ON THE GRAVITATION OF THE SOLAR SYSTEM

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ABSTRACT

On the basis of the analysis of the astronomical data we gave new geometrical interpretation of the Third Kepler Law and have shown, that gravitational radiuses of bodies suppose geometrical interpretation testifying to the benefit of the hypothesis about a hierarchical vortical structure of Solar system. Interpretation of the Third Kepler Law within the framework of axiomatics of Euclid geometry allows considering gravitational radius of a body, as parameter describing complex system of its internal vortical formations having velocities near to velocity of light.

We have introduced new geometrical axiomatics in consideration, based on the Third Kepler Law by means of its using in special dimensionless form. The executed analysis has shown, that in this axiomatics the spatial distribution of major planets and their satellites has spatial S - figurative distribution independent of their mass and the sizes; we found out some new invariants in Solar system.

The carried out analysis has shown that any change of the period of rotation and effective radius of the Sun because of emissions of substance from its visible surface accompanied by flashes on the Sun, especially in its active phase, should be by the cause of changing of the effective sizes of planets of Solar system, including Earth, provoking earthquake on planets.

1. INTRODUCTION

Everything, that we name substance in the micro world and the macro world, has surprising properties of its spatial hierarchical distribution in separate subsystems that interact under rotation. Bodies in each subsystem have rather steady rotation around of the central body that has the biggest gravitational radius. And if in a microcosm it is possible to know the rotational moment of substance indirectly, rotation in the macro world, for example in Solar system is observed directly. Being on the Earth, we rotate around of its axis, around of the Sun and together with it around of the central area of the Galaxy. Satellites rotate around of planets, forming a subsystem

rotating in turn around of the Sun. Enumeration can be continued. Therefore it is clear, that the basic attribute of the substance is a state of rather steady rotation. Where there is an observable rotation, - there is a substance and there, where there is not - vacuum is located. The vacuum is intangible; nevertheless, the area of vacuum is material. Material properties of vacuum are expressed in ability of energy radiation propagation between separate bodies with a constant group velocity like a sound in the homogeneous medium between the atoms separated in a vacuum on the distances considerably exceeding of them sizes. The substance and radiation in a field of vacuum are interacting and constantly exchanging by a part of their energy.
(Fig. 1)

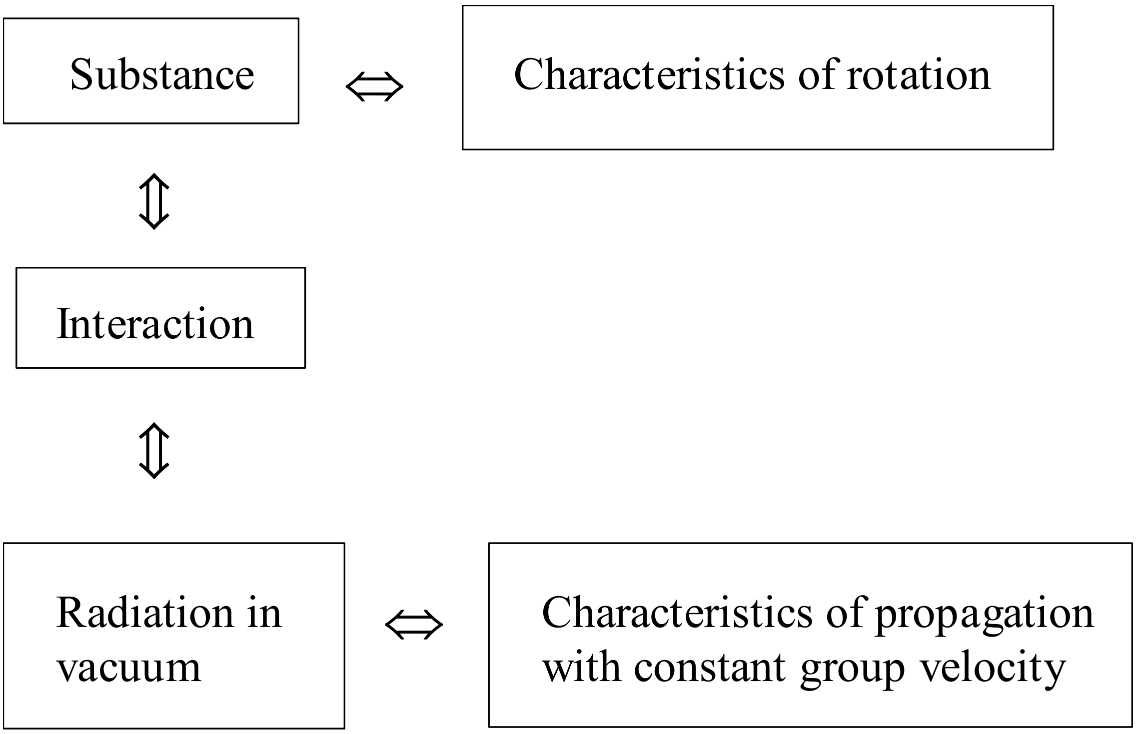


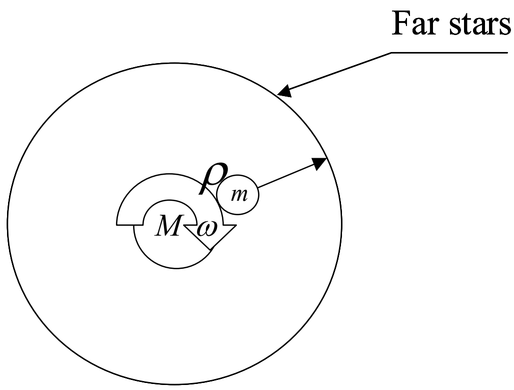
Fig.1 The basic properties of substance and radiation in vacuum.

By present time a number of rotary models are created, however any does not allow to explain the rotation of substance in macro world and micro world as a result of internal interaction between material bodies or fields. Particularly, they do not allow explaining rotation and special distribution of planets and their satellites and rings in Solar system in system of relationships of cause and effect[1].

Concerning the mechanics of Newton it is necessary to note the following: in the classical mechanics the basic law of Newton will not be executed in accelerated systems of coordinates. The matter is that at action on a material point of the same physical force determined as change of its impulse in dependence on the time, working on a material point in motionless and rotating system of coordinates of absolute space of Newton, the trajectory of this material point changes. Newton has developed the procedure of taking into account the known rotary movements, for example rotations of the surface of Earth with the known angular velocity in relation to "far stars", by means of using the compensation method of its surface acceleration and subtraction of rotation and reduced a dynamic problem in rotating system of coordinates to a problem of the description of a body' movement in inertial system of coordinates in which except the physical forces the non-physical "inertial forces" are acted. The magnitude of these non-physical forces depends on beforehand known angular velocity ω of a material point rotation in the motionless or moving regularly and rectilinearly system of coordinates of the absolute Newtonian space. The idea of taking into account beforehand known rotation of a body in the Newtonian mechanics of inertial systems is the most successful, but we are interested in a question on why planets of Solar system have those periods of rotation around of the Sun, which they have and move on those distances from the Sun, which we observe, instead of taking into account these movements. The theory of Newton does not give the answer to these questions.

The basic law of the mechanics of .Newton.

$$m\frac{d^2\rho}{dt^2} = -\gamma\frac{M}{\rho^2}m;$$



I.Newton method of taking into account of beforehand known acceleration of the body due to its rotation.

$$\frac{d^2\rho}{dt^2} - \omega^2\rho = -\gamma\frac{M}{\rho^2};$$

$$m\frac{d^2\rho}{dt^2} = -\gamma\frac{Mm}{\rho^2} + m\omega^2\rho;$$

$$\frac{d^2\rho}{dt^2} = 0;$$

The third J. Kepler law.

$$\Rightarrow -\gamma\frac{Mm}{\rho^2} + m\omega^2\rho = 0;$$

$$V = \frac{2\pi\rho}{T};$$

$$\rho^3 = \frac{\gamma M}{4\pi^2}T^2;$$

$$V\sqrt{\rho} = \sqrt{\gamma M};$$

The third J.Kepler law in formulation of J.Utting (1823). $V_k \cdot \sqrt{a_k} = const$

Fig. 2. The procedure of taking into account rotation in the problem of two - bodies.

