Anholonomic Electrodynamics

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DRAFT # 6C
UNDER CONSTRUCTION

"Sylvester (1876) ... described as an astonishing intellectual phenomenon, the fact that general statements are simpler than their particular cases .... a mathematical idea should not be petrified in a formalized axiomatic setting, but should be considered as flowing as a river. One should always be ready to change the axioms, preserving the informal idea .... The possibility of such informal generalization of all mathematics, for which we have no ready axioms, seems to me the most appealing dream ... Mistakes are an important and instructive part of mathematics, perhaps as important a part as the proofs. Proofs are to mathematics what spelling (or even calligraphy) is to poetry. Mathematical works do consist of proofs, just as poems do consist of characters... I would be able to provide dozens of more recent examples of mistakes in celebrated papers if I did not fear for my life." V. I. Arnold

"Make physics as simple as possible, but not simpler." Einstein

Abstract

The anholonomic inertial field comes from the unseen dimensions of the folded dynamic 3D universe embedded, in the sense of M-theory, into 11D hyperspace-time.[2] Einstein's intrinsic curvature field explains gravity inside 4D space-time geometry. Einstein's equivalence principle extends from 4D spacetime to 11D hyperspace-time. Just as a gravitational field on the surface of the Earth is locally equivalent to a linear acceleration, so too, an anholonomic field is locally equivalent to space-space rotations and space-time boosts. That is, I start from making Einstein's equivalence principle universal. Einstein's equivalence principle comes from the generalized action-reaction principle[3] that applies both to classical topological-geometrodynamics and to quantum theory equally. Connections with experiments are made.

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[2] August 2000, Scientific American, the specific number 11D is not essential.
[3] "You cannot touch without being touched." Paul Hewett

James Corum's equation[4] for the topology-changing[5] anholonomically constrained Maxwell electromagnetic field is

$$F^{\mu\nu} = \frac{\partial}{\partial x^{\mu}} A^{\nu} - \frac{\partial}{\partial x^{\nu}} A^{\mu} + 2\Omega^{\mu\nu}_{\lambda} A^{\lambda} \tag{1.1}$$

$$\Omega^{\mu\nu}_{\lambda} = \frac{1}{2}\left(\Gamma^{\mu\nu}_{\lambda} - \Gamma^{\nu\mu}_{\lambda}\right) = \Gamma^{[\mu\nu]}_{\lambda} \tag{1.2}$$

The electric 4-current J^{μ} is

$$J^{\mu} = \left(\frac{c}{4\pi}\right)\nabla_{\nu} F^{\mu\nu} \tag{1.3}$$

The covariant derivative is ∇_{μ} relative to the connection $\Gamma^{\lambda}_{\mu\nu}$. The 3D space part of (1.1) to (1.3) is the anholonomic field generalization to the classical vacuum of Ampere's law for the generation of magnetic field by both a real material current and the Maxwell displacement current from a time-changing electric **D** field. The time part of (1.3) is the anholonomic generalization of Gauss's law for the electric flux emanating from a net charge distribution. The orthodox sourceless Maxwell equations, before the new anholonomic field corrections of (1.1), corresponding to Faraday's law of electric induction from time-changing magnetic fields and the lack of divergence[6] of the magnetic flux from a magnetic monopole come from

$$F^{[\mu\nu;\lambda]} = 0 \tag{1.4}$$

where

$$;\lambda = \nabla_{\lambda} \tag{1.5}$$

[…] means antisymmetrize the indices.[7] That is

[4] Relativistic rotation and the anholonomic object, J. Math. Phys. 18(4), p. 770, 1977, Relativistic covariance and rotational electrodynamics, J. Math. Phys. 21(9), p. 2360, 1980

[5] In the sense of H. Kleinert and V.I. Arnold breaking of global 1-1 topology-conserving diffeomorphism symmetry. R. Kiehn says this requires Pffafian dimension 4.

[6] The anholonomic field creates both electric monopole and magnetic monopole classical vacuum polarization.

[7] This same formula also applies to many- (identical) particle quantum wave functions in configuration space in addition to this classical limit to ordinary 4D space-time. Ref: Herman Weyl, "Theory of Groups in Quantum Mechanics" (Dover).

$$T_{[\mu_1 \ldots \mu_n]} = \left(\frac{1}{n!}\right)\sum_{P=1}^{n!}\left(-1\right)^{\sigma(P)} P\left(T_{\mu_1 \ldots \mu_n}\right) \tag{1.6}$$

Where $\sigma(P)$ is the signature of the permutation P, similarly for the symmetrized objects without the power of –1. Local conservation of electric current[8] is

$$\nabla_\mu J^\mu = 0 \tag{1.7}$$

Eq. (1.1) with (1.7) *in a special case* gives Bo Lehnert's[9] classical vacuum polarization phenomenological equation

$$J^\mu_{vac} = \bar{\rho}_{vac}\left(C, ic\right) = \varepsilon_o \vec{\nabla} \cdot \vec{E}_{vac}\left(C, ic\right) \tag{1.8}$$

