RESONANT COUNTER GRAVITATION.

by

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ABSTRACT

Generally covariant unified field theory has been used to show that the equations of classical electrodynamics are unified with those of gravitation using standard Cartan geometry (Einstein Cartan Evans (ECE) field theory). By expressing the ECE field equations in terms of the potential field, linear inhomogeneous field equations are obtained for each of the fundamental laws of electrodynamics unified with gravitation. These equations have resonant solutions, and in this paper the possibility of resonant counter gravitation is demonstrated by showing that the Riemann curvature can be affected by the electromagnetic field. Examples are the Coulomb law and Ampere law respectively of electro-statics and magneto-statics. At resonance the effect is greatly amplified (as for any resonant phenomenon), so in theory, circuits can be built for effective resonant counter gravitation and used in the aerospace industry.

Keywords: Resonant counter gravitation; Einstein Cartan Evans (ECE) field theory; generally covariant unified field theory; linear inhomogeneous differential equations; resonance.

53rd paper of ECE theory

INTRODUCTION

The principle of general relativity is the fundamental hallmark of objective physics, a natural philosophy that is independent of the observer, independent of subjective input. The principle means that every equation of physics has to be generally covariant, meaning that it must retain its form under any type of coordinate transformation. The principle must evidently be applied to all equations of physics, including electrodynamics. Only in this way can an objective unified theory of physics emerge - a generally covariant unified field theory {1}. It is well established {2} that the principle of general relativity as applied to gravitational theory by Einstein and Hilbert {3} is very accurate when compared with experimental data, but the principle of general relativity is not applied to electrodynamics in the standard model. In the latter {4} electrodynamics is a theory of special relativity in which the field is thought of as an entity independent of the frame. The space-time of electrodynamics in the standard model is the Minkowski ("flat") space-time. As a result standard model electrodynamics is not generally covariant, it is Lorentz covariant, and as such cannot be unified with generally covariant gravitational theory in the standard model. It is well known that Riemann geometry with the Christoffel connection is the geometrical basis of gravitational general relativity. However in this type of geometry the torsion tensor is zero {5}. It was first suggested by Cartan{6} that the electromagnetic field be the torsion form of Cartan geometry. In 2003 {7-40} a generally covariant unified field theory was developed using this suggestion and using standard Cartan geometry. It has since been developed in many directions {1, 7-40}.

In Section 2 the field equations of ECE theory are expressed as linear inhomogeneous equations with resonant solutions. The Riemann term is isolated and it is shown that the electromagnetic part of the unified field can change the Riemann curvature, i.e. change the gravitational field. At resonance this effect is greatly amplified. In Section 3

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this general conclusion is exemplified using the Coulomb ad Ampere laws unified with gravitation. This means that a static electric or static magnetic configuration can change the gravitational field. In order to maximize the effect numerical methods of solution are needed to model a circuit which optimizes resonant counter gravitation. An assembly of such circuits can be placed aboard a device such as an aircraft or spacecraft, and is expected to be particularly effective in regions of near zero gravitation in outer space. Under the usual laboratory conditions it is well known that the electromagnetic and gravitational fields are essentially independent and have no influence on each other. This is observed experimentally in the Coulomb and Newton inverse square laws for example. If two charged masses are considered, then changing the charge on one of them has no effect on the Newton inverse square law. Similarly changing the mass of one of them has no effect on the Coulomb inverse square law. However, it is known through the Eddington effect that gravitation and electromagnetism interact and ECE theory was the first to give a classical explanation of the Eddington effect {7-40}. Einstein's famous prediction was based on photon mass and a semi-classical treatment. The Eddington effect is however tiny in magnitude, the enormous mass of the sun bends grazing light by a few seconds of arc only. Therefore resonant counter gravitation is the only practical method of counter gravitation. All claims to have observed an effect of electromagnetism on gravitation without resonance are almost certainly artifactual. Recently however the Mexican group of AIAS have observed resonantly enhanced electric power from ECE spacetime, the output power form a circuit was observed reproducibly {41} to exceed input power by a factor of one hundred thousand. This has been explained using ECE theory by the use of linear inhomogeneous differential equations of the same type as used in this paper for counter gravitation. The two phenomena are explained by a generally covariant unified field theory based on Cartan geometry.

