THE OBJECTIVE LAWS OF CLASSICAL ELECTRODYNAMICS: THE EFFECT OF GRAVITATION ON ELECTROMAGNETISM.

by

Myron W. Evans,

Alpha Institute for Advanced Study (AIAS),

emyrone@aol.com.

ABSTRACT

The four fundamental laws of classical electrodynamics are given in generally covariant form using the principles of differential geometry. In so doing it becomes possible to analyze in detail the effect of gravitation on electromagnetism. This development completes Einstein's generally covariant field theory of gravitation and shows that there is present in nature a source of electric power from the general four dimensional manifold. It is also shown that an electromagnetic field can influence gravitation, and there are major implications for power engineering and aerospace industries.

Keywords: generally covariant classical electrodynamics; Evans field theory; electric power from spacetime; the interaction of gravitation and electromagnetism.

26th Paper of the Unified Field Theory

1. INTRODUCTION

In order that physics be an objective subject it must be a theory of general relativity, in which ALL the equations of physics must be generally covariant. This is a well known and well accepted principle of natural philosophy first proposed by Einstein {1}who based his development on the philosophical ideas of Mach. Without this most fundamental principle there can be no objective knowledge (or science) of nature. However, the contemporary standard model does not conform correctly to this principle, because only gravitation is treated objectively. Classical electrodynamics in the standard model is a theory of special relativity, covariant only under the Lorentz transform {2-4} and unobjective under any other type of coordinate transformation. In other words electrodynamics in the standard model in general means different things to different observers. This is fundamentally unacceptable to natural philosophy and science, the objective observation of nature. In science, nature is objective to all observers, and if not we have no science (from the Latin word for "knowledge"). Furthermore the field theories of gravitation and electromagnetism in the standard model are conceptually different {4}. Gravitation is essentially a special case of Riemann geometry within Einstein's constant k, electromagnetism is a distinct, abstract, entity superimposed on the Minkowski ("flat") spacetime. It is well known that the origins of contemporary classical electrodynamics go back to the eighteenth century, to an era when space and time were also considered as distinct philosophical entities, not yet unified into spacetime. The contemporary standard model is still based on this mixture of concepts and is the result of history rather than reason.

In order to unify electromagnetism and gravitation in a correctly objective manner, it has been shown recently {5-36} that physics must be developed in a four dimensional manifold defined by the well known principles of differential geometry, notably the two Maurer Cartan structure equations, the two Bianchi identities, and the tetrad postulate {3}.

The Einstein field theory of gravitation is essentially a special case of differential geometry, and electromagnetism is described by the first Bianchi identity within a fundamental voltage. Gravitation and electromagnetism are unified naturally by the structure of differential geometry itself. This means that one type of field can influence the other, leading to the possibility of new technology as well as being a major philosophical advance. In the last analysis gravitation and electromagnetism are different manifestations of the same thing, geometry. This is hardly a new idea in physics, but the Evans theory {5-36} is the first correct unified field theory to be based on well accepted Einsteinian principles.

In this paper the four laws of classical electrodynamics are developed in correctly covariant form from the first Bianchi identity of differential geometry. In the standard model these four laws together constitute the Maxwell Heaviside theory of the electromagnetic sector. The standard model is fundamentally or qualitatively unable to analyze the important effects of gravitation on electrodynamics because the two fields are treated differently as described already. String theory makes matters worse by the introduction of adjustable mathematical parameters known optimistically as "dimensions". These have no physical significance and this basic and irremediable flaw in string theory originated a few years after the Einstein theory of 1916 in the fundamentally incorrect introduction of an unphysical fifth dimension in an attempt to unify gravitation with electromagnetism. The Evans field theory {5-35} achieves this aim by correctly using only the four physical dimensions of relativity, the four dimensions of spacetime. String theory should therefore be abandoned in favor of the simpler and much more powerful Evans field theory, which is the direct and logical outcome of Einstein's own work.

In Section 2 the correctly objective laws of classical electrodynamics are developed straightforwardly from the first Bianchi identity. The objective form of the Gauss law applied to magnetism and of the Faraday law of induction is obtained from the Bianchi identity itself, and the objective form of the Coulomb law and Ampère Maxwell law is obtained from the appropriate Hodge duals used in the Bianchi identity. Therefore all four laws become a direct consequence of the first Bianchi identity of differential geometry. Within a scalar $A^{(0)}$ with the units of volt s / m the electromagnetic field is the torsion form and the electromagnetic potential is the tetrad form. In Section 3 a discussion is given of some of the major consequences of these objective laws of classical electrodynamics.

