The Theory of Infinite Hierarchical Nesting of Matter as the Source of New Ideas

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Abstract

With the help of the theory of infinite hierarchical nesting of matter the need for change in the theoretical foundations of the scientific world outlook is derived – in the philosophy; in the logic of thinking; in cosmology; in interrelation of matter levels; in the theory of gravitation; in the analysis of the mass origin; in the theory of relativity; in the theory of elementary particles; in thermodynamics and other fields of knowledge. The possible ways are described of overcoming the difficulties and challenges existing in a number of modern physical theories.

Introduction

Over the past 20 years, both in physics and in philosophy, new results were obtained related to the rapid development of the Theory of Infinite Hierarchical Nesting of Matter. At the present time this theory claims to be the dominant scientific paradigm, affecting the whole science. The logical basis of the theory is syncretics or syncretic logic [1], which summarizes the formal , dialectical and various kinds of multivalued logics. The philosophical basis of the theory is the philosophy of carriers, and carriers are understood as the essence and the fundamental principle of the world. With the help of the logic new philosophical laws for carriers and their systems are formulated. Thus, the system theory is being developed. This makes easier the analysis of connections between the carriers of matter in cosmic systems, from the smallest particles to infinitely large stellar and metagalactic systems.

In physics, the theory in order to describe the structure of the Universe introduces into consideration the similarity of matter levels, including SPΦ symmetry, presents the scale dimension, substantiates the Le Sage's theory of gravitation as the physical mechanism for the emergence of gravitation at all levels of matter and strong gravitation at the level of atoms. Applying the theory of similarity between the stellar and the atomic matter levels makes it possible to construct substantial models of elementary particles, as the alternative to the Standard Model.

Among various predictions of the theory are the existence of new particles (including praons and nuons) as the basis of dark matter; the denial of the Big Bang; the absence of black holes; the concept of quarks as quasiparticles; the concept of the electron spin as a dynamical effect; the complex multicomponent structure of different types of neutrinos.

Infinite Hierarchical Nesting of Matter

In the Theory of Infinite Hierarchical Nesting of Matter all cosmic objects of the Universe can be arranged at separate scale levels [2], [3], [4]. There are basic and intermediate levels of matter. The basic levels include the atomic and stellar-planetary matter levels, between which the intermediate levels are located. The matter levels the objects of which are smaller than the

elementary particles, or larger than the visible Universe, are now inaccessible for research and are studied by theoretical methods.

The coefficients of similarity between the atoms and planetary systems can be conveniently found at the example of the *hydrogen system* [3]. These coefficients, obtained by dividing the corresponding values by each other, are shown in Table 1. For the coefficient of similarity in mass we obtain, for example: $\Phi_0 = \dfrac{M_{ps}}{M_p}$

Table 1. The parameters and similarity coefficients for the hydrogen system

Mass, kg	The radius of the orbit, m	The velocity in the orbit, m/s
Planetary System		
$M_{ps} = 1.11 \cdot 10^{29}$	$R_F = 2.88 \cdot 10^{12}$	$V_p = 1.6 \cdot 10^3$
Hydrogen atom		
$M_p = 1.67 \cdot 10^{-27}$	$R_B = 5.3 \cdot 10^{-11}$	$V_e = 2.19 \cdot 10^6$
The similarity coefficients		
$\Phi_0 = 6.654 \cdot 10^{55}$	$P_0 = 5.437 \cdot 10^{22}$	$S_0 = 7.34 \cdot 10^{-4}$

Between the levels of atoms and main-sequence stars there are 9 intermediate levels of matter, from the level of molecular complexes to the level of low-massive planets.

Table 2 shows the coefficients of similarity between the basic levels of matter for such objects as the proton and the neutron star. The radius of the proton in Table 2 corresponds to the results of the experiments and can be found theoretically in the self-consistent model [5]. The speed of light is considered as the characteristic velocity of the substance inside the proton, since the rest energy of the proton is equal to the absolute value of the total energy.

