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Main problems of unification the basic laws of physics and information theory

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Abstract
The main 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 evolution main universal physical laws from optical Ferma principle to action principle in their historical retrospective is resarched. The main thermodynamical principles as Carno theorem, Prigogine-Glensdorf principle are reresented. 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. Information theory is analyzed on the basis of its universal principle - Shannon's theorem. The connection between physics and information theory is shown. For this, the theory of information-physical structures was used. 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, including verbal and non-verbal knowledge systems, are analyzed and discussed. The idea of the possibility of creating a unified system of knowledge is also expressed.

Keywords: Unification, de Broglie, Rayleygh, uncertainty principle, physics, information theory

Introduction

The problem of unifying the laws of physics and information theory is closely related to the development of theoretical and mathematical physics [1-3]. Short analysis of universal physical and infoemative quantities (action [4, 5], entropy [6-8], negentropy [7]) is represented. It was in physics that the first universal laws were formulated: Fermat's principle (eiconal theory) [4], action principle of least action [4, 5], the second law of thermodynamics [2, 3, 6].

In his research, C. Shannon derived a quantity that had the same properties as entropy, and on the recommendation of J. von Neumann, he named it entropy (information entropy), and the law itself was named information entropy [8]. At the same time, a similar law was formulated in non-equilibrium thermodynamics, which was named the Prigozhin-Glensdorff principle [9, 10]. Later, Yu. Klimontovich built the theory of open systems on the basis of this principle [11].

Further unification is associated with the use of L. de Broglie's formula from the thermodynamics of a point [12], which was interpreted as the principle of equality of ordered and disordered information for a closed system [1]. This made it possible to consider all the principles of deterministic and stochastic science from a single point of view [1].

Also, on the basis of Rayleigh's principle of observability [13] in N. Bohr modification [14] and the principle of uncertainty [14], the theory of information-physical structures [3] was built, which allowed a deeper understanding of the connection between theoretical physics and information theory. This concept is connected with coherence theory [15].

On the basis of these studies, criteria were developed both for the construction of a more general theory of open systems and for the characterization of such phenomena as the vacuum [1, 2].

The place of symmetry in unification of physical theories (E. Vigner [16, 17] and Yu. Kulakov [18]) are discussed.

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 [19, 20].

Main results and Discussions

The problem of unification of the basic laws of physics and information theory has quite deep roots. It can be started with the saying of Archimedes "Give me points of support, and I will turn the whole world upside down." In this case, concepts, principles and theories should be chosen as points of support, which allow to describe as much as possible phenomena and processes from a single point of view. A historical comparative analysis of such concepts and theories is given in [1]. In this paper, we will analyze only physical and informational theories.

We will analyze the formation of universal laws of physics and information theory based on the works of P. Fermat, R. Descartes, P. Maupertuis, J. Lagrange, V. Hamilton, S. Carnot, R. Clausius, Rayleigh, V. Heisenberg, N. Bohr, L. de Broglie, I. Prigozhin and K. Shannon [4-14].

Let's consider in more detail the formation of optimal principles of physical theory. Before moving on to action, we should recall Fermat's principles and Descartes' derivation of the law of refraction of light [21]. Fermat's principle of least time, is the link between ray optics and wave optics. Fermat's principle states that the path taken by a ray between two given points is the path that can be traveled in the least time. It was proposed by the French mathematician Pierre de Fermat in 1662 for the explanation of the ordinary law of refraction of light [4, 5].

It should be noted that these studies were carried out thanks to R. Descartes. It was in a dispute with Descartes about the propagation of light in different environments that P. Fermat formulated his principle [21]. The law of refraction of light was formulated by Snell on the basis of experimental data and was theoretically deduced by Descartes [21]. It was Descartes who concluded from this law that the speed of light is a finite quantity. Roughly speaking, Fermat's principle was one of the most interesting dynamic optimal principles in physics.

The problem of creating the principles of optimality is closely related to the brachistochrone problem. It consists in the fact that it is necessary to find the shape of the curve along which the body should move when moving from an arbitrary upper position to an arbitrary lower one, if only the force of gravity acts on it. This task was formulated by B. Pascal in a letter to K. Huygens [1]. It was solved in quadratures by Descartes, who also obtained the equation of the cycloid [21]. In 1696, Bernoulli proposed to solve this problem by the methods of integro-differential calculus [4]. It was correctly solved by I. Newton, V. Leibniz and I. Bernoulli himself. This was the beginning of calculus of variations and the theory of optimal processes [4].

