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# THE CRISIS OF CLASSICAL PHYSICS AT THE BEGINNING OF THE XX CENTURY: WAS NON-CLASSIC PHYSICS A WAY OUT OF IT?

**(Abstract on the History and Philosophy of Science)**

**Abstract outline:**



## 1. Introduction

As you know, the great crisis of classical physics broke out at the turn of the 19th and 20th centuries. and lasted until the 1920s. It was caused by the inability of the previous physical concepts to explain a number of experimentally discovered phenomena, as well as by the internal logical contradictions of the classical picture of the world. Thus, Maxwell's classical electrodynamics turned out to be incompatible with classical mechanics. Already Maxwell himself abandoned in his "Treatise on Electricity and Magnetism" [1] from the concept of a mechanical Aether, which had contradictory properties and generated a lot of difficulties in the analysis of the electrodynamics of moving bodies. The experiments of Michelson, Trouton-Noble, Kaufmann only emphasized the contradictions between classical mechanics and classical electrodynamics [2-4]. This crisis was overcome by the efforts of G. Lorentz, A. Poincaré, A. Einstein and G. Minkowski, who laid the foundations for a new non-classical mechanics in the form of the Special Theory of Relativity (SRT), which turned out to be compatible with Maxwell's electrodynamics, but rejected classical mechanics. The latter has since received the status of the limiting case of relativistic mechanics - the case of speeds much less than the speed of light.

At the same time, atomic physics was making great strides: the electron was discovered, the reality of atoms was proved, the laws of radiation by atoms of continuous and discrete spectra were empirically discovered, the photoeffect was discovered, E. Rutherford discovered the atomic nucleus and built a classical planetary model of the atom. And again the experiments were in contradiction with the forecasts of classical mechanics and electrodynamics of Maxwell, which predicted a completely different form of the thermal spectrum, spoke of the instability of the planetary atom and led to other contradictions [5]. Lord Kelvin characterized these contradictions as small clouds on the clear horizon of classical physics, on the whole perfect and correct. However, in the end, it was these contradictions that forced scientists to abandon classical physics and accept new quantum physics and mechanics, which, together with the theory of relativity, eliminated contradictions and correctly predicted the results of observations.

Thus, it would seem, a way out of the great crisis in physics was found. And yet, there is still doubt whether non-classical physics was the only possible way out of the crisis. Moreover, at present, in quantum physics and in the theory of relativity, more and more problems and contradictions are revealed, such as indeterminism in natural phenomena, divergence and infinity in the analysis of the structure of the electron and the thermal spectrum, detection of superluminal velocities, undisclosed and contradictory structure of nuclei and elementary particles [6-10]. Therefore, one gets the impression that non-classical physics did not eliminate the crisis, but only postponed it, by means of formal reconciling methods that eliminated the contradictions only superficially, outwardly, but preserving them in a latent form. And the very roots of the contradictions that led to the crisis were not revealed. Therefore, in order to identify the causes of the long-standing crisis, let us study the views of physicists of that time and the "anti-crisis measures" they proposed. This will make it possible to understand whether non-classical physics was really the way out, and to identify alternative, less radical ways out of the crisis, which may be relevant in our time.

## 2. The roots of the theory of relativity and alternative concepts

Let us first consider the prerequisites for the creation and acceptance of the theory of relativity by the scientific community. It has long been noted that the theory of relativity appeared during the crisis of the concept of the world Aether - a continuous ideal environment, which, according to the views of scientists of the 19th century, was supposed to transfer electromagnetic influences, in particular light, just as air transmits sound, sound waves [2]. Long before the Michelson experiment, scientists began to realize the paradox of the Aether. Aether, on the one hand, must have tremendous rigidity, and on the other hand, it must be extremely rarefied and easily, without resistance, penetrate any body. This ephemeral substance should be absolutely motionless, and at the same time, it should be easily disturbed by the movement of charges. At the same time, the Aether is completely devoid of viscosity: this is the only way to explain that the light of distant stars comes to us practically without attenuation. When Michelson's experiment was staged, the inconsistency of the Aether concept was finally revealed: the propagation of light and electromagnetic influences is not absolute, but relative. That is, there is no absolutely immobile medium such as Aether, in which light would keep its speed unchanged.

However, Maxwell himself originally based his theory of electromagnetism on the concept of the Aether, considering its tension and compression, flows and vortices. That is why the mathematical apparatus of Maxwell's electrodynamics is in many respects similar to the mathematical apparatus of the physics of a continuous medium, which was considered the Aether. Seeing the contradictions of the Aether, Maxwell in his later works refused to mention it, and kept only the equations derived using the Aetheric concept. As they said at the time, Maxwell built a magnificent building of electrodynamics, but at the end of the construction he removed the scaffolding, that is, auxiliary structures in the form of Aether, which helped in the construction. It turns out that Maxwell's theory owes its birth to the concept of Aether. Therefore, many physicists continued to believe in the reality of the Aether, despite its many contradictions.

And when in 1887, in the Michelson-Morley experiment, it became clear that there was no Aether, it was a real crisis and hurt the supporters of Maxwell's electrodynamics. After all, Maxwell, even stopping to mention Aether, in fact, kept it in his equations. Moreover, in his treatise on electricity and magnetism, he himself proposed to conduct an experiment such as the Michelson experiment in order to test his concept and reveal the motion of the Earth in relation to the absolute frame of reference associated with the Aether [3]. Thus, the negative result of Michelson's experiment called into question not only the concept of the Aether, but also the entire electrodynamics of Maxwell, which had already been thoroughly tested by that time and received wide recognition and practical application. Numerous attempts have been made to save the concept of Aether, for example, through the contraction hypothesis of Lorenz-Fitzgerald, who suggested that when moving through the Aether, all bodies contract, and the contraction exactly compensates for the change in the speed of light from the motion of the Earth, which prevents the detection of this motion in relation to the Aether [11]. But all these attempts to save the Aether ran into insurmountable difficulties in explaining other experiments, for example, the Trouton-Noble experiment.

Thus, the concept of Aether had to be abandoned. But, even having rejected the Aether, physicists did not want to abandon the Maxwell electrodynamics based on it, which also contradicted Michelson's experiment. Therefore, A. Poincaré and A. Einstein proposed another, purely formal way out of the crisis. In order to combine Maxwell's electrodynamics with the result of Michelson's experiment, they proposed to modify the mechanics itself so that, firstly, all phenomena looked the same in all inertial systems, possessing only a relative, not absolute character (1st postulate of SRT), but second, so that the speed of light is always equal to the constant $c$ and does not depend on the movement of the source or receiver (2nd postulate of SRT). These two postulate statements became the basis of the new non-classical mechanics of the theory of relativity. On the one hand, they explained the negative result of Michelson's experiment by generalizing Galileo's principle of relativity to electromagnetic and optical phenomena. On the other hand, they eliminated the discrepancy between this principle of classical mechanics and Maxwell's electrodynamics. That is, classical mechanics was replaced by the relativistic mechanics of SRT, which no longer contradicted Maxwell's theory.

