Structural model of the light particles

Idea

To prove, that experimental data in relativistic classical Maxwell's electrodynamics can be described without the special relativity theory, in the model of macroscopically Newton's space and time. It will allow removing the restriction on the construction of mechanical models for the light particles. To find the mathematical and physical arguments for construction such model. To deduce the formula for the light particles energy.

Introduction

Since 1960 a large number of experiments on the definition of the light structure have been conducted. However, the standard theoretical point of view on the light structure has not been presented as yet. Now there exist new mathematical and physical arguments for construction of the structural light model. The derivation of the formula for energy of the light particles is of special interest for theorists.

Generalization of the Maxwell Electrodynamics

We start with the assumption that there is an individual observer. It has a system of measuring devices which are necessary and sufficient for studying the electromagnetic phenomena. The observer uses "absolute" standards of length and time according to the physical model of the Newton space $R^3 \times T^1$. We present the physical laws of the Maxwell electrodynamics in $R^3 \times T^1$ on the basis of three-dimensional rot and div in a vector form:

$$\nabla \times \vec{E} = -\frac{1}{c}\frac{\partial \vec{B}}{\partial t}, \ \nabla \cdot \vec{B} = \vec{0},$$

$$\nabla \cdot \vec{D} = 4\pi\rho, \ \nabla \times \vec{H} = \frac{1}{c}\frac{\partial \vec{D}}{\partial t} + 4\pi\frac{\vec{J}}{c}.$$

We add the generalized relations between the fields and inductions:

$$\vec{D} + w\left[\frac{\vec{U}}{c} \times \vec{H}\right] = \varepsilon\left(\vec{E} + \left[\frac{\vec{U}}{c} \times \vec{B}\right]\right), \ \vec{B} + w\left[\vec{E} \times \frac{\vec{U}}{c}\right] = \mu\left(\vec{H} + \left[\vec{D} \times \frac{\vec{U}}{c}\right]\right).$$

Considering the interaction between the light and matter as the relaxation process, we obtain the expressions

$$\vec{U} = (1-w)\vec{U}_{fs} + w\vec{U}_m, \ w = 1 - \exp\left(-P_0\frac{\rho}{\rho_0}\right).$$

Here U_{fs} is the velocity of the primary radiation source and U_m is the velocity of the environment acting as the secondary radiation source. The quantity w named the rate of the relation is included into the electromagnetism theory as an independent physical factor.

The solution for the group velocity in the nonrelativistic limit follows from the specified model

$$\vec{V}_g = \frac{c}{n}\frac{\vec{K}}{K} + \left(1 - \frac{w}{n^2}\right)\left[(1-w)\vec{U}_{fs} + w\vec{U}_m\right].$$

It indicates the dependence of the group velocity of the electromagnetic field not only on the rate of refraction, but also on a rate of the relation, not only on the velocity of the environment, but also on the velocity of the primary radiation source. On the basis of the specified model it is possible to explain the hole set of experimental data of relativistic electrodynamics not using the special relativity theory and its restrictions. The preconditions for the consideration of light particles as the products having structural components are created.

The filling group for physical models

Any physical model can be written in a matrix kind, if we use matrixes which have only one significant element equal to unit. These matrixes can be constructed algebraically, using the filling group for physical models. We can use for this purpose the system of the monomial matrixes which in each column and each row have only one significant element. We have obvious kind of the filling group using the matrixes 4×4 dimension:

$$\sigma_0^0 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \sigma_0^1 = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix} \sigma_0^2 = \begin{pmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \end{pmatrix} \sigma_0^3 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix}$$

$$\sigma_1^0 = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \sigma_1^1 = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix} \sigma_1^2 = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix} \sigma_1^3 = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix}$$

$$\sigma_2^0 = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix} \sigma_2^1 = \begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix} \sigma_2^2 = \begin{pmatrix} 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix} \sigma_2^3 = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix}$$

$$\sigma_3^0 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \end{pmatrix} \sigma_3^1 = \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 \\ 0 & 0 & -1 & 0 \end{pmatrix} \sigma_3^2 = \begin{pmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \end{pmatrix} \sigma_3^3 = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}.$$

This form of the filling group is based on the algorithm of mathematical expression for mutual relations in the physical system consisting of final quantity of objects. If the number of such objects is four, we obtained the matrixes of 4×4 dimension. We will express single relations in the first line for the first object, in the second -- for the second object. We will use the number system $[-1,0,1]$. We obtained the system of monomial matrixes. Having multiplied them on a minus unit, we obtained the filling group in the form of projective group $PSL(4,R)$.