The further development of the creation of universal principles of nature is related to mechanics and action. The first studies were initiated by P. Maupertuis. It was he who established the universality of action and formulated the principle of least action. To build his principle, he used the ideas that were used in the construction of Fermat's principle.

In its modern form, this action S_{aM} is written in the following form [5]

$$S_{aM} = \int \vec{p} d\vec{l}, \qquad (1)$$

Where p is linear momentum, $\vec{l}$ – geometrical coordinate. This action S_{aM} also called kinematic action. Action principle for S_{aM} has next form

$$\delta S_{aM} = \delta \int \vec{p} \cdot d\vec{l} = 0. \qquad (2)$$

In modern physics, the action introduced by J. Lagrange S_{aL} is more widely used

$$S_{aL} = \int L dt, \qquad (3)$$

Where

$$L = T - U \qquad (4)$$

is Lagrangian function, $T -$ kinetic energy, $U -$ potential energy, $t -$ time.

Action principle for S_{aL} has next form

$$\delta S_{aL} = 0. \qquad (5)$$

Strictly speaking, the integrals for the action must be determined and the action calculated for the transition of the system from some initial state to the selected final one.

In geometric optics, eikonal ψ (wave phase) is used instead of action. Then, instead of the principle of least action in the form of Maupertuis, we will get Fermat's principle after replacing the momentum vector with a wave vector [5].

$$\delta \psi = \delta \int \vec{k} \cdot d\vec{l} = 0. \qquad (6)$$

Where $\vec{k}$ is wave vector.

In vacuum, $\vec{k} = \frac{\omega}{c}\vec{n}$, and we have $d\vec{l} \cdot \vec{n} = dl.$

Where ω is frequency of wave, c – light velocity in vacuum. Therefore, we have

$$\delta \int dl = 0, \qquad (7)$$

Principle of rectilinear propagation of the rays [5].

A universal function in both physics and information theory is entropy, which was introduced by R. Clausius for reversible Carnot cycles [7]. This function has the form

$$S_e = \int \frac{d'Q}{T}, \qquad (8)$$

Where Q is amount of heat, $T -$ temperature.

Or

$$dS_e = \frac{d'Q}{T} = 0. \qquad (8a)$$

At the same time, entropy is a complete differential from the corresponding thermodynamic parameters, and the amount of heat is not. Therefore entropy has morrre universal nature.
The relationship between entropy and the probability of the system being in the appropriate thermodynamic state is given by the Boltzmann formula [7]. If we change the thermodynamic states to some other information states, we get the Shannon entropy of the information theory [8].
Let us now turn to the Rayleigh observability principle [13, 14] and its extension to the uncertainty principle of quantum mechanics [14]. This principle provides a condition for observing two waves, when they can be distinguished, and seen as a single entity.
In the theory of optical instruments the well-known Rayleigh formulas [13]. N. Bohr modification of these formulas [14] were used for the creation theory of informative-physical structures [3].
We give it in next form:

$$\Delta k_x \cdot \Delta x = \Delta k_y \cdot \Delta y = \Delta k_z \cdot \Delta z = \Delta\omega \cdot \Delta t = 1. \quad (9)$$

Where Δk_x, Δx, Δk_y, Δy, Δk_z, Δz, $\Delta\omega, \cdot \Delta t$ – 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 [14].

$$\Delta p_x \cdot \Delta x = \Delta p_y \cdot \Delta y = \Delta p_z \cdot \Delta z = \Delta E \cdot \Delta t \geq \hbar. \quad (10)$$

