Chapter 11

Antisymmetry Constraints in the ECE Engineering Model

by

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Abstract

It is argued that anti-symmetry constraints govern the whole of unified field theory, and determine the way in which new energy and counter-gravitational devices should be designed within the ECE engineering model. The constraints are a simple consequence of the anti-symmetry of the commutator of covariant derivatives used to generate terms in any space time in any dimension in Riemann geometry. Each term that is generated by the commutator is antisymmetric in the commutator indices. This simple result is developed as a law of the field theory in general, and applied in this paper to electromagnetic and gravitational theory within the context of the Einstein Cartan Evans (ECE) generally covariant unified field theory.

Keywords: ECE theory, antisymmetry constraints, commutator, electromagnetism, gravitation.

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11.1 Introduction

In Riemann geometry it is well known [1] that the covariant derivative is a fundamental concept. The commutator of covariant derivatives acts on any tensor to produce the curvature and torsion tensors simultaneously [2] - [11]. These tensors are combinations of terms, each of which takes the antisymmetry of the commutator indices. The commutator method is valid in any spacetime and in any dimension, and the result is independent of any other assumption. The commutator is antisymmetric by definition, and it follows immediately that all terms generated by a commutator are also antisymmetric in the same indices. In Section 2 this simple result is developed for use with Cartan geometry and the Einstein Cartan Evans (ECE) unified field theory and engineering model. It is shown in a simple way that antisymmetry refutes the standard model of physics in its gravitational and electromagnetic sectors. The demonstration is simple and easily understood. In Section 3, the theory of antisymmetry constraint is developed systematically in order to prepare for computer simulation of devices that take electric power from spin connection resonance [2] - [11] (SCR). The phenomenon of SCR is Euler Bernoulli resonance based on the presence of the spin connection in ECE theory, and is a plausible explanation for the well known Tesla resonances [12]. New energy circuits are already available in microchip format based on Tesla resonance, and are already being manufactured and marketed [13]. There is no explanation for them in the standard model of physics, which is easily shown by the commutator method to be deeply flawed and obsolete.

11.2 The Commutator Antisymmetry Law

The commutator of covariant derivatives in Riemann geometry may act on a four vector V^ρ, for example to produce the following well known result [1]:

$$\begin{aligned}[D_\mu, D_\nu]V^\rho = (\ \partial_\mu \Gamma^\rho_{\nu\sigma} -\ \partial_\nu \Gamma^\rho_{\mu\sigma} + \Gamma^\rho_{\mu\lambda}\Gamma^\lambda_{\nu\sigma} - \Gamma^\rho_{\nu\lambda}\Gamma^\lambda_{\mu\sigma})V^\rho \\ -(\Gamma^\lambda_{\mu\nu} - \Gamma^\lambda_{\nu\mu})D_\lambda V^\rho.\end{aligned} \tag{11.1}$$

Here $\Gamma^\lambda_{\mu\nu}$ denotes the connection, defined by the action of the covariant derivative D_μ on the four vector:

$$D_\mu V^\rho =\ \partial_\mu V^\rho + \Gamma^\rho_{\mu\lambda} V^\lambda. \tag{11.2}$$

The curvature tensor is defined as:

$$R^\rho{}_{\sigma\mu\nu} :=\ \partial_\mu \Gamma^\rho_{\nu\sigma} -\ \partial_\nu \Gamma^\rho_{\mu\sigma} + \Gamma^\rho_{\mu\lambda}\Gamma^\lambda_{\nu\sigma} - \Gamma^\rho_{\nu\lambda}\Gamma^\lambda_{\mu\sigma} \tag{11.3}$$

and the torsion tensor by:

$$T^\lambda{}_{\mu\nu} = \Gamma^\lambda_{\mu\nu} - \Gamma^\lambda_{\nu\mu}. \tag{11.4}$$

These quantities transform as tensors under the general coordinate transformation [1] - [11] but the connection does not transform as a tensor as is well known. By definition, the commutator is antisymmetric in the indices μ and ν :

$$[D_\mu, D_\nu]V^\rho = -[D_\nu, D_\mu]V^\rho. \tag{11.5}$$

This means that if μ is replaced by ν and ν by μ , the sign of the commutator is changed from positive to negative. If μ and ν are the same the commutator is zero. The same result must therefore be true for each term on the right hand side of Eq. (11.1), and each term must be antisymmetric in μ and ν . In the limit of Minkowski spacetime, the connection vanishes, so the right hand side becomes:

$$[D_\mu, D_\nu]V^\rho = (\ \partial_\mu\ \partial_\nu -\ \partial_\nu\ \partial_\mu)V^\rho. \tag{11.6}$$

