Article

Crisis in Physics: Causes of the Crisis & Ways Out of It

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Abstract

Many famous scientists have noted the presence of crisis in fundamental physics. Despite its technological success, the theory stopped answering many questions that are entitled to be asked by scientists. Which of our basic physical assumptions are wrong? What we need to change? The essay tries to answer these questions.

Keywords: crisis, fundamental physics, cause, solution.

1. Crisis in Physics

A considerable number of prominent scientists says about the crisis in fundamental physics, which is reflected in the fact that the last 30-40 years in this field of science there are no new results (Schroer, 2008; Schroer, 2009; Woit, 2007; Horgan, 1996; Seth, 2007; Smolin, 2006). So, well-known physicist Lee Smolin (Smolin, 2006) notes in his book "The trouble with physics":

The story I will tell could be read by some as a tragedy. To put it bluntly – and to give away the punch line – we have failed. We inherited a science, physics that had been progressing so fast for so ling that it was often taken as the model for how other kinds of science should be done. For more than two centuries, until the present period, our understanding of the laws of nature expanded rapidly. But today, despite our best effort, what we know for certain about these laws is no more than what we knew back in the 1970s*…Why is physics suddenly in trouble? And what can we do about it? These are the central questions of my book...*

The presence of the crisis is also confirmed by the philosophers (Popper, 1982):

Today, physics is in a crisis. Physical theory is unbelievably successful; it constantly produces new problems, and it solves the old ones as well as the new ones. And part of the present crisis -the almost permanent revolution of its fundamental theories - is, in my opinion, a normal state of any mature science. But there is also another aspect of the present crisis: it is also a crisis of understanding.…This crisis of our understanding is roughly as old as die Copenhagen interpretation of quantum mechanics.

The question arises about the causes of the crisis of fundamental science.

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2. Which of Our Basic Assumptions Are Wrong?

Although they use different terminology, physicists and philosophers converge to the same reason. Here is what Popper says (Popper, 1982):

In my view, the crisis is, essentially, due to two things: (a) the intrusion of subjectivism into physics; and (b) the victory of the idea that quantum theory has reached complete and final truth. Subjectivism in physics can be traced to several great mistakes. One is the positivism or idealism of Mach. It spread to the British Isles… through Russell, and to Germany through the young Einstein (1905). This view was rejected by Einstein in his forties (1926), and it was deeply regretted by the mature Einstein (1950). Another is the subjectivist interpretation of the calculus of probability, which is far older and which became a central dogma of the theory of probability through the work of Laplace.

Let us consider what the reasons are consistent with this in science. Simplistically, we can say that science is a method of obtaining the answer to a question in order to gain some benefit for people. Since Nature is only one, only one answer to each question must exist as well as one picture of each phenomenon. Such an answer is usually called true or correct. Methods that are used in order to obtain only one answer from Nature are named the methodology of science. In practice, methodology of science is a number of regulations.

The basis of methodology of scientific theory is nowadays a law (which conditionally can be named "Francis Bacon law of science methodology" (SEPh, 2003):

Scientific community has taken that any theory is true, if it is in agreement with experimental results when these experiments are invariant with respect to the space, time, experimentalists, technical means and some other conditions.

In other words, to announce a verdict about the truth of the theory, the experiments should give identical results in Moscow, Los Angeles, on the Moon or Aldebaran; a hundred years ago, today, tomorrow, after a thousand years; by experimentalists from USA, Argentines, Mars or Venus; by means of any device, which is fit for a given experiment; and the results of the experiment must be mathematically processed and presented by known methods.

This law is regularly worked until the early 20th century. But, as the science development shows, there is some incompleteness in the Bacon law: this law says nothing about the method of construction of theory and about theory structure. We assume that one of the main causes of the current crisis is precisely this point. What grounds are there for such a statement?

Historically, there are two aspects of mathematics. Proof-based mathematics is not the only form (Davis and Hersh, 1982). "The mathematics of Egypt, of Babylon, and of the ancient Orient was all of the algorithmic type. Dialectical mathematics -- strictly logical, deductive mathematics -- originated with the Greeks. But it did not displace the algorithmic."

It turned out that this difference is also characteristic for physics of XX-XXI centuries. Richard Feynman caught the attention of physicists on this particularity. In a series of lectures "The Character of Physical Law" (Feynman, 1964), he analyzed these issues in detail. The following are typical excerpts from his book:

...there are two kinds of ways of looking at mathematics, which for the purpose of this lecture I will call the Babylonian tradition and the Euclidean or Greek tradition. In Babylonian schools in mathematics the student would learn by doing a large number of examples until establishing the general rule... Tables of numerical quantities were available so that they could solve elaborate equations…But Euclid (under the Greek mathematical system) discovered that there was a way in which all of the theorems of geometry could be ordered from a set of axioms that were simple.

Further Feynman argued that, "*In physics, we need the Babylonian method, and not the Euclidian or Greek method*".