This equation, seen here to be a consequence of the anholonomic field from the unseen dimensions of hyperspace,[10] explains anomalous laboratory scale experimental data. Eq. (1.1) also explains the astrophysical data called the Blackett Effect on the appearance of a magnetic moment from rotating neutral masses.[11]

$$\nabla_\nu F^{\mu\nu} = \frac{\partial F^{\mu\nu}}{\partial x^\nu} + \Gamma^\mu_{\kappa\nu} F^{\kappa\nu} + \Gamma^\nu_{\kappa\nu} F^{\mu\kappa} \tag{1.9}$$

$$\Gamma^\lambda_{\mu\nu} = \Gamma^\lambda_{(\mu\nu)} + \Omega^\lambda_{\mu\nu} \tag{1.10}$$

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[8] This constrains the electromagnetic 4-potential in terms of the anholonomic field. That is, an anholonomic field, in the absence of real material charges generates both a 4-potential and an EM field.
[9] "New Developments in Electromagnetic Field Theory" ISSO Vigier 2000, University of California, Berkeley: e.g. Goos-Hanchen displacement of totally reflected light beam max at || polarization with quantized two-valued splitting analogous to Stern-Gerlach splitting; violation of Fresnel laws of reflection and refraction at boundary of dissipative medium with classical vacuum; Sagnac effect in rotating interferometers with counter-rotating beams; superluminal X S-waves; Planck law consistency etc. all as lab scale anholonomic field corrections? This is independent of Shipov's "Tolchin inertoid" claims attacked by V. A. Rubakov of the Russian Academy of Sciences in Uspekhi, 43(3) 309 (2000).
"Far from suspecting an error in his arguments [Gennady Shipov] … presents 'experimental evidence' of momentum-nonconservation in mechanics and then (pp.295, 296) draws a glowing picture of travelling by a new type of conveyance equipped with a 'torsion propelling device': such a vehicle 'will have no wheels, wings, propellers, jets, screws, or any other devices' and thus will need no 'engine starters. Runways, airports'…"
[10] Arnold Sommerfeld's "Mechanics", anholonomic constraints come from finite motions in a larger configuration space with non-integrable constraints confining the motion to the infinitesimal motions on a subspace with an effective non-Riemannian differential geometry. Similar results from Gabriel Kron cited by James Corum and, independently, by Cornelius Lanczos "Variational Principles of Mechanics" (Dover) and V.I. Arnold.
[11] Saul-Paul Sirag

$$\begin{aligned}\nabla_{\nu}F^{\mu\nu} &= \frac{\partial}{\partial x^{\nu}}\left(\frac{\partial}{\partial x^{\mu}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\mu} + 2\Omega^{\mu\nu}_{\lambda}A^{\lambda}\right) \\ &+\Gamma^{\mu}_{\kappa\nu}\left(\frac{\partial}{\partial x^{\kappa}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\kappa} + 2\Omega^{\kappa\nu}_{\lambda}A^{\lambda}\right) \\ &+\Gamma^{\nu}_{\kappa\nu}\left(\frac{\partial}{\partial x^{\nu}}A^{\kappa} - \frac{\partial}{\partial x^{\kappa}}A^{\mu} + 2\Omega^{\mu\kappa}_{\lambda}A^{\lambda}\right)\end{aligned} \tag{1.11}$$

$$\begin{aligned}\nabla_{\nu}F^{\mu\nu} &= \frac{\partial}{\partial x^{\nu}}\left(\frac{\partial}{\partial x^{\mu}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\mu} + 2\Omega^{\mu\nu}_{\lambda}A^{\lambda}\right) \\ &+\left(\Gamma^{\mu}_{(\kappa\nu)} + \Omega^{\mu}_{\kappa\nu}\right)\left(\frac{\partial}{\partial x^{\kappa}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\kappa} + 2\Omega^{\kappa\nu}_{\lambda}A^{\lambda}\right) \\ &+\left(\Gamma^{\nu}_{(\kappa\nu)} + \Omega^{\nu}_{\kappa\nu}\right)\left(\frac{\partial}{\partial x^{\nu}}A^{\kappa} - \frac{\partial}{\partial x^{\kappa}}A^{\mu} + 2\Omega^{\mu\kappa}_{\lambda}A^{\lambda}\right)\end{aligned} \tag{1.12}$$

