The Superposition Principle of Waves Not Fulfilled under M.W. Evans' O(3) Hypothesis

Erhard Wielandt
Institute of Geophysics, Stuttgart University, Germany

ew@geophys.uni-stuttgart.de, e.wielandt@t-online.de

Abstract

In 1992 M.W. Evans proposed a so-called O(3) symmetry of electromagnetic fields by adding a constant longitudinal "ghost field" to the well-known transversal plane em waves. He considered this symmetry as a *new law of electromagnetics*. Later on, since 2002, this O(3) symmetry became the center of his Generally Covariant Unified Field Theory which he recently renamed as ECE Theory. One of the best-checked laws of electrodynamics is the principle of linear superposition of electromagnetic waves, manifesting itself in interference phenomena. Its mathematical equivalent is the representation of electric and magnetic fields as vectors. By considering the superposition of two phase-shifted waves we show that the superposition principle is incompatible with M.W. Evans' O(3) hypothesis.

1. M.W. Evans' O(3) hypothesis

In the following text quotations from M.W. Evans' GCUFT book [1] appear with equation labels [1.nn] at the left margin.

The assertion of O(3) symmetry is at the center of M.W. Evans' considerations since 1992. He claims that each plane circularly-polarized electromagnetic wave is accompanied by a constant longitudinal field $\mathbf{B}^{(3)}$, a so-called "ghost field". In addition to numerous papers, with far reaching implications as e.g. in [2] and [3], M.W. Evans is author of *five* books on "The Enigmatic Photon" dealing with the claimed O(3)-symmetry of electromagnetic fields. His hypotheses have met many objections. The reader will find a historical overview written by A. Lakhtakia in (5; Sect.5].

M.W. Evans considers a circularly polarized plane electromagnetic wave propagating in z-direction, cf. [1; Chap.1.2]. Using the electromagnetic phase

[1.38] $$\Phi = \omega\, t - \kappa\, z\,,$$

where $\kappa = \omega / c$, he describes the wave relative to his complex circular basis [1.41] derived from the cartesian basis vectors **i**, **j**, **k**. The magnetic field is given as

[1.43/1] $$\mathbf{B}^{(1)} = {}^{1}/_{\mathrm{sqr}(2)}\, \mathrm{B}^{(0)}\, (\mathbf{i} - i\, \mathbf{j})\, e^{i\, \Phi},$$

[1.43/2] $$\mathbf{B}^{(2)} = {}^{1}/_{\mathrm{sqr}(2)}\, \mathrm{B}^{(0)}\, (\mathbf{i} + i\, \mathbf{j})\, e^{-i\, \Phi}\,,$$

[1.43/3] $\mathbf{B}^{(3)} = B^{(0)}\,\mathbf{k}$,

and satisfies the "cyclic O(3) symmetry relations"

[1.44/1] $\mathbf{B}^{(1)} \times \mathbf{B}^{(2)} = i\, B^{(0)}\, \mathbf{B}^{(3)*}$,

[1.44/2] $\mathbf{B}^{(2)} \times \mathbf{B}^{(3)} = i\, B^{(0)}\, \mathbf{B}^{(1)*}$,

[1.44/3] $\mathbf{B}^{(3)} \times \mathbf{B}^{(1)} = i\, B^{(0)}\, \mathbf{B}^{(2)*}$.

Especially equ.[1.43/3] defines the "ghost field" $\mathbf{B}^{(3)}$ which is coupled by the relations [1.44] with the transversal components $\mathbf{B}^{(1)}$ and $\mathbf{B}^{(2)}$.

M.W. Evans' **Cyclic Theorem** is the statement that each plane circularly polarized wave [1.43/1-2] is accompanied by a longitudinal field [1.43/3], and the associated fields fulfil the cyclic equations [1.44]. M.W. Evans considers this O(3) hypothesis as a **Law of Physics**.

2. Checking the superposition property of the O(3) hypothesis

Instead of [1.38] we consider a phase shifted wave with the more general phase function

(2.1) $\Phi_\alpha(t,z) = \omega\, t - \kappa\, z + \alpha = \Phi(t,z) + \alpha$

which can be understood as a time shifted wave where the time shift is $t_o := -\,{}^{\alpha}/_{\omega}$:

(2.2) $\Phi_\alpha(t,z) = \Phi(t-t_o,z)$.

We use the phase Φ_α in [1.43] to obtain the time-shifted magnetic field

(2.3) $\mathbf{B}^{(1)} = {}^{1}/_{\mathrm{sqr}(2)}\, B^{(0)}\, (\mathbf{i}-i\mathbf{j})\, e^{i(\Phi+\alpha)}$,

(2.4) $\mathbf{B}^{(2)} = {}^{1}/_{\mathrm{sqr}(2)}\, B^{(0)}\, (\mathbf{i}+i\mathbf{j})\, e^{-i(\Phi+\alpha)}$,

(2.5) $\mathbf{B}^{(3)} = \gamma\, B^{(0)}\, \mathbf{k}$,

incorrect
$\gamma = 1$
in general relativity

where we have introduced a coefficient γ that should equal 1 following M.W. Evans while in classical electrodynamics $\gamma = 0$.