Where Δp_x, Δp_y, Δp_z – corresponding changes of liner momentum coordinates.
Roughly speaking, it is nothing more than a mathematical form of the principle of complementarity and of the uncertainty principle.
But 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 (9) and (10), we will get a mathematical expression of the conditions of classical and quantum coherence [15]. Thus, in the quantum theory of coherence, it is proved that in the coherent state, the incoherent part of the energy is equal to the minimum possible value $\hbar\omega/2$, that is, the energy of the vacuum fluctuations of the field [15].
If we change the signs to differentials and use linear differential forms, we will get the theory of information-physical structures [3].
Recall that the relation (9) is a condition of observation of a unit wave. In the theory of information-physical structures, it is considered as a quantum of change of dimensionless physical measure.
Let's dwell in detail on the de Broglie approach. The doctrine of matter, which is consistent with the concept of the field, is very difficult to reconcile with the old Newtonian inert space. Therefore, the de Broglie's double-decomposition theory (in order to justify the principle of interference) must allow the existence of an ether, which is a certain equivalent environment. It is considered as a giant energy reservoir in a chaotic excitation, in which particles of a quantum level constantly fluctuate [12].
To understand the behavior of this medium, where Broglie created thermodynamics of an isolated particle [12]. This approach is correct in the following case. When the particle is "isolated", that is, it is located far from any other observed particle, it interacts with the "hidden" medium that is in a chaotic excitation, thereby introducing chaos, similar to the molecular chaos of L. Boltzman. Then it is natural to assume that any particle will always be subject to new thermodynamics, which is due to the statistical laws of this chaos, and values such as temperature, heat or entropy will have a corresponding meaning at this level.
The main task is to understand the meaning that these values will have in wave mechanics and to associate them with the fundamental parameters of atomic level particles, such as mass, frequency or wavelength.
It was on the basis of these considerations that de Broglie received the formula

$$mc^2 = h\nu. \quad (11)$$

It has been found that there are relations between action and cyclic frequency on the one hand and entropy and temperature on the other hand and these can be given in the form of the following formulas

$$h\nu_c = kT, \quad (12a)$$

$$S/h = S_e/k_B, \quad (12b)$$

Where k_B – Boltzmann constant.
We now present a brief analysis of the synthesis of information theory and thermodynamics, which was proposed by L. Brillouin [6].
To do this, we need to consider the negentropic principle of information in more detail. There are two types of information:

1. Free information I_f, which arises when possible cases are considered abstract and as not having a specific physical meaning;
2. Coupled information I_b, which arises when possible cases can be presented as microscopes of the physical system. Thus, the linked information is a partial case from the free one.

The basis for entering this conception is that we are going to discuss the connection between information and entropy (and its opposite – negentropy), and we will use the term "negentropy" only in the generally accepted thermodynamic sense. Thus, only the information that arises in certain physical tasks, that is, the information given will be provided with entropy.
To establish a connection between bound information and entropy we consider probabilistic cases as microstations (Table 1) [6].

Table 1: Link coupled information and entropy [6]

Related information	Statistical weight	Entropy
Initial position $I_{b0}=0$	P_0	$S_{e0}=k_B \cdot \ln P_0$
The final position $I_{b1} \neq 0$	$P_1 < P_0$	$S_{e1}=k_B \cdot \ln P_1$

It is obvious that in this scheme the system is not isolated: the entropy decreases with the receipt of information, and this information must be delivered by an external agent whose entropy will increase. The connection between the decrease in entropy and the required information is obvious:

$$I_{b_1} = k_B \cdot (\ln P - \ln P_0) = S_{e0} - S_{e1}, \quad (13)$$

or

$$S_{e1} = S_{e0} - I_{b_1}. \quad (14)$$

Thus, the related information is the negative part of the entropy of the physical system, and therefore the following relations are valid

Related information = decrease in entropy S_e = increase in negentropy N, (15)

Where negentropy is defined as negative entropy.
This provision is a complementary law for information and allows us to connect entropy and information more clearly. In it was shown how information turns into negentropy and vice versa. We will show how information can be transformed into negentropy and vice versa [6].
For free information, it makes no sense to talk about the relationship between information and entropy. Let us now consider the generalization of Carnot's principle [6]. When we single out a system, then with any of its further evolution

$$\Delta S_{e1} \geq 0;\ \Delta(S_{e1} - I_{b1}) \geq 0. \quad (16)$$

In this case, entropy can increase due to both its components (S_{e0} and I_{b1}) or any of them. When a system is isolated and left to itself, it naturally moves to the most likely thermodynamic state of the medium.
Consider the case of constant S_0, and there is no need to redefine I_{b1}. Then formula (8) takes the form

$$\Delta I_{b1} \geq 0, \quad (16a)$$

$$N = -S;\ \Delta N_1 \leq 0;\ \Delta(N_0 + I_{b1}) \leq 0, \quad (17)$$

If $\Delta I_{b1} \leq 0$, when the initial state is undefined. Using negentropy, we obtain the Kelvin energy degradation principle (17).
The equality holds for reversible processes, while irreversible processes are described by inequalities. The case $\Delta I_{b1} \leq 0$ corresponds to the previously obtained result regarding free information

$$\Delta I_f \leq 0. \quad (18)$$

Based on the formulas (17) and (18) we can summarize the relationship between thermodynamics and information theory according to L. Brillouin [6]:

negentropy N corresponds to information I;
temperature T means thermal noise that
violates the transfer of information; (19)
energy retains its normal meaning;

