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On The Gravitational Shielding, Gravitational Permeability and Hidden Matter

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Abstract

The possibility of gravitational shielding from more massive objects than the Moon—planet Earth and the giant planets of the Solar System is considered. Within the framework of the Lesage concept, the mutual spatial shielding of mass-forming elements—atomic nuclei in ordinary matter—was evaluated. It is concluded that the size of the Moon is insufficient for tangible gravitational shielding and partial mutual shielding is about 50% for planet Earth. It is determined that there is a critical thickness of ordinary matter at which complete mutual shielding of atomic nuclei is observed. The estimated critical thickness is about $d_c = 1.3\times10^8\,\text{m}$, which is typical for the sizes of giant planets. It is concluded that due to the presence of gravitational shielding, not the entire mass of massive celestial bodies participates in the act of gravitational interaction, which leads to the conclusion that there is a hidden mass of massive objects and to low values in the calculation of the density of the giant planets of the Solar System. It has been established that the true mass and true density of giant planets exceed their known values by 5 times. The presence of gravitational shielding from the planet Earth leads to a revision of the physical picture of nature and the consequences of tidal forces. The idea of P. Dirac concerning the accounting of the sizes of microparticles—nucleons, expressed for the further development of the physical theory, is realized. The gravitational size of the atomic nucleus is calculated on the order of 10^{-18} m.

Keywords

Gravitational Shielding, Gravitational Permeability, Lesage Theory, Gravity Variation, Universal Gravitational Constant, Semi-Daily Gravity Changes, Precession of Mercury Perihelion, Density of Planets

1. Introduction

In classical approaches to the description of gravitational interaction, the main arguments are the effect of ether particles pressure on physical bodies and the fact of mutual shielding of interaction elements. If an obvious assumption can be made regarding ether cosmic pressure, then the issue of mutual spatial shielding of physical objects does not have an appropriate theoretical basis.

The question of mutual shielding of physical objects is connected with the question of gravitational shielding, the physical picture of which is not unambiguously established at the moment. The study of this issue has a century-old history [1] [2] and it continues at the present stage due to its relevance [3]-[12]. With the classical approach, research on gravitational shielding is organically connected with the question of the ether, the existence of which was not in doubt in the intuitive vision of the classics of physical science, by which many physical phenomena were interpreted under the assumption of its existence.

A lot of studies conducted by different researchers in different years have been devoted to the study of the question of gravitational shielding, however, the results obtained do not allow us to evaluate them in an unambiguous way, and they do not meet the requirements of reproducibility, do not lead to general and unambiguous conclusions [13]-[20].

However, they confirm the fact of the manifestation of anomalies of an unknown nature in one form or another during the mutual shielding of celestial bodies, which gives grounds for further reflection and new research.

The issues of gravitational shielding are also considered within the framework of modern approaches. In [21] based on the gauge theory, the possibility of the existence of gravitational shielding was shown. In [22] the mass of a point particle is considered within the framework of modern physics. The introduction of gravitational mass offers an explanation of the mass deficit, dark energy and the cosmological constant. It is concluded that dark matter and dark energy have a gravitational nature. In [23] gravity and the nuclear interaction are considered in mutual connection: the mass defect is considered as a gravitational effect.

Although today the consideration of interaction issues is carried out within the framework of modern physics, however, the possibility of their consideration taking into account previously unaccounted circumstances within the framework of classical physics is not excluded. In such circumstances, consideration of the sizes of interacting elements is proposed, as indicated by P. Dirac in his review article [24]. Taking into account the size of the electrons and nonclones the results were obtained in [25] [26].