Now we consider the wave generated by the superposition of two waves with the phase functions Φ_α and $\Phi_{-\alpha}$, respectively, and α such that $\cos\alpha < 1$. According to the *superposition principle* the total field is then

(2.6) $\mathbf{B}^{(1)} = {}^{1}/_{\mathrm{sqr}(2)}\, B^{(0)}\, (\mathbf{i}-i\mathbf{j})\, [e^{i(\Phi+\alpha)} + e^{i(\Phi-\alpha)}] = {}^{1}/_{\mathrm{sqr}(2)}\, B^{(0)}\, (\mathbf{i}-i\mathbf{j})\, e^{i\Phi}\, 2\cos\alpha$, (2.7) $\mathbf{B}^{(2)} = {}^{1}/_{sqr(2)}\, B^{(0)}\, (\mathbf{i}+i\mathbf{j})\, [e^{-i(\Phi+\alpha)} + e^{-i(\Phi-\alpha)}] = {}^{1}/_{sqr(2)}\, B^{(0)}\, (\mathbf{i}+i\mathbf{j})\, e^{-i\Phi}\, 2\cos\alpha$,

(2.8) $\mathbf{B}^{(3)} = 2\,\gamma\, B^{(0)}\, \mathbf{k}$.

incorrect $B^{(3)}$ is a ... property, $\gamma = 1$

Considering the first two (transversal) components we recognize that the superposition yields the original wave [1.43/1-2] multiplied by the factor $2\cos\alpha$. Hence, according to M.W. Evans' O(3) hypothesis [1.43/3] it should be accompanied by a longitudinal component $2\,\gamma\cos\alpha \cdot B^{(0)}\,\mathbf{k}$ with $\gamma=1$. The superposition principle, however, yields $\mathbf{B}^{(3)} = 2\,\gamma\, B^{(0)}\,\mathbf{k}$ (Eq. (2.8)). Since we assumed $\cos\alpha < 1$, this is a contradiction. Only the classical case $\gamma=0$ is compatible with the superposition principle, and M.W. Evans' "ghost field" cannot exist.

M.W. Evans' cyclical O(3)-hypothesis *is incompatible with the superposition principle* of waves.

Remark without detailed proof:

A consequence of this incompatibility is that for $\gamma \neq 0$ it is impossible to construct (by Fourier synthesis) localized packets of circularly polarized waves. The transverse components $\mathbf{B}^{(1)}$ and $\mathbf{B}^{(2)}$ have an oscillatory phase in space and time and can therefore be chosen so as to interfere destructively outside the desired packet. However, according to eq. (1.43/3), the longitudinal $\mathbf{B}^{(3)}$ field of each Fourier component is a constant vector in space and time. By superposing such vectors we can only obtain another constant vector. The $\mathbf{B}^{(3)}$ field of a wave packet must either disappear or fill the whole universe at all times. This amplifies an objection raised by A. Lakhtakia [6] already in 1995.

References

[1] M.W. Evans, Generally Covariant Unified Field Theory, the geometrization of physics; Arima 2006

[2] M.W. Evans e.a., Classical Electrodynamics without the Lorentz Condition: Extracting Energy from the Vacuum;
Physica Scripta Vol. 61, No. 5, pp. 513-517, 2000
Abstract: http://www.physica.org/xml/article.asp?article=v061a00513.xml
Full text: http://www.physica.org/asp/document.asp?article=v061p05a00513

[3] M.W. Evans, On the Nature of the $B^{(3)}$ Field, Physica Scripta, Vol.61, 287--291, 2000,
Abstract: http://www.physica.org/xml/v061a00287.xml
Full text: http://www.physica.org/asp/document.asp?article=v061p03a00287

[4] G.W. Bruhn and A. Lakhtakia, Commentary on Myron W. Evans' paper "The Electromagnetic Sector ...",
http://www.mathematik.tu-darmstadt.de/~bruhn/EvansChap13.html

[5] G.W. Bruhn, Refutation of Myron W. Evans' B(3) field hypothesis,
http://www.mathematik.tu-darmstadt.de/~bruhn/B3-refutation.htm

[6] A. Lakhtakia, Is Evans' longitudinal ghost field $B^{(3)}$ unknowable?

see next page

Foundations of Physics Letters Vol. 8 No. 2, 1995

[7] E. Wielandt, The Superposition Principle of Waves Not Fulfilled under M.W. Evans' O(3) Hypothesis
http://arxiv.org/pdf/physics/0607262

HOME

We have, for each wave:

1) $$\underline{B}^{(1)}_{1} \times \underline{B}^{(2)}_{1} = \frac{B^{(0)2}}{2}\left(\underline{i} - i\underline{j}\right) \times \left(\underline{i} + i\underline{j}\right) e^{i(\Phi+\alpha)} e^{-i(\Phi+\alpha)}$$
$$= i\underline{B}^{(3)*}$$

2) $$\underline{B}^{(1)}_{2} \times \underline{B}^{(2)}_{2} = \frac{B^{(0)2}}{2}\left(\underline{i} - i\underline{j}\right) \times \left(\underline{i} + i\underline{j}\right) e^{i(\Phi-\alpha)} e^{-i(\Phi-\alpha)}$$
$$= i\underline{B}^{(3)*}$$

$\gamma = 1$ in each case