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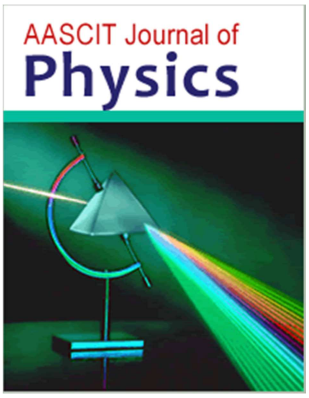

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The Classical Conversions of Electromagnetic Fields on Their Consequences

F. F. Mende

B. I. Verkin Institute for Low Temperature Physics and Engineering NAS, Ukraine

Email address
mende_fedor@mail.ru

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Abstract
The laws of classical electrodynamics they reflect experimental facts they are phenomenological. Unfortunately, contemporary classical electrodynamics is not deprived of the contradictions, which did not up to now obtain their explanation. The fundamental equations of contemporary classical electrodynamics are Maksvell's equation. But not all know that those equations, which it is customary to assume as Maxwell's equations, not are those equations, which used itself Maxwell. During writing of its equations it used the substantional derivative, that are made themselves they invariant with respect to the conversions of Galileo. Subsequently Hertz and Heaviside excluded from the substantional derivative its convective part, after writing down Maxwell's equations in the partial derivatives. In this form the equations are invariant to the conversions of Lorenz and this approach laid way to the creation of the special theory of relativity (SR). In the article are examined the conversions of electromagnetic fields on upon transfer of one inertial system to another, obtained on the basis of the equations of electromagnetic and magnetoelectric induction with the use by the substantional derivative and they are examined the consequences, which escape from such conversions.

1. Introduction

The laws of classical electrodynamics they reflect experimental facts they are phenomenological. Unfortunately, contemporary classical electrodynamics is not deprived of the contradictions, which did not up to now obtain their explanation. In order to understand these contradictions, and to also understand those purposes and tasks, which are placed in this work, let us briefly describe the existing situation.

The fundamental equations of contemporary classical electrodynamics are Makswell's equations. They are written as follows for the vacuum:

$$rot\ \vec{E} = -\frac{\partial \vec{B}}{\partial t}\ , \tag{1.1}$$

$$rot\ \vec{H} = \frac{\partial \vec{D}}{\partial t}, \tag{1.2}$$

$$div\ \vec{D} = 0\,, \tag{1.3}$$

$$div\ \vec{B} = 0\ , \tag{1.4}$$

where $\vec{E}$ and $\vec{H}$ are electrical and magnetic field, $\vec{D} = \varepsilon_0 \vec{E}$ and $\vec{B} = \mu_0 \vec{H}$ are electrical and magnetic induction, μ_0 and ε_0 are magnetic and dielectric constant of vacuum. From these equations follow wave equations for the electrical and magnetic fields

$$\nabla^2 \vec{E} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2}, \tag{1.5}$$

$$\nabla^2 \vec{H} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{H}}{\partial t^2}. \tag{1.6}$$

These equations show that in the vacuum can be extended the plane electromagnetic waves, the velocity of propagation of which is equal to the speed of light

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}. \tag{1.7}$$

For the material media of Maxwell's equation they take the following form:

$$rot\ \vec{E} = -\tilde{\mu}\mu_0 \frac{\partial \vec{H}}{\partial t} = -\frac{\partial \vec{B}}{\partial t}, \tag{1.8}$$

$$rot\ \vec{H} = ne\vec{v} + \tilde{\varepsilon}\varepsilon_0 \frac{\partial \vec{E}}{\partial t} = ne\vec{v} + \frac{\partial \vec{D}}{\partial t}, \tag{1.9}$$

$$div\ \vec{D} = ne, \tag{1.10}$$

$$div\ \vec{B} = 0, \tag{1.11}$$

where $\tilde{\mu}$ and $\tilde{\varepsilon}$ are the relative magnetic and dielectric constants of the medium and n, e and $\vec{v}$ are density, value and charge rate.

The equation (1.1 - 1.11) are written in the assigned inertial measuring system (IS), and in them there are no rules of passage of one IS to another. The given equations also assume that the properties of charge do not depend on their speed, since in first term of the right side of equation (1.9) as the charge its static value is taken. The given equations also assume that the current can flow as in the electrically neutral medium, where there is an equal quantity of charges of both signs, so also to represent the self-contained flow of the charged particles, moreover both situations are considered equivalent.