2. Method and Calculations

In the description of the gravitational interaction, the main argument is the mass of the interaction elements, which indicates that the existence of matter is expressed through its properties—through mass. If it is necessary to describe the interaction as a result of mutual spatial shielding, then it becomes necessary to take into account the size of the interaction elements. For ordinary substances, the basic elements of interaction are mass-forming elements, which are nucleons in the atomic nucleus and atomic nuclei in matter, to a small extent—electrons. It is possible to assess how capable they are of creating mutual spatial shielding. In [26], the equation of mutual spatial shielding of interaction elements was obtained in a general form and the case of close shielding—mutual spatial shielding of nucleons in the atomic nucleus was considered in detail. In this paper, the issue of mutual spatial shielding is considered in the case of mutual shielding of atomic nuclei in ordinary substances, which is a far shielding. In reality, ordinary substances for mutual spatial shielding are a fairly transparent medium—the ratio of the size of the atomic nucleus to the size of the atom is 10^{-4}. In order for spatial shielding with ordinary matter to occur, a sufficiently large thickness of it is required. This indicates that gravitational shielding, if it exists in nature, is dependent on the thickness of matter and can manifest itself with a sufficiently large thickness of a physical object of ordinary density. This circumstance makes it possible to talk about gravitational permeability.

For quantitative calculation, the formulation of the mutual spatial shielding of physical bodies is reduced to determining the shadow area that they form in relation to the selected direction or to the test element when parallel rays pass through them. The area of interaction of a physical system is defined as the area of the shadow S_{sh}, mentally formed from its elements during the passage of parallel rays on a screen perpendicular to the direction of the rays. The corresponding equation for describing the mutual shielding of interaction elements having the same cross-sectional area S_l is obtained in [26] in the form

$$S_{sh} = S_b\left[1-\left(1-\frac{S_l}{S_b}\right)^N\right], \quad (1)$$

where S_b is the area of the base of the shadow formation, N is the number of layers in which the shielding elements are located.

Expression (1) can be written as

$$S_{sh} = S_b\left[1-(1-\delta)^N\right], \quad (2)$$

where $\delta = \frac{S_l}{S_b}$ is a shielding parameter. It is always less than one. Its values determine in which cases the shielding effect can be expected to manifest. The application of relation (2) can be considered in two cases: the first case, when the interaction elements are at distances comparable to their sizes, when the shielding parameter has values close to unity $\delta \le 1$. This case is a close shielding [26]. The second case is when the interaction elements are at distances much larger than their size $\delta \ll 1$. This case is a far shielding. In general, both for close and far shielding, the graph of the dependence of expression (1) has a classical saturation character (**Figure 1**). The dependence curve has a linear growth section at the beginning, a plateau transition section in the middle, and a plateau section at the end. On a linear segment, the mutual shielding of elements is not significant, the total area is added in an additive way $S_{sh} = \sum S_i$. On the segment of the transition to the plateau, there is a partial mutual shielding of $S_{sh} \neq \sum S_i$. With an increase in the number of layers, at some values of *N*, there is a complete mutual shielding of elements, and there is an exit to the plateau $S_{sh} = const$. The higher the value of the parameter *δ*, the faster the plateau is reached.

To consider the mutual spatial shielding of atomic nuclei, assume that an ordinary medium consists of many layers with a crystal lattice thickness, in each of which nuclei are located at distances of the size of an atom from each other (**Figure 2**). It is required to determine the area of the shadow formed on the base of the object from randomly located atomic nuclei, depending on the number of layers. Since the size of the lattice is equal to the size of an atom, it has a base area $S_{sq} = 4R_a^2$, where R_a is the radius of the atom. To study the mutual shielding of atomic nuclei, it is necessary to determine the value of the shielding parameter $\delta = \frac{S_n}{S_{sq}}$, where S_n is the cross-sectional area of the atomic nucleus. Then the expression (1) is written as

$$S_{sh} = S_{sq}\left[1-\left(1-\frac{S_n}{S_{sq}}\right)^N\right]. \quad (3)$$

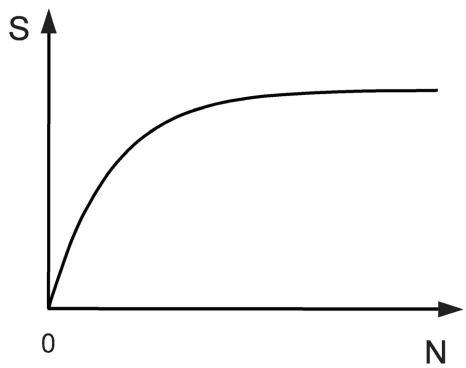

Figure 1. General view of the dependence of the area of mutual shielding of interaction elements on the number of shielding layers.