This relativistic mechanics has existed from the beginning of the 20th century to the present day, and on its basis, calculations are made for powerful accelerators and other high-energy units. So, it would seem that the non-classical mechanics of SRT was indeed the way out of the crisis. And yet there are still doubts that this solution is correct. This follows both from experimental considerations, for example, from the discovery of superluminal motions that are impossible according to STR, and from logical, general physical and philosophical considerations. The fact is that the theory of relativity, having eliminated the Aether, deprived the electromagnetic effects of the mechanical carrier, without offering anything in return. The electromagnetic field remains the same abstract substance as it was before Maxwell. Moreover, it has become even more idealized, abstract and contradictory than Aether. The concept of photons introduced by Einstein as carriers of electromagnetic influences only confused the situation, since it created even more contradictions than was in the concept of Aether: the photon had no mass and immediately possessed corpuscular and wave properties. Thus, it can be argued that the theory of relativity did not eliminate the contradictions of classical electrodynamics, but only hid them, disguised them by means of a formal reconciling and, in general, unjustified procedure. After all, from no experience or from intuitive considerations the second postulate about the independence of the speed of light from the movement of the source and receiver did not follow. Therefore, from the point of view of Occam's principle [12], this postulate, irreducible to experimental or intuitive knowledge, should be removed from science.

Indeed, the theory of relativity was not the only, or even the most natural, way out of the crisis. Thus, at the beginning of the 20th century, a number of physicists, including J. Thomson and W. Ritz, proposed a less radical and simpler way out of the crisis [13, 14]. They reasoned as follows: since classical mechanics and Maxwell's electrodynamics are incompatible, and since Michelson's experiment showed the fallacy of the concept of Aether with Maxwell's electrodynamics based on it, then wouldn't it be more logical to abandon not mechanics, but precisely Maxwell's electrodynamics, at least from it the previous version [15]. After all, this theory not only contradicted experience, but was much worse substantiated and tested than classical mechanics. Classical mechanics, founded by Galileo and Newton, existed by

1887 and had been comprehensively tested for more than two centuries. Whereas Maxwell's electrodynamics was published by the author only in 1860-1865. and immediately faced strong criticism and rejection. It was only in 1888 that Maxwell's electrodynamics was recognized thanks to the experiments of Hertz, who discovered the electromagnetic waves predicted by Maxwell. Thus, the moment of recognition of Maxwell's theory, thanks to Hertz's experiments, practically coincided with the Michelson experiment. Therefore, there was no reason to prefer such a crude, little-studied theory like Maxwell's, proven over the centuries, classical mechanics.

That is why Walter Ritz, Joseph Thomson, as well as some other physicists suggested that the root of the crisis lies precisely in Maxwell's electrodynamics, which contradicted classical mechanics and the principle of relativity. And the way out of the crisis must be sought in the assumption that electromagnetic effects and light obey classical mechanics, that is, their motion is relative, not absolute. According to Ritz, light has a constant speed $c$ only relative to the source, which, in the case of motion, imparts its speed to electromagnetic influences and light [15]. That is, Ritz generalized Galileo's principle of relativity from classical mechanics to light, electromagnetic phenomena. This immediately made it possible to explain the Michelson experiment, where the light source moved with the Earth, and therefore it was impossible to detect the change in the speed of light [14]. In this part, the conclusions of Ritz and Einstein coincide. But further, if Einstein, with his second postulate, rejects classical mechanics to preserve Maxwell's electrodynamics, then Ritz does not need this, since he does not aim to preserve, by all means, Maxwell's electrodynamics, which has revealed its inconsistency.

Ritz's point of view is both physically and logically more consistent, because, having accepted the principle of relativity of classical mechanics, he continues to follow it. So, considering all phenomena and movements relative, he also considers the movement of light to be relative, that is, he believes that the speed of light depends on the mutual movement of the source and the observer. Whereas Einstein falls into a contradiction, on the one hand accepting the relativity of all movements (the first postulate), and on the other, rejecting the relative nature of the movement of light, which, regardless of the movement of the source and the observer, always flies with the same speed (second postulate) [16].

The application of Galileo's principle of relativity from classical mechanics to light was more natural, logical also for the following reason. Already Galileo in his "Conversations" [17] and Newton in his "Optics" [18] came to the conclusion that light can be a stream of tiny particles-corpuscles emitted by luminous bodies. Therefore, Galileo and Newton considered it possible to apply the principles of Galilean mechanics and kinematics to the light formed by mechanical particles. Due to this, the moving source just had to impart its speed to the ejected light corpuscles and the light carried by them, just as a moving weapon additionally imparts its speed to the fired projectiles. It was this classical ballistic principle that Ritz used as the basis of his theory. Thus, Ritz, unlike Einstein, did not invent new speculative radical theories, but explained Michelson's experience with the classical corpuscular theory. If the 2nd postulate of Einstein was "taken from the ceiling", and not only contradicted common sense, intuition, but was not substantiated by anything, then the Ritz ballistic principle is not only natural and known for a long time, but also substantiated experimentally. Long before Michelson's experiment, the ballistic principle confirmed the phenomenon of stellar aberration, that is, the displacement of the apparent position of stars in the sky due to the orbital motion of the Earth. This phenomenon, discovered by Bradley in the 18th century, was explained by him just on the basis of the ballistic principle, that is, the application of classical kinematics (the rules for adding velocities) to light and the corpuscles carrying it [3].

Thus, the way out of the crisis, proposed by Ritz, Thomson and preserving classical mechanics, was more logical than the way of Einstein, since Newton's optics and mechanics already contained a ready-made recipe for overcoming the crisis generated by Michelson's experiment. But this concerned only optics, and from the point of view of preserving Maxwell's laws of electrodynamics, it would seem that Einstein's path was more natural. However, Ritz showed that there is no reason to preserve Maxwell's electrodynamics at any cost, which not only contradicted experiments (Michelson's experiment, Kaufmann's experiment), was poorly substantiated, but was also built from the outset completely arbitrarily, as a set of artificially selected formal rules. It was a purely phenomenological theory, that is, a theory whose equations were not strictly deduced on the basis of precisely established reasons, but were artificially selected in order to give a purely external description of phenomena. That is, Maxwell's phenomenological electrodynamics was an exact analogy of phenomenological thermodynamics and aerodynamics, the principles of which were not rigorously substantiated and had limited applicability. And only the molecular-kinetic theory made it possible to build a rigorous microscopic theory of thermodynamic and aerodynamic phenomena, from which the conclusions of the phenomenological theory were obtained as direct consequences, and only as a first approximation at low speeds. In the case of transonic speeds, and even more so supersonic speeds, the principles of phenomenological thermodynamics and aerodynamics, constructed for the case of low speeds, were no longer applicable, and only the use of microscopic theory, which studied the behavior of individual atoms and molecules, made it possible to obtain correct results. The same was found in Maxwell's phenomenological electrodynamics, where errors were revealed in the form of small deviations of the order of $V^2/c^2$ (in the case of Michelson's experiment), or large deviations (Kaufmann's experiment, where large, near-light velocities were realized [4]).