Table 2. The parameters and similarity coefficients for neutron stars and nucleons

Mass, kg	Radius, m	Characteristic velocity, m/s
The neutron star		
$M_s = 2.7 \cdot 10^{30}$	$R_s = 1.2 \cdot 10^4$	$C_s = 6.8 \cdot 10^7$
Proton		
$M_p = 1.67 \cdot 10^{-27}$	$R_p = 8.7 \cdot 10^{-16}$	$c = 2.99 \cdot 10^8$
The similarity coefficients		
$\Phi = 1.614 \cdot 10^{57}$	$P = 1.379 \cdot 10^{19}$	$S = 2.3 \cdot 10^{-1}$

The coefficients of similarity are an important tool for describing the similarity of matter levels and allow us to compare the properties of objects at different levels of matter. For example we can calculate of the *stellar Planck constant*, characterizing the rotation at the level of stars. Taking as the basis the reduced Planck constant $\hbar$, for the objects of the type of neutron stars, we

find: $\hbar_s = \hbar \Phi P S = 5.4 \cdot 10^{41}$ J·s. Using the coefficients of similarity and other standard physical constants, we can calculate the corresponding *stellar constants* for the level of stars, as well as for the level of matter, the objects of which make up the nucleon substance. Suppose, in particular, that as the neutron star contains $\Phi = 1.614 \cdot 10^{57}$ nucleons, so nucleons contain the same number of particles called "praons" [6]. Then the praon mass equals $M_{pr} = \frac{M_p}{\Phi} = 1.03 \cdot 10^{-84}$ kg and the praon radius equals $R_{pr} = \frac{R_p}{P} = 6.3 \cdot 10^{-35}$ m.

From the scenario of the evolution of the substance particles it follows that at the level of elementary particles the particles must exist, which are similar by their properties to such stars as white dwarfs. In article [7] such particles are called "nuons". The radii of these particles must be within $4 \cdot 10^{-13} - 1.1 \cdot 10^{-12}$ m, and the masses do not exceed the masses of nucleons. According to calculations the share of the nucleon substance in the visible Universe equals 61 % of the total mass, and 39 % of the mass is in the form nuons. Thus, nuons form the basis of dark matter, the action of which is noticeably manifested in galaxies.

Due to their large size relative to nucleons, nuons scatter the electromagnetic waves that pass in the space. This leads to the following. Firstly, the wave energy decreases exponentially with respect to the distance traveled by them, which is expressed as the redshift of the spectra of distant galaxies. Secondly, due to the scattering of photons by nuons the number of the photons reaching the observer on the Earth decreases. As a result, the energy of supernovae outbursts will seem less for the outbursts that occur further from the observer. Thirdly, the interaction of the electromagnetic emission with nuons leads to thermalisation of the emission, its transformation in the emission typical of the black body. This emission has the temperature of 2,725 K and is known as the microwave background radiation. If we assume that these effects are caused by nuons, then there is no need to explain the Hubble law by the Universe expansion and to consider the Big Bang model.

Another objection to the Big Bang model is the inability of appearing in the Theory of Infinite Hierarchical Nesting of Matter of singularities and black holes as objects, absorbing any substance and not giving anything out [3], [8], [9]. The substance density of black holes of stellar masses must exceed the density of nucleons, so nucleons must be crushed by gravitation. However, as it is stated in article [10], the maximum possible gravitational pressure from gravitons of the value $4 \cdot 10^{34}$ Pa is not sufficient, if we take into account the repulsive forces of the nucleons from each other. As a result, the substance can be compressed by gravitation only to the state of neutron stars. Even collisions of elementary particles with nucleons at superhigh energies do not produce black holes. But if black holes and singularities are not possible, then we can not assume according to the Big Bang model that the Universe was formed as a result of the explosion of the singularity, in which the substance was in an extremely dense and hot state.

The logical development of the Theory of Infinite Hierarchical Nesting of Matter was the discovering of the scale dimension [11]. The scale dimension is considered as the fifth dimension of spacetime. In fact, it reveals as a special spatial dimension that allows to determine the location of the object on the scale axis. If the scale axis is directed toward increasing of the size,

then during the motion along the axis the observer will move from one matter level to another and observe larger objects. However, we can introduce such principle of relativity, that the observer and his instruments would change their properties (sizes, masses, characteristic speeds) while moving along a scale axis in order to ensure that the observer could not see during his motion any changes in the surrounding objects. This leads to the SPΦ symmetry [3].

The Theory of Infinite Hierarchical Nesting of Matter is applicable not only to the carriers of matter in physics and chemistry, but is suitable for the carriers of life, for various living creatures and organisms [1], [12]. It turns out that living creatures, from tiny prions to whales, can be located at the same levels of matter, as inanimate objects. All living beings fit into five levels of matter, at the sixth level there are communities of living organisms and biocoenoses. In this case the main difference between the animate and inanimate is supposedly that inside the animate the inner source of order is hidden, which rules the living organism, and apparently this source of order is generated by living beings at the lowest levels of matter.

