Change of Characteristics of the Light Source at its Movement Relatively Receiver

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The influence of light source on the receiver as electromagnetic interaction is considered. The mechanical influence of the moving charged body on motionless one is defined by the experimental laws of electrodynamics. These laws determine the changes of parameters of the light source which moves relatively the receiver. The laws of change of light frequency and its direction of the moving source are derived from the laws of electromagnetism. At small velocity of source movement they coincide with classical results: the Doppler effect and phenomenon of aberration. The interaction of the source and receiver depends only on their velocity of movement relatively each other. There is no world medium, the relative movement to which would influence on the characteristics of light source.
Key words: light source, movement, relatively, receiver, laws of electromagnetism, Doppler effect, aberration.

Light is electromagnetic influence of a source on the receiver

There are many various concepts about a nature of light changes when the source moves relatively the receiver. I all shall not list and analyze them. Here I shall state that understanding to which I have come.

By numerous experiments it is established, that light is electromagnetic action of one body on another. A nature of light influence is the same, as well as a nature of action of transmitting aerial of a radiation source on the reception aerial of a radio receiver.

In the elementary transmitting aerial, in the flat condenser, the charged particle tests the action directed perpendicularly to plates. If the power supply is connected to the condenser with a variable voltage the force of action on this particle will change, remaining perpendicular to the plates. Such action on the charged particle will exist and outside of the condenser, but its value will decreases with distance. This variable electric action is named as electromagnetic waves. If between plates there will be a magnetized body the variable force of action on one of its poles will be directed perpendicularly to the force acting on the charged body, and also is perpendicular to a direction of removal from the condenser. Therefore, in any point of space near to the average plane of the condenser on the charged particle placed in it or on a magnetic pole there will be the action which is directed perpendicularly to the distance of this point from the condenser. Therefore the elementary waves name cross.

The receiver of this electromagnetic action might be the charged particle or the magnetic pole if it was possible to measure their cross fluctuations. But development of radio engineering went on other way. The receiver of variable electromagnetic influence is the similar condenser on which plates there is a variable electric charge which is transformed to an alternating current. This current is amplified, and that information which was transferred by the receiver thus is restored.

The electromagnetic influence of light differs from electromagnetic influence of radiowaves by the much greater frequency. By numerous experiments it is established that physical properties of electromagnetic action essentially depend on value of frequency. Apparently, appreciably it concerns to light. There is a line of its properties which for other electromagnetic waves are not shown. However there is the uniform electromagnetic nature of light and radiowaves concerning the action of a moving electromagnetic source on the receiver. In particular, there are identical laws of change of characteristics of electromagnetic action of a source at its movement relatively the receiver.

Laws of electromagnetic interaction of two objects at their relative movement

Well-known, that at movement of a magnet relatively the condenser, on its plates is appeared an electric charge. Therefore, if to place between plates of the condenser the charged particle there will be a mechanical action on it from a moving magnet, i.e. the particle will get movement. If the condenser plates to close a conductor, the current will run in the conductor. This effect is identical to a case when the magnet moves relatively the coil with a conductor. At short circuit of its ends the current will be in the conductor. The value of a current does not depend on that, the coil or a magnet moves. Strength of current is defined by velocity of their relative movement. As is known [1], this phenomenon is described by the Faraday's law induction.

The similar situation arises at movement of the electrified body. Its movement relatively a magnet is identically to a current, and the current creates mechanical action on a magnet pole, i.e. the moving charge creates the mechanical influence on a magnet. This influence is described [1] by experimental Biot-Savart-Laplace's law for the current element. The interaction of the moving charged body and the magnet also does not depend on that, the charged body or a magnet moves. It depends on velocity of their relative movement. If the charge and the magnet move relatively the third body, for example Earth's surface, but from each other they rest, in this case the charge and the magnet do not interact. Do not interact too in this case the coil with the magnet.

