

MAIN PROBLEMS OF SYNTHESIS THE PHYSICAL AND INFORMATION THEORIES**Petro P. Trokhimchuck**Anatolii Svidzinskiy Department of Theoretical and Computer Physics,
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Abstract: Some problems of unification the basic laws of physics and information theory are discussed. Next aspects of this problem: laws, constants and system, are analyzed. The role and influence of N. Bohr in the unification of the next theories in classical physics: Rayleigh ratio, the uncertainty principle of quantum mechanics, and the classical and quantum coherence theory is shown. The problem of main universal physical laws and quantities is researched. The connection between physics and information theory is shown. For this, the theory of information-physical structures was used. The role of physical constants in the creation universal theories is est note. Stoney and Planck system of fundamental physical constants and its place in modern theory are analyzed. A more universal unification was obtained from the generalization from L. de Broglie's formula about the equivalence of the amount of ordered and disordered information. It is shown that on the basis of a dimensionless quantity that can be interpreted both as a dimensionless action and as a dimensionless entropy, it is possible as a partial case to obtain the basic universal laws of physics and information theory. In this case, the analogy between thermodynamic and information entropy becomes more obvious. Further prospects for the development and application of the proposed methods of unification in in various branches of modern science are analyzed and discussed. The impact of the development of physical theories on the emergence and development of systems theory is shown. According to E. B. de Condillac, any set of connected elements is a system. Moreover, part of these elements are the principles by which the corresponding system was created. At the same time, the number of principles should be minimal, and preferably one. The idea of the possibility of creating a unified system of knowledge is also expressed.

Keywords: synthesis, de Broglie, Rayleygh, uncertainty principle, physics, information theory, open systems, polymetrical analysis.

INTRODUCTION

The problem of synthesis and unifying the laws and quantities of physics and information theory is closely related to the development of theoretical and mathematical physics [1-38].

The role and influence of N. Bohr [17] in the unification of the resolution problem in classical physics [4] (Rayleigh ratio [16]), the uncertainty principle of quantum mechanics, and the classical and quantum coherence theory [6, 18] is shown.

The main fundamental physical and information quantities are presented: momentum, angular momentum, Lagrange and Hamilton functions, energy, entropy, eikonal and their role in the creation of modern theories is shown [8-15, 37].

Further unification is associated with the use of L. de Broglie's formula from the thermodynamics of a point [15], which was interpreted as the principle of equality of ordered and disordered information for a closed system [1, 2]. This made it possible to consider all the principles of deterministic and stochastic science from a single point of view [1-5].

Also, on the basis of Rayleigh's principle of observability and the principle of uncertainty [17], the theory of information-physical structures [3] was built, which allowed a deeper understanding of the connection between theoretical physics and information theory.

On the basis of these studies, criteria were developed both for the construction of a more general theory of open systems and generalized the concept of physical vacuum [1].

The role of physical constants in the unification of physical theories and laws is discussed [1, 25, 26]. Thus, the Newtonian gravitational constant is the legalization of the unification of celestial and terrestrial mechanics into a single system, and the speed of light is the unification of electricity, magnetism, and optics into Maxwellian electrodynamics [9, 25, 26, 37].

The systems of Stoney constants (gravitational constant, speed of light in a vacuum, and electron charge) and Planck's constants (gravitational constant, speed of light in a vacuum, and Planck's constant) showed that it is possible to use dimensional analysis and an optimal set of constants to construct physical quantities that have a completely specific physical nature (plankeon in modern

cosmology) [1, 25].

The place of group theory in unification of physical theories are discussed. Short analysis of crystallography groups, including Neumann and Curie principles, is observing [19, 20]. It is shown that the application of the theory of continuous groups and the classification of E. Wigner [21-23] is, on the one hand, an extension of crystallographic groups to various diffeomorphic transformations, and on the other hand, led to the unification and simplification of a number of problems of quantum theory and elementary particle physics. The theory of phenomenological physical structures of Yu. Kulakov is also noted [24].

The problem of creation universal theory of systems, which is beginning by I. Newton [28] and E. von Condillac [29], is discussed. L. von Bertalanffy general theory of systems (theory of open systems) [30] and its development [31-34] are observed. Later, Yu. Klimontovich built the theory of open systems on the basis thermodynamical principle [14]. It is shown that hybrid systems theory, which is an extension of the research of Euclid, Descartes, Newton, and de Condillac, is the most general variant of general systems theory [1-5, 36].

