad (2.18)$$

Again from the intrinsic objective local invariance of the 1-form territory

$$\omega^{(1)}(P) = \omega_{\mu}^{(1)}(P) dx^{\mu} = \omega_{\nu}^{(1)'}(P) dx'^{\nu} \quad (2.19)$$

Therefore, by a similar argument to the one leading to (2.15)

$$\omega_{\nu}^{(1)'}(P) = \left. \frac{\partial x^{\mu}}{\partial x'^{\nu}} \right|_P \omega_{\mu}^{(1)}(P) \quad (2.20)$$

These are passive coordinate transformations at a fixed event P. We are simply changing the local maps of the same P territory. We can also formally imagine active transformations²⁷ in which event P maps to a different event P'. To do that physically we need a connection and the idea of parallel transport.

p-forms

Cartan’s differential forms generalize the antisymmetric vector algebra cross product to spaces of any number of integer dimensions. This is done for the co-tangent vectors, i.e. the forms, rather than for the tangent vectors as in high school vector algebra.

$\vec{\nabla}$, $\vec{\nabla} \times$, $\vec{\nabla} \cdot$ are all subsumed into a more general mathematical object with a unification of the line integral of a vector field, Stokes and the Gauss divergence theorems of vector calculus on flat Euclidean 3 space. The antisymmetric exterior wedge product of two forms is defined.

$$\begin{aligned} z^{(2)} &\equiv v^{(1)} \wedge w^{(1)} = -w^{(1)} \wedge v^{(1)} \\ v^{(1)}, w^{(1)} &\in V^{(1)} \\ z^{(2)} &\in V^{(2)} \end{aligned} \quad (2.21)$$

²⁷ Baez has a different purely formal meaning of “active transformation” on p. 52 that seems uninteresting physically. Baez cites the active-passive coordinate transformation distinction first introduced by Eugene Wigner if my memory of things past is not mistaken?

Form the graded Grassmann algebra²⁸ ΛV by taking all possible “quantum entangled” coherent linear superpositions of wedge products of all the linearly independent basic one-forms. The highest order non-vanishing form is an N-form where N is the integer dimension of the co-tangent vector space. This last fact is a bit like the Pauli exclusion principle in quantum physics, which also depends on a basic antisymmetry of composing pairs of objects. That is, the transposition of two identical fermions is analogous to a wedge product of two 1-forms. Therefore,

$$w^{(1)} \wedge w^{(1)} \equiv 0 \quad (2.22)$$

is formally equivalent to the Pauli exclusion principle that only zero or one real on mass shell fermion per cell of single-particle phase space per spin/internal quantum numbers mode.

Take as the 1-form basis in \mathbb{R}^3 , the usual dx, dy, dz ²⁹

$$\begin{aligned} v^{(1)} &\equiv v_x dx + v_y dy + v_z dz \\ w^{(1)} &\equiv w_x dx + w_y dy + w_z dz \\ v^{(1)} \wedge w^{(1)} &= (v_x w_y - v_y w_x) dx \wedge dy + (v_y w_z - v_z w_y) dy \wedge dz + (v_z w_x - v_x w_z) dz \wedge dx \end{aligned} \quad (2.23)$$

In general all 2-forms in $N \geq 2$ dimensional space can be written as

$$\begin{aligned} \omega^{(2)} &= \frac{1}{2!} \omega_{\mu\nu} dx^\mu \wedge dx^\nu \\ \mu, \nu &= 1, 2, \dots, N \\ \omega_{\mu\nu} &= -\omega_{\nu\mu} \end{aligned} \quad (2.24)$$

Note the implicit analogy to Paul spin matrices of the simplest non-trivial Clifford algebra. For example

$$dx \wedge dy \sim [\sigma_x, \sigma_y] \sim \sigma_z \quad (2.25)$$

Note, however, it would be wrong for Cartan forms to use $dx \wedge dy \rightarrow dz$ as is essentially done in ordinary vector algebra. This hasty substitution collapses a 2-form into a 1-form in an improper way. To do this properly requires a duality operation, the metric-dependent Hodge star operator that takes a p-form to a dual N-p form. For example, when $N = 3$

²⁸ I think that’s what the Pundits call it? I could be mistaken? Check out the relation if any to Clifford algebras.

²⁹ Ref. P. 57 of the Baez book.

$$\begin{aligned}
 *dx \wedge dy &\rightarrow dz \\
 *dz \wedge dy &\rightarrow dx \\
 *dx \wedge dz &\rightarrow dy
 \end{aligned}
 \tag{2.26}$$

Also analogous to $\vec{u} \cdot (\vec{v} \times \vec{w})$

$$u^{(1)} \wedge v^{(1)} \wedge w^{(1)} = \begin{vmatrix} u_x & u_y & u_z \\ v_x & v_y & v_z \\ w_x & w_y & w_z \end{vmatrix} dx \wedge dy \wedge dz
 \tag{2.27}$$

All 3-forms in $N \geq 3$ dimensional space can be written as

$$\omega^{(3)} = \frac{1}{3!} \omega_{\mu\nu\lambda} dx^\mu \wedge dx^\nu \wedge dx^\lambda
 \tag{2.28}$$

In general for p-forms in $N \geq p$ space

$$\omega^{(p)} = \frac{1}{p!} \omega_{\mu\nu\dots\lambda} dx^\mu \wedge dx^\nu \wedge \dots \wedge dx^\lambda
 \tag{2.29}$$

Summing over all repeated pairs of dummy upper and lower “tensor” indices. The components of the p-forms $\omega_{\mu\nu\dots\lambda}$ are completely antisymmetric tensors of rank p relative to some symmetry group G of physical frame of reference transformations. Symmetries are rules of unchanging invariance, the stillness in the motion, made to be broken of course.

Given an N-dim linear vector space $V^{(1)}$ of 1-forms, with a Grassmann exterior algebra ΛV that is a vector space of 2^N dimensions like a Clifford algebra of NxN matrices. The subspace of all p-forms $\Lambda^{(p)}V \equiv V^{(p)}$, i.e. all entangled coherent linear superpositions of products of p 1-forms. In particular $V^{(0)}$ is the algebraic field of coefficients of the vector space $V^{(1)}$ that can be the integers, rationals, reals, the complex plane, quaternions, octonians, and also the finite Galois fields of error correction codes and the like. There may even be a fractal generalization to non-integer dimensional vector spaces? Indeed, why not let the dimension of the vector space also be an algebraic field or something more general than a field?

The set of real numbers R, for example, of $V^{(0)}(R) \equiv R^1$ are now replaced by a space of functions $\{f\} \equiv \Omega^{(0)}(M)$ as the 0-forms on a manifold M . These can be real functions of real variable, complex functions of a complex variable, functions of several variables and

so on. With this move in the Glass Bead Game³⁰ we really do have a formalism that is able to the organically whole quantum non-mechanics³¹.

Note that, consistent with the Fermi-Dirac quantum permutation statistics of identical real particles of spin $\frac{1}{2}$, for example.

$$\omega^{(p)} \wedge \omega^{(q)} = (-1)^{pq} \omega^{(q)} \wedge \omega^{(p)} \quad (2.30)$$

Using Baez's convention, this rule defines ΛV as a "graded commutative" algebra. The Cartan p-forms are considered as contravariant objects from pullbacks corresponding to stacks of pilot qubit wave front crests of p identical entangled fermions in their subspace of Fock space.³²

The electric field polar 3-vector is a 1-form in 3-dim space whose components change sign under a spatial mirror image parity transformation from a left-handed to a right-handed Cartesian frame of reference e.g. the parity transform $(x, y, z) \rightarrow (-x, -y, -z)$.

$$\vec{E} \equiv (F_{0x}, F_{0y}, F_{0z}) \quad (2.31)$$

The magnetic field axial or pseudo 3-vector

$$\vec{B} \equiv (F_{yz}, F_{zx}, F_{xy}) \quad (2.32)$$

is a 2-form in 3-dim space whose components obviously do not change sign under space parity transformation because the components are quadratic in the space degrees of freedom and $-1 \times -1 = +1$. $F_{\mu\nu}$ is the antisymmetric Maxwell field tensor³³ of rank 2 under, for example the Lorentz symmetry group of rotations and boosts in special relativity for globally flat 4-dim spacetime. One can also add the 4 translation of space and time displacements subgroup because of global flatness. Gravity is the compensating non-Abelian local gauge field when we reduce the translation group from its global status to a only a local group. Locally gauging the translation group gives the DIFF(4) symmetry group of local coordinate transformations. This is part of Einstein's strong

³⁰ "Magister Ludi" by Hermann Hesse.

³¹ "non-mechanics" preferred by David Bohm and Basil Hiley rather than "quantum mechanics", because of the form-context dependence, intensity-independence, and lack of pre-assigned interactions in the pilot quantum information fields that give real matter its marching orders in addition to the marching orders on matter from geometry in Einstein's classical geometrodynamics.

