THE CRITICAL ANALYSIS
OF THE FOUNDATIONS OF QUANTUM MECHANICS

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Abstract. The critical analysis of the generally accepted foundations of quantum mechanics is proposed. The purpose of the analysis is to prove that the foundations include logical errors. The principle of the unity of formal logic and of rational dialectics is a methodological basis of the analysis. The result is as follows: (a) the generally accepted foundations (i.e., the interpretation of the experimental data on diffraction of quantum particles; the conception of wave-corpuscle dualism; the probabilistic interpretation of the psi-function) are logical errors; (b) the pseudo-informational meaning is the true meaning of the psi-function. Conclusion is that quantum mechanics is not a physical, objective theory but a pseudo-informational one. Therefore, quantum mechanics should be replaced by a physical, objective quantum theory. The new (correct) basis of quantum theory is proposed.

Introduction

1. As is known, the study of theoretical physics course plays an important role in modern physicist forming. However, the successful mastery of the course (for example, the world famous "Theoretical Physics Course" by L.D. Landau and E.M. Lifshitz, consisting of nine volumes: 1. Mechanics; 2. Theory of field; 3. Quantum mechanics: Non-relativistic theory; 4. Relativistic quantum theory; 5. Statistical physics; 6. Hydrodynamics; 7. Theory of elasticity; 8. Electrodynamics of continuum; 9. Physical kinetics) does not mean that a physicist understand, comprehend the foundations of theoretical physics. In order to understand the foundations of physics, physicist should, first, lose faith in scientific authorities, secondly, think independently and, thirdly, work in seclusion for many years. At the same time, attempts to think independently lead inevitably physicist to mastery of philosophical formalism and of formal logic – the only correct methodological basis of critical analysis of science. In order to make these three steps, I, for example, took 30 years.

2. In my opinion, critical situation arises in theoretical physics now. In this connection, Einstein's criticism concerning quantum mechanics can correctly define the state of modern theoretical physics as a whole because modern physics is essentially quantum physics:

– "The more successes are achieved by quantum theory, the more stupid it looks. How people far from physics would laughed if they knew about this state of cause" (1912);

– "The great successes achieved by quantum theory for incomplete quarter of the century from time of its inception can not hide from us the fact that the logical basis of this theory is still missing" (1923);

– "... In finding a common basis for all physics, one must, in my opinion, be careful to base oneself dogmatically upon scheme of the modern theory" (1948);

– "The peculiarity of the present situation in quantum mechanics is, in my opinion, that one calls in questions not the mathematical formalism of the theory but physical interpretation of its statements" (1953);

– "... Despite the fact that I at relatively young age apprehended admiringly de Broglie's a great discovery of internal connection between discrete quantum states and resonance states, nevertheless I made continually attempts to find another way to method of solution of enigma of

1

quanta or at least to promote preparing for such solution. The sense of deep dissatisfaction of the principled character, which I have from the basis of statistical quantum theory, underlies these attempts" (1953);

– "Perfection of the mathematical formalism of the theory and its considerable success hidden from our view the weight of those sacrifices which have been made for this success" (1953).

The emergence of this new (and, probably, unexpected for many scientists) situation means that there is a problem of truth in theoretical physics. The problem of truth in modern theoretical physics was considered for the first time in the books, "Surprises in theoretical physics" (1979) and "More surprises in theoretical physics" (1991) by famous theoretical physicist Sir Rudolf Peierls. But these books do not contain methodological basis for critical analysis of physics. Unfortunately, they are not handbooks for contemporary physicist. Today only a genius can be possessed of both intuition and courage to cast doubt on generally accepted theories and concepts because a genius goes in his own, independent way. A genius always goes against the stream!

