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Gravity Waves in the Model of the Universe with Minimum Initial Entropy

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Abstract: *The paper deals with the analysis of the current state of development of the theory of electromagnetic and gravitational interactions, as well as the modeling of these interactions within the model of creation of the Universe with minimum initial entropy. This analysis has shown that within the framework of the Standard model of creation and evolution of the Universe, only a phenomenological approach of solving the problem of physics of electromagnetic and gravitational interactions is possible. At the same time, the model of the Universe with minimum initial entropy allows us to understand the physics of electromagnetic and gravitational interactions. It is shown that for both types of interactions the Scalar Field is responsible for creation and controlling these interactions. Only the Scalar Field is capable of generating virtual electromagnetic and gravitational waves. The significant difference between these types of waves is that the electromagnetic waves are localized in three-dimensional space, while the gravitational waves have a larger dimension given to them by the Scalar Field. The multidimensionality of gravitational waves determines the very small value of the constant of gravitational interaction between bodies. However, this magnitude of the interaction constant provides the possibility of the existence of planets, stars, and galaxies, the existence of our Universe.*

Keywords: *gravitational waves, electromagnetic waves, Scalar Field, virtual gravitational and electromagnetic waves, registration of gravitational waves.*

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1. INTRODUCTION

Due to the discovery of gravitational waves [1], many scientific works appeared with the interpretation of the experimentally obtained results. The notion that gravitational waves arose from the union of two black holes is noteworthy. The process of unifying black holes has been previously considered by the author from the standpoint of a model of the Universe with minimum initial entropy [2], and it has been shown that the laws of physics will not be violated only if excess mass and energy go beyond the interaction with the black hole according to the virial theorem [3] in the form of a Scalar Field [4] characterized by 12 spatial coordinates, as well as temporal and information coordinates. Therefore, it has the ability to go beyond the black hole, causing the presence of a gravitational field in black holes. The notion that for gravitational attraction the corresponding gravitons, particles having relativistic mass, cannot satisfy the description of the gravitational field of black holes.

Previously, the author showed that the specific properties of the Scalar Field are capable of describing the formation of central jumper and galactic sleeves at the unification of black holes [3]. In this case, part of the energy will propagate in the form of gravitational waves. At the same time, when a black hole is absorbed by a conventional star, radiation will only occur along the axis of rotation of the black hole, fueling the Fermi bubbles.

Considering the opening of gravitational waves, it can be argued that these waves will propagate only along the central sleeves when black holes merge. Therefore, only in rare cases will these waves reach observers on Earth. So, we will see these galaxies from the edge. The source of gravitational waves can be found by recording the formation of new galactic arms in the galaxy. The encounter and fusion of neutron stars with the formation of gravitational waves in the Universe must be considered a completely incredible process.

In this paper, virtual electromagnetic and gravitational waves responsible for the manifestation of electromagnetic and gravitational interactions will be considered.

2. Development of the Gravity Theory

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

$$F = \frac{Gm_1m_2}{r^2},$$

which reflected the empirically derived Kepler laws for the motion of the planets of the solar system. Further development of the theory of gravity practically did not go beyond the phenomenological approach of understanding the phenomenon. As a consequence, the nature of the gravitational interaction remained unknown.

It is worth mentioning separately the theory of Kaluza, which, being geometric, has withstood the test of time. However, attempts at its analytical description are constantly being faced with an insurmountable obstacle. And yet, from Kaluza's theory, we can conclude that the unknown Scalar Field is responsible for the appearance of electromagnetic waves, as well as the gravitational field and gravitational waves. However, scientists pay little attention to this fact.

Just as Kaluza's theory withstands time, so does the geometric interpretation of the gravitational field by A. Einstein. However, in this case, too, one cannot say for certain the nature of the gravitational field.

Based on phenomenological considerations, the 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 electromagnetic interaction is described by a vector field and gravitational - by a tensor one. In addition, zero gravity, spin 2, and helix are attributed to graviton. Let us analyze this model with the example of a black hole.