$\Delta Q = T \cdot \Delta S$ is the heat that is involved in some process;
$\Delta W = T \cdot \Delta N = T \cdot \Delta I$ corresponds to the mechanical work
that can be performed. (19a)

As we see, L. Brillouin gave a perfect connection between thermodynamics and information theory.
It should be noted that any theory is informative, this also applies to physical theories. Therefore, it is quite clear that one way or another the basic laws of physics must also include informational laws. However, today we have practically only two general information laws: Shannon's theorem [8] and the negentropic principle of information [6].
The formula (10), which is simple to the Rayleygh ratio, can be regarded as a spatial-temporal representation of dimensionless entropy, as well as dimensionless action. They are equivalent to the de Broglie ratio [12].

$$\frac{S_a}{\hbar} = \frac{S_e}{k_B} = S_g \quad (20)$$

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 [1]. We denote this universal dimensionless quantity as S_g.
It is also appropriate to introduce the concept of vacuum in this formalism [1, 2]).
Definition 1. A generalized vacuum is the state of a system in which the change of the generalized measure is zero.
It was shown that this definition describes the main types of physical vacuums: Newton-Mach ether, electromagnetic vacuum and massive gravitational cosmological) vacuum [1, 3].
In 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 $\delta S_a = 0$.
Using a generalized measure, we can compactly write down the basic physical and informational principles in a more compact form (for a generalized measure we denote S_g):

$$\delta S_g > 0;\ S_g > 0; \quad (21)$$

$$\delta S_g < 0;\ S_g < 0; \quad (22)$$

$$\delta S_g = 0;\ S_g = 0. \quad (23)$$

The relation (21) is nothing more than the action principle, the Carnot principle [7], the Prigogine-Glensdorff principle [9, 10], the uncertainty principle [1], criterion of open systems [11].
It should be noted that Yu. Klimontovich's theory of open systems [11] is based on simple criteria. Where is the Krasovsky functional or the Kullback entropy.

$$\delta S_e > 0. \quad (21a)$$

When passing to a dimensionless quantity, we have a more general theory. In addition, we can go to the function or functionality of the action [1].

$$\delta S_a > 0, \quad (21b)$$

Which significantly expands this concept to ordered information (processes).The relation (22) is a generalization of the negentropic principle of the theory of information [6], principles of classic and quantum coherence theories [15], etc. Expression (23) is the condition for the existence of vacuum: $\delta S_g = 0$ is relative, $S_g = 0$ is absolute [1, 2].
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 [4], led to the creation of the foundations of the modern theory of systems by E. B. de Condillac [22]. According to Condillac, a system is a set of connected elements, some of which are called elements, and

others are system principles. The number of principles should be minimal, and it is best if there is one system principle [22].
At the same time, a number of laws of classical physics were obtained from a single point of view in the theory of information-physical structures.
Let's consider this in more detail. The generalized measure can be written as follows

$$S_g = k \cdot x - \omega \cdot t.$$

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 [1-3].
In contrast to the classical ideas that exist in cybernetics and physics, the theory of information-physical structures is a synthesis of physical and information theoryx3ï. Practically, the following problem is solved: whether it is possible to build a theory so that it is based on both informational and physical laws and principles. A variant of such implementation is this theory, the main element of which is Rayleigh's formula (9) modified by N. Bohr. We present it in one-dimensional form:

$$\Delta k \cdot \Delta x = \Delta \omega \cdot \Delta t = 1. \quad (9a)$$

Analogously we receive one-dimensional variant of formula (10).

$$\Delta p_x \cdot \Delta x = \Delta E \cdot \Delta t \geq \hbar. \quad (10a)$$

Roughly speaking, these formulas are 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:

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 2: Information-physical (dynamic) structures are called mathematical structures (constructive), which are formed and change under the influence of a change in any of the canonical parameters or a group of parameters, or the type of functional dependence (connection) between them.

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

$$k \cdot x = N_1, \ \omega \cdot t = N_2, \quad (24)$$

Where N_1, N_2 – numbers.
Main principles of theory of informative-physical structures are next [34].