3. As is known, modern theoretical physics consists of the set of theories (for example, physical cosmology, classical mechanics, condensed matter physics, dynamics, dark matter, electromagnetism, field theory, fluid dynamics, special and general relativity, particle physics, quantum mechanics, quantum field theory, quantum electrochemistry, solid state physics, statistical mechanics, thermodynamics) but it does not contain criterion of the truth of physical theories. In my opinion, lack of the criterion of the truth of theories in theoretical physics is explained by the fact that the system of physical (i.e. special scientific) concepts and laws is incomplete: it does not include many universal (i.e. the general scientific) concepts and laws. The complete system – the system of physical concepts and of laws, supplemented with the system of universal concepts and laws, – would represent not only basis of physics but also methodological basis for the deductive analysis of physics. From this point of view, the unified criterion of the truth of physical theory should be formulated as follows: a physical (i.e. special scientific) theory must not contradict the system of the universal (i.e. general scientific) concepts and laws. The system of the universal concepts and laws represents the unity of formal logic and of rational dialectics. And this unity is a science of most general laws of development of the Nature, human society, and correct thinking. Consequently, this system is a methodological basis for a critical analysis of physical theories. The main dialectics principle is the principle of objectivity of human knowledge. It is formulated as follows: objective laws and truth must be invariant under choice of means and methods of cognition, i.e. under change of properties of system of reference (in particular, objective laws and truth must not contain references to devices, procedure and accuracy of measurement or of calculation). This methodological basis contains general arguments for the deductive proof of the theoretical propositions. The general arguments are represented by the following premises:

(1) Information is essence of the Universe, and material objects (particles, fields, bodies) are manifestation of essence.

(2) The material object has physical properties, and physical properties are the inseparable characteristics of material object and belong only to material object.

(3) Quantitative characteristics of physical properties of material object are called physical quantities. The physical quantity is the measure of material object. The measure is the philosophical category meaning unity of qualitative and quantitative determinacy of material object. The measure means that quantitative determinacy belongs to qualitative determinacy.

(4) Mathematics studies the quantitative determinacy separated from qualitative determinacy of the material (physical) object. Therefore, mathematics has no physical meaning.(5) Theoretical physics studies the measure of material object, i.e. the unity of qualitative and quantitative determinacy of material object. In this case, the mathematical equation in theoretical physics belongs to physical object (i.e. the mathematical equation contains the reference to

physical object) and, consequently, has physical meaning. Mathematical (quantitative) operations on the equation do not lead to change of qualitative determinacy of physical object.

(6) Both quantitative and qualitative determinacy of object obey logic laws. Therefore, according to the logic law of identity, the left and right parts of the mathematical equation must belong to the same physical object (i.e. to the same property of physical object or the physical model of the object). And, according to the logic law of contradiction, the left and right parts of the mathematical equation must not belong to different physical objects (i.e. to different properties, models). These general arguments (as methodological basis) permit to analyze correctly the foundations of theoretical physics.

4. As is known, physics plays an important role in the development of science and technology. But the significant success of theoretical physics and the perfection of its mathematical formalism "hide from our view weight of those sacrifices which have been made for this success" (A. Einstein). It is obvious now that the truth is a name of these sacrifices. The existence of the problem of truth in theoretical physics means that physics enters the greatest crisis. Inevitability of the greatest crisis is corroborated by the fact that the foundations of theoretical physics (i.e. classical mechanics, classical electrodynamics, thermodynamics, statistical physics and physical kinetics, the special theory of relativity, quantum mechanics) include the set of logical errors [1-45]. These errors are explained by the global cause: the errors are a collateral and inevitable result of inductive method of knowledge of the Nature, i.e. result of movement from formation of separate concepts to formation of system of concepts. The inductive way of development of physics is characterized, for example, by A. Einstein's words: (a) *there has been formed a view that the foundations of physics were finally established and the work of a theoretical physicist should be to bring a theory in correspondence with all the time increasing abundance of the investigated phenomena. Nobody thought that a need for radical rebuilding of the basis of all physics could arise*; (b) *but the progress of science will cause revolution in its foundations. Our notions of physical reality never can be final ones. We should be always ready to change axiomatic basis of physics to substantiate facts of perception in logically most perfect form.* It follows from these words that "the progress in (inductive) science is the underlining of difficulties" (N. Bohr). And non-objective , incorrect theories should be replaced by objective, correct theories.

5. Larmor-Lorentz-Poincare-Einstein's special theory of relativity (STR), Einstein's general theory of relativity (GTR), and quantum mechanics (QM) play particularly important role in modern physics. Necessity of periodic change of basic principles of physics was shown for the first time in these theories. Change of science principles is always accompanied by broadening of scientists' consciousness, and broadened consciousness promotes deductive revision of foundations of science. At the same time, the STR, GTR, and QM brought the paradoxes in theoretical physics. In my opinion, paradoxes are not properties of real phenomena. The paradoxes are consequence the starting-points and bases of the STR, GTR, and QM. Therefore, the paradoxes are the inalienable parts of the STR, GTR, and QM. Today many physicists analyze critically consequences of the foundations of theoretical physics, but only some are aware of instability of the basis of physics. The starting-points and bases of the STR, QM, statistical physics (SP) and physical kinetics (PK), and classical thermodynamics (CT) were logically analyzed for the first time in my original works [1-45].