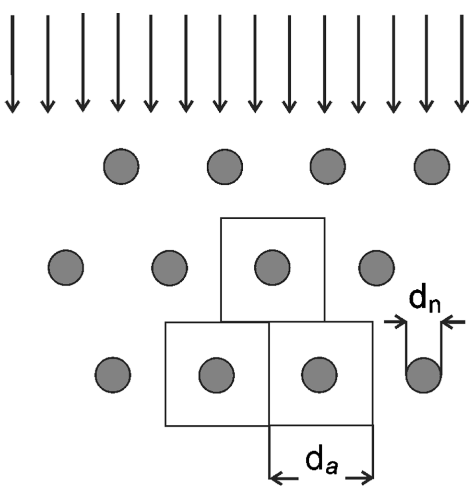

Figure 2. Scheme for calculating the spatial shielding of the interaction elements.

By supplying expressions for the cross-sectional area of the nucleus in the form $S_n = \pi R_n^2$ and the square base area in the form $S_{sq} = 4R_a^2$ and known values for the radii of the nucleus $R_n = 10^{-15}$ m and the atom $R_a = 10^{-10}$ m in the expression (13), we obtain:

$$S_{sh} = S_{sq}\left[1 - 0.99999999993^N\right] \quad (4)$$

In accordance with (4), the condition $0.9999999993^N \to 0$ must be met for complete shielding, which will be achieved for values of the order $N \approx 7 \times 10^{10}$. Multiplying this number by the height of the crystal lattice $L = 10^{-10}$ m, we obtain a thickness at which full shielding $d_c = 7$ m is achieved. The result obtained does not correspond to reality in value, but it can be discussed. From the result obtained, it can be concluded that the spatial mutual shielding for bodies of ordinary density depends on their thickness.

Another question is whether we can have d_c values that could provide manifestations of gravitational shielding of massive cosmic bodies? This is possible if it is possible to justify smaller values of $\frac{S_n}{S_{sq}}$ for them. In principle, the space-shielding size of atomic nuclei, which is the main argument for interaction according to classical concepts, should be distinguished from their size, considered and determined by their properties. The particle size, in the representation of mutual spatial shielding, can be called the gravitational size. It is natural to expect that the size of the atomic nucleus, currently established by physical properties, may not coincide with the space-shielding, gravitational size. Experimental data can be used to determine the gravitational size of atomic nuclei.

The phenomenon of gravitational shielding is sought for massive bodies since it definitely does not take place for ordinary terrestrial bodies, *i.e.*, the search is conducted depending on the size of the object. Usually, a solar eclipse is used to detect gravitational shielding. However, in order to identify the effect of gravitational shielding in the assumption of its existence, depending on the thickness, it is legitimate to consider not the Moon as a shielding object, but a more massive space object—the planet Earth, which has a much larger size than the Moon, which can provide more convincing data on gravitational shielding, if it exists in nature.

2.1. Consideration of the Planet Earth as a Shielding Object

To obtain results regarding the possibility of the shielding properties of the Earth, it is sufficient to analyze the existing data obtained during the study of the daily variation of gravity. Experimental observations of the diurnal variation of gravity revealed two features:

- The curve of daily variation is characterized by semi-daily manifestations;
- The observed effect is about two times less than the calculated one.

The existing physical concept connects the nature of semi-daily manifestations with the tidal deformation of the Earth and with the presence of a difference in the force of the impact of the luminaries on different points of the Earth

[27]. However, elementary calculations show that these effects have an order of 10^{-6} м/с^2, which is an order of magnitude lower than the observed effect. This does not allow us to consider them as the main causes of semi-daily manifestations.

As a possible cause of their manifestation, only one factor remains to be considered—the presence of gravitational shielding from the Earth. In the presence of gravitational shielding and its dependence on the thickness of the object, the gravitational shielding of a spherical object increases with increasing thickness, with distance from the poles and reaches a maximum near the equator or when the critical thickness of the shielding is reached. **Figure 3** schematically shows the gravitational structure of the planet Earth under the influence of a luminary located on the right along the horizon. When the body moves from the position of minimum 1 to the following positions, gravity passes through the maximum in the interval of positions 3 - 5 (conditionally, in position 4). Further, at position 5 it passes through the minimum due to the maximum growth of the shielding factor at the equator. Next, the maximum passes again at position 6 and returns to the initial position of the minimum 1. The corresponding gravity curve is shown in **Figure 4**.

