Short Review

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Electrodynamics of Compressible Ether

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ABSTRACT

It is proved that the system of Maxwell-Lorentz equations is derived from the system of equations of the compressible oscillating ether proposed by the author. It is shown that the classical electromagnetic wave describes only the transverse component of the propagation of a screw longitudinal-transverse wave in the ether while maintaining a constant ether density. And that the Maxwell-Lorentz equations are unsuitable for describing the propagation of longitudinal waves in the ether of variable density (waves of radiant electricity by Nikola Tesla).

Keywords: Maxwell-Lorentz equations, compressible oscillating ether, screw longitudinal-transverse wave of ether.

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INTRODUCTION

The main equations of classical electrodynamics are the Maxwell's linear equations, which have the form

$$\nabla \times \mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{B}}{\partial t}, \qquad \nabla \times \mathbf{B} = \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t} + \frac{4\pi \mathbf{j}}{c}, \tag{1}$$

$$\nabla \cdot \mathbf{B} = 0, \qquad \nabla \cdot \mathbf{E} = 4\pi\sigma. \tag{2}$$

where the vector **B** is the vector of the magnetic field induction, the vector **E** is the vector of the electric field strength, C is the speed of light in the so-called vacuum, and the scalar **σ** and vector **j** are the distribution densities of charge and current. Together with the equation derived by H. Lorentz for the force acting on a charge moving with velocity **u** in an electromagnetic field

$$\mathbf{F} = \sigma\left(\mathbf{E} + \frac{\mathbf{u}}{c} \times \mathbf{B}\right), \tag{3}$$

the system of Maxwell-Lorentz equations (1) - (3), linear with respect to vectors **B** and **E,** is a fundamental system of equations underlying in the operation of modern electrical and radio engineering, MHD generators and charged particle accelerators. Equations (1) - (3) were formulated solely on the basis of a generalization of the empirical laws of electrical and magnetic phenomena. As noted in the textbook on theoretical physics [1]: "the Maxwell-Lorentz equations do not follow from any more general theoretical provisions, but are a generalized record of the facts observed in experiment". Let us show that this is not so, and that equations (1) - (3) are a consequence of the system of ether equations

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{u}) = 0, \quad \frac{d\rho \mathbf{u}}{dt} = \frac{\partial \rho \mathbf{u}}{\partial t} + (\mathbf{u} \cdot \nabla)(\rho \mathbf{u}) = 0, \tag{4}$$

where vectors $\mathbf{r}(t)$ and $\mathbf{u}(t,\mathbf{r})$ in (4) are the coordinates and propagation velocity of local perturbations of the ether density $\rho(t,\mathbf{r})$ in the three-dimensional plane Euclidean space at each time moment t [2- 7].

RESULTS AND DISCUSSION

Derivation of Maxwell-Lorentz equations

Let us introduce ether definitions of the vectors of magnetic field induction $\mathbf{B}$ and electric field strength $\mathbf{E}$:

$$\mathbf{B} = c\nabla \times (\rho \mathbf{u}), \qquad \mathbf{E} = (\mathbf{u} \cdot \nabla)(\rho \mathbf{u}) \tag{5}$$

where c is the speed of propagation of perturbations in the ether (speed of light).

Three of Maxwell's equations of four are obtained quite simply from the system of ether equations (4). Let us apply the divergence operator $\nabla\cdot$ to expressions (5). We immediately obtain the last two equations (2) from the system of Maxwell's equations, and

$$\nabla \cdot \mathbf{B} = 0, \qquad \nabla \cdot \mathbf{E} = 4\pi\sigma. \tag{6}$$

where σ has the meaning of the charge density determined by the perturbations of the ether density.

$$4\pi\sigma = \nabla \cdot \left(|\mathbf{u}|\nabla(\rho|\mathbf{u}|)\right) - \nabla \cdot \left(\mathbf{u} \times \left(\nabla \times (\rho \mathbf{u})\right)\right).$$

