

On the Gravitational Waves of the Planets Closest to the Earth and Experimental Possible of Its Measurement

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Abstract

The laws of gravity are important for understanding the foundations of the material world at all its levels, from elementary particles to the entire Universe. Therefore, their study allows you to better understand the problems of natural science for all levels of the material world. The greatest opportunities for studying the laws of gravity are associated with the solar system, where the masses of space objects and the laws of their motion are well known. However, the determination of their fields on the basis of traditional theories of gravity still leads to abstract equations that do not give concrete results; therefore, they have a level of hypotheses. A number of initial scientific propositions based on abstract mathematical dependencies have controversial meanings. In particular, schemes of the gravitational interaction of the fields of 2 physical bodies belong to them. Elimination of this disadvantage is **the main goal of the work performed**. Its main difference and scientific novelty is the substantiation of the spatial wave system of the gravitational interaction of fields on the example of the Sun, the Earth and the planets closest to it, as well as the possibility of testing this system during experimental measurements. The solution to this problem is an urgent and important scientific and applied problem since it develops knowledge about the gravitational field and the material world in general. **The performed work is based on the methods of deduction** and induction in the research of the material world based on the application of the well-known reliable laws of physics and the general principles of the development of the theory of knowledge. Other research methods are still unknown since the work performed is associated with new scientific discoveries, the search for which is difficult to formalize by technique methods. **The results of the study** consist in the analysis of secondary waves on the based structural diagram of the superposition of primary gravitational waves between two objects such as the Earth and the Moon, which

made it possible to reveal the trail of the shock wave cone behind the orbit of the Moon's motion. A similar picture can be obtained for the Sun-Venus pair. In this case, the shock wave cone arising behind the orbit of the motion of Venus can intersect the orbit of the Earth's motion in 2 places: at the entrance to the cone and at the exit from it. It is possible to register a burst of gravitational waves from this cone using the LIGO, VIRGO, KAGRA observatories. **Conclusions:** To carry out the experiment, it is necessary to perform calculations of the cone of the shock wave of Venus when it moves around the Sun and the position of the points of entry of the Earth into and out of this cone. The solution to this problem is possible in modern conditions with joint work of physicists and astronomers.

Keywords

Space-Wave Theory of Gravity, Gravitational Shock Waves and Their Registration

1. Introduction

Solving the problems of gravity is an urgent and important task since it is associated with the foundations of the material world at all its levels, from elementary particles to the entire Universe. Its study provides a better understanding of the problems of natural science for all types of objects of the material world. The works of many generations of scientists of the world are devoted to this, from the times of ancient civilizations to the present day [1] [2] [3] and many others. However, they have not been fully resolved, which requires elimination of this deficiency.

The most important initial work should be considered the work of Newton [4], who solved the problem of determining the forces of gravity for two point bodies. A significant step was taken by Einstein, who developed the foundations of the theory of gravity in the framework of the axiom of curvature of space in the general theory of relativity (GR) [5]. Since then, the main provisions of this theory have been deepened and expanded in hundreds of scientific works based on this axiom using various types of tensor equations and other mathematical dependencies.

However, for more than 100 years of research of this theory with a large number of publications per year, the problems of the interaction of gravitational fields, even for 2 objects, have not been solved. For example, in one of such works [6], the study of the gravitational field and the obtained lines of force for two identical masses are shown (Figure 1).

In [6] states that "This procedure is the same in both gravity and electrostatics and results in the same interaction law within the accuracy of the negative multiplier", therefore their scheme "is similar to the interaction of static electric charges with the same sign". However, the circuit shown in Figure 1 refers to

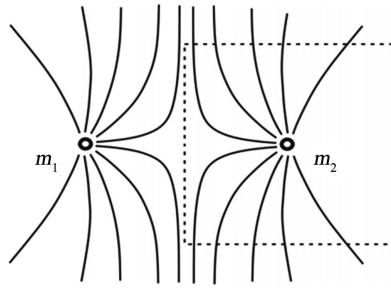


Figure 1. Force lines of gravity field of two identical masses [6].

electric charges with the same sign [7]. This is not a strictly proven fact, since all works in the field of gravity, created on the basis of [5] [6], provide solutions to tensor equations and other mathematical dependences of an abstract general form that are difficult to apply to specific objects, which reduces them to the level of hypotheses. The indicated drawback hinders the possibility of studying gravitational fields; therefore, its elimination is required.