³² In the Bohm realist hidden variable interpretation of quantum physics. Our motivation is different from that of the pure mathematician. We eschew formal elegance and rigor to get to the bottom line of application of these formal tools to physics problems we find interesting. If you are looking for a conventional mathematical book go elsewhere. This treatise is for warped metric engineers free falling down the wormhole. ☺

³³ It is the curvature of an internal symmetry connection that may also be thought of as extra space dimensions of hyperspace as in the Kaluza-Klein boson dimensional theory that is generalized to include fermion dimensions when supersymmetry transformations of fermions to bosons and back are permitted.

equivalence principle (EEP). The dynamical action of all known fundamental gauge force fields is invariant under space-parity except for the weak force causing radioactive beta decay of nuclear physics. Note that the rotations and the Lorentz boosts are not locally gauged in Einstein's 1915 geometrodynamics that eliminates Newton's gravity force replacing it by spacetime curvature. What happens if we locally gauge the Lorentz group in addition to the translation group. Gennady Shipov³⁴ of Moscow has tried that in his torsion theory extension of Einstein's theory, which has zero torsion. Is this a good idea for weightless warp drive to explain alleged flying saucers and to allow us to build our own? Maybe, it is too soon to tell.

The exterior derivative d generalized $\vec{\nabla}$

Recall from college vector calculus

$$\begin{aligned}\vec{\nabla} \times \vec{\nabla} f &= 0 \\ \vec{\nabla} \cdot (\vec{\nabla} \times \vec{A}) &= 0\end{aligned}\tag{2.33}$$

These are special cases of

$$d^2 \dots = 0\tag{2.34}$$

In general for the graded Grassmann algebra of 0-form functions on a manifold M of N dimensions, the exterior derivative of a p -form is a $p+1$ form. This is a little like the ladder operators in Fock occupation number space for many identical quantum particles of the second-quantization formalism for the special relativistic creation and destruction of real on mass shell elementary particles, and for quasi-particles in the non-relativistic many-particle physics of collective phenomena such as ourselves.³⁵

$$d : \Omega^{(p)}(M) \rightarrow \Omega^{(p+1)}(M)\tag{2.35}$$

$$\begin{aligned}\omega^{(1)} &= \omega_x dx + \omega_y dy + \omega_z dz \\ \omega^{(2)} &= d\omega^{(1)} = d\omega_x \wedge dx + d\omega_y \wedge dy + d\omega_z \wedge dz \\ &= \frac{1}{2} \omega_{\mu\nu} dx^\mu \wedge dx^\nu = \omega_{xy} dx \wedge dy + \omega_{yz} dy \wedge dz + \omega_{zx} dz \wedge dx \\ &= (\partial_x \omega_y - \partial_y \omega_x) dx \wedge dy + (\partial_y \omega_z - \partial_z \omega_y) dy \wedge dz + (\partial_z \omega_x - \partial_x \omega_z) dz \wedge dx \\ *d\omega^{(1)} &= (\partial_y \omega_z - \partial_z \omega_y) dx + (\partial_z \omega_x - \partial_x \omega_z) dy + (\partial_x \omega_y - \partial_y \omega_x) dz\end{aligned}\tag{2.36}$$

³⁴ Shipov visited us at ISSO several times in 1999, 2000 via Vladimir Poponin.

³⁵ We are open non-equilibrium systems with, I conjecture, post-quantum back-action of material Bohm hidden variables directly on its intrinsically mental nonclassical information pilot fields. This leads to post-quantum signal nonlocality violating the no-cloning theorems and related theorems of quantum computers, quantum cryptography and quantum teleportation et-al.

Note from the bottom line in (2.36) that the Hodge star dual of the exterior derivative $*d$ transforms a p-form into another p-form. That is

$$*d : \Omega^{(p)}(M) \rightarrow \Omega^{(p)}(M) \quad (2.37)$$

Also

$$d\omega^{(2)} = (\partial_z \omega_{xy} + \partial_x \omega_{yz} + \partial_y \omega_{zx}) dx \wedge dy \wedge dz \quad (2.38)$$

$$\begin{aligned} \vec{\nabla} &\approx d : \Omega^0(R^3) \rightarrow \Omega^1(R^3) \\ \vec{\nabla} \times &\approx d : \Omega^1(R^3) \rightarrow \Omega^2(R^3) \\ \vec{\nabla} \cdot &\approx d : \Omega^2(R^3) \rightarrow \Omega^3(R^3) \end{aligned} \quad (2.39)$$

Quantum Carnot heat engines

Holonomic integrable path independence comes from the equality of mixed partial derivatives of objects on a simply connected manifold without holes in it. For example, the path independence of the line integral of a force in a conservative potential i.e. work done is a state function. Another example, is reversible classical thermodynamics where the entropy is a state function as in the reversible Carnot heat engine³⁶ with efficiency

$$\frac{\text{Work - output}}{\text{Heat - input}} = 1 - \frac{T_{\text{cold}}}{T_{\text{hot}}} \quad (2.40)$$

Cartan form gauge covariant topological electrodynamics

$$\omega^{(2)} \rightarrow \vec{B} = B_x dy \wedge dz + B_y dz \wedge dx + B_z dx \wedge dy \quad (2.41)$$

$$\omega^{(1)} \rightarrow \vec{E} = E_x dx + E_y dy + E_z dz \quad (2.42)$$

³⁶ A quantum Carnot heat engine with a hot negative absolute temperature coupled to a cold positive absolute temperature has efficiency greater than 100% because heat from both hot and cold reservoirs are converted completely to useful work in the ideal reversible situation. Any negative temperature (like in a laser with population inversion, or in a spin system of qubits, is hotter than any positive temperature. This is not a violation of the classical second law of thermodynamics but is a counter-intuitive consequence of it when combined with the quantum principle. Indeed, this may lead to post-quantum signal nonlocality since negative temperatures are usually associated with local macro-quantum order parameters from some kind of Bose-Einstein condensate that need not be in thermal equilibrium. A laser is an open pumped system. These ideas were first dimly glimpsed by me when I co-directed the NSF Summer Institute for College Teachers in Macro-Quantum Physics at San Diego State University in the early 70's with Herschel Snodgrass and Fred W. Cummings.

The rule that there are no isolated magnetic monopoles and Faraday's law of magneto-electric induction in the trivial 3-dim spacelike static limit correspond respectively to

$$\begin{aligned} dB &= 0 \\ dE &= 0 \end{aligned} \tag{2.43}$$

These laws are pre-metrical not depending on being able to define lengths and angles. They are even pre-affine³⁷ not needing parallel transport of objects to different parts of the manifold. Indeed, they are global topological as in the Bohm-Aharonov-Josephson cluster of quantum effects. The unified Maxwell classical electromagnetic field is the 2-form

$$\omega^{(2)} \rightarrow F \equiv B + E \wedge dt \tag{2.44}$$

Note that this is essentially a global topological structure. We add local affine and metrical structure³⁸ by specifying that the components of the Cartan forms transform as tensors and/or spinors under several different symmetry groups of local/global frame transformations. The first pair of Maxwell's equations³⁹ in the 4-dimensional sense are simply and elegantly captured by the Cartan form equation

$$\begin{aligned} d\omega^{(2)} &= 0 \\ dF &= 0 \end{aligned} \tag{2.45}$$

A sufficient condition for this is that

$$F = dA \tag{2.46}$$

because $d^2 = 0$. The 1-form A includes the magnetic 3-vector potential \vec{A} and the electric potential or "voltage" A_0 . The internal U(1) gauge symmetry group comes from

$$\begin{aligned} A &\rightarrow A' = A + d\omega^{(0)} \\ F &= dA' = dA + d^2\omega^{(0)} = dA \end{aligned} \tag{2.47}$$

That is the classical local EM field tensor 2-form is invariant under these gauge transformations by an arbitrary 0-form $\omega^{(0)}$. This classical simplicity is lost both in micro and macro-quantum⁴⁰ phenomena with the Bohm-Aharonov⁴¹ and Josephson effects.

³⁷ Felix Klein's "Erlanger Programme" of 1872 of geometry as invariants of groups of transformations of local frames of reference on a manifold.

³⁸ Also projective and conformal wavelet scale dilation structures.

³⁹ No magnetic monopoles, and Faraday's induction law of electric motors and dual generators etc.

⁴⁰ With Bose-Einstein condensates i.e. macroscopic occupation of a low lying quantum state in many-particle configuration space. This is a single-particle state for bosons and an entangled EPR pair state for

Breaking the spacetime stiffness barrier

To summarize, the first pair of Maxwell's electromagnetic field equations, no magnetic monopoles and Faraday's induction are independent of metric. That is, they do not depend on defining distances in the manifold. Not so with Gauss's law for the electric flux from a charge distribution and Ampere's law for the generation of magnetic fields from current flows real and virtual (e.g. displacement current in vacuum). We need a metric to define an inner product from which we get lengths and angles. The metric for a real manifold is a symmetric bilinear mapping of co-tangent and tangent vector field flows on the manifold M

$$g : V^{(1)}(M) \times V_{(1)}(M) \rightarrow V^{(0)}(M) \quad (2.48)$$

For example in a special static spacetime with causal light cone structure, unlike imaginary time

$$g = -(cdt)^2 + {}^3g \quad (2.49)$$

In Bohmian quantum gravity the 3-dim spacelike piece of the metric is the "particle" or "hidden variable". In my new theory, there is no direct quantum gravity in this sense. That is classical gravity is an emergent local curvature collective mode from a spontaneous broken symmetry of an unstable completely micro-quantum random globally flat vacuum to a smooth nonrandom "superfluid" macro-quantum vacuum with only small residual random micro-quantum noise, i.e. normal fluid. Metric engineering of star gate time travel machines and weightless warp drives is the soft art of changing the relative balance of superfluid density to normal fluid density. It is more like Tao Chi rather than brute force. That is one must leapfrog over the spacetime stiffness barrier $G/c^4 \sim 10^{-33}$ cm per 10^{19} Gev. Note that the static metric form in (2.49) does not allow Ray Chiao's "gravity radio" efficient transduction between gravity and electromagnetic waves inside certain Type II superconductors. To get that effect requires mixed space-time Lense-Thirring metric components $\vec{h} \equiv (g_{0x}, g_{0y}, g_{0z})$ that couple to the magnetic 3-vector potential $\vec{A} \equiv (A_x, A_y, A_z)$. Note that the gravito-magnetic coupling energy density is $\sim \rho_e \vec{A} \cdot \vec{h}$ since \vec{h} is dimensionless and $\rho_e \vec{A}$ has dimensions of energy per unit volume same as the stress energy tensor of ordinary matter, but without the spacetime stiffness barrier factor G/c^4 . ⁴²Chiao is only concerned with far field radiation. We need to see if Chiao's approach leads to practical results for the near induction fields, both electromagnetic and geometrodynamical as suggested by several folklore legends around

fermions in the simplest of cases of (equilibrium) superfluid helium & superconductors, non-equilibrium laser beams & biological membranes with Frohlich's electric dipole BEC etc.