MAIN RESULTS AND DISCUSSIONS

It should be noted that besides the Euclidean-Descartian-Newtonian synthesis program in physics and information theory there are some modifications [1]. In contrast to classical representations that exist in cybernetics and physics, the theory of information and physical structures is the synthesis of physical and information theory. The following problem is practically addressed: is it not possible to construct the theory so that it is based on both informational and physical laws and principles.

Such a program was implemented in the theory of information and physical structures [3], the main element of which is the Rayleigh ratio [17]. We give it in a one-dimensional form [17]:

$$\Delta k_x \cdot \Delta x = \Delta k_y \cdot \Delta y = \Delta k_z \cdot \Delta z = \Delta \omega \cdot \Delta t = 1. \quad (1)$$

Where $\Delta k_x, \Delta x, \Delta k_y, \Delta y, \Delta k_z, \Delta z, \Delta \omega, \Delta t$ – corresponding changes of wave numbers, coordinates, frequency and time.

When multiplying this relation by \hbar (Planck (Dirac) constant) and changing the sign of equality to a sign greater than-equal, then we have [1, 3, 6, 17, 18]

$$\Delta p_x \cdot \Delta x = \Delta p_y \cdot \Delta y = \Delta p_z \cdot \Delta z = \Delta E \cdot \Delta t \leq \hbar. \quad (2 a)$$

$$\Delta p_x \cdot \Delta x = \Delta p_y \cdot \Delta y = \Delta p_z \cdot \Delta z = \Delta E \cdot \Delta t \geq \hbar. \quad (2 b)$$

Where $\Delta p_x, \Delta p_y, \Delta p_z, \Delta E$ – changes of proper components of linear momentum and energy. Equation (2 a) can be represented as a principle of coherence of quantum theory and (2 b) – the uncertainty principle [6].

However, in quantum mechanics, $\hbar/2$ is often written instead of \hbar . This is due to the fact that "half" of uncertainty is attributed to incoherent processes. (the so-called zero states of the quantum vacuum). If we put equal signs in formulas (1) and (2), we will get a mathematical expression of the conditions of classical and quantum coherence [6, 18]. If we change the signs to differentials and use linear differential forms, we will get the theory of information-physical structures [3].

Let us now consider the question of the emergence of fundamental physical and information quantities without which it is impossible to imagine the creation of modern theories. These are momentum, angular momentum, Lagrange and Hamilton functions, energy, action, eikonal and entropy (both physical and information) [8-15, 37]. Momentum is the main dynamic quantity in Newton's laws, angular momentum in celestial mechanics. Lagrange and Hamilton functions, as well as action, are the main quantities of solid theoretical and quantum mechanics. Energy is a universal quantity, which, in addition to physics, is one of the main quantities of chemistry, biology, etc. Entropy is a universal quantity for thermodynamics and especially for information theory. The eikonal is the phase of an electromagnetic wave and is one of the universal quantities of geometric optics. Fermat's principle is easily obtained from it. Also, if we multiply the phase by Planck's constant, we get the action. This formed the basis of the Lagrangian formalism of quantum mechanics [37]. In addition, the phase is the

scattering matrix in quantum theory [37].

Recall that the relation (1) is a condition of observation of a unit wave. In the theory of information-physical structures [3], it is considered as a quantum of change of dimensionless physical measure.

Thus, the relation (2), which is analogous to the Rayleigh ratio (1), can be regarded as a spatial-temporal representation of dimensionless entropy, as well as dimensionless action. They are equivalent according to the de Broglie ratio [15]

$$\frac{S_a}{\hbar} = \frac{S_e}{k_B} = S_g \quad (3)$$

about the equality of ordered and disordered information in closed system. Here S_a is an action, S_e – entropy, \hbar – Planck constant, k_B – Boltzmann constant, S_g – generalized dimensionless measure [1-5]. Therefore, it makes sense to consider dimensionless relations not as elements of dimensionless entropy or action, but as elements of a generalized information [1].

Formula (3) in this interpretation can be viewed as an extension of Brillouin's concept [10] of the synthesis of information theory not only with thermodynamics, but also at least with all of physics.