But not all know that the given equations, which it is customary to assume as Maxwell's equations, these are not those equations, which are given in his treatise [1]. During writing of its equations it used the substantional derivative, that are made themselves they invariant with respect to the conversions of Galileo. Subsequently Hertz and Heaviside excluded from the substantional derivative its convective part, after writing down Maxwell's equations in the partial derivatives. In this form the equations are invariant to the conversions of Lorenz and this approach laid way to the creation of the special theory of relativity (SR).

In Maksvell's equations are not contained indication that is the reason for power interaction of the current carrying systems, therefore to be introduced the experimental postulate about the force, which acts on the moving charge in the magnetic field.

$$\vec{F}_L = e\left[\vec{v} \times \mu_0 \vec{H}\right]. \tag{1.12}$$

However in this axiomatics is an essential deficiency. If force acts on the moving charge, then in accordance with third Newton's law the reacting force, which balances the force, which acts on the charge, must occur and to us must be known the place of the application of this force. In this case the magnetic field is independent substance, comes out in the role of the mediator between the moving charges. Consequently, we do not have law of direct action, which would give immediately answer to the presented question, passing the procedure examined. I.e. we cannot give answer to the question, where are located the forces, the compensating action of magnetic field to the charge.

The relationship (1.12) from the physical point sight causes bewilderment. The forces, which act on the body in the absence of losses, must be connected either with its acceleration, if it accomplishes forward motion, or with the centrifugal forces, if body accomplishes rotary motion. Finally, static forces appear when there is the gradient of the scalar potential of potential field, in which is located the body. But in relationship (1.12) there is nothing of this. Usual rectilinear motion causes the force, which is normal to the direction motion. What some new law of nature? To this question there is no answer also.

The magnetic field, which introduced Ampere [4], is one of the important concepts of contemporary electrodynamics. Its concept consists in the fact that around any moving charge appears the magnetic field (Ampere law), whose circulation is determined by the relationship

$$\oint \vec{H} d\vec{l} = I, \tag{1.13}$$

where I is conduction current. Equation (1.9) is the consequence of relationship (1.13), if we to the conduction current add bias current. As is known, to make this Maxwell for the first time proposed.

It should be noted that the introduction of the concept of magnetic field does not be founded upon any physical basis, but it is the statement of the collection of some experimental facts, which with the aid of the specific mathematical procedures in large quantities of the cases give the possibility to obtain correct answer with the solution of practical problems. But, unfortunately, there is a number of the physical questions, during solution of which within the framework the concepts of magnetic field, are obtained paradoxical results. Here one of them.

Using relationships (1.12) and (1.13) not difficult to show that with the unidirectional parallel motion of two like charges, or flows of charges, between them must appear the additional attraction. However, if we pass into the inertial system, which moves together with the charges, then there magnetic field is absent, and there is no additional attraction. This paradox in the electrodynamics does not have an explanation.

The force with power interaction of material structures, along which flows the current, are applied not only to the moving charges, but to the lattice, but in the concept of magnetic field to this question there is no answer also, since. in equations (1.1-1.13) the presence of lattice is not considered. At the same time, with the flow of the current through the plasma its compression (the so-called pinch effect), occurs, in this case forces of compression act not only on the moving electrons, but also on the positively charged ions. And, again, the concept of magnetic field cannot explain this fact, since in this concept there are no forces, which can act on the ions of plasma.

As the fundamental law of induction in the electrodynamics is considered Faraday law, consequence of whom is the first Maksvell equation. However, here are problems. It is considered Until now that the unipolar generator is an exception to the rule of flow. The existing state of affairs and those contradictions, which with this are connected, perhaps, are most are clearly formulated in the sixth volume of work [5]. We read on page 53 we read "…" flow rule", according to which emf. in the outline it is equal to the speed undertaken with the opposite sign, with which changes magnetic flux through the outline, when flow changes due to field change or when outline moves (or when it occurs and that and, etc). Two of the possibility - "the outline of moves" or "the field of changes" - are not distinguished of into to the formulation of the rule. Nevertheless, for explaining the rule in these two cases we used two completely different laws: $\left[\vec{v}\times\vec{B}\right]$ for "moving outline" and $\nabla\times\vec{E}=-\frac{\partial\vec{B}}{\partial t}$ for "changing field". "We know in physics not of one such example, if simple and precise general law required for its present understanding of analysis in the terms of two different phenomena. Usually of so of beautiful of the generalization of proves to be of outgoing of from of the united of the deep of that being basic of the principle of. But in this case of any separately deep principle it is not evident" (end of the quotation).