⁴¹ Magnetic shift in electron wave interference fringes even though $F = 0$ on the paths of the electrons. However A is not zero. Therefore, A has a local non-classical effect modifying the linear momentum of the electron. One only sees line integrals of this effect around closed loops, however the line integral of a zero local effect must be zero.

⁴² <http://stardrive.org/Jack/berry.pdf>

Serbia's most famous engineer Nicolas Tesla, Gabriel Kron and the 1943 US Navy Philadelphia Experiment that James Corum⁴³, an expert in all three, is so keen on. If Corum is interested than so am I. From what we see here I may have even better reason to be interested now than Corum realizes.

The second pair of Maxwell's classical EM field equations

Given the 2-form F for the Maxwell field from the non-metrical topological first pair of Maxwell's equations, we need the metric-dependent Hodge star duality operator taking a p-form to an N-p form to get the metrical second pair of Maxwell's equations. In this case of spacetime, $N = 4$.

$$\begin{aligned}
 F &= B + E \wedge dt \\
 *F &= *B + *(E \wedge dt) \\
 E_i &\rightarrow -B_i \\
 B_i &\rightarrow E_i \\
 i &= x, y, z
 \end{aligned}
 \tag{2.50}$$

The complete set of Maxwell's field equations with sources with the 4-dim spacetime metric g in terms of E. Cartan's "pilot wave" forms is

$$\begin{aligned}
 dF &= 0 \\
 *d * F &= {}^4 j_e
 \end{aligned}
 \tag{2.51}$$

The first line is both no magnetic monopoles and Faraday's induction. The second line is both Ampere's law of magnetic field from both real and displacement currents⁴⁴ and Gauss's law of electric flux from charge.

For now we only consider the globally flat spacetime of Einstein's special relativity of 1905. This means we can use the static equation between the 4-dim spacetime metric g and the 3-dim spacelike metric 3g .

$$g = -(cdt)^2 + {}^3g
 \tag{2.52}$$

Metrics allows us to convert cotangent vector forms to dual tangent vector fields and vice versa. In tensor language this means using the metric to raise and lower tensor indices with a dummy index and summation convention over pairs of upper and lower indices. For example, using the 3-metric fragment 3g , the "particle"⁴⁵ 3-dim electric current density tangent vector field

⁴³ With a large Federal budget at Institute Software Research in West Virginia via Senator Robert Byrd.

⁴⁴ The Maxwell displacement current may well turn out to be a universal superconducting "Meissner" vacuum virtual electron-positron charged current.

⁴⁵ Bohm material hidden variable with a definite path in the manifold.

$${}^3\vec{j}_e = j_e^x \partial_x + j_e^y \partial_y + j_e^z \partial_z \quad (2.53)$$

is converted to the dual “Bohm pilot wave” 1-form

$${}^3j_e = j_{ex} dx + j_{ey} dy + j_{ez} dz \quad (2.54)$$

In terms of components relative to the local basis frame of reference

$${}^3j_{ei} = {}^3g_{ik} j_e^k \equiv {}^3g_{ix} j_e^x + {}^3g_{iy} j_e^y + {}^3g_{iz} j_e^z \quad (2.55)$$

$i = x, y, z$

Note that the “particle” tangent vector field components relative to a basis local frame have tensor superscripts, whilst the “wave” dual co-tangent Cartan differential forms have tensor subscripts in this particular formal convention.

Next we use the full 4-dim metric in the globally flat trivially stationary/static spacetime of 1905 Einstein special relativity. The 4-electric particle current tangent vector field on the 4-dim spacetime manifold is

$${}^4\vec{j}_e = \rho_e \partial_t + j_e^x \partial_x + j_e^y \partial_y + j_e^z \partial_z \quad (2.56)$$

Use the 4-dim metric to get the pilot wave cotangent 4-current form

$${}^4j_e = {}^3j_e - \rho_e dt \quad (2.57)$$

The local 4-dim metric-dependent inner product is

$$\|{}^4j_e\|^2 = {}^4\vec{j}_e \cdot {}^4j_e = j_e^x j_{ex} + j_e^y j_{ey} + j_e^z j_{ez} - \rho_e^2 \quad (2.58)$$

Start with

$$*d * F = {}^4j_e \rightarrow d * F = *{}^4j_e \quad (2.59)$$

But $d^2 = 0$ implies the local current conservation equation

$$d^2 * F = d * {}^e j_e = 0 \quad (2.60)$$

Note, that F is a 2-form. Its Hodge star dual $*F$ is also a 2-form in 4-dim spacetime, though not in hyperspace if there are “unseen” space dimensions in the Super Cosmos of

parallel geometrodynamical “brane worlds”.⁴⁶ Therefore, $*^4 j_e$ is a 3-form dual to the 1-form ${}^4 j_e$.

The macro-quantum virtually superconducting vacuum meaning of Maxwell’s displacement current?

My basic idea here is simple. My new macro-quantum PV theory of the unified origin of light, gravity, inertia and quintessence is in accord with the Wheeler-Feynman/Hoyle-Narlikar idea that the EM field is dynamically redundant, i.e. there are only sources with zero proper time contact classical interactions along both future and past light cones (History and Destiny). The forces have no independent meaning apart from the sources that are virtually everywhere and everywhen in two fluid form. The superfluid is a Bose-Einstein condensate of virtual bound state positronium. The normal fluid is ionized positronium plasma. It is only the latter's tiny effects that is computed in orthodox QED.

The Maxwell-Ampere law is

$$\begin{aligned} \frac{\partial \vec{D}}{\partial t} + *^3 \vec{j}_{real} &= \vec{\nabla} \times \vec{H} \\ \vec{\nabla} \times \vec{H} &= *^3 \vec{j}_{(virtual-e^+e^-BEC)} + *^3 \vec{j}_{real} \end{aligned} \quad (2.61)$$

In my new theory, Maxwell’s ad-hoc purely classical fudge factor⁴⁷ displacement current density that worked and that made the vacuum equations look more symmetrical and that unified electricity with magnetism and light in the first unified field theory of ~ 1864 is⁴⁸

⁴⁶ “The Universe in a Nutshell” by Stephen Hawking. The hyperspace “material” hidden variable parallel brane worlds of Super Cosmos (e.g. the “Magonia” universe next door of “Greater Earth”) are not to be confused with the intrinsically “mental” pilot wave “multiverse” of David Deutsch’s book “The Fabric of Reality”. The brane worlds are hidden geometrodynamical Bohm variables that get their marching orders from the macro-quantum bit pilot wave multiverse that is Hawking’s “Mind of God”.

⁴⁷ The standard view is that the classical electromagnetic field is an independent local dynamical antisymmetrical tensor field of rank 2 under the Poincare group in globally flat spacetime. One can do that of course. However, Wheeler and Feynman, and then Hoyle and Narlikar, have questioned whether that is so. They say that the lepto-quark source is the only independent field needed. The electromagnetic field tensor is then only a convenient bookkeeping device. This would also mean that Haisch’s and Puthoff’s unsuccessful attempt to derive gravity and inertia from virtual transverse photons is misguided. There are also deep unresolved problems of principle with the quantization of the electromagnetic field like indefinite metrics in Hilbert space. There are several approaches to this but none IMO are satisfactory.