As shown in [1], with this measure one can generalize the concept of physical vacuum. Indeed, in modern physics, this concept plays a very important role. There are three basic types of vacuum. This is Newtonian ether – a completely elastic environment in which all known physics interactions can be described and described; In electromagnetism (the quantum field theory also), this is a space-time continuum with $\varepsilon = 1$ and $\mu = 1$ (where ε , μ – the relative dielectric and magnetic permeability of the medium).

W. Pauli [1], by the way, considered an electromagnetic vacuum as a kind of ether. The third kind of vacuum is cosmological, which is main in cosmology.

In [1] the view was expressed that an electromagnetic vacuum is mainly a dynamic environment, and Newtonian ether is static.

According to [1] we introduce the concept of vacuum from a polymetric analysis.

Definition 1. A generalized vacuum is the state of a system in which the change of the generalized measure is zero.

Here are examples:

1. Ether of Newton – Mach. The reference system – the absolute and spatial-temporal measure is also absolute, so the change of this measure is zero.
2. Electromagnetic vacuum. Measure is the quantum of action Planck constant h , $\delta h = 0$.
3. The theory of informational-physical structures: the measure is or dimensionless entropy, or action, the vacuum states will be states with $\delta S_e = 0$ and $\delta S_a = 0$.

From the latter, the role of the principle of dynamic equilibrium is very clearly visible: it is the principle of equilibrium between physics and information. Entropic representations and the principle of dynamic equilibrium itself can be summarized as follows (for a generalized measure we denote S_g) [1]:

$$\delta S_g > 0, S_g > 0; \quad (4)$$

$$\delta S_g < 0, S_g < 0; \quad (5)$$

$$\delta S_g = 0, S_g = 0. \quad (6)$$

The relation (4) is nothing more than the action principle, the Carnot principle, the Prigogine-Glensdorff principle, the uncertainty principle, criterion of open systems. The relation (5) is a generalization of the negentropic principle of the theory of information, principles of classic and quantum coherence theories, etc. Expression (6) is the condition for the existence of vacuum: $\delta S_g = 0$ is relative, $S_g = 0$ is absolute.

It should be noted that the trends in the development of theoretical physics in XVII – XVIII centuries, in particular the principle of Fermat and Maupertuis [8], led to the creation of the foundations of the modern theory of systems by E. B. de Condillac [29].

Thus, in the theory of information-physical structures and in this section in terms of laws the most general unification was carried out [3]. Here are some thoughts on the relationship between physics and information theory. Consider a more detailed relationship $S_g = k \cdot x - \omega \cdot t$.

In fact, if $S_g > 0$, that is, $k \cdot x > \omega \cdot t$, then the structure changes, which means that over time the

structural part of the measure increases, that is, it increases its entropy, action, etc. When $S_g < 0$, this means that the structural part of the measure of relatively intense (frequency-time) changes little, so physical processes pass at a different speed than information [1].

As we see at the level of laws, physics and information theory are synthesized and thus, using the example of physics, they showed that any theory is also informative.

In contrast to classical representations that exist in cybernetics and physics, the theory of information and physical structures is the synthesis of physical and information theory [3]. The following problem is practically addressed: is it not possible to construct the theory so that it is based on both informational and physical laws and principles. Such a program was implemented in the theory of information and physical structures [3], the main element of which is the Rayleigh ratio. We give it in a one-dimensional form:

$$\Delta k \cdot \Delta x = \Delta \omega \cdot \Delta t = 1. \quad (1a)$$

Analogously we receive one-dimensional variant of formula (2a).

$$\Delta p_x \cdot \Delta x = \Delta E \cdot \Delta t \geq \hbar. \quad (2c)$$

This is nothing more than a mathematical expression of Bohr's complementarity and the principle of uncertainty.

The main concepts of the theory of information-physical structures are [3]:

- 1) the principle of fundamental harmonic equilibrium;
- 2) the equivalence of all canonical parameters: E – energy; p – linear momentum; k – wave number; x – coordinate; ω – frequency; t – time;
- 3) polymetry, that is, for each physical phenomenon corresponds to its own metric (symmetry, geometry, dimension, etc.).

Definition 1. Information-physical (dynamic) structures will be called mathematical structures (constructive), which are formed and changed under the influence of the change of any of the canonical parameters or group of parameters, or the type of functional dependence (communication) between them [3].

Definition 2. A dynamic structure with pure bonds is called a structure in which [3]

$$kx = N_1, \quad \omega t = N_2 \quad (7)$$

where N_1, N_2 – numbers.