Note the cross-term coupling $2\Gamma^{\mu}_{(\kappa\nu)}\Omega^{\kappa\nu}_{\lambda}A^{\lambda}$, for example, between the symmetric and the antisymmetric parts of the connection field $\Gamma^{\lambda}_{\mu\nu}$. Inhomogeneities in the symmetric part of the connection field give the curvature of 4D space-time that Einstein showed was the classical gravitational field. Imagine a closed world line in space-time, the holonomic symmetric part of the connection is single-valued and parallel transports a vector so that upon its return to its starting event, it has undergone a relative rotation. In contrast, the anholonomic antisymmetric part of the connection field is multi-valued. Imagine the 4D geometry folded on itself in a higher dimensional hyperspace like a crinkled quilt on your bed. These folds are Rene Thom catastrophes described most powerfully by V. I. Arnold's "singularity theory".[12] The result of the folding of the space-time geometry by the anholonomic constraint field from hyperspace is a translational gap that is similar to the bosonic space-time displacement from successive supersymmetry transformations in the fermionic sector of 8D superspace. This property of the anholonomic constraints on the unseen dimensions of the universe[13], to make the dynamic differential motions in the 3D membrane we live inside of as Flatlanders, is the basis for propellantless propulsion and traversable wormhole engineering. Another way to look at this[14] is local nontriviality of the SO(1,3) principal fiber with the T4 base, so that, for example, the commutator of 3D space rotation infinitesimal generators M_{ij} with 3D space translation infinitesimal generators P^{μ} fails to commute because of the anholonomic constraint field Ω^{μ}_{ij}.[15]

[12] Not the same as the Hawking-Penrose big bang and black hole singularities.
[13] August 2000, Scientific American
[14] As in the theory of Gennady Shipov.
[15] Important clarification from ISSO Science Pow Wow today 8/29/00

Re: Shipov-Tolchin Inertoid Machine

I suggested in both the ISSO Torsion Workshop and Vigier 2000 that the essential mechanical criterion for propellantless propulsion is

$$[P^{\lambda}{}_{cm}, J_{\mu\nu}] = \Omega_{\mu\nu}{}^{\lambda} = \text{Anholonomic field object}$$

Where $P^{\lambda}{}_{cm}$ is the 4-momentum generator of infinitesimal translations of the CENTER OF MASS of an extended rigid many-particle system, and $J_{\mu\nu}$are the three angular momentum generators RELATIVE TO THE CENTER OF MASS. J_{xy} generates a clockwise rotation about BODY-FIXED z axis (J_{yx} generates counter-clockwise rotation around body-fixed z), J_{zx} generates rotation around body-fixed y axis and J_{yz} around body fixed x axis etc. For N particles (Galilean relativity good enough for the Shipov-Tolchin inertoid)

$$R_{cm} = (\Sigma_{j=1}{}^{N} m_j R_j) / (\Sigma_{j=1}{}^{N} m_j)$$

Define the relative body-fixed coordinates to be $r_j = R_j - R_{cm}$ The total orbital angular momentum is then

$$L = \Sigma_{j=1}{}^{N} m_j r_j \times dr_j/dt \rightarrow \Sigma_{j=1}{}^{N} (h/i)\, r_j \times d/dr_j$$

Note that the 3D space part of $P^{\lambda}{}_{cm}$ is $\mathbf{P_{cm}}$ which is canonically conjugate to R_{cm}. In quantum notation

$$P_{cm} = (h/i)\, d/dR_{cm}$$

Therefore,

$$[P_{cm}, L] = 0$$

because

$$[d/dRcm, rj] = 0$$

and

$$[d/dRcm, d/drj] = 0$$

This clarifies a formal paradox, since if we do not make the split into CM and the relative body-fixed coordinates one has a phony translational-rotational coupling in ordinary physics sans the anholonomic field, i.e. looking at the Lie algebra of the Galilean group (Poincare group same story in this regard). For example,

$$[p_{\mu}, J_{\nu}] = i\, \varepsilon_{\mu\nu\lambda}\, p^{\lambda}$$

e.g. p. 9 "Particles, Sources and Fields" Julian Schwinger, 1970

That is, in general the commutators of the translational generators with the spacetime rotations (in both Galilean and Poincare group in flat space-time) do not commute in

$$\left[M_{ij}^{rel}, P_{cm}^{\mu}\right] = \Omega_{ij}^{\mu} \tag{1.13}$$

Where the space-space parts of M_{ij}^{rel} form the orbital angular momentum generators canonically conjugate to rotation angles about body-fixed axes passing through the center of mass of the material object. P_{cm}^{μ} is the 4-momentum generator of the center of mass canonically conjugate to the space-time displacement of the center of mass. The commutator (1.13) should not be confused with the standard non-vanishing commutator between linear and angular momentum in the Poincare group algebra. That commutator is written relative to a Lab frame whose origin is external to the extended material system whose motion we are describing. There is no separation of the center of mass displacement from the relative body-fixed coordinate frame in that case.

Local current conservation (1.7) gives an additional constraint.

$$\frac{\partial}{\partial x^{\mu}}\left(\frac{\partial}{\partial x^{\nu}}\left(\frac{\partial}{\partial x^{\mu}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\mu} + 2\Omega_{\lambda}^{\mu\nu}A^{\lambda}\right)\right)$$
$$+\left(\Gamma_{(\kappa\mu)}^{\mu} + \Omega_{\kappa\mu}^{\mu}\right)\left\{\begin{array}{l}\frac{\partial}{\partial x^{\nu}}\left(\frac{\partial}{\partial x^{\kappa}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\kappa} + 2\Omega_{\lambda}^{\kappa\nu}A^{\lambda}\right) \\ +\left(\Gamma_{(\eta\nu)}^{\kappa} + \Omega_{\eta\nu}^{\kappa}\right)\left(\frac{\partial}{\partial x^{\eta}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A^{\eta} + 2\Omega_{\lambda}^{\eta\nu}A^{\lambda}\right) \\ +\left(\Gamma_{(\eta\nu)}^{\nu} + \Omega_{\eta\nu}^{\nu}\right)\left(\frac{\partial}{\partial x^{\kappa}}A^{\eta} - \frac{\partial}{\partial x^{\eta}}A^{\kappa} + 2\Omega_{\lambda}^{\kappa\eta}A^{\lambda}\right)\end{array}\right\} = 0$$