The purpose of the present work is: to show within the framework of the methodological basis – the unity of formal logic and of rational dialectics – that the generally accepted foundations of QM contain logical errors and, consequently, to prove that theoretical physics enters the greatest crisis; to explain that the inductive method of research of the Nature exhausts its potentialities; to develop deductive method of research of the Nature; to show that application of the deductive method leads to formulation of a new science paradigm and of a new theory of knowledge; to propose the theoretical model of God as key to new foundations of science. Or, in comprehensive form, the purpose of the present work is to prove the following theoretical propositions:

(1) The generally accepted foundations of theoretical physics contain essential logical errors. The existence of logical errors is irrefutable proof of incorrectness of the generally accepted foundations. The errors are explained by the global cause: the errors are a collateral and inevitable result of inductive method of knowledge of the Nature, i.e. result of movement from formation of separate concepts to formation of system of concepts.

(2) Theoretical physics is not essence science but phenomenon science. It means that theoretical physics is an unwieldy science (because it is created by the inductive method); having primitive non-universal foundations; not having a clear purpose; containing a set of delusions, logical errors, and vagueness (vagueness often cannot even be realized and formulated in the generally accepted physical concepts since physics does not contain many universal concepts; furthermore, vagueness often results from the "thoughtless application of mathematics" (L. Boltzmann)). Therefore, physical theories and fields of physics defy both natural unification and correct development. These statements – as a result of my 30-year experience of the critical analysis of foundations of theoretical physics – are the ground for the following main conclusion: physics enters the greatest crisis. The crisis in physics leads to the general crisis in science. Consequently, the inductive method of research of the Nature exhausts its potentialities.

(3) According to M. Planck's opinion, the correct theoretical physics will be created by the rising generation, and opponents of correct physics will gradually die out not having acknowledged their own wrongness. And in accordance with the principle of development of Humankind, the correct physical laws found in the deductive and meditative way will not carry the names of their discoverers.

(4) The problem of scientific truth is the most urgent problem of our time. This problem can be solved only with help of a new theory of knowledge since "science without the theory of knowledge becomes primitive and muddled; … science without religion is lame, religion without science is blind" (A. Einstein).

(5) Application of the deductive method of research of the Nature leads to formulation of a new science paradigm and of a new theory of knowledge. In this connection, the theoretical model of God is a key to new foundations of science.

(6) In accordance with the new theory of knowledge [16, 21, 23–25, 34, 35, 42, 44], science – as "threats and bribery" for Humankind – is a means of cognition. Knowledge of Universe Moral (i.e. universal moral, moral in the broad sense) is aim of scientific activity of Humankind as well as the criterion of truth of science and of human life. Scientific achievements depend on the moral qualities of man: in ancient Greek philosopher Socrates' opinion, the existence of objective truth is consequence of the existence objective moral principles. Therefore, "the moral qualities of the prominent person are, probably, of great importance for the given generation and all course of history than purely intellectual achievements. The lasts depend on greatness of spirit in a greater degree than it is usually accepted to consider" (A. Einstein).

1. The Critical Analysis of Experiments on Diffraction of Quantum Particles

The purpose of this section is to prove that the conception of wave-corpuscle dualism contradicts well-known experimental data on diffraction of quantum particles (for example, photons, electrons, neutrons, atoms, molecules). Arguments for the deductive proof are represented by the following premises [19, 20]:

(1) An experimental device for studying diffraction of particles consists of the following basic parts: (a) a source which emits non-interacting homoenergetic particles of the same kind; (b) a scatterer (the scattering target) which scatters particles emitted by the source; (c) a photographic plate which registers emitted particles.

(2) Any emitted particle is registered as a point on the photographic plate. Some points form an incomplete diffraction picture. The great set of points forms a complete diffraction picture.

(3) The set of the oscillations of a physical quantity is called a wave if these oscillations are the connected oscillations. The set of the oscillations which are the unconnected oscillations is not a wave. An oscillation and a wave are forms of absolute motion.

