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The Interaction of Gravitation and Electromagnetism

Summary. The interaction of gravitation and electromagnetism in Evans field theory is governed by the first Bianchi identity of differential geometry. The Christoffel symbol of the unified field is in general asymmetric in its lower two indices. The Einstein field theory of gravitation is recovered when the Christoffel symbol becomes symmetric and the torsion tensor vanishes. The Maxwell Heaviside field theory of electromagnetism is recovered when the Christoffel symbol becomes antisymmetric. The theory of O(3) electrodynamics is recovered when the Christoffel symbol is antisymmetric and when the tangent bundle index is developed in a complex circular basis. The Evans unified field is described in general by an asymmetric Christoffel symbol. In this case gravitation and electromagnetism are mutually influential. The details of this interaction are found by solving the first Bianchi identity of differential geometry, which is the homogeneous Evans field equation within a C negative scalar. These details are important for the design of major new technologies which take electromagnetic energy from Evans spacetime defined by the asymmetric Christoffel symbol, and for the design of new counter-gravitational aerospace devices.

Key words: Evans field theory; gravitation; electromagnetism; electromagnetic energy from Evans spacetime; counter-gravitational technology.

23.1 Introduction

The Evans field theory [1]–[29] is the first generally covariant unified field theory, and goes beyond the standard model in several ways. An important consequence of the theory is that it is able to describe the interaction of gravitation and electromagnetism, leading to major new technologies. In this note the details of the interaction are defined. These details are important for the acquisition of electromagnetic energy in theoretically unlimited quantities from Evans spacetime, the term given to spacetime with an asymmetric Christoffel symbol. This appellation is a convenient way of distinguishing such a spacetime from the Riemann spacetime with symmetric Christoffel symbol. The latter defines Einstein's theory of gravitation [30] uninfluenced by electromagnetism. It is shown in Section 23.2 that the Einstein and Maxwell-Heaviside field theories are well defined limiting forms of the Evans unified field. However, neither the Einstein nor the Maxwell-Heaviside theory is capable of describing the mutual interaction of gravitation and electromagnetism, for this we must progress beyond the standard model and use the Evans unified field..

In Section 23.2 the Bianchi identity of differential geometry [31] is developed into the homogeneous Evans field equation. This is an identity of differential geometry, and may be developed in tensor notation. The familiar Bianchi identity of Einstein's gravitational field theory is recovered from the Evans homogeneous field equation when the Christoffel symbol becomes symmetric in its lower two indices and when the torsion tensor vanishes in consequence. The homogeneous field equation of the Maxwell Heaviside theory is recovered when the Christoffel symbol becomes antisymmetric. This is because there is no contribution to electromagnetism from a symmetric Christoffel symbol, electromagnetism is spacetime torsion [1]–[29], and the torsion tensor is defined as the difference of two Christoffel symbols:

$$T^{\kappa}{}_{\mu\nu} = \Gamma^{\kappa}{}_{\mu\nu} - \Gamma^{\kappa}{}_{\nu\mu} \tag{23.1}$$

This vanishes if the Christoffel symbol is symmetric, i.e. when:

$$\Gamma^{\kappa}{}_{\mu\nu} = \Gamma^{\kappa}{}_{\nu\mu} \tag{23.2}$$

A powerful new understanding therefore emerges in section two from Evans field theory: gravitation and electromagnetism can be mutually influential if and only if the Christoffel symbol is asymmetric in its lower two indices. Finally in section three a short discussion is given of the implications of this principle for urgently needed new technologies.