The Babylonian tradition and the Euclidean or Greek tradition in the framework of physics and mathematics can also be named “algorithmic approach” and “axiomatic approach”; following Karl Popper (Popper, 1982), they can be called "instrumentalism" and "realism"; recalling the T. Kuhn analysis (Kuhn, 1962), we can also name these methods “Babylonian paradigm” and “Greek paradigm”; or “neo-positivistic approach” and “classical approach” (Mach, 1897; Holton, 1968)).

In framework of “Babylonian approach” (see, for example, the mathematical cuneiform tablets of Mesopotamia, Egypt papyri, the Ptolemeus astronomy theory) the theory is formulated in the form of regulations, rules, recipes of calculations found in any way, including through trial and error or the method of fitting. It is clear that the number of these regulations, rules and prescriptions should be almost as great as the number of questions to be answered. Any mathematic apparatus can be invented here to obtain the result, without understanding its connection with other part of theory.

If these statements are tested experimentally, and provide an opportunity to get answers to practical questions, the theory is recognized as real. However, it is clear that the number of regulations, rules and prescriptions should be almost as great as the number of questions to be answered, and their formulation and composition may vary widely. The connection between them is not compulsory, and every branch of science may have its own collection of recipes and instructions. Moreover, during the theory development it is difficult to find by means of such methods, new instructions and recipes (as an example works here the complication of the Ptolemaic theory of epicycles).

In contrast, according to the "Greek approach", for each field of science, a system of prior knowledge - axioms must exist or be built. Namely, a collection of definitions and statements (axioms) about natural objects, their movement and interaction, formulated on the basis of observations. Moreover, all the mathematical results of predictions should follow from this system by means of the consistent application of the Aristotle formal logic and mathematics.

In this formulation of the structure of science a question arises naturally about universal axiomatics, covering all branches of science. For example, Maxwell's theory combines optics and electromagnetics. After the appearance of the microscopic theory of electromagnetism, Lorentz and others raised the issue of constructing a unified electromagnetic theory of matter. The discovery of

the electron required further development of the theory on the basis of the nonlinear electromagnetic theory of matter (Gustav Mie). In these theories, all mathematical results of the predictions are derived only from the given system of postulates by means of consistent application of formal logic and mathematical calculations. (Unfortunately, all of these theories were non-quantum, and therefore had not been completed.) As examples of successful construction of axiomatics, we can specify the geometry of Euclid and the classical mechanics of Newton.

Many scientists are familiar with the Euclidean geometry, as the first axiomatic theory, (though, unfortunately, its modern exposition in schools goes far away from the axiomatic approach and creates false impressions about it.) However, the fact that Newtonian mechanics is a strictly axiomatic theory, is known perhaps only to the science historians, and to curious people who became familiar with the Newton book "Principles of Natural Philosophy" (note, that by the term “natural philosophy” in Middle Ages was meant as physics, and philosophy has nothing to do with it).

When compared the structure of modern physics with the structure of Newtonian physics, the latter is always cited as an example of transparency and facility of understanding. Due to axiomatics, the interpretations, assumptions and hypotheses which are typical of the "Babylonian" physics, are absent in the Newtonian mechanics and in theories, which are built on its basis.

Although both approaches are not against the Bacon law, it is difficult to disagree with the fact that a scientific theory, which enjoys a huge number of practical recipes and instructions, found by means of trial and error method, contradicts to our intuitive understanding of the unity of the world picture (Planck, 1910).

Is the physical picture of the world, only more or less an arbitrary creation of our mind, or, conversely, we have to admit that it reflects a real, totally independent from us, phenomena of nature? ...

If, on the basis of the above, I answer affirmatively this question, I am well aware that the answer lies in a certain contradiction with the direction of the philosophy of nature, which is headed by Ernst Mach and which now enjoys great sympathy among scientists. According to this doctrine, in nature there is no other reality other than our own feelings, and every study of nature is, ultimately, only the economical adaptation of our thoughts to our feelings, to which we come under the influence of the struggle for existence. The difference between the physical and mental is purely practical and conventional; i.e. the unique elements of world - this is our experience.

Although I am firmly convinced that in the Mach system, if it is consistently held, there is no self-contradiction, it seems to me no less significant that its value is, in essence, purely formal and does not concern the foundations of science. The reason for this is that the Mach system is completely alien to the most important attribute of any natural science research: the desire to find a permanent, independent of change of times and the people, world picture ...

The goal does not lie in the complete adaptation of our ideas towards our sensations, but in the complete liberation of the physical picture of the world from the individuality of the creative mind. This is a more precise statement of what I described above as the exemption from anthropomorphic elements.

When the great creators of the exact science - Copernicus ..., Kepler ..., Newton ..., Huygens…, Faraday,... - introduced their ideas to science, surely none of these scientists have relied on the economic point of view in the fight against the inherited beliefs and overwhelming authority. The support of all their activities was the unshakable belief in the reality of their world view. In view of this undoubted fact, it is difficult to get rid of the fear that the train of thoughts of leading minds would be violated, the flight of imagination weakened, and the development of science would be fatally delayed, if the principle of economy of Mach really became the focal point of the theory of knowledge. Maybe it will actually be more "economical" if we give the principle of economy a more modest place?