(1.14)

Let's take the simplest case of a spatially uniform static electromagnetic 4-potential. Equation (1.1) for the anholonomically induced electromagnetic field is

$$F^{\mu\nu} \to 2\Omega_{\lambda}^{\mu\nu}A^{\lambda} \tag{1.15}$$

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ordinary classical and quantum physics. This, in itself, does NOT imply a violation of Newton's Third Law of Action-Reaction from 3D translational symmetry. This is because if you separate out the motion of the center of mass from the body fixed coordinates relative to that center of mass, there will be commutation UNLESS there is the anholonomic constraint field from hyperspace intervening to allow the "vacuum propeller effect" of APPARENT self-acceleration of the center of mass in the absence of external forces. That is a whole new ball game. In fact, the action-reaction principle is obeyed at the higher symmetry level because the propellantless anholonomic constraint warp-drive mechanism is pushing against the "unseen dimensions of the universe" (Aug 2000 Scientific American).

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Eq. (1.3) for the superconducting "Meissner" vacuum current, corresponding to Vigier's rest mass of the photon, is

$$J^{\mu} = \left(\frac{c}{2\pi}\right)\nabla_{\nu}\Omega^{\mu\nu}_{\lambda}A^{\lambda} \tag{1.16}$$

Eq. (1.14) for current conservation simplifies to

$$\begin{aligned}&\frac{\partial}{\partial x^{\mu}}\left(\frac{\partial}{\partial x^{\nu}}\left(2\Omega^{\mu\nu}_{\lambda}A^{\lambda}\right)\right)\\&+\left(\Gamma^{\mu}_{(\kappa\mu)}+\Omega^{\mu}_{\kappa\mu}\right)\left\{\begin{matrix}\frac{\partial}{\partial x^{\nu}}\left(2\Omega^{\kappa\nu}_{\lambda}A^{\lambda}\right)\\+\left(\Gamma^{\kappa}_{(\eta\nu)}+\Omega^{\kappa}_{\eta\nu}\right)\left(2\Omega^{\eta\nu}_{\lambda}A^{\lambda}\right)\\+\left(\Gamma^{\nu}_{(\eta\nu)}+\Omega^{\nu}_{\eta\nu}\right)\left(2\Omega^{\kappa\eta}_{\lambda}A^{\lambda}\right)\end{matrix}\right\}=0\end{aligned} \tag{1.17}$$

Note that all the derivatives operate only on the anholonomic field. Therefore, I wistfully conjecture[16] that we have here a self-consistent classical analog of spontaneous broken gauge symmetry, but with a conserved local current, in which the electromagnetic order parameter A^{μ} is determined from the anholonomic field $\Omega^{\lambda}_{\mu\nu}$ alone. To simplify further, suppose we can ignore the gravity field in the single-valued topology-conserving symmetric holonomic connection field $\Gamma^{\lambda}_{(\mu\nu)}$.

$$\begin{aligned}&\frac{\partial}{\partial x^{\mu}}\left(\frac{\partial}{\partial x^{\nu}}\left(2\Omega^{\mu\nu}_{\lambda}A^{\lambda}\right)\right)\\&+\left(\Omega^{\mu}_{\kappa\mu}\right)\left\{\begin{matrix}\frac{\partial}{\partial x^{\nu}}\left(2\Omega^{\kappa\nu}_{\lambda}A^{\lambda}\right)\\+\left(\Omega^{\kappa}_{\eta\nu}\right)\left(2\Omega^{\eta\nu}_{\lambda}A^{\lambda}\right)\\+\left(\Omega^{\nu}_{\eta\nu}\right)\left(2\Omega^{\kappa\eta}_{\lambda}A^{\lambda}\right)\end{matrix}\right\}=0\end{aligned} \tag{1.18}$$

The simplest case of all is to forget, as a first approximation over a small enough scale, the gradients of the anholonomic field so that

[16] In qualitative agreement with Gennady Shipov's conjecture.

$$\left(\Omega^{\mu}_{\kappa\mu}\right)\left\{\left(\Omega^{\kappa}_{\eta\nu}\right)\left(2\Omega^{\eta\nu}_{\lambda}A^{\lambda}\right)+\left(\Omega^{\nu}_{\eta\nu}\right)\left(2\Omega^{\kappa\eta}_{\lambda}A^{\lambda}\right)\right\}\approx 0 \qquad (1.19)$$