Let us give the still one exception, to which thus far no one turned attention. Farady law indicates that the magnetic flux when through some section changes, then in the outline, which surrounds this section, vortex electric field appears. And if conductor is this outline, then in it currents are induced. Thus, in accordance with the law of the induction of Faraday the necessary condition of the appearance of currents in this outline is a change in the magnetic flux through the area, included by outline. If we insert the conducting outline into the magnetic field, then for the appearance of current in accordance with the Farady law, the lines of force of magnetic field must intersect outline itself. But it is known that the magnetic lines of force do not penetrate the superconductor and therefore they cannot intersect it. Therefore, if we take the superconductive ring, then magnetic flux through its section will be always equal to zero and as long as superconductor is superconductor, it cannot under no circumstances change. Now give let us introduce the superconductive ring into the magnetic field. Naturally so that the magnetic flux through the section of ring would remain zero, it is necessary to compensate for external magnetic field in such a way that the magnetic flux through the section of ring would not change. This can be made an only method, after exciting in the ring the persistent currents, whose magnetic fields compensate for external magnetic field. But in order to excite such currents, it is necessary to the wire of the superconductive ring to apply electric field. But arises question, as such fields can arise, if summary magnetic flux through the section of ring did not change, and in accordance with the Farrday law vortex electrical fields on there must not be.

All these examples be evidence the fact that the law of the induction of Faraday is inaccurate or not complete and does not reflect all possible versions of the appearance of electrical fields on with a change of the magnetic field or during the motion in this field.

Let us give one additional statement of the work [5]: "The observations of Faraday led to the discovery of new law about the connection of electrical and magnetic fields on: in the field, where magnetic field changes in the course of time, is generated electric field". But from this law also there is an exception. Actually, the magnetic fields be absent out of the long solenoid; however, electric fields are generated with a change of the current in this solenoid around the solenoid. Is explained this fact thereby that around the long solenoid there is a circulation of vector potential [5]. When the flow of the magnetic induction of solenoid changes, then a circulation control of vector potential appears. With this interpretation of this phenomenon these changes lead to the appearance of electrical fields on out of the solenoid. In the work [5] even it is indicated that into 1956. Bohm and Aron experimentally detected this potential. But the point of view about existence of vector potential out of the long solenoid, where magnetic fields be absent, also runs into a number of fundamental difficulties, since it follows from the adoption of this concept that the electric fields around the solenoid appear instantly after connection to the solenoid of dc power supply. In addition to this, such fields do not possess energy.

In the classical electrodynamics does not find its explanation this well known physical phenomenon, as phase aberration of light, when with the observation of stars from moving IS, telescope must be inclined to a certain angle in the direction of motion.

From entire aforesaid it is possible to conclude that in the classical electrodynamics there is number of the problems, which still await their solution.

2. Dynamic Potentials and the Field of the Moving Charges

Gertz not only rewrote Maksvell's equations in the terms of partial derivatives. It made mistakes only in the fact that the electrical and magnetic fields were considered the invariants of speed. But already simple example of long lines is evidence of the inaccuracy of this approach. With the propagation of wave in the long line it is filled up with two forms of energy, which can be determined through the currents and the voltages or through the electrical and magnetic fields in the line. And only after wave will fill with electromagnetic energy all space between the generator and the load on it will begin to be separated energy. I.e. the time, by which stays this process, generator expended its power to the filling with energy of the section of line between the generator and the load. But if we begin to move away load from incoming line, then a quantity of energy being isolated on it will decrease, since. the part of the energy, expended by source, will leave to the filling with energy of the additional length of line, connected with the motion of load. If load will approach a source, then it will obtain an additional quantity of energy due to the decrease of its length. But if effective resistance is the load of line, then an increase or the decrease of the power expendable in it can be connected only with a change in the stress on this resistance. Therefore we come to the conclusion that during the motion of the observer of those of relatively already existing in the line fields on must lead to their change.

Being located in assigned IS, us interest those fields, which are created in it by the fixed and moving charges, and also by the electromagnetic waves, which are generated by the fixed and moving sources of such waves. The fields, which are created in this IS by moving charges and moving sources of electromagnetic waves, we will call dynamic. Can serve as an example of dynamic field the magnetic field, which appears around the moving charges.