In this limit, there are two terms on the right hand side, and each are antisymmetric, so:

$$\partial_\mu\ \partial_\nu V^\rho = -\ \partial_\nu\ \partial_\mu V^\rho, \tag{11.7}$$

$$\partial_\nu\ \partial_\mu V^\rho = -\ \partial_\mu\ \partial_\nu V^\rho. \tag{11.8}$$

However, coordinate orthogonality means that:

$$\partial_\mu\ \partial_\nu V^\rho =\ \partial_\nu\ \partial_\mu V^\rho, \tag{11.9}$$

$$\partial_\nu\ \partial_\mu V^\rho =\ \partial_\mu\ \partial_\nu V^\rho \tag{11.10}$$

so we obtain the well known result:

$$\partial_\mu\ \partial_\nu V^\rho =\ \partial_\nu\ \partial_\mu V^\rho\ = 0 \tag{11.11}$$

which is the only possible solution of Eqs. (11.7) and (11.9). The antisymmetry law therefore proves coordinate orthogonality, Q. E. D. If on the other hand it is assumed that only the following combination is antisymmetric:

$$[\ \partial_\mu,\ \partial_\nu]\ V^\rho = -[\ \partial_\nu,\ \partial_\mu]\ V^\rho \tag{11.12}$$

there is no way of proving co-ordinate orthogonality from the commutator. In this case, coordinate orthogonality becomes an assumption, and is not part of a more general geometry.

Each of the six terms on the right hand side of Eq. (11.1) must be antisymmetric. Therefore:

$$\partial_\mu \Gamma^\rho_{\nu\sigma} = -\ \partial_\nu \Gamma^\rho_{\mu\sigma}, \tag{11.13}$$

$$\Gamma^\rho_{\mu\lambda}\Gamma^\lambda_{\nu\sigma} =\ -\ \Gamma^\rho_{\nu\lambda}\Gamma^\lambda_{\mu\sigma}, \tag{11.14}$$

$$\Gamma^\lambda_{\mu\nu} = -\Gamma^\lambda_{\nu\mu}. \tag{11.15}$$

In the standard model of gravitation, the above antisymmetries are erroneously overlooked, and arbitrary choices of antisymmetry are restricted to the following:

$$R^{\rho}{}_{\sigma\mu\nu} = -R^{\rho}{}_{\sigma\nu\mu}, \tag{11.16}$$

$$T^{\lambda}{}_{\mu\nu} = -T^{\lambda}{}_{\nu\mu}. \tag{11.17}$$

It is claimed erroneously that:

$$\Gamma^{\lambda}_{\mu\nu} = \Gamma^{\lambda}_{\nu\mu}. \tag{11.18}$$

Eq. (11.18) however leads to the result:

$$[D_\mu, D_\nu]V^{\rho} = 0 \tag{11.19}$$

so that all the terms on the right hand side of eq. (11.1) are zero, reductio ad absurdum. Another way of seeing this error in the standard model is to assume:

$$\mu = \nu \tag{11.20}$$

and it follows that all the terms on both sides of Eq. (11.1) are zero. There is no symmetric part to a commutator nor to any term that is generated by a commutator and so takes the indices of that commutator. It is not known why such severe errors as the assumption (11.18) have been perpetrated for nearly a century, but events like these happen many times in the history of science. Another basic error of the standard model is that it asserts that the torsion tensor:

$$T^{\lambda}{}_{\mu\nu} = \Gamma^{\lambda}_{\mu\nu} - \Gamma^{\lambda}_{\nu\mu} \tag{11.21}$$

may have a symmetric component. This is erroneous because the commutator cannot have a symmetric component. This error is seen clearly from the fact that in the standard model, the curvature tensor:

$$R^{\rho}{}_{\sigma\mu\nu} = -R^{\rho}{}_{\sigma\nu\mu} \tag{11.22}$$

is always treated as if it has no symmetric component, i.e.:

$$R^{\rho}{}_{\sigma\mu\nu} = R^{\rho}{}_{\sigma\mu\nu}(A) \tag{11.23}$$

and if

$$\mu = \nu \tag{11.24}$$

then

$$R^{\rho}{}_{\sigma\mu\nu} = 0. \tag{11.25}$$

If the curvature is antisymmetric the torsion must also be antisymmetric:

$$T^{\lambda}{}_{\mu\nu} = -T^{\lambda}{}_{\nu\mu} \tag{11.26}$$

and if:

$$\mu = \nu \tag{11.27}$$

then

$$T^{\lambda}{}_{\mu\nu} = 0. \tag{11.28}$$

This means that we recover Eq. (11.18) Q.E.D., i.e.:

$$\Gamma^{\lambda}_{\mu\nu} = -\Gamma^{\lambda}_{\nu\mu}. \tag{11.29}$$

However, in the standard model, the following error is made:

$$T^{\lambda}{}_{\mu\nu} = \Gamma^{\lambda}_{\mu\nu} - \Gamma^{\lambda}_{\nu\mu} = 0 \tag{11.30}$$

so that the connection is erroneously asserted to be:

$$\Gamma^{\lambda}_{\mu\nu} = \Gamma^{\lambda}_{\nu\mu}. \tag{11.31}$$

These fundamental inconsistencies of simple logic have been perpetrated uncritically to such an extent that the torsion is almost unknown in standard textbooks. This is what happens when logic is replaced by empty dogma, science is rendered meaningless by habitual repetition of error. Nearly one hundred years of research in gravitational physics have been wasted, and a tremendous dogmatic inertia built up. In contrast ECE theory has already produced a satisfactory cosmology without repetition of these errors [2] - [11].

The commutator antisymmetry law must be applied self consistently to the whole of field theory. The ECE field theory for example is built directly on Cartan geometry, in which the tetrad postulate is [1]- [11]:

$$D_\mu q^a_\mu = \partial_\mu q^a_\nu + \omega^a_{\mu b} q^b_\nu - \Gamma^{\lambda}_{\mu\nu} q^a_\lambda = 0. \tag{11.32}$$

Here q^a_ν is the Cartan tetrad, and $\omega^a_{\mu b}$ is the Cartan spin connection. Using the fundamental rules of Cartan geometry [1]:

$$\omega^a_{\mu b} q^b_\nu = \omega^a_{\mu\nu},\ \Gamma^{\lambda}_{\mu\nu} q^a_\lambda = \Gamma^a_{\mu\nu} \tag{11.33}$$

the tetrad postulate simplifies to:

$$\partial_\mu q^a_\nu = \Gamma^a_{\mu\nu} - \omega^a_{\mu\nu} \tag{11.34}$$

so that:

$$\Gamma^a_{\mu\nu} = \partial_\mu q^a_\nu + \omega^a_{\mu\nu}. \tag{11.35}$$

The mixed index connection $\Gamma^a_{\mu\nu}$ is defined by:

$$\Gamma^a_{\mu\nu} = q^a_\lambda \Gamma^{\lambda}_{\mu\nu} \tag{11.36}$$

and from the commutator law, Eq. (11.18), is antisymmetric:

$$\Gamma^a_{\mu\nu} = -\Gamma^a_{\nu\mu}. \tag{11.37}$$

From Eq. (11.35), it follows that:

$$\partial_\mu q^a_\nu + \omega^a_{\mu\nu} = -(\ \partial_\nu q^a_\mu + \omega^a_{\nu\mu}), \tag{11.38}$$

i.e.

$$\partial_\mu q^a_\nu + \ \partial_\nu q^a_\mu + \omega^a_{\mu\nu} + \omega^a_{\nu\mu} = 0 \tag{11.39}$$

which is the antisymmetry constraint of Cartan geometry.

Eq. (11.39) is a new law of Cartan geometry, and must be used with Cartan structure equations, the first of which defines the Cartan torsion as:

$$T^a{}_{\mu\nu} = \ \partial_\mu q^a_\nu - \ \partial_\nu q^a_\mu + \omega^a_{\mu\nu} - \omega^a_{\nu\mu}. \tag{11.40}$$

The ECE field theory is based on the hypothesis:

$$A^a_\mu = A^{(0)} q^a_\mu \tag{11.41}$$

defining the electromagnetic potential, and the hypothesis:

$$F^a{}_{\mu\nu} = A^{(0)} T^a{}_{\mu\nu} \tag{11.42}$$

defining the electromagnetic field. The general antisymmetry constraint of electrodynamics is therefore:

$$\partial_\mu A^a_\nu + \ \partial_\nu A^a_\mu + \omega^a_{\mu b} A^b_\nu + \omega^a_{\nu b} A^b_\mu = 0 \tag{11.43}$$

and it is seen that it is derived directly from the commutator in Eq. (11.1). These consequences of the commutator antisymmetry law are developed in Section 3. To end this section it is shown that the U(1) sector symmetry of the standard model is fundamentally erroneous, as is its gravitational sector as just shown. The standard gravitational sector is erroneous fundamentally because it always uses the incorrect symmetry:

$$\Gamma^\lambda_{\mu\nu} = \Gamma^\lambda_{\nu\mu} \tag{11.44}$$

which leads to:

$$T^a{}_{\mu\nu} = q^a_\lambda T^\lambda{}_{\nu\mu} = 0. \tag{11.45}$$

This is quite easily shown [2] - [11] to be inconsistent with basic geometry.

