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Laws of the Electro-Electrical Induction

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Laws of the Electro-Electrical Induction

F. F. Mende [α] & A. S. Dubrovin [σ]

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I. Introduction

Maxwell equations attest to the fact that in the free space the transverse electromagnetic waves can exist [1, 2]. Together with the boundary conditions these equations give the possibility to solve the problems of reflection and propagation of such waves in the locked and limited structures. With the aid of Maxwell equations it is possible to solve the problems of emission. But since the equations indicated are phenomenological, physics of such processes thus far remains not clear. Similar problems can be solved, also, with the use of potentials. This approach opens greater possibilities, but physics of the vector potential of magnetic field also up to now remained not clear. The development of the concept of scalar- vector potential, which dedicated a number of works [3-10], it made it possible to open the physical essence of a number of the fundamental laws of electrodynamics, charges connected with the motion. This concept assumes the dependence of the scalar potential of charge on its relative speed. It is obtained by the way of the symmetrization of the laws of induction with the use by the substantial derivative. This approach made possible to explain such phenomena as the phase aberration of electromagnetic waves, transverse Doppler effect, power interaction of the current carrying systems and nature of Lorentz force. In this article the new law of electro-electrical induction, which explains nature of dipole emission, will be examined on the basis of the concept of scalar-vector potential.

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II. Law of the Electro-Electrical Induction

In the works [3-10] is developed the concept of scalar vector potential, from which it follows that the scalar potential depends on speed. This dependence is determined by relationship.

$$\varphi(r,t)=\frac{g\ ch\frac{v_\perp}{c}}{4\pi\ \varepsilon_0 r},$$

where $v_\perp$ is component of the charge rate g, normal to to vector $\vec{r}$, connecting charge with the observation point.

Since pour on any process of the propagation of electrical and potentials it is always connected with the delay, let us introduce the being late scalar- vector potential, by considering that the field of this potential is extended in this medium with a speed of light [1, 2]:

$$\varphi(r,t)=\frac{g\ ch\frac{v_\perp\left(t-\frac{r}{c}\right)}{c}}{4\pi\ \varepsilon_0 r} \qquad (2.1)$$

where $v_\perp\left(t-\frac{r}{c}\right)$ is component of the charge rate of g, normal to to the vector $\vec{r}$ at the moment of the time $t'=t-\frac{r}{c}$, r is distance between the charge and the point, at which is determined the field, at the moment of the time t.

Using a relationship of $\vec{E}=-grad\ \varphi(r,t)$, let us find field at point 1 (Fig. 1) The gradient of the numerical value of a radius of the vector of $\vec{r}$ is a scalar function of two points: the initial point of a radius of vector and its end point (in this case this point 1 on the axis of x and point 0 at the origin of coordinates). Point 1 is the point of source, while point 0 - by observation point. With the determination of gradient from the function, which contains a radius depending on the conditions of task it is necessary to distinguish two cases:

1) the point of source is fixed and $\vec{r}$ is considered as the function of the position of observation point.
2) observation point is fixed and $\vec{r}$ is considered as the function of the position of the point of source.

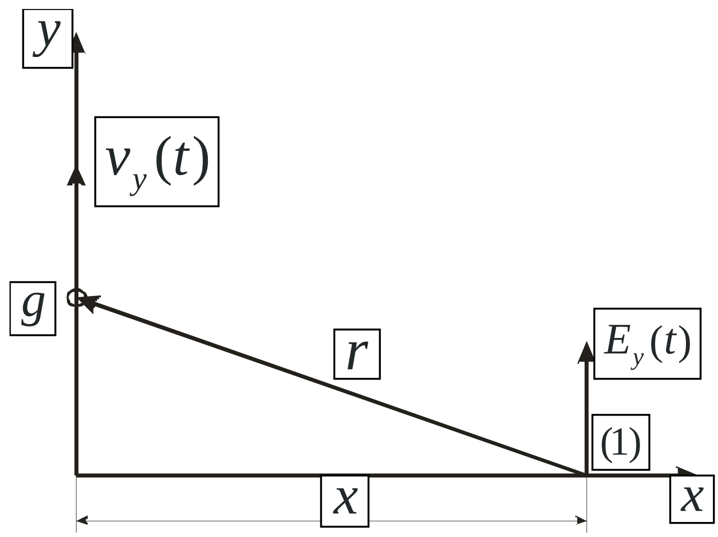

Fig. 1 : Diagram of shaping of the induced electric field.

