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COMMENTARY

On the Existence of K. Meyl's Scalar Waves

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Abstract—In the fall of 2000, several talks were delivered by K. Meyl. These talks described his theory of so-called Tesla's scalar waves (e.g., in Meyl ["Scalar Waves…" (2000) and "Longitudinalwellen-Experiment…" (2000)], and on his Web site). In the following article, we shall mainly discuss the theoretical part of these publications, although the experimental part would deserve a detailed discussion in its own right. The scalar wave, according to Meyl, is an *irrotational* electric vector solution **E** of the *homogeneous wave equation* having non-vanishing sources. However, and this is Meyl's logical flaw, *it is not the homogeneous wave equation but Maxwell's equations that are the actual starting point* of any theory of electromagnetic waves. And, as will be seen see in Section 1, the homogeneous wave equation is valid only in vacuum and in its natural generalization, in homogeneous materials *without free charges and currents*, while in other cases the *inhomogeneous* wave equation would apply. So in Section 2, our next immediate result is that *Meyl's source conditions are inconsistent* with the material properties. Hence, we have to assume the vector field **E** to *be source free. But— as will be shown further for this case—Maxwell's equations do not admit other than trivial scalar waves of the Meyl type, since only time- independent* solutions are admissible. Under those conditions, the only permissible conclusion is that *Meyl's scalar waves do not exist.* At the end of his talks (Meyl, "Scalar Waves…" [2000] and "Longitudinalwellen-Experiment…" [2000]), Meyl makes another remarkable assertion, which we shall discuss in Section 3. Meyl claims to have generated 'vortex' solutions that propagate *faster than light.* But for *solutions of the homogeneous wave equation*, this would *clearly contradict a well-known theorem of the mathematical theory of the wave equation*. In addition, Meyl's *proof* for his claim will turn out to be *a simple flaw of thinking.*

1. Maxwell's Equations

We start by reminding the reader of the initial part of Maxwell's theory: For a homogeneous medium of constant dielectricity ε and constant permeability $\propto$, Maxwell's equations read as follows:

$$\operatorname{curl} \mathbf{E} = -\mu \frac{\partial \mathbf{H}}{\partial t}, \tag{1}$$

$$\operatorname{div} \mathbf{E} = \frac{\varrho}{\varepsilon}, \tag{2}$$

$$\operatorname{curl}\mathbf{H} = \varepsilon\frac{\partial\mathbf{E}}{\partial t} + \mathbf{j}, \tag{3}$$

$$\operatorname{div}\mathbf{H} = 0. \tag{4}$$

Here ϱ denotes the density of free charges, and $\mathbf{j}$ is the current density caused by the motions of the free charges. These differential equations are actually extracted from the original integral relations that describe the well-known standard experiments of Œrsted, Ampère, Biot, Savart and Faraday.

Using standard algebra, each of the vector fields $\mathbf{H}$ or $\mathbf{E}$ can be eliminated. This yields

$$\operatorname{curl}\operatorname{curl}\mathbf{E} + \frac{1}{c^2}\frac{\partial^2\mathbf{E}}{\partial t^2} = \mu\frac{\partial\mathbf{j}}{\partial t}$$

and

$$\operatorname{curl}\operatorname{curl}\mathbf{H} + \frac{1}{c^2}\frac{\partial^2\mathbf{H}}{\partial t^2} = \operatorname{curl}\mathbf{j}, \qquad \text{where } \frac{1}{c^2} = \varepsilon\mu; \tag{5}$$

and by means of the vector identity

$$\operatorname{curl}\operatorname{curl}\mathbf{F} = \operatorname{grad}\operatorname{div}\mathbf{F} - \Delta\mathbf{F}$$

and using Equations 2 and 4, we obtain the *inhomogeneous wave equations*

$$\Delta\mathbf{E} - \frac{1}{c^2}\frac{\partial^2\mathbf{E}}{\partial t^2} = \frac{1}{\varepsilon}\operatorname{grad}\varrho - \mu\frac{\partial\mathbf{j}}{\partial t} \quad \text{and} \quad \Delta\mathbf{H} - \frac{1}{c^2}\frac{\partial^2\mathbf{H}}{\partial t^2} = -\operatorname{curl}\mathbf{j}. \tag{6}$$