Another question concerns the degree of manifestation of gravitational shielding. The paper [28] presents the results of gravity measurements obtained by various

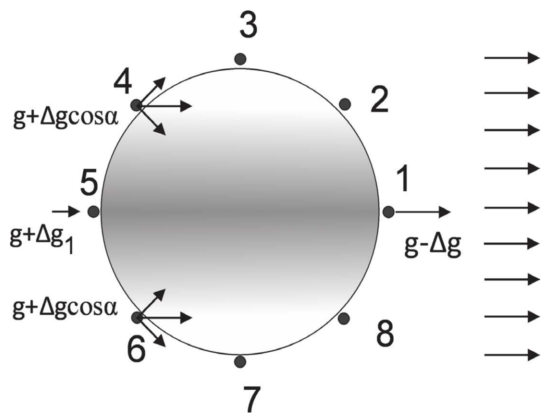

Figure 3. Daily change of vertical gravity depending on the gravitational structure of a massive body in the gravitational field of another massive body located on the right.

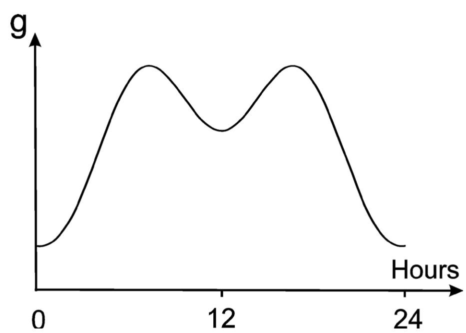

Figure 4. Possible manifestation of sevi-daily factors in the daily change in gravity during the gravitational shielding by the Earth the influence of the luminary.

researchers. The observed effect ranges from 0.42 to 0.68 of the theoretical calculation. Since approximately half of the effect is observed in the daily variation of gravity from the calculated one, it can be assumed that the Earth only partially shields bodies from the gravitational influence of the luminaries, and this indicates that the thickness of the Earth is still insufficient to completely shielding the gravitational influence.

2.2. On the Hidden Mass

The existence of a shielding thickness for bodies of ordinary density presupposes the existence of a hidden mass if they have sufficient dimensions for shielding. Schematically, the picture of the issue under consideration within the framework of the Lesage concept can be presented in accordance with **Figure 5**, where a qualitative picture of the interaction of two massive bodies with dimensions greater than the critical thickness of the shielding is given. The impact of ether particles coming from the left and right is shielded by bodies on the right and left, respectively. According to the gravitational structure, these bodies consist of shielding parts B and shielded parts A. According to the dependence curve, part B grows in thickness to the beginning of the plateau (**Figure 1**.), *i.e.*, ether particles are completely blocked up to the boundary of the B-A transition. In part B, there is a partial mutual shielding of the interaction elements, *i.e.*, a part of the substance in it does not participate in the act of interaction. As for part A, it is essentially shielded from the impact and does not participate in the act of gravitational interaction of these two bodies in any way. If such a picture is valid in reality, then more massive cosmic bodies possess matter that does not participate in the act of gravitational interaction, *i.e.*, there is a large amount of hidden matter in the Universe. It is possible to estimate the amount of hidden mass depending on the thickness of the body of the usual density.