As the result of the development of physics according to the "Babylonian" approach, in the last 40 years no remarkable achievements appeared in physics.

In 1952, E. Schrodinger even more clearly expressed dissatisfaction with algorithmic (Babylonian, neopositivistic) development of modern physics (Schrödinger, 1952):

(Quotes from Part I) *The innovations of thought in the last o years, great and momentous and unavoidable as they were, are usually overrated compared with those of the preceding century; and the disproportionate foreshortening by time-perspective, of previous achievements on which all our enlightenment in modem times depends, reaches a disconcerting degree according as earlier and earlier centuries are considered.…*

A theoretical science, where this is forgotten, and where the initiated continue musing to each other in terms that are, at best, understood by a small group of close fellow travellers, will necessarily be cut off from the rest of cultural mankind; in the long run it is bound to atrophy and ossify, however virulently esoteric chat may continue within its joyfully isolated groups of experts...

The disregard for historical connectedness, nay the pride of embarking on new ways of thought, of production and of action, the keen endeavour of shaking off, as it were, the indebtedness to our predecessors, are no doubt a general trend of our time…

There is, however, so I believe, no other nearly so blatant example of this happening as the theories of physical science in our time...

There have been ingenious constructs of the human mind that gave an exceedingly accurate description of observed facts and have yet lost all interest except to historians. I am thinking of the theory of epicycles.

(Quotes from Part II) *There is, of course, among physicists a widely popular tenet, informed by the philosophy of Ernst Mach, to the effect that the only task of experimental science is to give definite prescriptions for successfully foretelling the results of any future observations from the known results of previous observations…*

If our task is only to predict precisely and correctly by any means whatsoever, why not by false mathematics?

A question arises, of whether the contemporary quantum field theory can be formulated axiomatically. Further we will examine the structure of the contemporary theory of elementary particles – quantum field theory - and will note its “Babylonian” difficulties.

3. Achievements and limitations of quantum field theory

Quantum mechanics is a self-consistent mathematical theory, whose predictions agree with experiments. The most peculiar features of quantum mechanics are quantum nonlocality, indeterminism, interference of probabilities, quantization, wave function collapse during measurement. There are several basic principles of quantum mechanics that are generally accepted and called “The Copenhagen interpretation”:

1. A system is completely described by a wave function ,

2. The wave function represent the state of the system, which grows gradually with time but, upon measurement, collapses suddenly to its original size.

3. The description of nature is essentially probabilistic,. The probability of an event related to the square of the amplitude of the wave function.

4. Heisenberg's uncertainty principle: it is not possible to know the value of all the properties of the system at the same time; those properties must be described by probabilities.

5. Wave-particle duality. An experiment can show both the particle-like and wave-like properties of matter; in some experiments both of these complementary viewpoints must be invoked to explain the results, according to the complementarity principle of Niels Bohr.

6. Since measuring devices are essentially classical devices, it can measure only classical properties.

These peculiarities can not be explained on basis of quantum mechanics. QM describes the nature of the Universe as being much different then the world we see. As Niels Bohr said, "Anyone who is not shocked by quantum theory has not understood it." The question arises, what grounds exist for the adoption of these concepts? It turns out that there are no bases, apart from the general agreement of physicists. As Niels Bohr (Bohr, 1962) said:

After a short period of ideological disorder and the disagreements, caused by short term of restriction of "presentation", the consensus about replacement of concrete images with abstract mathematical symbols, for example as , has been reached. In particular, the concrete image of rotation in three-dimensional space has been replaced by mathematical characteristics of representation of group of rotation.

Therefore, many physicists have subscribed to the instrumentalist (or, according to R. Feynman, Babylonian) interpretation of quantum mechanics, a position, which is often equated with denial all interpretation. It is summarized by the sentence "Shut up and calculate!".

While expounding (Prugovecki, 1992), as the undisputed leader of the Copenhagen school, his peculiar mixture of positivism, realism, and existentialism, Bohr unfortunately did not anticipate the long-range effects of his teachings on future generations of physicists who lacked the philosophical training or the sophistication required to distinguish between subtle philosophical nuances and their gross over-simplifications. Such physicists condensed Bohr's entire philosophy into simplified enunciations of the principles of complementarity, wave-particle duality and the purportedly "classical nature" of the "apparatus," and simply ignored the rest. Indeed, what Karl Popper calls the "third group of physicists," who emerged right after World War II and soon became the overwhelming majority, is described by him as follows:

It consists of those who have turned away from discussions [concerning the confrontation between positivism and realism in quantum physics] they regard them, rightly, as philosophical, and because they believe, wrongly, many younger physicists who have grown up in a period of over-specialization, and in the newly developing cult of narrowness, and the contempt for the non-specialist older generation: a tradition which may easily lead to the end of science and its replacement by technology (Popper, 1982, p. 100).

