# Chapter 9

# Potential Anti-Symmetry Equations of Electromagnetic and Gravitational Theory

by

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## Abstract

By use of commutator theory it is shown that there exist fundamental and novel potential anti-symmetry equations in the theory of electromagnetism and gravitation. These change profoundly the way in which the field is related to scalar and vector potentials in the theory of electromagnetism and gravitation. The antisymmetry of the Riemannian connection was inferred in paper 122 of this series, and the methods used in that paper are developed here. It is not known why these straightforward antisymmetries have not been realized before, they mean that a scalar potential in electromagnetism or gravitation cannot be considered in isolation of a vector potential and vice versa. These subject areas must therefore be revised fundamentally. The new equations lead to a simplification and strengthening of the ECE engineering model.

Keywords: Antisymmetric potential equations, electromagnetism, gravitation.

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## 9.1 Introduction

In paper 122 of this series [1] - [10] it was shown by straightforward use of the commutator [11] of covariant derivatives that the Riemannian connection is antisymmetric. This finding has profound consequences for standard gravitational theory in physics, because the latter is incorrectly based on a symmetric Riemannian connection and is therefore rendered obsolete by paper 122. The standard theory of gravitation and standard cosmology have been replaced by the Einstein Cartan Evans (ECE) dynamical field equations based correctly on Cartan geometry with finite torsion. In Section 2 the simple proof of the antisymmetry of the Riemannian connection is reviewed as an introduction to the commutator method as used in electromagnetism. In a manner precisely analogous to the use of the commutator in gravitational theory, the method results in new and powerful potential antisymmetry equations of electromagnetism on the ECE level, and also in the O(3) and U(1) symmetry gauge field theories of electromagnetism [1] - [10]. In Section 3 some consequences are discussed, the main one being that it is not correct to consider a scalar potential in isolation of a vector potential and vice versa, as is the habit in the standard model of electrodynamics and gravitation. Use of the antisymmetric potential equations simplifies and strengthens the ECE engineering model [1] - [10].

## 9.2 Commutator Method and Antisymmetry Equations

The proof of the antisymmetry of the Riemannian connection is simple. It is well known that the Riemannian curvature and torsion are produced simultaneously by the action of the commutator of covariant derivatives on any tensor in any dimension [1] - [11]. If the commutator acts on a vector in four dimensions, the governing equation is the very fundamental:

$$[D_\mu, D_\nu]V^\rho = R^\rho{}_{\sigma\mu\nu}V^\sigma - T^\lambda{}_{\mu\nu}D_\lambda V^\rho \tag{9.1}$$

where $V^\rho$ is the vector, $R^\rho{}_{\sigma\mu\nu}$ is the Riemannian curvature, $T^\lambda{}_{\mu\nu}$ is the Riemannian torsion, and where $D_\lambda$ denotes covariant derivative, defined by the Riemannian connection $\Gamma^\lambda_{\mu\nu}$ as follows:

$$D_\lambda V^\rho = \partial_\lambda V^\rho + \Gamma^\rho_{\lambda\sigma}V^\sigma \tag{9.2}$$

By definition [1] - [11] the commutator is antisymmetric:

$$[D_\mu, D_\nu]V^\rho = -[D_\nu, D_\mu]V^\rho. \tag{9.3}$$

The Riemannian torsion is defined by:

$$T^\lambda{}_{\mu\nu} = \Gamma^\lambda_{\mu\nu} - \Gamma^\lambda_{\nu\mu} \tag{9.4}$$

therefore:

$$[D_\mu, D_\nu]V^\rho = \Gamma^\lambda_{\mu\nu}D_\lambda V^\rho + \ldots \tag{9.5}$$

Now let:

$$\mu \rightarrow \nu, \ \nu \rightarrow \mu \tag{9.6}$$

then

$$[D_\nu, D_\mu]V^\rho = \Gamma^\lambda_{\nu\mu} D_\lambda V^\rho + \dots \tag{9.7}$$

However:

$$[D_\mu, D_\nu]V^\rho = -[D_\nu, D_\mu]V^\rho \tag{9.8}$$

by definition, so:

$$\Gamma^\lambda_{\nu\mu} = -\Gamma^\lambda_{\mu\nu} \tag{9.9}$$

Q.E.D.