Figure 2 illustrates the task on the movement of two bodies in which the material body with mass m makes circular orbital movement with the angular velocity

$$\omega = \frac{2\pi}{T} = \frac{V}{\rho}.$$

Here, in figure 2, ρ is a distance between Newtonian material points with masses M and m, t is a time parameter, T is a period and V is an average velocity of rotation of mass m, γ is the gravitational constant, a_k is a semi – major axis of an elliptic orbit of the k-th planet of the Solar system.

The basic law of classical dynamics for system of two bodies in absolute Newtonian space is defined by the equation:

$$\frac{d^2 m\rho}{dt^2} = -\gamma \frac{Mm}{\rho^2}.$$

In conditions of rotation of system of coordinates with angular velocity ω relatively absolute space and in the assumption of a constancy m, Newton has offered to take into account known rotation of a material point with mass m in relation to “far stars” by the method of subtraction of the appropriate to it acceleration $\omega^2\rho$ and, thus, to reduce a dynamic problem in rotating system of coordinates to resolution of a problem about movement of material points in the inertial system of coordinates described by the equation:

$$\frac{d^2 r}{dt^2} - \omega^2 \rho = -\gamma \frac{M}{\rho^2} \Leftrightarrow m\frac{d^2 \rho}{dt^2} = -\gamma \frac{Mm}{\rho^2} + m\omega^2 \rho.$$

At absence of radial acceleration, the right part of the basic equation of Newton with the compensated acceleration $\omega^2\rho$ describes Third Kepler law, which can be written down in two equivalent formulations:

$$\rho^3 = \frac{\gamma M}{4\pi^2} T^2 \Leftrightarrow V\sqrt{\rho} = \sqrt{\gamma M} \equiv C\sqrt{R_{gr}}.$$

It is clear, that to take into account rotation in the system of three bodies moving with various accelerations on unequal distances from each other by with the help of Newton’s algorithm is impossible, as indemnification of acceleration on any of them will not provide compensation of acceleration of all bodies in relation to “far stars”.

Non-physical forces of inertia are defined outside of axiomatics of the theory of Newton, therefore is not surprisingly that in 1823 J.Utting has carried out the analysis of the astronomical data for those objects in Solar system that for him were known at those times and as a result of which he has phenomenologically established Third Kepler law in the formulation [2]

$$V_k \sqrt{a_k} = const ,$$

and, thus, he has found conformity between of the Third Kepler law and its formulation in the theory of Newton.

Thus Newton reduced the problem of two bodies in rotating system of coordinates to the task in inertial system of coordinates, successfully gave explaining for macro bodies movings on the Earth and, moreover resolved a general problem of the description of movement of two bodies, interpreted three empirical law of Kepler. Nevertheless, the classical Newtonian mechanics don't give the opportunity to explain special spatial distributions of orbits of major planets and satellites of planets of the Solar system - those astronomical observations, which nevertheless the Titius-Bode law describes. This law, absent in classical mechanics, describes the average planetary distances that according to astronomical observations approximately present the geometrical progression. All attempts to explain this problem within the frames of known physical formal systems have failed [1]. The situation is intelligible: The Titius-Bode Law of planetary distances describes the problem of N bodies and every attempt of compensating of a few rotaries, known beforehand, jointly, evidently, has no sense.

Thus, rotation is present in the theory of the classical mechanics is not due to laws of bodies interaction but owing to bringing in systems of coordinates outside of axiomatics of classical mechanics, that rotate together with bodies having acceleration by of rotary or orbital character concerning the far stars and that is known beforehand.

The similar problem is present and in those known general theories of gravitation which ignore one of the most known properties of the gravitational interaction distinguishing his, for example, from electrostatic interactions of charged bodies that describe by the mathematical model similar to model of interaction of bodies in the mechanics of Newton. The essence of this properties consist in absence of barrier for forces of gravitation and independence of the gravitational phenomena from theirs chemical compound.

The Solar system with evidence shows the law of movement of planets and consequently there is a task of attentive investigation of trajectories measurements of planets and their satellites received for many decades.

The purpose of the given work consisted in discovering unknown functional connection of those known real phenomena of bodies' movement dynamics in Solar system, which couldn't have been established and interpreted by me on a base of axiomatics of any known existing theory.

In process of researches we were using astronomical data that have been reliably established: the group velocity of light, the angular sizes of the Sun, planets and their satellites, the periods of their rotation and some of other parameters of their orbits that have been established experimentally. With this goal I was using the basic astronomical data that were rather reliably established[4 − 18].

The formalization of relationships of cause and effect in apparent chaos of environmental real world is forming in our consciousness with of using criteria of symmetry and similarity and for using of them in the model of the world it is enough to define his geometry, but instead of that in given work have been entered into consideration r - parameter and the metrics r - distances $r_i - r_j$ among i - th and j - th of bodies, by means of the third Kepler law in dimensionless form

$$r_k \equiv \frac{C}{V_k} = \frac{CT_k}{2\pi a_k} = \sqrt{\frac{a_k}{R_{c,gr}}}, \quad k = 1,2,..., N-1 \cdot$$

Here $a_k = C\tau_k$ is the average radius of the orbit of any k - th body of the system of N bodies, τ_k is appropriate time of radiation propagation from any k - th body up to the central, most massive body of the system of N bodies with the biggest gravitational radius $R_{c,gr}$ around of which k - th body rotates with the period T_k.

Let's suppose further, that in r - metrics of the system of N bodies, where every k - th body with the gravitational radius $R_{k,gr}$ makes an orbital movement in vacuum around of a central body of the system with biggest gravitational radius $R_{c,gr}$, the relationships of cause and effect are determined by expressions:

$$V_k \to C \Leftrightarrow C\tau_k \equiv a_k \to R_{c,gr} \Leftrightarrow r_k \to 1;$$

$$0 < V_k < C = const;$$

$$R_{c,gr} << a_k \Leftrightarrow C >> V_k; \; R_{k,gr} << R_{c,gr}; \; k = 1,2,..., N-1 \cdot$$

2. The ANALYSIS of DATA

2.1 The Scale of planetary distances

The Sun is the most massive object of our planetary system. Assuming, that magnitudes of the period of rotation of Sun and the velocity of light both represent two key parameters describing gravitational properties of the Sun, with the help of method of the theory of dimensions it can be shown[3] the Sun surface gravitation in its equatorial zone $g_{\otimes e}$ obeys the empirical relation feasible with relative error of 0.2%

$$g_{\otimes} = g_{\otimes e} \equiv \frac{2C}{T_{\otimes e}}. \ (1)$$

In (1) C is the group speed of light, $g_{\otimes}$ is the acceleration of free falling on a surface of the Sun

$$g_{\otimes} = \gamma \frac{M_{\otimes}}{R_{\otimes e}^2} = 2.737 \cdot 10^4 \frac{\text{cm}}{\sec^2},$$

$g_{\otimes e}$ is the "gravitation" on a surface of the Sun,

$$g_{\otimes e} \equiv g(B) = \frac{2C}{T_{\otimes e}} = 2.7417 \cdot 10^4 \frac{\text{cm}}{\sec^2}, \quad -16^{\circ} \le B \le +16^{\circ},$$

$T_{\otimes e}$ is sidereal period of rotation of the Sun, $R_{\otimes e}$ is the radius of the Sun corresponding to heliographic latitude B, γ is a gravitational constant, $M_{\otimes}$ is the mass of the Sun $T_{\otimes e}$. Thus, the gravitational field of the Sun in equatorial area of its surface $g_{\otimes e}$ and the acceleration of free falling on a surface of the Sun $g_{\otimes}$ coincide within the limits of measurements accuracy of parameters included in them. This concurrence cannot be accepted casual, as in [3] was found out else one empirical law connecting magnitudes of periods of rotation of major planets of Solar system around the Sun T_k with the equatorial period of rotation of points on a surface of the Sun $T_{\otimes e}$, the gravitational field $g_{\otimes e}$ in equatorial region of the Sun, acceleration of free falling on the surface of the Sun $g_{\otimes}$, the group speed of light C and the accelerations on a surface of planets g_k. Really, by introducing into consideration of magnitudes $2C/T_k$ and by determining their sum and the sum of magnitudes of acceleration of free falling on a surface of planets g_k, we can get the following dependences of changing of magnitudes g_k and $2C/T_k$ in dependency on number k of an orbit of planets that are represented on the figure 3.