As shown above, the curve of the dependence of the mutual shielding of the

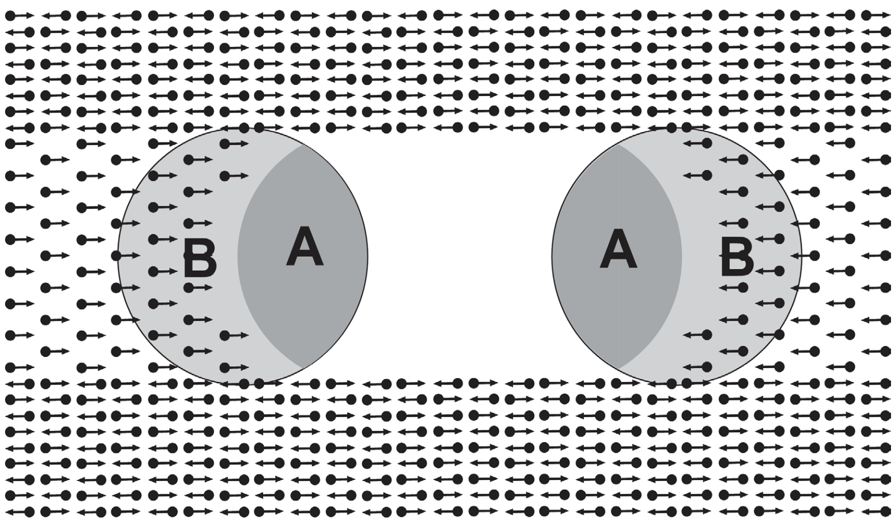

Figure 5. Qualitative picture of demonstration of the existence of a hidden mass in the interaction of two massive celestial bodies.

interaction elements is characterized by the classical type of saturation (**Figure 1**). The initial section of this curve is linear. Extrapolation of a straight line along this section gives an increase in the total area of the interaction elements if they were located in one layer without mutual shielding with increasing thickness. The difference $S_L - S_{sh}$ gives the value of the substance hidden from the interaction (**Figure 6**). From the figure we get that $\text{tg}\alpha = \frac{S_L}{d}$, where α is the angle between the straight S_L and the axis of the abscissa—thickness *d*. On the other hand, the magnitude of the angle is proportional to the magnitude of δ: the greater the δ, the greater the angle α (**Figure 7**). You can write $\text{tg}\alpha = k\delta$ or $S_L = kd\delta$, where k is the proportionality coefficient. Taking into account the latter, the shielded area is determined by the formula

$$S_h = kd\delta - S_{sh}$$

or using mass-area equivalence [26], you can write:

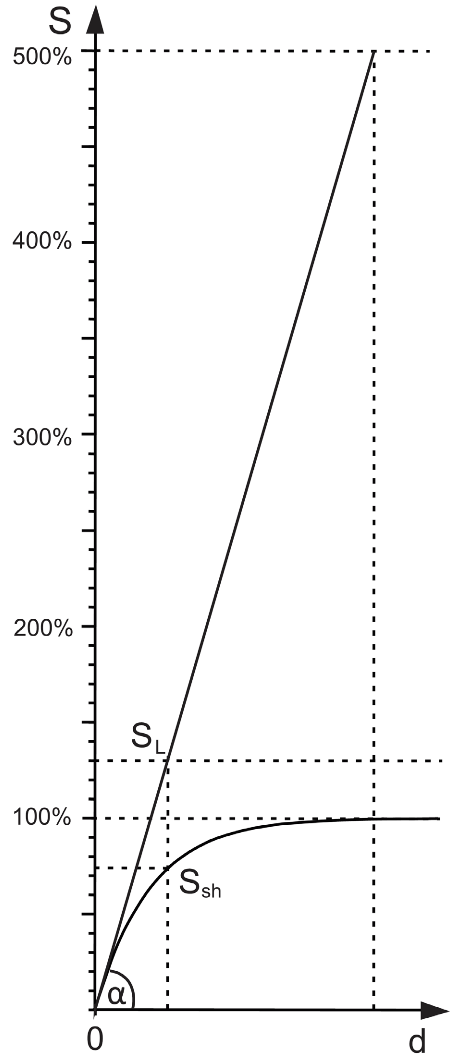

Figure 6. On the calculation of hidden mass of objects with dimensions greater than the critical thickness of the shielding.

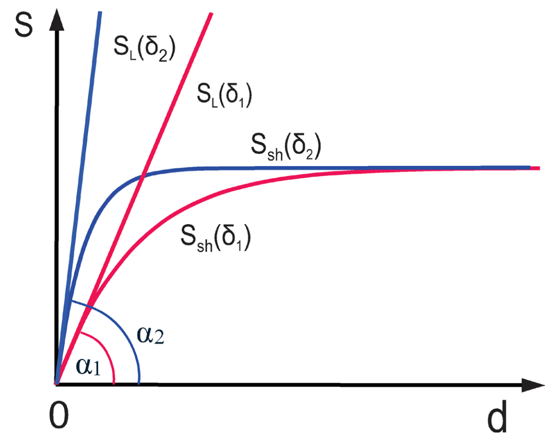

Figure 7. To the proportionality of tgα and the shielding parameter δ: $\alpha_2 > \alpha_1$, $\delta_2 > \delta_1$.

$$M_h = kd\delta - M_g, \tag{5}$$

where M_h is the hidden mass, M_g is the mass of the object that participates in the gravitational interaction.

