NEW PHYSICS OF LIGHT AND GRAVITY

The fundamental components of life are Light and Gravity. Deepening or expanding their theories, even in the form of initial seed points, initiates the development of a new paradigm in natural science.

The main obstacle to their development, since the early 20th century, has been and remains the hypothesis, authoritatively established by great minds, that Light and Gravity do not possess a structure consisting of particles composed of interacting micro-particles with their own internal structure.

This hypothesis has two "dimensions." On the one hand, progress is hindered by Einstein’s relativity: light particles cannot have dimensions due to the singularity of lengths at the speed of light in a vacuum. Overcoming such a "barrier" in theory requires a generalization of Maxwell's electrodynamics, allowing all available experiments to be explained without the limitations of previous models. Such a theory has existed in my works since 1986. Its essence lies in introducing a normalized scalar value — the ratio parameter — into the theory, and in generalizing the relationships between fields and inductions, taking into account not only the medium’s velocity but also the source of radiation. In this way, singularities are overcome, and relativistic Doppler and aberration effects receive a dynamic interpretation. The speed of light depends on the velocity of the radiation source, and it is also possible for this speed to "disappear" based on a shift in the light frequency.

The dynamics of changing light parameters go through stages: its initial stage is described by the Galilean group, while the final stage (not entirely) corresponds to the Lorentz group, which adequately describes the results of interaction. These groups belong to a common family defined by the ratio parameter. It has been proven that such a family defines a Jordan algebra.

On the other hand, progress has been hindered by the hypothesis that the micro- and macroscopic worlds have no structural analogy: in the macroscopic world, objects have structure, while in the microscopic world, only continuous wave functions are realized. Discreteness is ensured not by structure, but by additional boundary conditions. I have proven that the Schrödinger equation is a consequence of the equations of motion for viscous fluids at very low velocities. Therefore, there is no real basis for denying the possibility of structure within light particles, initiating the study of their components and internal interaction algorithms.

The first models of light particles were proposed by me in the early 21st century. Their ideology is based on my matrix model of electrodynamics, defined on a pair of unit quaternions. Neutral matrices of dimension 4, with zero total charge, are sufficient to understand the gravitational and electrical neutrality of the proposed light particles.

The analysis led to a model of light atoms resembling planetary systems. In these systems, a pair of gravitational pre-charges with opposite signs is located at the center, while a pair of electrical pre-charges moves in coordination on the periphery. This model explains many phenomena in a new way: there are no point-like light particles (no zero size), nor infinite sizes (it is impossible to "contain" a very large number of light atoms). The understanding of diffraction effects also changes: they are the result of interactions between the medium and structured particles with a "diameter."

The differential extension of Maxwell's electrodynamics equations made it possible to construct a system of third-order differential equations and introduce into the analysis not only electrodynamic fields but also a symmetric gravitational tensor.

On this basis, a hypothesis was formulated about the existence of gravitational atoms in the form of hidden light: in such particles, gravitational pre-charges move on the periphery, while electrical pre-charges are "hidden" at the center.

This is another world, one that remains completely unknown to us. There is still much to explore.

DETAILS AND SPECIFICS OF THE COMBINATION OF THE GALILEAN AND LORENTZ GROUPS

In the generalized model of classical Maxwell electrodynamics with a spectrum of different velocities and a dynamic scalar ratio parameter, the Galilean group defines the relationships between quantities at the initial stage of dynamic processes of interaction between the field and the medium. Physically, it aligns with the Lorentz group, which defines the relationships at the final stage of such dynamic processes. Their mathematical combination is ensured not through Lie algebra, but through symmetric Jordan algebra. Additionally, there are other groups which, although often overlooked, are important from a physical perspective.

Let us analyze the spectrum of groups and the algorithm for their algebraic unification.

Newton limited the analysis of mechanics and optics to situations in physical space-time, assuming that the coordinates and time for different "observers" are essentially identical but may differ by a scaling factor accounting for their relativity. Mathematically, this can be expressed through coordinate and time transformations, which we shall call the Newton group:

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \gamma \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ t \end{pmatrix} \to x' = \gamma x, t' = \gamma t.$$

We will allow for different scaling factors for coordinates and time, with the additional condition that time intervals associated with frequency changes may depend on coordinates, velocities, and other parameters. Let these transformations form a group, which we shall call the Barykin group:

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \gamma \begin{pmatrix} 1 & 0 \\ \frac{u}{c}w & 1 \end{pmatrix} \begin{pmatrix} x \\ t \end{pmatrix} \to x' = \gamma x, t' = \gamma \left(t + \frac{u}{c} wx \right).$$

Galileo adopted the model of universal time for different observers and a possible dependence of coordinates on dimensionless velocity:

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \gamma \begin{pmatrix} 1 & \frac{u}{c} \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ t \end{pmatrix} \to x' = \gamma \left(x + \frac{u}{c} t \right), t' = \gamma t.$$

This is the simplest form of the Galilean group.

Lorentz analyzed the space-time symmetry properties of Maxwell's vacuum electrodynamic equations. He proved their invariance under the transformations:

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \gamma \begin{pmatrix} 1 & \frac{u}{c} \\ \frac{u}{c} & 1 \end{pmatrix} \begin{pmatrix} x \\ t \end{pmatrix} \to x' = \gamma \left(x + \frac{u}{c} t \right), t' = \gamma \left(t + \frac{u}{c} x \right), \gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}.$$

These define the Lorentz group.