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Therefore, we can not exclude an opportunity of existence of other paradigm, which are not breaking the mathematical apparatus of quantum mechanics, but give the essentially other theory. "Is it possible to make differently?" - the analysis of this question from known followers of de Broglie (Andrade and Loshak, 1972) leads to following statement of a question:

From the point of view of the sensible scientific approach, here there is no talk about whether postulates of the Copenhagen school correct or false are. The discourse goes simply about that any philosophical postulates have itself no evidential force, even if their logic connection with quantum mechanical calculations was perfect and the great discoveries on its basis were made. Hence, we should set for ourselves a problem: to establish, whether it is possible, proceeding from other postulates, to construct other interpretation of quantum mechanics and, thus, to come to the theory, which are distinct from those, which we know, and bringing new results In other words, can we do differently or even better?

At the same time, the structure of quantum theories, in particular of Standard Model (SM), is non-axiomatic. Briefly and meaningfully about this peculiarity of QFT spoke one of the creators of SM, the Nobel laureate Murray Gell-Mann. (Gell-Mann, 1981):

In elementary particle theory one assumes the validity of three principles that appear to be exactly correct. (1) *Quantum mechanics, that misterious, confusing discipline, which none of us really understands but which we know how to use. It works perfectly, as far as we can tell, in describing physical reality, but it is a ‘counter-intuitive discipline’, as social scientists would say. Quantum mechanics is not a theory, but rather a framework, within which we believe any correct theory must*

fit. (2) *Relativity*. (3) *Causality…These three principles together constitute the basis of Quantum Field Theory*.

According to known British physics-theoretic (Anthony, 1985): *The quantum mechanics is not a completely dynamic theory: it says nothing about the nature of the particles, forming the Universe, and about forces, which operate between them. More likely, it is the set of rules, with help of which it is possible to find, what will take place according to the given dynamic theory under certain conditions*.

It is necessary to recognize that such structure of theory is completely acceptable for the technical applications. But at the same time, for this reason, QFT does not answer many questions that are entitled to be asked by any inquisitive mind. Among these, for example, are: what is the origin of the mass; why fundamental particles - electron and quarks - don't have size (i.e., are point); why the wave function has not a physical sense.

We do not know the physical meaning of quantization; uncertainty principle of Heisenberg; a wave-particle dualism; non-commutativity of dynamic variables; the operator form of QM; statistical interpretation of wave function; phase and gauge invariance; four-dimensional world; Pauli exclusion principle;

The theory does not explain elementariness of the charge; the charge and fine structure constant values; the "charges" of weak and strong interactions; universality of electron charge; existing of plus and minus charge of the particles; particle spin; helicity; the existing of different kinds of particles: intermediate bosons, leptons, mesons, baryons; and why other particles don't exist; confinement of the quarks; the stability and instability of the elementary particles; existence of particles and antiparticles; spontaneous breaking of symmetry; Zittertbewegung; etc.

We do not know the physical sense of the mathematical characteristics of Dirac's electron equation: why the spinor equation does contain two equations, and the bispinor - four equations? Why into the Dirac equations the matrices are used, which in the classical theory describe the rotation? Etc. The understanding of the fact that "quantum mechanics is not a theory, but rather a framework, within which we believe any correct theory must fit", cause the desire to construct within the framework of existing theory the completely axiomatic theory of elementary particles.

We propose as such a theory to consider the nonlinear quantum field theory. Under this theory, it can be shown that all the peculiarities of modern quantum field theory arise due to the fact that it is artificially treated as a linear theory. The mathematics of the nonlinear theory in the linear approximation is identical to the mathematics of existing QFT. At the same time, all abovementioned features of modern quantum field theory in the nonlinear theory have a natural physical explanation and do not require artificial interpretations. Moreover, it appears that all the items of the Copenhagen interpretation are a mathematical consequence of the theory itself.

4. Axiomatic theory of elementary particles

(For details, see http://prespacetime.com/index.php/pst/article/view/30). For simplicity and ease of the comparison with existing quantum field theory, we will consider only the linear representation of

the nonlinear theory. We will present here very brief results of this theory, referring to the details and proofs in the complete theory (the latest, most detailed version of the theory is published in the on-line journal (Prespacetime Journal" http://prespacetime.com)

4.1 Axiomatic basis of the theory

The axiomatic basis of the proposed theory is composed by 5 postulates, from which the first 4 are the postulates of contemporary field theory. Postulate 4 expresses the specific nonlinearity of theory, but it does not contradict to the results of contemporary physics.

1) Postulate of fundamentality of the electromagnetic field: ***Maxwell's equation for the field without sources:***

$$\frac{1}{c}\frac{\partial \vec{\mathrm{E}}}{\partial t} - rot\vec{\mathrm{H}} = 0, \qquad div\vec{\mathrm{E}} = 0,$$

$$\frac{1}{c}\frac{\partial \vec{\mathrm{H}}}{\partial t} + rot\vec{\mathrm{E}} = 0, \qquad div\vec{\mathrm{H}} = 0$$

are fundamental independent equations of motion of fields.

Definition 1: A self-propagated in space, alternated electric and magnetic fields is called electromagnetic (EM) wave.