In spite of relation $2C/T_k \neq g_k = \gamma\, m_k / R_k^2$, nevertheless, by performing calculations it is possible to show, that parities take place:

$$\sum_{k=1}^{9} g_k = 0.844 \cdot 10^4 \frac{\text{cm}}{\sec^2}; \quad \sum_{k=1}^{9} \frac{2C}{T_k} = 1.412 \cdot 10^4 \frac{\text{cm}}{\sec^2}; \quad \frac{2C}{T_{10}} \approx 6.6 \frac{\text{cm}}{\sec^2}.$$

By means of analyzing of the performed calculations, and, by taking into account (1), we made conclusion about reliability of the resonant relations:

$$\sum_{k=1}^{9} g_k \sim \sum_{k=1}^{9} \frac{2C}{T_k} \approx \frac{g_{\otimes e}}{2} = \frac{C}{T_{\otimes e}}; \Leftrightarrow \sum_{k=1}^{9} \frac{1}{T_k} \approx \frac{1}{2T_{\otimes e}}. \qquad (2)$$

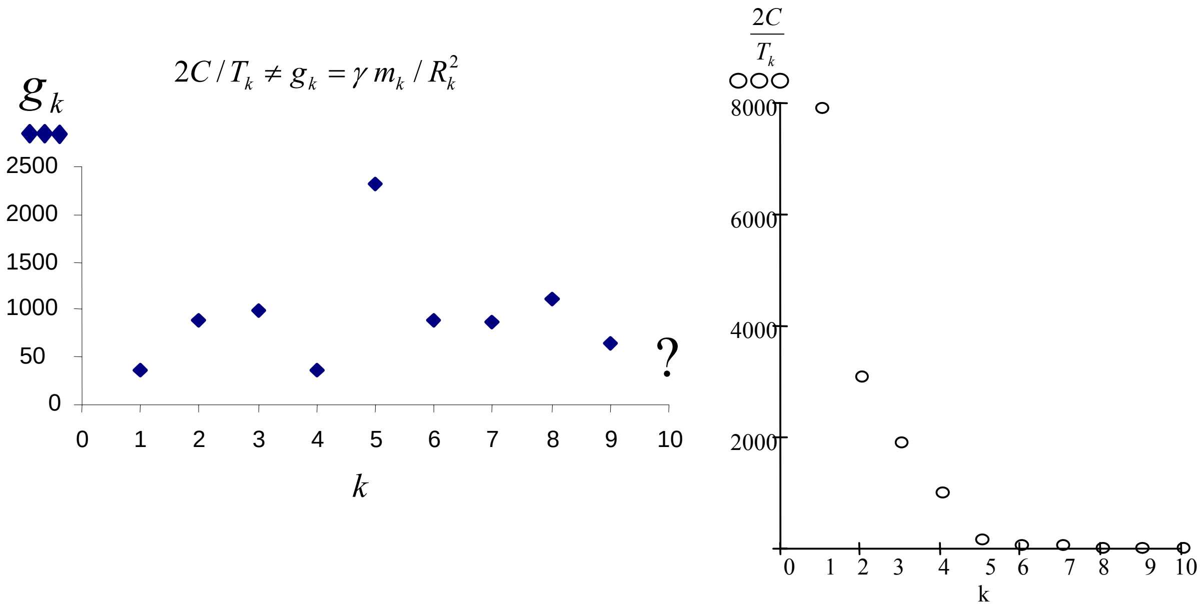


Fig.3 Magnitudes g_k and $2C/T_k$ in dependency on of ascending of numbers of planets k from the Sun.

In equations (2) were not taken into account: the contribution of acceleration of free falling g_{10} on a surface of the tenth planet of Solar system Quaoar, that was opened recently in 2003, as we have no authentic data on its size, gravitation in the belt of asteroids, acceleration of free falling on a surface of two groups of asteroids located on distance 60^0 from the Jupiter on its orbit, gravitation of satellites and rings of planets; everything this in aggregate could lead to decrease of magnitude of the sum g_k.

Taking into account relations (1) and (2), that have been experimentally established, it is difficult to refuse representation that the magnitude of the gravitational constant γ depends on sidereal period of rotation of substance in Solar system.

The following stage of searching of empirical laws in Solar system consisted in the investigation of a spatial distribution of orbits of major planets. With this purpose, by taking into account, that the mass of all planets is much less than mass of the Sun, we used the traditional Newtonian expression of the Third law of Kepler, but in dimensionless formulation and with this goal was used the gravitational radius of the Sun in the basic law of classical mechanics:

$$a_k^3 = \frac{g_{\otimes e}}{4\pi^2} R_{\otimes e}^2 T_k^2 = \frac{C R_{\otimes e}^2 T_k^2}{2\pi^2 T_{\otimes e}}; \Leftrightarrow r_k \equiv \frac{C}{V_k} = \sqrt{\frac{a_k}{R_{\otimes g}}}. \ (3)$$

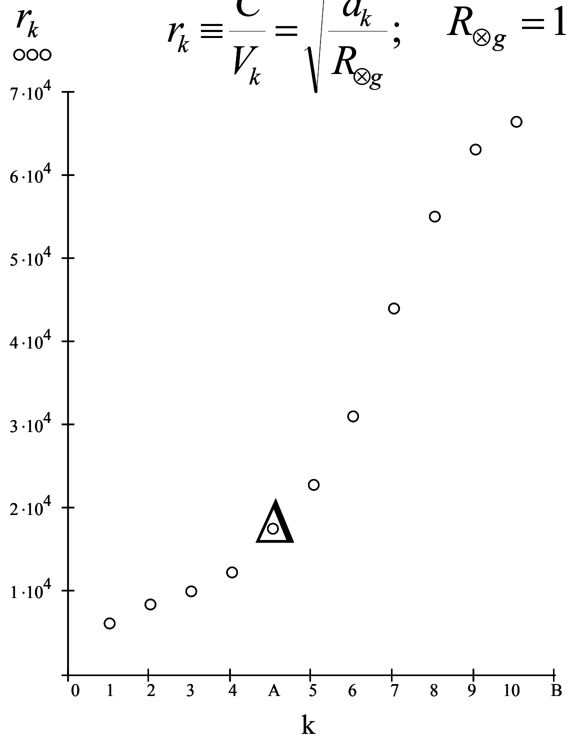
Here in (3) a_k is semi -major axis of k- th planets, T_k is sidereal period of rotation of k- th planets around of the Sun, k - th numbers vary in limits from $k=1$ for planet Mercury up to Quaoar for $k=10$ - of the tenth planet of Solar system (Quaoar is belonging to objects of border of belt Kuiper more precisely): $k=1,2,...,10$, $V_k = 2\pi a_k / T_k$ is an average orbital velocity of k- th planets, $R_{\otimes g}$ is the gravitational radius of the Sun. Taking into account (1), expression for $R_{\otimes g}$ can be presented as[3]:

$$R_{\otimes g} = \gamma \frac{M_\otimes}{C^2} = \frac{2R_{\otimes e}^2}{CT_{\otimes e}} = 1.4777 \cdot 10^5 \text{ cm} \ .$$

Entered into consideration with the help of Third Kepler Law of (3) dimensionless r- the parameter $r_k = C/V_k$ was used for research of spatial properties of orbital movements of planets in Solar system.

