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The True Geometry of Nature (Hypothesis)

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ABSTRACT

It is assumed that the geometric basis of the physical world is not the Minkowski space, but the three-dimensional projective space in which the absolute is given in the form of an oval surface. The fundamental changes, which in this case will occur in mathematical physics, are briefly outlined.

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The crazy idea that will form the basis of the future fundamental physical theory will be the realization that the physical meaning has some mathematical image that was not previously associated with reality. From this point of view, the problem of such an idea is the problem of choice, not of generation.

Yu.I. Manin ("Mathematics and Physics", 1979)

September 21, 1908 H. Minkowski made in Cologne his famous report "Space and Time." In it he proposed to combine three spatial coordinates with the temporal one to four-dimensional space with an unusual metric (it is called pseudo-Euclidean space or Minkowski space). But even earlier A. Poincaré established that the Lorentz transformations determine the rotation in space of four dimensions, the points of which have the coordinates (x, y, z, it). It is believed that the

Minkowski space is an adequate geometric basis for the Einstein SRT, that it expresses the whole essence of this theory.

Thus, Minkowski introduced a pseudo-Euclidean space with signature (1, 1, 1, -1), in which the expression (for real variables)

$$x^2 + y^2 + z^2 -- t^2$$

is the so-called four-dimensional interval. With the conventional Lorentz transformations, the interval is preserved (invariant).

However, H. Lorentz, A. Poincaré and A. Einstein made a mistake in deriving the transformation formulas (see our brochure `Memoir on the Theory of Relativity and Unified Field Theory` [1]): they unreasonably equated 1 a scale factor, which, as we found out, characterizes the Doppler effect. As a result, a group of transformations was artificially narrowed -- from conformal, including dilatation and inversion (15 parameters), to linear orthogonal (10 parameters).

In the corrected transformations (with the Doppler factor included), only the zero interval will be invariant:

$$x^2 + y^2 + z^2 -- t^2 = 0. \qquad (1)$$

Equation (1) defines an isotropic (zero) cone in the Minkowski space, and it specifies a condition for the constancy of the speed of light. It is from the requirement that condition (1) be preserved that we can derive a correct, extended form of coordinate transformations corresponding to the conformal group – in this we see the particularly important fundamental value of equation (1). Elimination of errors committed by the founding fathers of relativism made possible to remove the paradoxes of SRT, leads to a grandiose simplification in general relativity and seems is opening the way to the construction of a unified field theory (all this was discussed in our brochure [1]).

Now we want to take the next step: to give a new geometric interpretation to the very equation (1). The point is that neither Euclidean geometry nor pseudo-Euclidean geometry (Minkowski space) are fundamental geometries -- they are some of their particular types. Therefore, to expect that they lie at the base of the physical world, there are no serious reasons. A

fundamental, as is known, is projective geometry -- recall the words of A. Cayley: "projective geometry is *all* geometry".

HYPOTHESIS: The geometric basis of the physical world is a three-dimensional (real) projective space in which an invariant (absolute) is given in the form of an oval surface (quadric). In the homogeneous coordinates x_1, x_2, x_3, x_4, its equation

$$x_1^2 + x_2^2 + x_3^2 - x_4^2 = 0 \qquad (2)$$

The three coordinates x_1, x_2, x_3 correspond to the three spatial coordinates of the Minkowski geometry, and x_4 (it differs qualitatively from the others because it is introduced to represent the projective space in homogeneous coordinates) – to time; thereby clarifying the mathematical meaning of time. The transition to the non-homogeneous coordinates $x = x_1/x_4$, $y = x_2/ x_4$, $z = x_3/x_4$ gives three velocity components (v_x, v_y, v_z), which will be described by hyperbolic geometry (Lobachevsky geometry). Equation (2) determines the constancy of the speed of light -- this is its physical meaning. (It should be noted that VA Shashlov [2] recently described such an interpretation, on which he develops his own projective approach.)