As already mentioned, in the classical electrodynamics be absent the rule of the conversion of electrical and magnetic fields on upon transfer of one inertial system to another. This deficiency removes SR, basis of which are the covariant Lorenz conversions. With the entire mathematical validity of this approach the physical essence of such conversions up to now remains unexplained [6].

In this division will made attempt find the precisely physically substantiated ways of obtaining the conversions fields on upon transfer of one ISO to another, and to also explain what dynamic potentials and fields can generate the moving charges. The first step, demonstrated in the works [7-10], was made in this direction a way of the introduction of the symmetrical laws of magnetoelectric and electromagnetic induction. These laws are written as follows:

$$\begin{aligned} \oint \vec{E}'dl' &= -\int \frac{\partial \vec{B}}{\partial t}d\vec{s} + \oint \left[\vec{v}\times\vec{B}\right]dl' \\ \oint \vec{H}'dl' &= \int \frac{\partial \vec{D}}{\partial t}d\vec{s} - \oint \left[\vec{v}\times\vec{D}\right]dl' \end{aligned} \tag{2.1}$$

or

$$\begin{aligned} rot\vec{E}' &= -\frac{\partial \vec{B}}{\partial t} + rot\left[\vec{v}\times\vec{B}\right] \\ rot\vec{H}' &= \frac{\partial \vec{D}}{dt} - rot\left[\vec{v}\times\vec{D}\right] \end{aligned}. \tag{2.2}$$

For the constants fields on these relationships they take the form:

$$\begin{aligned} \vec{E}' &= \left[\vec{v}\times\vec{B}\right] \\ \vec{H}' &= -\left[\vec{v}\times\vec{D}\right] \end{aligned}. \tag{2.3}$$

In relationships (2.1-2.3), which assume the validity of the Galileo conversions, prime and not prime values present fields and elements in moving and fixed IS respectively. It must be noted, that conversions (16.3) earlier could be obtained only from Lorenz conversions.

The relationships (2.1-2.3), which present the laws of induction, do not give information about how arose fields in initial fixed IS. They describe only laws governing the propagation and conversion fields on in the case of motion with respect to the already existing fields.

The relationship (2.3) attest to the fact that in the case of relative motion of frame of references, between the fields $\vec{E}$ and $\vec{H}$ there is a cross coupling, i.e., motion in the fields $\vec{H}$ leads to the appearance fields on $\vec{E}$ and vice versa. From these relationships escape the additional consequences, which were for the first time examined in the work [7].

The electric field $E = \frac{g}{2\pi\varepsilon r}$ outside the charged long rod with a linear density g decreases as $\frac{1}{r}$, where r is distance from the central axis of the rod to the observation point.

If we in parallel to the axis of rod in the field E begin to move with the speed Δv another IS, then in it will appear the additional magnetic field $\Delta H = \varepsilon E \Delta v$. If we now with respect to already moving IS begin to move third frame of reference with the speed Δv, then already due to the motion in the field ΔH will appear additive to the electric field $\Delta E = \mu\varepsilon E\left(\Delta v\right)^2$. This process can be continued and further, as a result of which can be obtained the number, which gives the value of the electric field $E'_v\left(r\right)$ in moving IS with reaching of the speed $v = n\Delta v$, when $\Delta v \to 0$, and $n \to \infty$. In the final analysis in moving IS the value of dynamic electric field will prove to be more than in the initial and to be determined by the relationship:

$$E'\left(r, v_\perp\right) = \frac{gch\frac{v_\perp}{c}}{2\pi\varepsilon r} = Ech\frac{v_\perp}{c}.$$

If speech goes about the electric field of the single charge e , then its electric field will be determined by the relationship:

$$E'(r, v_\perp) = \frac{ech\frac{v_\perp}{c}}{4\pi\varepsilon r^2},$$

where $v_\perp$ is normal component of charge rate to the vector, which connects the moving charge and observation point.

Expression for the scalar potential, created by the moving charge, for this case will be written down as follows:

$$\varphi'(r, v_\perp) = \frac{ech\frac{v_\perp}{c}}{4\pi\varepsilon r} = \varphi(r)ch\frac{v_\perp}{c} \qquad (2.4)$$

where $\varphi(r)$ is scalar potential of fixed charge. The potential $\varphi'(r, v_\perp)$ can be named scalar- vector, since. it depends not only on the absolute value of charge, but also on speed and direction of its motion with respect to the observation point. Maximum value this potential has in the direction normal to the motion of charge itself. Moreover, if charge rate changes, which is connected with its acceleration, then can be calculated the electric fields, induced by the accelerated charge.