(4) The essence (qualitative determinacy) of a wave movement of physical quantity is manifested in that the diffraction and interference pictures formed by waves are always complete.

From the premises (1)–(4), the following conclusions are deduced:

(a) The distinction between the complete and incomplete diffraction pictures formed by scattered particles is the quantitative distinction. There is no qualitative distinction since particles always hit in the regions of the diffraction maximums of intensity. It means that the qualitative determinacy of the set of particles is identical to the qualitative determinacy of one particle.

(b) The phenomena of diffraction of a wave and diffraction of a set of quantum particles are not identical. It means that essence (qualitative determinacy) of wave motion of a physical quantity and essence of motion of a particle are not identical. In other words, translational motion of a particle is not wave movement of a physical quantity.

(c) From comparison of diffraction pictures of a wave and of a set of quantum particles, it follows that qualitative determinacy of wave motion of physical quantity and qualitative determinacy of motion of a set of quantum particles have a common aspect: namely, periodicity of motion, that is, oscillations. Hence, translational motion of a set of free quantum particles is a set of unconnected oscillations. Therefore, translational motion of one particle is oscillatory, absolute motion (oscillation).

(d) As it follows from the experimental data, the connectedness or the unconnectedness of oscillations is not the essential feature for formation of a complete diffraction picture. But it is essential feature for formation of an incomplete diffraction picture.

(e) From the phenomenon of interference of a set of quantum particles, it follows that the quantum particle flows around the obstacle and passes through the double-slit. It means that, firstly, the quantum particle is a particle with a varying size and a varying form, and secondly, oscillatory change both of size and form of quantum particle is a way of transitional motion. Therefore, transitional motion is absolute. (These results underlie the new quantum theory [7, 12, 22]).

(f) There are three various forms of matter (namely, a free quantum particle, a field and a body) and, correspondingly, three various forms of translational motion in nature. Transitional motion of a free quantum particle is oscillatory, absolute motion. Transitional motion of a field is a wave, absolute motion. (A field (for example, the electromagnetic field) is a set of connected quantum particles (for example, photons)). Transitional motion of a body (i.e. of a classical particle) is relative (non-absolute) motion.

Thus, the correct theoretical analysis of experimental data on diffraction of quantum particles leads to the conclusion that there is no wave-corpuscle dualism of motion of a quantum particle (i.e. motion of a matter particle is not associated with a matter wave) in nature because the motion of a quantum particle has no wave aspect.

2. The Conception of Wave-Corpuscle Dualism: A Logical Error

The purpose of this section is to prove that de Broglie's hypothesis (associating motion of a quantum particle with a matter wave) and Born's principle (connecting the number of quantum particles with the amplitude of a wave) are logical errors. Arguments for the deductive proof are represented by the following premises [19, 20]:

(1) From the principle of unity of discreteness and of continuity, it follows that models of a structure of material objects is divided into two opposite (nonintersecting) classes: a class of models of discrete structure and a class of models of continuous structure. Opposite classes are boundaries of each other.

(2) The law of identity,

<p style="text-align:center">(Model of discrete structure) = (Model of discrete structure),</p>
<p style="text-align:center">(Model of continuous structure) = (Model of continuous structure),</p>

expressing   identity of quality is a formal-logic law.

(3) The law of contradiction,

<p style="text-align:center">(Model of discrete structure) $\neq$ (Model of continuous structure),</p>

expressing contradiction of qualities is a formal-logic law.

(4) Motion is change in general. Periodic change of physical quantity with time is called oscillatory motion (oscillation) of this quantity. If there is oscillation in each point of the object described by model of continuous structure, the set of the mutually connected oscillations is called a wave. And the set of unconnected oscillations is not called a wave. An oscillation and a wave are forms of absolute motion of physical quantity.

(5) Set of non-interacting (free) quantum particles of the same kind (for example, photons, electrons, neutrons, atoms, molecules) is the object which is described by a model of discrete structure and is not described by a model of continuous structure. From the premises (1)–(5), the following conclusions are deduced:

(a) Set of non-interacting quantum particles has no wave form of motion. Consequently, any quantum particle (as the particular case of the set) has no wave form of motion.