Principle of fundamental harmonic equilibrium [3]: When in the information-physical structure with pure bonds the form of connections does not change (does not change its dimension), the structure is in a state of harmonic equilibrium.

Principle of dynamic equilibrium [3]: A structure is called dynamically equilibrium if

$$k \cdot x - \omega \cdot t = 0 \quad (8)$$

or

$$k \cdot x = \omega \cdot t. \quad (9)$$

Roughly speaking, correlations (7) and (8) are expanded Rayleigh correlation (ratio) [3].

Now we rewrite Rayleigh ratio (1 a) and (2 a):

$$\Delta k \cdot \Delta x = \Delta \omega \cdot \Delta t, \quad (10)$$

$$\Delta p_x \cdot \Delta x = \Delta E \cdot \Delta t. \quad (11)$$

We replace the operator Δ on a differential d . If only the parameter under the differential does not go to zero, then this substitution is mathematically correct. In this case we have [3]

$$dk_x \cdot dx = d\omega \cdot dt, \quad (12)$$

$$dp_x \cdot dx = dE \cdot dt. \quad (13)$$

or equivalent

$$\frac{dx}{dt} = \frac{d\omega}{dk_x} = const, \quad (14)$$

$$\frac{dx}{dt} = \frac{dE}{dp_x} = const. \quad (15)$$

Integrating (14) and (15), with $const = V$ (speed) we have

$$E = p_x V + C_1; \quad x = Vt + C_2; \quad \omega = k_x V + C_3. \quad (16)$$

Where C_1, C_2, C_3 – integration constants. Having put $C_1 = E_0, C_2 = x_0, C_3 = \omega_0$, we have [3]

$$E = p_x V + E_0; x = Vt + x_0; \omega = k_x V + \omega_0. \quad (17)$$

that is nothing else than the law of conservation of energy, the law of inertia and the law of addition of frequencies, and also the law of constant interaction velocity in an isotropic medium (relation (14) and (15)). In an electromagnetic environment, this will be the speed of light c . If in the first case, replace V on c , and E_0 on $m_0 c^2$, where m_0 – the initial mass of the moving body, then we have [3]

$$E = p_x V \pm m_0 c^2. \quad (18)$$

that is, the law of conservation of energy in an isotropic electromagnetic environment.

Further, the expansion of the relation (8) is carried out through the harmonic potential [3]

$$\varphi = \varphi_0 \exp\{i(kx - \omega t)\}. \quad (19)$$

As shown in [3], is nothing more than a dimensionless entropy; for large values of parameters it becomes equal to Boltzmann or Shannon (in more detail it is disassembled in [3] entropy, that is

$$S_e = kx - \omega t. \quad (20)$$

We can change S_e on δS_e , then we have for $\delta S_e = kx - \omega t > 0$ the law of increasing the entropy, and for $\delta S_e = kx - \omega t < 0$ the negentropic principle of information theory [3].

It should be noted that cybernetics is also a synthetic science [33], which, in addition to physics and information theory, includes a number of other sciences. In general, it should be an open system. Therefore, the theory of information-physical structures removes part of the problems in creating a more universal theory – polymetric analysis (a universal theory of analysis and synthesis of any knowledge system) [1].

However, $kx - \omega t$ and $px - Et$ is also a wave phase and entropy can be replaced by action. In particular, this was reflected in the construction of the Lagrangian formalism of quantum mechanics [37]. As we see at the level of laws, physics and information theory are synthesized.

Now we represented some problems of fundamental constants and here influence on synthesis in modern theoretical physics according [1, 25, 26].

First is gravitational constant G allowed to unite of earth and celestial mechanics. Second, light speed in vacuum c , allowed to unite electromagnetism and optics. Third, electron charge e , is the minimal charge of classic electrodynamics. Four, Planck constant h , minimal value of action, is basic in quantum physics.