Thus, restricting ourselves to the normal *case of absence of free charges*, where $\varrho = 0$ and $\mathbf{j} = \mathbf{0}$, we obtain the homogeneous Maxwell equations

$$\operatorname{curl}\mathbf{E} = -\mu\frac{\partial\mathbf{H}}{\partial t}, \tag{1'}$$

$$\operatorname{div}\mathbf{E} = 0, \tag{2'}$$

$$\operatorname{curl}\mathbf{H} = \varepsilon\frac{\partial\mathbf{E}}{\partial t}, \tag{3'}$$

$$\operatorname{div}\mathbf{H} = 0. \tag{4'}$$

and the *homogeneous* wave equations

$$\operatorname{curl}\operatorname{curl}\mathbf{E} + \frac{1}{c^2}\frac{\partial^2\mathbf{E}}{\partial t^2} = \mathbf{0} \quad \text{and} \quad \operatorname{curl}\operatorname{curl}\mathbf{H} + \frac{1}{c^2}\frac{\partial^2\mathbf{H}}{\partial t^2} = \mathbf{0} \tag{5'}$$

or

$$\Delta\mathbf{E} - \frac{1}{c^2}\frac{\partial^2\mathbf{E}}{\partial t^2} = \mathbf{0} \quad \text{and} \quad \Delta\mathbf{H} - \frac{1}{c^2}\frac{\partial^2\mathbf{H}}{\partial t^2} = \mathbf{0}. \tag{6'}$$

Conclusion 1. The *homogeneous* wave equations (6') are deduced from Maxwell's equations under the *assumption of the absence of free charges and* *currents*. If this assumption is not fulfilled, then only the more general *inhomogeneous* wave equations (6) are valid, and these must be used.

1. Meyl's Longitudinal Waves

A solution **E** of the first homogeneous wave equation in Equation 6', which satisfies the additional conditions

$$\operatorname{curl} \mathbf{E} = 0 \tag{7}$$

and

$$\operatorname{div} \mathbf{E} = \frac{\varrho}{\varepsilon} \neq 0, \tag{2''}$$

is denoted *longitudinal* by K. Meyl in his talks "Scalar Waves…" (2000) and "Longitudinalwellen-Experiment…" (2000). But the assumption (2'') is a *logical flaw, since it contradicts the absence of free charges*, $\varrho = 0$, in the medium (e.g., in vacuum). Hence, we obtain

Conclusion 2. In order to describe waves in a medium without free charges (e.g., in vacuum or in another homogeneous medium without free charges), we must use Equation 2' and not Equation 2''.

Then we have to discuss solutions of Maxwell's equations (Equations 1'–4') under the additional assumption (7), or—which is equivalent—we have to look for solutions **E** of the homogeneous wave equation that are irrotational and source free. But the first equation (5') together with (7) yields

$$\frac{\partial^2 \mathbf{E}}{\partial t^2} = \mathbf{0}, \tag{8}$$

which must be fulfilled by Meyl's longitudinal **E**-waves. Thus, **E** is linearly time-dependent,

$$\mathbf{E} = \mathbf{E}_0(\mathbf{x}) + t\,\mathbf{E}_1(\mathbf{x}).$$

But if $\mathbf{E}_1(\mathbf{x}) \neq 0$, then the energy of the field **E** contained in some bounded area would (approximately) increase proportionally to t^2. But, in accordance with energy conservation, the energy should not exceed a fixed constant. Thus, for energetic reasons, an electric field **E** linearly *increasing* with time is impossible, and we obtain

$$\mathbf{E}(\mathbf{x},t) = \mathbf{E}_0(\mathbf{x}), \tag{9}$$

(i.e., *time independent* fields are the *only* source-free longitudinal solutions). (Here $\mathbf{E}_0$ has to be an arbitrary solution of $\Delta\mathbf{E}_0 = \mathbf{0}$.)