It is not known why this fundamental antisymmetry property is ignored in the standard physics of gravitation [11]. The connection can never be symmetric, because if it were, the commutator would be a null operator, and BOTH the torsion and curvature would vanish. It seems that the now obsolete standard physics ignored torsion arbitrarily. In previous papers of this series an entirely new and more powerful cosmology has been inferred from Cartan torsion [1] - [11], in which the torsion is correctly non-zero. Note carefully that the Riemannian torsion is identically non-zero and always antisymmetric in its lower two indices. There is no way in which concepts based on the arbitrary neglect of the Riemannian torsion can have any meaning in physics. Such concepts include big bang, black holes and dark matter - the entire paraphenalia of twentieth century cosmology is incorrect, and astonishing but inevitable conclusion.

It is therefore straightforward to show that there exist fundamental potential antisymmetry equations in electrodynamics, because it is well known [1] - [11] that the commutator method is also used for example in gauge theory. On the ECE level of electromagnetism the electromagnetic field is directly proportional to the Cartan torsion:

$$T^a{}_{\mu\nu} = q^a_\lambda T^\lambda{}_{\mu\nu} \tag{9.10}$$

where $q^a_\lambda$ is the Cartan tetrad. For the sake of illustration these fundamental equations are derived in the U(1) gauge symmetry electromagnetism, known now [1] - [11] to be riddled with errors and thoroughly obsolete. On the U(1) level the argument is quite simple to follow. The commutator of covariant derivatives acts on the gauge field [12] $\psi$ as follows:

$$[D_\mu, D_\nu]\psi = -ig[\partial_\mu, \ A_\nu]\psi \tag{9.11}$$

where g is a constant and $A_\nu$ is the U(1) symmetry electromagnetic four-potential:

$$A_\nu = (A^{(0)}, -\mathbf{A}) \tag{9.12}$$

Now let:

$$\mu \rightarrow \nu, \ \nu \rightarrow \mu, \tag{9.13}$$

then by definition:

$$[D_\mu, D_\nu]\psi = -[D_\nu, \ D_\mu]\psi \tag{9.14}$$

so:

$$[D_\mu, D_\nu]\psi = -[D_\nu, \ D_\mu]\psi. \tag{9.15}$$

The commutator is expanded with the Leibnitz Theorem as follows:

$$\begin{aligned}&[\partial_\mu, D_\nu]\psi = \partial_\mu(A_\nu\psi) - A_\nu(\partial_\mu\psi)\\ &= (\partial_\mu A_\nu)\psi + A_\nu(\partial_\mu\psi) - A_\nu(\partial_\mu\psi)\\ &= (\partial_\mu A_\nu)\psi.\end{aligned} \tag{9.16}$$

Therefore:

$$[\partial_\mu, A_\nu]\psi = (\partial_\mu A_\nu)\psi \tag{9.17}$$

$$[\partial_\nu, A_\mu]\psi = (\partial_\nu A_\mu)\psi \tag{9.18}$$

and Eq. ((9.15)) is:

$$(\partial_\mu A_\nu)\psi = -(\partial_\nu A_\mu)\psi \tag{9.19}$$

giving the new and fundamental potential antisymmetry equations:

$$\partial_\mu A_\nu = -\partial_\nu A_\mu \tag{9.20}$$

on the U(1) level of electromagnetism (Maxwell Heaviside theory). Eqs. (9.20) profoundly change the nature of electric and electronic engineering in all its aspects, and also for example the theory of the Aharonov Bohm effects. They have been inexplicably missed since Heaviside, in the late nineteenth century, first produced the vector equations which are wrongly attributed to Maxwell.

Eqs. (9.20) immediately show that a U(1) gauge symmetry is incorrect and self inconsistent. The basic assertion of U(1) = O(2) gauge symmetry electromagnetism is that there are only transverse states of polarization for an electromagnetic wave propagating in a vacuum. This incorrect assertion is linked to the equally incorrect assertion of identically zero photon mass [1] - [11]. The vector potential plane wave in U(9.1) symmetry electromagnetism is therefore:

$$\mathbf{A} \ = \frac{A^{(0)}}{\sqrt{2}}(i\mathbf{i} + \mathbf{j})e^{i\varphi} \tag{9.21}$$

where the phase is:

$$\varphi = \omega t - \kappa Z. \tag{9.22}$$

Here $\omega$ is the angular frequency at instant t and $\kappa$ the wave number at position Z. Therefore:

$$\frac{\partial \mathrm{A}_X}{\partial \mathrm{Z}} = -i\kappa \mathrm{A}_X = \kappa \frac{\mathbf{A}^{(0)}}{\sqrt{2}} e^{i\varphi}, \tag{9.23}$$

$$\frac{\partial \mathrm{A}_Y}{\partial \mathrm{Z}} = -i\kappa \mathrm{A}_Y = -i\kappa \frac{\mathbf{A}^{(0)}}{\sqrt{2}} e^{i\varphi}. \tag{9.24}$$