In the U(1) gauge theory of standard electrodynamics, methods are used which are borrowed from Riemann geometry. In U(1) electrodynamics the covariant derivative is:

$$D_\mu = \ \partial_\mu - igA_\mu \tag{11.46}$$

where g is a proportionality that is scalar valued. Here A_μ is the four potential. The commutator of covariant derivatives acts on the gauge field ψ . Thus:

$$\begin{aligned}[D_\mu, D_\nu]\psi &= [\ \partial_\mu - igA_\mu,\ \partial_\nu - igA_\nu]\psi \\ &= [\ \partial_\mu,\ \partial_\nu]\psi - ig[A_\mu,\ \partial_\nu]\psi - ig[\partial_\mu, A_\nu]\psi - g^2[A_\mu, A_\nu]\psi.\end{aligned} \tag{11.47}$$

The commutator antisymmetry law implies that:

$$[D_\mu, D_\nu]\psi = -[D_\nu, D_\mu]\psi \tag{11.48}$$

$$[\partial_\mu, \partial_\nu]\psi = -[\partial_\nu, \partial_\mu]\psi \tag{11.49}$$

$$[A_\mu, \partial_\nu]\psi = -[\partial_\nu, A_\mu]\psi \tag{11.50}$$

$$[\partial_\mu, A_\nu]\psi = -[A_\nu, \partial_\mu]\psi \tag{11.51}$$

$$[A_\mu, A_\nu]\psi = -[A_\nu, A_\mu]\psi \tag{11.52}$$

As in gravitational theory, each term on the right hand side of Eq. (11.47) is antisymmetric, and as in gravitational theory:

$$\partial_\mu\partial_\nu\psi = -\partial_\nu\partial_\mu\psi = 0. \tag{11.53}$$

Therefore:

$$[D_\mu, D_\nu]\psi = -ig[\partial_\mu, A_\nu]\psi + ig[\partial_\nu, A_\mu]\psi - g^2[A_\mu, A_\nu]\psi. \tag{11.54}$$

By definition:

$$[\partial_\mu, A_\nu]\psi = \partial_\mu(A_\nu\psi) - A_\nu(\partial_\mu\psi). \tag{11.55}$$

Use the Leibnitz Theorem:

$$\partial_\mu(A_\nu\psi) = (\partial_\mu A_\nu)\psi + A_\nu(\partial_\mu\psi). \tag{11.56}$$

Therefore:

$$[\partial_\mu, A_\nu]\psi = (\partial_\mu A_\nu)\psi. \tag{11.57}$$

Similarly:

$$[\partial_\nu, A_\mu]\psi = (\partial_\nu A_\mu)\psi. \tag{11.58}$$

From Eqs. (11.50) and (11.51):

$$(\partial_\mu A_\nu)\psi = -(\partial_\nu A_\mu)\psi, \tag{11.59}$$

$$(\partial_\nu A_\mu)\psi = -(\partial_\mu A_\nu)\psi \tag{11.60}$$

and

$$\partial_\mu A_\nu = -\partial_\nu A_\mu. \tag{11.61}$$

From Eq. (11.52):

$$[A_\mu, A_\nu] = -[A_\nu, A_\mu]. \tag{11.62}$$

Using these results:

$$[D_\mu, D_\nu]\psi = -ig(\partial_\mu A_\nu - \partial_\nu A_\mu - ig[A_\mu, A_\nu])\psi. \tag{11.63}$$

The following fundamental errors occur in the U(1) gauge field theory of electrodynamics, often referred to as the U(1) sector of standard attempts at a unified field theory.

1. It is claimed incorrectly that only the following combination of terms is antisymmetric:

$$F_{\mu\nu} = -F_{\nu\mu} \tag{11.64}$$

   where

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu. \tag{11.65}$$

   There is no logic behind this claim, it is arbitrary, and $F_{\mu\nu}$ is the electromagnetic field tensor in U(1) gauge field theory.

2. It is claimed incorrectly that:

$$[A_\mu, A_\nu] = 0. \tag{11.66}$$

The inverse Faraday effect shows experimentally [2] - [11] that this claim is incorrect, because the conjugate product of non-linear optics is observable experimentally in several ways. This has been known for sixty years, but the U(11.1) dogma still adheres to Eq. (11.66).