Therefore, Ritz concluded that the root of the crisis lay precisely in Maxwell's electrodynamics, built purely formally, phenomenologically, and therefore having applicability, limited by the framework in which this theory was built (the case of low velocities). Maxwell's four equations, each of which should be considered as a separate hypothesis, were not strictly derived from some initial rigorously established and comprehensively proven principles, but artificially selected in order to best describe the phenomena. And the likelihood that all of them were guessed correctly, moreover, so as to be fair at any speed, is very small. That is why Ritz proposed to build, on the basis of classical mechanics, a strict microscopic theory of electrodynamic phenomena, which would be valid at any speeds of motion, and which would reveal the meaning of electric and magnetic fields, just as the molecular-kinetic theory revealed the true meaning of pressures and temperatures as characteristics movement of large ensembles of microparticles.

The need to build a microscopic theory of electrodynamic phenomena stemmed from Newton's representation of light in the form of a stream of particles, a kind of light atoms [18]. In addition, according to Ritz, the need to create a microscopic theory was dictated by the fact that Maxwell's phenomenological electrodynamics, which are based on differential equations, gave infinitely many solutions, most of which had no physical meaning [15]. And to find the correct solution, even the known initial and boundary conditions were often not enough, it was necessary to accept specially invented artificial boundary conditions (constituting another hypothesis), for example, the Sommerfeld radiation condition. According to Ritz, the fundamental laws of physics should have an integral, not a differential form, so as to give a unique solution and not allow unnecessary, physically impossible solutions, excluded purely arbitrarily. Thus, Ritz proposed, instead of the continualist phenomenological Maxwellian electrodynamics of continuous media, to construct atomistic electrodynamics, the laws of which were strictly derived from the laws of classical mechanics.

The need for such a microscopic atomistic description of the phenomena of electrodynamics also stemmed from the fact that after the abolition of the Aether, it became unclear how the electromagnetic influences are transferred. That is, in Maxwell's electrodynamics, instead of short-range action, the specter of long-range action arose again. This problem was also easily solved if we assume, according to Newton and Ritz, that electromagnetic influences carry the smallest particles-corpuscles, scattering from their source at light speed. It is this statement that Ritz used as the basis of his emission electrodynamics: each charge constantly emits standard microparticles (rheons) in all directions, scattering from the charge at the standard speed of light *c*. The impact of these particles on another charge creates a Coulomb repulsion. That is, the electric field, the electric impact was explained in the same way as the pressure in the molecular kinetic theory - by the impact of microparticles. If the charge is stationary, it creates a stationary flow of particles and has a constant electrical effect, and if it oscillates, then the flow turns out to be modulated in terms of the density and velocities of the particles: a periodically changing electrical effect arises, which propagates in the form of electromagnetic waves, the speed of which is set by the speed of the modulated particle flow, that is, the light speed of their emission $c$.

Thus, the main advantage of Maxwell's electrodynamics, which predicted the existence of electromagnetic waves, was reduced to naught, since these waves could be explained and predicted within the framework of Newton's corpuscular theory of light, which, in addition, explained the microstructure and nature of these waves and electrical influences, which Maxwell's theory could not do. Also, it was the corpuscular theory that explained what the standard for the speed of electromagnetic waves and light was set by - the speed of emission of microparticles (nuclear physics really has a number of examples when particles are emitted by other particles or nuclei with a standard near-light speed). But Maxwell's theory, after the abolition of the Aether (the propagation of elastic disturbances of which previously set the speed of light), could no longer explain the standard of the speed of light. The theory of relativity explained this standard by the fact that nothing simply can move with a speed greater than $c$, and therefore light, as the fastest process, must fly exactly at that speed.

In 1914 the scientist and philosopher I. Orlov [16, 19] clearly showed that the way out of the crisis, proposed by Ritz, is not only more natural than Einstein's way out, but also resolves, in contrast to the relativistic theory, the long-standing problem of Newtonian mechanics, which was, in fact, the mechanics of long-range action: influences, for example, gravitational ones, instantly spread over any distance without any intermediary, and therefore without delay. Even then, in the 17th century, it was clear that this was an idealization, since the influences must be transferred by a certain agent having, albeit a large, but still limited speed. This followed, at least, from the fact that particles-carriers of influences, having a finite mass, could, under the action of a finite force, receive only a limited speed. However, the finite time of propagation of impacts was neglected until the 20th century. Newtonian mechanics continued to be used as if the influences were transferred instantly. This led to a number of contradictions at the end of the 19th century.

The theory of relativity, as Orlov notes, did not abolish, but preserved, disguised these contradictions, simply for the infinitely high speed of propagation of influences, which nobody can reach, artificially took the speed of light $c$. Due to this, according to the theory of relativity, the forces of interaction between bodies, as well as in the mechanics of Newton's long-range action, did not depend on the motion of these bodies. So, the central force (say, the force of gravity) was always directed along the line connecting the bodies, and always had the same magnitude, regardless of whether the bodies were at rest or moving with great speed. And in the case of a delay in the impacts due to their finite speed, the force had to depend on the relative speed of the interacting bodies. And if Einstein did not correct the idealization of the instantaneous long-range action of Newtonian mechanics, then Ritz, seeing the deep roots of the crisis, just took into account the final speed of the effects and the change in forces due to this, having built a refined theory of electromagnetism and gravity.

Strictly speaking, it was precisely along this path that electrodynamics and the theory of gravity followed before the appearance of Maxwell's field theory. Already in the works of Ampere, Weber, Gauss and Riemann, electrodynamics was constructed, in which the electric Coulomb interaction of charges depended on their mutual motion - on their relative speed and acceleration [1, 20, 21]. As a result, they immediately received a qualitative and quantitative explanation of the magnetic and inductive forces, which, as you know, are created precisely by the movement of charges. Let us recall that Maxwellian electrodynamics did not explain in any way why, when charges move, their electric effect generates magnetic and induction. Maxwell only stated the existence of these forces in his equations, presenting mathematical expressions for them. And Weber and Gauss found out their nature: magnetic and induction forces are small changes in the electrical force of interaction caused by the finite speed of propagation of electrical influences, that is, their delay. Moreover, it was already noticed then that the constant in Weber's formula for the electromagnetic force is very close to the speed of light $c$ [20]. That is, already in Weber's formula, long before Maxwell, one could read that electrical influences are carried at the speed of light, from where one step is to the idea of electromagnetic waves and the electromagnetic nature of light. Ritz showed rigorously that it is the final light speed $c$ of the ejection of particles carrying the impact that creates magnetic, inductive effects and determines the speed of electromagnetic waves. Whereas in Maxwell's electrodynamics everything is exactly the opposite: the rate of transformation of an electrical disturbance into a magnetic one determines the speed of propagation of electromagnetic waves. And again, there is no indication of what this rate of transformation of electrical disturbances into magnetic and vice versa is given.

