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Universe Hierarchy and Gravitational Interaction

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Abstract: *Based on the analysis of the gravitational interaction within the model of creation of the Universe with minimum initial entropy (UMIE), it is shown that electromagnetic and gravitational interactions are formed similarly to the strong interaction. In all cases, the corresponding charges are exchanged by virtual bosons created thanks to the Scalar Field. Electric and magnetic fields, electromagnetic waves and virtual electromagnetic waves are realized in three-dimensional space, and the gravitational field and gravitational waves have a dimension that exceeds the dimension of the Universe and are discovered mainly in one-dimensional and two-dimensional layers of layered space. The high dimensionality of gravitational waves is responsible for the gravitational interaction between an electron and a proton, which is almost 40 orders of magnitude weaker than the electromagnetic one. However, during the exchange of ions in World-2, the electromagnetic and gravitational interactions have the same order of magnitude. Using UMIE, it is shown that optical observations can record only 5% of all matter in the Universe, while the gravitational interaction covers all 100% of the mass of the Universe. The information from the scientific literature about the registration of a gravitational wave simultaneously with an electromagnetic pulse caused by the merger of two black holes or neutron stars corresponds to the registration of an energy pulse carried by the Scalar Field.*

Keywords: *Scalar Field, gravitational waves, electromagnetic waves, layered space, scale factor, hierarchical levels of the Universe.*

1. INTRODUCTION

In connection with the discovery of gravitational waves [1], many scientific works appeared with the interpretation of experimentally obtained results. At the same time, the idea that gravitational waves arose when two black holes merged is worthy of attention. The author considered the process of merging black holes from the standpoint of the model of the Universe with minimum initial entropy (UMIE) [2]. It was shown that the laws of physics would not be violated only in the case when the excess mass and energy, according to the virial theorem, go beyond the limits of interaction with a black hole [3] in the form of a Scalar Field [4], which is characterized by 12 spatial and temporal coordinates. Therefore, it can go beyond the boundaries of a black hole, creating the conditions for the existence of a gravitational field in black holes. This work will consider virtual electromagnetic and gravitational waves responsible for the manifestation of electromagnetic and gravitational interaction.

2. DEVELOPMENT OF THE THEORY OF GRAVITY

The development of the theory of gravity began with the writing of Newton's formula

$$F = \frac{Gm_1m_2}{r^2}, \quad (1)$$

Which reflected Kepler's empirically derived laws for the motion of the planets of the solar system. Further development of the theory of gravity only went beyond the phenomenological approach to understanding the phenomenon. As a result, the nature of the gravitational interaction remained unknown.

Kalutsa's theory should be mentioned separately, which, being geometric, has withstood the test of time. However, attempts at its analytical description constantly encounter an insurmountable obstacle. Nevertheless, from Kalutsa's theory, we can conclude that the unknown Scalar Field is responsible for the appearance of electromagnetic waves and the gravitational field and gravitational waves.

Moreover, based on the Law of unity and similarity [2, 5], it can be stated that the Scalar Field is responsible for all fundamental interactions in the Universe.

Just as Kalutsa's theory stands the test of time, so does A. Einstein's geometric interpretation of the gravitational field stands the test of time. However, even in this case, it is only possible to reliably say something about the nature of the gravitational field.

Based on phenomenological considerations, gravitational interaction is described similarly to the description of other interactions, and in particular, electromagnetic interaction, as the exchange of gravitons between interacting masses. At the same time, they forget that a vector field describes the electromagnetic interaction and the gravitational one by a tensor. In addition, the graviton is assigned zero rest mass, spin 2, and helicity. Let's analyze this model using the example of a black hole.

It is known that a black hole has such a powerful gravitational field that not even a quantum of light can escape from it. The graviton has properties similar to those of photons. The gravitational interaction between bodies indicates that a graviton must have non-zero mass and energy. So, how can it leave the gravitational field of a black hole?