Principle of fundamental harmonic equilibrium: 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: A structure is called dynamically equilibrium if

$$k \cdot x - \omega \cdot t = 0 \quad (25)$$

or

$$k \cdot x = \omega \cdot t. \quad (26)$$

Roughly speaking, correlations (24) and (25) are expanded modified Rayleygh correlation (ratio).
Now we rewrite modified Rayleygh ratio (9a) and N. Bohr uncertainty principle (10a) [3]:

$$\Delta k \cdot \Delta x = \Delta \omega \cdot \Delta t, \quad (27)$$

$$\Delta p_x \cdot \Delta x = \Delta E \cdot \Delta t. \quad (28)$$

Let's assume that Δ is a finite-difference operator. Let's replace it with the differential d. In this case we have [3].

$$dk \cdot dx = d\omega \cdot dt, \quad (29)$$

$$dp_x \cdot d\,x = dE \cdot dt, \quad (30)$$

or equivalent

$$\frac{dx}{dt} = \frac{d\omega}{dk} = const, \ (31) \quad \frac{dx}{dt} = \frac{dE}{dp_x} = const. \quad (32)$$

Integrating (31) and (32), with $const = V$ (speed) we have

$$E = p_x V + C_1; \ x = Vt + C_2; \ \omega = kV + C_3; \quad (33)$$

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

$$E = p_x V + E_0; \ x = Vt + x_0; \ \omega = kV + \omega_0; \quad (34)$$

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 (31) and (32). 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

$$E = p_x V \pm m_0 c^2, \quad (35)$$

That is, the law of conservation of energy in an isotropic electromagnetic environment.
Further, the expansion of the relation (22) is carried out through the harmonic potential [3].

$$\varphi = \varphi_0 exp\{i(kx - \omega t)\}. \quad (36)$$

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

$$S_e = kx - \omega t. \quad (37)$$

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 negetntropic principle of information theory.

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.

It should be noted that cybernetics is also a synthetic science [23], 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, 2].

But $kx - \omega t$ 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 [24].

It should be noted that the phase plays an important role in quantum mechanics as well. These are the theory of scattering, unitary (canonical, point) transformations and the Lagrangian formalism of quantum mechanics. Let us dwell on the Lagrangian formalism, the idea of which was proposed by P. Dirac, and its full implementation was carried out by R. Feynman, Y. Schwinger, and S. Tomonaga. The relationship between the Hamiltonian function $H = E$ (total energy) and the Lagrange function L is given by the Legendre transformation. For the one-dimensional case, this can be written as follows

$$L = pv - E. \quad (38)$$

Where v is speed?

The action function is related to the Lagrange function as follows

$$S = \int_{t_0}^{t} L dt = \int_{t_0}^{t} (pv - E) dt = \int (pdx - Edt). \quad (39)$$

In the Lagrangian formalism of quantum mechanics, the action is included in the exponent of the propagator or Green's function [24]. In real calculations of propagators and Green's functions, the Lagrange function is written as the difference between kinetic and potential energy.

We see the similarity of expressions (30) and (39).

As we see at the level of laws, physics and information theory are synthesized.

The problem of the unification of physical theories and laws also includes the results of Yevgeny Wigner on the application, along with crystallographic groups, of Lie groups in theoretical physics, including the physics of high energies and elementary particles [16, 17]. Yuriy Kulakov's research will complement these results by building a theory of phenomenological symmetries, in other words, for the phenomenological laws of physics (Newton's laws, Ohm's law, Faraday's law, etc.) [18].

Physical constants play a significant role in the unification of physical laws [19, 20]. 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.

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 (plankion in modern cosmology) [19, 20].

Among other concepts of the unification of physics and information theory, the analogy between nonlinear optical phenomena and phase transitions of the second kind proposed by H. Haken [25] should be highlighted: nonlinear optical phenomena can be considered as non-equilibrium phase transitions. Later, in Relaxed Optics, this was extended to phase transitions of the first order [1]. In contrast to nonlinear optics, it is more appropriate to use physicochemical models in Relaxed Optics [1]. Physical-chemical approaches make it possible to unify nonlinear optical phenomena themselves [1].

Conclusion

1. The problem of unification physical and information laws is researched.
2. Short analysis of universal physical and informative concepts and its relationship is represented.
3. The influence of these studies on the further unification of the laws of physics and information theory is shown.
4. The theory of informational and physical structures is analyzed.
5. The influence of symmetry and physical constants on the creation of universal theories is shown.
6. Some questions about the perspectives for the development of this direction of research are discussed.

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