Thus, there was no reason to prefer Maxwell's electrodynamics to the former Weber-Gauss electrodynamics. That is why, at first, Maxwell's theory was rejected by the scientific community and was not recognized for a long time. And only the discovery of electromagnetic waves by Hertz brought it recognition in 1888. However, electromagnetic waves, as shown by Ritz, were obtained in the former Weber-Gauss electrodynamics. Thus, the contradiction of Maxwell's theory to Michelson's experiment and other experiments should be interpreted as confirmation of the previous Weber-Gauss electrodynamics, where the Galilean principle of relativity worked, and where the principles of Newtonian mechanics were refined, which neglected the speed of propagation of influences. This is exactly what Ritz spoke about at the beginning of the 20th century, when science was at a crossroads.

But instead of taking this classical path, the scientific community chose the risky path of Einstein, who, contrary to logic, proposed to preserve Maxwellian electrodynamics, rejecting classical mechanics. Consider, for example, how Kaufmann's experiment was explained according to the theory of relativity. In this experiment, it was discovered that fast electrons behave quite differently from what Maxwell's electrodynamics prescribed for them. Moving in an electric field, electrons are deflected at an angle less than the calculated one [4]. Since the deflecting action of the electrodes is characterized by an acceleration $a = F/m$, which imparts an electric force $F$ to an electron of mass $m$, Einstein interpreted this not so that Maxwell's electrodynamics is erroneous, which predicts the same magnitude of force, regardless of speed, but as if erroneous classical mechanics, in which the mass $m$ - constant. The discrepancy between the deviation and the acceleration proportional to it $a = F/m$ with the calculated one is caused, according to Einstein, by an increase in the mass of an electron with an increase in its speed. Although, as is easy to understand, there is no reason for such an increase in mass. Moreover, this contradicts all our experience and the definition of mass as the amount of matter that must be conserved according to the law discovered by Lavoisier and Lomonosov. Even nuclear physicists themselves are already aware of the inconsistency of the concept of growing mass: according to the theory of relativity, the mass of a body depends not only on velocity, but also on its direction in relation to force [10]. That is, even at a given speed, mass cannot be considered an unambiguously defined value: indeterminism arises. Ritz proposed a simpler explanation: the difference in the deviation or acceleration $a = F/m$ from the calculated one is caused by a change in the force $F$ acting on a moving electron, with its mass $m$ unchanged. Such a change in force is not only quite natural (for example, the Lorentz force and aerodynamic forces depend on the speed), but also expected, since taking into account the final velocity of propagation of influences with a light speed, as Ritz showed, should lead to a change in force and acceleration precisely by the value that was recorded in the experiment of Kaufmann [15]. That is, Kaufmann's experience once again revealed the incorrectness of Maxwellian electrodynamics and the inadmissibility of neglecting the final speed of propagation of influences.

As Ritz showed, it is no less important to take into account the final velocity for gravitational influences, the delay of which should also change the gravitational forces. Indeed, although for two centuries scientists calmly used Newton's mechanics and his law of universal gravitation, predicting the positions of the planets with great accuracy and even "opening at the tip of a pen" new planets from the observed disturbances, by the end of the 19th century it became clear that these laws were not quite accurate. When studying the motion of Mercury, it was found that its orbit rotates (perihelion shifts) slightly faster than it follows from the calculations [22]. Back in 1908, Ritz showed that this is due precisely to the unaccounted rate of propagation of gravitational influences, and if we take this speed equal to the speed of light, then the change in force caused by the delay will just lead to the observed perturbations in the motion of Mercury. Ritz also predicted on the basis of this hypothesis the displacement of the perihelions of other planets - Venus and Earth, later confirmed [22].

However, here, too, the scientific community moved not along such a natural path, which followed from the inevitable refinement of Newtonian mechanics, but along the path of Einstein, who, again without any reason, began to formulate new postulates. From them followed the curvature of space by massive bodies, which led to a change in the rate of flow of time and additional disturbances in the motion of the planets. From this General Theory of Relativity, Einstein obtained in 1915, seven years after Ritz, the same conclusion for the displacement of the perihelion of Mercury. Thus, here, too, there was no reason to prefer the path of non-classical mechanics to the historically conditioned classical path. The contradictions and inaccuracies of classical mechanics, which led to the crisis, were not studied as expected, with all thoroughness, but were purely formally eliminated, neutralized by artificial postulates. They tried to compensate for the old ones with new errors, instead of fixing them. That is why there is every reason to assert that the theory of relativity was not a way out of the crisis, and the way out had to be sought along the path discovered by Ritz, who deeply studied the long-discovered problems of Newton's mechanics and simply refined it, discarding the idealization of instantaneous long-range action, and accordingly transforming electrodynamics and the theory of gravity.

So, Ritz did not confine himself, like Maxwell or Einstein, to an external description of electrodynamic and gravitational phenomena, but tried to delve into their essence, to establish their microscopic, atomistic causes. Assuming the existence of a material mediator in the form of particles emitted by charges, Ritz not only paved the way for future physicists (according to his idea, Dirac, Wheeler and Feynman developed exchange interaction models: charges interact through the exchange of virtual particles), but also linked physics with the past, with deep views ancient philosophers-atomists. Even in Ancient India, the atomist philosopher Kanada taught that the smallest particles emitted by bodies carry light [23, 24]. The same point of view was defended in Ancient Greece by Empedocles, Leucippus, Democritus, Epicurus, and they believed that electric, magnetic and gravitational influences are actually exerted by a stream of particles emitted from bodies [20, 21], as shown in more detail in the poem " On the nature of things, "the ancient Roman popularizer of their teachings Lucretius [25]. In addition, it seems that the same point of view was held by such prominent thinkers of antiquity as Thales and Pythagoras. Thales is credited with the first studies and descriptions of electricity and magnetism [21]. Moreover, he explained these effects by the "soul" emanating from the magnets and rubbed amber. If we take into account that the ancients often meant subtle substances, vapors of bodies, consisting of small particles, by the soul, then this point of view of Thales also fully corresponds to the later and more grounded views of Ritz and Thomson. And later, many classical physicists who laid the foundation of optics, the doctrine of electricity, magnetism and gravity (Alhazen, W. Hilbert, P. Gassendi, G. Galilei, I. Kepler, I. Newton, G. Lesage [20–22] ), adhered to precisely this point of view on the nature of light, electromagnetic and gravitational influences. Thus, the way out of the crisis, proposed by Ritz, was historically and scientifically substantiated; it was a continuation of the line of development of classical physics along the path of atomism.

And most importantly, within the framework of such a hypothesis about a common carrier of all types of influences (light, electromagnetic and gravitational) in the form of elementary particles scattering at the speed of light, a simple and natural way was opened to the construction of a unified field theory, which Einstein tried in vain to build, and which until has not yet been completed. The problems that have opened up in the creation of such a unified theory are connected precisely with an inadequate, external, descriptive concept of nature. Whereas Ritz, already in his work in 1908, brought together the electric, magnetic and gravitational effects [15]. And on the basis of his model of the structure of atoms and nuclei, it is possible to reduce to the electromagnetic and nuclear strong, as well as weak interaction, which was already partly done in the works of Ritz [9]. Thus, the difficulties that arose in non-classical physics in the construction of a unified field theory can also be considered a confirmation that it was not a real way out of the crisis, and the solution had to be sought along the path of classical atomic theories, as suggested by Ritz and Thomson.