The variable electromagnetic interaction between the source and the receiver (in a modern terminology it is electromagnetic waves) is defined by first and second Maxwell's equations. In turn, these equations are other form of record of two experimental laws[1]: Faraday's law induction and Biot-Savart-Laplace's law. Excepting magnetic intensity H from Maxwell's equations, we receive Dalembert's equation for electric intensity E

$$\frac{\partial^2 \vec{E}}{\partial x^2}+\frac{\partial^2 \vec{E}}{\partial y^2}+\frac{\partial^2 \vec{E}}{\partial z^2}-\frac{1}{c_1^2}\frac{\partial^2 \vec{E}}{\partial t^2}=\frac{4\pi}{\varepsilon}\left[\frac{1}{c_1^2}\frac{\partial(\rho\vec{v})}{\partial t}+\operatorname{grad}\rho\right], \tag{1}$$

where $c_1 = c/\sqrt{\mu\varepsilon}$ is speed of light in the considered media; ε is dielectric permittivity of media; μ is magnetic permeability of media; ρ is the density of electric charges distributed in the space of system of coordinates xyz; $\vec{v}$ is velocity of charges. The equation (1) defines force of influence of moving charges on a motionless point particle which charge is equal to unit. And the movement with velocities $\vec{v}$ occurs relatively a motionless particle.

We have solved Dalembert's equation (1) for action of one point charged particle on another when the first moves relatively the second with velocity $\vec{v}_{12}$, also we have received expression for force

$$\vec{F}_{12}=\frac{q_1 q_2}{\varepsilon}\frac{\vec{R}_{12}\left(1-\beta^2\right)}{\left\{R_{12}^2-\left[\vec{\beta}\times\vec{R}_{12}\right]^2\right\}^{3/2}}, \tag{2}$$

where $\vec{R}_{12}$ is the radius-vector from the first charge to the second; $\vec{\beta}=\vec{v}_{12}/c_1$ is the normalized velocity.

Force (2) depends on relative velocity of movement $\vec{v}$ and at $\vec{v}$ = 0 it passes in Coulomb's law:

$$\vec{F}_{12}=\frac{q_1 q_2}{\varepsilon}\frac{\vec{R}_{12}}{R_{12}^3}, \tag{3}$$

which, as it is known, determines force of interaction of two motionless charges.

So, all electromagnetic experiments and results (1) - (2), which follow from them, testify, that laws of electromagnetic interaction of two objects depend on their relative velocity. From here the two important conclusions follows. The first one testifies an inaccuracy of the principle of relativity, when it applies to interaction of objects moving from each other. In this case we may not tell that laws of a nature (for example, Coulomb's law (3)) do not depend on movement of object. On the contrary, the law of electromagnetic interaction of two objects (2) depends on their relative movement. So, the principle of relativity, which used in the Theory of Relativity (TR), is incorrect. The second conclusion testifies to absence of the world media: the luminiferous media, ether, the media of physical vacuum etc. It follows that electromagnetic interaction of two objects depends on their relative velocity and does not depend on absolute velocity relatively to the imagined world media.

Laws of the description of electromagnetic waves

Thus, the variable electromagnetic action (in the accepted terminology: electromagnetic waves, electromagnetic radiation, light etc.) of a source on the receiver depends on their relative velocity. This dependence (Doppler effect, phenomenon of aberration) for a long time was established by astronomers from observations. However for their theoretical explanation various models of propagation of light were involved. As we see, all these models are speculative. Real dependence of light influence of a source on the receiver at their relative movement may be established only on the basis of experimental laws of electromagnetism, which are received as a result of measurement of mechanical interactions.

In case of variable electromagnetic action the constant charge is absent, and its density $\rho = 0$, therefore at equality to zero of the right part of Dalembert's equation (1) it turns to the wave equation

$$\frac{\partial^2 \vec{E}}{\partial x^2} + \frac{\partial^2 \vec{E}}{\partial y^2} + \frac{\partial^2 \vec{E}}{\partial z^2} - \frac{1}{c_1^2}\frac{\partial^2 \vec{E}}{\partial t^2} = 0 . \tag{4}$$

As shown in our works, for example, [2-3] the partial case of its solution is the equation of a plane wave

$$\vec{E}(x, y, z, t) = \vec{E}_0 \cos[2\pi f(\pm t - (\hat{\alpha}x + \hat{\beta}y + \hat{\gamma}z)/c_1)] , \tag{5}$$

where $\vec{E}_0$ = const is amplitude; *f* is frequency of fluctuations; $\vec{n} = \hat{\alpha}\vec{i} + \hat{\beta}\vec{j} + \hat{\gamma}\vec{k}$ is a normal to a plane of wave, directing cosines which with the axes of coordinates *x, y, z* are equal: $\hat{\alpha} = \cos(n\hat{x})$; $\hat{\beta} = \cos(n\hat{y})$; $\hat{\gamma} = \cos(n\hat{z})$.