2) The postulate of the quantization of EM wave fields: ***electromagnetic wave fields consist of the elementary electromagnetic wave formations (particles) – photons.***

3) Postulates of Planck and de Broglie: ***the relationship between the energy, frequency and wavelength of photon is determined by the following formulas:***

$$\varepsilon_{ph} = h\nu = \hbar\omega, \quad \lambda = \frac{h}{p_{ph}} = \frac{hc}{\varepsilon},$$

4) Postulate of the massive particles' generation: ***for generation of the massive particles the field of photon must undergo the rotation transformation.***

5) The postulate of superposition of wave fields: ***in the general case electromagnetic waves are the superposition of elementary wave fields, the simplest of which are photons.***

(above: $\vec{\mathrm{E}}$ and $\vec{\mathrm{H}}$ are the vectors of strength of electrical and magnetic fields; ε is energy, $\vec{p}$ is momentum, λ is wavelength, c is speed of light).

General consequences of the accepted axiomatics:

1) Since the Lorentz transformation was found for Maxwell equations, these transformations are valid for all theories that are based on Maxwell's equations. In other words, postulate 1 ensures that all these theories are relativistic.

2) Postulates 2 and 3 provide the transition from the classical theory of electromagnetic waves to the quantum theory of photons.

3) Postulate 4 provides a transition from the photon theory to quantum theory of massive fundamental particles and corresponding antiparticles: electron, neutrinos and quarks. In turn, the quantum theory of massive particles, due to the Ehrenfest theorem, generates classical mechanics (although, as discussed in (Kyriakos. (2011), classical mechanics can be built directly on the basis of Maxwell-Lorentz theory, if we consider it as the movement of energy and momentum of the field objects).

4) Postulate 5 allows us to describe the non-fundamental (composite) elementary particles, if we consider the fundamental particles as waves that can interfere with each other.

Thus, an additional advantage of the proposed nonlinear theory of elementary particles (NTEP) is that without further hypotheses it unifies together three modern fundamental theories: classical relativistic mechanics, classical theory of electromagnetism and quantum field theory. (The possibility of encompassing the fourth fundamental theory - the relativistic theory of gravity - also has serious grounds and being examined. See (Kyriakos. (2012a,b,c)).

Let us use the abovementioned postulates to obtain the equations of each type of elementary particles.

4.2 Equation of photon

(For details, see http://prespacetime.com/index.php/pst/article/view/59) Using the postulates 1 and 3, we can obtain from Maxwell's equations the wave equation of the photon. An electromagnetic (EM) wave propagating (Akhiezer and Berestetskii, 1965) in any direction can have two independent waves with plane polarizations or one wave with circular polarization. In both cases these waves contains only four field vectors. For example, in the case of y-direction, we have known wave equation:

$$\left[\left(\hat{\alpha}_o \hat{\varepsilon}\ \right)^2 - c^2\left(\hat{\vec{\alpha}}\ \hat{\vec{p}}\right)^2\right]\ \Phi = 0\,, \qquad (4.2.1)$$

where $\hat{\varepsilon} = i\hbar\,\partial/\partial t$, $\hat{\vec{p}} = -i\hbar\vec{\nabla}$ are the operators of energy and momentum; $\hat{\alpha}_0$; $\hat{\vec{\alpha}}$; $\hat{\beta} \equiv \hat{\alpha}_4$ are Dirac matrices, while Φ is certain matrix; in this case:

$$\Phi\ = \begin{pmatrix} \mathrm{E}_x \\ \mathrm{E}_z \\ i\mathrm{H}_x \\ i\mathrm{H}_z \end{pmatrix},\ \Phi^+ = \left(\mathrm{E}_x \quad \mathrm{E}_z \quad -i\mathrm{H}_x \quad -i\mathrm{H}_z\right), \qquad (4.2.2)$$

The harmonic functions are the solution of this equation:

$$\begin{cases} \vec{\mathrm{E}} = \vec{\mathrm{E}}_o e^{-i(\omega t+ky)} + \vec{\mathrm{E}}_o^{*} e^{i(\omega t-ky)} \\ \vec{\mathrm{H}} = \vec{\mathrm{H}}_o e^{-i(\omega t+ky)} + \vec{\mathrm{H}}_o^{*} e^{i(\omega t-ky)} \end{cases}, \qquad (4.2.3)$$

where energy and momentum are quantified according to postulate 3: $\omega = \varepsilon/\hbar$ and $k = p/\hbar$.