The simplest case is azimuthal symmetry[17] where there are only 6 nonvanishing *kinematical* anholonomic field components. The pure space axes are 1 and 3. Axes 2 and 4 are mixed space-time axes[18]. They are

$$\begin{aligned}\Omega^{2}_{12} &= -\Omega^{2}_{21} = \frac{\gamma^2 r\omega^2}{2c^2}\\ \Omega^{4}_{12} &= -\Omega^{4}_{21} = \frac{\gamma^2 r\omega}{c}\\ \Omega^{4}_{41} &= -\Omega^{4}_{14} = \frac{\gamma^2 r\omega^2}{2c^2}\end{aligned} \qquad (1.20)$$

Where

$$\gamma = \frac{1}{\sqrt{1-\frac{r^2\omega^2}{c^2}}} \qquad (1.21)$$

However, there are no uniform static axisymmetric broken symmetry solutions that obey local current conservation. The next simplest case is spherical symmetry with 12 nonvanishing *kinematical* anholonomic field components.

[17] Corum op-cit
[18] (1.24) below

$$
\begin{aligned}
\Omega^3_{13} &= -\Omega^3_{31} = \left(\frac{1}{2}\right)\frac{\gamma^2 r\omega^2 \sin^2\theta}{c^2} \\
\Omega^3_{23} &= -\Omega^3_{32} = \left(\frac{1}{2}\right)\frac{\gamma^2 r^2\omega^2 \sin\theta\cos\theta}{c^2} \\
\Omega^4_{41} &= -\Omega^4_{14} = \left(\frac{1}{2}\right)\frac{\gamma^2 r\omega^2 \sin^2\theta}{c^2} \\
\Omega^4_{42} &= -\Omega^4_{24} = \left(\frac{1}{2}\right)\frac{\gamma^2 r^2\omega^2 \sin\theta\cos\theta}{c^2} \\
\Omega^4_{31} &= -\Omega^4_{13} = \gamma^2 \frac{r\omega \sin^2\theta}{c} \\
\Omega^4_{32} &= -\Omega^4_{23} = \gamma^2 \frac{r^2\omega \sin\theta\cos\theta}{c}
\end{aligned}
\tag{1.22}
$$

$$
\gamma = \frac{1}{\sqrt{1 - \frac{r^2\omega^2\sin^2\theta}{c^2}}} \tag{1.23}
$$

The indices 1,2,3,4 are relative to a special anholonomic local Cartan frame[19] set of 4 orthogonal vector basis fields $\vec{e}_\mu$ for the tangent space fibers extending over the entire space. These vector fields have 4D vorticity so that there are no integrable path-independent global holonomic coordinates covering the entire space-time 4-geometry. Einstein's "vierbeins" are a special case. Although there are no single-valued global holonomic coordinates for the 4 vierbein vector fields, the vector fields themselves are integrable and single-valued. In contrast, Kleinert's "super-tetrads" have the further property of being multiply valued nonintegrable. So, we have to see if the helical Corum tetrads for the indices 1,2,3,4 are single-valued vierbeins or multiply valued super-tetrads? Corum wrote:

"One may obtain a field of orthogonal frames by letting the helical world line of the rotating observer provide the timelike direction and then construct orthogonal spatial vectors from the formulas of Frenet and Serret. The result is the field of frames"[20]

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[19] Corum

[20] Think of r as a small displacement from the common instantaneous local contact origin of the helical super-tetrads with the inertial frame of vierbeins connected by (1.25). The helical frame and the inertial frame are in arbitrary relative rotation and arbitrary relative translational motion.

$$\begin{aligned}\vec{e}_{r'} &= \frac{\partial}{\partial r}\\ \vec{e}_{\theta'} &= \gamma\frac{\partial}{\partial \theta} + \frac{\gamma r^2 \omega}{c}\frac{\partial}{\partial t}\\ \vec{e}_{z'} &= \frac{\partial}{\partial z}\\ \vec{e}_{t'} &= \frac{\gamma}{c}\frac{\partial}{\partial t} + \frac{\gamma\omega}{c^2}\frac{\partial}{\partial \theta}\end{aligned} \tag{1.24}$$

This is a Lorentz boost[21] in the $\theta - t$ plane in the cylindrical curvilinear pseudo-coordinates where multi-valued θ is an anholonomic non-coordinate. Corum continues:

"These are orthogonal and at every space-time event they are related to the natural basis vectors of the inertial observer by a Lorentz-like transformation (an 'instantaneous' Lorentz transformation). That is,"

$$h_a^{\mu} = \begin{matrix} 1 & 0 & 0 & 0 \\ 0 & \gamma & 0 & \gamma\omega/c \\ 0 & 0 & 1 & 0 \\ 0 & \gamma r^2\omega/c & 0 & \gamma \end{matrix} \tag{1.25}$$

Latin indices for instantaneous local inertial "Lab observer"[22], Greek indices for "moving" observer.