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2. THE RESONANCE EQUATIONS OF ECE FIELD THEORY.

The overall aim of this section is to develop the ECE field equations to define the effect of electromagnetism on gravitation. In order to do this the Riemann term is isolated on the right hand side of the following field equations:

$$d \wedge F + \omega \wedge F = A^{(0)} R \wedge q, \quad - (1)$$

$$d \wedge \tilde{F} + \omega \wedge \tilde{F} = A^{(0)} \tilde{R} \wedge q, \quad - (2)$$

$$F = d \wedge A + \omega \wedge A. \quad - (3)$$

In these equations we have used a notation {1} which suppresses the various indices on the quantities on the left and right hand sides. This concise notation is used to reveal the basic structure of the equations. Later they will be developed into differential form, tensor and vector notation. Here F denotes the electromagnetic field, ω the spin connection, R the Riemann curvature and q the tetrad. The symbol ^ denotes Cartan's wedge product. The tilde denotes the Hodge dual {1} and A the potential field. Finally $A^{(0)}$ is the proportionality constant between F and the Cartan torsion:

$$F = A^{(0)} T \quad - (4)$$

which is the ECE ansatz {1}. So Eqs.(1) and (2) balance electromagnetic terms on the left hand side and on the right hand side a gravitational term R^q multiplied by $A^{(0)}$. Using Eq. (3) in Eq. (1) gives a linear inhomogeneous equation:

$$d \wedge \left(d \wedge A + \omega \wedge A \right) + \omega \wedge \left(d \wedge A + \omega \wedge A \right) = A^{(0)} R \wedge q, \quad - (5)$$

with resonance solutions {42}. Therefore resonance amplification of the effect of electromagnetism on R^q is possible in general relativity. In the standard model gravitation is described by:

$$R \wedge q = 0 \quad - (6)$$

which is the Ricci cyclic equation {1} of Einstein Hilbert field theory. In tensorial notation the Ricci cyclic equation is:

$$R_{\sigma\mu\nu\rho} + R_{\sigma\rho\mu\nu} + R_{\sigma\nu\rho\mu} = 0 \quad -(7)$$

where $R_{\sigma\mu\nu\rho}$ is the index lowered Riemann curvature tensor. Eq. (6) or equivalently Eq. (7) are true if and only if the Christoffel connection is assumed:

$$\Gamma^{\kappa}{}_{\mu\nu} = \Gamma^{\kappa}{}_{\nu\mu} . \quad -(8)$$

The assumption (8) implies that the torsion tensor is zero:

$$T^{\kappa}{}_{\mu\nu} = \Gamma^{\kappa}{}_{\mu\nu} - \Gamma^{\kappa}{}_{\nu\mu} = 0 . \quad -(9)$$

In the standard model the spin connection is missing because the Minkowski frame is not spinning, and so in the standard model:

$$d \wedge F = 0, \quad -(10)$$

$$d \wedge \tilde{F} = \mu_0 J, \quad -(11)$$

$$F = d \wedge A. \quad -(12)$$

Using Eq. (12) in Eq. (10) gives the Poincaré Lemma:

$$d \wedge (d \wedge A) = 0 \quad -(13)$$

which does not have resonance solutions. In order to understand the influence of electromagnetism on gravitation numerical solutions of Eq. (5) are needed. At resonance the effect is greatly amplified. In the standard model J is not recognized as originating in elements of the Riemann tensor. The interaction between electromagnetism and gravitation is defined by:

$$R \wedge q \neq 0 \quad -(14)$$

and by a non-zero and asymmetric spin connection. Both conditions are needed. It is important to note that for rotational motion, as for example in a free space electromagnetic field in ECE theory {1}, the spin connection is dual to the tetrad:

$$\omega^a{}_b = -\frac{\kappa}{2} \epsilon^a{}_{bc} q^c \qquad -(15)$$

where κ is a wave-number and $\epsilon^a{}_{bc}$ is the index raised Levi-Civita tensor in the tangent space-time. Eq. (15) implies that the Cartan torsion tensor is dual to the Riemann tensor:

$$R^a{}_b = -\frac{\kappa}{2} \epsilon^a{}_{bc} T^c. \qquad -(16)$$

So it must be clearly understood that there is a Riemann spin tensor for free electromagnetism in ECE field theory. There is also a Riemann tensor for gravitation, the well known curvature Riemann tensor. When electromagnetism and gravitation are mutually influential R^q is not zero, and Eqs. (15) and (16) no longer apply. This is the condition needed for resonant counter gravitation. If R^q is zero then electromagnetism does not influence gravitation. Similarly if the spin connection is dual to the tetrad there is no mutual influence, and when the Cartan torsion is dual to the Riemann spin tensor, there is no mutual influence. These conclusions follow directly from Cartan geometry. For the free electromagnetic field, the homogeneous field equation {1} reduces to:

$$d \wedge F^a = 0 \qquad -(17)$$

which for each polarization index a, and using vector notation, gives the Gauss law applied to magnetism:

$$\underline{\nabla} \cdot \underline{B}^a = 0 \qquad -(18)$$

and the Faraday law of induction:

$$\underline{\nabla} \times \underline{E}^a + \frac{\partial \underline{B}^a}{\partial t} = \underline{0}. \quad -(18)$$

The inhomogeneous field equation of ECE theory {1} is:

$$d \wedge \tilde{F} = A^{(o)}\left(\tilde{R} \wedge q - \omega \wedge \tilde{T}\right). \quad -(19)$$

When the electromagnetic field is free of gravitation:

$$\left(\tilde{R} \wedge q\right)_{e/m} = \left(\omega \wedge \tilde{T}\right)_{e/m} \quad -(20)$$

and the inhomogeneous field equation (19) reduces to:

$$d \wedge \tilde{F} = A^{(o)}\left(\tilde{R} \wedge q\right)_{grav} := \mu_o J. \quad -(21)$$

This means that the inhomogeneous current is derived from the mass of an electron in the

Einstein Hilbert limit, i.e purely from the curving of space-time as described by the

Schwarzschild metric {1}. When the electromagnetic and gravitational fields are mutually

independent, there is no interaction between the spinning and curving of space-time. In this

limit Eq. (21) gives for each index a the Coulomb Law:

$$\underline{\nabla} \cdot \underline{D}^a = \rho^a \quad -(22)$$

and the Ampère Maxwell law:

$$\underline{\nabla} \times \underline{H}^a - \frac{\partial \underline{D}^a}{\partial t} = \underline{J}^a. \quad -(23)$$

In the weak field limit of gravitation uninfluenced by electromagnetism the Newton inverse

square law is also recovered.

In standard differential form notation Eq. (1) is:

$$d \wedge F^a + \omega^a{}_b \wedge F^b = A^{(o)} R^a{}_b \wedge q^b$$

$$- (24)$$

and this in tensor notation is:

$$\partial_\mu F^a{}_{\nu\rho} + \partial_\nu F^a{}_{\rho\mu} + \partial_\rho F^a{}_{\mu\nu} + \omega^a{}_{\mu b} F^b{}_{\nu\rho} + \omega^a{}_{\nu b} F^b{}_{\rho\mu} + \omega^a{}_{\rho b} F^b{}_{\mu\nu}$$

$$= A^{(o)} \left(R^a{}_{b\nu\mu} q^b{}_\rho + R^a{}_{b\rho\nu} q^b{}_\mu + R^a{}_{b\mu\rho} q^b{}_\nu \right).$$

$$- (25)$$

Now use:

$$R \wedge q = -q \wedge R \qquad - (26)$$

and the right hand side of Eq. (25) becomes:

$$- A^{(o)} \left(q^b{}_\mu R^a{}_{b\nu\rho} + q^b{}_\nu R^a{}_{b\rho\mu} + q^b{}_\rho R^a{}_{b\mu\nu} \right).$$