23.2 The First Bianchi Identity of Differential Geometry and the Homogeneous Evans Field Equation

The first Bianchi identity of differential geometry is written most succinctly as:

$$D \wedge T = R \wedge q \tag{23.3}$$

where indices have been suppressed to reveal the basic structure of the equation. Here T is shorthand for the torsion form, R shorthand for the curvature or Riemann form, q shorthand for the tetrad form and $D\wedge$ represents the covariant exterior derivative [1]–[29], [31]. Eq. (23.3) is valid in Evans spacetime with asymmetric Christoffel symbol and is the geometrical equation that can be developed as follows into the homogeneous Evans field equation. Multiply both sides of Eq. (23.3) by a C negative scalar-valued potential magnitude $A^{(0)}$ with the units of tesla metres or weber per metre:

$$A^{(0)}D \wedge T = A^{(0)}R \wedge q \tag{23.4}$$

and define:

$$F = A^{(0)}T \tag{23.5}$$

$$A = A^{(0)}q \tag{23.6}$$

to obtain the basic structure of the homogeneous Evans field equation:

$$D \wedge F = R \wedge A \tag{23.7}$$

it is seen that Eq. (23.7) is a restatement of Eq. (23.3), and so Eq. (23.7) is differential geometry. All of physics is causal and objective and is defined by differential geometry, a major advance from the contemporary standard model.

Now start to use the received terminology of electrodynamics to identify F as the electromagnetic field and A as the electromagnetic potential. These terms are used only in deference to the history of physics, because Eq (23.7) governs a new concept: the generally covariant unified Evans field. The homogeneous field equation is developed now as an equation of the tangent spacetime of differential geometry:

$$D \wedge F^a = R^a{}_b \wedge A^b \tag{23.8}$$

for all types of base manifold. The tangent spacetime with Latin indices is a Minkowski spacetime and the base manifold with Greek indices an Evans spacetime. The electromagnetic field F^a is a vector valued two-form of differential geometry [1]–[29], [31], and the electromagnetic potential $A^{(0)}$ is a vector valued one-form. The Riemann tensor$R^a{}_b$ is a tensor valued two-form.

In tensor notation Eq. (23.8) becomes [1]–[29], [31]:

$$D_\mu F^a{}_{\nu\rho} + D_\rho F^a{}_{\mu\nu} + D_\nu F^a{}_{\rho\mu} = -A^b{}_\mu R^a{}_{b\nu\rho} - A^b{}_\nu R^a{}_{b\rho\mu} - A^b{}_\rho R^a{}_{b\mu\nu} \tag{23.9}$$

where:

$$D_\mu F^a{}_{\nu\rho} = \partial_\mu F^a{}_{\nu\rho} + \omega^a{}_{\mu b} F^b{}_{\nu\rho} \quad \text{etc.} \tag{23.10}$$

Here $\omega^a{}_{\mu b}$ is the well-known spin connection of differential geometry, related to the Christoffel connection through the tetrad postulate:

$$D_\mu q^a{}_\nu = 0. \tag{23.11}$$

The Einstein theory of gravitation 30 is the limit:

$$R^\sigma{}_{\mu\nu\rho} + R^\sigma{}_{\nu\rho\mu} + R^\sigma{}_{\rho\mu\nu} = 0. \tag{23.12}$$

In this limit the torsion tensor vanishes because Eq (23.12) implies [31] that the Christoffel symbol is symmetric in its lower two indices. Self consistently therefore, there is no electromagnetism present under condition (23.12), only gravitation. It follows that the Einstein theory cannot be used to describe the mutual influence of gravitation and electromagnetism. For this we need Eq. (23.9) of the unified Evans field. The mutual interaction of gravitation and electromagnetism is however of paramount importance to the urgently needed question of energy acquisition, because only by using Eq. (23.9) can we understand how to obtain electromagnetic energy from Evans spacetime. The existence of this spacetime is the key to clean energy in unlimited quantities.