⁴⁸ Note I use $*2eN/V$ for the local frame-invariant identically vanishing vacuum effective charge density so as not to confuse it with the electrically neutral vacuum superfluid number density $\rho_{virtuale^+e^-BEC}$.

$$\begin{aligned}
 \frac{\partial \vec{D}}{\partial t} &= {}^*3\vec{j}_{(\text{virtual-}e^+e^-BEC)} \\
 \frac{\partial \vec{D}}{\partial t} &\equiv \left[\frac{\partial {}^*F_{tx}}{\partial t}, \frac{\partial {}^*F_{ty}}{\partial t}, \frac{\partial {}^*F_{tz}}{\partial t} \right] \\
 {}^*3j_{0(\text{virtual-}e^+e^-BEC)} &\equiv \frac{\partial {}^*F_{tt}}{\partial t} = 0
 \end{aligned} \tag{2.62}$$

Note that the bottom line of (2.62) for the effective charge density ${}^*3j_{0(\text{virtual-}e^+e^-BEC)}$ of the virtual electron-positron vacuum superfluid vanishes in all local frames of reference because $\partial {}^*F_{tt}/\partial t \rightarrow \partial {}^*F'_{t't'}/\partial t' = 0, x \rightarrow x'(x), F_{tt} \rightarrow F'_{t't'} \equiv 0$. The vacuum Ampere equation is then

$$\vec{\nabla} \times \vec{H} = {}^*3\vec{j}_{(\text{virtual-}e^+e^-BEC)} \tag{2.63}$$

with a conserved virtual current, i.e. in all local frames

$$\begin{aligned}
 \vec{\nabla} \cdot (\vec{\nabla} \times \vec{H}) &= \vec{\nabla} \cdot {}^*3\vec{j}_{(\text{virtual-}e^+e^-BEC)} = 0 \\
 {}^*3\vec{j}_{0(\text{virtual-}e^+e^-BEC)} &= 0 \\
 \vec{\nabla} \cdot {}^*3\vec{j}_{(\text{virtual-}e^+e^-BEC)} + \frac{\partial}{}^*3\vec{j}_{0(\text{virtual-}e^+e^-BEC)} &= 0
 \end{aligned} \tag{2.64}$$

The basic idea is simple. The apparent vacuum oscillation of the electric displacement field acting like an oscillating vacuum current really is that! It is not an analogy, but is a proportionality!⁴⁹ The seemingly classical permittivity of vacuum ϵ_0 and magnetic permeability of vacuum μ_0 with purely reactive non-dissipative vacuum impedance⁵⁰ $Z_{vac} = \sqrt{\mu_0/\epsilon_0} = 377\text{Ohms}$ is from the phase coherent virtual positronium Bose-Einstein Josephson-type supercurrent oscillations in the locally nonrandom macro-quantum *phase coherent* vacuum. This *macro-quantum* ‘‘Polarized Vacuum’’ (PV) effect should not be confused with the very tiny *micro-quantum* PV effects computed by Feynman and Schwinger, e.g. with the Feynman closed electron loop perturbation diagrams. That is only for the locally *randomly phased* ‘‘normal fluid’’ zero point Heisenberg uncertainty noise from ionized virtual positronium plasma. Indeed, when the effective Wigner phase space density of ionized virtual positronium plasma is negative $\Lambda < 0$ that is the ‘‘dark energy’’ that is the missing mass of the universe. On the other hand, when the effective

⁴⁹ Feynman had a similar epiphany ~ 1940 when he read Dirac’s statement that the classical action of a particle along a path segment was analogous to the phase of the quantum wave amplitude for the particle’s history along the path to begin and end at the endpoints of the segment.

⁵⁰ ‘‘Superconductors as transducers and antennas for gravitational and electromagnetic radiation’’, Ray Chiao, gr-qc/0204012 (11 April 2002).

Wigner phase space density of ionized virtual positronium plasma is positive $\Lambda > 0$ that is the antigravitating exotic vacuum. The term “exotic matter” is not accurate because this is a macro-quantum vacuum phase. This gives a deeper meaning to why there is light at all? The existence of light is direct experimental evidence for my new macro-quantum e^+e^- BEC theory of the vacuum, as is Einstein's gravity and quintessence. This is the power of a new paradigm to organize old knowledge in new ways as well as to predict new amazing mind-boggling stuff!⁵¹

How should we really write Maxwell's classical electromagnetic field equations? We see from the early 20th Century Munich lectures of Arthur Sommerfeld⁵² that the best way to write the two pairs of equations in the formally elegant language of E. Cartan is

$$\begin{aligned} dF &= 0 \\ d * F &= *^4 j_e \end{aligned} \tag{2.65}$$

Note that both equations deal with 3-forms not 1-forms. The locally conserved electric current density is a 3-form.

Sommerfeld, using the older “engineering” vector calculus, writes the above equations as

$$\begin{aligned} \vec{\nabla} \cdot \vec{B} &= 0 \\ \frac{\partial \vec{B}}{\partial t} &= -\vec{\nabla} \times E \end{aligned} \tag{2.66}$$

for the first pair, and

$$\begin{aligned} \vec{\nabla} \cdot \vec{D} &= * \rho_e \equiv * j_{0e} \\ \frac{\partial \vec{D}}{\partial t} + *^3 \vec{j}_e &= \vec{\nabla} \times \vec{H} \end{aligned} \tag{2.67}$$

Note that the metric-dependent 4-dim Hodge star duality operator splits in the stationary/static spacetime metrics of (2.52) into a timelike and spacelike 3-dim pieces. The latter is denoted as $*_s$. Gauss's law in Cartan forms is then

⁵¹ My new POV has to obey both local Lorentz and general coordinate covariance. The RHS of (2.62) is a pseudo three-dimensional vector current density that is not the spacelike part of a first rank tensor or Lorentz four-vector. The pseudo-current density of the virtual e^+e^- BEC is zero in all local frames of reference because of the antisymmetry of the Maxwell field tensor $F_{\mu\nu}$, e.g. $F_{tt} = 0$ identically. The field tensor stays antisymmetrical under any kind of local spacetime transformation. The local virtual electron-positron charge density is the partial time derivative of the diagonal time-time component of the field tensor which is identically zero in all local frames since diagonal parts of the field tensor vanish in all local frames.

⁵² Sommerfeld's students included Werner Heisenberg, Wolfgang Pauli and Hans Bethe.

$$\begin{aligned}
 *_s d_s *_s E &= \rho_e \rightarrow d_s *_s E = *_s \rho_e \\
 D &= *_s E \\
 d_s D &= *_s \rho_e
 \end{aligned} \tag{2.68}$$

The bottom line in Gauss's law (2.66) is a 3-form equation with d_s as the exterior derivative in 3-dim vector space. We saw that E was a 1-form. The 3-dim spacelike Hodge star duality operator changes the electric 1-form to a dual displacement 2-form in 3-dim space.⁵³ Similarly for Ampere's law with the vacuum Maxwell displacement current responsible for far field $\sim 1/r$ transversely polarized radiation leaking energy out of the localized energy time-dependent induction near fields $\sim 1/r^2$ etc. that include longitudinal polarizations in addition to transverse polarizations. Therefore for Ampere's law + virtual vacuum current we have

$$\begin{aligned}
 -\partial_t E + *_s d_s *_s B &= {}^3 j_e \\
 \rightarrow -\partial_t *_s E + d_s *_s B &= *_s {}^3 j_e \\
 D &\equiv *_s E \\
 H &\equiv *_s B \\
 -\partial_t D + d_s H &= *_s {}^3 j_e
 \end{aligned} \tag{2.69}$$

This is how to match the Cartan form language to Sommerfeld's language. H is a 1-form because it is spacelike dual to the 2-form B . Similarly, each term in the bottom line of (2.65) is a 2-form. Going back to Sommerfeld's notation and remembering the vacuum impedance so essential to Ray Chiao's "gravity radio" transduction of electromagnetic waves into gravity waves and vice-versa in certain impedance matched regions of a real Type II superconductor, compare (2.65) to (2.66) for dimensional consistency, i.e.

$$\begin{aligned}
 [B] &= \frac{\text{force}}{\text{pole-strength}} = \frac{\text{Newton-sec}}{\text{Coulomb-meters}} \\
 [H] &= \frac{\text{pole-strength}}{\text{area}} = \frac{\text{Coulombs}}{\text{meter-sec}} \\
 [D] &= \frac{\text{charge}}{\text{area}} = \frac{\text{Coulombs}}{\text{meter}^2} \\
 [E] &= \frac{\text{force}}{\text{charge}} = \frac{\text{Newtons}}{\text{Coulombs}} \\
 [\rho_e] &= \frac{\text{charge}}{\text{volume}} = \frac{\text{Coulombs}}{\text{meters}^3} \\
 [*_s {}^3 j] &= \frac{\text{charge}}{\text{area-time}} = \frac{\text{Coulombs}}{\text{meter}^2\text{-sec}}
 \end{aligned} \tag{2.70}$$

⁵³ Maxwell's equations have to be re-looked at in nanotechnology with 2-dim quantum wells, 1-dim quantum wires and 0-dim quantum dots. There are the anyons associated with quantum wells and high T_c superconductors as well as the anomalous Hall effect.

The vacuum is a medium in quantum electrodynamics. Assuming isotropy for simplicity. For the moment suppressing the different levels of Cartan's forms – keeping the above distinctions in mind, however, the “engineer” view is

$$\begin{aligned}
 \vec{D} &= \epsilon_0 \vec{E} \\
 \vec{B} &= \mu_0 \vec{H} \\
 c^2 &= \frac{1}{\epsilon_0 \mu_0} \\
 \Omega_{vac} &= \sqrt{\frac{\mu_0}{\epsilon_0}}
 \end{aligned} \tag{2.71}$$

The bottom line in (2.67) is the imaginary resistance, i.e. the “impedance”, of “classical vacuum” at least in the ELF limit where frequency $\omega \rightarrow 0$.

Recall that in a real electron pair macro-quantum superconductor, the Meissner effect depends on the deBroglie -Bohm equation pilot-field guidance equation for the charged supercurrent

$${}^3\vec{j}_{se^-e^-} = \frac{2e\rho_{se^-e^-}}{2m_e} \left(\hbar \vec{\nabla} \arg \Psi - \frac{2e}{c} \vec{A} \right) = \frac{e\rho_{se^-e^-}}{m_e} \left(\hbar \vec{\nabla} \arg \Psi - \frac{2e}{c} \vec{A} \right) \tag{2.72}$$

where $\Psi = \Psi(\vec{r}, t)$ is the spacetime localized macro-quantum order parameter or giant quantum pilot wave of the superfluid Bose-Einstein condensate with long range phase coherence. We cannot use (2.70) for the virtual vacuum superconductor for two reasons:

1. The virtual electron-positron BEC super current is not charged as is the real electron pair supercurrent.
2. The virtual electron-positron BEC pseudo-super current does not frame transform as a first rank tensor under the local Lorentz group the way the real electron pair superconductor current does.