The local Lorentz transformation between the Lab vierbeins $\vec{e}_a$ and the Corum helical tetrads $\vec{e}_{\mu}$ is

$$\vec{e}_a = h_a^{\mu}\vec{e}_{\mu} \tag{1.26}$$

The anholonomic Lie algebra for the Corum helical tetrads is

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[21] rotation through imaginary angle i.e., "rapidity"

[22] In axisymmetric cylindrical coordinates. The inertial Lab observer can be, *but need not be*, "geodesic" in which both gravity and anholonomic fields are zero at a point. For vierbeins there are tidal effects, for supertetrads there are no tidal effects to second order. That is both first and second derivatives of the metric field vanish for multiple-valued super-tetrads generated in active topology-changing defect creating and destroying transformations as shown by Kleinert. How to physically engineer machines to generate these space-time dislocations is what we are aiming for at ISSO.

$$\left[\vec{e}_\mu,\vec{e}_\nu\right]=\Omega^{\lambda}_{\mu\nu}\vec{e}_\lambda \tag{1.27}$$

The dual 1-forms $\tilde{\omega}^{\mu}$[23] are

$$\begin{aligned}\tilde{\omega}^1&=dr\\ \tilde{\omega}^2&=\gamma\left(d\theta-\omega dt\right)\\ \tilde{\omega}^3&=dz\\ \tilde{\omega}^4&=\gamma c\left(dt-\frac{r^2\omega}{c^2}d\theta\right)\end{aligned} \tag{1.28}$$

The corresponding 1 forms for the inertial Lab observer are $\tilde{\sigma}^a$

$$\tilde{\sigma}^a=h^a_\mu\tilde{\omega}^\mu \tag{1.29}$$

The anholonomic field $\Omega^{\lambda}_{\mu\nu}$ transforms as a 3rd rank tensor under Einstein's locally single-valued holonomic topology-conserving homeomorphic "general coordinate transformations"[24]

$$x^{\mu'}=x^{\mu'}\left(x^\mu\right) \tag{1.30}$$

With the corresponding multi-linear transformation coefficients

$$E^{\mu'}_{\mu}=\frac{\partial x^{\mu'}}{\partial x^\mu} \tag{1.31}$$

When (1.31) is true, we have $dx^{\mu'}$ as an integrable exact differential

$$dx^{\mu'}=\frac{\partial x^{\mu'}}{\partial x^\mu}dx^\mu \tag{1.32}$$

Whose dual tangent vectors are the natural holonomic bases $\frac{\partial}{\partial x^{\mu'}}$. (1.30) fails both for Einstein's vierbeins and Kleinert's super-tetrads. That is, both have "vorticity" in first order[25]

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[23] Not to be confused with the rotation field ω that like the translational acceleration field is virtual in the classical geometrodynamical vacuum structure in the sense of Einstein's equivalence principle.
[24] diffeomorphisms
[25] anholonomic non-coordinates

$$\begin{aligned}\partial_a\tilde{\sigma}^b - \partial_b\tilde{\sigma}^a \neq 0\\ \partial_\mu\tilde{\omega}^\nu - \partial_\nu\tilde{\omega}^\mu \neq 0\end{aligned} \tag{1.33}$$

They differ in their integrability in second order

$$\begin{aligned}\left(\partial_a\partial_b - \partial_b\partial_a\right)\tilde{\sigma}^c = 0\\ \left(\partial_\mu\partial_\nu - \partial_\nu\partial_\mu\right)\tilde{\omega}^\lambda \neq 0?\end{aligned} \tag{1.34}$$

(1.34) is only to illustrate the conceptual difference between single-valued integrable Einstein vierbeins and the multiply-valued Kleinert super-tetrads. (1.28) shows that Corum's helical tetrads are super-tetrads in Kleinert's sense. That is, physical machines that generate anholonomic constraint fields from M-theory hyperspace-time are active topology-changing Kleinert transformations creating and destroying space-time defects of the dislocation type corresponding to traversable wormholes connecting nearby sections of folded 3D membranes.

The anholonomic field $\Omega^\lambda_{\mu\nu}$ does transform homogeneously as a third rank tensor under Einstein's single-valued general coordinate transformation (1.31)

$$\Omega^{\lambda'}_{\mu'\nu'} = \frac{\partial x^{\lambda'}}{\partial x^\lambda}\frac{\partial x^\mu}{\partial x^{\mu'}}\frac{\partial x^\nu}{\partial x^{\nu'}}\Omega^\lambda_{\mu\nu} \tag{1.35}$$

Therefore from that much too narrow orthodox perspective it has "physical reality" under Diff(4). In contrast, $\Omega^\lambda_{\mu\nu}$ transforms inhomogeneously as a connection under the local Lorentz like transformation of (1.25) between the Corum tetrads and the local instantaneous inertial frames.

$$\Omega^c_{ab} = h^c_\lambda h^\mu_a h^\nu_b \Omega^\lambda_{\mu\nu} - h^\mu_a h^\nu_b \partial_\mu h^c_\nu \tag{1.36}$$