$$- (26a)$$

Eq. (26) is the same as:

$$\partial_\mu \tilde{F}^{a\mu\nu} + \omega^a{}_{\mu b} \tilde{F}^{a\mu\nu} = - A^{(o)} q^b{}_\mu \tilde{R}^a{}_b{}^{\mu\nu}.$$

$$- (27)$$

Similarly Eq. (2) becomes:

$$\partial_\mu F^{a\mu\nu} + \omega^a{}_{\mu b} F^{a\mu\nu} = - A^{(o)} q^b{}_\mu R^a{}_b{}^{\mu\nu}. \quad - (28)$$

In the standard model Eq. (27) is:

$$\partial_\mu \tilde{F}^{\mu\nu} = 0 \qquad - (29)$$

and Eq. (28) is:

$$\partial_\mu F^{\mu\nu} = \mu_o J^\nu. \qquad - (30)$$

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From Eq. (29) we obtain the Gauss law and Faraday law of induction of the standard model, and from Eq. (30) we obtain the standard model's Coulomb Law and Ampère Maxwell Law. In ECE theory these laws must be obtained from Eqs. (27) and (28). The details are given in Appendix K of ref. (1).

The Coulomb Law in vector notation in ECE theory will be derived and explained in detail later in this section. The result is:

$$\underline{\nabla} \cdot \underline{E}^a + \underline{\omega}^a{}_b{}' \cdot \underline{E}^b = -c \underline{A}^b{}' \cdot \underline{R}^a{}_b . \quad -(31)$$

Similarly the Ampère Maxwell Law in vector notation in ECE theory is:

$$\underline{\nabla} \times \underline{B}^a + \underline{\omega}'^a{}_b \times \underline{B}^a - \frac{1}{c^2} \left(\frac{\partial \underline{E}^a}{\partial t} + \omega'^a{}_{ob} \underline{E}^b \right) = \mu_o \underline{J}^{a}{}' . \quad -(32)$$

These laws are required to understand the effect of electromagnetism on gravitation, and to design devices for resonant counter gravitation. Gravitation is represented by the Riemann terms on the right hand sides of Eqs. (31) and (32), and electromagnetism by the terms on the left hand sides. The equations therefore show that elements of the Riemann tensor can be affected by electric and magnetic fields. The engineering challenge is to maximize the effect with resonance amplification. The latter possibility is seen by writing out Eq. (3) in vector notation {7-49}:

$$\underline{E}^a = -\frac{\partial \underline{A}^a}{\partial t} - c \underline{\nabla} A^{oa} - c \omega^{oa}{}_b \underline{A}^b + c \underline{\omega}^a{}_b A^{ob} \quad -(33)$$

and

$$\underline{B}^a = \underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b . \quad -(34)$$

By substituting Eqs. (33) and (34) into (31) and (32) linear inhomogeneous

differential equations are obtained. The final step is to solve these numerically to design circuits that give resonance amplification of the effect of electromagnetism on gravitation. If the Riemann tensor is decreased, gravity is lessened, and conversely. This is a highly non-trivial problem in general and shows why previous attempts to understand this problem are naive. In the standard model these linear inhomogeneous differential equations are replaced by the d'Alembert wave equation {43} using the Lorentz gauge condition. The solutions are the Liennard- Wiechert potentials, and these are electromagnetic waves without resonance and without the information given by the interaction fo gravitation and electromagnetism of ECE field theory.