To further consider the problem, let us first consider the electrostatic interaction.

The energy of the electrostatic interaction between an electron and a proton, depending on the distance between them, is

$$U = \frac{e^2}{r} \cdot 9 \cdot 10^9 J = \frac{1}{r} \cdot 23.04 \cdot 10^{-29} J \quad (2)$$

Let's imagine this interaction occurs by transferring a virtual photon between charges. In this case, a standing electromagnetic wave will be established between the authorities, and the length of this wave will be equal to twice the distance between the charges. You can calculate the photon's energy and compare it with the power of the Coulomb interaction.

$$E = \frac{2hc}{\lambda} = \frac{2}{\lambda} \cdot 6.626 \cdot 10^{-34} \cdot 3 \cdot 10^8 = \frac{2}{\lambda} \cdot 19.878 \cdot 10^{-26} J, \quad (3)$$

i.e., the photon energy is three orders of magnitude greater than the Coulomb interaction energy. Therefore, a virtual photon can interact with elementary particles' electric charges. Being virtual, this photon is deep in the potential well and ensures electrostatic interaction.

It was shown in the article [6] that it is possible to describe the Coulomb interaction using virtual photons only by assuming that circularly polarized photons provide such interaction. This fact is facilitated by the presence of helicity of electrons [7]. At the same time, the helicity of electrons is negative, i.e., they are left-polarized, and positrons are positive - right-polarized. Therefore, it can be assumed that a negative charge will absorb a left-polarized circular electromagnetic wave and a positive one - a right-polarized one. At the same time, they will emit a wave of another polarization.

A right-polarized wave emitted by a negative charge is described by the sum of two linearly polarized waves:

$$E_z = E_0 \cos(\omega t - kx),$$

$$E_y = E_0 \sin(\omega t - kx) = E_0 \cos(\omega t - kx - \pi/2). \quad (4)$$

Of course, an electromagnetic wave should be described by the formula $E=E_0 \cdot \exp[-i(\omega t - kx)]$, but for clarity, the representation of waves by trigonometric functions is used here. The distance between the charges will be equal to $\lambda/2$. The E_z wave resembles a standing wave in a pipe; the reverse wave occurs without losing phase. As for the E_y wave, it resembles a standing wave in a string. In this case, the return wave loses its phase by a factor of π. So, the wave reflected from the positive charge will become left-polarized. The interaction between these charges provides attraction. If the charges had the same sign, the absorption of waves by the above mechanism would not occur. There would be repulsion between them.

It is worth detailing the interaction between the charges. In nature, everything happens according to the Laws of unity and similarity, so there is a Law of similarity for fundamental interactions.

Therefore, we will use the robust interaction mechanism to explain the electromagnetic and gravitational interactions.

The formula determines the energy of the electrostatic charge field

$$W = \frac{1}{2} \cdot \frac{q^2}{4\pi\epsilon\,\epsilon_0 R}, \quad (5)$$

Where is $R = \hbar/mc$ [8].

The emission of a virtual photon by the field of a charged particle will lower the energy of the electrostatic field of this charge since this energy depends not only on the size of the charge but also on the particle's mass. However, the charge of the particle is quantized, i.e. constant. Therefore, the emission of a virtual photon is carried out by the electric field of the particle's charge due to the energy of the Scalar Field localized on the same particle and responsible for its mass [4]. The transfer of a virtual photon between particles is accompanied by the reverse transfer of energy of the Scalar Field, which restores the energy of the Scalar Field of the first charge. The absorption of a virtual photon by a charge of the opposite sign leads to the transfer of the energy of the virtual photon to it and the restoration of the energy of the electrostatic field. Therefore, the Scalar Field is localized on it. Thus, the binding energy between charges of opposite signs will equal twice the energy of a virtual photon. Absorption of a photon is a dynamic process, so it is immediately accompanied by the emission of another virtual photon with the opposite polarization, which can be perceived as the appearance of a standing electromagnetic wave.