(b) de Broglie's hypothesis (according to which relation between corpuscular and wave aspects of motion of a quantum particle is established by the mathematical equation $E = h\nu$ where E is the energy of the particle, ν is the frequency of the wave, h is the Planck constant) represents incorrect interpretation of the mathematical equation $E = h\nu$. Really, according to de Broglie's interpretation, the left part of the equation belongs to the model of discrete structure, and the right part of the equation belongs to the model of continuous structure. Such an interpretation is a logical error because, according to the law of identity, the left and right parts of the equation must belong to the same model, i.e. E and ν must characterize an individual particle. (According to the new quantum theory [7, 12, 22],

$$E_{(particle)} = h\nu_{(particle)}$$

where $\nu_{(particle)}$ is a frequency of periodic process of mutual transformation of internal and of external (transitional) motion of a quantum particle. Therefore, transitional motion of a free quantum particle represents oscillation of the size and of the form of the particle).

(c) The mathematical (quantitative) relation,

$$I_{(particles)} \neq I_{(wave)}$$

where I is an intensity, follows from the law of contradiction,

<p style="text-align:center">(Model of discrete structure)$\neq$ (Model of continuous structure).</p>

Therefore, Born's principle,

$$I_{(particles)} = I_{(wave)} \sim A^2_{(wave)}$$

(where $A_{(wave)}$ is the amplitude of the wave), is a logical error. (In particular, from Born's principle, it follows that motion of one particle is a wave. However, it is refuted by the experimental fact that
scattering of a particle does not result in complete diffraction picture). Thus, the conception of wave-corpuscle dualism is a logical error.

3. The Probabilistic Interpretation of the Psi-Function: A Logical Error

As is known, the problem of the interpretation of the ψ-function in quantum mechanics was the subject of the great but uncompleted discussion between Einstein and Bohr. After Einstein and Bohr this problem was not in the centre of physicists' attention. Therefore, now probabilistic interpretation (together with de Broglie's hypothesis) groundlessly underlies the standard formulation of quantum mechanics. In this connection, the purpose of this section is to prove that Born's principle, $P = |\psi|^2$ connecting the probability density P with the ψ-function, is a logical error. Arguments for the deductive proof are represented by the following premises [19, 20]:

(1) According to dialectics, essence and phenomenon are not random aspects of objective reality. When the certain complex of conditions (i.e. the certain complex of external connections and relations) is realized, the phenomenon is divided into a set of events. Events are divided into two opposite (nonintersecting) classes: a class of random events and a class of nonrandom (certain) events. If there is a relation of randomness between elementary events of complete set of events, the relation of randomness defines the concept of the random event. In accordance with this, a class of the variables characterizing events is divided into two opposite (nonintersecting) classes: a class of random quantities and a class of nonrandom (certain) quantities. Opposite classes are boundaries of each other.

(2) Qualitative determinacy of events obeys to the formal-logic laws. The law of identity,

(Random event) = (Random event),
(Certain event) = (Certain event),

expressing identity of quality is a formal-logic law. The law of contradiction,

(Random event) ≠ (Certain event),

expressing contradiction of qualities is a formal-logic law.

(3) The concepts of random event, random quantity, probability of random event, and average value of random quantity are basic concepts of the theory of probability.

(4) The statistical ensemble of physical systems defines probability, and probability characterizes the ensemble. The statistical ensemble of physical systems represents an imagined (mental, informational) set of identical physical systems. The probability is the ratio of numbers of the systems of the ensemble. Therefore, the probability is an informational concept, and it has no physical meaning. Only the average of physical quantity has the physical meaning.

(5) The theory of probability studies measure, i.e. unity of qualitative and quantitative determinacy of random events. In this case, the mathematical equation in the theory of probability belongs to the qualitative determinacy of event. Such a mathematical equation has both quantitative and qualitative meaning. Mathematical (quantitative) operations over the equation do not lead to a change of qualitative determinacy of this equation. Both quantitative and qualitative determinacy of the mathematical equation obey to the formal-logic laws. According to the logic law of identity, the left and right parts of the mathematical equation must belong to the same qualitative determinacy. And according to the logic law of contradiction, the left and right parts of the mathematical equation must not belong to different qualitative determinacy.

(6) Formation of the complete diffraction picture in experiments on diffraction of wave is a certain event because there are no incomplete diffraction pictures. In this case, it means that the complete diffraction picture is not the sum of incomplete diffraction pictures.