## 3. Roots of quantum physics and alternative concepts

At the beginning of the 20th century, the crisis affected not only electrodynamics and optics, but also thermodynamics, as well as the theory of the structure of the atom. To resolve this crisis, scientists had to revise even more the foundations of classical mechanics, but not in the region of high speeds and energies, but in the region of low speeds, energies and scales. This crisis arose again in optics, in the analysis of the radiation spectrum of an absolutely black body. The fact is that the spectrum of a black body predicted on the basis of classical mechanics, thermodynamics and electrodynamics did not correspond to the actually measured one. According to calculations, the spectrum should be described by the Rayleigh-Jeans formula, according to which the radiation intensity increased with increasing frequency [5]. This formula worked well at low frequencies, but contradicted observations at high frequencies. And with an infinite increase in frequency, the radiation power had to grow infinitely, so that the bodies would glow immensely brightly in the ultraviolet part of the spectrum, and would instantly cool down due to this radiation. This problem, called the ultraviolet catastrophe, further exacerbated the crisis in physics.

A way out of this crisis was found in 1900 by Max Planck, who proposed a hypothesis of quanta, according to which the energies of $E$ oscillators - vibrating electrons cannot have arbitrary values, but are rigidly related to the frequency $f$ of their oscillations by the formula $E = hf$, where $h$ is the fundamental a constant called Planck's constant. This simple hypothesis made it possible not only to eliminate the ultraviolet catastrophe, but also theoretically calculate the form of the thermal spectrum described by Planck's formula and exactly corresponding to the experimentally measured one. In the very hypothesis of Planck, as he repeatedly noted, there was still nothing that would contradict classical mechanics and electrodynamics. In fact, since the emitting electrons are in an atom, the mechanism of which was not yet known, it could well turn out that the energies of their vibrations in a certain way depend on the frequency of their rotation or vibrations. We observe a similar dependence for the planets of the solar system, the periods of revolution of which obey Kepler's third law. That is, the frequency of the planet's revolution around the Sun is rigidly connected with the radius of the orbit, and hence with the speed, the energy of the planet's revolution.

If we take into account that this is exactly how the atom began to be represented a dozen years later in the planetary model of E. Rutherford (electrons rotate in circular orbits near the nucleus under the influence of its Coulomb attraction), then such a relationship between $E$ and $f$ would be only natural. The fact that this connection in Rutherford's model would turn out differently than $E = hf$ is not so fundamental and only says that the model needs to be corrected, and the connection between $E$ and $f$, in principle, can arise within the framework of classical mechanics, it is necessary just find a suitable model of the atom. The fact that Rutherford's planetary model of the atom was erroneous also followed from the fact that it could not explain the stability of the atom: electrons spinning in orbits, losing energy during radiation, would gradually narrow the orbit and fall on the nucleus. This also contradicts Planck's formula $E = hf$, from which it can be seen that with a decrease in the energy of an electron's revolution, the frequency of its revolution $f$ should decrease, and not increase, as in the planetary model of the atom.

The instability of Rutherford's atom further exacerbated the crisis in physics. A way out of the crisis was found by A. Einstein and N. Bohr. Einstein interpreted the dependence $E = hf$ in his own way, assuming that it means not just proportionality of the energy of the oscillator to its frequency, but that all this energy is emitted at once, in the form of a whole portion $E = hf$, and this energy is immediately absorbed by such an indivisible portion-quantum : This is how Einstein explained the photoelectric effect. And Bohr developed this conclusion of Einstein, applying it to Rutherford's model: since electrons cannot emit continuously, but emit energy only in portions, then they will no longer gradually fall on the nucleus, but must move along stationary orbits without radiation. Only at the moment of radiation the electron changes its orbit abruptly, emitting the corresponding portion of energy. Moreover, since the energy of electrons is quantized, their stationary orbits can have only certain radii. This also explained the discrete line spectra of atoms: each line, each frequency in the spectrum corresponded to a certain transition of an electron from one stationary orbit to another, with the emission of a certain energy, rigidly associated with the radiation frequency. Thus, it would seem, another problem of classical physics was solved, for which the discrete nature of atomic spectra seemed mysterious for a long time. Thus, at first glance, a way out of this crisis in physics was also found, albeit at a high cost: at the cost of abandoning the principles of classical mechanics and electrodynamics, where energy changes and is emitted continuously.

But even this way out, if you think about it, was not a real way out, since it went against the logic of scientific development. After all, the problems and the crisis were associated precisely with the planetary model of the atom, just created and therefore untested. Testing it, in fact, immediately showed the fallacy of this model. But, just as in the case of Maxwell's electrodynamics, scientists did not take the path of rejection of the discredited newly-made theory, but the path of rejecting the time-tested and innocent classical mechanics. The desire to preserve, in spite of all the facts, Maxwell's erroneous electrodynamics led to the emergence of a formal reconciling link in the form of the theory of relativity and relativistic mechanics, which asserts the fallacy of classical mechanics in the region of high velocities. And the desire to preserve the erroneous planetary model of the atom ultimately led to the creation of quantum physics and quantum mechanics, which assert the fallacy of classical mechanics in the case of low speeds and scales.

This desire of Niels Bohr to save, by all means, the planetary model of Rutherford, who was his teacher, is quite understandable. But how the scientific community could agree with this solution is not entirely clear. Moreover, science still eventually abandoned the planetary model, although the quantum physics that arose because of it survived. In fact, quantum physics, like relativistic mechanics, did not eliminate the contradictions that led to the crisis, but only hid them by means of a formal technique that allowed for some time to obtain results consistent with experience. When discrepancies with experience began to arise again, physicists invented new postulates, introduced new, logically, physically and intuitively unsupported hypotheses to eliminate contradictions. As a result, quantum physics has gone through several stages of such artificial "improvements" [5]. In many ways, this resembles the construction of the Ptolemaic geocentric theory of planetary motion, where more and more epicycles were gradually and without any reason arbitrarily added in order to obtain an external description of the apparent motion of the planets in the sky, consistent with experience. In the same way, in quantum mechanics, more and more new hypotheses were introduced, quantum numbers, like epicycles characterizing the movement of electrons around the nucleus, were adopted by Bohr's prohibition rules. And right up to our days, a heap of unsupported hypotheses, for example, about quarks, is multiplying. However, the number of contradictions in the quantum model of the world does not decrease, but multiplies even faster. And now physicists themselves do not hide the fact that they cannot understand how elementary particles and even atomic nuclei are really arranged. Thus, quantum physics, like the theory of relativity, did not solve the problems that led to the crisis, but only formally bypassed them, postponing their solution to a later time. As a result, the problems only grew.