Factorizing of (4.2.2), we will obtain the system:

$$\begin{cases} \Phi^{+}\left(\hat{\alpha}_o \hat{\varepsilon} - c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right) = 0 \\ \left(\hat{\alpha}_o \hat{\varepsilon} + c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right)\Phi = 0 \end{cases}, \qquad (4.2.4)$$

These equations, taking into account the quantization of energy and momentum, are the known quantum equations of photon, equivalent to one equation (4.2.1). The physical sense of these equations is revealed with the substitution of expressions (4.2.2). As a result we obtain Maxwell's equations for the advanced and retarded waves:

$$\begin{cases} \frac{1}{c}\frac{\partial \mathrm{E}_x}{\partial t} - \frac{\partial \mathrm{H}_z}{\partial y} = 0 \\ \frac{1}{c}\frac{\partial \mathrm{H}_z}{\partial t} - \frac{\partial \mathrm{E}_x}{\partial y} = 0 \\ \frac{1}{c}\frac{\partial \mathrm{E}_z}{\partial t} + \frac{\partial \mathrm{H}_x}{\partial y} = 0 \\ \frac{1}{c}\frac{\partial \mathrm{H}_x}{\partial t} + \frac{\partial \mathrm{E}_z}{\partial y} = 0 \end{cases}, \quad (4.2.5') \qquad \begin{cases} \frac{1}{c}\frac{\partial \mathrm{E}_x}{\partial t} + \frac{\partial \mathrm{H}_z}{\partial y} = 0 \\ \frac{1}{c}\frac{\partial \mathrm{H}_z}{\partial t} + \frac{\partial \mathrm{E}_x}{\partial y} = 0 \\ \frac{1}{c}\frac{\partial \mathrm{E}_z}{\partial t} - \frac{\partial \mathrm{H}_x}{\partial y} = 0 \\ \frac{1}{c}\frac{\partial \mathrm{H}_x}{\partial t} - \frac{\partial \mathrm{E}_z}{\partial y} = 0 \end{cases}, \quad (4.2.5'')$$

which confirms the EM nature of photon. Further let us show, how the mass of elementary particles is generated.

4.3 Equation of intermediate boson ("massive photon")

(For details, see http://prespacetime.com/index.php/pst/article/viewFile/105)

In the framework of nonlinear QFT particles acquire mass through an intermediate massive boson. The last is generated with the rotation transformation of EM field. We will use the postulate 4 and produce the rotation transformation $\hat{R}$ of photon fields Φ:

$$\hat{R}\Phi \to \Phi', \qquad (4.3.1)$$

where Φ' is the new wave function, which appears after the transformation of the rotation:

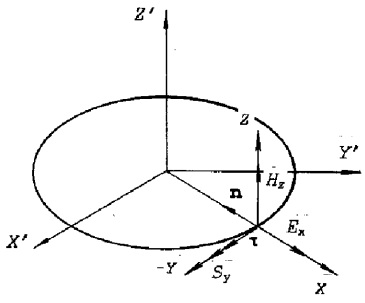

Fig.1

$$\Phi' = \begin{pmatrix} \mathrm{E}'_x \\ \mathrm{E}'_z \\ i\mathrm{H}'_x \\ i\mathrm{H}'_z \end{pmatrix} = \begin{pmatrix} \Phi'_1 \\ \Phi'_2 \\ \Phi'_3 \\ \Phi'_4 \end{pmatrix}, \tag{4.3.2}$$

where $(\mathrm{E}'_x,\ \mathrm{E}'_z,\ \mathrm{H}'_x,\ \mathrm{H}'_z)$ are the vectors of the electromagnetic field, which appear after the rotation transformation and are the wave functions of the new particle within the framework of quantum theory.

Let us examine the EM wave, which is rotated around the axis *Z'*, so that vectors $\vec{E}, \vec{H}$ and Poynting's vector $\vec{S}$ move as shown in the figure 1. Displacement current in equations (4.2.5) is determined by the expression:

$$j_{dis} = \frac{1}{4\pi}\frac{\partial \vec{\mathrm{E}}}{\partial t}, \tag{4.3.3}$$

The electric field vector of the expression (4.3.3), during the motion along the curvilinear trajectory, can be recorded in the form:

$$\vec{\mathrm{E}} = -\mathrm{E}\cdot\vec{n}, \tag{4.3.4}$$

where $\mathrm{E} = \left|\vec{\mathrm{E}}\right|$, and $\vec{n}$ is the unit vector of the normal to the curve. After differentiation the displacement current of the plane wave, which moves along the ring, can be recorded in the form:

$$\vec{j}_{dis} = -\frac{1}{4\pi}\frac{\partial \mathrm{E}}{\partial t}\vec{n} + \frac{1}{4\pi}\omega_p \mathrm{E}\cdot\vec{\tau}, \tag{4.3.5}$$

where $\omega_p = \dfrac{\varepsilon_p}{\hbar} = \dfrac{m_p c^2}{\hbar} \equiv c\mathrm{K}$, and $m_p = \varepsilon_p / c^2$ is a mass, which corresponds to photon energy ε_p; $\vec{j}_n = \dfrac{1}{4\pi}\dfrac{\partial \mathrm{E}}{\partial t}\vec{n}$ and $\vec{j}_\tau = \dfrac{\omega_p}{4\pi}\mathrm{E}\cdot\vec{\tau}$ are the normal and tangential components of displacement current of "nonlinear" EM waves, respectively.