Maxwell's electrodynamics on the filling group

Generalised Maxwell's electrodynamics has a simple matrix form on the filling group $PSL(4,R)$. We write some electrodynamics equation:

$$\left\{\begin{pmatrix}0&0&0&-1\\0&0&1&0\\0&-1&0&0\\1&0&0&0\end{pmatrix}\partial_x+\begin{pmatrix}0&0&-1&0\\0&0&0&-1\\1&0&0&0\\0&1&0&0\end{pmatrix}\partial_y+\begin{pmatrix}0&1&0&0\\-1&0&0&0\\0&0&0&-1\\0&0&1&0\end{pmatrix}\partial_z+\begin{pmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&1\end{pmatrix}\frac{(-i)}{c}\partial_t\right\}\times$$

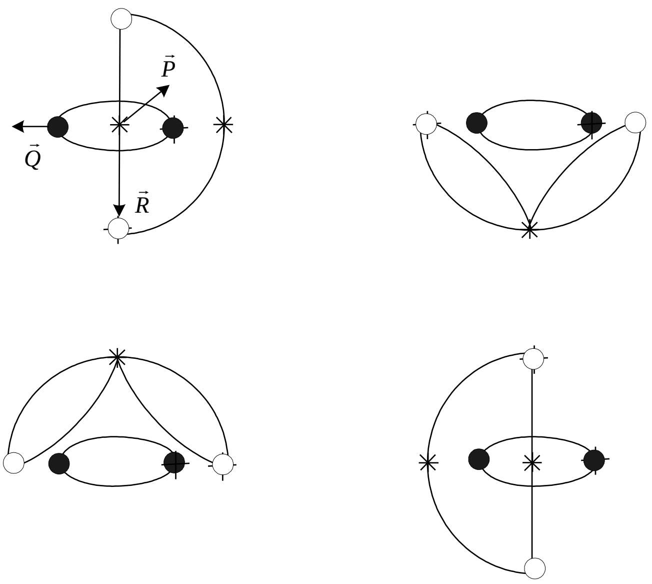
$$\times\begin{pmatrix}E_x-iB_x\\E_y-iB_y\\E_z-iB_z\\0\end{pmatrix}+\left\{\begin{pmatrix}0&0&0&1\\0&0&1&0\\0&-1&0&0\\-1&0&0&0\end{pmatrix}\partial_x+\begin{pmatrix}0&0&-1&0\\0&0&0&1\\1&0&0&0\\0&-1&0&0\end{pmatrix}\partial_y+\begin{pmatrix}0&1&0&0\\-1&0&0&0\\0&0&0&1\\0&0&-1&0\end{pmatrix}\partial_z+\right.$$

$$\left.+\begin{pmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&1\end{pmatrix}\frac{i}{c}\partial_t\right\}\begin{pmatrix}E_x+iB_x\\E_y+iB_y\\E_z+iB_z\\0\end{pmatrix}=0$$