At first glance, this "spectrum" of groups appears to lack a unifying algorithm. However, this is not the case. Analysis shows that the unification of these groups is natural both mathematically and physically. In particular, a parametric unification proposed by Ignatowski, Frank, and Rott is known (later applied by me in relativistic electrodynamics):

$$\begin{pmatrix} x' \\ t' \end{pmatrix} = \gamma^* \begin{pmatrix} 1 & \frac{u}{c} \\ \frac{u}{c}w & 1 \end{pmatrix} \begin{pmatrix} x \\ t \end{pmatrix} \to x' = \gamma^* \left(x + \frac{u}{c} t \right), t' = \gamma^* \left(t + \frac{u}{c} wx \right), \gamma^* = \frac{1}{\sqrt{1 - w\frac{u^2}{c^2}}}$$

These transformations do not form a group, although they belong to the group of special linear transformations. The new parameter introduced in electrodynamics — called the field-to-matter ratio parameter — unites into a single family otherwise non-isomorphic groups.

Transformations with the ratio parameter can be regarded as a superposition of the aforementioned groups with multiplicative factors in their additive form:

$$\gamma^* \begin{pmatrix} 1 & \frac{u}{c} \\ \frac{u}{c}w & 1 \end{pmatrix} = \gamma^* \begin{pmatrix} 1 & \frac{u}{c} \\ 0 & 1 \end{pmatrix} + \gamma^* \begin{pmatrix} 1 & 0 \\ \frac{u}{c}w & 1 \end{pmatrix} - \gamma^* \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}.$$

We may rewrite them as:

$$\gamma^* \begin{pmatrix} 1 & \frac{u}{c} \\ \frac{u}{c}w & 1 \end{pmatrix} + \gamma^* \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = \gamma^* \begin{pmatrix} 1 & \frac{u}{c} \\ 0 & 1 \end{pmatrix} + \gamma^* \begin{pmatrix} 1 & 0 \\ \frac{u}{c}w & 1 \end{pmatrix}.$$

The morphological representation of the group spectrum allows for the formal expression:

Lorentz = Newton = Galilean + Barykin.

On one hand, the uniqueness of this situation lies in the fact that transformations that do not form a group can nevertheless be represented as an additive-multiplicative superposition of groups.

On the other hand, the ratio parameter can take negative or complex values, allowing for qualitatively new interpretations and applications of space-time symmetries.

I have proven that such parametric unification of symmetries is realized within the framework of nonlinear Jordan algebra, which is unattainable within the framework of linear Lie algebra.

DIFFERENTIAL EXTENSION OF MAXWELL'S FIELD EQUATIONS

The standard form of Maxwell's electrodynamics equations is as follows:

$$\partial_y E_z - \partial_z E_y + \frac{1}{c}\partial_\tau B_x = 0,$$
$$\partial_z E_x - \partial_x E_z + \frac{1}{c}\partial_\tau B_y = 0,$$
$$\partial_x E_y - \partial_y E_x + \frac{1}{c}\partial\ B_z = 0,$$
$$\partial_x B_x + \partial_y B_y + \partial_z B_z = 0.$$

We introduce antisymmetric and symmetric second-rank tensors. On one hand, they establish functional connections with the 4-potentials of electromagnetic and gravitational entities. On the other hand, they combine into unified sets the pair of electromagnetic field vectors and the triplet of gravitational vectors:

$$F_{mn} = \partial_m A_n - \partial_n A_m, \qquad G_{mn} = \partial_m S_n + \partial_n S_m,$$

$$F_{mn} = \begin{pmatrix} 0 & -B_z & B_y & -E_x \\ B_z & 0 & -B_x & -E_y \\ -B_y & B_x & 0 & -E_z \\ E_x & E_y & E_z & 0 \end{pmatrix}, G_{mn} = \begin{pmatrix} P_x & K_z & K_y & L_x \\ K_z & P_y & K_x & L_y \\ K_y & K_x & P_z & L_z \\ L_x & L_y & L_z & P_\tau \end{pmatrix}.$$

We then apply a differential extension of the electrodynamics equations for the free field, obtaining functional equation components for the pair of these tensors:

$$\partial_x(\partial_y E_z - \partial_z E_y + \frac{1}{c}\partial_\tau B_x = 0) \leftrightarrow \partial_1(\partial_2 F_{03} + \partial_0 F_{32} + \partial_3 F_{20} = 0),$$

$$\partial_y(\partial_z E_x - \partial_x E_z + \frac{1}{c}\partial_\tau B_y = 0) \leftrightarrow \partial_2(\partial_3 F_{01} + \partial_0 F_{13} + \partial_1 F_{30} = 0),$$

$$\partial_z(\partial_x E_y - \partial_y E_x + \frac{1}{c}\partial\ B_z = 0) \leftrightarrow \partial_3(\partial_1 F_{02} + \partial_0 F_{21} + \partial_2 F_{10} = 0),$$

$$\partial_\tau(\partial_x B_x + \partial_y B_y + \partial_z B_z = 0) \leftrightarrow \partial_0(\partial_1 F_{32} + \partial_3 F_{21} + \partial_2 F_{13} = 0).$$

The sum of these terms combines into a functional equation, valid for both the antisymmetric and symmetric tensors:

$$\partial_m\left(\partial_k \Phi_{nl} - \partial_n \Phi_{kl}\right) + \partial_l\left(\partial_n \Phi_{km} - \partial_n \Phi_{km}\right) = 0.$$

Thus, third-order differential equations provide the initial and simple functional unification of field models for electromagnetism and gravity.

LITERATURE

For introductory reading:

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