A more general expression can be obtained, describing rotation in the curvilinear geometry. In this case it occurs that the currents are determined by the connections of field, i.e., by the symbols of Ricci (or, in the most general case, by Christoffel symbols). The physical sense of the generation of mass consists of the following. At the moment of rotation transformation, a self-interaction of own fields occurs in the photon (mass-free boson). Due to this fact the photon fields revolve in the small region of space. In this case its energy does not move from infinity to infinity with the speed of light, but it is locked in a small space region. This concentration of photon energy is a massive particle, one of characteristics of which is the value $m = \varepsilon_p / c^2$.

Characteristically, the mass of the particles appears in theory not as a primary characteristic, but as the ratio of energy to the square of the speed of light. Its property - to be a coefficient in the mechanical momentum of the particle, which determines the inertia - is found in the electromagnetic theory by means of direct calculation of the electromagnetic field momentum. Because of the rotation, this mass assigns an angular momentum of particle, i.e. spin (in this case, equal to 1). Simultaneously the tangential current appears. Since in this case the current is sinusoidal, electrical charge of "massive photon" is equal to zero.

As a result of the transformation of rotation we will obtain the equation of intermediate boson - self-acting massive photon (short, selfact-photon):

$$\left(\hat{\alpha}_o\hat{\varepsilon} - c\hat{\vec{\alpha}}\cdot\hat{\vec{p}} - \mathrm{K}\right)\left(\hat{\alpha}_o\hat{\varepsilon} + c\hat{\vec{\alpha}}\cdot\hat{\vec{p}} + \mathrm{K}\right)\Phi' = 0\,, \tag{4.3.6}$$

Or, taking into account the value K (see above), we will obtain this equation in form:

$$\left(\hat{\varepsilon}^2 - c^2\hat{\vec{p}}^2 - m_p^2c^4\right)\Phi' = 0, \tag{4.3.7}$$

The Lagrangian equation (4.3.7) can be recorded in the form:

$$L = D_\mu\Phi'^{+}\,D^\mu\Phi' = \partial_\mu\Phi'^{+}\,\partial^\mu\Phi' - \Phi'^{+}\,m_p^2c^4\Phi', \tag{4.3.8}$$

where the term, which directly contains the mass of intermediate boson, can be represented as follows

$$\Phi' m_p^2c^4\Phi' = \frac{\Delta\tau}{8\pi}\Phi'\left[\left(\Phi'^{+}\,\hat{\alpha}_0\Phi'\right)^2 - 4\left(\Phi'^{+}\,\hat{\vec{\alpha}}\Phi'\right)^2\right]\Phi', \tag{4.3.9}$$

and describes in the nonlinear theory the energy of self-interaction. It is not difficult to see that the expression (4.3.9) has a similarity with Higgs's potential. However, the mass of the particles corresponding to the function Φ', in this case, does not describe the mass of the particles that compose the Higgs vacuum.

According to modern concepts, virtual particles that compose the physical vacuum are massless. Both in the SM and in NTEP, vacuum consists primarily of virtual photons, but also of virtual particles of any kind, which are transformants of the photon vacuum. In other words, physical vacuum is composed of many vacuums of different virtual elementary particles. As supposed, among them there is Higgs vacuum of, consisting of virtual Higgs bosons. As a virtual particle, the Higgs boson is a massless particle.

Thus, the function R in the case of the Higgs mechanism does not describe a particle of the virtual vacuum of Higgs, but some selfact-photon, which appears at a very high excitation of the Higgs vacuum . This effect is called reification or materialization of vacuum excitations. Namely this selfact-photon was found at the LHC at CERN. Its energy (mass) corresponds to the energy (mass) of production of intermediate massive bosons of the weak interaction. In the following section we will examine the question of the generation of massive charge leptons: electron and positron.

4.4 Equations of charge leptons - electron and positron

(For details, see http://prespacetime.com/index.php/pst/article/viewFile/132) We will now perform, relatively speaking, a symmetry breaking of selfact-photon (which occurs spontaneously in nature due to the electromagnetic interaction of its half-periods to one another). In the case of the plane-polarized initial photon the equation (4.3.7) gives the possibility to obtain two oppositely charged particles with half-integral spin of the type of electron and positron. For this, we will make, conditionally speaking, the breaking of the intermediate boson symmetry. Multiplying equation (4.3.7) to the left on Φ'^{+} and making factorizing, we will obtain the equations of two particles, which are located in the field of each other:

$$\left[\left(\hat{\alpha}_o\hat{\varepsilon} + c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right) + \hat{\beta}\ m_p c^2\right]\psi = 0\,, \qquad (4.4.1')$$

$$\psi^{+}\left[\left(\hat{\alpha}_o\hat{\varepsilon} - c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right) - \hat{\beta}\ m_p c^2\right] = 0\,, \qquad (4.4.1'')$$

Here $\psi = \begin{pmatrix} E_x \\ E_z \\ iH_x \\ iH_z \end{pmatrix} \equiv \begin{pmatrix} \psi_1 \\ \psi_2 \\ \psi_3 \\ \psi_4 \end{pmatrix}$ is lepton wave function, which corresponds to electromagnetic field after the breakdown of intermediate boson (this ψ-function is not the vector, but a so-called - by L.D. Landau - semi-vector, i.e. spinor).