Note that $2e\vec{A}/c$ is the electromagnetic field momentum attached to the pair state in the center of mass motion that is macroscopically occupied to form the Bose-Einstein condensate (BEC).

$$\begin{aligned}
 \rho_s &\rightarrow \rho_s(x) \equiv |\Psi(x)|^2 \\
 [\rho_s] &= \frac{1}{\text{volume}} = \frac{1}{\text{meters}^3}
 \end{aligned} \tag{2.73}$$

However, we must proceed with caution in making the next step to make sure the equations are locally covariant. For now I will only deal with special relativity, i.e. a

globally flat spacetime. One can then use the tetrad map from Einstein's EEP to make the equations covariant under Diff(4) in the standard way.

Torsion-like vacuum structure

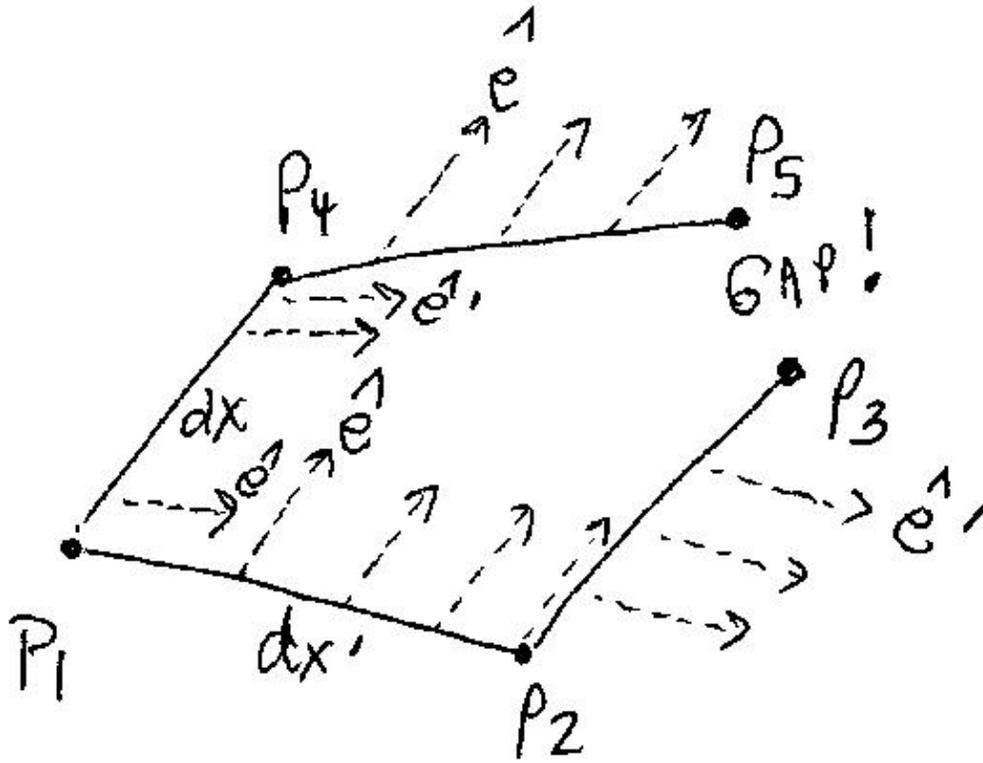
We know from Yang-Mills non-abelian gauge theory of the weak and strong forces that for internal symmetry groups⁵⁴

$$F_{\mu\nu} = \frac{\partial A_\nu}{\partial x^\mu} - \frac{\partial A_\mu}{\partial x^\nu} + T_{\mu\nu}^\lambda A_\lambda \quad (2.74)$$

James Corum <http://www.bielek.com/corum.htm> uses this kind of equation where the last term on RHS has a third rank non-tensor anholonomic connection field representing, I think, locally rotating noninertial tangent space frames. However, I will only use local "torsion" third rank tensors corresponding to gaps in the attempt to "parallel transport"⁵⁵ tangent vectors around closed loops. For example, start at a given point P1. Choose two different directions from point P represented by unit tangent vectors \mathbf{e} and \mathbf{e}' . Consider two tiny displacements dx and dx' along \mathbf{e} and \mathbf{e}' respectively. OK, step 1: parallel transport \mathbf{e} by dx' along \mathbf{e}' . This takes us from P1 to nearby P2. Step 2: parallel transport \mathbf{e}' by dx along the new vector direction $\mathbf{e}(P2)$. This takes us to point P3. Now do the same thing in reverse order again starting from P1. Step 3: parallel transport \mathbf{e}' by dx along \mathbf{e} to P4. Step 4: Starting from P3, parallel transport \mathbf{e} along the new \mathbf{e}' from P4 to P5. The "torsion gap" means P4 and P5 are not the same point! That is, the little self-generated parallelogram does not close up to make a tiny local loop in spacetime.

⁵⁴ I suppress the internal symmetry indices.

⁵⁵ Parallel transport of arrows along a path means keeping a fixed angle between the arrow and the local tangent vector defining each point of the path. This is a metric-dependent concept and it requires a third rank connection field analogous to T in (2.72) to do it. Parallel transport relative to a connection allows one to define covariant directional derivatives in curved spaces. The electromagnetic 4-potential A_μ is actually a connection in an internal fiber bundle over spacetime. That is, imagine a little one-handed Salvador Dali clock at each spacetime point P. Imagine a path in this 5-dimensional space in which a coordinate in the fifth dimension is a given time on the one-handed clock at any spacetime point P. We then imagine parallel transporting objects along this path in hyperspace. This is rough of course. I need to develop this intuitive picture in more detail. It may be in the literature but I am not aware of it. The electromagnetic field tensor $F_{\mu\nu}$ of Maxwell is then really a kind of curvature in this internal space fiber bundle over spacetime as the base space of the bundle.



Note that Corum distinguishes two kinds of gaps from two kinds of connections. One is his non-tensorial anholonomic connection gap, and second his tensorial torsion connection gap. Einstein's 1915 geometrodynamics of gravity using the metric Levi-Civita connection has no gaps. That is, the little parallelograms always close up. In terms of Hagen Kleinert's "world crystal" <http://www.physik.fu-berlin.de/~kleinert/> this means that the only line (string) topological defects are disclination defects. There are no dislocation defects. This, however, is probably only an approximation. Einstein's attempts at a classical unified field for electricity and gravity included torsion gaps absent from his original theory of 1915.

The new Ansatz of the macro-quantum vacuum to replace (2.70) that I conjecture is

$$\frac{\partial^* F_{\mu\nu}}{\partial x^\eta} = 2e\rho_{se^+e^-} T_{\mu\nu,\eta}^\lambda \left[\frac{\hbar}{2m} \partial_\lambda \Theta - \frac{2e}{mc} A_\lambda \right] \quad (2.75)$$

Where the local macro-quantum order parameter of the physical vacuum is

$$\Psi_{se^+e^-} = \sqrt{\rho_{se^+e^-}} e^{i\left(\Theta - \frac{2e}{\hbar c} \int A_\lambda dx^\lambda\right)} \quad (2.76)$$

There is no irreversible dissipation in the macro-quantum vacuum because the virtual electron-positron pairs in the BEC stay virtual. Therefore, the vacuum impedance is pure imaginary reactance. Only the irreversible resistance in an electrical circuit consumes power. The imaginary reactance combined with real resistance creates a phase lag between current and voltage in an ordinary non-superconducting electrical circuit with Ohm's law as current = voltage/impedance. Indeed I venture to conjecture that *all* of the New Age Cargo Cult "Free Energy" crackpot claims based on electrical circuits are based faulty power input-output measurements based on a common amateurish misunderstanding of Ohm's generalized impedance law with inductive and capacitive reactance induced phase differences between current and voltage in the circuit.⁵⁶ This was certainly true for the ones tested at ISSO or any we have heard about including bogus claims of "negative vacuum resistance" IMO. In the present problem, the random quantum uncertainty noise virtual electron-positron pairs are not a source or sink for energy and momentum. In particular, the normal fluid random zero point energy Heisenberg uncertainty part of the vacuum cannot be used as an energy supply or as a vacuum propeller by any of those faulty schemes.