Another important note: the energy of the interaction between charges due to the creation of a virtual photon depends on the magnitude of the charges of the interacting particles. It is proportional to the product of the interacting charges. This is easy to understand because an arbitrary charge consists of elementary charges, and each first particle's elementary charge interacts with every second particle's elementary charge. The interaction occurs between the charges, but the Scalar Field controls it.

Thus, we have free and virtual photons. And all of them are in three-dimensional space. At the same time, virtual photons provide electromagnetic interaction between electrically charged particles using the control of the Scalar Field as the process organizer.

From a classical point of view, an electrostatic field exists around a charged body. An attractive or repulsive force will act on another charged particle placed in it, regardless of the relative motion between the charges. In reality, electrostatic interaction occurs due to transferring a virtual photon between charges. Such targeted transfer of a virtual photon is possible only thanks to the guiding action of the Scalar Field, which knows the coordinates of another charged particle. If there is no other charged particle in a certain direction, then the transfer of a virtual photon will not occur in that direction. And therefore, there is no field in the space outside the interacting particles.

Further, the electromagnetic interaction is implemented exclusively in our three-dimensional space. If all the charged particles stood still, there would be conditions for creating a standing wave for an arbitrary distance between the charges. However, all charges are moving. Therefore, at large distances, such as between the Sun and the planets, the condition for the emergence of a standing electromagnetic wave will be violated. From here, we have the absence of the influence of electric charges on the parameters of the Earth's motion.

The ratio between gravitational and electrostatic interactions in an electron-proton pair is $k_{ep}=4.4126\times10^{-40}$. However, in nature, gravitational interaction is manifested between massive objects, the mass of which is determined by nucleons. Therefore, such a ratio should be considered in a proton-antiproton pair. In this case, this ratio is $k_{pp}=0.808\times10^{-36}$. This ratio is important since the gravitational interaction is manifested exclusively between large masses represented by nucleons.

It is worth paying attention to one more relationship between gravitational and electrostatic interactions in a pair of Planck particles since time, mass, and Planck length determine the birth of the Universe [10]. In this case, we get the ratio:

$$0.2304\cdot10^{-27}:1.23\cdot10^{-27}. \quad (6)$$

In this formula, the combined Planck mass is used. As we can see, the electrostatic and gravitational interactions now have the same order of magnitude. If we use the data on the real electric charge of

dyons (e/6), it turns out that in World-2, the gravitational interaction is 2 orders of magnitude greater than the electrostatic one. We obtain such a ratio under the assumption that the value of ε_0 is the same in all layers of the layered space. Most likely, this is not the case. Therefore, it can be expected that the gravitational and electromagnetic interactions in World-2 have the same magnitude.

However, Planck particles are in the one-dimensional layer of the Super-Universe. This fact gives reason to consider the gravitational interaction not in the Universe but in the stratified Super-Universe.

What is the difference between gravitational and electrostatic interactions that manifest at an arbitrary distance between objects?

3. GRAVITATIONAL INTERACTION

In contrast to the electrostatic interaction, the gravitational interaction is strictly manifested within the solar system and in the Galaxy, in clusters of galaxies and between clusters in the Universe. As a result, large clusters of galaxies and large voids appear. Therefore, the gravitational interaction is fully manifested in the Universe, regardless of the constant movement of stars, galaxies and their clusters. Since the gravitational interaction exists between the masses, the magnitude of which is determined by the Scalar Field localized on the particles [4], the Scalar Field also controls the gravitational interaction, creating massive virtual waves called gravitons. The Scalar Field is multidimensional; therefore, gravitons, unlike electromagnetic waves, are multidimensional.