Interaction of the source and the receiver at their relative movement

Expression (5) describes change of electric intensity *E* in any point of coordinate's system *xyz* and at any moment. This change is caused by a variable electromagnetic source. From the formula (5) follows, that the changes of *E* in space are propagated with speed c_1. If an electromagnetic source is point one, far from it the equation (5) will describe its influence at little changes of distance. And for the exact description of its action it is necessary to use the solution of the wave equation (4) for a spherical wave [2-3]. The receiver, which is placed in a point with coordinates *x, y, z*, according to expression (4) will test variable action of a source.

In case of movement of a source, for example, with velocity υ in a direction of an axis *x*, its influence on the receiver already will be another. So as to calculate it, it is necessary to make change of electromagnetic characteristics of a source, which it is caused by its movement relatively the receiver. In works [2-3] we have went in another way. We are asked a question, under what conditions expression (2) for force of interaction the relatively moving charged particles will coincide with Coulomb's law (3) for force of interaction of the motionless charged particles? It is obvious, that for this purpose it is necessary the values which are included in expression (3) to express through values on which depends (2). Appeared, that exists two variants of transformations of expression (3) to expression (2). We shall use one of them. Thus the parameters interaction of relatively moving charges, we shall write down with an index "υ":

$$x = \frac{x_\upsilon - \upsilon t_v}{\sqrt{1-\beta^2}},\ t = \frac{t_\upsilon - (\upsilon / c_1^2) x_\upsilon}{\sqrt{1-\beta^2}},\ y = y_\upsilon,\ z = z_\upsilon,\ E_{vx} = E_x,\ E_{vy} = \frac{E_y}{\sqrt{1-\beta^2}},\ E_{vz} = \frac{E_z}{\sqrt{1-\beta^2}}. \quad (6)$$

Here we used the electric intensity created by the first charge, by which the force of its action on the second charge is written as $\vec{F}_{12} = q_2 E$.

So, after transformation of parameters of Coulomb's law (3) by expressions (6) it turns to expression (2) for force of interaction relatively moving charges. A similar way, having substituted in the wave equation (5) transformations (6), we shall receive expression for influence of a moving variable source with velocity υ on the receiver in the following form:

$$\vec{E}_\upsilon = \vec{E}_{o\upsilon} \cos\left\{ \frac{1+\hat{\alpha}\beta}{\sqrt{1-\beta^2}} 2\pi f \left[\pm t_\upsilon - \frac{x_\upsilon(\hat{\alpha}+\beta) + y_\upsilon \hat{\beta}\sqrt{1-\beta^2} + z_\upsilon \hat{\gamma}\sqrt{1-\beta^2}}{c_1(1+\hat{\alpha}\beta)} \right] \right\}. \quad (7)$$

It is obvious, that equation (7) we may result in the equation of a plane wave

$$\vec{E}_\upsilon(x,y,z,t) = \vec{E}_{0\upsilon} \cos[2\pi f_\upsilon (\pm t_\upsilon - (\hat{\alpha}_\upsilon x + \hat{\beta}_\upsilon y + \hat{\gamma}_\upsilon z)/c_1)], \quad (8)$$

by assistance of expressions for frequency and directing cosines of the wave front of a moving source in the following view:

$$f_\upsilon = f \frac{1+\hat{\alpha}\beta}{\sqrt{1-\beta^2}}, \quad (9)$$

$$\hat{\alpha}_\upsilon = \frac{\hat{\alpha}+\beta}{1+\hat{\alpha}\beta}, \quad (10)$$

$$\hat{\beta}_\upsilon = \frac{\sqrt{1-\beta^2}}{1+\hat{\alpha}\beta}\hat{\beta}, \quad (11)$$

$$\hat{\gamma}_\upsilon = \frac{\sqrt{1-\beta^2}}{1+\hat{\alpha}\beta}\hat{\gamma}. \quad (12)$$

Let's note, that for directing cosines as it is easy to check up, there is truthful expression: $\hat{\alpha}_\upsilon^2 + \hat{\beta}_\upsilon^2 + \hat{\gamma}_\upsilon^2 = 1$.

Doppler effect and aberration of light

We shall consider the change of frequency of light at movement of a source. Let the source comes nearer along an axis *x* with the normalized velocity $\vec{\beta}$ to the receiver, which is ahead of the receiver. In this case the normal of wave front with an axis *x* has a zero angle: $(n\hat{x})$ = 0, т.е. $\hat{\alpha} = \cos(n\hat{x}) = 1$. At small velocity of the source movement the value β^2 in comparison with 1 in expression (9) it is possible to neglect, and the source frequency will be defined by the formula

$$f_\upsilon = f(1+\beta). \quad (13)$$

It coincides with the formula of classical Doppler effect. At the source movement to the receiver the frequency of light will increase. And at removal of the source from the receiver ($\beta < 0$) the frequency of light will decrease. However at velocity of the source movement or of the receiver movement with the velocity comparable to speed of light, more precisely change of frequency of a light source is necessary for defining under the formula (9). At velocity υ comparable to speed of light ($\vec{\beta} \to 1$) the change of frequency of a source will essentially differ from the value determined by Doppler effect (13).