However, the antisymmetry law (9.20) means that:

$$\frac{\partial A_Z}{\partial \mathrm{X}} = -\frac{\partial \mathrm{A}_X}{\partial Z} = -\kappa \frac{\mathbf{A}^{(0)}}{\sqrt{2}} e^{i\varphi}, \tag{9.25}$$

$$\frac{\partial A_Z}{\partial \mathrm{Y}} = -\frac{\partial \mathrm{A}_Y}{\partial Z} = i\kappa \frac{\mathbf{A}^{(0)}}{\sqrt{2}} e^{i\varphi}, \tag{9.26}$$

showing immediately that there must be a longitudinal polarization $\mathrm{A}_Z$ .

The U(1) gauge theory of electromagnetism is trivially incorrect [1] - [11] and so is any attempt at a unified field theory based on a U(1) electromagnetic sector symmetry.

Using the de Moivre Theorem:

$$e^{i\varphi} = cos\varphi + isin\varphi \tag{9.27}$$

so:

$$\frac{\partial \mathrm{A}_Z}{\partial \mathrm{X}} = -\kappa \frac{\mathbf{A}^{(0)}}{\sqrt{2}} \cos, \frac{\partial \mathrm{A}_Z}{\partial \mathrm{Y}} = -\kappa \frac{\mathbf{A}^{(0)}}{\sqrt{2}} \sin\varphi \tag{9.28}$$

and

$$(\frac{\partial \mathrm{A}_Z}{\partial \mathrm{X}})^2 + (\frac{\partial \mathrm{A}_Z}{\partial \mathrm{Y}})^2 = \kappa^2 \frac{\mathbf{A}^{(0)2}}{2} \ . \tag{9.29}$$

If cylindrical symmetry is assumed for the sake of simplicity:

$$X = Y \tag{9.30}$$

it is found that:

$$\mathrm{A}_Z = \pm\frac{1}{2}\ X\ \kappa \mathrm{A}^{(0)} \tag{9.31}$$

and there are three senses of space-like polarization. The new antisymmetry equations (9.20) also show straightforwardly that there must be a time-like polarization so that the wave is manifestly covariant [1] - [10] with four physically meaningful senses of polarization as in ECE theory. The potential is physical, not mathematical, so gauge theory is obsolete. It is well known that gauge theory conflicts with photon mass theory [12], because the Proca equation is not gauge invariant. It is well known that all these problems are removed by ECE theory [1] - [10].

In the obsolete U(1) symmetry theory the electric field strength E (volts per metre) is related to the scalar potential $\varphi$ and the vector potential $\mathbf{A}$ by:

$$\mathbf{E} = -\boldsymbol{\nabla}\varphi - \frac{\partial \mathbf{A}}{\partial t} \tag{9.32}$$

The magnetic flux density $\mathbf{B}$ (tesla) is defined by:

$$\mathbf{B} = \boldsymbol{\nabla} \times \mathbf{A}. \tag{9.33}$$

It is claimed in the obsolete physics that a static electric field is defined by:

$$\mathbf{E} =? \ -\boldsymbol{\nabla}\varphi \tag{9.34}$$

and that for a static electric field:

$$\frac{\partial \mathbf{A}}{\partial t} =? \ 0. \tag{9.35}$$

The antisymmetry equations (9.20) show that the assertion (9.35) is fundamentally incorrect, because:

$$\boldsymbol{\nabla}\varphi =? \ \frac{\partial \mathbf{A}}{\partial t} \neq? \ 0 \tag{9.36}$$

The electric field is always defined by Eq. (9.36) in all situations in the natural sciences and engineering. This inference works its way into myriad areas and is of immediate industrial interest.