J. Stoney to construct such a system in 1874 [25]. He selected the following constants: the Newtonian gravitational constant, the speed of light and the electron charge. Based on considerations of dimension, he received the length l_s , time t_s and mass m_s .

$$l_s = \left(\frac{Ge^2}{c^4}\right)^{1/2} \sim 10^{-35} \text{ cm}, \quad (21)$$

$$t_s = \left(\frac{Ge^2}{c^6}\right)^{1/2} \sim 3 \cdot 10^{-46} \text{ s}, \quad (22)$$

$$m_s = \left(\frac{e^2}{G}\right)^{1/2} \sim 10^{-7} \text{ gm}. \quad (23)$$

Some years later, in 1906, and apparently not knowing to Johnstone Stoney's work, Planck also considered the question of “natural units” [25]. He chose the velocity of light and Newtonian gravitational constant like his predecessor and but his third chose was the newly introduced quantum of action, h , which we now call Planck's constant [25]. The Planck's units there

$$l_p = \left(\frac{G\hbar}{c^3}\right)^{1/2} \sim 10^{-33} \text{ cm}, \quad (24)$$

$$t_p = \left(\frac{G\hbar}{c^5}\right)^{1/2} \sim 5 \cdot 10^{-44} \text{ s}, \quad (25)$$

$$m_p = \left(\frac{c\hbar}{G}\right)^{1/2} \sim 10^{-5} \text{ gm}. \quad (26)$$

Where $\hbar = h/2\pi$.

Planck units were used for the modeling “gravitational” vacuum” (plankeon) [25, 26].

The beginning of the application of group theory in physics is the creation of crystallographic groups [19, 20]. As is known, there are 32 point symmetry groups and 230 spatial symmetry groups [19, 20]. The connection with the physical properties of the medium is given by the principles (theorems)

of Neumann and Curie [19].

Neumann's principle (1885) [19] states that a physical property of a crystal may have a higher symmetry than the crystal, but it must necessarily include the symmetry of the point group of the crystal ^[1]. The meaning of Neumann's principle is that a symmetry transformation inherent in a crystal cannot change its physical properties. The term Neumann's principle belongs to Voldemar Vogt [19]. Neumann's principle can be considered as a consequence of Curie's principle [19], although it was established earlier and played an important role in the development of crystal physics [19, 20].

Curie's principle (principle of superposition of symmetry groups) is a physical principle that states: the symmetry group of two (or many) objects, considered as a single whole, is a common higher subgroup of the symmetry groups of these objects, which is determined taking into account the mutual arrangement of their symmetry elements [19].

This principle, which is quite obvious for geometric shapes, was extended by P. Curie to physical phenomena and was called the Curie symmetry principle [19, 20].

For geometric figures, the Curie principle can be formulated much more simply-when combining two or many different figures into one figure, this combined figure will have only those symmetry elements that are common to both or several figures, taking into account their mutual coincidence in space [19, 20].

When describing physical phenomena, the Curie symmetry principle mainly concerns the lowering of the symmetry of the medium under the action of a field with a certain symmetry [19, 20]. In this case, the symmetry of the action (field quantity) is attributed to the symmetry of the mathematical quantity that describes this action (scalar-e.g. hydrostatic pressure, pseudoscalar-e.g. dissolution of chiral molecules in an isotropic liquid, vector-e.g. electric field strength, axial vector-e.g. magnetic field strength, polar or axial tensor-e.g. mechanical stress or mechanical torsion, respectively). That is, when a field with a certain symmetry acts on the medium, the symmetry of the medium will decrease to one that will contain only common elements of symmetry of the medium and the field.

In crystal physics, the Curie principle, according to which all symmetry elements of a crystal are at the same time symmetry elements of any of its physical properties, is a generalization of the Neumann principle [19], which adds to the formulation of the Neumann principle a mention of the symmetries of influence together with the symmetry of the crystal point group and the symmetry of its physical properties, which are referred to in the Neumann principle: the symmetry group of the physical properties of a crystal G_{prop} includes the crystal symmetry point group $G_{crystal}$, i.e., the latter is a subgroup of the first [19, 20]

$$G_{prop} \subseteq G_{crystal} \dots (27)$$

In other words, the symmetry group of the tensors characterizing the physical properties of a crystal either coincides with the crystal symmetry group or is wider than it. Additional symmetry elements can arise for various reasons, for example, as a consequence of the crystal shape. Under external influence, a crystal changes its point symmetry in such a way that it retains only the symmetry elements common to the symmetry elements of the influence. If the original symmetry group of the crystal is a subgroup of the symmetry group of the influence, then the symmetry of the crystal does not change under this influence [19, 20].