In fact, this has long been known: recall that a century ago, in his famous book "Theory of Relativity" (1921), speaking about the theorem of addition of velocities in SRT, W. Pauli made a footnote [par. 25]: "... if we consider dx_1, dx_2, dx_3, dx_4 as homogeneous coordinates in projective three-dimensional space, then the invariance of equation

$$(dx_1)^2 + (dx_2)^2 + (dx_3)^2 - (dx_4)^2 = 0$$

means the introduction of the Cayley metric and at the same time the real conic section is placed in the basis. Everything follows from the well-known considerations of Klein".

Despite the authority of Pauli, his remark did not attract attention and his thought was not developed. In general, the projective approach has not received recognition in physics, although some attempts in this direction have been, for example, the idea of twistors (R. Penrose); P.Dirac noted that the best tool for research related to the Lorentz transformations is projective geometry, but he admitted that he had not published anything about it.

It is widely believed that since in the projective geometry the distinction between the finite and the infinite is eliminated, it cannot have strong roots in physics. As the Russian historian of

physics V.P. Vizgin wrote (1974), "physicists traditionally dislike the projective concept, which is organically related to the conformal group". Yes, projective revolution in geometry of the XIX century has not found a reflection in modern physics; theorists usually do not know well this geometry, in many textbooks it is not mentioned at all.

Now let`s ask the main question: to what does the interpretation of equation (2) as an oval absolute in projective space lead? One can say that it will radically change all mathematical physics, fill it with a new meaning. These very important aspects were briefly considered in the last chapter, "Review of Applications of Non-Euclidean Geometry" of F. Klein's book "Non-Euclidean Geometry" (1927). Indeed, Felix Klein was a great Seer.

The clue moment is that there is a one-to-one correspondence between the points of the oval surface and complex numbers (in non-homogeneous coordinates the oval surface will be a two-dimensional sphere, which is the Riemann sphere, and it is also the absolute). Through this correspondence, a connection is established between the motions of three-dimensional and two-dimensional hyperbolic spaces with linear substitutions (complex). And through them -- with the theory of functions, namely with their deepest and most meaningful sections (elliptic, modular, automorphic functions); apparently, there is also a connection with the "Poincare ball". They form a veritable intrinsic mathematics of nature.

Moreover, finite subgroups of linear substitutions correspond to regular polyhedra, and in the icosahedral theory, as Klein showed in his famous `Lectures on the icosahedron and the solution of equations of the fifth degree` (1884), different branches of mathematics converge; I`ll quote G. Weil: "... his lectures on the icosahedron are a wonderful symphony in which geometry, algebra, theory of functions and group theory merge into an amazing polyphonic melody".

We can assume that this is the true "music" of nature. Therefore, the connection of elementary particles with regular polyhedra discovered by us (see the article "Platonic Solids and Elementary Particles" [3]) will not seem strange. In addition, we believe that the space-time and impulse-energy representations are dual (connected by a pole-polar correspondence), and the particle-wave dualism of quantum mechanics is also a manifestation of projective duality (see our article "Prototype of the Beauty of the World" [4]).

And what about the familiar Euclidean geometry? Apparently, it happened to be the most convenient device for describing mechanics in the macrocosm, and this fact determined the domination of "Euclidean thinking" for many centuries. Perhaps for optics projective geometry is

better suited, that is, there is a certain "subjectivity" [5]. Euclidean and pseudo-Euclidean geometry can be obtained within the framework of the projective concept of Cayley--Klein (choosing certain geometric images that will serve as absolutes).

We have already said which mathematical riches are enclosed in an oval absolute. Probably, it was they who ensured the possibility of a complex organization of matter, the emergence of life and even consciousness. If so, then it's time to start reconstructing all theoretical physics on the basis of projective geometry, as the true geometry of nature. And may it will come to pass: "The stone which the builders rejected has become the head of the corner" (Psalm 117:22).

I`d like to add that for a number of years I am stimulated by virtual communication with the mathematician, the enthusiast of projective geometry Franz Herman.

LITERATURE

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