The "geodesic" instantaneous local inertial frame is then the one for which

$$\Omega^c_{ab} = 0 \tag{1.37}$$

From (1.15) the approximate anholonomic induced electromagnetic field for azimuthal symmetry from (1.20) is

$$F^{12} \to 2\Omega^{12}_{2} A^{2} + 2\Omega^{12}_{4} A^{4}$$
$$F^{14} \to 2\Omega^{14}_{4} A^{4} \qquad (1.38)$$

The 12 component is a magnetic field and the 14 component is an electric field. We need to discuss gauge phase invariance in addition to the local current conservation equation (1.7) and (1.14). This suggests replacing A^{λ} by

$$A^{\lambda} \to -g_n c P^{\lambda} + A^{\lambda}$$
$$g_n = \frac{2\pi n}{e} \qquad (1.39)$$
$$n = 0,1,2,3...$$

Which suggests an effective anholonomic magnetic charge g for neutral matter as in the Blackett astrophysical phenomenon studied by Saul-Paul Sirag.[26] "Gravitational Magnetism" is a misnomer. What we are seeing is anholonomic field magnetism generated by neutral matter in motion. The matter is not electrically or magnetically charged in the usual sense. We are also seeing anholonomic field effects in the several anomalous electromagnetic phenomena noted by Bo Lehnert. These anholonomically induced electromagnetic field effects from hyperspace-time are not weak like gravity and will, I suspect, have profound technological impact on the economy of this planet in the not too distant future.

The stress-energy tensor of the electromagnetic field is often cited to be

$$T^{\mu\nu} = \frac{1}{4\pi}\left(F^{\mu\alpha} F^{\nu}_{\alpha} - \frac{1}{4} g^{\mu\nu} F_{\alpha\beta} F^{\alpha\beta} \right) \qquad (1.40)$$

However, this may not really be correct since the general form of the canonical energy momentum stress tensor need not be symmetric. For example,[27]

$$T^{\mu\nu} = -\frac{\partial L}{\partial\left(\partial_{\nu}\phi\right)} \partial^{\mu}\phi + g^{\mu\nu} L \qquad (1.41)$$

The first term on the RHS need not be symmetric for the general classical relativistic field ϕ where L is the field Lagrangian. The anholonomic constraints from hyperspace-time are not included in (1.41). A fudge factor $\Theta^{\mu\nu}$ is added adhoc to (1.41) and the sum

[26] "Gravitational Magnetism", Nature, Vol 278, p.535, April, 1979.
[27] P. 93, "Geometry, Particles, and Fields" Bjorn Felsager (Springer, 1998)

is called "the true energy-momentum tensor". One reason for doing this is that rotational symmetry is violated if you do not do it. There is no compensating anholonomic field.

Nevertheless, to start with (1.40) with this caveat subsitute (1.1) with the anholonomic field correction to get

$$T^{\mu\nu} = \frac{1}{4\pi}\left(\begin{array}{l}\left(\frac{\partial}{\partial x^{\mu}}A^{\alpha} - \frac{\partial}{\partial x^{\alpha}}A^{\mu} + 2\Omega^{\mu\alpha}_{\lambda}A^{\lambda}\right)\left(\frac{\partial}{\partial x^{\alpha}}A^{\nu} - \frac{\partial}{\partial x^{\nu}}A_{\alpha} + 2\Omega^{\nu}_{\lambda\alpha}A^{\lambda}\right) \\ -\frac{1}{4}g^{\mu\nu}\left(\frac{\partial}{\partial x^{\alpha}}A_{\beta} - \frac{\partial}{\partial x^{\beta}}A_{\alpha} + 2\Omega^{\lambda}_{\alpha\beta}A_{\lambda}\right)\left(\frac{\partial}{\partial x^{\alpha}}A^{\beta} - \frac{\partial}{\partial x^{\beta}}A^{\alpha} + 2\Omega^{\alpha\beta}_{\lambda}A^{\lambda}\right)\end{array}\right) \tag{1.42}$$

Look at some of the new terms in anholonomic corrected local stress-energy tensor of the "vacuum electromagnetic field" in the absence of material charges. For example, for azimuthal symmetry

$$\begin{aligned}&2\Omega^{\mu\alpha}_{\lambda}A^{\lambda}\frac{\partial}{\partial x^{\alpha}}A^{\nu} \\ &= 2\Omega^{\mu 1}_{\lambda}A^{\lambda}\frac{\partial}{\partial x^{1}}A^{\nu} + 2\Omega^{\mu 2}_{\lambda}A^{\lambda}\frac{\partial}{\partial x^{2}}A^{\nu} + 2\Omega^{\mu 4}_{\lambda}A^{\lambda}\frac{\partial}{\partial x^{4}}A^{\nu} \\ &= 2\Omega^{\mu 1}_{2}A^{2}\frac{\partial}{\partial x^{1}}A^{\nu} + 2\Omega^{\mu 1}_{4}A^{4}\frac{\partial}{\partial x^{1}}A^{\nu} + 2\Omega^{\mu 2}_{2}A^{2}\frac{\partial}{\partial x^{2}}A^{\nu} \\ &+ 2\Omega^{\mu 2}_{4}A^{4}\frac{\partial}{\partial x^{2}}A^{\nu} + 2\Omega^{\mu 4}_{4}A^{4}\frac{\partial}{\partial x^{4}}A^{\nu} \\ &= 2\Omega^{\mu 1}_{2}A^{2}\frac{\partial}{\partial x^{1}}A^{\nu} + 2\Omega^{\mu 1}_{4}A^{4}\frac{\partial}{\partial x^{1}}A^{\nu} + 2\Omega^{\mu 2}_{2}A^{2}\frac{\partial}{\partial x^{2}}A^{\nu} \\ &+ 2\Omega^{\mu 2}_{4}A^{4}\frac{\partial}{\partial x^{2}}A^{\nu} + 2\Omega^{\mu 4}_{4}A^{4}\frac{\partial}{\partial x^{4}}A^{\nu}\end{aligned} \tag{1.43}$$