The Neumann principle connects the symmetry of the properties of the crystal with the symmetry of the crystal itself before the influence, while the Curie principle allows you to determine the symmetry of the crystal after the influence. For example, thermal expansion of a crystal (the influence of a scalar - temperature) can lead to a change in the angles between the faces of the crystal, but cannot lead to a change in its symmetry (if there are no phase transitions). When the symmetry of the crystal changes under anisotropic influence, the Curie principle allows you to immediately find this changed symmetry, and therefore the corresponding changes in the symmetry of the physical properties [19, 20].

This principle may be illustrated by considering the optical indicatrix of a crystal, which is an ellipsoid. If the medium is invariant with respect to a three-fold, a four-fold or a six-fold rotation (as in a trigonal, tetragonal or hexagonal crystal, for instance), its optical indicatrix must also be invariant with respect to the same operation, according to Neumann's principle. As an ellipsoid can only be ordinary or of revolution, the indicatrix of a trigonal, tetragonal or hexagonal crystal is necessarily an ellipsoid of revolution. These crystals are said to be uniaxial. In a cubic crystal, which has four three-fold axes, the indicatrix must have several axes of revolution. It is therefore a sphere, and cubic media behave as

isotropic media for properties represented by a tensor of rank 2 [19, 20].

It should be remembered that, imposing prohibitions on certain effects, the Curie principle does not at all assert that effects that do not contradict it really exist. Yes, it prohibits crystals with a center of symmetry from exhibiting piezoelectric properties, but it does not at all follow from it that non-centrosymmetric crystals necessarily exhibit such properties [19, 20].

Later, the crystallographic group approach was extended to continuous groups (Lie groups) ^[3]. The merit in this is E. P. Wigner. He started with a solid, and in 1938 used this theory in quantum mechanics [21-23]. Now this theory is widely used both in condensed matter physics and in elementary particle physics. Roughly speaking, Wigner's approach is an extension of the crystallographic approach to continuous groups [21-23]. Now it is difficult to imagine modern physics without symmetry breaking.

Group theory plays an important role in quantum field theory, in particular for describing symmetries and their consequences. It allows us to classify particles and their interactions, as well as to study the properties of physical systems that remain unchanged under certain transformations [21-23].

In general, Group Theory studies mathematical structures that describe symmetries. In quantum field theory, these symmetries are related to physical conservation laws, such as the conservation of energy, momentum, and charge [21-23].

Particles and fields in quantum field theory are typically described by representations of certain groups. These representations determine how these objects change under symmetry transformations [21-23].

The most important groups in quantum field theory are continuous Lie groups, such as the Lorentz group (which describes the symmetries of space- time) and internal symmetries (e.g., SU(3) in quantum chromodynamics) [21-23].

The presence of symmetries leads to certain consequences, for example, the appearance of new particles or the simplification of calculations [21-23].

Group theory is used to classify particles, determine conservation laws, study the properties of interactions, and simplify calculations in quantum field theory ^[3].

In addition to the Lorentz and Poincaré groups, there are internal symmetries that describe symmetries that do not depend on space-time coordinates, such as isospin symmetry or color symmetry in quantum chromodynamics. These symmetries are related to the existence of certain quantum numbers and interactions [21-23].

In general, group theory is a powerful tool for constructing and analyzing quantum field theories. It allows us to systematically classify and understand the diversity of particles and their interactions, as well as to develop new physical models [21-23].

The connection of the integrals of motion with the integral of action is established by Noether's theorems [8, 37]. Thanks to them it is possible to establish which integrals of motion correspond to which symmetry (group). This theorem plays an important role in quantum physics and in theories of everything.

The group-theoretical approach is also the basis of Yu. Kulakov's theory of phenomenological structures [24].

Let us now dwell on the systemic aspects of synthesis and unification in the creation of new theories [1, 2, 5, 28-36].

The forerunner of modern systems theory should be considered Newton, it was with his System of the World, the third part of his Mathematical Principles of Natural Philosophy [28], that the modern system theory was initiated. At the basis of his System of the World, he laid the four rules of inference in physics, which is nothing more than the application of the four rules of the Descartes method [35] to create the first applied mathematical discipline (classical mechanics).

Thus, Newton completed the method of obtaining exact knowledge (mathematics) from other branches of knowledge, in other words, he completed at a systemic level what Euclid (axiomatic method) and Descartes (method of creating this axiomatization) had begun [1].