And the correct and logical way out of the crisis, dictated by the entire history of the development of physics, consisted in establishing the root of contradictions, in studying the real structure of the atom and building a model of it that could explain all the discovered regularities within the framework of existing theories, including within the framework of classical mechanics and electrodynamics. It was on this path that Planck initially took, who for a long time, up to the 1920s, asked physicists to be very careful with the hypothesis of quanta, reminded that quanta cannot be understood as portions of energy that can individually move in space. Planck always believed that the quantum hypothesis was quite compatible with classical physics. Indeed, the connection between the vibration frequency of an electron and its energy can be realized in the classical model of the atom [9]. Moreover, such a classical connection easily explains the photoelectric effect. If light of frequency $f$ falls on a metal, then, due to resonance, the light effectively acts only on electrons vibrating at the same frequency $f$, and, by swinging them, makes them fly out of the atom and metal with conservation of kinetic energy $E = hf$. Thus, according to Planck, the energy of photoelectrons is not contained at all in light, but in the metal itself, in its atoms, while the action of light only initiates the emission of electrons, like a spark that explodes a keg of gunpowder [26]. This immediately classically explained the inertialessness of the photoelectric effect and its other mysterious properties, which, at first glance, contradicted classical physics.

So, when studying the laws associated with the behavior of such little-studied objects as atoms, it was much more natural not to change and formally adapt classical mechanics to the observed laws, but to study the atoms themselves, their structure. It was along this classical path that many physicists went, such as M. Planck, J. Thomson, I. Stark, F. Lenard, W. Ritz. So, Thomson showed that the atom should not be a dynamic, but a static system, due to which the atom was obtained stable within the framework of classical mechanics. Indeed, Thomson gave specific examples in which systems of many charges or magnets formed stable systems with a standard structure and size [21]. Thus, Thomson referred to the experiments of A. Mayer, in which a set of identical magnetic floats formed stable configurations near a central magnet (analogue of an atomic nucleus). Moreover, the magnets were arranged in concentric rings. This is what led Thomson to the idea that electrons can also be located in an atom in separate shells, and their successive filling explains the structure of the periodic table, where each period is associated with the filling of a certain shell with electrons. So, this idea of the electron shells of the atom first naturally arose precisely in the classical model of the atom. Whereas in the quantum, Bohr model of the atom, the shells were obtained arbitrarily, by artificially introducing quantum numbers, by means of unsubstantiated hypotheses and formal techniques. Thus, if the classical theory of the atom was built reasonably, in an effort to know the structure of the atom, then quantum physics offered many unsupported and even contrary to common sense hypotheses, solely in order to give an external, superficial, formal description of the properties of the atom.

Even less known is the classical model of the atom, which was the first to explain the spectrum of hydrogen, alkali metals and even predicted new spectral lines that were later discovered. This model was proposed by Walter Ritz, who, like Thomson, believed that the atom contains a kind of nucleus, composed of ordered particles that form a kind of chains and crystals [9, 15]. Electrons can be located in the nodes of this crystal lattice, and when vibrating in its magnetic field, they generate precisely those frequencies that correspond to frequencies in the spectrum of hydrogen and other atoms. Thus, it was not Bohr, but Ritz who was the first to construct a model of the atom, which explained the discrete spectra of atoms [27], and this model was classical (Bohr did not hide that he based his theory on the Ritz formula obtained within the framework of the classical model of the atom [5]). It turns out that the discrete nature of atomic processes and atomic spectra confirmed not a discrete structure of energy, but a discrete structure of matter, an atom formed from many ordered particles. And Bohr only transferred the regularities already discovered by Thomson and Ritz into quantum language, although there was no longer any need for this, since they were easily obtained within the framework of the usual classical physics, without any radical hypotheses that were not supported by anything and contradict common sense.

As shown by Ritz, and after him by Stark, such a classical model of the atom could easily explain the Zeeman and Stark effects, that is, changes in the spectra of atoms in a magnetic and electric field. There was only a displacement of electrons from equilibrium positions in these fields and a change in the vibration frequency under the action of the superimposed field, which distorts the intra-atomic field in which the electrons vibrated. But this classical conclusion was also changed later into a quantum way with the help of perturbation theory.

Thus, numerous successes of non-classical science and specifically quantum physics really belonged to classical physicists, who received the corresponding laws within the framework of the classical model of the atom and classical physics. Sometimes, when analyzing the crisis, physicists of the early 20th century mention another phenomenon: a decrease in the molar heat capacity of solids and gases upon cooling [5]. This experimentally discovered result seemed to contradict classical thermodynamics, where, on the basis of molecular kinetic theory, it turned out that the heat capacity at a constant volume should not depend on temperature, as the Dulong-Petit law asserted. This contradiction with experiment was eliminated by the quantum theory, in which it was taken into account that the energy of vibrating atoms is quantized, that is, it takes on a discrete series of values and cannot be below a certain limiting value. Therefore, with a decrease in temperature, when the energy of thermal vibrations of atoms becomes below this limiting value, they stop fluctuating and no longer contribute to the heat capacity, which is why it decreases. However, even here we cannot agree with such a way out of the crisis. The fact is that the conclusion about the constancy of the heat capacity was obtained in the classical theory, taking into account a number of simplifications, idealizations, within the framework of which this conclusion was valid. Therefore, the contradictions should be eliminated not along the path of a radical revision of the provisions of classical mechanics, but along the path of refining the classical theory, which would have to take into account the interactions between atoms, as well as their finite sizes [9].

Something like this at the end of the 19th century, it turned out that the Clapeyron-Mendeleev equation for describing the state of an ideal gas has only limited applicability and ceases to be fulfilled under certain conditions, for example, at low temperatures. But the situation was easily corrected without a fundamental breakdown of ideas, but only by refining the rough ideal gas model. After taking into account the finite size of the molecules and their interactions, a much better agreement between the theory and observations within the framework of van der Waals's law was obtained. Note that even this simple law predicts the deviation of the heat capacity from the classical value, and the heat capacity also depends on temperature. Thus, in other cases, when analyzing the heat capacity, an adequate result can be obtained within the framework of the classical theory, if we abandon idealizations and refine the theory. At the same time, quantum theory took the path of purely formal elimination of problems. The same can be said about the quantum theory of electrical conductivity and about other problems of classical physics that led to a powerful crisis. In all such cases, the solutions and ways out of the crisis, proposed by quantum mechanics, cannot be considered logically sound and rigorous. That is why in the 20th century the problems of physics did not diminish over time, but only multiplied. And at the present time, already in quantum physics, so many contradictions have accumulated that their number is many times greater than the number of contradictions in the previous classical physics. Therefore, a way out of the crisis should be sought on the path of clarifying the previous classical models, on the path of revealing the real causes of the crisis and determining the real structure of the atom, and not on the path of a formal description of observations, through all the multiplicable contradictory hypotheses. That is, quantum physics cannot be considered a real way out of the crisis at the beginning of the 20th century.

## 4. Historical background for the recognition of non-classical physics

It was shown above that non-classical physics, including the theory of relativity and quantum physics, was not a real way out of the crisis, did not solve the problems that gave rise to this crisis, but only formally eliminated and avoided them. The question arises, why, in spite of all this, did the scientific community take exactly this unnatural way out of the crisis? In addition, at first glance, it is completely incomprehensible why non-classical physics still works to this day, why its inconsistency has not been clearly revealed, as in the case of classical physics?