During the motion in the magnetic field, using the already examined method, we obtain:

$$H'(v_\perp) = Hch\frac{v_\perp}{c}.$$

where $v_\perp$ is speed normal to the direction of the magnetic field.

If we apply the obtained results to the electromagnetic wave and to designate components fields on parallel speeds IS as $E_\uparrow$ and $H_\uparrow$, and $E_\perp$ and $H_\perp$ as components normal to it, then with the conversion fields on components, parallel to speed will not change, but components, normal to the direction of speed are converted according to the rule

$$\begin{aligned} \vec{E}'_\perp &= \vec{E}_\perp ch\ \frac{v}{c} + \frac{v}{c}\vec{v}\times\vec{B}_\perp sh\frac{v}{c}, \\ \vec{B}'_\perp &= \vec{B}_\perp ch\ \frac{v}{c} - \frac{1}{vc}\vec{v}\times\vec{E}_\perp sh\frac{v}{c}, \end{aligned} \qquad (2.5)$$

where $c = \sqrt{\frac{1}{\mu_0\varepsilon_0}}$ is speed of light.

Conversions fields (2.5) they were for the first time obtained in the work [7].

However, the iteration technique, utilized for obtaining the given relationships, it is not possible to consider strict, since its convergence is not explained

Let us give a stricter conclusion in the matrix form even let us show that the form of conversions is wholly determined by the type of the utilized law of addition of velocities - classical or relativistic. This method is proposed by a participant in the scientific forum of movement for the revivals of domestic science to N. A. Drobyshev.

Let us examine the totality IS of such, that IS K_1 moves with the speed Δv relative to IS K, IS K_2 moves with the same speed Δv relative to K_1 , etc. If the module of the speed Δv is small (in comparison with the speed of light c), then for the transverse components fields on in IS K_1, K_2,…. we have:

$$\begin{aligned} \vec{E}_{1\perp} &= \vec{E}_\perp + \Delta\vec{v}\times\vec{B}_\perp \qquad & \vec{B}_{1\perp} &= \vec{B}_\perp - \Delta\vec{v}\times\vec{E}_\perp / c^2 \\ \vec{E}_{2\perp} &= \vec{E}_{1\perp} + \Delta\vec{v}\times\vec{B}_{1\perp} \qquad & \vec{B}_{2\perp} &= \vec{B}_{1\perp} - \Delta\vec{v}\times\vec{E}_{1\perp} / c^2 \end{aligned} \qquad (2.6)$$

Upon transfer to each following IS of field are obtained increases in $\Delta\vec{E}$ and $\Delta\vec{B}$

$$\Delta\vec{E} = \Delta\vec{v}\times\vec{B}_\perp, \qquad \Delta\vec{B} = -\Delta\vec{v}\times\vec{E}_\perp / c^2 \qquad (2.7)$$

where of the field $\vec{E}_\perp$ and $\vec{B}_\perp$ relate to current IS. Directing Cartesian axis x along $\Delta\vec{v}$, let us rewrite (2.7) in the components of the vector

$$\Delta E_y = -B_z\Delta v, \qquad \Delta E = B_y\Delta v, \qquad \Delta B_y = E_z\Delta v / c^2 \qquad (2.8)$$

Relationship (2.8) can be represented in the matrix form

$$\Delta U = AU\Delta v \qquad \begin{pmatrix} 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 1/c^2 & 0 & 0 \\ -1/c^2 & 0 & 0 & 0 \end{pmatrix} \qquad U = \begin{pmatrix} E_y \\ E_z \\ B_y \\ B_z \end{pmatrix}$$

If one assumes that the speed of system is summarized for the classical law of addition of velocities, i.e. the speed of final IS $K' = K_N$ relative to the initial system K is $v = N\Delta v$, then we will obtain the matrix system of the differential equations of

$$\frac{dU(v)}{dv} = AU(v) \qquad (2.9)$$

with the matrix of the system v independent of the speed A . The solution of system is expressed as the matrix exponential curve $\exp(vA)$:

$$U' \equiv U(v) = \exp(vA)U, \qquad U = U(0), \qquad (2.10)$$

here U is matrix column fields on in the system K , and U' is matrix column fields on in the system K'. Substituting (2.10) into system (2.9), we are convinced, that U' is actually the solution of system (2.9):

$$\frac{dU(v)}{dv} = \frac{d\left[\exp(vA)\right]}{dv}U = A\exp(vA)U = AU(v)$$

It remains to find this exponential curve by its expansion in the series:

$$\exp(va) = E + vA + \frac{1}{2!}v^2A^2 + \frac{1}{3!}v^3A^3 + \frac{1}{4!}v^4A^4 + ...$$

where E is unit matrix with the size 4×4 . For this it is convenient to write down the matrix A in the unit type form

$$A=\begin{pmatrix}0 & -\alpha\\ \alpha/c^2 & 0\end{pmatrix},\qquad \alpha=\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix},\qquad 0=\begin{pmatrix}0 & 0\\ 0 & 0\end{pmatrix}.$$

then

$$A^2=\begin{pmatrix}-\alpha^2/c^2 & 0\\ 0 & -\alpha/c^2\end{pmatrix},\qquad A^3=\begin{pmatrix}0 & \alpha^3/c^2\\ -\alpha^3/c^4 & 0\end{pmatrix},$$

$$A^4=\begin{pmatrix}\alpha^4/c^4 & 0\\ 0 & \alpha^4/c^4\end{pmatrix},\qquad A^5=\begin{pmatrix}0 & -\alpha^5/c^4\\ \alpha^5/c^6 & 0\end{pmatrix}\ldots..$$

And the elements of matrix exponential curve take the form

$$[\exp(vA)]_{11}=[\exp(vA)]_{22}=I-\frac{v^2}{2!c^2}+\frac{v^4}{4!c^4}-....,$$

$$[\exp(vA)]_{21}=-c^2[\exp(vA)]_{12}=\frac{\alpha}{c}\left(\frac{v}{c}I-\frac{v^3}{3!c^3}+\frac{v^5}{5!c^5}-.....\right),$$

where I is the unit matrix 2×2. It is not difficult to see that $-\alpha^2=\alpha^4=-\alpha^6=\alpha^8=....=I$, therefore we finally obtain

$$\exp(vA)=\begin{pmatrix}Ich\ v/c & -c\alpha sh\ v/c\\ \left(\alpha sh\ v/c\right)/c & Ich\ v/c\end{pmatrix}=$$

$$\begin{pmatrix}ch\ v/c & 0 & 0-csh\ v/c\\ 0 & ch\ v/c & csh\ v/c & 0\\ 0 & \left(ch\ v/c\right)/c & ch\ v/c & 0\\ -\left(sh\ v/c\right)/c\ 0 & 0 & ch\ v/c\end{pmatrix}$$

Now we return to (2.10) and substituting there $\exp(vA)$, we find

$$\begin{aligned}E'_y&=E_y ch\ v/c-cB_z sh\ v/c,\\ E'_z&=E_z ch\ v/c+cB_y sh\ v/c,\\ B'_y&=B_y ch\ v/c+\left(E_z/c\right)sh\ v/c,\\ B'_z&=B_z ch\ v/c-\left(E_y/c\right)sh\ v/c\end{aligned},$$

Or in the vector record

$$\begin{aligned}\vec{E}'_\perp&=\vec{E}_\perp ch\ \frac{v}{c}+\frac{v}{c}\vec{v}\times\vec{B}_\perp sh\frac{v}{c},\\ \vec{B}'_\perp&=\vec{B}_\perp ch\ \frac{v}{c}-\frac{1}{vc}\vec{v}\times\vec{E}_\perp sh\frac{v}{c},\end{aligned}\qquad (2.11)$$

This is conversions (2.5)

Regular question arises, why differ the conversions examined, indeed with the low speeds $\Delta\vec{v}$ occur identical relationships (2.6) and (2.7). The fact is that according to the relativistic law of addition of velocities, are added not speeds, but rapidities (https://ru.wikipedia.org/wiki/Rapidity). According to definition the rapidity is introduced as

$$\theta=c\ arth\frac{v}{c}\qquad (2.12)$$

Precisely, if the rapidity of the systems K_1 and K, K_2 and K_1, K_3 and K_2 they are distinguished to $\Delta\theta$, then rapidity the rapidity IS $K'=K_N$ relative to K is $\theta=N\Delta\theta$. With the low speeds $\Delta\theta\cong\Delta v$; therefore formula (2.7) it is possible to rewrite so

$$\Delta\vec{E}=\Delta\theta\times\vec{B}_\perp,\qquad \Delta\vec{B}=-\Delta\vec{\theta}\times\vec{E}_\perp/c^2$$

