THE GENERAL COVARIANCE OF THE B CYCLIC THEOREM

by

M. W. Evans

Civil List,

Doctor in Scientia, University of Wales,

Sometime JRF Wolfson College, Oxford,

Sometime Ramsay Memorial Fellow, University of London.

www.webarchive.org.uk, www.aias.us , www.atomicprecision.com, www.upitec.org,

www.et3m.net

ABSTRACT

The general covariance of the B Cyclic Theorem is proven straightforwardly and in detail. The Lorentz covariance of the B Cyclic Theorem is a special case of the general covariance. The proof proceeds by reducing the B Cyclic Theorem to the frame of reference, which is generally covariant by definition. The B Cyclic Theorem demonstrates that the existence of transverse spacelike modes of electromagnetic radiation implies that of the longitudinal spacelike mode. This is an obvious result which is denied obscurely in the obsolete standard model of physics.

Keywords: ECE theory, B cyclic theorem, frame of reference, general covariance.

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1. INTRODUCTION

The B Cyclic Theorem {1 - 10} is a straightforward demonstration of the existence of the longitudinal magnetic flux density always associated with circularly polarized radiation, the $\underline{B}^{(3)}$ field. The theorem proves that there is a cyclical relation between the transverse magnetic flux density, $\underline{B}^{(1)}$, its complex conjugate, the transverse $\underline{B}^{(2)}$, and the longitudinal $\underline{B}^{(3)}$. The existence of the transverse modes implies the existence of the longitudinal mode, an entirely simple result. However, the now obsolete dogma of the standard model {11, 12} of physics asserts that $\underline{B}^{(3)}$ does not exist, despite the fact that it is a routine observable of the inverse Faraday effect. The previous paper in this series, UFT 184 (www.aias.us) reviews the tortuous arguments of the old physics. The B Cyclic Theorem is generally covariant because it reduces to the cyclic relation between unit vectors of the complex circular group. Basis vectors are generally covariant by definition {12}. In Section 2 the B Cyclic Theorem is reduced to the cyclic relation between unit vectors of the complex circular basis: $\underline{e}^{(1)}$, $\underline{e}^{(2)}$, and $\underline{e}^{(3)}$. Each unit vector is generally covariant, and the reason for this is that the complete vector field is invariant under the general coordinate transform. The Lorentz transform is a special case, so each unit vector is Lorentz covariant. The Lorentz covariance is given in detail.

2. DETAILS OF THE PROOF

The B Cyclic Theorem {1 - 10} is:

$$\underline{B}^{(1)} \times \underline{B}^{(2)} = i B^{(0)} \underline{B}^{(3)*} \quad -(1)$$

et cyclicum

where:

$$\underline{B}^{(1)} = \underline{B}^{(2)*} = \frac{B^{(0)}}{\sqrt{2}} \left(\underline{i} - i \underline{j} \right) e^{i\phi} \quad -(2)$$

and where:

$$\underline{B}^{(3)} = \underline{B}^{(3)*} = B^{(0)}\underline{k}. \quad -(3)$$

Here B denotes magnetic flux density in a radiated electromagnetic field, and ϕ is the phase. Define the unit vectors of the complex circular basis by:

$$\underline{e}^{(1)} = \underline{e}^{(2)*} = \frac{1}{\sqrt{2}}\left(\underline{i} - i\underline{j}\right), \quad -(4)$$

$$\underline{e}^{(3)} = \underline{k}, \quad -(5)$$

where $\underline{i}$, $\underline{j}$ and $\underline{k}$ are the Cartesian unit vectors. By simple algebra Eq. (1) reduces to:

$$\underline{e}^{(1)} \times \underline{e}^{(2)} = i\,\underline{e}^{(3)*} \quad -(6)$$

et cyclicum

which is the cyclical property of the frame of reference, a relation between unit vectors or basis elements. Eq. (6) has the same cyclical symmetry as that between the Cartesian unit vectors:

$$\underline{i} \times \underline{j} = \underline{k}. \quad -(7)$$

et cyclicum

The complete vector field {12} is invariant under the general coordinate transformation as follows:

$$V = V^{\mu} e_{\mu} = V^{\mu'} e_{\mu}' \quad -(8)$$

where V^{μ} denote components and where e_{μ} denote basis elements. The components of the unit vector are denoted e^{μ}, and for unit vectors:

$$V = e^{\mu} e_{\mu} = e^{\mu'} e_{\mu}' \quad -(9)$$

and the complete vector field is the covariant contravariant product (9) of unit vectors.