The last question is easy to answer. From the very beginning, non-classical physics was built in such a way that unnatural, unfounded hypotheses were introduced to reconcile theoretical predictions with experiment. When a disagreement with the theory arose again, it was not rejected, but additional, even more absurd hypotheses were invented, formally eliminating the contradiction. It is clear that by introducing a sufficient number of hypotheses, moreover, if there is no restriction in their choice, any set of phenomena can be explained. Therefore, such a contradiction could not arise that would have forced to abandon the theory: as soon as it arose, new hypotheses were invented (similar to the introduction of new epicycles in the geocentric system). In this sense, classical physics had fewer degrees of freedom: classical physicists severely limited themselves, considering it possible to accept only a limited number of hypotheses, moreover natural, intuitive and obvious, as well as experimentally substantiated. In classical physics, contradictions could not be eliminated by a formal method, the problem always had to be solved strictly. Therefore, in classical physics the crisis was very acute.

At the same time, in non-classical science, an acute crisis, in principle, cannot develop, since it would be immediately eliminated with the help of new hypotheses. The fact that such hypotheses, indeed, were regularly added, once again proves that non-classical physics does not reveal the deep structure of the world, and is not a microscopic, but only a phenomenological theory, which gives only an external, formal description of phenomena, without understanding their causes and essence ... This explains why most of the phenomena discovered in the 20th century were not predicted by either the theory of relativity or quantum physics, which, offering only an external description, did not have predictive power in terms of the discovery of new phenomena, and only explained them hindsight by attracting new hypotheses. This is how, without the help of non-classical physics, superconductivity, superfluidity of helium, the properties of synchrotron radiation, the whole set of elementary particles and space objects were discovered. Likewise, many devices, which are said to have been created only thanks to the use of non-classical physics, were actually built without its help and even contrary to its dogmas and forecasts. Suffice it to cite the story of N.G. Basov, who, when creating the maser, turned to many prominent specialists in quantum theory, and all of them unanimously declared that the maser should not work in accordance with quantum theory [28]. Likewise, T. Meiman built the first laser, according to him, not thanks to, but rather contrary to the ideas and principles of scientists who were engaged in quantum theory. However, after the maser and laser were created, they were declared a triumph of quantum theory and called quantum generators, although they were originally created and worked according to classical laws and contrary to quantum theory. The same can be said about accelerators and nuclear power plants. At the origins of their creation, at the origins of the discovery of nuclear reactions were classical physicists, including E. Rutherford and F. Soddy, who were skeptical about the theory of relativity. Therefore, the statement that modern devices and phenomena confirm non-classical physics is not entirely legitimate.

All non-classical phenomenological theories have predictive power only within the framework in which they were developed. Just like Ptolemy's theory, they explained only what they were invented for, and could not predict anything new. The success of predictions within a limited range of phenomena, to which these theories were fitted, is explained by the fact that their formal apparatus contained correct relationships between observable quantities, and these relationships could be obtained in other theories, including classical ones. The only difference was which values were considered fixed and which variables. So, in the theory of relativity, for the interpretation of Kaufmann's experiment, the force $F$ was considered fixed, and the variable was mass $m$, and in the classical, on the contrary, the force $F$ changed, and the mass $m$ was fixed, but their ratio $a = F/m$, which was actually measured in the experiment, turned out to be the same in both theories. This is approximately how Ptolemy's theory predicted almost the same relative positions of the planets in the sky as Copernicus's theory, but if the geocentric theory fixed the position of the Earth and considered the position of the Sun to be variable, then Copernicus's heliocentric theory, on the contrary, fixed the coordinates of the Sun, and the Earth was assumed to be moving around it ... Thus, the efficiency of nonclassical theories is solely due to the fact that they use the same mathematical relations as in the classical theory, although these relations are understood in a completely different way. And it is characteristic that a number of such relations were obtained for the first time in classical physics, and then they were borrowed by quantum and relativistic physics. This is how non-classical physics borrowed from classical physicists the spectral formula of hydrogen and the Ritz combination principle, the Planck relation $E = hf$ and the $E = mc^2$ relation, first obtained by Thomson, Lorentz and Heaviside in the framework of classical theories and having a completely different meaning than in the theory of relativity.

The question remains as to why physicists chose the path of non-classical physics and rejection of classical physics, although, as was shown above, this path was neither the simplest nor the most natural. The fact is that the heyday and recognition of non-classical physics fell on the era of troubled times in 1910–1920, when the world was going through serious shocks in the form of World War, famine, crisis and the October Revolution in Russia. It was literally a time of troubles, a time of anarchy not only in the world, but also in science. Due to the war, science was in decline, it was poorly funded, scientific schools fell apart, scientists were scattered and confused. And in this troubled time, any theory could theoretically come to power. That is why, without special efforts and without sufficient grounds, non-classical physics was recognized in the form of the theory of relativity and quantum physics. They did not meet the proper resistance and criticism from the classical physicists, although separate voices of protest were heard. In addition, many perceived these revolutionary concepts as a historical necessity, as fresh trends sweeping away along with the established world order and the patriarchal classical concept. Many physicists viewed these non-classical theories as temporary, in the hope that gradually everything would become clear, and these theories would either acquire a classical interpretation, or they would be replaced on the basis of strict classical views. But time and contradictions passed, the divergences of new theories with classical physics only deepened. When the situation in the world more or less stabilized, and physicists in the 1920s woke up, starting to point out the unfounded acceptance of non-classical concepts, it was already too late. Non-classical concepts, accepted only as temporary, firmly entrenched in science, so that their criticism began to be perceived almost as retrograde, as a sign of backwardness and inability to perceive new physical concepts. So such criticism was often not allowed on the pages of scientific journals.

The scientific community itself was transformed: the leading classical physicists either died or retired, science lost many physicists in the course of world wars and upheavals. Thus, the Russian intelligentsia was largely physically destroyed during the Revolution, emigrated or died of starvation. As a result, the classic physicists have been replaced by a new generation of physicists with distorted ideas about the world, brought up on the ideas of non-classical physics. As Planck said: "Usually new scientific truths win not so that their opponents are convinced and they admit they are wrong, but mostly so that these opponents gradually die out, and the younger generation learns the truth immediately." And the few classical physicists who survived tried not to vote at all and not express their views. They only regretted that they had not passed away earlier. Here is how H. Lorentz said about the new physics in 1924: "Where is the truth if mutually exclusive statements can be made about it? Are we able to find out the truth at all and does it make sense to do science at all? I have lost confidence that my scientific work led to objective truth, and I do not know why I lived; I only regret that I did not die five years ago, when it still seemed clear to me ... Instead of clear and bright images, there arises a desire for some mysterious schemes that are not subject to clear presentation ".