As shown in papers 131 and 132 on www.aias.us Eq. (11.61) means that:

$$\boldsymbol{\nabla}\varphi = \frac{\partial \mathbf{A}}{\partial t} \tag{11.67}$$

so:

$$\boldsymbol{\nabla} \times \boldsymbol{\nabla}\varphi = \frac{\partial}{\partial t}(\boldsymbol{\nabla} \times \mathbf{A}) = 0. \tag{11.68}$$

Therefore:

$$\frac{\partial \mathbf{B}}{\partial t} = 0. \tag{11.69}$$

In U(1) electrodynamics:

$$\mathbf{B} = \boldsymbol{\nabla} \times \mathbf{A}, \tag{11.70}$$

$$\mathbf{E} = -\frac{\partial \mathbf{A}}{\partial t} - \boldsymbol{\nabla}\varphi \tag{11.71}$$

so the antisymmetry law leads to:

$$\nabla \times \mathbf{E} = 0, \tag{11.72}$$

$$\frac{\partial \mathbf{B}}{\partial t} = 0. \tag{11.73}$$

If A is non-zero and irrotational, **E** and **B** are static fields. In U(1) electrodynamics, there can be no radiation, an incorrect result. Even worse for the standard model, the usual U(1) assumption for a static electric field is [1]:

$$\mathbf{A} = 0 \tag{11.74}$$

so the static electric field in U(1) gauge field theory is denoted:

$$\mathbf{E} = -\nabla \varphi. \tag{11.75}$$

If this assumption is used, then Eq. (11.67) implies:

$$\mathbf{E} = 0,\ \mathbf{B} = 0 \tag{11.76}$$

which is reductio ad absurdum (reduction to absurdity), because in U(1) (standard electromagnetism) , there are no fields at all because of commutator antisymmetry.

In conclusion, it is seen that the simple commutator antisymmetry law means that the standard model of physics is refuted in both its gravitational and electromagnetic sectors. In Section 3 the antisymmetry law is applied to ECE level electrodynamics.

11.3 Antisymmetry in the ECE Engineering Model

In their most general form, the electric field strength (volts per metre) and magnetic flux density (tesla or weber per square metre) of the ECE engineering model are as follows:

$$\mathbf{E}^a = -\nabla \varphi^a - \frac{\partial \mathbf{A}^a}{\partial t} - c\omega^a_{0b}\mathbf{A}^b + cA^b_0 \boldsymbol{\omega}^a_b, \tag{11.77}$$

$$\mathbf{B}^a = \nabla \times \mathbf{A}^a - \boldsymbol{\omega}^a_b \times \mathbf{A}^b. \tag{11.78}$$

Here, the index a is that of an O(3) representation space, for example the complex circular basis whose unit vectors are related to the Cartesian unit vectors as follows [1] - [11], [14]:

$$\mathbf{e}^{(1)} = \frac{1}{\sqrt{2}}(\mathbf{i} - i\mathbf{j}), \tag{11.79}$$

$$\mathbf{e}^{(2)} = \frac{1}{\sqrt{2}}(\mathbf{i} + i\mathbf{j}), \tag{11.80}$$

$$\mathbf{e}^{(3)} = \mathbf{k}. \tag{11.81}$$

These are related by an O(11.3) symmetry Lie algebra as follows:

$$\mathbf{e}^{(1)} \times \mathbf{e}^{(2)} = i\mathbf{e}^{(3)*}, \tag{11.82}$$

$$\mathbf{e}^{(3)} \times \mathbf{e}^{(1)} = i\mathbf{e}^{(2)*}, \tag{11.83}$$

$$\mathbf{e}^{(2)} \times \mathbf{e}^{(3)} = i\mathbf{e}^{(1)*}. \tag{11.84}$$

The complex circular basis is the natural basis for states of circular polarization of the electromagnetic field. The basis can be any basis with O(3) symmetry that is different form the Cartesian basis defined by:

$$\mathbf{i} \times \mathbf{j} = \mathbf{k}, \tag{11.85}$$

$$\mathbf{k} \times \mathbf{i} = \mathbf{j}, \tag{11.86}$$

$$\mathbf{j} \times \mathbf{k} = \mathbf{i}. \tag{11.87}$$

The presence of a is a fundamental geometrical or topological requirement. For example the well known B(3) field of electromagnetism [2] - [11] is defined by the conjugate product of non-linear optics as follows:

$$\mathbf{B}^{(3)*} = -ig\mathbf{A}^{(1)} \times \mathbf{A}^{(2)} \tag{11.88}$$

using the complex circular basis. Here $\mathbf{A}^{(1)}$ and $\mathbf{A}^{(2)}$ are complex conjugates and describe a state of circular polarization. Therefore φ^a is the scalar potential in a state of polarization denoted a, $\mathbf{A}^a$ is the vector potential of the same state. The spin connection is defined in general by two indices, a and b, and summation occurs over the index b . The spin connection is a four vector:

$$\omega^a_{\mu b} = (\omega^a_{0b}, -\boldsymbol{\omega}^a_b) \tag{11.89}$$

and so is the potential:

$$A^a_\mu = (A^a_0, -\mathbf{A}^a). \tag{11.90}$$

Finally the four derivative is defined as usual by:

$$\partial_\mu = (\frac{1}{c}\frac{\partial}{\partial t}, \boldsymbol{\nabla}). \tag{11.91}$$

Using the fundamental rules of Cartan geometry [1]:

$$\omega^a_{\mu\nu} = \omega^a_{\mu b} q^b_\nu \tag{11.92}$$

which means that the spin connection can be expressed in terms of one index a. The fundamental ECE hypothesis (11.41), together with Eq. (11.39), is then used to deduce that the antiymmetry constraint in ECE theory is:

$$\partial_\mu A^a_\nu + \partial_\nu A^a_\mu + \omega^a_{\mu b} A^b_\nu + \omega^a_{\nu b} A^b_\mu = 0. \tag{11.93}$$

As in previous work the homogeneous field equations of ECE without a magnetic monopole are:

$$\boldsymbol{\nabla} \cdot \mathbf{B}^a = 0, \tag{11.94}$$

$$\boldsymbol{\nabla} \times \mathbf{E}^a + \frac{\partial \mathbf{B}^a}{\partial t} = 0 \tag{11.95}$$

and the inhomogeneous field equations are:

$$\boldsymbol{\nabla} \cdot \mathbf{D}^a = \rho^a, \tag{11.96}$$

$$\boldsymbol{\nabla} \times \mathbf{H}^a - \frac{\partial \mathbf{D}^a}{\partial t} = \mathbf{J}^a \tag{11.97}$$

where $\mathbf{D}^a$ is the electric displacement, ρ^a is the electric charge density, $\mathbf{H}^a$ is the magnetic field strength, and $\mathbf{J}^a$ is the electric current density. The constitutive equations of ECE electrodynamics are:

$$\mathbf{D}^a = \varepsilon_0 \mathbf{E}^a + \mathbf{P}^a, \quad \mathbf{B}^a = \mu_0(\mathbf{H}^a + \mathbf{M}^a) \tag{11.98}$$

where $\mathbf{P}^a$ is the polarization and $\mathbf{M}^a$ the magnetization. Here ε_0 and μ_0 are the S.I. vacuum permittivity and vacuum permeability. More generally, ECE electrodynamics allows for the possible existence of a magnetic charge density and a magnetic current density [2] - [11], so that the right hand sides of Eqs. (11.94) and (11.95) are non-zero. It has been shown [2] - [11] that the magnetic four current density may arise form the interaction of free field electromagnetism and free field gravitation.

Using Eq. (11.92) the ECE engineering model may be linearized, so that the ECE electromagnetic field tensor is:

$$F^a{}_{\mu\nu} = \partial_\mu A^a_\nu + \partial_\nu A^a_\mu + A^{(0)}(\omega^a_{\mu\nu} - \omega^a_{\nu\mu}) \tag{11.99}$$

constrained as follows by antisymmetry:

$$\partial_\mu A^a_\nu + \partial_\nu A^a_\mu + A^{(0)}(\omega^a_{\mu\nu} + \omega^a_{\nu\mu}) = 0. \tag{11.100}$$

In vector notation:

$$\mathbf{E} - \mathbf{E}(\text{connection}) = -\boldsymbol{\nabla}\varphi - \frac{\partial \mathbf{A}}{\partial t}, \tag{11.101}$$

$$\mathbf{B} - \mathbf{B}(\text{connection}) = \boldsymbol{\nabla} \times \mathbf{A} \tag{11.102}$$

where

$$\mathbf{E}(\text{connection}) = cA^{(0)}\boldsymbol{\omega}_E, \tag{11.103}$$

$$\mathbf{B}(\text{connection}) = A^{(0)}\boldsymbol{\omega}_B. \tag{11.104}$$

The electric and magnetic spin connection vectors are:

$$\boldsymbol{\omega}_E = \omega_{XE}\ \mathbf{i} + \omega_{YE}\ \mathbf{j} + \omega_{ZE}\ \mathbf{k}, \tag{11.105}$$

$$\boldsymbol{\omega}_B = \omega_{XB}\ \mathbf{i} + \omega_{YB}\ \mathbf{j} + \omega_{ZB}\ \mathbf{k} \tag{11.106}$$

where:

$$\begin{aligned} \omega_{XE} &= -(\omega_{01} - \omega_{10}), & \omega_{XB} &= -(\omega_{23} - \omega_{32}), \\ \omega_{YE} &= -(\omega_{02} - \omega_{20}), & \omega_{YB} &= -(\omega_{31} - \omega_{13}), \\ \omega_{ZE} &= -(\omega_{03} - \omega_{30}), & \omega_{ZB} &= -(\omega_{12} - \omega_{21}). \end{aligned} \tag{11.107}$$

The electric antisymmetry constraints are therefore:

$$\begin{aligned} \partial_0 A_1 + \partial_1 A_0 + A^{(0)}(\omega_{01} + \omega_{10}) &= 0, \\ \partial_0 A_2 + \partial_2 A_0 + A^{(0)}(\omega_{02} + \omega_{20}) &= 0, \\ \partial_0 A_3 + \partial_3 A_0 + A^{(0)}(\omega_{03} + \omega_{30}) &= 0 \end{aligned} \tag{11.108}$$

and the magnetic antisymmetry constraints are:

$$\begin{aligned} \partial_1 A_2 + \partial_2 A_1 + A^{(0)}(\omega_{12} + \omega_{21}) &= 0, \\ \partial_3 A_1 + \partial_1 A_3 + A^{(0)}(\omega_{31} + \omega_{13}) &= 0, \\ \partial_2 A_3 + \partial_3 A_2 + A^{(0)}(\omega_{23} + \omega_{32}) &= 0. \end{aligned} \tag{11.109}$$

In vector notation Eqs. (11.108) to (11.109) become:

$$-\frac{1}{c}\frac{\partial \mathbf{A}}{\partial t} + \boldsymbol{\nabla} A_0 = -A^{(0)}\boldsymbol{\Omega}_E, \tag{11.110}$$

$$\boldsymbol{\nabla} \times \mathbf{A} = -A^{(0)}\boldsymbol{\Omega}_B \tag{11.111}$$

where:

$$\boldsymbol{\Omega}_E = -(\omega_{01} + \omega_{10})\mathbf{i} - (\omega_{02} + \omega_{20})\mathbf{j} - (\omega_{03} + \omega_{30})\mathbf{k}, \tag{11.112}$$

$$\boldsymbol{\Omega}_B = -(\omega_{23} + \omega_{32})\mathbf{i} - (\omega_{31} + \omega_{13})\mathbf{j} - (\omega_{12} + \omega_{21})\mathbf{k}. \tag{11.113}$$

In summary, for each each state of polarization a:

$$\mathbf{E} - \mathbf{E}(\text{connection}) = -\boldsymbol{\nabla}\varphi - \frac{\partial \mathbf{A}}{\partial t}, \tag{11.114}$$

$$\mathbf{B} - \mathbf{B}(\text{connection}) = \boldsymbol{\nabla} \times \mathbf{A}, \tag{11.115}$$

$$\boldsymbol{\nabla}\varphi - \frac{\partial \mathbf{A}}{\partial t} + \varphi^{(0)}\boldsymbol{\Omega}_E = 0, \tag{11.116}$$

$$\boldsymbol{\nabla} \times \mathbf{A} + \frac{\varphi^{(0)}}{c}\boldsymbol{\Omega}_B = 0. \tag{11.117}$$

Therefore:

$$\mathbf{E}(\text{ECE}) = \mathbf{E} - \mathbf{E}(\text{connection}) = -2\boldsymbol{\nabla}\varphi - \varphi^{(0)}\boldsymbol{\Omega}_E, \tag{11.118}$$

$$\mathbf{B}(\text{ECE}) = \mathbf{B} - \mathbf{B}(\text{connection}) = -\frac{\varphi^{(0)}}{c}\boldsymbol{\Omega}_B. \tag{11.119}$$

For practical applications, spin connection resonance (SCR) [2] - [11] is important, because it is a plausible explanation for the Tesla resonances [12] upon which basis new energy circuits are already being manufactured and marketed [13]. These circuits use the following Euler Bernoulli resonance phenomenon generated by the presence of the spin connection in the equations of ECE electrodynamics. These are the only correct electrodynamics available are present. The presence of SCR has been demonstrated in many ways [2] - [11]. To demonstrate it in the presence of antisymmetry is important, and the demonstration proceeds as follows. For each polarization a , Eq. (11.100) is:

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu + \omega_{\mu b} A^b_\nu - \omega_{\nu b} A^b_\mu. \tag{11.120}$$

To simplify the mathematics without loss of generality, consider the case where there is only one state of polarization present:

$$a = b. \tag{11.121}$$

Then Eq. (11.120) simplifies to:

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu + \omega_{\mu\nu} - \omega_{\nu\mu} \tag{11.122}$$

with the antisymmetry constraint:

$$\partial_\mu A_\nu + \partial_\nu A_\mu + \omega_{\mu\nu} + \omega_{\nu\mu} = 0. \tag{11.123}$$

The electric field from Eq. (11.122) is [2] - [11]:

$$\mathbf{E} = -\boldsymbol{\nabla}\varphi_0 - \frac{\partial \mathbf{A}}{\partial t} - \omega_0 \mathbf{A} + \boldsymbol{\omega}\varphi_0 \tag{11.124}$$

and the magnetic field from Eq. (11.122) is [2] - [11]:

$$\mathbf{B} = \boldsymbol{\nabla} \times \boldsymbol{A} - \boldsymbol{\omega} \times \mathbf{A}. \tag{11.125}$$

The relevant four vectors are:

$$A_\mu = (A_0, -\mathbf{A}) = (\frac{\varphi_0}{c}, -\mathbf{A}), \tag{11.126}$$

$$\omega_\mu = (\omega_0, -\boldsymbol{\omega}), \tag{11.127}$$

$$\partial_\mu = (\frac{1}{c}\frac{\partial}{\partial t}, \boldsymbol{\nabla}) \tag{11.128}$$

with

$$A_0 = \frac{\varphi_0}{c}, \quad \mathbf{A} = \frac{\boldsymbol{\varphi}}{c}. \tag{11.129}$$

In vector notation, the constraint (11.123) for the electric field is:

$$\boldsymbol{\nabla}\varphi_0 - \boldsymbol{\omega}\varphi_0 = \frac{1}{c}\frac{\partial \boldsymbol{\varphi}}{\partial t} + \omega_0 \boldsymbol{\varphi}. \tag{11.130}$$

For each a the Coulomb law without polarization being present is:

$$\boldsymbol{\nabla} \cdot \mathbf{E} = \rho/\varepsilon_0 \tag{11.131}$$

where the electric field strength is:

$$\mathbf{E} = -2(\boldsymbol{\nabla}\varphi_0 - \boldsymbol{\omega}\varphi_0) = -2(\ \frac{1}{c}\ \frac{\partial \boldsymbol{\varphi}}{\partial t} - \omega_0 \boldsymbol{\varphi}). \tag{11.132}$$

In the Coulomb law there is only one, longitudinal polarization:

$$a = (3). \tag{11.133}$$

Therefore:

$$\boldsymbol{\nabla}^2\varphi_0 - (\boldsymbol{\nabla} \cdot \boldsymbol{\omega})\varphi_0 - \boldsymbol{\omega} \cdot \boldsymbol{\nabla}\varphi_0 = -\frac{1}{2}\rho/\varepsilon_0 \tag{11.134}$$

which produces Euler Bernoulli resonance [2] - [11], [14] if $\boldsymbol{\nabla}\cdot\boldsymbol{\omega}$ is negative valued and if the charge density is oscillatory. This is the fundamentally important phenomenon of SCR in the Coulomb law, first evaluated in paper 63 of the ECE series. There are many other types of SCR, and all are Tesla resonances. None occur in U(1) and as argued, U(1) is incorrect.

It is possible to experiment with different solutions of the general antisymmetry constraint (11.123), for example the Lindstrom constraint:

$$\partial_\mu A_\nu = -\omega_\nu A_\mu, \ \ \partial_\nu A_\mu = -\omega_\mu A_\nu. \tag{11.135}$$

In vector notation the Lindstrom constraint is:

$$\mathbf{E} = -2\,(\boldsymbol{\nabla}\ \varphi + \frac{\partial \mathbf{A}}{\partial t}) = -c\omega_0\mathbf{A} + cA_0\boldsymbol{\omega} \tag{11.136}$$

for the electric field strength, and

$$\mathbf{B} = 2\,\boldsymbol{\nabla} \times \mathbf{A} = -2\,\boldsymbol{\omega} \times \mathbf{A} \tag{11.137}$$

for the magnetic flux density. Spin connection resonance is also compatible with the Lindstrom constraint.

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