We will consider that the charge of e accomplishes fluctuating motion along the axis of y, in the environment of point 0, which is observation point, and fixed point 1 is the point of source and $\vec{r}$ is considered as the function of the position of charge. Then we write down the value of electric field at point 1:

$$E_y(1) = -\frac{\partial \varphi_\perp(r,t)}{\partial y} = -\frac{\partial}{\partial y}\frac{e}{4\pi\varepsilon_0 r(y,t)}\, ch\frac{v_y\left(t-\frac{r(y,t)}{c}\right)}{c}$$

When the amplitude of the fluctuations of charge is considerably less than distance to the observation point, it is possible to consider a radius vector constant. We obtain with this condition:

$$E_y(x,t) = -\frac{e}{4\pi\varepsilon_0 cx}\frac{\partial v_y\left(t-\frac{x}{c}\right)}{\partial y}\, sh\frac{v_y\left(t-\frac{x}{c}\right)}{c} \qquad (2.2)$$

where x is some fixed point on the axis x.

Taking into account that

$$\frac{\partial v_y\left(t-\frac{x}{c}\right)}{\partial y} = \frac{\partial v_y\left(t-\frac{x}{c}\right)}{\partial t}\frac{\partial t}{\partial y} = \frac{\partial v_y\left(t-\frac{x}{c}\right)}{\partial t}\frac{1}{v_y\left(t-\frac{x}{c}\right)}$$

we obtain from (2.2)

$$E_y(x,t) = \frac{e}{4\pi\varepsilon_0 cx}\frac{1}{v_y\left(t-\frac{x}{c}\right)}\frac{\partial v_y\left(t-\frac{x}{c}\right)}{\partial t}\, sh\frac{v_y\left(t-\frac{x}{c}\right)}{c} \qquad (2.3)$$

This is a complete emission law of the moving charge.

If we take only first term of the expansion of $sh\frac{v_y\left(t-\frac{x}{c}\right)}{c}$, then we will obtain from (2.3):

$$E_y(x,t) = -\frac{e}{4\pi\varepsilon_0 c^2 x}\frac{\partial v_y\left(t-\frac{x}{c}\right)}{\partial t} = -\frac{e a_y\left(t-\frac{x}{c}\right)}{4\pi\varepsilon_0 c^2 x} \qquad (2.4)$$

where $a_y\left(t-\frac{x}{c}\right)$ is being late acceleration of charge. This relationship is wave equation and defines both the amplitude and phase responses of the wave of the electric field, radiated by the moving charge.

If we as the direction of emission take the vector, which lies at the plane xy, and which constitutes with the axis y the angle α, then relationship (2.4) takes the form:

$$E_y(x,t,\alpha) = -\frac{ea_y\left(t-\frac{x}{c}\right)\sin\alpha}{4\pi\varepsilon_0 c^2 x} \qquad (2.5)$$

The relationship (2.5) determines the radiation pattern. Since in this case there is axial symmetry relative to the axis y, it is possible to calculate the complete radiation pattern of this emission. This diagram corresponds to the radiation pattern of dipole emission.

Since $\frac{ev_z\left(t-\frac{x}{c}\right)}{4\pi x} = A_H\left(t-\frac{x}{c}\right)$ is being late vector potential, relationship (2.5) it is possible to rewrite

$$E_y(x,t,\alpha) = -\frac{ea_y\left(t-\frac{x}{c}\right)\sin\alpha}{4\pi\varepsilon_0 c^2 x} = -\frac{1}{\varepsilon_0 c^2}\frac{\partial A_H\left(t-\frac{x}{c}\right)}{\partial t} =$$

$$= -\mu_0\frac{\partial A_H\left(t-\frac{x}{c}\right)}{\partial t}$$

Is again obtained complete agreement with the equations of the being late vector potential, but vector potential is introduced here not by phenomenological method, but with the use of a concept of the being late scalar- vector potential. It is necessary to note one important circumstance: in Maxwell's equations the electric fields, which present wave, vortex. In this case the electric fields bear gradient nature.

Let us demonstrate the still one possibility, which opens relationship (2.5). Is known that in the electrodynamics there is this concept, as the electric dipole and the dipole emission, when the charges, which are varied in the electric dipole, emit electromagnetic waves. Two charges with the opposite signs have the dipole moment:

$$\vec{p} = e\vec{d}\,, \qquad (2.6)$$

where the vector $\vec{d}$ is directed from the negative charge toward the positive charge. Therefore current can be expressed through the derivative of dipole moment on the time

$$e\vec{v} = e\frac{\partial\vec{d}}{\partial t} = \frac{\partial\vec{p}}{\partial t}$$

Consequently

$$\vec{v} = \frac{1}{e}\frac{\partial\vec{p}}{\partial t},$$

and

$$\vec{a} = \frac{\partial\vec{v}}{\partial t} = \frac{1}{e}\frac{\partial^2\vec{p}}{\partial t^2}.$$

Substituting this relationship into expression (2.5), we obtain the emission law of the being varied dipole.

$$\vec{E} = -\frac{1}{4\pi r\varepsilon_0 c^2}\frac{\partial^2 p(t-\frac{r}{c})}{\partial t^2} \qquad (2.7)$$

This is also very well known relationship [1].