Let's pay attention to the fact that Newton's formula (1) for gravitational interaction provides an invariant value when the scale of interaction changes. For this, it is necessary to simultaneously change the value of the interacting masses and the distance between them by the same value. This fact makes use of the gravitational interaction at different hierarchical levels. For example, transferring a graviton wave between two interacting stars within the same Galaxy would require many years if the graviton were three-dimensional. With the motion of all the stars in the Galaxy, such an interaction was impossible. Since the graviton wave is multidimensional, it can immediately take advantage of the existing delocalized point of interaction between World-4 (the three-dimensional Universe) and World-3 (the world of quarks, which is characterized by two spatial coordinates).

Let's pay attention to one more fact. The analysis shows that only those large systems organized according to the hierarchical principle can be stable. Other systems in the process of evolution must stop all their species due to their instability [11]. Therefore, the result of the evolution of any large natural system is the formation of its hierarchical structure [5, 11]. Then, it turned out that each structure corresponds to a separate physical interaction. However, an arbitrary hierarchical system should have 7 levels [5, 8, 11]. This is also the hierarchical structure of our Universe (Table 1).

It follows from Table 1 that, in addition to the known interactions, there must also be other interactions that manifest themselves on a large scale [5, 11]. At the same time, 7 principles are described in [5, 11] that describe hierarchical structures. The first principle is the Law of unity within the element of the hierarchical level (HL).

Table1. *Hierarchical structure of the Universe.*

HL	Substance	Interaction	Reaction
1	Elementary particles	weak	Particle decay and lepton scattering on baryons
2	Atomic nuclei	Strong	Interaction between baryons
3	Atoms, molecules, molecular systems, plasma	Electromagnetic	Interaction between charged particles
4	Planetary systems	Gravitational I	Interaction between gravitating bodies within the planetary system
5	Star systems	Gravitational II	Interaction between stars within the galaxy
6	Cluster of galaxies	Gravitational III	Interaction between galaxies (cellular structure of the Universe)
7	Metagalaxy	Gravitational IV	Interaction between galaxy clusters
8	God of the system		

Interaction for a separate element of HL ensures temporal unity with respect to all other elements of the same HL - interaction between them. Time unity means that within the time limit $\Delta t = h/mc^2$, the unity signal will cover the HL's characteristic (smallest) element. This fact causes different properties of gravitational fields at different hierarchical levels.

Experience shows that the transformation of a star into a black hole does not lead to the disappearance of the gravitational attraction of stars to the black hole. It exists and ensures that matter from near space is captured by a black hole, including stars and other black holes that have come close enough to the black hole.

We have already discussed similar phenomena in the article [3], where it was shown that galactic arms could form only due to the merger of black holes. At the same time, only the multidimensional Scalar Field [4] could ensure the exit of matter beyond the boundaries of black holes.

Thus, only the Scalar Field and the gravitational waves generated by the Scalar Field, exhibiting their unique properties, can go beyond the black hole.

Using its multidimensionality and information interaction between the layers of stratified space, which occurs through a delocalized point, the Scalar Field "knows" the coordinates of all masses in the Universe [4]. Therefore, it can always organize interaction between massive bodies (planets, stars) or massive systems of bodies (galaxies). The Scalar Field and the gravitational waves generated by it must have a dimension that exceeds the dimension of our Universe.

The interaction between masses of the same sign is carried out through the exchange of gravitons represented by a double helix, indicating the gravitational wave's tensor nature.

At the same time, the standing wave of interaction (virtual graviton) between massive bodies must contain a full wavelength so that the phases at both ends are the same. At $x = r = \lambda$, the wave's phase will change by 2π; the condition for the next radiation is preserved. The Scalar Field forms this wave, and since the flow of gravitational field intensity in our space is spherically symmetric, its magnitude does not depend on the distance from the field source. Therefore, the force of gravitational interaction between massive bodies will depend inversely proportionally to the square of the distance. In addition, it will be proportional to the product of the masses of the interacting bodies (see similar information for charges above). Such dependence will exist at an arbitrary speed of virtual gravitational waves. Since the Scalar Field, thanks to its dimension, can overcome arbitrary distances in the Universe instantly, it can contribute to the fact that the interaction between galaxies will take place almost instantly. The author indicated this possibility in the article [12]. Note that this possibility is caused by the hierarchical structure of the Universe [12]. In this case, at the first three levels (weak, strong, and electromagnetic), the propagation speed of the interaction is equal to the speed of light. And already at the planetary levels and at the levels of star systems, galaxies and galactic clusters, other laws of gravitational interaction operate.