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

For further consideration of the problem, let us first look at the electrostatic interaction.

3. Electromagnetic Interaction

The energy of electrostatic interaction between the electron and the proton (depending on the distance between them) is

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

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

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

that is, the photon energy is 3 orders of magnitude greater than the Coulomb interaction energy.

Therefore, a virtual photon can provide interaction between the electrical charges of elementary particles. Being virtual, this photon is located deep in the potential well (Fig. 1) and provides electrostatic interaction.

In article [5] it was shown that to describe Coulomb interaction by means of virtual photons it is possible only assuming that such interaction is provided by circularly polarized photons. This fact is facilitated by the presence of spiral electrons [6]. In this case, the helical electrons are negative, that is, they are left polarized, and the positrons are positive - right polarized. Therefore, it can be assumed that the negative charge will absorb the left-polarized circular electromagnetic wave and the positive charge will absorb the right-polarized. In doing so, they will emit a wave of other polarization.

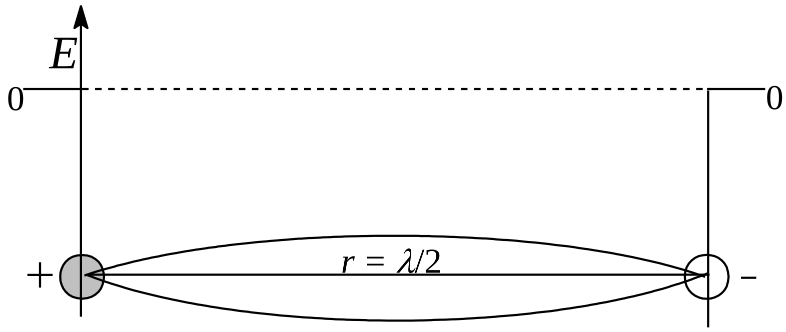

Fig1. *A virtual photon (projection E_y) in the potential well between interacting charges.*

A right-polarized wave emitted by a negative charge will be described by the sum of two linearly polarized waves[1]:

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

$E_y = E_0 \sin(\omega t - kx) = E_0 \cos(\omega t - kx - \pi/2)$. (1)

The distance between charges will be λ/2. The wave E_z is reminiscent of a standing wave in a pipe, that is, a return wave occurs without loss of phase. As for the wave E_y, it resembles a standing wave in a string (Fig. 1). In this case, the return wave loses the phase on a π value. As a result, the wave reflected from the positive charge will become left-polarized. Consequently, an interaction will be established between these charges to provide attraction between them. If the charges had the same sign, the absorption of the waves by the mechanism described above would not occur. There would be repulsion between them.

The interaction between the charges is worth a bit of detail. Everything happens according to the Laws of Unity and Similarity in the nature [2, 7]. So, there is also a Law of Similarity for fundamental interactions. Therefore, we use a strong interaction mechanism to explain electromagnetic and gravitational interactions.

The energy of the electrostatic charge field is determined by the formula

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

where $R = \hbar/mc$ [8].

The radiation of a virtual photon by a charge field can reduce the energy of the electrostatic field of this charge, since this energy depends not only on the magnitude of the charge, but also on the mass of the particle. However, the charge of the particle is quantized, that is, unchanged. Therefore, the radiation of the virtual photon is carried out by the electric field of charge of the particle due to the energy of the Scalar Field, localized to the same particle and responsible for its mass. The transfer of a virtual photon between the particles is accompanied by a reverse transfer of Scalar Field energy, which recovers the first charge's Scalar Field energy. Absorption of the virtual photon by the charge of the opposite sign leads to the transfer of the energy of the virtual photon and the restoration of the energy of the electrostatic field, and hence the localized Scalar Field. Thus, the bond energy between the charges of opposite signs will be equal to twice the energy of the virtual photon. Photon absorption is a dynamic process, so it is immediately accompanied by the emission of another virtual photon with opposite polarization, which can be seen as the appearance of a standing electromagnetic wave.