In figure 4, the r - parameter dependence on k-th number was received with the help of direct calculations r_k with parameters C, T_k and a_k . The dependence shows the surprising symmetry and the S- figurative distribution of orbits of major planets at the absence of dependence on planets size and their mass.

$$r_k \equiv \frac{C}{V_k} = \sqrt{\frac{a_k}{R_{\otimes g}}}; \quad R_{\otimes g} = 1.4777 \cdot 10^5 \, cm; \quad \sqrt{R_{\otimes g}} = 384.41 \, cm^{\frac{1}{2}};$$



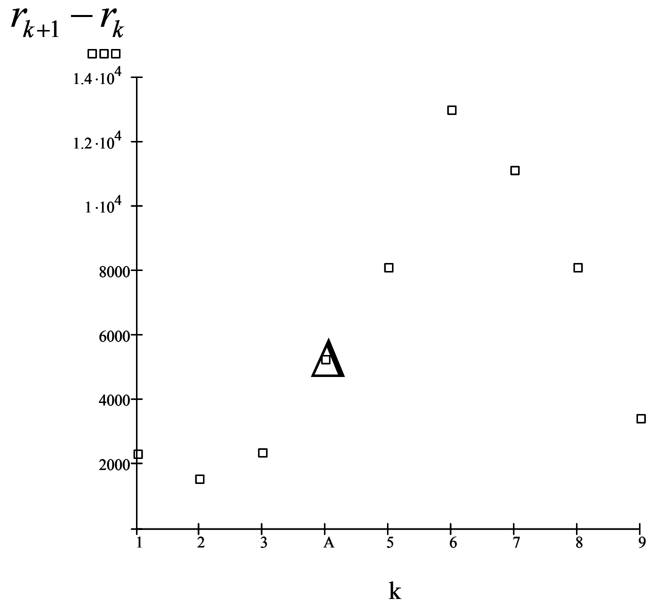
k	Planets
1.	Mercury
2.	Venus
3.	Earth
4.	Mars
	A.Belt of asteroids $\quad r_A \approx \frac{r_4 + r_5}{2}$
5.	Jupiter
6.	Saturn
7.	Uranus
8.	Neptune
9.	Pluto
10.	Quaoar
	B.Belt of Kuiper $\quad r_{Kuiper} - ?$

Fig.4 The S- distribution of major planets.

The big group of small planets in the belt of asteroids, marked on the diagram by A , possesses by average magnitude r_A of their parameters r . The letter B marks an average position of bodies in the belt Kuiper, but appropriate average parameter r in this area r_{Kuiper} was not calculated because of absence of the reliable data.

The result of calculations of changes of r-th distances $r_{k+1} - r_k$ between the neighboring orbits of planets of Solar system is submitted in figure 5.The changes of r- distances $r_{k+1} - r_k$ have wavy character. Thus the major planets demonstrate the symmetry of their spatial distribution in r- metrics both in Earth group and in outer group of planets, irrespective of masses and sizes of planets and magnitudes a_k :

$$r_2 - r_1 \approx r_4 - r_3 \ ; \qquad r_6 - r_5 \approx r_9 - r_8 \ .$$



$$\begin{bmatrix} r_2 - r_1 \\ r_3 - r_2 \\ r_4 - r_3 \end{bmatrix} = \begin{bmatrix} 2.292 \\ 1.508 \\ 2.347 \end{bmatrix} \cdot 10^3;$$

$$\Delta = r_A - r_4 = r_5 - r_A = 5246;$$

$$\begin{bmatrix} r_6 - r_5 \\ r_7 - r_6 \\ r_8 - r_7 \\ r_9 - r_8 \end{bmatrix} = \begin{bmatrix} 8.090 \\ 12.950 \\ 11.080 \\ 8.085 \end{bmatrix} \cdot 10^3;$$

$$r_{10} - r_9 = 3393 .$$

Fig. 5 r - distances $r_{k+1} - r_k$ between the orbits of major planets.

Pay attention, the orbit of Jupiter contains two big groups of asteroids, which are moving on 60^0 from the both sides of Jupiter. According to our analysis they are not influencing on the symmetry of r - th of distances between of orbits of Neptune and of Pluto, that possess small size and mass, and of orbits of massive Saturn and of massive Jupiter, which possesses besides of by asteroids on its orbit.

Besides of we could not notice connection between the symmetry of r - th of distances between of orbits of major planets and the variances in of quantity of satellites on the orbits of major planets.

We attempted to approximate differences $r_{k+1} - r_k$ and had got the recurrence relations that possess the strongly expressed mathematical symmetry:

$$r_{k+1}-r_k \approx 12\pi[1\cdot 3\cdot 5(k-2)^2(k-3)^2+ \\ +2\cdot 4\cdot 5(k-1)^2(k-3)^2+ \\ +1\cdot 3\cdot 5(k-1)^2(k-2)^2\big]; \qquad k=1,2,3; \quad (4)$$

$$r_{k+1}-r_k \approx 14\pi[1\cdot 5(k-6)^2(k-7)^2(k-8)^2+ \\ +7\cdot 9(k-5)^2(k-6)^2(k-8)^2+ \\ +8\cdot 9(k-5)^2(k-7)^2(k-8)^2+ \\ +1\cdot 5(k-5)^2(k-6)^2(k-7)^2]; \qquad k=5,6,7,8. \quad (5)$$

Expressions (4) and (5) are well approximating those magnitudes $r_{k+1}-r_k$ that are result of the direct calculation.

The analysis has shown, that expressions take place:

$$\frac{N_2}{N_1}\approx 2\pi\,;\, N_1=\sum_{k=1}^{3}(r_{k+1}-r_k)=6.15\cdot 10^3 \approx 2\pi 10^3\,;\, N_2=\sum_{k=5}^{8}(r_{k+1}-r_k)=40.20\cdot 10^3\approx(2\pi)^2 10^3\,.$$

Constants N_1 and N_2 are sums of r- distances between orbits of major planets in Earth and external group.

By using expressions (3), (4) and (5) it is possible to define the recurrence relations describing a scale of planetary distances in Earth and external groups of planets outside the first belt of asteroids by the expression:

$$a_{k+1}=q_k\, a_k\,. \quad (6)$$

Here

$$q_k=\left[1+\sqrt{\frac{R_{\otimes g}}{a_k}}(r_{k+1}-r_k)\right]^2;\; R_{\otimes g}=\left[\frac{\sqrt{a_{k+1}}-\sqrt{a_k}}{r_{k+1}-r_k}\right]^2.$$

The dependence q_k on the number k is presented in figure 6.The magnitude of the "denominator" q_k is not a constant, but sluggish function of number k; q_k is changing in rather small limits and it allows to draw a conclusion that (6) really approximately represents a geometrical progression.

Expressions (4), (5) and (6) describe The Titius -Bode Law of planetary distances scale with relative error less than 1 % and remove all doubts connected with this law and all complications connected with the mathematical description of this law [1].