Considering the hierarchical structure of the Universe, the author was surprised that at the upper hierarchical levels, the speed of gravitational interaction should significantly exceed the speed of light. When it was possible to describe the properties of the Scalar Field [4], it became clear that such a fact could occur since the graviton's dimension is much higher than the dimension of our Universe. This explains the gravitational interaction in the Galaxy and between galaxies in the Universe.

However, at all hierarchical levels, gravitational interaction occurs due to virtual gravitational waves (gravitons) exchange. This exchange looks like this. Perturbation by the gravitational field (or Scalar Field) of one mass of the gravitational field of the second mass causes the emission of a graviton by the second mass. At the same time, the energy of the second body decreases by the amount of energy of the virtual graviton. The movement of the graviton to the first mass causes the opposite simultaneous movement of the Scalar Field responsible for the first mass. By absorbing the graviton, the first mass returns the lost energy. The dynamics of graviton capture causes a new graviton to be emitted by the first mass. The cycle of graviton emissions and absorptions repeats itself endlessly. The multidimensionality of the Scalar Field and gravitational waves will be responsible for the extremely weak gravitational interaction between bodies.

To model the gravitational interaction at different hierarchical levels, we will take some numbers as a basis, which can be refined in the future according to the data of observation of the Universe. First of all, let's pay attention to the estimate of the radius of the Universe and the mass of matter in the Universe given in [2]: $R_U = 1.3 \cdot 10^{26}$ m, $M_U = 4.18 \cdot 10^{51}$ kg. The effective value of the number of stars with a mass equal to the mass of the Sun is $N_{ef} \approx 2.1 \cdot 10^{21}$. This quantity can be imagined as the product of the total number of galaxies (the total number of galaxies, N_{tng}) by the number of stars (N_{Star}) in the Galaxy: $N_{ef} = N_{tng} \cdot N_{Star}$. Assume that $N_{tng} = N_{Star} \approx 4.6 \cdot 10^{10}$, corresponding to the estimate in the article [13]. Let us further assume that the total number of galaxies in the Universe is divided between the number of galaxy clusters (galaxy cluster, N_{gc}) and the number of galaxies in the cluster (N_g) so that $N_g = 2 \cdot 10^3$ galaxies, and $N_{gc} = 2.3 \cdot 10^7$.

And finally, we will introduce the scaling factor (k) for all HLs where the gravitational interaction is manifested. The magnitude of the scale factor will determine in which layer of the stratified Super-Universe the gravitational interaction takes place.

At the same time, the magnitude of the interaction force will be the same both in the Universe and in another layer of stratified space. The scaling factor does not work for the magnitude of the gravitational interaction energy. Therefore, we can talk about energy only in World-4. If the value of k is chosen to be the same at all gravitational hierarchical levels, then we will reduce these HLs to one HL. Hence, the conclusion is that the value of k must be different on different HLs.

Above, we talked about temporal unity on different HLs. From here, it is easy to calculate the value of k.

In the Universe, $\Delta t = h/M_{min}c^2$. In another layer, $\Delta = h/kM_{min}c^2$.

In this case

$$\Delta t_1 \cdot c = kR_{min} \tag{7}$$

And

$$k = \sqrt{\frac{h}{M_{min}\, R_{min}\, c}} \tag{8}$$

The calculation of the values of the parameters included in Newton's formula for each hierarchical level (HL) is given in Table 2.