where $\vec{\theta}=\theta\frac{\vec{v}}{v}$. System (2.9) taking into account the additivity of rapidity, but not speed, it is substituted by the system of equations

$$\frac{dU(\theta)}{d\theta}=AU(\theta)$$

Thus, all computations will be analogous given above, only with the difference that in the expressions instead of the speeds will figure rapidity. In particular formulas (2.11) take the form

$$\begin{aligned}\vec{E}'_\perp&=\vec{E}_\perp ch\ \frac{\theta}{c}+\frac{\theta}{c}\vec{\theta}\times\vec{B}_\perp sh\frac{\theta}{c},\\ \vec{B}'_\perp&=\vec{B}_\perp ch\ \frac{\theta}{c}-\frac{1}{\theta c}\vec{\theta}\times\vec{E}_\perp sh\frac{\theta}{c},\end{aligned}$$

or

$$\begin{aligned}\vec{E}'_\perp&=\vec{E}_\perp ch\ \frac{\theta}{c}+\frac{v}{c}\vec{v}\times\vec{B}_\perp sh\frac{\theta}{c},\\ \vec{B}'_\perp&=\vec{B}_\perp ch\ \frac{\theta}{c}-\frac{1}{vc}\vec{v}\times\vec{E}_\perp sh\frac{\theta}{c},\end{aligned}\qquad (2.13)$$

Since

$$ch\frac{\theta}{c}=\frac{1}{\sqrt{1-th^2\left(\theta/c\right)}},\qquad sh\frac{\theta}{c}=\frac{th\left(\theta/c\right)}{\sqrt{1-th^2\left(\theta/c\right)}}$$

that substitution (2.12) in (2.13) leads to the well known conversions fields on

$$\begin{aligned}\vec{E}'_\perp&=\frac{1}{\sqrt{1-v^2/c^2}}\left(\vec{E}_\perp+\vec{v}\vec{B}_\perp\right)\\ \vec{B}'_\perp&=\frac{1}{\sqrt{1-v^2/c^2}}\left(\vec{B}_\perp-\frac{1}{c^2}\vec{v}\times\vec{E}_\perp\right)\end{aligned}.\qquad (2.14)$$

With the small relative conversion rates (2.11) and (2.14) differ, beginning from the terms of the expansion of the order v^2/c^2.

3. Phase Aberration of Electromagnetic Waves and the Transverse Doppler Effect

Using relationships (2.5) it is possible to explain the phenomenon of phase aberration, which did not have within the framework existing classical electrodynamics of explanations. We will consider that there are components of the plane wave H_z, E_x, which is extended in the direction y, and primed system moves in the direction of the axis x with the speed v_x. Then components fields on in the prime coordinate system in accordance with relationships (2.5) they will be written down:

$$E_x' = E_x,$$
$$E_y' = H_z sh\frac{v_x}{c},$$
$$H_z' = H_z ch\frac{v_x}{c}.$$

Thus, is a heterogeneous wave, which has in the direction of propagation the component E_v'.

Let us write down the summary field E' in moving IS:

$$E' = \left[\left(E_x'\right)^2 + \left(E_y'\right)^2\right]^{\frac{1}{2}} = E_x ch\frac{v_x}{c}. \tag{3.1}$$

If the vector $\vec{H}'$ is as before orthogonal the axis y, then the vector $\vec{E}'$ is now inclined toward it to the angle α, determined by the relationship:

$$\alpha \cong sh\frac{v}{c} \cong \frac{v}{c}. \tag{3.2}$$

This is phase aberration. Specifically, to this angle to be necessary to incline telescope in the direction of the motion of the Earth around the sun in order to observe stars, which are located in the zenith.

The Pointing vector is now also directed no longer along the axis y, but being located in the plane xy, it is inclined toward the axis y to the angle, determined by relationships (3.2). However, the relation of the absolute values of the vectors $\vec{E}'$ and $\vec{H}'$ in both systems they remained identical. However, the absolute value of Poynting vector increased. Thus, even transverse motion of inertial system with respect to the direction of propagation of wave increases its energy in the moving system. This phenomenon is understandable from a physical point of view. It is possible to give an example with the rain drops. When they fall vertically, then is energy in them one. But in the inertial system, which is moved normal to the vector of their of speed, to this speed the velocity vector of inertial system is added. In this case the absolute value of the speed of drops in the inertial system will be equal to square root of the sum of the squares of the speeds indicated. The same result gives to us relationship (3.1).