The saturation curve has some mathematical features for analysis. The intersection of the linear line S_L with the vertical line passing through the saturation point in the curve S_{sh} always occurs at the point when S_L reaches a fivefold value of S_{sh}. This is the case in all cases of saturation. It follows from this that when the thickness is reached, where there is a complete spatial shielding, the hidden mass is 4 times greater than the mass that participates in the gravitational interaction. In order to determine the total amount of matter in more massive celestial bodies, the value of their mass, determined from the conditions of gravitational interaction, should be multiplied by the number 5. The number 5 for cases of saturation acts as a kind of fundamental constant. Using the expression for the mass-area equivalence $M = kS$, as well as the dependencies $\text{tg}\alpha = \frac{S_L}{d}$ and t $\text{tg}\alpha = \frac{5S_{sh}}{d_c}$ from **Figure 6** for the total mass of massive objects we find:

$$M_t = \frac{5d}{d_c} M_g$$

Another feature of the saturation curve is that with the certainty of the data of one of its points, it is possible to construct the entire curve. If the function is known for a given thickness, it is possible to determine its value at any other points, including the saturation point. This property can be used to evaluate the manifestation of gravitational shielding of objects of a certain size. According to the available materials, this point is known for the planet Earth. It was noted above that the reason for the manifestation of semi-daily manifestations in the variation of gravity is the gravitational shielding from the Earth. The experimental observations carried out by different authors have shown underestimated values in the daily variation of gravity. The observed value was in the range from 0.52 to 0.66 of the calculated value [29] [30] [31]. These data indicate partial gravitational shielding from the Earth. According to various authors, a decrease in gravity in its daily variation is observed in the range from 34 to 48 percent. These data are the results of observations at the latitudes of the northern hemisphere—the cities of Strasbourg, Heidelberg, and Potsdam. In [32] the dependence of gravity variation on geographical latitude is shown, which in the case of our approach implies the dependence of the manifestation of the effect on the thickness of the Earth. Taking into account the above, it can be assumed that the planet Earth shields the body from the gravitational influence by about half.

The presence of gravitational shielding leads to the presence of hidden matter. Figure 8 shows that the hidden mass for the planet Earth $S_L - S_{sh}$ is about 20%. With this in mind, the total mass of the Earth is 20% more than currently known, and therefore its density is also greater than the known value.

The analysis of the saturation curve in Figure 4 shows that the thickness of the full shielding for objects of ordinary density is reached in the order of 1.3 × 10^8 m. The diameters of the giant planets of the Solar System are comparable with this value. The established physical picture of the passage of ether particles through substances is similar to the picture of the passage of neutrinos through the Earth's thickness.

2.3. Qualitative Assessment of the Gravitational Size of Atomic Nuclei

Taking the critical thickness of the shielding equal to $d_c = 1.3\times10^8\ \text{m}$, it is possible to qualitatively estimate the average gravitational size of atomic nuclei. Dividing the maximum thickness of the shielding by the size of the crystal lattice $L = 10^{-10}\ \text{m}$, we obtain the number of layers $N = 1.3\times10^{18}$. The calculation using the formula (3) gives the average value of the gravitational size of the atomic nucleus in the order $R_n = 10^{-18}\ \text{m}$.