(7) In experiments on diffraction of the quantum particles, the complete diffraction picture is the sum of incomplete diffraction pictures. In this case, the formation of the incomplete diffraction picture is a random event.

(8) The ψ-function describes a certain event – formation of a complete diffraction picture.

(9) The ψ-function has no physical meaning, i.e. the ψ-function is not a physical quantity.

From premises (1)–(9), the following conclusions are deduced:

(a) The $|\psi|^2$ has neither a probabilistic nor a physical meaning since mathematical (i.e. quantitative) operations do not lead to the birth of probabilistic and physical meaning (qualitative determinacy).

(b) The mathematical (quantitative) expression,

$$P_{(Random\ event)} \neq |\psi_{(Certain\ event)}|^2 ,$$

is corollary of the formal-logic (qualitative) relation,

$$(Random\ event) \neq (Certain\ event),$$

because the probability of a random event is not a characteristic of a certain event. Thus, the probabilistic interpretation of the ψ-function, i.e. Born's principle

$$P_{(Random\ event)} = |\psi_{(Certain\ event)}|^2 ,$$

is a logical error. And a correct interpretation the ψ-function should be based on the logic law of identity,

$$(Certain\ event) = (Certain\ event).$$

4. The True Meaning of the Psi-Function

As is known, Einstein could not convince Bohr and other physicists that the concepts "objective reality" and "complete description" represent the key to understanding of true meaning of the ψ-function in quantum mechanics. Einstein's arguments have not been realized. Therefore, the problem of the meaning of the ψ-function has not been solved. In this connection, the purpose of this section is to prove that the pseudo-informational meaning is the true meaning of the ψ-function. Arguments for the deductive proof are represented by the following premises [19, 20]:

(1) Concepts of objective reality and system of reference are key concepts.

(2) The system, 'mankind + means of knowledge', belongs to subjective reality and is called system of reference [14]. In this wide sense, the system of reference is the universal informational and cognitive (cognizing) basis (i.e. the system consisting of natural bodies and processes, the constructed devices and instruments, the sum of human knowledge and skills) created and used by the mankind for the purpose of knowledge of the world.

(3) The main informational property of the unitary system, 'set of physical objects under research + system of reference', is that the 'system of reference' defines (measures, calculates)

parameters of the subsystem, 'set of physical objects under research'; parameters characterize the 'system of reference'.

(4) The main cognitive (cognizing) property of the system, 'set of physical objects under research + system of reference', is that the 'system of reference' defines (formulates) the physical laws (i.e. creates theories); the physical laws characterize the 'system of reference'.

(5) Objective physical law is a form of scientific knowledge of objective reality. Opposites (i.e. objective reality and nonobjective (subjective) reality) are boundaries of each other. The principle of objectivity of physical laws is as follows: objective physical laws (i.e. truth) must not contain references to system of reference (in particular, references to procedure and accuracy of measurement or of calculation).

(6) Quantities are divided into two opposite (nonintersecting) classes: a class of physical quantities and a class of nonphysical (informational) quantities. Physical quantities are objective characteristics of researched material objects. Nonphysical (informational) quantities are not objective characteristics of researched material objects. Nonphysical (informational) quantities are characteristics of a system of reference.

(7) "The peculiarity of the present situation in quantum mechanics is, in my opinion, that one calls in questions not the mathematical formalism of the theory but physical interpretation of its statements" (Einstein, 1953).

(8) The ψ-function has no physical meaning. Hence, the $|\psi|^2$ has no physical meaning because mathematical (i.e. quantitative) operations do not lead to the birth or extermination of physical meaning (i.e. qualitative determinacy).

(9) ψ-function describes certain event. Hence, the $|\psi|^2$ has no probabilistic meaning because mathematical (i.e. quantitative) operations do not lead to the birth or extermination of the probabilistic meaning (i.e. qualitative determinacy).

From premises (1)–(9), the following conclusions expressing true meaning of the ψ-function are deduced:

(a) The ψ-function is not the measure of researched physical object. In other words, the ψ-function (i.e. quantitative determinacy) does not belong to the researched material object (i.e. qualitative determinacy). Therefore, the ψ-function does not represent the complete description of a material object (i.e. of objective reality).