Similarly in gravitational theory the Newtonian acceleration due to gravity is always defined in the obsolete physics as:

$$\mathbf{g} =? - \boldsymbol{\nabla}\Phi \tag{9.37}$$

where $\Phi$ is the gravitational potential. However, it is straightforward to infer from the unified nature of ECE theory that the gravitational field must be defined in the Newtonian limit by:

$$\mathbf{g} = -\boldsymbol{\nabla}\Phi = -\frac{1}{c}\frac{\partial \boldsymbol{\Phi}}{\partial t} \tag{9.38}$$

where $\boldsymbol{\Phi}$ is the gravitational equivalent of the vector potential $\mathbf{A}$ in electromagnetism. These points are developed in Section 3.

## 9.3 Some Field Potential Equations on the ECE Level

In its electromagnetic sector the fundamental ECE hypothesis is [1] - [10]:

$$A^a_\mu = A^{(0)} q^a_\mu \tag{9.39}$$

where the electromagnetic potential in volts is:

$$\Phi^a_\mu = cA^a_\mu \tag{9.40}$$

The electromagnetic field in the notation of differential geometry is then:

$$F^a_{\mu\nu} = (D \wedge A^a)_{\mu\nu}, \tag{9.41}$$

$$F^a = d \wedge A^a + \omega^a_b \wedge A^b \tag{9.42}$$

which in tensor notation becomes:

$$F^a_{\mu\nu} = \partial_\mu A^a_\nu - \partial_\nu A^a_\mu + \omega^a_{\mu b} A^b_\nu - \omega^a_{\nu b} A^b_\mu \tag{9.43}$$

where $\omega^a_{\mu b}$ is the Cartan spin connection [11]. The presence of the $a$ index is fundamentally important and the index must be retained in order to retain maximum information about the electromagnetic and gravitational fields. The electric field strength is:

$$E^a_{01} = \Phi^{(0)}(\partial_0 q^a_1 - \partial_1 q^a_0 + \omega^a_{0b} q^b_1 - \omega^a_{1b} q^b_0) \tag{9.44}$$

in S.I. units of volts per metre. Using the new antisymmetry laws, the electric field strength is:

$$\begin{aligned} E^a_{01} &= 2\Phi^{(0)}(\partial_0 q^a_1 + \omega^a_{0b} q^b_1) \\ &= -2\Phi^{(0)}(\partial_1 q^a_0 + \omega^a_{1b} q^b_0) \end{aligned} \tag{9.45}$$

where $a$ is defined by the complex circular [1] - [10] representation space:

$$a = (0), (1), (2), (3) \tag{9.46}$$

in four dimensions. The longitudinal component is, in general:

$$\begin{aligned} E^{(3)}_Z &= -2\left(\frac{\partial \Phi^{(3)}_0}{\partial Z} + \omega^{(3)}_{3(0)}\Phi^{(0)}_0 + \omega^{(3)}_{3(1)}\Phi^{(1)}_0 + \omega^{(3)}_{3(2)}\Phi^{(2)}_0 + \omega^{(3)}_{3(3)}\Phi^{(3)}_0\right) \\ &= -2\left(\frac{\partial A^{(3)}_Z}{\partial t} + c(\omega^3_{0(0)} A^{(0)}_Z + \omega^3_{01} A^{(1)}_Z + \omega^3_{02} A^{(2)}_Z + \omega^3_{33} A^{(3)}_Z)\right). \end{aligned} \tag{9.47}$$

However, by definition:

$$A^{(1)}_Z = A^{(2)}_Z = 0 \tag{9.48}$$

so:

$$\omega^{(3)}_{0(1)} A^{(1)}_Z = \omega^{(3)}_{3(1)} \Phi^{(1)}_0 = 0, \tag{9.49}$$

$$\omega^{(3)}_{0(2)} A^{(2)}_Z = \omega^{(3)}_{3(2)} \Phi^{(2)}_0 = 0. \tag{9.50}$$

Therefore the longitudinal electric field strength is:

$$E_Z^{(3)} = -2(\frac{\partial \Phi_0^{(3)}}{\partial Z} + \omega_{3(3)}^{(3)} \Phi_0^{(3)} + \omega_{3(0)}^{(3)} \Phi_0^{(0)}) \tag{9.51}$$

$$= -2(\frac{\partial A_z^3}{\partial t} + c(\omega_{0(0)}^3 A_Z^{(0)} + \omega_{33}^3 A_z^3)) \tag{9.52}$$

and the first two terms give spin connection resonance [1] - [10] in space coordinates and in time. The longitudinal electric field is that of the Coulomb law, so spin connection resonance occurs in the Coulomb law, a discovery of by now acknowledged major importance in the natural sciences and engineering. The result in the obsolete physics:

$$\mathbf{E} =?\ -\boldsymbol{\nabla}\Phi \tag{9.53}$$

can only be obtained by ignoring both the spin connection of general relativity and by ignoring fundamental antisymmetry.