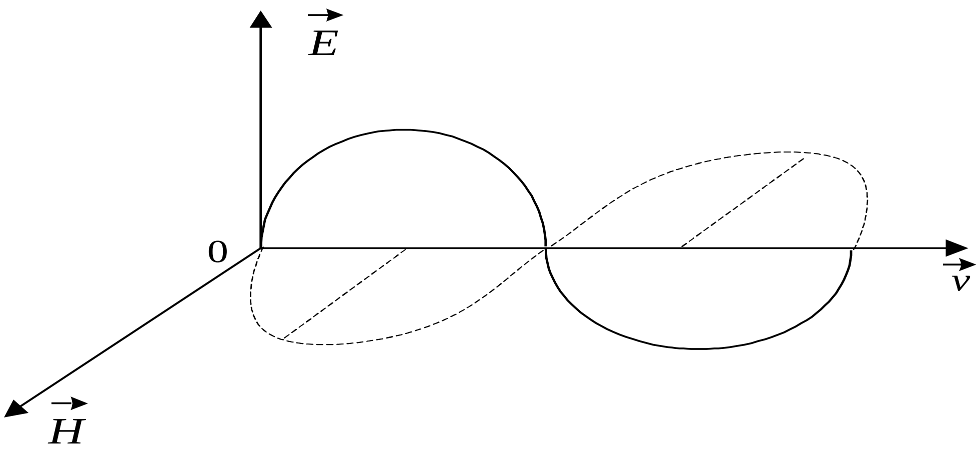
Other equations of electrodynamics, including connections between fields and induction, can be written similarly on the filling group. From this circumstances we can suggest, that in electrodynamics we have some four objects and the relations between them. The problem is to construct on this basis some mechanical model of the light.

Basic Elements of Light Particles

Let us accept the point of view that all light particles are made of the same components named precharges. We can introduce four different precharges. We present the situation geometrically:



We can introduce the vector $\vec{R}$ specifying the position of the particle (-○-) in the light particle, named a noton, the vector $\vec{Q}$ setting a direction from (-●-) to (●), and the vector $\overline{P}$ that is perpendicular to $\vec{Q}$ and forms with it the system coordinated with movement of (-○-) around the center. We introduce the fields $\vec{E}$ and $\vec{H}$ into the formulas $\vec{E} = a\vec{P}\left(\vec{R}\vec{Q}\right)$ and $\vec{H} = b\vec{Q}\left(\vec{R}\vec{Q}\right)$. Here $\left(\vec{R}\vec{Q}\right)$ is the scalar product of the vectors. We consider a picture of movements. The fields $\vec{E}$, $\vec{H}$ vary cyclically and in coordination with the circular movement of peripheral precharges around central precharges. In this model, the change of the position of precharges is coordinated with the dynamics of the receptors. In the classical theory of electromagnetism the fields E and H are connected by the linear dependence: $\sqrt{\mu}H = \sqrt{\varepsilon}E$. They simultaneously have maxima and minima. The vectors $\vec{H}$ and $\vec{E}$ are changes mutually perpendicular. We present a cycle of periodic changes $\vec{E}$ and $\vec{H}$ as:



Such behavior is coordinated now with the mechanical model of a light particle.

Calculation of the Light Particle Energy

We consider a basic element of the light particles in the torus shape. Then proposed model is close to the primary mechanical model of the light particle, which is introduced by Thomson. He used the formula for the energy of a power tube:

$$\varepsilon_0 E = 2\pi f^{\,2} V.$$

Here f is the dielectric polarization and V is the volume of a power tube. The power tube connects the pair of positive and negative electric charges e. The polarization obeys the formula

$$f \cdot S = \pi \cdot f \cdot b^2 = p \cdot e.$$

We designate an external radius of the ring of a power tube as r and the radius of the section as b. The factor $p \le 1$ considers whether all power lines are concentrated in the power tube. Thomson has received the expression

$$E = 8\pi^2 \left(p \frac{r}{b} \right)^2 \frac{e^2}{\varepsilon_0 c} \omega.$$

The frequency is set by the formula

$$\omega = \frac{c}{2\pi \cdot r}.$$

If we use the value of electric charge $e = 1.6021892 \cdot 10^{-19}$ kl, the velocity of the light in vacuum $c = 2.9979256 \cdot 10^8 m \cdot c^{-1}$ we obtain the expression

$$E = \hbar \omega.$$

The calculated value of the Planck constant $\hbar$ is close to its experimental value if the condition

$$p \frac{r}{b} \cong 0{,}37226$$

is accepted. We assume that this expression to be suitable for the elementary block of a light particle. Then the electric precharge is used instead of an electric charge. At its small value Planck's constant will turn out at small speeds of rotation of periphery round the centre. This formula for the energy of the light particle proves the nonequivalence of the weight and the energy as gives the dependence of energy on a square of electric charge.