2.4. About the Density of the Giant Planets of the Solar System

According to the available data, the giant planets of the Solar System have large sizes, but rather low density, which in an intuitive view is perceived somewhat unexpected. In addition, the solid surface of these planets has not been determined, which further enhances the mystery of their physical condition. Another picture can be obtained if we assume that, due to their large size, they have a

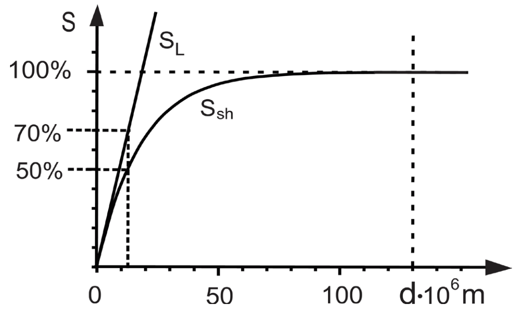

Figure 8. On the definition of the hidden mass of the Earth.

large gravitational shielding in accordance with their size. According to the concept outlined above, depending on their size, giant planets may have a part that is shielded by its other part from gravitational interaction. Then their density cannot be defined as

$$\rho = \frac{M_g}{V}, \tag{6}$$

where M_g is the mass of the planet determined from the conditions of gravitational interaction, V is the volume of the planet. In this case, the true mass will be determined as follows: $M_t = M_g + M_h$, where M_h is the hidden mass. In turn, the hidden mass consists of the hidden mass in part B (**Figure 5**) and part A. $M_h = M_{sh} + M_B$. The true density is determined by the formula

$$\rho_t = \frac{M_g + M_{sh} + M_B}{V}. \tag{7}$$

In general terms, we can consider the dependence of the apparent density of massive objects on their size. To simplify, let's imagine that the volume growth occurs with an increase in thickness d at volume $V = abd$, where a and b remain constant.

Equation (3), which is written for the atomic cross-sectional area, can also be written for the cross-sectional area $S = ab$. Then Equation (3) can be written as:

$$S_{sh} = ab\left[1-\left(1-\frac{S_n}{S_{sq}}\right)^N\right]. \tag{8}$$

Using the mass-area equivalence, in the form $M_g = kS_{sh}$ we can write $\rho_a = \frac{k}{ab}\frac{S_{sh}}{d}$.

Using $N = \frac{d}{L}$, where L is the thickness of the crystal lattice and supplying an expression for S_{sh} from expression (8), for the apparent density we obtain:

$$\rho_a = k\frac{1-\left(1-\frac{S_n}{S_{sq}}\right)^{\frac{d}{L}}}{d} \tag{9}$$

Substituting numerical values:

$S_n = \pi R_n^2 = \pi 10^{-36}\ \text{m}^2$ и $S_{sq} = 10^{-20}\ \text{m}^2$, we get:

$$\rho_a = k\frac{1-\left(1-10^{-16}\right)^{10^{10}d}}{d} \tag{10}$$

The behavior of the apparent density curve ρ_a from the thickness is shown in **Figure 9**, which coincides with the nature of the curve drawn for the dependence of the density of the planets of the Solar system on their size (**Figure 10**).

Taking into account the above circumstances leads to the conclusion that giant planets also have a density of solid matter, not gas or liquid. Since the diameters of the giant planets are comparable to the critical thickness of the gravitational permeability, at a qualitative level, we can use the regularity $M_t = 5M_g$,

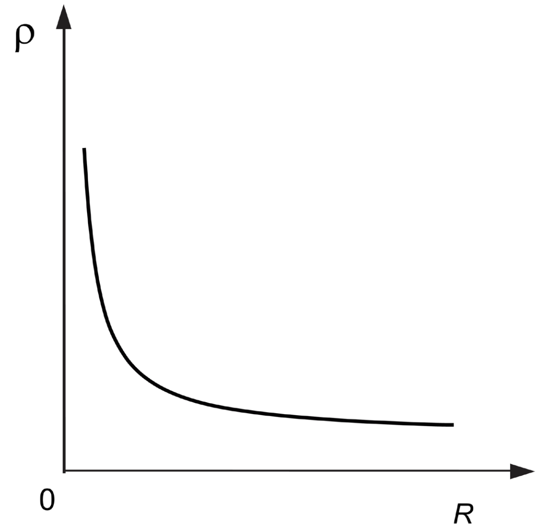

Figure 9. The course of the curve calculated by the formula (10).