Indeed, modern non-classical physics is distinguished, first of all, by the eclecticism of its views. For example, as shown above, the first and second postulates of the theory of relativity, in fact, contradict each other, which is where all the paradoxes of SRT come from [6, 7, 9]. Even more contradictory is the wave-particle dualism of quantum mechanics, according to which a particle can be simultaneously considered as a wave. In non-classical physics, such fundamental concepts as the determinism of natural phenomena and the principle of causality are rejected. Moreover, such eclecticism, as V.I. Lenin [12], is often passed off as dialectics, through the substitution of concepts. Quantum mechanics supposedly creates a more general holistic picture of the world, although in reality it simply mixes up conflicting concepts. Lenin noted that in non-classical physics there is a strong tendency to replace physics with mathematics: "matter disappears, only equations remain" [29, 30]. That is, even at the inception of non-classical physics, its idealistic tendencies, alien to the spirit of materialistic science, were clearly visible. These tendencies were even more vividly manifested in the future - in cosmology, in the theory of the Big Bang (invented by the priest J. Lemaitre and, in fact, returning science to the biblical tales of the creation of the world), in elementary particle physics. Moreover, many physicists, the founders of non-classical physics, did not even then hide their idealistic views, as noted by S.I. Vavilov [30]. Thus, despite the fact that non-classical physics triumphed, its victory was not due to either physical, logical or philosophical reasons, but only the historical situation, a chain of accidents and mistakes.

## 5. Conclusion and conclusions

So, in conclusion, we can say that the crisis in physics at the beginning of the 20th century really had serious theoretical and experimental reasons and was associated with the imperfection of the classical picture of the world. However, these problems were explained not by the erroneousness of the classical picture of the world, but by its incompleteness, its idealizations and simplifications that existed in physics since the time of Newton (when they were natural and necessary), as well as the imperfection of ideas about the structure of matter, atom, about the structure and nature of the electromagnetic and gravitational fields. Therefore, the most natural way out of the crisis would consist in the elimination of idealizations and a deeper study of the picture of the world. After all, the whole history of the development of physics shows that scientists first build an approximate model of phenomena, give a simplified description within the framework of some idealizations (model of planets in the form of material points, model of an ideal solid body, model of an ideal gas, etc.), obtaining a solution only in the form first approximation. And then physicists gradually refine this solution, abandoning idealizations and rough, simplified models, and take into account a larger number of factors. However, in resolving the crisis of the 20th century, physicists did not follow this natural and natural path of rejection of idealizations, but the path of complete rejection of the well-proven classical physics, with a heap of contradictory and unfounded postulates and hypotheses instead of it. The scientific community tried to overcome the crisis with the help of non-classical science, through formal elimination of contradictions and an abstract, phenomenological, superficial description of phenomena. Scientists have abstracted from the real structure of atoms, electric and gravitational fields, agreeing to describe them as "black boxes", through external characteristics using formal procedures and rules. That is why such a formal path, imprecise and limited, cannot be considered a real way out of the crisis.

Moreover, this path turned out to be, in fact, not the most logical, because, firstly, there were simpler and more consistent classical theories aimed at eliminating the long-known weaknesses and inaccuracies of classical physics, and secondly, the scientific community adopted non-classical physics in many ways for the sake of preserving what in the end still had to be rejected. Thus, the crisis testified to the falsity of the Aether concept, which physicists did not want to abandon and on which Maxwell's theory was originally based. And many saw it in the theory of relativity as the way to save the Aether, even Einstein himself did not deny the Aether and, in fact, like Maxwell, kept it in his equations [13]. However, in the end, the concept of Aether was still abandoned, which casts doubt on the advisability of adopting the theory of relativity. Likewise, quantum physics was adopted in order to save the planetary model of the atom, to get rid of the infinities and divergences that the classical model led to. However, in the course of the development of quantum physics, they still abandoned the planetary model of the atom: now it is no longer possible to say that electrons move in orbits around the nucleus. And, therefore, there was no point in adopting quantum theory either. In addition, it led to an even greater number of divergences and infinities, at least in the thermal spectrum, where, as in classical physics, it turns out that at an infinite frequency, electrons have an infinitely high energy of zero-point vibrations. That is, non-classical physics did not fulfill the functions assigned to it, for the sake of which it was accepted by the scientific community. However, by that time it was already firmly entrenched in science and these historical premises of non-classical physics were forgotten.

In general, the adoption of non-classical ideas that break the old, firmly established classical picture of the world, in many ways resembles the process of the October Revolution (which had common historical roots and preconditions with the scientific revolution), which won in the era of anarchy and in the absence of serious confrontation, when they were largely exterminated or weakened bearers of classical traditions, the nobility and the intelligentsia. Likewise, in physics, not the strongest, but the most scandalous, radical concept triumphed, completely rejecting the classical foundations, principles and trends in the development of physics. Many noted the nervous, restless atmosphere of that time, a kind of mass psychosis of society, when entire peoples, communities of people and scientific circles easily fell under the hypnosis of new, revolutionary ideas completely devoid of common sense. This was also facilitated by the open in 1910-1920. some experimental facts, for example, the curvature of light rays near the Sun, as well as the correspondence of the measured displacement of the perihelion of Mercury with the calculation of the general theory of relativity. However, the same facts found a simple explanation in the classical theory of Ritz [9, 15, 22]. But, ironically, it was at this time that physicists abandoned Ritz's theory in connection with De Sitter's analysis of binary stars. In fact, De Sitter's argument turned out to be incorrect, and double stars, as E. Freundlich and P. Gutnik showed already then, just confirmed the Ritz theory [8, 13]. But their arguments were not taken into account, and Ritz himself had already died by that time and could not respond to criticism. Therefore, all the facts since then began to be interpreted one-sidedly, only from the point of view of the theory of relativity. And the development of all alternative classical theories was suspended along with publications on them, which allowed physicists of the new generation to assert that only non-classical physics is capable of explaining well-known phenomena.

So until now, scientists interpret all experimentally established facts only from the standpoint of quantum physics and the theory of relativity, even if these facts did not initially fit into the framework of these theories, could not be predicted by them and even contradicted them. As T. Kuhn correctly notes, within the framework of the existing paradigm, it is no longer facts that judge a theory and determine whether it is true or not, but scientists judge facts, considering them through the prism of their theory, and determine whether these facts can enter into meaningful experience, interpret them from the point of view of the theory, or rejected as contradicting the theory [31]. Indeed, at the moment, a huge number of facts have accumulated that contradict the non-classical picture of the world, but are relatively easy to explain within the framework of classical concepts, including the ballistic theory of Ritz and the classical model of the atom [6–9]. This proves once again that non-classical physics did not eliminate the crisis, but only postponed it for an indefinite time. If we draw an analogy, the crisis in physics can be compared to a crack in a wall, which, instead of being eliminated by eliminating the cause of the crack's growth, was simply smeared over, painted over with a thin layer of putty and paint. And if because of the crisis, the physics building needed major repairs, then non-classical physics, proposing a formal superficial elimination of problems, was, in fact, only a cosmetic European-style repair, in which the defects were not eliminated, but were closed from the eyes with overhead wall panels, stretch ceilings and bulk sexes, in the form of artificial postulates and additional matching hypotheses. Therefore, in the near future, we can expect that the building of physics will crackle again, and the crisis will break out with even greater force, and it will be possible to resolve it only within the framework of classical physics, through the disclosure of deeply hidden contradictions that led to the crisis of the early XX century.

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