In the simplest case of the production electron-positron pair $m_p = 2m_e$, and from (4.4.1) we have:

$$\left[\left(\hat{\alpha}_o\hat{\varepsilon} + c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right) + 2\hat{\beta}\ m_e c^2\right]\psi = 0\,, \qquad (4.4.2')$$

$$\psi^{+}\left[\left(\hat{\alpha}_o\hat{\varepsilon} - c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right) - 2\hat{\beta}\ m_e c^2\right] = 0\,, \qquad (4.4.2'')$$

It is obvious that in order to become free, the electron and positron must spend energy. It is not difficult to calculate, that during their removing from each other an amount of energy must be spent, equal to the amount, which is necessary for the formation of particle themselves. The external field of particles arises due to this process. Using a linear writing of the energy-momentum conservation law, we will obtain for the external field of the particle:

$$\hat{\beta}\ m_e c^2 = -\varepsilon_{ex} - c\hat{\vec{\alpha}}\ \vec{p}_{ex} = -e\varphi_{ex} - e\hat{\vec{\alpha}}\ \vec{A}_{ex}\,, \qquad (4.4.3)$$

where “ex” indicates “external”; then, substituting (4.4.3) in (4.4.2), we obtain Dirac's equation with the external field:

$$\left[\hat{\alpha}_0\left(\hat{\varepsilon} \mp \varepsilon_{ex}\right) + c\hat{\vec{\alpha}}\cdot\left(\hat{\vec{p}} \mp \vec{p}_{ex}\right) + \hat{\beta}\ m_e c^2\right]\psi = 0\,, \qquad (4.4.4)$$

At a sufficiently great distance between the particles, when these fields are not important, we obtain Dirac's equations for the free particles - electron and positron:

$$\left[\left(\hat{\alpha}_o\hat{\varepsilon}+c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right)+\hat{\beta}\ m_e c^2\right]\psi=0\,, \qquad (4.4.5')$$

$$\psi^{+}\left[\left(\hat{\alpha}_o\hat{\varepsilon}-c\hat{\vec{\alpha}}\ \hat{\vec{p}}\right)-\hat{\beta}\ m_e c^2\right]=0\,, \qquad (4.4.5'')$$

4.5 Equation of the massive neutrino

(For details, see http://prespacetime.com/index.php/pst/article/viewFile/189) It can be easy shown that from the circularly polarized photon field, massive neutrino is formed with all its known properties. The equation of the neutrino is not a spinor equation, but necessarily a bispinor Dirac equation.

It is noticeable that in this case the helicities of neutrino and antineutrino are mutually opposite and no transformation can change this property. In other words, the neutrino has always the left spirality, and antineutrino – right spirality (note that in SM this property is not explained and is accepted as a postulate).

4.6 Equation of the hadrons

(For details, see http://prespacetime.com/index.php/pst/article/viewFile/200) It is shown here that quarks are spatial analogs of leptons, fields of which are distributed in three dimensions. Their stability is given by the interaction of two or three quarks that make up the composite particles - hadrons. In other words, according to the fifth postulate, hadrons are the superposition of several particles, like leptons.

The formation of different hadrons is also connected with the described characteristics of leptons. According to the fifth postulate, wave fields can form superpositions. It is possible to show that with the superposition of elementary fields, which are equivalent to leptons, different hadrons can be formed, which are described by Yang–Mills equation. Moreover from two lepton-like fields mesons can be formed, and with the superposition of three lepton-like fields - baryons. To the important results of NTEP should also be attribute the results related to the understanding of the current theory and to the further development of the theory of elementary particles.

In NTEP is shown that all interpretations adopted in the SM are quite legitimate, but they reflect purely formal mathematical features that have objects of microcosm. Thus NTEP does not contradict to the results of SM, but only generalizes and refines them. In the SM the unitarity of the theory at high energies is violated, if is not used the Higgs mechanism. The NTEP works equally well in both low and high energy without using the Higgs mechanism (due to the analogy of mathematical description, conditionally it can be said that it is embedded in NTEP).

Conclusion: What should be done to overcome the crisis in physics?

The above analysis shows that the main cause of the crisis in physics is the use of the positivistic (Machian, "Babylonian") method of study of physical phenomena. For the 100 years of its

development this approach led to the violation of the integrity and unity of the description of the picture of nature, to its mosaicism and to the neglect of the reality of these solutions. Over the past decade, physics has lost touch with reality and has degenerated into abstract mathematics, whose results can not be verified experimentally (string theory, supersymmetry etc). In this approach, any other way was declared false and many interpretations of mathematical results were made to justify this.

We have shown that these interpretations are not justified from a physical point of view, and that they are descriptions of mathematical features of the theory. We have also shown that a return to the axiomatic (realistic, "Greek") approach is not only possible, but allows us to construct a theory that is an extension of the "pre-Babylonian" theory taking into account all recent experimental and theoretical results. This theory restores a single coherent picture of the world and allows us to specify the direction of the further development of physics.

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