Another important point is that the energy of interaction between charges by creating a virtual photon depends on the magnitudes of the charges of the interacting particles and is proportional to the product of the interacting charges. This is easy to understand, since an arbitrary charge consists of elementary charges, and each elementary charge of the first particle interacts with each elementary charge of the second particle. The interaction takes place between charges, but is controlled by the Scalar Field.

[1] Of course, the electromagnetic wave must be described by the formula $E = E_0 \exp[-i(\omega t - kx)$, but for the sake of clarity, the image of the waves by trigonometric functions is used here.

When interacting with the same charge, the condition for absorbing the virtual photon directly by the charge is absent. To detect such interaction, an additional transfer of Scalar Field energy to the charge is required. As a consequence, this leads to an increase in the energy of the system of two eponymous charges at the expense of the Scalar Field. There is repulsion between the charges.

So we have interconnected electric and magnetic fields, as well as free and virtual photons. And they are all in three-dimensional space, providing electromagnetic interaction between electrically charged particles using Scalar Field Control as a process catalyst.

Now let us look at the **gravitational interaction** between electron and proton

$$U = \frac{Gm_1m_2}{r} = \frac{1}{r} \cdot 6{,}67259{\cdot}10^{-11} \cdot 9.1093897 \cdot 10^{-31} \cdot 1.6726231 \cdot 10^{-27} =$$

$$= \frac{1}{r} \cdot 10.1667422{\cdot}10^{-68}\ J \quad (3)$$

The ratio between electrostatic and gravitational interactions in this pair of particles is $2.266{\cdot}10^{39}$. The inverse is $4.4126{\cdot}10^{-40}$.

To equalize these energies, one must take gas containing $2.266{\cdot}10^{39}$ hydrogen atoms, whose mass is $3.792{\cdot}10^{12}$ kg. The Earth's mass $5.9737{\cdot}10^{24}$ kg is only 12 orders of magnitude greater.

There is a rather strong electric field above the Earth's surface. It is known [9] that the Earth has a rather large electric charge, the value of which is approximately equal to $5{\cdot}10^5$ *Cl*. In this case, almost all the electric field is localized between the Earth's surface and the ionosphere. A weak electric current flows through the atmosphere, reducing the electric field in this capacitor[2]. At the same time, the solar wind (stochastic solar flares) supplies charges into the ionosphere, stabilizing to some extent the magnitude of the electric field.

Therefore, there may be an electric charge on Earth whose magnitude changes over time as a result of cosmic radiation. The intensity of cosmic radiation is a time-varying non-periodic character. A similar assumption will hold true for the Sun. In this case, the question is why the electrostatic interaction between the Sun and Earth does not affect the characteristics of the Earth's orbit around the Sun?

Let's look carefully at Fig. 1. Recall that electromagnetic interaction is realized exclusively in our three-dimensional space. If all the charged particles were in place, then there would be conditions for creating a standing wave for an arbitrary distance between charges. However, all charges are moving. Therefore, at long distances, such as between the Sun and the planets, the condition for a standing wave will be disturbed. Hence the lack of influence of electric charges on the parameters of the Earth's motion. What is the difference between gravitational interaction that occurs at an arbitrary distance between objects?

4. Gravitational Interaction

A completely different situation is observed in the case of gravitational interaction. It is strictly manifested not only within the solar system, but also in the galaxy, in the cluster of galaxies, in the Universe. As a result, large clusters of galaxies and large voids appear. Therefore, gravitational interaction manifests itself in the Universe to the full, despite the constant movement of stars, galaxies and their clusters.

A black hole with help us in the consideration of gravitational interaction.