The Maxwell-Heaviside theory of electromagnetism [32],[33] is the limit of Eq. (23.9) defined by:

$$\partial_\mu F_{\nu\rho} + \partial_\nu F_{\rho\mu} + \partial_\rho F_{\mu\nu} = 0. \tag{23.13}$$

This limit is reached when:

$$d \wedge F^a = 0 \tag{23.14}$$

$$\begin{aligned} j^a &= \frac{1}{\mu_0}\left(R^a{}_b \wedge A^b - \omega^a{}_b \wedge F^b\right) \\ &= 0 \end{aligned} \tag{23.15}$$

$$A^{(0)}\left(R^a{}_b \wedge q^b - \omega^a{}_b \wedge T^b\right) = 0 \tag{23.16}$$

Eqs. (23.14) to (23.16) define a particular type of Evans spacetime and Eq. (23.16) may be rewritten as:

$$\left(\partial_\mu F_{\nu\rho} + \partial_\nu F_{\rho\mu} + \partial_\rho F_{\mu\nu}\right)^a = 0. \tag{23.17}$$

Eq. (23.17) is an equation of the base manifold (i.e. the Evans spacetime) for all indices a of the tangent bundle (Minkowski spacetime). It is inferred that Eq. (23.13) is a special case of Eq. (23.17) when the quantity inside the brackets of Eq. (23.17) vanishes for all a. In the Maxwell Heaviside theory, Eq. (23.13), the latter index is not present. This is therefore the meaning of the Maxwell Heaviside theory - in this limit the tangent spacetime of Evans spacetime has not been defined or recognized to exist (there is no index a in Eq. (23.13)) and in consequence the base manifold has not been distinguished from the tangent spacetime. The two spacetimes have merged conceptually into a single flat spacetime upon which is superimposed a separate nineteenth century concept - the Maxwell Heaviside electromagnetic field. A properly covariant description of electromagnetism always requires the presence of two indices, a and μ. The first realization of this requirement was O(3) electrodynamics, in which the experimentally observable Evans spin field was defined self consistently [1]–[29] for the first time. In O(3) electrodynamics the indices of the tangent spacetime are defined with a complex circular basis whose space components are:

$$a = (1)\,,(2)\,,(3)\,. \tag{23.18}$$

In contrast Eq. (23.9) is generally covariant, i.e. is an equation of general relativity and thus of objective and causal physics. The Maxwell Heaviside field theory was inferred many years before the development of relativity, in an era when the electromagnetic field was considered to be an entity superimposed on separated space and time. Apart from the fusion of space and time into a four dimensional Minkowski ("flat") spacetime, this description and concept are still the ones adhered to in the contemporary standard model. This is not, however, a generally covariant description as required by general relativity (causal and objective physics). In the standard model the electromagnetic field is the archetypical field of special relativity. In the Evans field theory it is part of a generally covariant unified field, and due to the spinning and curving of Evans spacetime. In consequence the standard model loses a great deal of key information. It can be seen that Eq. (23.13) is a drastic simplification of Eq. (23.9) and so both the Einstein and Maxwell-Heaviside field theories are incomplete. Similarly, special relativity (developed about 1887 to1905) showed that Newtonian physics is incomplete.

23.3 Discussion

The unified Evans field theory is generally covariant in all its sectors [1]–[29] and shows that there are many hitherto unknown effects in nature which can be harnessed for the good of humankind. For example:

1. Gravitation has effects on electromagnetism and the latter may be generated from Evans spacetime. Prototype devices based on this inference are already available and have been shown to be reproducible and repeatable [34]. Hopefully they will lead to the replacement of fossil fuel and the elimination of harmful emissions therefrom.
2. Electromagnetism has effects on gravitation, leading in principle to various new aerospace technologies based on the counter-gravitational effect of an on-board electromagnetic field.

Eq (23.14) may be re-expressed as:

$$(D \wedge \omega) \wedge q = \omega \wedge (D \wedge q) \tag{23.19}$$

so Maxwell Heaviside field theory may be more fully identified as:

$$\omega^a{}_b = -\kappa \epsilon^a{}_{bc} q^c \tag{23.20}$$

In Maxwell Heaviside theory in free space, appropriate to the homogeneous field equation, the d'Alembert wave equation becomes:

$$\Box A_\sigma = 0 \tag{23.21}$$

and so:

$$\Box A^a{}_\sigma = \mu_0 \tilde{j}^a{}_\sigma \tag{23.22}$$

Eq. (23.22) can now be identified as a special case of the Evans Lemma 1-29:

$$\Box A^{a}{}_{\mu} = R A^{a}{}_{\mu} \tag{23.23}$$

where R is scalar curvature (not to be confused with the shorthand R in Eq. (23.3)).