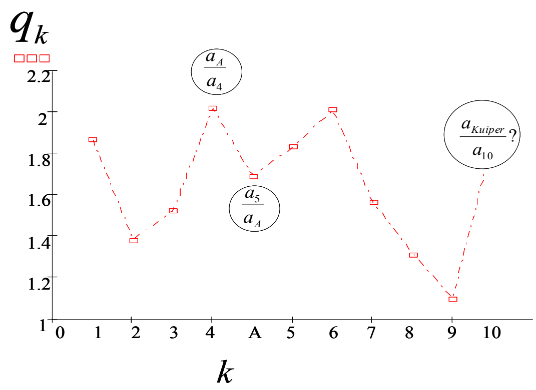


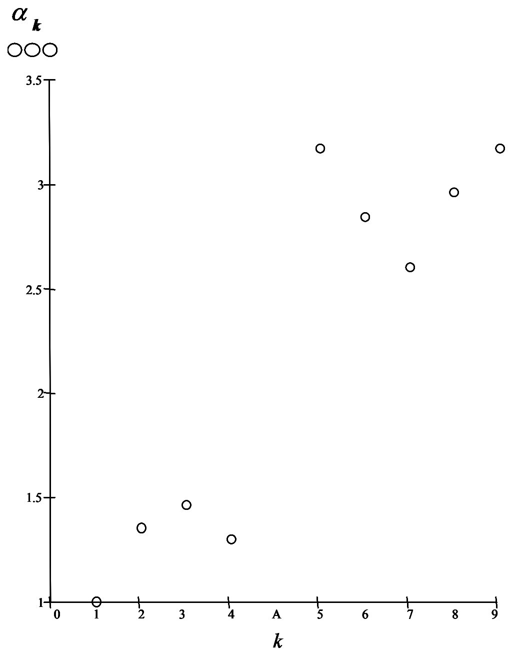
Fig. 6 The “denominator" q_k dependence on number k.

By taking into account functional connection of accelerations of free falling g_k on the visible surface of major planets, that was defined by expression (2), by with periods T_k of rotation of major planets around the Sun, by with the period of rotation of the Sun $T_{\otimes e}$ and by with velocity of light C, may be put forward a hypothesis that gravitation of planets basically is defining the central body of the planetary system - the Sun. By considering that periods of rotations of planets are smaller than their sidereal periods of rotations around of the Sun, we may accept hypothesis that their own gravitational fields, which probably are generated at rotation of planets and hold their satellite systems are much less than gravitation that we are measuring on their surface. Within the frames of this hypothesis, by means of using a method of the theory of dimensions, we made attempt of presentation of acceleration of free falling on a surface of planets by expression:

$$g_k = \gamma \frac{m_k}{R_k^2} \equiv \frac{4\pi R_k}{T_k^2} \left(\frac{M_\otimes}{m_k} \right)^{\alpha_k} . \quad (7)$$

Here m_k is mass, R_k is radius, g_k is acceleration of free falling on a surface k - th planets, and α_k are factors which are defined by the equation (7).

In figure 7 the result of calculation α_k is presented depending on number k of major planets. Here, in figure 7, the region between Mars and the Jupiter, where the enormous quantity of small planets of a belt of the asteroids having a wide spectrum of their sizes rotate around of the Sun, is marked on an axis of numbers of major planets by the letter A.



$\alpha_1 = 1.0016298;$
$\alpha_2 = 1.3571473;$
$\alpha_3 = 1.4645268;$
$\alpha_4 = 1.3018916;$
A.Belt of asteroids
$\alpha_5 = 3.1810311;$
$\alpha_6 = 2.8505207;$
$\alpha_7 = 2.6048175;$
$\alpha_8 = 2.9685156;$
$\alpha_9 = 3{,}1804322;$
$\alpha_{10} = ?$
Belt of Kuiper

Fig.7 Dependence of parameter α_k on number k of an orbit of major planets.

The dependence α_k has discovered two symmetrical areas shared by the point A. The region in vicinity of point A can be interpreted as area of orbital instability of planetary formations. It is interesting to note, coefficient α_5 for Jupiter coincide with α_9 for Pluto with very high accuracy, in spite of essential distinctions of Jupiter and Pluto in sizes and mass and to compare this result to a picture of changing r - th distances, which are shown in figure 5.

By using expressions $g_\otimes = \gamma M_\otimes / R_\otimes^2$, $g_{\otimes e} = 2C/T_{\otimes e}$, $g_{\otimes e} = g_\otimes$, expression for acceleration of free falling of bodies on a surface of planets $g_k = \gamma m_k / R_k^2$ and the expression (1), it is possible to show:

$$g_k = \frac{2C}{T_{\otimes e}} \frac{R_\otimes^2}{R_k^2} \frac{m_k}{M_\otimes}; \quad \Leftrightarrow \quad \frac{M_\otimes}{m_k} = \frac{2C}{T_{\otimes e}} \frac{R_\otimes^2}{R_k^2} \frac{1}{g_k}. \qquad (8)$$

By taking into account expression (8), the expression (7) is possible to transform to a kind, in which connection between gravitation on a surface of the Sun $g_{\otimes e}$ and by gravitation on a surface of planets g_k depend only on radius of the Sun $R_\otimes$, on radiuses of planets R_k, of their periods rotation around of the Sun T_k and group velocity of light C:

$$g_k = (4\pi)^{\frac{1}{1+\alpha_k}} g_{\otimes e}^{\frac{\alpha_k}{1+\alpha_k}} \frac{1}{T_k^{\frac{2}{1+\alpha_k}}} \frac{R_{\otimes}^{\frac{2\alpha_k}{1+\alpha_k}}}{R_k^{\frac{2\alpha_k - 1}{1+\alpha_k}}} . \qquad (9)$$

Factors α_k can be approximated by expressions:

$$\alpha_k \approx \begin{cases} -0.11572(k-3)^2 + 1.4645268 & \text{при} \quad k = 1,2,3,4; \\ +0.14405(k-7)^2 + 2.6048175 & \text{при} \quad k = 5,6,7,8,9. \end{cases} \qquad (10)$$

Thus, g_k also as $g_{\otimes e}$ are functionally connected by expressions (9) and (10). This interesting fact testifies to global influence of solar activity on change not only orbits of planets and their satellites, but also all sizes of all planets, rotating around of the Sun, as emission of substance accompanying flashes on the Sun, undoubtedly, should be the cause of changing of the period of its rotation on which according to expression (1) depends $g_{\otimes e}$.

2.1 Scales of distances of satellites and rings of Jupiter, Saturn, Uranus and Neptune.

Let's present the third law of Kepler for orbit of i - th satellite of k - th planets in the formulation similar to expression (3):

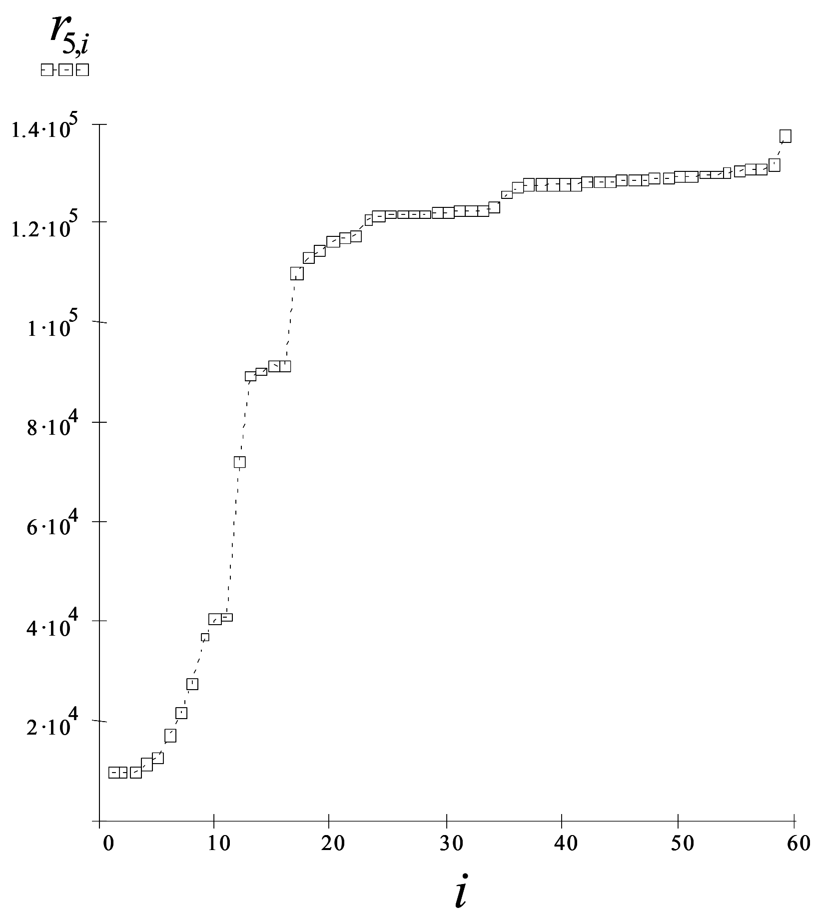
$$a_{k,i}^3 = \frac{g_k}{4\pi^2} R_k^2 T_{k,i}^2 \;;\; \Leftrightarrow \; r_{k,i} \equiv \frac{C}{V_{k,i}} = \sqrt{\frac{a_{k,i}}{R_{k,g}}} . \qquad (11)$$