If the gravitational field were like the electrostatic field, that is, it was described by a vector field and manifested only in our three-dimensional space, then the behavior of these fields would be the same over long distances. In addition, neither electromagnetic nor gravitational waves could reach beyond the black hole. However, experience has shown that turning a star into a black hole does not lead to the disappearance of the gravitational pull of stars to a black hole. It exists and seeks to capture matter from the near space by a black hole, including stars and other black holes that are close enough to the black hole.

[2] The bottom plate of this capacitor is the Earth's surface and the upper one is the thick layer of the ionosphere. Therefore, the intensity of the electric field is of maximum value near the Earth's surface, and decreases to almost zero with a height above the Earth.

We have already discussed similar phenomena in an article [3], which showed that galactic sleeves could be formed only as a result of the merging of black holes. In this case, the output of matter beyond the black holes could provide only a multidimensional Scalar Field [4].

Thus, only the Scalar Field can go beyond the black hole, showing its unique properties. Therefore, only the Scalar Field can tolerate gravitational interaction.

Using its multidimensionality and the presence of information interaction between layers of stratified space that occurs through a delocalized point, the Scalar Field "knows" the coordinates of all masses in the Universe [4]. Therefore, it can always organize interactions between massive bodies or massive systems of bodies (galaxies). It is clear that not only the Scalar Field, but also the gravitational field generated by it, including gravitational waves, must have a dimension that exceeds the dimension of our Universe. It follows that not only the real but also the imaginary magnitudes of the amplitude must be taken into account in the gravitational wave equations [8]:

$$G = G_0 \cdot \widehat{U} \cdot \exp[-i(\omega t - kx)], \qquad (4)$$

where $\widehat{U}$ – unitary matrix that describes the tensor nature of the gravitational wave (double helix).

So, we get a double helix with identical start and end phases.

In this case, the standing interaction wave (*virtual graviton*) between the massive bodies must contain the full wavelength so that the phases at both ends are the same. At $x = r = \lambda$ the phase of the wave will change by 2π, i.e. the condition for the next radiation remains. This wave is formed by the Scalar Field, and since the flux of the gravitational field in our space is spherically symmetrical, its magnitude does not depend on the distance from the field source. Therefore, the force of gravitational interaction between massive bodies will depend in inverse proportion to the square of the distance. In addition, it will be proportional to the product of the masses of interacting bodies (see above for charges). Such dependence will exist at an arbitrary speed of virtual gravitational waves. Because the Scalar Field, thanks to its size, has the ability to overcome arbitrary distances in the Universe at once, it can contribute to the interaction between galaxies almost instantaneously. The author pointed to this possibility in the article [10]. Note that this possibility is caused by the hierarchical structure of the Universe [10]. In this case, at the first four levels (weak, strong, electromagnetic, and gravitational on a planetary scale), the rate of propagation of the interaction is equal to the speed of light. And already at the levels of stellar clusters, galaxies and Metagalaxy, other laws of gravitational interaction apply. Considering the hierarchical structure of the Universe, the author wondered that at the top hierarchical levels the speed of gravitational interaction is much higher than the speed of light. After the task of description of the properties of the Scalar Field is done [4], it became clear that such a fact could take place, since the dimension of graviton is much higher than the dimension of our Universe. In fact, this explains the existence of gravitational interaction in the galaxy and between galaxies in the Universe.

However, at all hierarchical levels, gravitational interaction occurs through the exchange of virtual gravitational waves (gravitons). This exchange looks like this. The perturbation by gravitational field (or Scalar Field) of one mass of the field of the second mass causes radiation of the second mass of graviton. This decreases the energy of the second body. Moving the graviton to the first mass causes the reverse simultaneous movement of the Scalar Field responsible for the first mass. Absorbing the graviton, the first mass returns the energy lost. The dynamics of graviton capture causes the emission of a new graviton by first mass. The cycle of emission and absorption of the graviton is repeated indefinitely. The multidimensionality of the Scalar Field and gravitational waves will be responsible for the extremely weak gravitational interaction between the bodies.