As a consequence of Equation 7, Meyl is allowed to introduce a potential φ (locally) by

$$\mathbf{E} = -\ \text{grad}\ \varphi \tag{10}$$

Then, Equation 9 yields the time independency of the potential function φ,

$$\varphi(\mathbf{x},t) = \varphi_0(\mathbf{x}). \tag{11}$$

Conclusion 3. Maxwell's equations for media without free charges and currents do not admit any other than *trivial* longitudinal waves ($\mathbf{E},\varphi$) in the manner defined by Meyl. These solutions are *not waves* since they are *time independent.*

Remarks. The above conclusion is a result of certain discrepancies between Maxwell's equations and the wave equation. Of course, every solution of Maxwell's equations 1'–4' will fulfil the wave Equation 6'. *But the reverse is not true*, as when, for example, an arbitrary solution for E of Equation 6' violates Equation 2' in general. In other words, as demonstrated above, Maxwell's Equations 1'–4' together with the additional condition (7) cause such strong restrictions for the vector field **E** that **only trivial longitudinal solutions can exist**.

At the end of his talks ("Scalar Waves…" [2000] and "Longitudinalwellen-Experiment…" [2000]), Meyl makes another remarkable assertion. He claims that there exist 'vortex' solutions that have *velocities faster than light.* If these 'vortex' solutions were *solutions of the homogeneous wave equation*, this would *clearly contradict the results of the mathematical theory of the wave equation*. One of the *main results of this mathematical theory* is that the *maximum* signal velocity is *c*, the velocity of light (cf. e.g., John, 1982; p. 126 ff., or any other textbook of partial differential equations).

Meyl reports on the 7.0-MHz waves he observed at the receiver during his experiments, while his (shielded) emitter worked at 4.7 MHz. He explains the appearance of the higher frequency at the receiver with a *higher velocity* of the signal; hence, he concludes, his signal is *faster than light.*

But an emitter frequency of 4.7 MHz means that the emitter sends 4.7 millions of waves per second; then by no means can 7.0 millions of waves per second can arrive at the receiver, *independent of the signal velocity. Where should the additional number of 2.3 millions of waves have come from?* The number of waves per second at the emitter and at the receiver *must* agree, *whatever the signal velocity might be*. Hence, Meyl's conclusion of a higher signal velocity is baseless and a *flaw of thinking.* (The only possibility of finding out the signal velocity is to measure the transit time T of the signal over the distance of R between emitter and receiver. Then the velocity is given by $v = R/T$. But this is easier said than done.) Conversely, whenever a signal of 7.0 MHz was detected at the receiver, it must necessarily have had a source oscillating with the same frequency of 7.0 MHz, most likely as an artefact by the electronics, for example, an intermodulation frequency, which was radiated by an unshielded cable.

Leaving these experimental difficulties aside, even if Meyl could prove *by reliable measurement* that there exist ‘vortex' solutions faster than light, then he would have shown by experimental measurement that *the wave Equation 6' could not apply to these ‘vortex' solutions*. But the wave Equation 6' was Meyl's starting point.

References

Meyl, K. (2000). *Scalar waves—Theory and experiments*. Talk delivered at the Fifth Biennial Meeting of the Society for Scientific Exploration at the University of Amsterdam. Available at: http://www.k-meyl.de/Aufsatze/SalarwellenScalar_waves/Scalar_waves/scalar_waves.html. (An article based on Meyl's presentation immediately precedes this commentary, pp. 199–205).

Meyl, K. (2000). *Longitudinalwellen-experiment nach Nikola Tesla*. Talk delivered at the Seminar für Theoretische Chemie der Universität Tübingen. Available at: http://www.k-meyl.de/Aufsatze/Salarwellen-Scalar_waves/Skalarwellen/skalarwellen.html.

John, F. (1982). *Partial Differential Equations* (4th ed.). New York: Springer.