Here a_k is semi - major axis of an elliptic orbit of k - th satellite, and $T_{k,i}$ is period of sidereal rotation of i - th a satellite or a ring of k - th planets, $R_{k,g}$ is a gravitational radius k - th planets. Number i we count of in ascending order of distances up to satellites and up to rings from k - th planet.

The dependence r on number i for satellites Jupiter is presented in figure 8. The r - parameters were received by means of direct calculations $r_{5,i}$ with parameters C, $T_{5,i}$ and $a_{5,i}$.

The Jupiter r - parameters has characteristic symmetrical dependence on number i of its satellites independently of their size and mass. The S - figurative distribution of Jupiter satellites have the r - distribution analogous one in figure 4 for major planets.

Notice that Leda, Himalia, Lysithea, Elara in r - distribution has positions of quasi-mono velocity bodies similar to group of asteroids on r- distribution for major planets.



i	Satellites of Jupiter		
1.	Metis	29.	Praxidike
2.	Adrastea	30.	Thyone
3.	Ring Gossamer	31.	Iocaste
4.	Amalthea	32.	S 2003 J10
5.	Thebe	33.	Hermippe
6.	Io	34.	Ananke
7.	Europa	35.	S 2003 J15
8.	Ganimede	36.	S 2003 J11
9.	Callisto	37.	Eurydome
10.	S2002J1	38.	S 2003 J17
11.	Magaelite	39.	Pasithee
12.	Themisto	40.	S2003J9
13.	Leda	41.	S2003J7
14.	Himalia	42.	Chaldene
15.	Lysithea	43.	Isonoe
16.	Elara	44.	Erinome
17.	S 2003 J20	45.	Kale
18.	S2003J3	46.	Aitne
19.	S 2003 J18	47.	Taygete
20.	S 2003 J12	48.	S 2003 J19
21.	S2003J4	49.	Carme
22.	Euporie	50.	Sponde
23.	S 2003 J16	51.	Kalyke
24.	Orthosie	52.	Pasiphae
25.	Euanthe	53.	S 2003 J13
26.	S 2003 J21	54.	S2003J1
27.	Harpalyke	55.	Sinope
28.	S2003J6	56.	S 2003 J14
		57.	Autonoe
		58.	S2003J5
		59.	S 2003 J2

$$a_{5,i+1} = \left[\sqrt{a_{5,i}} + \sqrt{R_{5,g}}\,(r_{5,i+1} - r_{5,i})\right]^2; \quad R_{5,g} = 140.9\text{см}; \quad \sqrt{R_{5,g}} = 11.87\,\text{см}^{\frac{1}{2}};$$

Fig. 8 S - distribution of satellites of the Jupiter.

The wavy structure of dependence r - distances between known orbits of satellites and rings of the Jupiter is shown in figure 9. The dependence of dimensionless r - distances $r_{5,i+1} - r_{5,i}$ has hilly structure with the expressed symmetry in its each local formation.

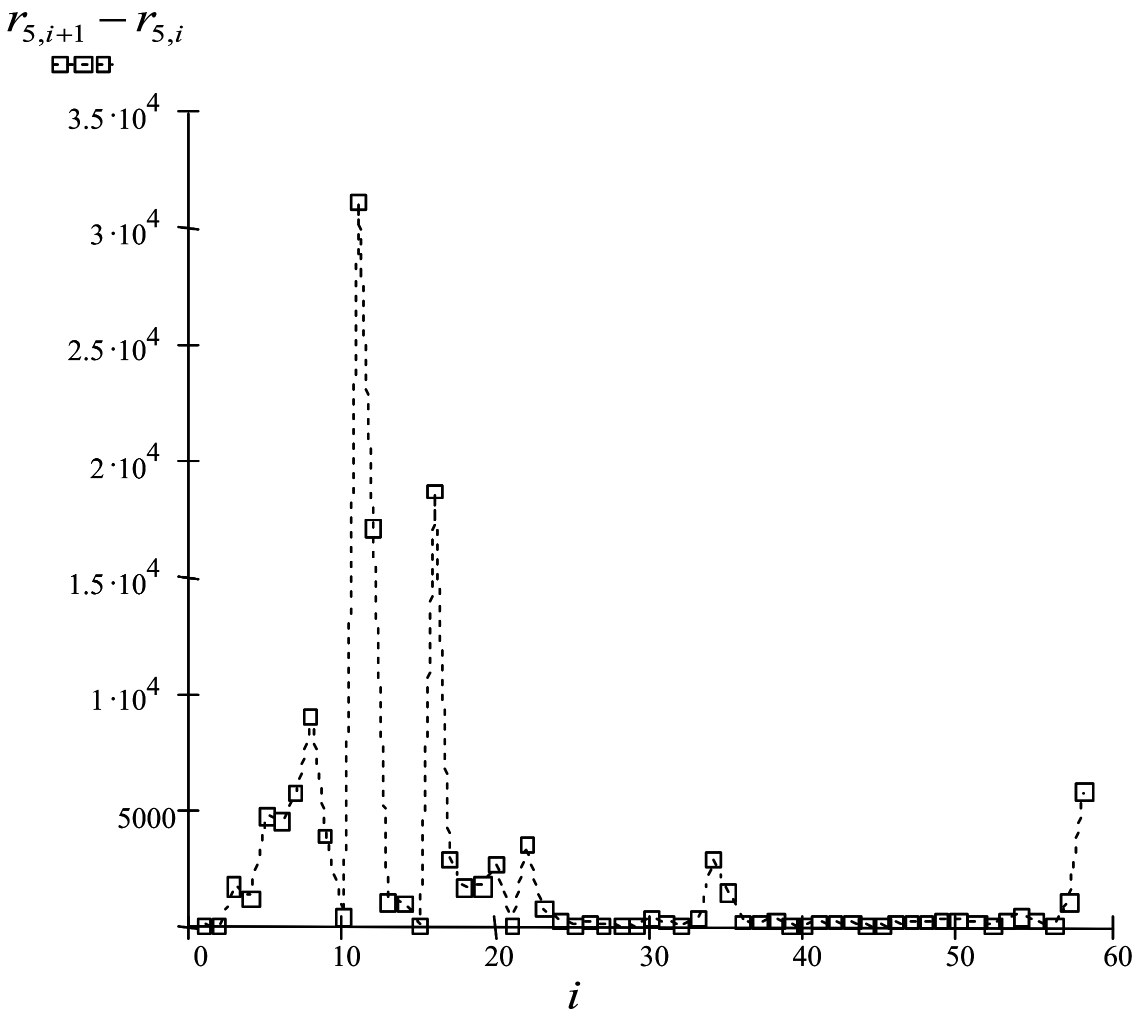


Fig. 9 r - distances $r_{5,i+1} - r_{5,i}$ between the orbits of satellites of Jupiter.