2. THE OBJECTIVE LAWS OF CLASSICAL ELECTRODYNAMICS.

The first Bianchi identity of differential geometry is well known to be {3}:

$$D \wedge T^a = R^a{}_b \wedge q^b . \quad -(1)$$

Here D ^ denotes the covariant exterior derivative, d ^ is the exterior derivative, T^a is the torsion form and $R^a{}_b$ is the curvature form, also known as the Riemann form. The covariant exterior derivative is defined {3} as:

$$D \wedge T^a = d \wedge T^a + \omega^a{}_b \wedge T^b , \quad -(2)$$

where $\omega^a{}_b$ is the spin connection of differential geometry. As is customary in differential geometry {3} the indices of the base manifold are suppressed (not written out), because they are always the same on both sides of any equation of differential geometry. Therefore only the indices of the tangent bundle are given in Eq. (1). The first Bianchi identity is therefore:

$$d \wedge T^a = -\left(q^b \wedge R^a{}_b + \omega^a{}_b \wedge T^b \right) \quad -(3)$$

which implies the existence of the base manifold indices as follows:

$$d \wedge T^a_{\mu\nu} = -\left(q^b \wedge R^a{}_{b\mu\nu} + \omega^a{}_b \wedge T^b_{\mu\nu}\right). \quad -(4)$$

The basic axiom of differential geometry is that in a given base manifold there is a tangent bundle to that base manifold at a given point {3}. The tangent bundle was not used by Einstein in his field theory of gravitation, Einstein considered and needed only the restricted base manifold geometry defined by the Christoffel symbol and metric compatibility condition {3}. These considerations of Einstein were sufficient to describe gravitation, but not to unify gravitation with electromagnetism. No one knew this better than Einstein himself, who spent thirty years (1925 - 1955) in attempting objective field unification in various ways.

The Bianchi identity (3) becomes the equations of electrodynamics using the following fundamental rules or laws:

$$A^a_\mu = A^{(0)} q^a_\mu, \quad -(5)$$

$$F^a_{\mu\nu} = A^{(0)} T^a_{\mu\nu}, \quad -(6)$$

defining the electromagnetic potential A^a_μ, and the electromagnetic field $F^a_{\mu\nu}$. These appellations are used only out of habit, because both A^a_μ and $F^a_{\mu\nu}$ have now become parts of the unified field, i.e. of electromagnetism influenced by gravitation (or vice versa). The homogeneous field equation of the Evans field theory (HE equation) is therefore:

$$d \wedge F^a = -A^{(0)}\left(q^b \wedge R^a{}_b + \omega^a{}_b \wedge T^b\right) \quad -(7)$$

and the homogeneous current of the HE is:

$$j^a = -\frac{A^{(0)}}{\mu_0}\left(q^b \wedge R^a{}_b + \omega^a{}_b \wedge T^b\right). \quad -(8)$$

When this current vanishes the HE becomes:

$$d \wedge F^a = 0 \quad -(9)$$

and is for each index a the homogeneous field equation of the Maxwell Heaviside theory:

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

Equation (10) is a combination in differential form notation {3} of the Gauss law applied to magnetism:

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(11)$$

and of the Faraday law of induction:

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0}. \quad -(12)$$

These two laws are well tested experimentally so the homogeneous current must be very small or zero within contemporary instrumental precision. These experimental considerations define the "free space condition":

$$R^a{}_b \wedge q^b = \omega^a{}_b \wedge T^b. \quad -(13)$$

In general relativity however the homogeneous current may be different from zero, and so general relativity means that the Gauss law and Faraday induction law are special cases of a more general theory. This is the objective theory given by the HE. Similarly it will be shown that the Coulomb and Ampère Maxwell laws are special cases of the inhomogeneous equation (IE) of the Evans field theory. The IE is deduced from the HE using the appropriate Hodge duals, those of F^a and $R^a{}_b$. Therefore objective classical electrodynamics is deduced entirely from the Bianchi identity (1) using the rules (5) and (6). Within contemporary instrumental precision the HE can therefore be written in differential form notation as Eq. (9).

In tensor notation this becomes {3}:

$$\partial_\mu F^a_{\nu\rho} + \partial_\rho F^a_{\mu\nu} + \partial_\nu F^a_{\rho\mu} = 0 \qquad -(14)$$

and this is the same equation as:

$$\partial_\mu \tilde{F}^{a\mu\nu} = 0 \qquad -(15)$$

where:

$$\tilde{F}^{a\mu\nu} = \frac{1}{2} |g|^{1/2} \epsilon^{\mu\nu\rho\sigma} F_{\rho\sigma} \qquad -(16)$$

is the Hodge dual tensor defined {3} by:

$$|g| = |g_{\mu\nu}|. \qquad -(17)$$

In Eq. (16) $|g|^{1/2}$ is the positive square root of the metric determinant {3}. This is a scalar and its exterior derivative vanishes, implying through the Leibniz Theorem that:

$$d \wedge |g|^{1/2} = 0. \qquad -(18)$$