In the gravitational sector of ECE theory the fundamental hypothesis is:

$$\Phi_\mu^a = \Phi^{(0)} q_\mu^a \tag{9.54}$$

where $\Phi_\mu^a$ is the gravitational potential. In tensor notation:

$$g_{\mu\nu}^a = \partial_\mu \Phi_\nu^a - \partial_\nu \Phi_\mu^a + \omega_{\mu b}^a \Phi_\nu^b - \omega_{\nu b}^a \Phi_\mu^b \tag{9.55}$$

The component used in the gravitational attraction of masses is analogous to the electric field strength in the electric attraction or repulsion of charges:

$$g_{01}^a = \Phi^{(0)} (\partial_0 q_1^a - \partial_1 q_0^a + \omega_{0b}^a q_1^b - \omega_{1b}^a q_0^b) \tag{9.56}$$

Therefore we obtain:

$$\begin{aligned} g_Z^{(3)} &= -2(\frac{\partial \Phi_0^{(3)}}{\partial Z} + \omega_{3(3)}^{(3)} \Phi_0^{(3)} + \omega_{3(0)}^{(3)} \Phi_0^{(0)}) \\ &= -2(\frac{1}{c}\frac{\partial \Phi_Z^{(3)}}{\partial t} + \omega_{0(3)}^{(3)} \Phi_Z^{(3)} + \omega_{0(0)}^{(3)} \Phi_Z^{(0)}) \end{aligned} \tag{9.57}$$

using the same methods as given for the electric field strength. There is therefore spin connection resonance in the theory of gravitation, a fact that is of immediate industrial interest in applications such as counter gravitation. The antisymmetry laws of gravitation on the ECE level are:

$$\partial_\mu \Phi_\nu^a = -\partial_\nu \Phi_\mu^a \tag{9.58}$$

$$\omega_{\mu b}^a \Phi_\nu^b = -\omega_{\nu b}^a \Phi_\mu^b \tag{9.59}$$

In the obsolete physics:

$$\mathbf{g} =?\ -\boldsymbol{\nabla}\Phi \tag{9.60}$$

and the spin connection and antisymmetry laws are ignored, thus losing a great deal of important practical information.

ACKNOWLEDGMENTS
The British Government is thanked for the award of a Civil List Pension in 2005 and Armorial bearings in 2008 for contributions to Britain in science. The staffs of AIAS and TGA are thanked for many interesting discussions.

# Bibliography


[1] M. W. Evans, "Generally Covariant Unified Field Theory" (Abramis 2005 to present), volumes 1 - 6, (see www.aias.us).

[2] L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007 and Spanish translation on www.aias.us).

[3] K. Pendergast, "The Life of Myron Evans" (www.aias.us preprint, film script for a film to be directed by Ken Russell).

[4] K. Pendergast, "Crystal Spheres" (www.aias.us).

[5] F. Fucilla (Director), "The Universe of Myron Evans" (52 minute science film, youtube clip).

[6] Accompanying notes to paper 131 and other ECE papers on www.aias.us.

[7] M. W. Evans, Omnia Opera Section of www.aias.us, papers and books from 1992 to present.

[8] M.. W. Evans (ed.), "Modern Nonlinear Optics" (Wiley, 2nd. Ed., 2001); ibid. first edition edited by M. W. Evans and S. Kielich (Wiley 1992, 1993, 1997).

[9] M. W. Evans and L. B. Crowell, "Classical and Quantum Electrodynamics and the B(9.3) Field" (World Scientific, 2001).

[10] M. W. Evans and J.-P. Vigier, "The Enigmatic Photon" (Kluwer, 1994 to 2002, hardback and softback), in five volumes.

[11] S. P. Carroll, "Spacetime and Geometry: an Introduction to General Relativity" (Addison Wesley, New York, 2004, and downloadable 1997 notes).

[12] L. H. Ryder, "Quantum Field Theory" (Cambridge Univ. Press, 1996, 2nd ed.).