(b) The ψ-function belongs to a system of reference (i.e. subjective reality). The ψ-function is the fictitious informational quantity because, firstly, it does not belong to the researched material object, and secondly, it represents the result of the incorrect analysis of the experimental information. Therefore, the ψ-function is a pseudo-informational quantity.

(c) Probabilistic interpretation of $|\psi|^2$ should be replaced by pseudo-informational interpretation,

$$I_{(pseudo-\inf ormation)} = |\psi_{(pseudo-\inf ormation)}|^2$$

where $I_{(pseudo-\inf ormation)}$ is the pseudo-information intensity. In this case, pseudo-informational average of a physical quantity can be compared with experimental data.

Thus, the generally accepted quantum mechanics is a nonobjective theory (based on unreliable information), a pseudo-theory containing only a partial truth.

5. The New Basis of Quantum Theory

The basis of the new quantum theory representing a new viewpoint that has arisen from the critical analysis of statistic physics, the special theory of relativity, and quantum mechanics was proposed in works [7, 12, 13, 19–22]. The basis is formed by the following heuristic principles:

(1) The principle of motion of quantum particle: the motion is the form of existence of quantum particle; the motion represents unity of internal and external (i.e. translational) motions.

(2) The principle of energy of quantum particle: the energy

$$E_n \neq 0, \; n = 0, 1, 2, \ldots$$

(where n is the energetic quantum number) is inalienable property of a quantum particle. Energy levels n of the quantum particle arise and disappear only as a result of absorption and emission of other quantum particles, respectively. (Consequently, the problem of quantization of energy is not the Shrödinger problem of eigenvalues).

(3) The principle of equivalence of energy E_n and frequency ν_n of quantum particle: energy E_n is related to frequency ν_n by the formula

$$E_n \equiv h \nu_n, \; \nu_n \neq 0$$

where h and ν_n are the Planck constant (i.e. quantum of action) and the frequency of the periodic process of mutual transformation of the internal and external motions, respectively. The concepts of energy E_n and of frequency ν_n are identical ones. Multiplication of the quantities h and ν_n is permitted by logic law of identity if h is an oscillating quantity [41].

(4) The principle of speed of translational motion of quantum particle: the speed v_n is defined by the formula

$$v_n \equiv \lambda_n \nu_n$$

where $\lambda_n \neq 0$ is the size (the diameter) of the particle. The λ_n equals the distance traveled by the particle for the oscillation period

$$\tau_n \equiv 1/\nu_n \; .$$

This translational motion is a result of contraction and extension of the size (diameter) of the particle. Therefore, the translational motion of the quantum particle relative to a reference system is an absolute one. The absolute motion is invariant under choice of a reference system. This statement means that the velocity addition theorem for quantum particle is not valid.

(4) The principle of mass and momentum of quantum particle: the mass m_n and the momentum p_n are defined by the formula

$$E_n \equiv (E_n / v_n^2) v_n^2 \equiv m_n v_n^2 \equiv p_n v_n \; .$$

The concept of mass m_n and the concept of energy E_n are not identical ones. Therefore, the formula

$$E_n \equiv m_n v_n^2$$

does not express the principle of equivalency of mass and energy.

(5) The principle of equivalency of mass and energy of quantum particle: the energy E_n is related to the mass M_n by the formula

$$E_n \equiv k M_n$$

where the concepts of the energy E_n and the mass M_n are identical ones, k is a universal constant, $[k] = erg/g$.

(6) The principle of acceleration and of deceleration of quantum particle: acceleration and deceleration of particle are results of absorption and emission of other quantum particles, respectively. The acceleration $w_{n+1,n}$ of the quantum particle under the transition $n \to (n+1)$ which is due to absorption of other quantum particle (photon) is defined by the formula

$$w_{n+1,n} \equiv (v_{n+1} - v_n)(V_{n+1} - V_n) \equiv v_{n+1,n} \, V_{n+1,n}.$$

Conclusion

Thus, the foundations of the generally accepted quantum mechanics contain logical errors: the conception of wave-corpuscle dualism; probabilistic interpretation of the psi-function. The true meaning of the psi-function is a pseudo-informational meaning. Therefore, quantum mechanics is a nonphysical, nonobjective, pseudo-informational theory. This theory (i.e. the incomplete description of objective reality) should be replaced by the physical, objective quantum theory (i.e. the complete description of objective reality). The proposed correct foundations of quantum theory furnish the clue to correct description of reality.

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