The Ampère law of magneto-statics is obtained when there is no electric field present, only a magnetic field, so eq. (32) reduces to:

$$\underline{\nabla} \times \underline{B}^a + \underline{\omega}'^a{}_b \times \underline{B}^b = \mu_0 \underline{J}^{a'} . \quad - (35)$$

As discussed in the introduction the standard model's Coulomb, Ampère and Newton inverse square laws hold to high precision {43}. Therefore no influence of electromagnetism on gravitation has hitherto been detected in the laboratory. The reason is that resonance amplification has not been used, and resonance amplification occurs only in general relativity, not in special relativity. However an influence of gravitation on electromagnetism has been detected in the Eddington effect. ECE field theory is the first self-consistent explanation of the Eddington effect both on the classical and quantum levels. Einstein's famous prediction which led to the Eddington experiment was semi-classical and was based on Einstein Hilbert field theory, so used only gravitation and not the required unified field theory. Light in Einstein's prediction was a photon with mass, the concomitant electric and magnetic fields were not considered. The semi-classical theory happens to be very accurate for the solar system, { 1 }, but in general effects are expected due to the

interaction of gravitation and electromagnetism. These may occur not only in a cosmological context but also in an atom or a circuit on the microscopic scale. In the vicinity of an electron space-time curvature is large because of the small electron radius, and electric fields are intense, giving plenty of scope for the interaction of space-time spin and curvature.

The origin of Coulomb's law in ECE field theory is the inhomogeneous field equation {1}:

$$\partial_\mu F^{a\mu\nu} = \mu_0 J^{a\nu} = A^{(0)}\left(R^a{}_b{}^{\mu\nu} q^b_\mu - \omega^a{}_{\mu b} T^{b\mu\nu}\right) \quad - (36)$$

and the law is obtained by using

$$\nu = 0 \quad - (37)$$

in Eq. (36) to give:

$$\partial_1 F^{a10} + \partial_2 F^{a20} + \partial_3 F^{a30} + \omega^a{}_{1b} T^{b10} + \omega^a{}_{2b} T^{b20}$$
$$+ \omega^a{}_{3b} T^{b30} = A^{(0)}\left(R^a{}_b{}^{10} q^b_1 + R^a{}_b{}^{20} q^b_2 + R^a{}_b{}^{30} q^b_3\right) \quad - (38)$$

which translates into the vector notation of Eq. (31). The primed quantities arise because the metric $g_{\mu\nu}$ must be used to raise and lower indices, so:

$$A^a{}_\mu{}' := g_{\mu\nu} A^{a\nu}, \quad - (39)$$

$$\omega^a{}_{\mu b}{}' := g_{\mu\nu} \omega^{\nu a}{}_b, \quad - (40)$$

where the unprimed quantities are defined by convention as metric free. Other conventions may be adopted, but in ECE theory the metric is not the Minkowski metric in general, so contra-variant and covariant quantities must be defined carefully. It is no longer sufficient just to switch the sign from positive (contra-variant space part of a four-vector) to negative (covariant space part of a four- vector). These details must be programmed carefully in

numerical applications.

The resonant version of Eq. (31) may now be developed from Eq. (33)

substituted into Eq. (31) to give:

$$c \underline{\nabla} \cdot \underline{\nabla} A^{oa} + \underline{\nabla} \cdot \frac{\partial A^{a}}{\partial t} + c \underline{\nabla} \cdot \left(\omega^{o}{}_{b}^{a} \underline{A}^{b} - \omega^{a}{}_{b} A^{ob} \right)$$

$$+ \underline{\omega}^{a}{}_{b}{}' \cdot \left(\frac{\partial A^{b}}{\partial t} + c \underline{\nabla} A^{ob} + c\omega^{ob}{}_{c} \underline{A}^{c} - c\underline{\omega}^{b}{}_{c} A^{oc} \right) \qquad -(41)$$

$$= -c \, \underline{A}^{b}{}' \cdot \underline{R}^{a}{}_{b} \; .$$

If we restrict consideration to a static electric field configuration Eq. (41) simplifies as

follows. In order to guide this simplification exercise consider first the standard model's static

electric field:

$$\underline{\nabla} \cdot \underline{E} = \rho / \epsilon_{o}, \qquad -(42)$$

$$\underline{\nabla} \times \underline{E} = 0, \qquad -(43)$$

$$\nabla^{2} \Phi = -\rho / \epsilon_{o}, \qquad -(44)$$

where Φ is the scalar potential of the Poisson equation {43}. Eq. (43) implies that:

$$\underline{E} = -\underline{\nabla} \Phi . \qquad -(45)$$

For a time-dependent electric field:

$$\underline{E} = -\underline{\nabla} \Phi - \frac{\partial A}{\partial t}, \qquad -(46)$$

so a static electric field means:

$$\frac{\partial A}{\partial t} = 0 . \qquad -(47)$$

If we further assume for the sake of approximation that:

$$\underline{\nabla} \cdot \underline{A}^{b} = 0 \qquad -(48)$$

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Eq. (41) simplifies to:

$$\underline{\nabla} \cdot \underline{\nabla} A^{\circ a} - \underline{\nabla} \cdot \left(\underline{\omega}^{a}{}_{b} A^{\circ b} \right) + \underline{\omega}^{a}{}_{b}{}' \cdot \underline{\nabla} A^{\circ b}$$
$$+ \underline{\omega}^{a}{}_{b}{}' \cdot \underline{\omega}^{\circ b}{}_{c} \underline{A}^{c} - \underline{\omega}^{a}{}_{b}{}' \cdot \underline{\omega}^{b}{}_{c} A^{\circ c} = - \underline{A}^{b/} \cdot \underline{R}^{a}{}_{b}$$
$$:= c\mu_{o} J^{\circ a} \qquad - (49)$$

This is still a complicated equation so to simplify further we consider the limit of weak

interaction between the electromagnetic and gravitational fields {1}:

$$d \wedge \tilde{F} = \mu_{o} J \longrightarrow A^{(o)} (\tilde{R} \wedge q)_{grav.} \qquad - (50)$$

In this limit:

$$(\tilde{R} \wedge q)_{elm} \sim (\omega \wedge \tilde{T})_{elm}, \quad \tilde{T}_{grav} \sim 0. \qquad -(51)$$

The structure of Eq. (31) simplifies to:

$$\underline{\nabla} \cdot \underline{E}^{a} \sim - c \underline{A}^{b/} \cdot \underline{R}^{a}{}_{b} \qquad - (52)$$

and the spin connection in Eq. (33) can be considered to be approximately dual to the

tetrad. So Eq. (41) simplifies further to

$$\underline{\nabla} \cdot \left(- \frac{\partial \underline{A}^{a}}{\partial t} - c \underline{\nabla} A^{\circ a} - c \underline{\omega}^{\circ a}{}_{b} \underline{A}^{b} + c \underline{\omega}^{a}{}_{b} A^{\circ b} \right)$$
$$\sim - c \underline{A}^{b/} \cdot \underline{R}^{a}{}_{b} \qquad - (53)$$

with

$$\omega^{a}{}_{b} \sim - \frac{\kappa}{2} q^{c} \epsilon^{a}{}_{bc}. \qquad - (54)$$

If we use a static electric field and asume Eq. (48), Eq. (53) simplifies to:

$$\underline{\nabla} \cdot \underline{\nabla} A^{\circ a} - \underline{\nabla} \cdot \left(\underline{\omega}^a{}_b A^{\circ b} \right) \sim -\underline{A}^{b\prime} \cdot \underline{R}^a{}_b .$$

$$- (55)$$

If we do not assume Eq. (48) we obtain:

$$\underline{\nabla} \cdot \underline{\nabla} A^{\circ a} + \underline{\nabla} \cdot \left(\omega^{\circ a}{}_b \underline{A}^b \right) - \underline{\nabla} \cdot \left(\underline{\omega}^a{}_b A^{\circ b} \right)$$

$$\sim -\underline{A}^{b\prime} \cdot \underline{R}^a{}_b . - (56)$$

Eq. (55) is a Hooke's Law type of resonance equation with a driving term on the right hand side, Eq. (56) has an additional damping term. In both cases gravitation is resonantly affected by a static electric field. In order for this to occur the spin connection must be identically non-zero, meaning that κ in Eq. (54) must be identically non-zero. In the limit of an identically static electric field, κ is identically zero, and we recover the standard model's Coulomb law. In so doing we loose the possibility of influencing gravitation with a static electric field.