We now apply the rotor operator $c\nabla \times$ to the second equation of the system of equations (4). We immediately obtain the first equation from the system of Maxwell's equations (1)

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$$\frac{\partial \mathbf{B}}{\partial t} + c\nabla \times \mathbf{E} = 0, \quad (7)$$

which is a generalization of Faraday's law of induction. The most difficult is the derivation of the second equation from the system of Maxwell's equations (1), which contains the current density $\mathbf{j}$ and displacement current. We apply to the second equation of system (4) the operator of the derivative along the curve $(\mathbf{u}\cdot\nabla)$. We get

$$\frac{\partial \mathbf{E}}{\partial t} + (\mathbf{u}\cdot\nabla)\big((\mathbf{u}\cdot\nabla)(\rho\mathbf{u})\big) - \left(\frac{\partial \mathbf{u}}{\partial t}\cdot\nabla\right)(\rho\mathbf{u}) = 0.$$

Using further the equation following from system (1)

$$\frac{\partial \mathbf{u}}{\partial t} = (\nabla\cdot\mathbf{u})\mathbf{u} - (\mathbf{u}\cdot\nabla)\mathbf{u}.$$

and the well-known rules of action with the operator nabla ∇, we obtain

$$\frac{\partial \mathbf{E}}{\partial t} - \nabla \times \left(\frac{|\mathbf{u}|^2}{c}\mathbf{B}\right) + 4\pi\mathbf{j} = 0, \quad (8)$$

where $\mathbf{j}$ has the meaning of the electric current density vector and

$$4\pi\mathbf{j} = (\mathbf{b}\cdot\nabla)\mathbf{u} + \mathbf{u}(\nabla\cdot\mathbf{b}) - \mathbf{b}(\nabla\cdot\mathbf{u}) - \nabla\times\Big(\mathbf{u}\times\big(\nabla(\mathbf{u}\cdot\mathbf{a}) - (\mathbf{a}\cdot\nabla)\mathbf{u} - \mathbf{a}\times(\nabla\times\mathbf{u})\big)\Big) +$$
$$\nabla\times\Big(\mathbf{u}\big(\mathbf{u}\cdot(\nabla\times\mathbf{a})\big)\Big) - \Big(\big((\nabla\cdot\mathbf{u})\mathbf{u} - (\mathbf{u}\cdot\nabla)\mathbf{u}\big)\cdot\nabla\Big)\mathbf{a}, \qquad \mathbf{a} = (\rho\mathbf{u}), \qquad \mathbf{b} = (\mathbf{u}\cdot\nabla)\mathbf{a}.$$

In the case of $|\mathbf{u}| \approx c$ equations (6) - (8) transform into the classical linear system of Maxwell's equations (1) - (2). Expression (3) for the Lorentz force follows from the equality

$$\sigma\left(\mathbf{E} + \frac{\mathbf{u}}{c}\times\mathbf{B}\right) = \sigma\Big((\mathbf{u}\cdot\nabla)(\rho\mathbf{u}) + \mathbf{u}\times\big(\nabla\times(\rho\mathbf{u})\big)\Big) = \sigma\nabla(\rho\mathbf{u})^2/(2\rho) = \sigma|\mathbf{u}|\nabla(\rho|\mathbf{u}|) = \mathbf{F}.$$

It is important to note that the original ether equations (4) are invariant under the Galileo transformation. One of the reasons for the loss of such invariance in the classical Maxwell's equations is the linearization of the generalized nonlinear Maxwell's equations (6) - (8) for $|\mathbf{u}| \approx c$. Another reason is the use of differentiation operators when passing to vectors **E** and **B.** The latter also leads to the loss of the longitudinal component in the classical electromagnetic wave.