Since 2014, it has become possible to experimentally determine gravitational waves, since several observatories have been created that can register a burst of gravitational waves reaching the Earth from distant space. For their discovery in 2017, the Nobel Prize in Physics was awarded [8]. Laser interferometric gravitational-wave observatories (LIGOs) built in the USA: one in Livingstone, Louisiana, and the other in Hanford, Washington [9], was used to register the wave burst. They determined the relative frequency wave's shift of the forward and reverse paths of laser beams under the action of this burst.

At the initial stage, the oscillations of the forward and backward laser waves were tuned in mutually opposite phases, so they suppressed each other. A gravitational wave passing through the beams caused a delay in the shift of the wave oscillation frequency, which excluded their suppression and laser light appeared, which was recorded by sensors. The system is in the event standby mode. The first was registered on September 14, 2015, which was identified with the merger of Black Holes. Until September 2017, 3 more such events were registered. The latter was also recorded by the European observatory near the city of Pisa (Italy) by the Franco-Italian gravitational wave recorder (VIRGO) [10]. This gravitational wave was identified with the explosion of a neutron star, the outburst of which was confirmed by optical observations [8].

A Kamioka gravitator (KAGRA) of a similar type has been operating in the Japanese city of Kamioka since 2019 [11].

These observatories and the sensitivity of their equipment are constantly being improved, so in 2019 more than 50 such bursts were recorded.

These observatories recorded gravitational waves from mergers of Black holes and explosions of neutron stars. However, the use of them for the experimental detection of gravitational waves of the planets closest to the Earth was not intended. In addition, this possibility was not considered, since it did not have a theoretical basis.

The purpose of this work is to substantiate such a possibility and develop condi-

tions for its implementation. Her scientific novelty is the substantiation of the wave system of the gravitational interaction of the Earth and the planets closest to it and the possibility of their experimental measurement.

The solution to this problem is an urgent and important scientific and applied problem since it develops knowledge about the gravitational field and the material world in general.

2. Working Methods

The performed work is based on the methods of deduction and induction in the research of the material world based on the application of the well-known reliable laws of physics and the general principles of the development of the theory of knowledge. Other theoretical research methods are still unknown since the work performed is associated with new scientific discoveries, the search for which is difficult to formalize by traditional methods of conducting scientific research. Methods of scientific research of gravitational waves in observatories of the LIGO type were also used.

3. Results and Their Discussion

The work is based on the space-wave system of gravitational waves proposed in [12]. The physical model of this system is based on the propagation of spherical waves of gravitational fields emitted by these objects. An example of such a system for the Earth and the Moon is shown in **Figure 2(a)**. The next research process is to analyze the secondary waves of interaction of waves of gravitational fields; this is “moiré” in the block diagram shown in **Figure 2(a)**. Three zones of “moiré” are clearly visible: 1) wave connections between two objects, such as the Earth and the Moon, 2) the trail of the shock wave cone behind the orbit of the Moon’s motion, 3) the general “echo” of gravitational waves from the rear side of the Earth. They are marked in **Figure 2(b)** by the superposition lines of spherical waves of the primary gravitational fields of the Earth and the Moon. Their formation is a new scientific hypothesis of this work.

The direction of action of these lines of force is from a more massive object to a less massive one because, in a pair of interacting objects, the secondary waves of a more massive object suppress the waves of a less massive object.

These secondary waves of interaction of waves of gravitational fields and diagram of the lines coincides well with the lines of force of the electromagnetic field E in the interaction of opposite charges (**Figure 3(a)**). This is possible if the gravitational fields of 2 objects are the same, *i.e.* are formed by them of the same mass and size, (**Figure 3(b)**), which does not exist in the Solar system.