For example,

$$
\begin{aligned}
T^{2\nu} &\approx 2\Omega_{\lambda}^{2\alpha} A^{\lambda} \frac{\partial}{\partial x^{\alpha}} A^{\nu} \\
&= 2\Omega_{2}^{21} A^{2} \frac{\partial}{\partial x^{1}} A^{\nu} + 2\Omega_{4}^{21} A^{4} \frac{\partial}{\partial x^{1}} A^{\nu}
\end{aligned}
\tag{1.44}
$$

$$
\begin{aligned}
T^{21} &\approx 2\Omega_{2}^{21} A^{2} \frac{\partial}{\partial x^{1}} A^{1} + 2\Omega_{4}^{21} A^{4} \frac{\partial}{\partial x^{1}} A^{1} \\
&\approx \left(2\Omega_{2}^{21} A^{2} + 2\Omega_{4}^{21} A^{4}\right) \frac{\partial}{\partial x^{1}} A^{1}
\end{aligned}
\tag{1.45}
$$

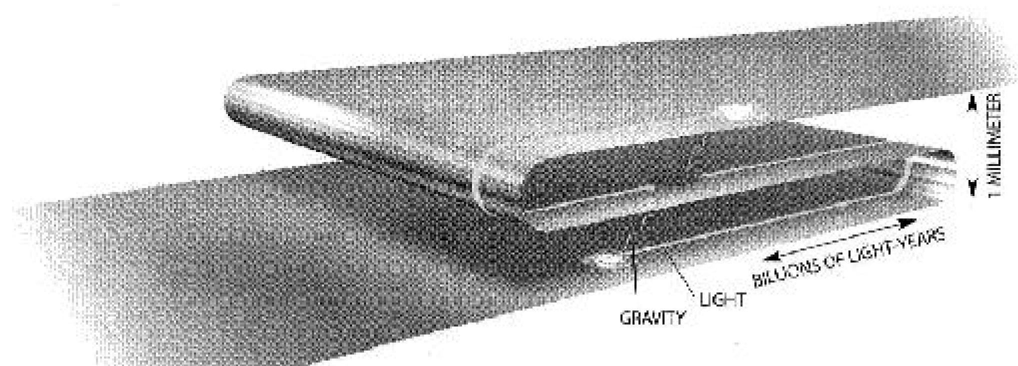
$$
\begin{aligned}
T^{12} &\approx 2\Omega_{\lambda}^{1\alpha} A^{\lambda} \frac{\partial}{\partial x^{\alpha}} A^{2} \\
&= 2\Omega_{2}^{12} A^{2} \frac{\partial}{\partial x^{2}} A^{2} + 2\Omega_{4}^{12} A^{4} \frac{\partial}{\partial x^{2}} A^{1} + 2\Omega_{4}^{14} A^{4} \frac{\partial}{\partial x^{4}} A^{2}
\end{aligned}
\tag{1.46}
$$

Clearly, it appears that the anholonomic electromagnetic field tensor is the classical vacuum when no ordinary classical material charged sources are present, is not symmetric. That is,

$$
T^{12} \neq T^{21} \tag{1.47}
$$

However, it is too soon to jump to this conclusion as the tensor algebra is quite formidable and there are a lot of terms to consider, so that one still might get cancellation of the non-symmetric terms in the complete calculation? I am continuing to work on this. Breakdown of symmetry in the stress-energy tensor is required for propellantless propulsion, extraction of useful energy from the classical vacuum and stabilization of traversable wormhole Star Gate short cuts in Jan 2000 Scientific American

between the different portions of the folded 3D membranes, possibly separated only by a 1 millimeter hyperspace barrier as shown in August 2000 Scientific American



PARALLEL UNIVERSES may exist invisibly alongside ours, on their own membranes less than a millimeter away from ours. Such parallel universes could also be different sheets of our own universe folded back on itself. So-called dark matter could be explained by ordinary stars and galaxies on nearby sheets: their gravity (*red*) can reach us by taking a shortcut through the extra dimensions, but we cannot see them because light (*yellow*) must travel billions of light-years to the folds and back.

CONTINUE TO PART II