Screw longitudinal-transverse wave of ether (photon)

Really, let us put $\mathbf{u} = (u_x, u_y, u_z)^T$ and rewrite the system of ether equations (4) in the form

$$\begin{aligned}
&\frac{\partial\rho}{\partial t} + \frac{\partial(\rho u_x)}{\partial x} + \frac{\partial(\rho u_y)}{\partial y} + \frac{\partial(\rho u_z)}{\partial z} = 0,\\
&\frac{\partial(\rho u_x)}{\partial t} + u_x\frac{\partial(\rho u_x)}{\partial x} + u_y\frac{\partial(\rho u_x)}{\partial y} + u_z\frac{\partial(\rho u_x)}{\partial z} = 0,\\
&\frac{\partial(\rho u_y)}{\partial t} + u_x\frac{\partial(\rho u_y)}{\partial x} + u_y\frac{\partial(\rho u_y)}{\partial y} + u_z\frac{\partial(\rho u_y)}{\partial z} = 0,\\
&\frac{\partial(\rho u_z)}{\partial t} + u_x\frac{\partial(\rho u_z)}{\partial x} + u_y\frac{\partial(\rho u_z)}{\partial y} + u_z\frac{\partial(\rho u_z)}{\partial z} = 0.
\end{aligned} \quad (9)$$

The solution of system (9) with $\rho = \rho_0 = const$ will be sought in the form of a longitudinal-transverse screw wave (photon) oscillating in the plan (x, z) and propagating with the speed of light c in the y direction, that is

$$\mathbf{u}(t,\mathbf{r}) = u_0\sin(\omega t - ky)\mathbf{i}_x + c\mathbf{i}_y + u_0\cos(\omega t - ky)\mathbf{i}_z, \quad \omega = kc, \quad (10)$$

where $\mathbf{i}_x, \mathbf{i}_y, \mathbf{i}_z$ are unit basis vectors of the Cartesian coordinate system, u_0 is the amplitude of the ether oscillation velocity transverse to the y-axis, ω is the oscillation frequency. Since

$$u_y = c, \qquad \frac{\partial u_x}{\partial x} = \frac{\partial u_x}{\partial z} = \frac{\partial u_z}{\partial x} = \frac{\partial u_z}{\partial z} = 0,$$

then it is easy to check that the vector (10) is a solution to the system of equations (9). We now calculate the vectors of the magnetic field induction and the electric field strength by the formulas (5)

$$\mathbf{B} = c\nabla\times(\rho\mathbf{u}) = u_0\rho_0\omega(\sin(\omega t - ky)\mathbf{i}_x + \cos(\omega t - ky)\mathbf{i}_z), \quad (11)$$

$$\mathbf{E} = (\mathbf{u}\cdot\nabla)(\rho\mathbf{u}) = u_0\rho_0\omega(-\cos(\omega t - ky)\mathbf{i}_x + \sin(\omega t - ky)\mathbf{i}_z). \quad (12)$$

Vectors (11) and (12) are orthogonal to each other, have equal modules $|\mathbf{E}| = |\mathbf{B}| = u_0\rho_0\omega$ and lie in the plane (x, z), orthogonal to the direction of motion of the ether wave. In addition, it is obvious that $\nabla\cdot\mathbf{E} = 4\pi\sigma = 0$, that is, the charge density in this case is zero. It is also easy to verify that vectors (11) and (12) are solutions of the classical linear system of Maxwell's equations (1) - (2) in the absence of charges and currents. It follows from this that in the nonlinear system of generalized Maxwell's equations (6) - (8), the current density $\mathbf{j}$ must be nonzero. Substituting expressions for **E** and **B** from (11) - (12) into the formula for current density and taking into account that in this particular case

$$(\nabla\cdot\mathbf{u}) = 0, \ \ |\mathbf{u}|^2 = c^2 + u_0^2, \ \ (\nabla\times\mathbf{B}) = \rho_0\omega(\nabla\times\mathbf{u}), \ \ \big(\mathbf{u}\cdot(\nabla\times\mathbf{u})\big) = ku_0^2,$$

we obtain that all terms in the current density formula vanish, except for the term

$$\nabla\times\Big(\mathbf{u}\big(\mathbf{u}\cdot(\nabla\times(\rho\mathbf{u}))\big)\Big) = \rho_0(\mathbf{u}\cdot(\nabla\times\mathbf{u}))(\nabla\times\mathbf{u}) = \nabla\times\left(\frac{u_0^2}{c}\mathbf{B}\right).$$

Consequently, in this particular case, with a constant ether density and a specific solution of the ether equations in the form of a screw photon wave, the linear system of Maxwell's equations with zero charge and current densities gives the correct result in the form of a plane monochromatic circularly polarized electromagnetic wave (Figure 1).