The circuit shown in **Figure 3(a)** is opposite to the circuit shown in **Figure 1**, and its coincidence with the circuit in **Figure 3(b)** is well explained by the unity of the gravitational and electromagnetic fields, which was substantiated in [13] [14] [15]. The totality of the given data testifies to the shortcomings of determining the wave and force parameters of the gravitational field on the basis of traditional theories [5] [6], the criticism of which is given in [12].

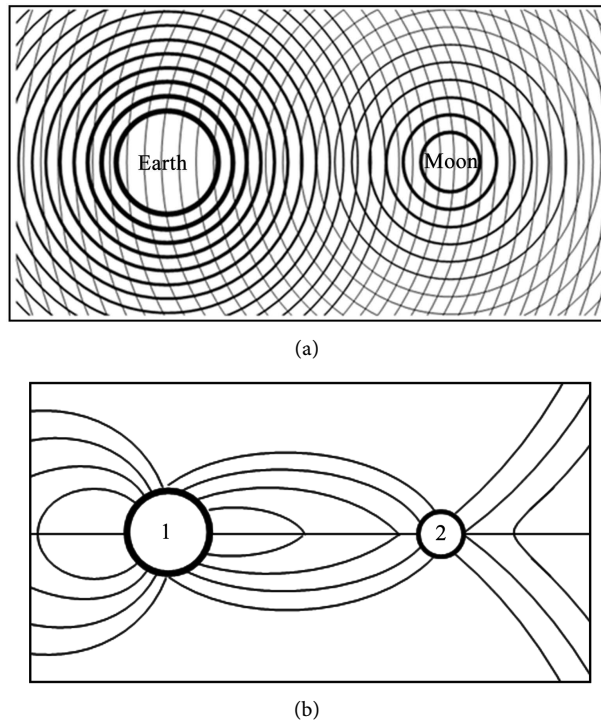


Figure 2. (a) Spatial model of gravitational waves in the Earth (1) and Moon (2) [12]; (b) diagram of the lines force of secondary waves of interaction of waves of gravitational fields.

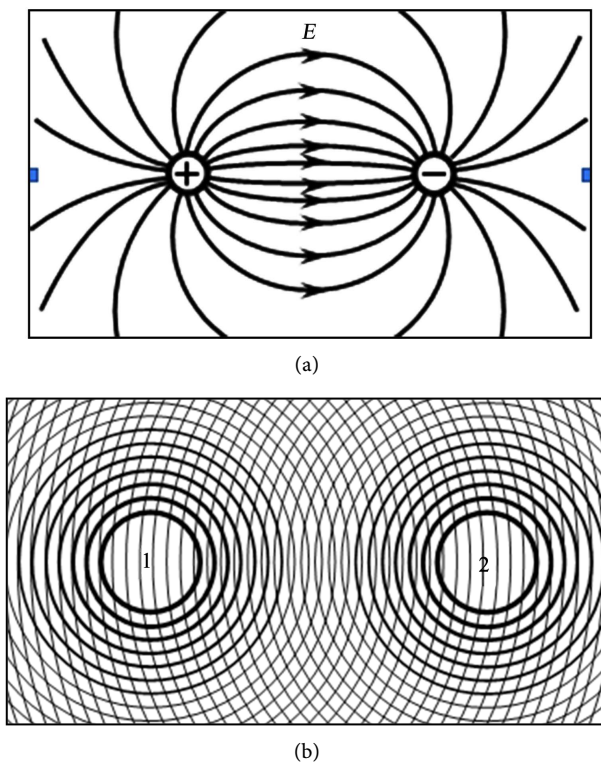


Figure 3. Scheme of action of the same magnitude of static electric charges of opposite sign (a) [7] and the scheme of interaction of objects 1 and 2 with the same parameters of gravitational fields (b).