We shall consider the change of the direction of light wave front at source movement, i.e. the aberration of light (see fig. 1). Let the source *(S)* goes along an axis *x*, and the receiver *(R)* is in a plane *xy*. So as the designations coincided with accepted ones in astronomy, we shall replace angles between the normal of wave front of a moving source S: $(n_{\upsilon}\hat{x}) = \theta$ and of a motionless source S': $(n\hat{x}) = \theta'$. Then expression (10) for change of the light wave front at the source or at the movement receiver will be written down so:

$$\cos\theta = \frac{\cos\theta' + \beta}{1 + \cos\theta'\beta}. \qquad (14)$$

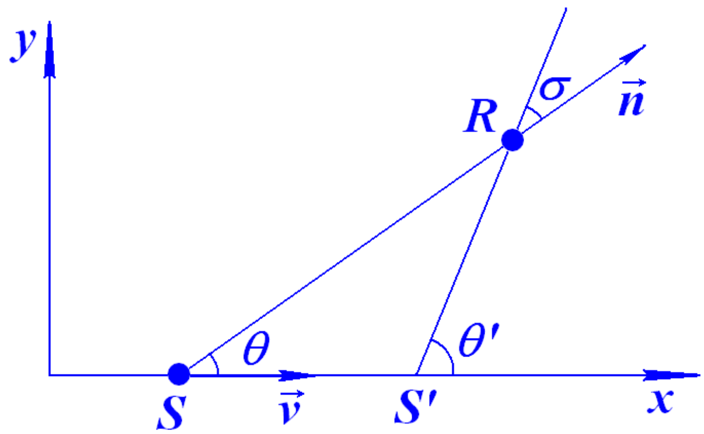

Fig. 1. Change of light direction at the movement of source *S*. *S* is a moving light source, which is observed by receiver *R*; *S'* is a motionless light source, which is observed by the receiver *R*.

Let's designate (see fig. 1) the difference of angles of normal to fronts of light waves of motionless and moving sources a symbol σ, which refers to as angle of the light aberration. From fig. 1 it is visible, that

$$\theta' = \theta + \sigma. \qquad (15)$$

Let's find expression for the aberration angle. With this purpose we shall find θ' from the formula (14):

$$\cos\theta' = \frac{\cos\theta - \beta}{1 - \cos\theta\beta}. \qquad (16)$$

Let's substitute θ' accordingly (15) in (16), also we shall transform cosine

$$\cos\theta\cos\sigma - \sin\theta\sin\sigma = \frac{\cos\theta - \beta}{1 - \cos\theta\beta}. \qquad (17)$$

As in astronomy the aberration angle, which takes into account orbital movement of the Earth, is used. Therefore it is very small (about 20″) and it is possible to accept in (17), that $\cos\sigma = 1$. Therefore from (17) it is received:

$$\sin\sigma = \frac{\beta\sin\theta}{1 - \cos\theta\beta}. \qquad (18)$$

At the small normalized velocities $\vec{\beta}$ of the source movement by the second term in a denominator it is possible to neglect. Then the angle of an aberration will be defined by the formula:

$$\sin\sigma = \beta\sin\theta. \qquad (19)$$

In astronomy under this formula is computed the annual movement of stars which is caused by the Earth orbital movement around of the Sun.

Last decades the astronomers find out objects which move with velocities which are comparable to speed of light. The formula (19) will be incorrect for them. The changes of their angle of the light wave front direction it is necessary to calculate under the formula (10) or, in other designations, under the formula (14).

Conclusions

1. Light is electromagnetic influence of the source on the receiver.
2. The electromagnetic action of one body on another depends on velocity of their relative movement. This action does not depend on velocity of movement of the receiver or of the source from any imagined media.
3. There is no luminiferous media (an ether, a field, the media of physical vacuum etc.), the movement of the source or of the receiver relatively which would change the source action on the receiver.
4. The change of frequency of light and its direction at the source movement relatively the receiver is completely determined by laws of electromagnetism.

Refrences

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