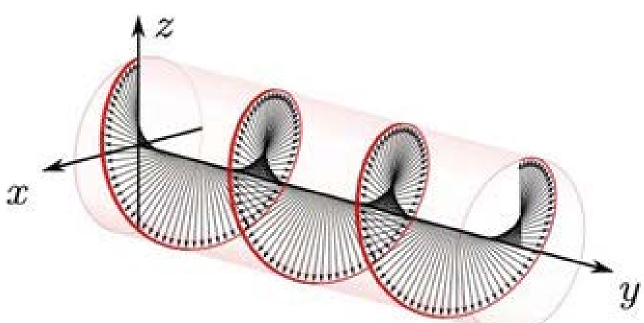

Figure 1. Screw wave of ether (photon).

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However, the undoubted advantage of the ethereal representation of an electromagnetic wave is the presence in it in an explicit form of the longitudinal velocity component in the direction of wave propagation, in addition to the transverse oscillating component. In an electromagnetic wave, the longitudinal component in the vectors **E** and **B** disappears due to differentiation. In addition, the artificiality of the classical interpretation of an electromagnetic wave becomes obvious, in which, as is commonly believed, a change in the electric field causes a change in the magnetic field and vice versa. This is not in the ethereal wave. Thus, the classical linear Maxwell's equations give the correct result only in rare cases of wave propagation in the ether of constant density.

Radiant electric wave

Now consider a wave propagating in the ether with the speed of c' in the y direction, but caused by periodic small local oscillations (compressions - stretches) of the ether density

$$\mathbf{u}(t,\mathbf{r}) = c'\mathbf{i}_y, \quad \rho(t,\mathbf{r}) = \rho_0(1 + \alpha \sin(\omega t - ky)), \quad \omega = kc', \quad \alpha \ll 1. \tag{13}$$

Wave (13) is a solution to the system of ether equations (4), (9). Let us calculate the vectors of the magnetic field induction and the electric field strength by the formulas (5)

$$\mathbf{B} = c'\nabla \times (\rho\mathbf{u}) = 0, \quad \mathbf{E} = (\mathbf{u}\cdot\nabla)(\rho\mathbf{u}) = -c'\omega\rho_0\alpha\cos(\omega t - ky)\mathbf{i}_y\,. \tag{14}$$

Obviously, the vectors **E** and **B** found in this way are solutions of the linear system of Maxwell's equations only when the densities of charges and currents of a special form are considered, and that the mutual influence of the vectors **E** and **B** on each other is completely absent. Consequently, the classical linear system of Maxwell's equations is unsuitable for describing waves propagating in the ether caused by oscillations of its density. In addition, it is very likely that the longitudinal wave (14) is a unidirectional electric wave of radiant electricity, discovered experimentally by Nikola Tesla. Not being a wave of propagation of free oscillations in the ether of constant density, the wave (13) - (14) can theoretically induce the powerful radiant electricity, capable of propagating over a very large space with practically no loss of intensity and with a speed significantly exceeding the speed of light $c' \gg c$. The condition for the existence of such a wave is a sequence of short unidirectional pulses.

This example and many other examples show that Maxwell's equations do not fully describe the essence of electromagnetic processes. They a priori contain the concept of long-range action, which postulates the absence of a mechanism for the transmission of interactions in space. There is no longitudinal component of the transmission rate of such interactions. In addition, Maxwell's equations are linear equations, which allows us to speak with confidence only about an approximate model for partially describing electromagnetic phenomena by these equations. For a more complete description of electromagnetic phenomena and processes, it is necessary to use more complex nonlinear equations of electrodynamics of the ether (4).

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