First concept and theory of systems was created by de Condillac [29]. He was determined the notion of system [29]: "Any system is nothing but the arrangement of various parts of some art or science in a certain order, in which they mutually support each other and in which the last parts are explained first. Parts containing explanations of other parts are called principles, and the system is the more perfect, the fewer the number of its principles; it is even desirable that their number be reduced to one." He selected three types of principles. First principles are general or abstract maxims. Second type is suppositions put forward to explain things for which reasons cannot be given. Third type is abstract concepts that are necessary to bring order to our knowledge, as they indicate to each idea its place. Roughly speaking it must be principles of metascience or theory of everything [1, 29]. Moreover, today it is one of the most general self-sufficient systems theories.

Let us now note the general systems theory (GST) by L. von Bertalanffy [30]. GST is an interdisciplinary concept developed in the 1940s that studies the fundamental principles, laws, and models common to systems of any nature (biological, technical, social). The main goal is to unify sciences by identifying isomorphisms (structural analogies). Bertalanffy emphasized that living organisms are "open systems" that constantly exchange matter and energy with their environment, unlike closed physical systems. The scientist shifted the emphasis from the study of individual parts (mechanism) to the integrity, interaction of elements, and organization of the system. The existence of identical models (isomorphisms) in different scientific disciplines allows the use of common systemic methods to describe biology, psychology, sociology, and technology. The existence of identical models (isomorphisms) in different scientific disciplines allows the use of common systemic methods to describe biology, psychology, sociology, and technology. The ability of a system to reach the same final state from different initial conditions and by different paths, which is characteristic of open living systems. Bertalanffy developed this theory as a response to the need to unify knowledge, as classical physics could not fully describe complex living and social organisms [30].

The physical theory of open systems by Yu. L. Klimontovich [14] is a fundamental approach in statistical physics that describes self-organization and processes in systems exchanging energy and matter with the environment. It extends the thermodynamics of non-equilibrium processes, based on the analysis of nonlinear dynamics, chaos, and dissipative structures, where ordering arises due to non-equilibrium. The basic principle of this theory is the generalized second law of thermodynamics

$$\delta S_e > 0 \quad (28)$$

where S_e is Krasovsky functional or Kullback entropy [14].

Various aspects of open systems theories are discussed in [31-34].

In modern science, more attention is paid to the study of closed hierarchical systems [30-34].

It should be noted that from a systemic point of view, G. Haken's synergetics should also be included in the theories of open systems [38].

A more general theory of systems is hybrid systems theory, a component of polymetric analysis [1, 2, 5, 36]. This theory is a more detailed deductive extension of the works of Euclid, Descartes, Newton, and de Condillac to modern science, taking into account its development in the past, present, and future. This theory of systems is created for information lattices (multifunctional matrices) and, roughly speaking is optimal system formalization N. R. Campbell concept of fundamental and derived measurements [27]. The main principles of this theory are the criteria of reciprocity and simplicity, as well as the introduced parameter of connectedness between the elements of the information lattice. The basis of these criteria is the concept of completeness of the corresponding type of lattice and the principle of optimal information calculations. It was shown that any formalized structure can be reduced to one of the types of information lattices. It was established that there are 10 minimal types of knowledge formalization, taking into account 15 types of generalized mathematical transformations 150, the number of real systems can be arbitrarily large. Since the principle of optimal information calculations is a generalization of the most basic principles of physics and information theory, this theory can also be used to obtain and process information. Hybrid systems theory is a theory of systems with a variable hierarchy and a theory of open systems. The parameters of openness here are the types of generalized mathematical transformations and the connectivity parameter. This theory can be an expert system for determining the complexity of a particular problem. In addition, it can be used to predict the feasibility of creating new knowledge systems and developing existing knowledge systems. It is easy to see that

hybrid systems theory can be considered as an optimal extended version of the formalization of the mysterious system theory of L. von Bertalanffy.

CONCLUSIONS

1. The problem of unification Rayleigh resolution principle, uncertainty principle and classical and quantum coherent theories is observed.
2. The problem of physical and informative quantities and its place in modern science is discussing.
3. The question about using de Broglie ratio for the unification main variation principles of physics and information theory is resolved.
4. The problem of unification a concept of physical and information vacuum is researched
5. The theory of informational and physical structures is analyzed.
6. The questions about applications group theory for unifications physical and information laws and theories are discussing.
7. Short analysis the system theories and its role in the synthesis of science is made.
8. It was showing that the most general theory that can solve the problems of synthesizing different branches of knowledge is the hybrid systems theory.

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