Assuming globally flat spacetime with "Faltung" convolutions⁵⁷ \otimes of the electromagnetic products so that the Fourier transforms multiply

$$\begin{aligned} {}^3\tilde{j}_{(\text{virtuale}^+e^-BEC)} &= \frac{\partial \vec{D}}{\partial t} = \epsilon_0 \frac{\partial \vec{E}}{\partial t} = -\epsilon_0 \frac{\partial^2 \vec{A}}{\partial t^2} \\ {}^3\tilde{j}_{(\text{virtuale}^+e^-BEC)}(\vec{k}, \omega) &= \omega^2 \epsilon_0(\vec{k}, \omega) \tilde{\vec{A}}(\vec{k}, \omega) \\ \sigma_{(\text{virtuale}^+e^-BEC)}(\vec{k}, \omega) &\equiv -\omega \epsilon_0(\vec{k}, \omega) \end{aligned} \quad (2.77)$$

The bottom line of (2.78) is the effective macro-quantum vacuum conductivity. From (2.75)

$$\begin{aligned} \frac{\partial^* F_{\mu\nu}}{\partial x^\eta} &= 2e\rho_{se^+e^-} \otimes T_{\mu\nu,\eta}^\lambda \otimes \left[\frac{\hbar}{2m} \partial_\lambda \Theta - \frac{2e}{mc} A_\lambda \right] \\ {}^*j_{i(\text{virtuale}^+e^-BEC)} &= \frac{\partial^* F_{i0}}{\partial x^0} = 2e\rho_{se^+e^-} \otimes T_{i0,0}^\lambda \otimes \left[\frac{\hbar}{2m} \partial_\lambda \Theta - \frac{2e}{mc} A_\lambda \right] \\ i &= x, y, z \end{aligned} \quad (2.78)$$

$${}^*j_{i(\text{virtuale}^+e^-BEC)}(\vec{k}, \omega) = 2e\tilde{\rho}_{se^+e^-}(\vec{k}, \omega) \tilde{T}_{i0,0}^\lambda(\vec{k}, \omega) \left[\frac{\hbar}{2m} k_\lambda \tilde{\Theta}(\vec{k}, \omega) - \frac{2e}{mc} \tilde{A}_\lambda(\vec{k}, \omega) \right]$$

⁵⁶ Ch. 6 "The ARRL Handbook for Radio Amateurs" shows how foolish the New Age free-energy cargo cult claims are. Creon Levit tested several at ISSO in 1999-2000. Obviously none of them worked as advertised because the inventors did not understand the elementary physics in the reference here.

⁵⁷ Not assuming retarded causality BTW remembering Wheeler-Feynman.

Equate bottom line of (2.79) to the middle line in (2.78)

$$\omega^2 \varepsilon_0(\vec{k}, \omega) \tilde{A}_i(\vec{k}, \omega) = 2e \tilde{\rho}_{se^+e^-}(\vec{k}, \omega) \tilde{T}_{i0,0}^\lambda(\vec{k}, \omega) \left[\frac{\hbar}{2m} k_\lambda \tilde{\Theta}(\vec{k}, \omega) - \frac{2e}{mc} \tilde{A}_\lambda(\vec{k}, \omega) \right] \quad (2.79)$$

This resembles a plasma frequency equation. Notice however that the contraction over λ is 4-dimensional. In the very special case of uniform macro-quantum phase, with many of the torsion-like tensor gradients vanishing

$$\begin{aligned} \omega^2 \varepsilon_0(\vec{k}, \omega) \tilde{A}_i(\vec{k}, \omega) &\approx -\frac{4e^2}{mc} \tilde{\rho}_{se^+e^-}(\vec{k}, \omega) \tilde{T}_{i0,0}^\lambda(\vec{k}, \omega) \tilde{A}_\lambda(\vec{k}, \omega) \\ &\rightarrow -\frac{4e^2}{mc} \tilde{\rho}_{se^+e^-}(\vec{k}, \omega) \tilde{T}_{i0,0}^{(i)}(\vec{k}, \omega) \tilde{A}_i(\vec{k}, \omega) \end{aligned} \quad (2.80)$$

In a too- crude approximation, summation convention is suspended in bottom line of (2.80). In general we need to generalize (2.79) to 4-dim and include possibility of anisotropy in the dielectric coefficient on LHS of (2.79). We then have a 4x4 matrix equation to diagonalize for each point in (\vec{k}, ω) Fourier space. We cannot, of course, really neglect the macro-quantum phase variations. Indeed that is the key to metric engineering. Also, we need to use adaptive windowed wavelet transform generalizations from the translation group of the Fourier transform to the conformal group. This is a major job that will take time. These equations for macro-quantum vacuum structure are brand new.

Note that the plasma frequency gap as $k \rightarrow 0$ for real electrons in a positive background is of a similar form, except there ρ is a constant.

$$\omega_p^2 = \frac{4\pi\rho e^2}{mc\varepsilon_0} \quad (2.81)$$

The real plasma oscillations, i.e. real quanta called plasmons are on the mass shell with the dispersion curve

$$\omega^2 = \omega_p^2 + (c_p \vec{k})^2 \quad (2.82)$$

A real plasma like that is not what we have here in the macro-quantum vacuum. The vacuum response in (2.71) is virtual off-mass-shell⁵⁸ for the Feynman propagators, which means that the virtual superfluid density is a real function whose domain is the entire 4-dim $\omega - \vec{k}$ space. Indeed, we should probably use scaled wavelet transformations rather than Fourier transforms and also use a conformal group scaled adaptive windowed wavelet analog of the Wigner phase space density built out of Fourier transforms rather than the wavelet transforms based on the translation group of globally flat spacetime. Remember the $\tilde{\rho}_{se^+e^-}(\omega, \vec{k})$ is the Fourier transform of the Bose-Einstein condensate of the centers of mass motions of virtual electron-positron pairs not real ones! Note, that when an electric displacement field \vec{D} is applied in vacuum, the virtual electrons and virtual positrons are accelerated in opposite directions in space, but because they have opposite charges the net virtual currents of equal strength add constructively in the same space direction that is entrained or enslaved by the oscillating vacuum $\vec{D}_{vac} = \epsilon_0 \vec{E}$ field in the absence of any real electric currents. This is my qualitative macro-quantum vacuum picture of why there is a Maxwell displacement current to begin with! It is also satisfying that I also get Einstein's classical curved geometrodynamics field $g_{\mu\nu}(x)$ from modulating the BEC phase $\arg \Psi(x)$ and the quintessence local field $\Lambda(x)$ from modulating the BEC amplitude $|\Psi(x)| = \sqrt{\rho_{s(e^+e^-BEC)}}$ out of this same picture where

$$\rho_{s(e^+e^-BEC)} + \rho_{n(unbounde^+e^-)} = \frac{1}{L_p^3} \tag{2.83}$$

To summarize my new paradigm: In terms of the reality of e+-e-, you can see that I am now saying that the very existence of light, i.e. Maxwell displacement current density is direct proof to the reality of the giant virtual e+-e- Bose Einstein condensate (BEC) that is the generally covariant locally Lorentz invariant "aether" that is the Dirac "substratum" of the macro-world.

Value of $\Lambda = L_p \rho_{n(unbounde^+e^-)}$	Type of vacuum	Type of gravity light shift
$\Lambda = 0$	Non-gravitating	none
$\Lambda > 0$	Anti-gravitating "exotic" i.e., star gates, warp drive	blueshift
$\Lambda < 0$	Gravitating "dark energy"	redshift

⁵⁸ The mass-shell is the pole of the single-particle propagator in the complex energy plane of Feynman's special relativistic renormalizable quantum field theory. Note that a direct quantization of Einstein's general theory of relativity of gravity is not renormalizable. My theory leap frogs over this problem. Gravity is an emergent macro-quantum collective mode that does not need renormalization in the usual sense.

E-mail notes

July 4, 2002

Subject: Re: Torsion, Lorentz & General Covariance in e+-e- BEC Origin of Light

My new macro-quantum PV theory of the unified origin of light, gravity, inertia and quintessence is in accord with the Wheeler-Feynman/Holye-Narlikar idea that the EM field is dynamically redundant i.e. there are only sources with zero proper time contact classical interactions along both future and past light cones (History and Destiny). The forces have no independent meaning apart from the sources that are virtually everywhere and everywhen in two fluid form. The superfluid is a Bose-Einstein condensate of virtual bound state positronium. The normal fluid is ionized positronium plasma. It is only the latter's tiny effect that is computed in orthodox QED.

BTW: This is why I say the Haisch-Rueda-Puthoff (AKA HRP) attempt to implement Andre Sakharov's 1967 idea (see end of MTW) is completely superficial and wrongly conceived. HRP are like Jonathan Swift's Laputan Pundits "To get sunbeams from cucumbers, they've a plan." (Princess Ida, G&S). HRP have the LOL ludicrous idea that they can derive smooth coherent classical geometrodynamical gravity, hence inertia, from ONLY the locally randomly phased virtual transverse polarized zero point photons. That is ridiculous.

1. All gauge bosons are probably dynamically redundant -- Wheeler-Feynman. What we have here really is "forces without forces", i.e. only the (lepto-quark) sources are really fundamental. Call this "sourcery" if you will. ;-)
2. Even if not, the transverse polarized photons are not the complete EM field - it misses the important near induction fields of every day electrical power systems engineering.
3. HRP are completely clueless about the gravitational effects of their zero point EM fluctuations. They simply do not understand what is in Peacock's text "Cosmological Physics" p. 25-6. Puthoff makes a ludicrous hand-waving argument about this among others equally ludicrous that no mainstream relativist takes seriously - and with very good reason I might add.
4. To a good approximation only the virtual positronium sector is important - the other lepto-quarks make tiny corrections.

How to picture the macro-quantum virtually superconducting vacuum meaning of Maxwell's displacement current? My basic idea here is simple. In my new theory, Maxwell's displacement current density that worked and that made the vacuum equations look more symmetrical and that unified electricity with magnetism and light in the first unified field theory of ~ 1864 is an ad-hoc purely classical fudge factor -- an extremely useful and powerful one to be sure.