When solving the problem of determining the wave parameters of the gravitational field and its combination with the electromagnetic field, the initial is the oscillation frequency of the wave ν_G of the gravitational field (1), or the Nastasenko constant [16] [17] [18]. It is obtained on the basis of a strict physical dependence consist of the 3th fundamental physical constants: the speed of light in vacuum c , the gravitational constant G and Planck's constant h , the numerical values of which are recommended by CODATA [19]:

$$\nu_U = \sqrt{\frac{c^5}{Gh}} = 7.39994 \times 10^{42} \text{ (s}^{-1}\text{)} \rightarrow 7.39994 \times 10^{42} \text{ (s}^{-1}\text{)} \quad (1)$$

Since the constant $\nu_G = 7.4 \times 10^{42} \text{ s}^{-1}$, which has the dimension s^{-1} (or Hz), was found on the basis of the real constants c , G , h , according to a strict physical dependence (1), therefore it is real quantity—the frequency of oscillation of the waves of the gravitational field [17] [18]. Therefore of denying its reality is equivalent to denying of the real constants c , G , h . This constant ν_G (1) is absent in the works of M. Planck, who determined only the opposite value—the second (s), or the metric of the unit of time. But is without binding it is to the gravitational field, it is an abstract value [19]. M. Planck did not investigate gravitational fields and their wave parameters. Considering that the constant $\nu_G = 7.4 \times 10^{42} \text{ s}^{-1}$ has the level of scientific discovery, the author has the right to give it his name [21].

Taking into account the dependence (2) (Nastasenko's equation) found in [22], we can apply the oscillation frequency $\nu_G = \nu_U$ when determining the constant G (3), with which the gravitational field is associated, and the constants h (4) and c (5), with which the electromagnetic field is connected:

$$Gh\nu_U^2 = c^5 \quad (2)$$

$$G = \frac{c^5}{h\nu_U^2} \quad (3)$$

$$h = \frac{c^5}{G\nu_U^2} \quad (4)$$

$$c = \sqrt[5]{Gh\nu_U^2} \quad (5)$$

Therefore, in [12] on a strict physical basis, the gravitational and electromagnetic fields were combined in the Unified field, which makes it possible to take into account the analogy of their lines of force shown in **Figure 3**.

A picture similar **Figure 2**, can be obtained for the Sun-Venus pair. In this case, the shock-wave cone arising behind the orbit of the motion of Venus with a period of rotation around the Sun of 243 days, cross the orbit of the Earth's motion with a period of rotation around the Sun of 365 days, in the 2nd point: at the entrance to the cone (**Figure 4(a)** and **Figure 4(b)**) and at the exit from it (**Figure 4(c)** and **Figure 4(d)**).

The gravitational fields of Mercury and the Earth are not shown in **Figure 4**, so as not to clutter it up and to highlight the structures of the fields of the main interaction on it. At the same time, it was taken into account that the influence