The question remains: does the movement of galaxies affect the magnitude of the gravitational interaction? It is possible that such influence exists, and the magnitude of the gravitational interaction decreases further with the distance between galaxies. Purely phenomenologically, this can be thought of as an additive repulsion, the magnitude of which increases with distance. In this case, we get an accelerated galaxy run [11, 12].

On the other hand, in [13] it was argued that the accelerated divergence of galaxies may be due to the nonzero value of the cosmological constant Λ. Since in fact $\Lambda = 2.7958473 \cdot 10^{-56}$ sm^{-2} [8], it is most realistic that this fact also causes the accelerated expansion of the Universe. To the surprise of the author of this article, physicists are not familiar with I. Gerlovin's monograph [8], so the author of this article cited I. Gerlovin's data regarding it in his article [14].

It is worth saying a few words about the gravitational interaction of a massive body with a photon. The photon is known to have the mass $m_{ph} = h\nu/c^2$. Therefore, it will be attracted to massive bodies, distorting its trajectory of motion. It has been shown above that gravitational interaction is entirely caused by the involvement of the Scalar Field. Is there a Scalar Field near the photon? To answer this question, one should again refer to I. Gerlovin's monograph [8], in which he showed that the excitation of vacuum particles causes the appearance of a wave moving with velocity c. That is, along with the photon, the wave of excitation of the vacuum particles to the virtual state is moving. And such excitement is possible only through Scalar Field. Therefore, the photon moves with the Scalar Field, and therefore can have mass and participate in the gravitational interaction.

On the possibility of measuring the speed of propagation of gravitational interaction

We already know that gravitational interaction is 40 orders of magnitude weaker than electromagnetic interaction. Therefore, it is not surprising that neither the virtual gravitational wave nor the free gravitational wave can be fixed by our devices. We can register a separate quantum of an electromagnetic wave. Therefore, it may be possible to record the disappearance or occurrence of a volume exceeding 10^{12} kg. Thus, it is hoped to detect supernova explosions, provided that they are located close enough to Earth, as well as the merging of black holes in the center of the galaxies, if a gravitational wave is directed toward the Earth.

In the 1960s, a series of articles appeared in which Joseph Weber reported the creation of a gravity wave detector, which featured an aluminum cylinder weighing 1500 kg with end-to-end sanders. He then placed several detectors at a distance of about 1000 km. In one of the experiments at both locations, singles were recorded almost simultaneously (up to 0.2 s), which Weber perceived as the registration of gravitational waves. It is clear that such a signal could not be from gravitational waves, since the maximum possible time offset between the recorded signals could not exceed 0.003 s. Most likely recorded fluctuations in the Earth's crust, which are quite often detected.

The availability of information about the results of Weber's research interested the author of this article and led to the start of his own theoretical research in this direction. Several variants of the gravity wave detector have been found. Among them was a detector in which the working body was the crust. At a great distance from each other it is necessary to install parallel decals (a variant of the Michelson interferometer), between which a laser beam must pass. The interference pattern at the output of the sensor should feel the vibrations of the earth's crust. It is clear that, first of all, the earth's crust fluctuations will be felt. Therefore, the project proposed to create a receiver of gravitational waves on the same principle as the created radio telescopes.

Another variant of gravity wave detector was a compact detector designed to measure the speed of propagation of gravitational waves. Therefore, this detector must record gravitational waves from explosions on the surface of the Sun and compare them with the simultaneous registration of these explosions in the optical range. Simultaneous bursts of intensity could indicate the same propagation speeds of gravitational and electromagnetic waves. This statement of the problem was caused by the fact that the gravitational wave was attributed to a much higher propagation rate than the electromagnetic wave.