Is not difficult to show that, if we the polarization of electromagnetic wave change ourselves, then result will remain before. Conversions with respect to the vectors $\vec{E}$ and $\vec{H}$ are completely symmetrical, only difference will be the fact that to now come out the wave, which has to appear addition in the direction of propagation in the component H_v'.

Such waves have in the direction of its propagation additional of the vector of electrical or magnetic field, and in this they are similar to E and H of the waves, which are extended in the waveguides. In fact obtained wave is the superposition of plane wave with the phase speed $c = \sqrt{\frac{1}{\mu\varepsilon}}$ and additional wave of plane wave with the infinite phase speed orthogonal to the direction of propagation.

Let us examine one additional case, when the direction of the speed of the moving system coincides with the direction of propagation of electromagnetic wave. We will consider that there are components of the plane wave E_x and H_z, and also component of the speed $\pm v_y$. Taking into account that in this case is fulfilled the relationship $E_x = \pm Z_0 H_z$, we obtain:

$$E_x{}' = E_x\left(ch\frac{v_y}{c} - sh\frac{v_y}{c}\right) = E_x \exp\left(\mp\frac{v_y}{c}\right),$$
$$H_z{}' = H_z\left(ch\frac{v_y}{c} - sh\frac{v_y}{c}\right) = H_z \exp\left(\mp\frac{v_y}{c}\right).$$

I.e. amplitudes fields on exponentially they diminish or they grow depending on direction of motion.

The Doppler transverse effect, who long ago is discussed sufficiently, until now, did not find its confident experimental confirmation. For observing the star from moving IS it is necessary to incline telescope on the motion of motion to the angle, determined by relationship (3.2). But in this case the star, observed with the aid of the telescope in the zenith, will be in actuality located several behind the visible position with respect to the direction of motion. Its angular displacement from the visible position in this case will be determined by relationship (3.2). But this means that this star with respect to the observer has radial velosity determined by the relationship

$$v_r = v\sin\alpha$$

Since for the low values of the angles of $\sin\alpha \cong \alpha$, and $\alpha = \frac{v}{c}$, Doppler frequency shift will compose

$$\omega_{d\perp} = \omega_0\frac{v^2}{c^2} \tag{3.3}.$$

This result numerically coincides with results SR, but it is principally characterized by of results fact that it is considered into SR that the transverse Doppler effect, determined by relationship (3.3), there is in actuality, while in this case this only apparent effect. If we compare the results of conversions fields on (2.5) with conversions SR, then it is not difficult to see that they coincide with an accuracy to the quadratic members of the ratio of the velocity of the motion of charge to the speed of light.

Conversion SR, although they were based on the postulates, could correctly explain sufficiently accurately many physical phenomena, which before this explanation did not have. With this circumstance is connected this great success of this theory. Conversions (2.4) and (2.5) are obtained on the physical basis without the use of postulates and they with the high accuracy coincided with SR. Difference is the fact that in conversions (2.5) there are no limitations on the speed for the material particles, and also the fact that the charge is not the invariant of speed. The experimental confirmation of the fact indicated can serve as the confirmation of correctness of the proposed conversions. And such experimental facts are located, in works [8, 11-13] is obtained experimental confirmation of the electrization of the superconductive windings and tori during the introduction in them of direct current. This fact contradicts the invariance of the charge with respect to the speed, which follows of SR. The experimental fact, which contradicts SR, is also the appearance of the electric pulse of the nuclear explosion [14-16]. This phenomenon contradicts SR, but it can be described with the aid of the obtained conversions.

4. Conclusion

The laws classical electrodynamics they reflect experimental facts they are phenomenological. Unfortunately, contemporary classical electrodynamics is not deprived of the contradictions, which did not up to now obtain their explanation. the fundamental equations of contemporary classical electrodynamics are Maxwell's equations. But not all know that those equations, which it is customary to assume as Maxwell's equations, not are those equations, which used itself Maxwell. During writing of its equations it used the substantional derivative, that are made themselves they invariant with respect to the conversions of Galileo. Subsequently Hertz and Heaviside excluded from the substantional derivative its convective part, after writing down Maxwell's equations in the partial derivatives. In this form the equations are invariant to the conversions of Lorenz and this approach laid way to the creation of the special theory of relativity. In the article are examined the conversions of electromagnetic fields on upon transfer of one inertial system to another, obtained on the basis of the equations of electromagnetic and magnetoelectric induction with the use by the substantional derivative and they are examined the consequences, which escape from such conversions.

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