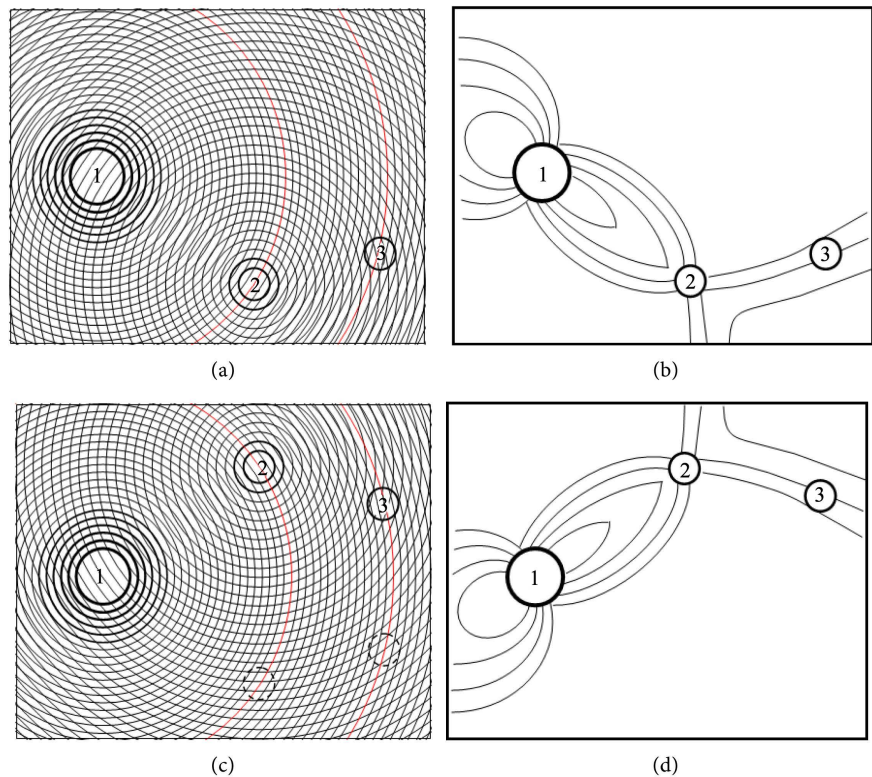


Figure 4. Scheme of the interaction of the Earth with the shock-wave cone of the gravitational field of Venus and his power lines: (a), (b) at the cone entrance, (c), (d) at the exit from it, 1—Sun, 2—Venus, 3—Earth.

of these planets on the overall picture of gravitational interaction does not exceed 5%, which fits into the general error limits for conducting such experiments.

There is reason to believe that the Earth will be “shaken” by the waves of this cone. Although the impulse is unlikely to be noticeable at the macrolevel, several observatories LIGO have already been created on Earth that can record the burst of gravitational waves that have reached it from the distant expanses of space.

It should be noted that the sources of gravitational fields recorded by these observatories have higher power than the shock-wave cone of the Venus. However, the distance of the Venus from it to the Earth is much less, which creates the basis for its registration by the indicated observatories. In addition, the accuracy of the observatories and the operation of their instruments are constantly improving, which creates the basis for the possibility of recording the cone of the Venus shock wave by the above observatories. But the problem of fixing gravitational waves from the planets of the solar system closest to the Earth by these stations was not posed or solved.

At present, there is a possibility of calculating the parameters of the shock-wave cone of Venus based on the wave parameters of the gravitational field (1), (6) ... (10), which were first found in [22] [23]:

- 1) Period of oscillation T_G :

$$T_G = \frac{1}{\nu_G} = 0.1351 \times 10^{-42} \text{ (s)} \quad (6)$$

2) Length of carrier wave λ_G :

$$\lambda_G = \frac{c}{\nu_G} = 4.051249432 \times 10^{-35} \text{ (m)} \quad (7)$$

3) Amplitude of oscillation A_G :

$$A_G = \lambda_G = 4.051249432 \times 10^{-35} \text{ (m)} \quad (8)$$

4) Wave energy E_G its maximum quantum of energy:

$$\begin{aligned} E_G = h\nu_G &= 6.626070040 \times 10^{-34} \text{ (J} \cdot \text{s)} \times 7.4 \times 10^{42} \text{ (s}^{-1}\text{)} \\ &= 4.9032918286 \times 10^9 \text{ (J)} \end{aligned} \quad (9)$$

5) Mass equivalent m_G of the wave energy E_G (5) of the gravitational field:

$$m_G = \frac{E_G}{c^2} = \frac{h\nu_G}{c^2} = 5.455647929 \times 10^{-8} \text{ (kg)} \quad (10)$$

It should also be taken into account that within the framework of the analogy of the scheme shown in **Figure 2** for the Earth and the Moon, a direct action of the gravitational field of Venus on the Earth is possible. However, for the Sun, which has a mass $M_\odot = 1.9885 \times 10^{30} \text{ kg}$ and a distance to the Earth $L_\odot = 1.496 \times 10^{11} \text{ m}$, and Venus, which has a mass of $M_\venus = 4.8675 \times 10^{24} \text{ kg}$ and the minimal distance to the Earth is $L_\venus = 0.38 \times 10^{11} \text{ m}$, within the framework of Newton's Universal Law of Gravitation, the ratio of these parameters will be (11):

$$\frac{M_\odot}{M_\venus} = \frac{1.9885 \times 10^{30} \text{ kg}}{4.8675 \times 10^{24} \text{ kg}} = 4.085 \times 10^5 \gg \frac{(L_\odot)^2}{(L_\venus)^2} = \frac{(1.496 \times 10^{11} \text{ m})^2}{(0.38 \times 10^{11} \text{ m})^2} = 15.499 \quad (11)$$