Such a detector was proposed to be made in the form of a long dielectric tube filled with a substance sensitive to gravitational waves. Such a substance was able to be constructed on the basis of a molecule of ferrocene (an iron atom between two five-membered carbon rings). The five-membered rings are crosslinked using a chain of 10 carbon atoms. In such a construction, a sufficiently large positive charge must exist on the iron atom, and a negative charge of corresponding magnitude will be accommodated on the carbon atoms. Only a few years later, information on the synthesis of fullerenes, in particular C_{20} fullerene, was met. In addition, it is found that fullerene C_{20}, which is in the form of dodecahedron, easily absorbs iron cations. In this case, the iron cation is weakly bound to fullerene. Because the ratio of the cross-sectional areas of fullerene to iron is extremely large, they will respond differently to the gravity wave stream. As a result, the volume will be noticeably polarized with the frequency of the gravitational wave, which will be easily detected by electrodes at the ends of the tube.

Such research confirmed the author's own interest in the problem. However, the main topic of research in those years was processes related to lasers, solid-state optics, and the recording of optical information on molecular systems. Therefore, reflections on the problem of detecting gravitational waves were rather a training of the mind and were not subject to publication. And it's nice to see that some ideas were implemented by groups of physicists who were able to register gravitational waves. It is hoped that the further improvement of gravity-field detectors and the implementation of radio astronomy-specific registration methods will allow them to see the objects emitting gravitational waves and the processes that cause the generation of gravitational waves.

Only in recent years has the author fully matured to understanding and describing the model of creation and evolution of the Universe [2,13], from which it became clear that the gravitational field is created by a multidimensional Scalar Field and is therefore multidimensional. This fact is entirely responsible for the fact that the gravitational field is almost 40 orders of magnitude weaker than the electromagnetic field. And it is good that such a relationship exists. Otherwise, with increasing gravitational interaction by several orders of collapse, not only stars but also planets would fall. The weakness of the gravitational interaction can limit the observation of gravitational waves generated only within the galaxy. And supernova explosions can only be detected in close proximity.

In the article [14] it was shown that in the model of the Universe with the minimum initial entropy by optical methods it is possible to see no more than 8% of mass in the Universe. This is because we are observing the past of distant galaxies. And in the past their mass was much smaller. Gravitational waves see all 100% of the mass of the Universe. Proof of this is the complete correspondence between the modern mass of the Universe and the magnitude of the Hubble constant. The lack of understanding of this fact within the Standard Model of the birth of the Universe led to the emergence of the theory of black matter and black energy, which no one has seen and will not be able to see. Since the introduction of these concepts into consideration is not scientific and demeans science, they should be withdrawn from use.

5. Conclusion

Based on the analysis of gravitational interaction using the model of creation of the Universe with the minimum initial entropy the following conclusions are made.

1. The electromagnetic interaction between the electric charges is formed like a strong interaction. Charges are exchanged by virtual photons created by the Scalar Field. The virtual photon wavelength is twice the distance between charges. In this case, photons with circular polarization are emitted and absorbed by the charges, which provides attraction of different electric charges and repulsion of the same charges.

2. Electric and magnetic fields, electromagnetic waves and virtual electromagnetic waves take place in three-dimensional space. In this case, electromagnetic waves and virtual electromagnetic waves arise with the participation of the Scalar Field.

3. The gravitational field and gravitational waves have a dimension that exceeds the dimension of the Universe.

4. Since masses exist due to the Scalar Field, the gravitational interaction between the masses is entirely caused by the action of the Scalar Field. The fundamental dimension of the Scalar Field determines the high dimension of the gravitational field and gravitational waves.

5. The high dimension of the gravitational field and gravitational waves is responsible for the fact that gravitational interaction is weaker by almost 40 orders of magnitude for electromagnetic interaction. Thanks to this fact, there are planets, stars, and galaxies in the Universe.

6. The concept of dark matter and dark energy is due to the fact that in the Standard Model it is impossible to understand that optical observations can register only 5% of all matter in the Universe, while the gravitational field interacts with 100% of the mass of the Universe.

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