The dependence r on number i for satellites Saturn is presented in figure 10.

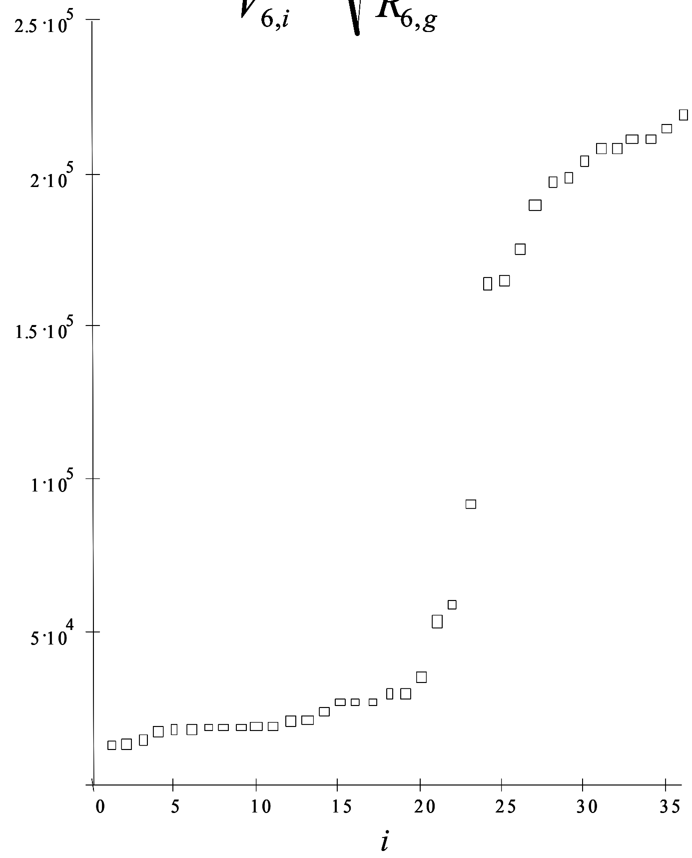
The Saturn r - parameters has characteristic symmetrical dependence on number i of its satellites independently of their size and mass. The S - figurative distribution of Saturn satellites have the r - distribution analogous one in figure 4 for major planets, as well as in a case r - distributions for the satellites of the Jupiter shown in figure 8.

The r - parameters were received by means of direct calculations $r_{6,i}$ with parameters C, $T_{6,i}$ and $a_{6,i}$.

The wavy structure of dependence r - distances between known orbits of satellites and rings of the Saturn is shown in figure 11. The dependence of dimensionless r - distances $r_{6,i+1} - r_{6,i}$ have hilly structure with the expressed symmetry in its each local formation irrespective of Saturn satellites sizes, mass and magnitudes of $a_{6,i}$.

$r_{6,i}$

$$r_{6,i} = \frac{C}{V_{6,i}} = \sqrt{\frac{a_{6,i}}{R_{6,g}}};$$



$$a_{6,i+1} = \left[\sqrt{a_{6,i}} + \sqrt{R_{6,g}}\,(r_{6,i+1} - r_{6,i})\right]^2$$

$$R_{6,g} = 42.13 \text{ см}; \quad \sqrt{R_{6,g}} = 6.49 \text{ см}^{\frac{1}{2}}.$$

i	Satellites of Saturn
1	RingD
2	RingC
3	RingB
4	Ring A
5	Pan
6	Atlas
7	Prometheus
8	Ring F
9	Pandora
10	Epimetheus
11	Janus
12	Ring E
13	Mimas
14	Enceladus
15	Tethys
16	Telesto
17	Calypso
18	Dione
19	Helene
20	Rhea
21	Titan
22	Hyperion
23	Iapetus
24	Kiviuq
25	Ijiraq
26	Phoebe
27	Paaliaq
28	Albiorix
29	Skadi
30	Erriapo
31	Siarnaq
32	Tarvos
33	S 2003 S1
34	Mundilfari
35	Suttung
36	Thrym
37	Ymir

Fig. 10 S - distribution of satellites of Saturn.

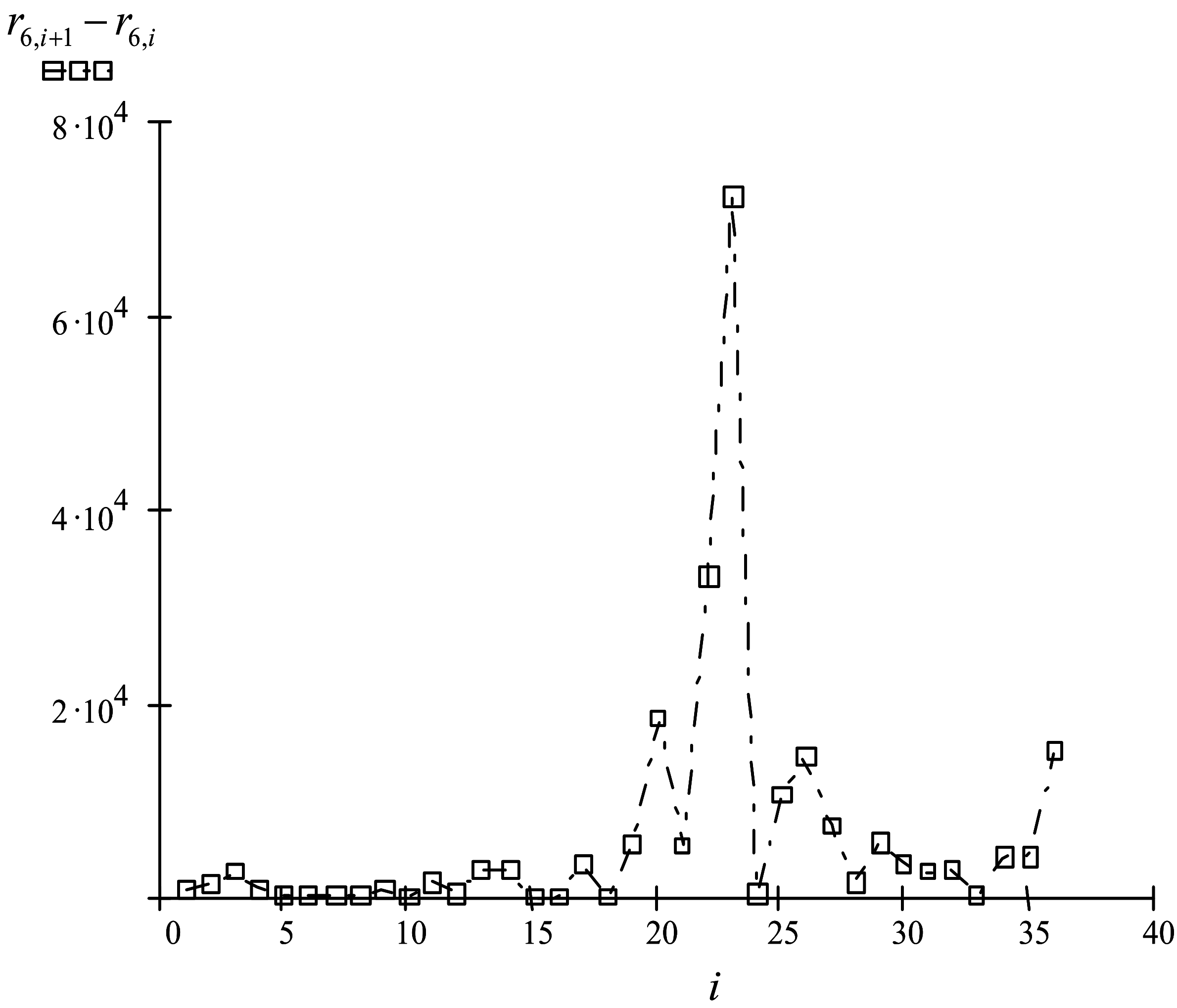
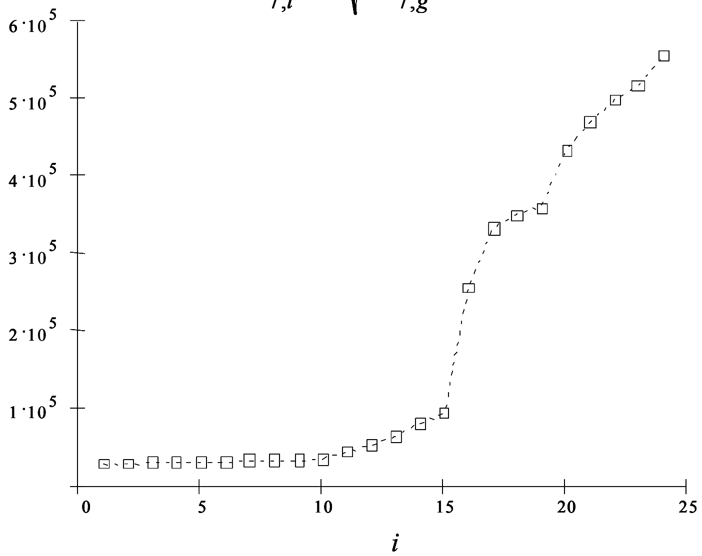


