

## Rebuttal of Remarks by Hehl

by

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### Abstract

Some subjective remarks by Hehl on Einstein Cartan Evans theory are corrected straightforwardly. It is shown that Hehl uses the  $U(1)$  gauge group for electromagnetism, whereas ECE concludes that this is not the group of electromagnetism. Hehl incorrectly asserts that the tetrad and torsion forms are not covariant, and ignores approximately thirty discriminating experimental tests of ECE theory.

**Keywords:** Einstein Cartan Evcans (ECE) field theory, incorrect remarks by F. W. Hehl.

### 3.1 Introduction

Recently, Einstein Cartan Evans (ECE) field theory has been used to develop a generally covariant unified field theory which has been accepted by the scientific community [1–10]. The ECE theory has been tested experimentally in approximately thirty ways, each intended to be a test where the Maxwell Heaviside theory fails or is not applicable. ECE theory and its precursor gauge theories [1–10] have appeared in about fifteen different refereed journals and books over fourteen years of development, and is therefore a valid theory by any accepted measure. Despite this, F. W. Hehl [11] has attempted to reject the ECE Ansatz by purely subjective assertion, thus violating the basic Baconian principle of natural philosophy, that a hypothesis may be made freely,

and tested experimentally. In so doing he has made surprisingly elementary errors which are corrected in this rebuttal.

### 3.2 Cartan Riemann Geometry

The equations (3.1) to (3.5) of Hehl are the same as those used in ECE theory. Hehl's equations (3.2) and (3.3) are the first and second Cartan structure equations, and his equations (3.4) and (3.5) are the first and second Bianchi identities. Therefore Hehl uses precisely the same Cartan geometry as ECE theory. His equation (3.1) is related to the tetrad postulate of ECE theory. Hehl claims that Cartan geometry may be derived from a lagrangian. This appears to be the only point of originality in his work. The notation used in his equations (3.1) to (3.5) is abstract and nearly incomprehensible to working scientists, whereas ECE theory has been developed meticulously in form, tensor and vector notation, and applied using computation methods [1–10]. Hehl makes no attempt to compare his theory with experimental data for which MH fails. This is a violation of the Baconian principle that a theory must be tested against sufficiently discriminating data. A theory cannot be refuted by another theory or by mere subjective assertion. A theory is not restricted to lagrangian development.

The subjective assertion made by Hehl is that classical electrodynamics must be a gauge theory, and must have U(1) symmetry. This is the Maxwell Heaviside (MH) theory, which fails [1–10] to describe the data that ECE successfully reproduces. Hehl ignores all the experimental evidence in favor of ECE and against MH. In other words Hehl ignores the work of the past fourteen years mentioned in the introduction, and therefore violates the Baconian principles of natural philosophy. He is therefore a pseudo-scientist because science is governed by the Baconian philosophy. It may be stated that natural philosophy (physics) is Baconian philosophy.

The ECE hypothesis or ansatz is a simple one, that the electromagnetic field is the Cartan torsion within a proportionality factor  $A^{(0)}$ , where  $cA^{(0)}$  has the units of volts. The electromagnetic potential is the tetrad within the same factor, thus:

$$A_{\mu}^a = A^{(0)} q_{\mu}^a, \quad (3.1)$$

$$F_{\mu\nu}^a = A^{(0)} T_{\mu\nu}^a. \quad (3.2)$$

The inverse Faraday effect [1–10] shows that there exists in non-linear optics a conjugate product of vector potentials such as plane wave potentials, one being the complex conjugate of the other:

$$\mathbf{A}^{(1)} = \mathbf{A}^{(2)*} = \frac{A^{(0)}}{\sqrt{2}} (\mathbf{i} - i\mathbf{j}) e^{i\phi} \quad (3.3)$$

where  $\phi$  is the electromagnetic phase. The conjugate product defines the ECE spin field which was introduced in 1992 [12]:

$$\mathbf{B}^{(3)*} = -ig\mathbf{A}^{(1)} \times \mathbf{A}^{(2)}. \quad (3.4)$$

So in addition to the  $\mu$  index:

$$\mu = ct, X, Y, Z \quad (3.5)$$

there exists the  $a$  index:

$$a = (0), (1), (2), (3) \quad (3.6)$$

The basic postulate of the ECE theory is to identify the  $a$  and  $\mu$  indices of the inverse Faraday effect with those of the tetrad, as in Eq. (3.1). Spin is inherent in the electromagnetic field as is well known. The basis for this hypothesis was worked out in many papers and books [1–10] from 1992 to present. Hehl ignores all this literature in an arbitrary manner. This means that Hehl is a pseudo-scientist because he does not follow the Baconian philosophy, ignores well accepted scholarship, and also ignores experimental data which are well known, and well known to have been analyzed by ECE theory [1–10]. Many papers of ECE theory have dealt with the frame definitions needed to define  $a$  and  $\mu$ . Again, Hehl ignores all this work. The Lagrangian for ECE theory has been found and again this fact is ignored by Hehl. The latter then uses his ignorance to reject a journal submission, a process which is null and void.

Finally Hehl makes some basic errors of mathematics by asserting that geometrical forms are not generally covariant. The general covariance of the tetrad and Cartan torsion are well known, because both are mixed index tensors, and their general covariance has been described in great detail [1–10] in publications which are again ignored by Hehl.

## Conclusion

This is an intellectually dishonest and unscientific attempt by an editor to censor a valid theory which is widely accepted by the physics community.

## Acknowledgments

Parliament is thanked for the award of a Civil List Pension, an appointment and high honour intended to express in Victorian terms “the gratitude of the Nation” (1837 Act) for distinguished services to Britain and the Commonwealth in science. The staff of AIAS and many others are thanked for interesting discussions.

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