In the process of fluctuating the electric dipole are created the electric fields of two forms. First, these are the electrical induction fields of emission, represented by equations (2.4), (2.5) and (2.6), connected with the acceleration of charge. In addition to this, around the being varied dipole are formed the electric fields of static dipole, which change in the time in connection with the fact that the distance between the charges it depends on time. Specifically, energy of these pour on the freely being varied dipole and it is expended on the emission. However, the summary value of field around this dipole at any moment of time defines as superposition pour on static dipole pour on emissions.

The laws (2.4), (2.5), (2.7) are the laws of the direct action, in which already there is neither magnetic pour on nor vector potentials. I.e. those structures, by which there were the magnetic field and magnetic vector potential, are already taken and they no longer were necessary to us.

Using relationship (2.5) it is possible to obtain the laws of reflection and scattering both for the single charges and, for any quantity of them. If any charge or group of charges undergo the action of external (strange) electric field, then such charges begin to accomplish a forced motion, and each of them emits electric fields in accordance with relationship (2.5). The superposition of electrical pour on, radiated by all charges, it is electrical wave.

If on the charge acts the electric field of , then the acceleration of charge is determined by the equation:

$$a = -\frac{e}{m} E'_{y0} \sin \omega t \cdot$$

Taking into account this relationship (2.5) assumes the form

$$E_y(x,t,\alpha) = \frac{e^2 \ \sin \alpha}{4\pi \varepsilon_0 c^2 mx} E'_{y0} \sin \omega (t - \frac{x}{c}) = \frac{K}{x} E'_{y0} \sin \omega (t - \frac{x}{c}) \quad (2.8)$$

where the coefficient $K = \frac{e^2 \ \sin \alpha}{4\pi \varepsilon_0 c^2 m}$ can be named the coefficient of scattering (re-emission) single charge in the assigned direction, since it determines the ability of charge to re-emit the acting on it external electric field.

The current wave of the displacement accompanies the wave of electric field:

$$j_y(x,t) = \varepsilon_0 \frac{\partial E_y}{\partial t} = -\frac{e \sin \alpha}{4\pi c^2 x} \frac{\partial^2 v_y \left(t - \frac{x}{c} \right)}{\partial t^2} .$$

If charge accomplishes its motion under the action of the electric field of , then bias current in the distant zone will be written down as

$$j_y(x,t) = -\frac{e^2 \omega}{4\pi c^2 mx} E'_{y0} \cos \omega \left(t - \frac{x}{c} \right) . \quad (2.9)$$

The sum wave, which presents the propagation of electrical pour on (2.8) and bias currents (2.9), can be named the electrocurent wave. In this current wave of displacement lags behind the wave of electric field to the angle equal $\frac{\pi}{2}$. For the first time this term and definition of this wave was used in the works [3, 4].

In parallel with the electrical waves it is possible to introduce magnetic waves, if we assume that

$$\vec{j} = \varepsilon_0 \frac{\partial \vec{E}}{\partial t} = rot \vec{H} \quad (2.10),$$

$$div \vec{H} = 0 .$$

Introduced thus magnetic field is vortex. Comparing (2.9) and (2.10) we obtain:

$$\frac{\partial H_z(x,t)}{\partial x} = \frac{e^2 \omega \ \sin \alpha}{4\pi c^2 mx} E'_{y0} \cos \omega \left(t - \frac{x}{c} \right) .$$

Integrating this relationship on the coordinate, we find the value of the magnetic field

$$H_z(x,t) = \frac{e^2 \ \sin \alpha}{4\pi cmx} E'_{y0} \sin \omega \left(t - \frac{x}{c} \right) . \quad (2.11)$$