Table2. *Calculation of gravitational interaction parameters at different hierarchical levels.*

HL	R_{HL}, m	R_{HLmin}, m	M_{min}, kg	R_{HL}/R_{HLmin}	k	kM_{min}	$k \cdot R_{HLmin}$	$k \cdot R_{HL}$
Planetary systems	$\sim 4.5 \cdot 10^{12}$	$6.4 \cdot 10^{6}$	$6 \cdot 10^{24}$	$0.7 \cdot 10^{6}$	$2.3 \cdot 10^{-37}$	$1.4 \cdot 10^{-12}$	$1.5 \cdot 10^{-30}$	$1.1 \cdot 10^{-24}$
Star systems	$\sim 4.7 \cdot 10^{20}$	$\sim 4.5 \cdot 10^{12}$	$2 \cdot 10^{30}$	$1.04 \cdot 10^{8}$	$5 \cdot 10^{-44}$	$1 \cdot 10^{-12}$	$2.3 \cdot 10^{-30}$	$2.3 \cdot 10^{-22}$
Cluster of galaxies	$\sim 2 \cdot 10^{23}$	$\sim 4.7 \cdot 10^{20}$	$9 \cdot 10^{40}$	425	$2.3 \cdot 10^{-52}$	$2.1 \cdot 10^{-11}$	$1.1 \cdot 10^{-31}$	$7 \cdot 10^{-29}$
Metagalaxy	$1.3 \cdot 10^{26}$	$\sim 2 \cdot 10^{23}$	$1.8 \cdot 10^{44}$	650	$2.5 \cdot 10^{-55}$	$2.2 \cdot 10^{-14}$	$5 \cdot 10^{-32}$	$3.3 \cdot 10^{-29}$

To interpret the obtained results, let's pay attention to the fact that in World-3, the average distance between quarks is 10^{-13} m, and between dyons in World-2 - $6 \cdot 10^{-34}$ m [2, 14]. A comparison of the parameters given in the last three columns of Table 2 with the parameters of particles in the three layers of the stratified Super-Universe shows that the reduced distances are significantly smaller than in World-3 but larger than in World-2. At the same time, the minimum reduced mass is several orders of magnitude less than the Planck mass and several orders of magnitude greater than the mass of particles in World-3 and World-4. Such a result may indicate that gravitational waves propagate simultaneously in World-2 and World-3. Therefore, in theory, we deal with reduced masses and distances that describe the gravitational interaction in the multidimensional Super-Universe.

The value of the constant in Coulomb's law is different in different layers of the stratified Super-Universe. Let us assume that in World-2, the magnitudes of electrostatic and gravitational interaction

between dyons are the same. This will allow us to estimate the value of the constant in Coulomb's law for one-dimensional space. Since the gravitational interaction is implemented in one-dimensional and two-dimensional layers of the Super-Universe, it can be assumed that the constant G is the same for the entire Super-Universe. In this case, formula (6) will be rewritten in the form:

$$k\left(\frac{e}{6}\right)^2 = Gm_P^2 = \hbar c \tag{9}$$

From here

$$k = \frac{36\hbar c}{e^2} = 4{,}45 \cdot 10^{13}, \tag{10}$$

which is almost 5000 times greater than the value of the constant in Coulomb's law in the Universe. If we use the combined Planck mass, the value of k in formula (10) will decrease by a factor of 8π, i.e. it will become equal to $1.77 \cdot 10^{12}$.

However, the question remains: does the hierarchical level affect the value of the gravitational interaction constant (γ, G)? It is possible that such an influence exists, and the value of the gravitational interaction constant additionally decreases with the transition from lower to higher HL. This is indicated by a significant decrease in the value of *k·RHL* for the interaction between galaxies and clusters of galaxies. Purely phenomenological, this can be imagined as an additive repulsion, the magnitude of which increases with increasing distance. In this case, we will get an accelerated scattering of galaxies [15, 16].