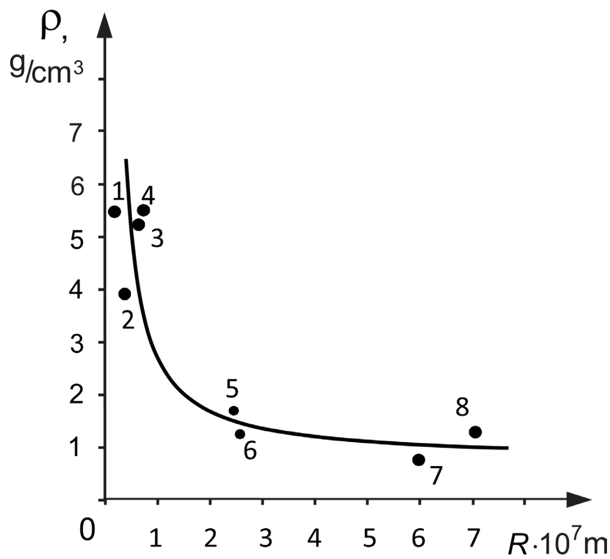

Figure 10. The density of the planets of the Solar system depending on their size: 1—Mercury, 2—Mars, 3—Venus, 4—Earth, 5—Uranus, 6—Neptune, 7—Saturn, 8—Jupiter.

which gives the density value in the values that the planets of the Earth group have.

The presence of gravitational shielding can cause other phenomena regarding the interaction and movement of celestial bodies. The mutual shielding of the planets of the Solar System can be studied as the cause of the precession of the perihelion of Mercury, whereas the existing concept does not offer anything in describing the cause of this precession, limiting itself only to geometry [33]. The existence of gravitational shielding from the planet Earth can contribute to the interpretation of the features of the manifestation of tides.

3. Discussion

Mutual spatial shielding of interaction elements is the basis of the classical approach to the issues of gravitational interaction. With the advent of new physical concepts, since the beginning of the 20th century, there has been a massive departure of researchers from classical concepts. For this reason, the classical theory of gravity by Lesage was not considered taking into account the structure of matter established by E. Rutherford. It was found that the sizes of the elements capable of participating in the act of shielding, atomic nuclei, turned out to be very small, which suggests that mutual shielding of interaction elements can occur only with sufficiently massive objects and assumes the existence of its dependence on thickness.

In this work, based on the proposed mathematical formula, new results are obtained that can link a number of physical manifestations with the presence of gravitational shielding. The results obtained confirm the thoroughness of the intuitive expectations of the classics of physical science about the mechanism of interaction. The applied approach is a development of the Lesage theory, gives a clear idea of the causes of the precession of the trajectory of Mercury and artificial satellites of the Earth, gives a different interpretation of the low-density values of giant planets, and offers a different point of view regarding the effects of tidal forces.

In this paper, mutual shielding is considered depending on the equatorial thickness of massive celestial bodies, which gives it a somewhat qualitative character. However, this does not change the essence of the issues under consideration and the value of the results obtained. Taking into account the thickness of the spherical shape of massive celestial bodies, including the Earth, requires more accurate calculations.

4. Conclusions

The question of mutual shielding of interaction elements—atomic nuclei for substances of ordinary density and related phenomena in the framework of the classical representation is considered. It is established that the curve of the dependence of the mutual shielding of elements on the thickness of the substance is characterized by a linear growth at the beginning, an exit to the plateau in the middle and a plateau section at the end. In the linear section, the phenomenon of mutual shielding does not manifest itself, partial shielding takes place at the exit to the plateau, and full mutual shielding occurs on part of the plateau.

It is established that the size of the Moon is insufficient for the manifestation of noticeable gravitational shielding, which is why gravitational shielding is not detected in studies during a solar eclipse. It has been established that by its thickness, the planet Earth shields gravity by about 50%. Full gravitational shielding is manifested at an object thickness of the order $d_c = 1.3 \times 10^8$ m, which is typical for giant planets of the Solar System.

It is established that due to the presence of gravitational shielding, not all matter in massive cosmic bodies participates in the act of gravitational interaction, there is a hidden matter shielded from gravitational interaction. The mass and density of massive celestial bodies determined from the conditions of gravitational interaction do not reflect their true mass and density. The density of giant planets determined from the conditions of gravitational interaction is underestimated by at least 5 times of their true value.

Gravitational shielding is considered as the cause of the precession of the perihelion of Mercury, disturbances in the movement of artificial satellites of the Earth, as well as manifestations of the features of tidal forces on the planet Earth.

Conflicts of Interest

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

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