This example shows that the Evans field theory is capable of giving a good deal of new insight to the meaning both of the Einstein and the Maxwell Heaviside field theories. This is the hallmark or characteristic of a paradigm shift: a new theory gives extra meaning to older theories to which it reduces in well defined limits.

Non-linear optics, for example [1]–[29], has shown in many ways that the Maxwell Heaviside theory is incomplete. One non-linear optical effect led to the inference of the Evans spin field $\boldsymbol{B}^{(3)}$ and subsequently O(3) electrodynamics. This effect is magnetization by a circularly polarized electromagnetic field, the inverse Faraday effect, whose magnetization is due to the Evans spin field:

$$\boldsymbol{B}^{(3)*} = -ig\boldsymbol{A}^{(1)} \times \boldsymbol{A}^{(2)} \tag{23.24}$$

It is seen that the well known conjugate product of potentials $\boldsymbol{A}^{(1)} \times \boldsymbol{A}^{(2)}$ has been defined in terms of the tangent bundle indices (1) and (2). Thus, O(3) electrodynamics is recognized as another well defined limiting form of Eq. (23.9):

$$j^{a} \rightarrow 0 \tag{23.25}$$

in which the tangent bundle index a appears and is well defined.

It may be deduced with great confidence that Eq. (23.3) (or equivalently Eqs. (23.7) to (23.9)) is the ONLY way to develop a unified field theory based on the principle of objectivity in physics, the principle of general relativity. Without objectivity, physics to one observer would be different from physics to another observer. Objectivity in physics was recognized by Einstein to be a manifestation of geometry, and differential geometry is the only type of geometry that is self-consistently capable of describing both torsion and curvature [31], the spinning and curving of Evans spacetime. The other governing principle of physics is causality, any event has a cause. Causal and objective physics therefore inexorably leads us to differential geometry. Conversely, differential geometry gives us physics. There are two main governing equations in physics, Eq. (23.9) and the Evans wave equation:

$$\left(\Box + kT\right) q^{a}{}_{\mu} = 0. \tag{23.26}$$

The subsidiary proposition leading to Eq. (23.26) is the Evans Lemma [1]–[29]:

$$\Box q^{a}{}_{\mu} = R q^{a}{}_{\mu}. \tag{23.27}$$

Eq. (23.27) is an identity of differential geometry. It states that:

$$D^{\mu}\left(D_{\mu} q^{a}{}_{\nu}\right) = 0 \tag{23.28}$$

and thus originates [1]–[29] in the well-known tetrad postulate (23.11).

$$D^{\mu}D_{\mu} = \Box - R. \tag{23.29}$$

The wave equation is obtained from the Lemma using a generalization of Einstein's field equation of gravitation to all radiated and matter fields. In index contracted form:

$$R = -kT \tag{23.30}$$

where R is scalar curvature, k is Einstein's constant and T is the index contracted canonical energy momentum tensor (not to be confused with the shorthand torsion symbol T in Eq. (23.3)).

So these are the concepts and equations upon which to build the urgently needed new technologies mentioned already. Heisenberg uncertainty and Bohr complementarity have recently been refuted experimentally [35],[36] using for example advanced microscopy and careful Young interference experiments. In contrast Einsteinian objectivity (general relativity) and de Broglie wave particle dualism have withstood the test of experiment. The copious experimental evidence for the Evans spin field and O(3) electrodynamics is summarized in the literature [1]–[29].

Finally the multi-disciplinary Pinter hypothesis [37] argues that life evolved in a rigorously causal manner from the Evans unified field, in other words there would be no life on earth without the existence of a generally covariant unified field and without the interaction of gravitation and electromagnetism.

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