Re: <http://stardrive.org/Jack/Maxwell.pdf> Note that the bottom line of (2.62) for the effective charge density of the virtual electron-positron vacuum superfluid covariantly

vanishes in all local frames of reference. The basic idea is simple. The apparent vacuum oscillation of the electric displacement field acting like an oscillating vacuum current really is that! It is not an analogy, but is a proportionality! Feynman had a similar epiphany ~ 1940 when he read Dirac's statement that the classical action of a particle along a path segment was analogous to the phase of the quantum wave amplitude for the particle's history along the path to begin and end at the endpoints of the segment.

The seemingly classical permittivity of vacuum and magnetic permeability of vacuum with purely reactive non-dissipative vacuum impedance is from the phase coherent virtual positronium Bose-Einstein Josephson-type supercurrent oscillations in the locally nonrandom macro-quantum phase coherent vacuum. This macro-quantum "Polarized Vacuum" (PV) effect should not be confused with the very tiny micro-quantum PV effects computed by Feynman and Schwinger, e.g. with the Feynman closed electron loop perturbation diagrams. That is only for the locally randomly phased "normal fluid" zero point Heisenberg uncertainty noise from ionized virtual positronium plasma. Indeed, when the effective Wigner phase space density of ionized virtual positronium plasma is negative $\wedge < 0$ that is the "dark energy" that is the missing mass of the universe. On the other hand, when the effective Wigner phase space density of ionized virtual positronium plasma is positive $\wedge > 0$, that is the antigravitating exotic vacuum. The term "exotic matter" is not accurate because this is a macro-quantum vacuum phase. This gives a deeper meaning to why there is light at all? The existence of light is direct experimental evidence for my new macro-quantum e+-e- BEC theory of the vacuum, as is Einstein's gravity and quintessence. This is the power of a new paradigm to organize old knowledge in new ways as well as to predict new amazing mind-boggling stuff!

Also what I say here should not be confused with Puthoff's "PV without PV" theory of gravity.

Dr X (Jack Sarfatti) wrote:

I do this lecture in the style of Valatin Bargmann when I attended his lectures on Group Theory in Quantum Mechanics at Brandeis I think Fall of 60 or maybe Fall of 61. Stan Klein was there. He may remember? Bargmann was visiting from Princeton. I usually use the sarcastic style of Polish mathematician Mark Kac in his Cornell course in mathematical physics that I took. I snoozed through most of both, but something must have sunk in? I have snoozed through lectures by the greatest physics minds of the 20th century when I was a young rascal. :-)

OK I may have spoken too soon. In my attempt to make the new equations completely covariant it looks like I need to put in something that looks like a torsion.

I will only talk about a torsion-like tensor, not Jim Corum's non-tensorial "anholonomic object".

In Yang-Mills non-abelian gauge theory we have in 4-dim

, denotes partial derivative

$$F_{uv} = A_{u,v} - A_{v,u} + T_{uv}{}^z{}_z$$

Where $T_{uv}{}^z{}_z$ is a third rank tensor in spacetime under Diff 4 and also under local Lorentz group after a tetrad map to the local tangent space in accord with EEP.

I proposing something different which has some formal similarities however.

In U(1) EM the "internal" $T_{uv}{}^z{}_z = 0$.

I am proposing, however, in the spirit of the Meissner effect, here it is oscillatory not damped, for U(1) EM internal group, in the approximation of uniform coherent superfluid phase:

$$F_{uv} = A_{u,v} - A_{v,u} = -(2e^2/mc)(N_s(\text{virtual } e^+e^- \text{ BEC})/V)X_{uv}{}^z{}_z$$

Note the torsion-like 3rd-rank tensor $X_{uv}{}^z{}_z$, antisymmetric in the bottom uv indices.

The second pair of Maxwell's equations with sources (Ampere's law with displacement current generating magnetic flux + Gauss's law generating electric flux) is in 4-dim covariant tensor form (globally flat spacetime only):

$*F_{uv},v = *j_u$ (real charges in motion) 3-form version with constitutive "metric-dependent" epsilon dielectric and mu permeability tensors implicit. * is the Hodge star duality operator. This is an equation for 3-forms in 4-dim vector space.

$*j_u$ is a 3-Cartan form 4-vector, i.e. 3-Cartan form first rank Lorentz tensor under, e.g. Poincare group (the only spacetime group in globally flat spacetime).

For example, Ampere's law with displacement current density, in manifestly covariant notation, is

$$*F_{kv},v = *F_{kx},x + *F_{ky},y + *F_{kz},z - *F_{k0},ct = *j_k(\text{real charges in motion})$$

$$k = x, y, z$$

$$\text{Note that } *F_{xx} = *F_{yy} = *F_{zz} = *F_{00} = 0$$

Indeed, in old engineering notation

$$\text{Curl } H = *F_{kx},x + *F_{ky},y + *F_{kz},z$$

$$D,t = *F_{k0},ct$$

I have defined

$$*j_k(\text{virtual } e^+e^- \text{BEC}) = *F_{k0,ct}$$

only for $k = x, y, z$

What happens when $k = 0$?

This is pretty!

$$*j_0(\text{virtual } e^+e^- \text{BEC}) = *F_{00,ct} = *F_{00,0} = 0 \text{ identically!}$$

This rigorously justifies my morning quick and dirty back-of-the-envelope hand-waving upon waking from the UFO ET Abduction Dream School (John Mack, Principal) that Saul-Paul Sirag (from Robert Anton Wilson's "Cosmic Trigger" mind you) writes about in "Contact".

That is I show that the virtual e^+e^- BEC pseudo charge density is EXACTLY ZERO in every local frame of reference both in the local flat tangent space of the Lorentz group

OK I will finish this in detail in <http://stardrive.org/Jack/Maxwell.pdf>

The last part up there now is not correct. I have to make it fully covariant the way I started to do here.

Note in particular, in my new Ansatz:

$$*j_k(\text{virtual } e^+e^- \text{BEC}) = *F_{k0,0} = -(2e^2/mc)[(N_s(\text{virtual } e^+e^- \text{BEC})/V)*X_{k0}^z A_z],_0$$

$$*j_0(\text{virtual } e^+e^- \text{BEC}) = *F_{00,0} = -(2e^2/mc)[(N_s(\text{virtual } e^+e^- \text{BEC})/V)*X_{00}^z A_z],_0 = 0 \text{ identically}$$

With the third rank tensor

Looking suspiciously like a torsion of some kind?

So I take back below not needing torsion. It looks like I need it to combine the macroquantum e^+e^- vacuum origin of light with the superconducting oscillating Meissner effect. Normally the Meissner effect expels magnetic flux, but that is for real superconductors with BECs made out of electron-electron pairs on mass shell, not for macro-quantum vacua with BECs made out of bound states of virtual electron-positron pairs off mass shell.

You can say my macro-quantum vacuum unified origin of light (i.e., real transverse photons on mass shell = light cone here), gravity, quintessence and inertia is based upon a superfluid BEC of virtual positronium. The small normal fluid random noise (that Hal

Puthoff and Bernie Haisch confuse with the whole pie rather than a small piece of the pie) is ionized virtual positronium makes the local quintessent field $\Lambda(x)$ that can be positive (exotic matter with anti-gravity blue shift of real photons detected in our vacuum), or zero -- the vacuum we live in, or negative (dark energy gravitating missing mass with anomalous red shifts of real photons detected in our vacuum). Orthodox QED only calculates the TINY effects of ionized virtual positronium plasma! Also this is scale-dependent in sense of wavelet adaptive windows combined with Wigner phase space densities generalized to reduced density matrices with off-diagonal-matrix elements.

Dr X wrote:

Black Ops Agent Y wrote:

"Jack, I read quickly through the Maxwell.pdf."

Jack replied : Keep updating. It's evolving rapidly. I just uploaded a new 32 page more rigorous version for the superfluid e^+e^- PV vacuum origin of light. Since it is the virtual e^+e^- pairs that macroscopically occupy the same single-particle bound state wave-packet in the center of mass motion that literally creates light as the Maxwell displacement vacuum current density contribution to Ampere's law, it is perfectly obvious that Bernie Haisch's attempt to derive inertia from zero point light is an interesting colossal blunder as is Hal Puthoff's "PV without PV" -- neither of their attempts bring us any closer to Andre Sakharov's 1967 Ansatz. Sakharov's idea requires P. W. Anderson's "More is different" that he announced at UCSD in winter of 1967 -- I was there as a grad student with Greg Benford et-al as described in the novel "Timescape". It was hanging around the Matthias-Frohlich-Anderson crowd that got me thinking about this as I had already done the Goldstone/Jahn-Teller paper with Marshall Stoneham at UKAERE in summer of 1966 that fit PW Anderson's idea. I was also starting to teach at SDSU with Fred Alan Wolf that same year 1967 via George Chapline Jr who later became one of Ed Teller's key people. I need to credit Haisch and Puthoff as providing the "qabalistic resistance" (Carlo Suares Paris, 1973), the impetus without which I would not have stumbled, like one of Arthur Koestler's sleep walkers, onto the real zero point PV unified theory of the origin of light, gravity, inertia and cosmological quintessence. I also must credit Joe Firmage, who in his random shot gun scatter higgledy-piggledy funding of a broad spectrum of good physics (my own) to hilarious Laputan Cargo Cult, e.g. (one of several) "David Hudson inspired "Ormus Powder" from a white powder that was allegedly "high temperature superconducting from deformed high spin nuclei" numbo-jumbo etc. by well known New Age con men, also brought me together with Hal and Bernie and others in an explosive mix whose results now lie before you.