Gravitation

Despite the fact that general relativity is a generally accepted theory of gravitation, it has a fundamental drawback – it lacks the stress-energy tensor of the gravitational field. As a result, the gravitational field is described indirectly, through the metric tensor and the principle of equivalence. In order to overcome this drawback within the special relativity the Lorentz-invariant theory of gravitation (LITG) was developed, in which the stress-energy tensor of the gravitational field is presented in the explicit form [3], [8], [9]. LITG predicts the existence of the torsion field as the relativistic supplement to the gravitational field. In the general relativity the action of the torsion field is presented as gravitomagnetic force. Due to the torsion field in LITG the effect of gravitational induction was discovered [6]. The next step was the formulation of LITG in the general covariant form suitable for use in curved spacetime. So the covariant theory of gravitation (CTG) appeared.

In contrast to the general relativity, in CTG the theory was divided into three relatively independent parts. One of them describes the principle of relativity in curved spacetime, while another describes the gravitational field, and the third part specifies the interaction of the substance and fields. Therefore in CTG three different equations must be simultaneously solved – to find the metric, to determine the gravitational field (and to determine the electromagnetic field, if it is present) and the equation of motion of particles (bodies) and the wave quanta in the available fields. Since CTG is an axiomatically constructed theory [6], it is possible to compare CTG with the general relativity and to axiomatize the general relativity itself [13]. Besides CTG was derived from the principle of least action [14]. Further analysis led to Hamiltonian, which in the framework of CTG specifies the relativistic energy of the system [15].

Among the obtained results is determining of the four-dimensional operator of proper-time-derivative, of the generalized 4-velocity and 4-vector of Hamiltonian. Besides, identification of the action function is made as of the function, with the help of which the relativistic time dilation effect is calculated. In the derivation of the equation for the metric from the principle of least action the physical meaning of the cosmological constant Λ was found.

Within the framework of CTG the problem is studied of mass as the measure of the body's inertia, taking into account the contribution of the mass-energy of the proper gravitational (electromagnetic) field of the body to the mass [16], [17], [18]. The main conclusion is that if there is the scattered substance with the total mass m' of all the particles of the substance, then in case of the collapse of this substance into a gravitationally bound object the mass of this object M must be greater than m'. In other words, the mass-energy of the gravitational field increases the mass of the body the more, the denser is the body. The increase of the mass occurs due to the work of the gravitational field. This conclusion is opposite to the results of the general relativity, where the body mass decreases due to the action of the field.

In the Theory of Infinite Hierarchical Nesting of Matter it is assumed that the mechanism of gravitation is described by the Le Sage's theory of gravitation. Numerous fluxes of gravitons permeate the space in all directions, and if there are any two bodies, they will be attracted to each other due to the effect of shielding of the graviton fluxes falling on these bodies. The validity of this approach is confirmed in article [10], in which the Newton law of gravitation is deduced, and the gravitational constant is expressed through the characteristics of the graviton fluxes. Here the energy density of the graviton fluxes $4\cdot10^{34}\,\mathrm{J/m^3}$, the power of the energy flux of gravitons through unit area from unit solid angle $10^{42}\,\mathrm{W/(\ sr\cdot m^2)}$, the cross section of interaction of gravitons with the nucleon form of the substance $7\cdot10^{-50}\,\mathrm{m^2}$ were found.

The relation between the Le Sage's theory of gravitation and the CTG is expressed by the fact that the gravitational potential ψ, the gradient of which specifies the gravitational field strength $\boldsymbol{G}$, is proportional to the difference between the energy density of graviton fluxes at infinity far from the bodies and the energy density of graviton fluxes near the body, where the gravitational potential is determined. This leads to the Newton formula for the gravitational force $F=\dfrac{\gamma M_1 M_2}{R^2}$, where γ is the gravitational constant, M_1 and M_2 are the masses of the attracting bodies, R is the distance between the centers of the bodies. Outside the single stationary body at the distance r the potential is equal to $\psi=-\dfrac{\gamma M}{r}$ and the acceleration has the form: $\boldsymbol{G}=-\nabla\psi=-\dfrac{\gamma M\mathbf{r}}{r^3}$. Inside the body the gravitational acceleration depends on the density of the body substance ρ by the formula: $\nabla\cdot\boldsymbol{G}=-4\pi\gamma\rho$. If we now consider the moving body and make the Lorentz transformations for all the physical quantities, the gravitational torsion field $\boldsymbol{\Omega}$ will appear, and the Lorentz-invariant equations for the fields $\boldsymbol{G}$ and $\boldsymbol{\Omega}$ will be similar to the Maxwell equations for the electric field $\boldsymbol{E}$ and the magnetic field $\boldsymbol{B}$.