Thus, relationship (2.8), (2.9) and (2.11) can be named the laws of electrical-electrical induction, since. They give the direct coupling between the electric fields, applied to the charge, and by fields and by currents induced by this charge in its environment. Charge itself comes out in the role of the transformer, which ensures this prozess. The magnetic field, which can be calculated with the aid of relationship (2.11), is directed normally both toward the electric field and toward the direction of propagation, and their relation at each point of the space is equal:

$$\frac{E_y(x,t)}{H_z(x,t)} = \frac{1}{\varepsilon_0 c} = \sqrt{\frac{\mu_0}{\varepsilon_0}} = Z ,$$

where Z is wave drag of free space

Wave drag determines the active power of losses on the single area, located normal to the direction of propagation of the wave:

$$P = \frac{1}{2} Z E^2{}_{y0} .$$

Therefore electrocurent wave, crossing this area, transfers through it the power, determined by the data by relationship, which is located in accordance with Poynting theorem about the power flux of electromagnetic wave. Therefore, for finding all parameters, which characterize wave process, it is sufficient examination only of electrocurent wave and knowledge of the wave drag of space. In this case it is in no way compulsory to introduce this concept as magnetic field and its vector potential, although there is nothing illegal in this. In this setting of the relationships, obtained for the electrical and magnetic field, they completely satisfy Helmholtz's theorem. This theorem says, that any single-valued and continuous vectorial field $\vec{F}$, which turns into zero at infinity, can be represented uniquely as the sum of the gradient of a certain scalar function φ and rotor of a certain vector function $\vec{C}$, whose divergence is equal to zero:

$$\vec{F} = grad \varphi + rot \vec{C} ,$$

$$div \vec{C} = 0 .$$

Consequently, must exist clear separation pour on to the gradient and the vortex. It is evident that in the expressions, obtained for those induced pour on, this separation is located. Electric fields bear gradient nature, and magnetic is vortex.

Thus, the construction of electrodynamics should have been begun from the acknowledgement of the dependence of scalar potential on the speed. But nature very deeply hides its secrets, and in order to come to this simple conclusion, it was necessary to pass way by length almost into two centuries. The grit, which so harmoniously were erected around the magnet poles, in a straight manner indicated the presence of some power pour on potential nature, but to this they did not turn attention; therefore it turned out that all examined only tip of the iceberg, whose substantial part remained invisible of almost two hundred years.

Taking into account entire aforesaid one should assume that at the basis of the overwhelming majority of static and dynamic phenomena at the electrodynamics only one formula (2.1), which assumes the dependence of the scalar potential of charge on the speed, lies. From this formula it follows and static interaction of charges, and laws of power interaction in the case of their mutual motion, and emission laws and scattering. This approach made it possible to explain from the positions of classical electrodynamics such phenomena as phase aberration and the transverse Doppler effect, which within the framework the classical electrodynamics of explanation did not find. After entire aforesaid it is possible to remove construction forests, such as magnetic field and magnetic vector potential, which do not allow here already almost two hundred years to see the building of electrodynamics in entire its sublimity and beauty.

Let us point out that one of the fundamental equations of induction (2.4) could be obtained directly from the Ampere law, still long before appeared Maxwell equations. The Ampere law, expressed in the vector form, determines magnetic field at the point x, y, z

$$\vec{H} = \frac{1}{4\pi}\int \frac{I d\vec{l} \times \vec{r}}{r^3}$$

where I is current in the element $d\vec{l}$, $\vec{r}$ is vector, directed from $d\vec{l}$ to the point x, y, z.

It is possible to show that

$$\frac{[d\vec{l}\vec{r}]}{r^3} = grad\left(\frac{1}{r}\right) \times d\vec{l}$$

and, besides the fact that

$$grad\left(\frac{1}{r}\right) \times d\vec{l} = rot\left(\frac{d\vec{l}}{r}\right) - \frac{1}{r} rot\ d\vec{l}.$$

but the rotor $d\vec{l}$ is equal to zero and therefore is final

$$\vec{H} = rot \int I\left(\frac{d\vec{l}}{4\pi r}\right) = rot\ \vec{A}_H$$

where

$$\vec{A}_H = \int I\left(\frac{d\vec{l}}{4\pi r}\right) \qquad (2.12)$$

the remarkable property of this expression is that that the vector potential depends from the distance to the observation point as $\frac{1}{r}$. Specifically, this property makes it possible to obtain emission laws.

Since $I = gv$, where g the quantity of charges, which falls per unit of the length of conductor, from (2.12) we obtain:

$$\vec{A}_H = \int \frac{gv\ d\vec{l}}{4\pi r}.$$

For the single charge of e this relationship takes the form:

$$\vec{A}_H = \frac{e\vec{v}}{4\pi r},$$

and since

$$\vec{E} = -\mu \frac{\partial \vec{A}}{\partial t},$$

that

$$\vec{E} = -\mu \int \frac{g \frac{\partial v}{\partial t}\ d\vec{l}}{4\pi r} = -\mu \int \frac{ga\ d\vec{l}}{4\pi r}, \qquad (2.13)$$

where a is acceleration of charge.