Black Ops Agent Y: "The text in the first part is very clear and descriptive, some of the best I've seen you do. Latter part not as clear to me, at least to my layman's reading."

Jack: That's because I am getting the ideas in real time for the first time as I type them in stream of consciousness Jack Kerouac mode (see Herb Gold's "Bohemia", 1993).⁵⁹ There is also a continual error-correcting code in successive drafts. Now with the Internet future historians of physics will have a detailed map of my creative process such as was not possible before digital computers and the internet. I am basically uploading my mind to the Internet! This is at least conceptual high-tech art of the highest order.⁶⁰

Black Ops Agent Y: "I note the very clear explanation of anholonomic torsion, and the indication of your piqued interest in Corum's work,

Jack: It still looks like Corum's electromagnetic stress propulsion physics⁶¹ will literally not fly because of very recent work by James Woodward⁶² I have seen that is not available yet to public until he publishes it. It's not so much Corum's theory that interests me but it is his access to classified US Black World and his long-term keen interest in both the Tesla Archive in Beograd and the Philadelphia Experiment that Jacques Vallee debunked in Haisch's journal.⁶³ That and the fact that Corum has a hefty piece of the Black Op Federal Pie via Senator Robert Byrd. I am also interested because of what then alleged CIA analyst Robert Dickson Crane⁶⁴ said about Philadelphia Experiment back in 1980 to his daughter, Maiti, when she was my girl friend.

Torsion may be important, but so far I do not really need it.

I take that back. Looks like you were doing precognitive remote-viewing here Al. :-)

⁵⁹ http://www.geometry.net/authors/corso_gregory.php

<http://www.libraries.psu.edu/iasweb/nabokov/colo.htm>

⁶⁰ The human mind is a *local* non-equilibrium pumped open system "Frohlich" BEC mental pilot field order parameter with long-range stable holographic phase coherence in the brain. P W Anderson's "Generalized Phase Rigidity" in "More is different" shows why objections like Max Tegmark's et-al of the hot warm brain do not apply here. Quantum entanglement only plays a small role. Consciousness is generated in the direct post-quantum back-action of brain matter patterns on the intrinsically mental pilot field order parameter. "More is different." Micro-quantum signal locality with micro-quantum passive nonlocality does not apply for macro-quantum non-equilibrium systems that have post-quantum active signal nonlocality violating the micro-quantum no-cloning theorem and upsetting completely the untappable quantum cryptography-teleportation apple cart. This qualitatively explains the brain-mind data of Libet, Radin, Bierman and the RV projects IMO. It's what Roger Penrose was seeing through the glass darkly in his teleology remarks in "The Emperor's New Mind".

⁶¹ <http://www.softwaresearch.org/indexframesflash.html>

⁶² <http://chaos.fullerton.edu/Woodward.html>

⁶³ <http://www.scientificexploration.org/jse/abstracts/v8n1a2.html>

⁶⁴ **DR. ROBERT DICKSON CRANE** grew up in Cambridge, Mass and graduated with B.A. from Northwestern University in 1956 and JD from Harvard in 1959. He was personal adviser to President Nixon and was appointed Deputy Director for Planning in the National Security Council. He served as Ambassador to the United Arab Emirates from 1981 until 1984 when he embraced Islam. He has authored a dozen books and several dozen articles on policy issues. He continues his research on Islam and is leading an effort on how American Muslims can take the true faith of Islam back from extremists. Currently established an organization called CUI which stands for Center for Understanding Islam and its main goal is to counter extremism.

Previously!

Black Ops Agent Y: "But I didn't see where you added torsion back-in after you redefine Maxwell's equations, except for the notation of use of the em field space time tensor.

Jack: Correct, so far I don't need it for anything important that relates to experiment and observation. I may need it later. It's on the back burner.

Black Ops Agent Y: "But I don't see any development of the anholonomic nonintegrable path in the restated Maxwell harmonic oscillator equation or did I miss something?"

Jack: No, it plays no role there.⁶⁵

Black Ops Agent Y: " Reading this reminds me again of the writings of that old German 17th Century German philosopher, Jacob Boehme. He wrote in 1612-24 of the "ungrund," the ungrounded state of nothingness, which is the vacuum. He said that in "ja und nein" everything exists, which I think perhaps could be compared physically to your virtual $e^+ e^-$ pairs in a BEC. Boehme's philosophical system, a theogony the purpose of which to bring forth the conscious and revealed Mind of God, is based on the dialectic. In fact Boehme, prior to Hegel was the first to do so. Basic to this dialectic was the idea of the principle of back action or the reactive or equal but opposite force in the vacuum. In Boehme's dialectic, the attraction in the vacuum between the opposites, i.e. yes and no, or + and -, is the first movement in the vacuum and gives rise to an equal but opposite reaction or repulsion, as the second movement. This repulsive or expansive movement is the antithesis to the attraction of the first movement. The third movement or synthesis of the first two is rotation or torsion, and in Boehme's theogony it is a dynamo of becoming. But it is not a real energy sink or plenum, by itself, and without more leads to nothing and remains only a virtual part of the vacuum state. "

Jack: These guys were simply precognitive remote viewers RV seeing a few hundred years into the future, but not having adequate concepts yet to express what they see in Hal Puthoff should go back to RV work! :-)

Black Ops Agent Y: "Relating this to your Maxwell.pdf, you note that normally the fluid part of the vacuum cannot be used as a vacuum propeller."'⁶⁶

Jack: That's the random normal fluid part of broken virtual e^+e^- ⁶⁷ - a small uncontrollable locally random jiggling⁶⁸ on the stupendous bound state e^+e^- BEC with generalized phase rigidity as explained by P W Anderson in "More is different" and his succeeding papers on that theme.

⁶⁵ Since retracted.

⁶⁶ <http://www.fourmilab.ch/documents/vprop/>

⁶⁷ Ionized virtual positronium plasma physics is what the orthodox quantum electrodynamics of "vacuum polarization" is all about.

⁶⁸ Micro-quantum Heisenberg uncertainty principle noise on the coherent mutable macro-quantum physical vacuum.

Black Ops Agent Y: "Likewise, in Boehme's dialectic the first three movements alone leads to nothing, but sets the stage for a required transition or cross-over function from nothingness to somethingness. This critical transition or crossover is Boehme's fourth movement from which the fifth movement, "light" arises, which Boehme equates to information, also calling this light, a word, from which its antithesis arises, which, instead of "one word", is many words, i.e. a voice, which is the sixth movement, and the synthesis of these is the seventh movement, i.e. the manifest fully conscious and operating Mind of God. The 5th 6th and 7th movements are mirrors of the 1st 2nd and 3rd and thus associated. Point to all of this is that what happens in the vacuum is then reflected in what happens in the macro system, as related by the transitional or cross over function."

Jack: I don't have time to try to understand that number metaphor. It is not really interesting to me because it is not couched in modern math which is the essential language to get to practical metric engineering of Weightless Warp Drive and of Star Gate Time Travel Hyperspace Passageways to "Magonia"⁶⁹, The Many Parallel Brane Universes Next Door of Super Cosmos. It's an archaic tangent for historians of ideas. Getting into that would only slow me down.

Black Ops Agent Y: "You said that if an electric displacement field is applied in the vacuum, virtual e^- and e^+ are accelerated in opposite directions, and since have opposite charges, net virtual currents of equal strength add constructively in the same space direction required by the oscillating vacuum field, all in the absence of any real electric current. As I understood this, and please correct any misunderstanding, what happens in the vacuum then results in the macro-quantum vacuum picture of why there is a real Maxwell displacement current, and thus why there are real photons on the mass shell. But, quite frankly this part is not clear to me."

Jack: Yes, that's the idea. The basic intuitive idea is immediate. What else can Maxwell's $\partial \vec{D} / \partial t$ be sitting out there lonely all by itself in the nothingness of the delusion of classical vacuum? I mean one can take the pragmatic "Don't ask questions about reality!" Bohr Smoky Dragon POV and just let it hang there as a formal device that symmetrizes Maxwell's vacuum equations and demands special relativity. Or, like Einstein's pre-quantum objective thinking, one can posit that \vec{D} is a piece of a real objective field. Or one can look deeper as I did. There is no naïve classical limit of anything. There is only the macro-quantum limit that in first approximation looks like a classical limit. This is the deep meaning of P.W. Anderson's "More is different." Though he may not agree? The fact that I also get gravity and quintessence from the same picture in which the gauge sources are more fundamental than the gauge forces (as in Wheeler-Feynman BTW) is conclusive in my book. This is a simple, elegant, powerful surprising synthesis into a really new physics paradigm that never ceases to amaze me daily with new interesting

⁶⁹ Jacques Vallee <http://ufoinfo.com/magonia/>
http://www.amazon.com/exec/obidos/tg/stores/detail/-/books/0809237962/reader/1/ref=lib_dp_TFCV/102-6986163-8175355#reader-link

surprises. I simply do The Will of Allah and receive “Tauhid” messages from The Gods on The Wind of The Lion of Judah. :-) If you catch my drift? ☺

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

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

Black Ops Agent Y: “What I also don't see yet is what happens in the virtual $e^- e^+$ BEC and in the macro system when anholonomic torsion is applied to your restated Maxwell harmonic oscillator equations? I still think intuitively that Gabriel Kron was right, the anholonomic object is important to this and, as Kron said repeatedly, it is always a geometrical object.”

Jack: Maybe. We will see. Rome was not built in a day. And even God needed six days so they say. :-)