According to the Theory of Infinite Hierarchical Nesting of Matter at each basic level of matter there is its own form of gravitation. At the level of stars and planets we have the ordinary gravitation and at the atomic matter level the main force of gravitation is assumed to be strong gravitation. Under the influence of gravitation at each basic level of matter the densest and stablest objects appear, the substance of which is in equilibrium with the external pressure from the fluxes of gravitons and with the internal pressure of the repulsion of the substance particles from each other. At the level of stars such objects are neutron stars, and at the level of elementary

particles – nucleons, the lifetime of which is very large. From these objects, which can carry the electrical charge and have a strong magnetic field and the greatest gravitational acceleration near the surface, there is the largest emission of energetic particles and wave quanta. Even larger emission takes place during the formation of such objects, the example of this is the formation of a neutron star with emission of a huge flux of neutrinos. It is assumed that all types of emission, which emerged at lower levels of matter, become gravitons for the objects of higher levels of matter. According to calculations based on the analysis of the density of the emitted energy, the gravitons for the ordinary gravitation must be the emissions produced by the particles at the praon level of matter or even at a lower level of matter [19]. For the electric interaction of charged bodies the dynamic model was found similar to the Le Sage's theory [6], when in the fluxes of gravitons there are charged particles affecting the charges of bodies. Thus it is possible to explain the existence of cosmic objects and fields by the fact that fluxes of gravitons create the densest objects such as nucleons and neutron stars, which in turn generate fluxes of particles and emissions, becoming gravitons for the highest levels of matter.

To calculate the strong gravitational constant, acting at the level of elementary particles, two methods are used [3]. In the first of them the similarity coefficients between neutron stars and nucleons are used from Table 2. With their help, according to the theory of dimensions the ordinary gravitational constant γ is converted into the strong gravitational constant: $\Gamma = \gamma \frac{\Phi}{PS^2}$.

In the second method, the electrical force of attraction between the electron and the proton in the hydrogen atom at the Bohr radius R_B is equated to the force from strong gravitation. It follows:

$$\frac{e^2}{4\pi\varepsilon_0 R_B^2} = \frac{\Gamma M_p M_e}{R_B^2}, \qquad \Gamma = \frac{e^2}{4\pi\varepsilon_0 M_p M_e} = 1.514 \cdot 10^{29} \ \mathrm{m^3 \cdot kg^{-1} \cdot s^{-2}},$$

where e is the elementary charge, ε_0 is the vacuum permittivity, M_p and M_e are the masses of the proton and the electron, respectively.

As the universal force of attraction, strong gravitation must act between any elementary particles, irrespective of whether they are hadrons or leptons. Due to the strong gravitation the substance of elementary particles must be bound, the atomic nuclei are formed as clusters of protons and neutrons, as well as atoms and molecules. As the sizes of interacting objects increase in the transition from the atomic to the stellar levels of matter, the strong gravitation between the particles is converted into the ordinary gravitation between the bodies.

Theory of relativity

Besides the theory of gravitation, the theory of relativity has undergone significant change. The disadvantage of the special relativity is combination of two different axioms. If the axiom of the applicability of the principle of relativity is acceptable from the standpoint of physics, then the axiom of the constancy of the speed of light in inertial reference frames seems more a convention than an axiom, which has its own physical meaning. In this regard, in 2002 on the axiomatic basis the *extended special theory of relativity* (ESTR) has been developed, which

contains five axioms [8]. The difference of ESTR from special relativity is that instead of the axiom of the constancy of the speed of light the axiom of the existence of an isotropic reference frame is used, in which the speed of light propagation is equal in all directions and does not depend on the speed of the light emitter. Despite the different axiomatics, in ESTR all the formulas of the special relativity are derived, as well as the postulate of the constancy of the speed of light for all inertial observers. In this case the constancy of the speed of light is a conditional concept, which is the consequence of the procedure of space-time measurements, when the electromagnetic wave during the measurements must pass a closed path in space and return to the starting point.

In special relativity all inertial reference frames are equal so that the introduction of the ether, which specifies the preferred reference frame, seems unnecessary. However, ESTR implies such a preferred coordinate system, in which the speed of light is isotropic. In this case it is logical to assume that in the isotropic reference frame the ether is isotropic, which is associated with the propagation of electromagnetic quanta in it. Such ether can be conceived as the fluxes of gravitons propagating in all directions. Under gravitons tiny particles are meant, including charged particles like those found in cosmic rays of high energies. The graviton composition can include such particles as neutrinos and photons. As shown above, gravitons are formed at the lowest levels of matter. The ether of this kind is discrete, consisting of separate gravitons, and quasicontinuous, due to the multiplicity of gravitons. According to [3], [10], if the system of bodies is moving at a constant velocity, the force of gravitation does not depend on the velocity, which leads to the principle of relativity and the motion by inertia.