This relationship appears as follows for the single charge:

$$\vec{E} = -\frac{\mu e\vec{a}}{4\pi r} \qquad (2.14)$$

If we in relationships (2.13) and (2.14) consider that the potentials are extended with the final speed and to consider the delay of $\left(t - \frac{r}{c}\right)$, and assuming $\mu = \frac{1}{\varepsilon_0 c^2}$, these relationships will take the form:

$$\vec{E} = -\mu \int \frac{ga(t - \frac{r}{c})\ d\vec{l}}{4\pi r} = -\int \frac{ga(t - \frac{r}{c})\ d\vec{l}}{4\pi\varepsilon_0 c^2 r}, \qquad (2.15)$$

$$\vec{E} = -\frac{e\vec{a}(t - \frac{r}{c})}{4\pi\varepsilon_0 c^2 r} \qquad (2.16)$$

The relationship (2.15) and (2.16) represent, it is as shown higher (see (2.4)), wave equations. Let us note that these equations - this solution of Maxwell's equations, but in this case they are obtained directly from the Ampere law, not at all coming running to Maxwell equations. To there remains only present the question, why electrodynamics in its time is not banal by this method.

Given examples show, as electrodynamics in the time of its existence little moved. The phenomenon of electromagnetic induction Faraday opened into 1831 and already almost 200 years its study underwent practically no changes, and the physical causes for the most elementary electrodynamic phenomena, until now, were misunderstood. Certainly, for his time Faraday was genius, but that they did make physics after it? There were still such brilliant figures as Maxwell and Hertz, but even they did not understand that the dependence of the scalar potential of charge on its relative speed is the basis of entire classical electrodynamics, and that this is that basic law, from which follow the fundamental laws of electrodynamics.

III. Conclusion

Maxwell equations attest to the fact that in the free space the transverse electromagnetic waves can exist. Together with the boundary conditions these equations give the possibility to solve the problems of reflection and propagation of such waves in the locked and limited structures. With the aid of Maxwell equations it is possible to solve the problems of emission. But since the equations indicated are phenomenological, physics of such processes thus far remains not clear. Similar problems can be solved, also, with the use of potentials. This approach opens greater possibilities, but physics of the vector potential of magnetic field also up to now remained not clear. The development of the concept of scalar-vector potential, which dedicated a number of works [3-10], it made it possible to open the physical essence of a number of the fundamental laws of electrodynamics, charges connected with the motion. This concept assumes the dependence of the scalar potential of charge on its relative speed. It is obtained by the way of the symmetrization of the laws of induction with the use by the substantional derivative. This approach made possible to explain such phenomena as the phase aberration of electromagnetic waves, transverse Doppler effect, power interaction of the current carrying systems and nature of Lorentz force. In this article the new law of electro-electrical induction, which explains nature of dipole emission, will be examined on the basis of the concept of scalar-vector potential.

References Références Referencias

1. S. Ramo, John. Winner. Fieldsand Waves in modern electronics.OGIZ: 1948.
2. V. V. Nicolsky, T.I. Nicolskaya, Electrodynamics and propagation of radio waves, Moscow, Nauka, 1989.
3. F. F. Mende, On refinement of equations of electromagnetic induction,– Kharkov, deposited in VINITI, No 774 – B88 Dep.,1988.
4. F. F. Mende. On refinement of certain laws of classical electrodynamics, arXiv, physics/0402084.
5. F. F. Mende. Conception of the scalar-vector potential in contemporary electrodynamics, arXiv.org/abs/physics/0506083.
6. F. F. Mende New electrodynamics. Revolution in the modern physics. Kharkov, NTMT, 2012.
7. F. F. Mende, On refinement of certain laws of classical electrodynamics, LAP LAMBERT Academic Publishing 2013.
8. F. F. Mende. The Classical Conversions of Electromagnetic Fields on Their Consequences AASCIT Journal of PhysicsVol.1 , No. 1, Publication Date: March 28, 2015, Page: 11-18
9. F. F. Mende. On thephysical basis ofunipolar induction.A new type of unipolar generator. EngineeringPhysics, № 6, 2013, p. 7-13.
10. F. F. Mende, Concept of Scalar-Vector Potential in the Contemporary Electrodynamic, Problem of Homopolar Induction and Its Solution, International Journal of Physics, 2014, Vol. 2, No. 6, 202-210.
11. R. Feynman, R. Leighton, M. Sends, Feynman lectures on physics, – M..Mir, Vol. 6, 1977.

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