On the other hand, in [17], the reasoning is expressed that the accelerated dispersion of galaxies may be due to the non-zero value of the cosmological constant Λ. Since, in fact, $\Lambda = 2.7958473 \cdot 10^{-56}$ cm^{-2} [8], this fact may contribute to the Universe's accelerated expansion. It turned out that physicists are not familiar with I. Gerlovin's monograph [8], so the author cited the data on Λ in the article [18].

It is worth saying a few words about the gravitational interaction of a massive body with a photon. We know that a photon has a mass of $m_{ph} = h\nu/c^2$. Therefore, it will be attracted to massive bodies, distorting its trajectory. It was shown above that the participation of the Scalar Field completely determines the gravitational interaction. Is the Scalar Field present near the photon? To answer this question, it is worth referring again to I. Gerlovin's monograph [8] showed that the excitation of vacuum particles causes the appearance of a wave that moves at a speed of c. Simultaneously with the photon, the excitation wave of vacuum particles moves to the virtual state. And such excitation is possible only thanks to the Scalar Field. Therefore, the photon moves together with the Scalar Field and, therefore, can have mass and participate in the gravitational interaction.

The article [18] showed that at most 8% of the mass in the Universe can be seen in the UMIE model by optical methods. Since the mass of stars is constantly increasing from birth to the present time, their mass was significantly lower in the past. We can conclude, taking into account the well-known fact that the radiative capacity of a star depends on its mass, that at the beginning of the development of the Universe (perhaps during hundreds of millions of years), when the mass of stars was still small, it was impossible to see newborn stars by optical methods. Therefore, we can see at most 5% of the mass of stars with astronomical instruments.

All 100% see gravitational waves of the modern mass of the Universe. This is confirmed by the complete correspondence between the Universe's current mass and the Hubble constant's value. The lack of understanding of this fact within the framework of the Standard Model of the birth of the Universe caused the emergence of the theory of dark matter and dark energy, which no one has seen and will never see. Since introducing these concepts is unscientific and demeaning to science, they should be removed.

The article [13] claims that the speed of propagation of gravitational interaction in the Universe is equal to the speed of light on the basis that it was possible to register the collision of two neutron stars simultaneously in the form of a flash of high-energy γ-quanta and a gravitational wave pulse. In this regard, it is worth saying that in reality, the experimenters did not see a gravitational wave, which is responsible for the gravitational interaction, but the energy pulse of the Scalar Field [4], which carries out excess energy during the merger of two massive bodies - neutron stars or black holes [3]. Being

multidimensional, the Scalar Field can form an energy pulse both in the multidimensional Super-Universe and in the three-dimensional Universe. The transfer of energy by the Scalar Field in the Universe can occur only at a speed that does not exceed the speed of light in a vacuum.

4. CONCLUSIONS

The following conclusions were made based on the gravitational interaction analysis based on the Universe creation model with minimal initial entropy.

1. The electromagnetic interaction between electric charges is formed similarly to the strong interaction. Charges are exchanged by virtual photons created by the Scalar Field. The wavelength of a virtual photon is equal to twice the distance between the charges. At the same time, photons with circular polarization are emitted and absorbed by charges, which ensures the attraction of electric charges of different names and the repulsion of charges of the same name.
2. Electric and magnetic fields and electromagnetic and virtual electromagnetic waves are implemented in three-dimensional space. The gravitational field and waves have a dimension that exceeds the dimension of the Universe and cover mostly one-dimensional and two-dimensional layers of layered space.
3. The high dimensionality of gravitational waves is responsible for the fact that the gravitational interaction between an electron and a proton is almost 40 orders of magnitude weaker than the electromagnetic one. However, during the interaction of dyons in World-2, the electromagnetic and gravitational interactions have the same order of magnitude.
4. Optical observations can record only 5% of all matter in the Universe, while gravitational interaction covers all 100% of the mass of the Universe.
5. Information about the registration of a gravitational wave simultaneously with an electromagnetic pulse caused by the merger of two black holes or neutron stars corresponds to the registration of an energy pulse carried by the Scalar Field.

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