The further development of the theory is the metric theory of relativity (MTR), which includes as a particular case the special relativity and ESTR, and also substitutes the principle of general relativity in that part which concerns the transformation of physical quantities from one frame to another [6] [13]. MTR is built on the axiomatic basis and implies the dependence of the spacetime metric on the properties of the test particles and waves, by which the metric is measured. In contrast to the general relativity, in MTR the gravitational field of the body is the source of mass-energy in determining the metric. Another difference of MTR is that instead of the equivalence principle the principle of local equivalence of the energy-momentum is used.

Elementary particles

In our opinion, the absence of substantial, real physical models of the structure of elementary particles significantly inhibits the development of the theory of these particles. These models of particles can be constructed with the help of the Theory of Infinite Hierarchical Nesting of Matter [3]. From the similarity of the atomic and stellar levels of matter it follows that the neutron corresponds to the neutron star, the proton is similar in its properties to the magnetar, the pion is similar to the neutron star of the minimum mass, and the analogue of the muon at the level of stars is the white dwarf. In the *substantial model of neutron*, this particle has in its center the positive charge and its shell is negatively charged, which allows us to explain the opposite direction of the magnetic moment of the neutron relative to the spin [6, § 11]. The proton is described in the *substantial model of proton* as the analogue of magnetar, a neutron star with the strong magnetic field and electric charge. It is assumed that magnetars blow away protons and atomic nuclei by their electric fields, turning these particles into cosmic rays of high energies.

In the substantial model nucleons consist of praons as neutron stars consist of neutrons and a certain number of protons and electrons. In this case, knowing only the mass, charge and magnetic moment of the proton, and taking into account the strong gravitation as the main force at the level of elementary particles, in accordance with the experimental data we can calculate the radius of the proton, the density of its substance in the center and the maximum angular velocity [5], [20]. Due to substantial models of nucleons, it became possible to describe the specific mechanisms of interaction of elementary particles with neutrinos, as well as to understand the internal structure of neutrinos and the nature of weak interaction. With the help of strong gravitation in the *gravitational model of strong interaction* we can describe the strong interaction between nucleons in atomic nuclei, to construct the models of the simplest nuclei, to find the balance of forces and the distance between the nucleons in the deuteron, to explain the dependence of the specific binding energy of the nucleus on the mass of the nucleus [6, § 10].

The impossibility to obtain the quarks in the free state means that the quarks are quasiparticles, i.e. the states of the substance inside hadrons. The substantial models of nucleons allow us to construct the *model of quark quasiparticles* and to reduce the six known quarks to different combinations of the two states of the nucleon substance, α – phase and β – phase. Since all hadrons are considered to be composed of quarks, it follows that each particle contains the corresponding quantity of α – phase and β – phase, specifying the mass, charge and magnetic moment of particles [6, § 12]. At the example of the interaction of pions with nucleons it is shown that the peculiarities of emergence and the properties of resonances can be explained through the interaction of particles by means of strong gravitation, torsion field and electromagnetic forces. Thus, instead of quarks and gluons introduced by quantum chromodynamics it becomes possible to consider the structure of elementary particles in the classical way, with the help of the substantial models of particles. The weak point of the approach of chromodynamics is seen in the fact that it can not explain what particles the quarks themselves are composed of – since can these particles be the last bricks of matter?

From the Theory of Infinite Hierarchical Nesting of Matter and the *substantial model of electron* it follows that the electron in the atom must be in the form of a flat disc. In this picture it is possible to understand the nature of the electron spin – the spin emerges at the moment of transition of the electron from one energy state to another, after which it disappears [6, § 14]. The analysis of various phenomena with electrons in the atom – the model of the helium atom with two electrons, the magnetic moments, the multiplicity, the Lamb shift, magnetomechanical effects, etc., conform well to the proposed model of the electron.

Conclusion

Due to the Theory of Infinite Hierarchical Nesting of Matter it became possible to find the alternative explanations in cases when the standard theories clearly fail. In [21] it is concluded: "The current paradigm of physical knowledge is obsolete and is subject to inevitable replacement based on the transition to substantial theoretical models of a deeper level".

The Theory of Infinite Hierarchical Nesting of Matter also had influence on a number of theoretical models in physics. For example, the electrokinetic model of emergence of the magnetic fields in planets and stars appeared [6, § 15]. Another example is the development of the electron-ionic model of ball lightning [22], [23], as well as of the bead lightning [6, § 1]. At the stellar level of matter the *discreteness of stellar parameters* and the *quantization of parameters of cosmic systems* are discovered.

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