This indicates that the energy of gravitational waves from the shock cone of Venus's motion around the Sun is much higher than the energy of the direct action of its gravitational waves on the Earth, which is more favorable for registering them by LIGO-type observatories.

Further transformations of wave parameters (6) ... (10), taking into account the masses of the Sun and Venus, make it possible to determine the wave parameters of their gravitational fields, the superposition of which forms the shock cone. After that, astronomers can calculate the moments of the Earth's contact with this cone at the entrance and at the exit. Astronomers are invited to collaborate.

For research, it is proposed to use not only the LIGO observatories, but also VIRGO and GEO600 in Europe, as well as Kamioka gravitator (KAGRA) of a similar type has been operating in the in Japan and an observatory under construction LIGO in India (**Figure 5**). The main thing is the condition that at this moment the listed observatories are turned towards of this cone. If such a coincidence is impossible for the listed stations (**Figure 5**), it will be necessary to build a new one located at the estimated place and time of the cone crossing.

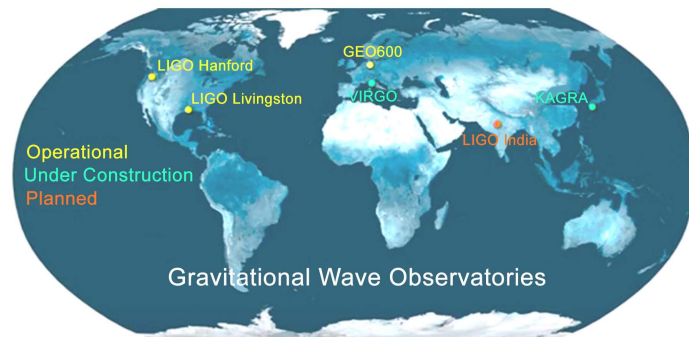


Figure 5. A network of current and future gravitational wave detectors. Image from the press conference on February 11, 2016 [9].

The novelty of this proposal lies in the fact that no one has used LIGO and other observatories to record the gravitational waves of Venus. This is the level of novelty—the application of the known in new conditions.

Thus, for Einstein, the solar eclipse of 1919 was the finest hour, and for the wave gravitation theory, such a triumph could be the registration of a cone of a shock gravitational wave from the moving Venus, as it passes through the Earth's orbit and the stations LIGO, VIRGO, and KAGRA located on it.

The new model of gravity (**Figure 2**) on a rigorous scientific basis is justified by the actually existing laws of physics and leads to the establishment of previously unknown objectively existing laws, properties and phenomena of the material world that make fundamental changes in the level of scientific knowledge, which has all the signs of scientific discovery [21]. This paper does not deny the works on the curvature of space and can supplement them, which requires further research to coordinate them.

4. Conclusions and Recommendations

1) A space-wave model of the gravitation action is proposed, based on the wave parameters of the gravitational field of the Universe and the fields of material objects included in it (which reduces their structures to similar ones within the framework of the unity of the gravitational and electromagnetic fields).

2) When material objects move in the gravitational field of the base object, secondary waves appear in the form of a shock cone, the registration of which is possible experimentally by LIGO, VIRGO, and KAGRA observatories on the example of the interaction of the Sun in Venus-Earth system.

3) To carry out the experiment, it is necessary to perform calculations of the shock-wave cone of the Venus when it moves around the Sun and the position of the points of the Earth's entry into this cone and its exit from it. The solution to this problem is possible in modern conditions with joint work of physicists and astronomers.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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