Consider the Lorentz transformation, a special case {12} of the general coordinate transformation. Under the Lorentz transformation the contravariant unit vector becomes:

$$e^{\mu'} = \Lambda^{\mu'}{}_{\mu} e^{\mu} \quad -(10)$$

where $\Lambda^{\mu'}{}_{\mu}$ is the Lorentz matrix {12}. So the unit vector is Lorentz covariant by definition, Q. E. D. A Lorentz covariant equation contains elements that are each Lorentz covariant, so Eqs.

(1), (6) and (7) are Lorentz covariant by definition, Q. E. D. This means that $\underline{B}^{(3)}$ always exists in circularly polarized radiation. The standard model on the other hand is not Lorentz covariant because it violates the definitions (6) and (7) of frame of reference in that $\underline{e}^{(1)}$ and its complex conjugate $\underline{e}^{(2)}$ exist, but $\underline{e}^{(3)}$ does not exist if $\underline{B}^{(3)}$ does not exist. So in the old standard dogma, $\underline{k}$ does not exist. This is the clearest demonstration of the absurdity of the standard dogma, known as U(1) gauge invariance.

Consider the Lorentz boost matrix {12}:

$$\Lambda^{\mu'}{}_{\mu} = \begin{bmatrix} \cosh\phi & -\sinh\phi & 0 & 0 \\ -\sinh\phi & \cosh\phi & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \quad -(11)$$

The inverse Lorentz boost matrix is:

$$\Lambda^{\mu'}{}_{\mu} = \begin{bmatrix} \cosh\phi & \sinh\phi & 0 & 0 \\ \sinh\phi & \cosh\phi & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \quad -(12)$$

and the covariant unit vector transforms as:

$$e_{\mu'} = \Lambda^{\mu}{}_{\mu'} e_{\mu}. \quad -(13)$$

This gives the results:

$$e^{0\prime} = e^{0}\cosh\phi - e^{1}\sinh\phi \quad , e^{2\prime} = e^{2}, \quad -(14)$$
$$e^{1\prime} = -e^{0}\sinh\phi + e^{1}\cosh\phi, \; e^{3\prime} = e^{3},$$

and

$$e_0' = e_0\cosh\phi + e_1\sinh\phi, \quad e_2' = e_2, \quad -(15)$$
$$e_1' = e_0\sinh\phi + e_1\cosh\phi, \quad e_3' = e_3.$$

It is seen that:

$$e^{0\prime} = (\cosh\phi - \sinh\phi)\, e^{0} \quad -(16)$$

and

$$e^{1\prime} = (\cosh\phi - \sinh\phi)\, e^{1}. \quad -(17)$$

In vector notation:

$$\underline{i}' = (\cosh\phi - \sinh\phi)\, \underline{i} \quad -(18)$$

with:

$$\cosh\phi = \gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}, \quad \sinh\phi = \frac{v}{c}\gamma. \quad -(19)$$

Therefore under the Lorentz boost defined above:

$$\underline{i}' = \left(\frac{1 - v/c}{1 + v/c}\right)^{1/2} \underline{i}. \quad -(20)$$

This is a Lorentz covariant result because the tensorial structure is maintained intact, which means that $\underline{i}^{\prime}$ is a scalar multiplied by $\underline{i}$. The other two unit vectors $\underline{j}$ and $\underline{k}$ are not changed by this type of Lorentz boost. Therefore:

$$\underline{j}^{\prime} \times \underline{k}^{\prime} = \underline{j} \times \underline{k} \quad -(21)$$

and

$$\underline{i}^{\prime} = \left(\frac{1 - v/c}{1 + v/c} \right)^{1/2} \underline{j}^{\prime} \times \underline{k}^{\prime} \quad -(22)$$

which means that the cyclical structure of Eq. (7) becomes Eq. (22). The cyclical structure is maintained, and is Lorentz and indeed generally covariant, Q. E. D. When v is zero the two equations (7) and (22) become the same. The B Cyclic Theorem always applies to electromagnetic radiation propagating at the speed of light c. It makes no sense therefore to apply a Lorentz boost to the B Cyclic Theorem unless v is zero, because c is the maximum speed allowed in relativity. In order for c to be hypothetically exceeded, v must be greater than c in Eq. (22), so $\underline{i}^{\prime}$ would be imaginary valued, reductio ad absurdum. Note carefully that the existence of $\underline{B}^{(3)}$ implies a rigorously non zero photon mass, meaning that c is no longer the velocity of the photon, the constant c is an upper bound of the theory. The photon mass is thought to be very small, so the photon travels at a speed that is infinitesimally less than c, but not exactly at c.

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