Fig.11 r - distances $r_{6,i+1} - r_{6,i}$ between the orbits of satellites of Saturn.

The S - distributions and r - distances $r_{k,i+1} - r_{k,i}$ in satellites systems of Uranus and Neptune is represented in figures 12,13,14 and 15. We mark, that satellites of Uranus and Neptune in the metrics r - distances have analogous S - distributions similar to S - distributions of major planets of Solar system and satellites of Jupiter and Saturn.

$$r_{7,i} = \frac{C}{V_{7,i}} = \sqrt{\frac{a_{7,i}}{R_{7,g}}};$$



i Satellites of Uranus
1. Cordelia
2. Ophelia
3. Bianca
4. Cressida
5. Desdemona
6. Juliet
7. Portia
8. Rosalind
9. Belinda
10. Puck
11. Miranda
12. Ariel
13. Umbriel
14. Titania
15. Oberon
16. S 2001 U3
17. Caliban
18. Stephano
19. Trincub
20. Sycorax
21. S 2003 U3
22. Prospero
23. Setebos
24. S 2001 U2

$$a_{7,i+1} = \left[\sqrt{a_{7,i}} + \sqrt{R_{7,g}}(r_{7,i+1} - r_{7,i})\right]^2;$$

$$R_{7,g} = 6.53\ \text{см}; \sqrt{R_{7.g}} = 2.5\ \text{см}^{\frac{1}{2}}.$$

Fig. 12 S - distribution of satellites of Uranus.

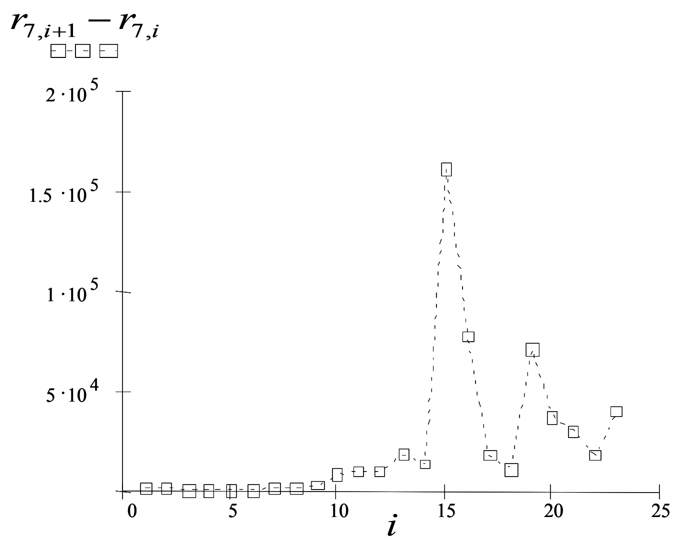
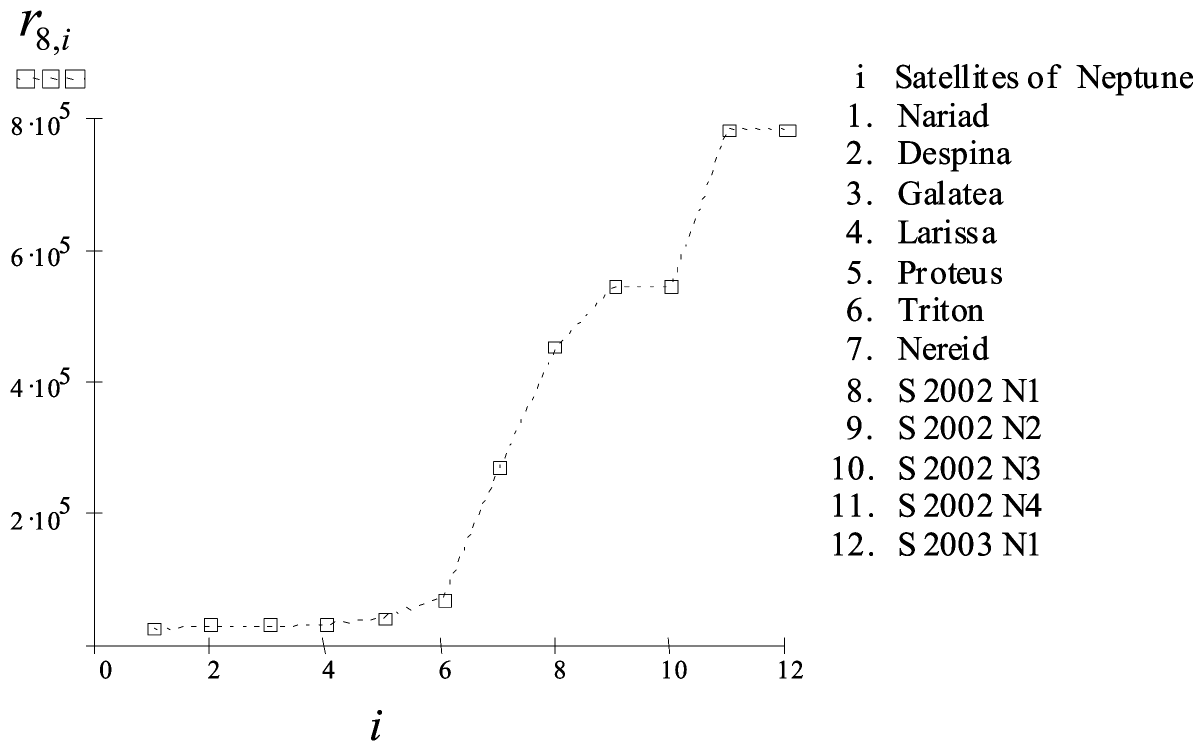


Fig.13 r - distances $r_{7,i+1} - r_{7,i}$ between the orbits of satellites of Uranus.



$$a_{8,i+1} = \left[\sqrt{a_{8,i}} + \sqrt{R_{8,g}}\,(r_{8,i+1} - r_{8,i})\right]^2;$$

$$R_{8,g} = 7.64 \text{ см}; \quad \sqrt{R_{8,g}} = 2.76 \text{ см}^{\frac{1}{2}}.$$

Fig. 14 S - distribution of satellites of Neptune.

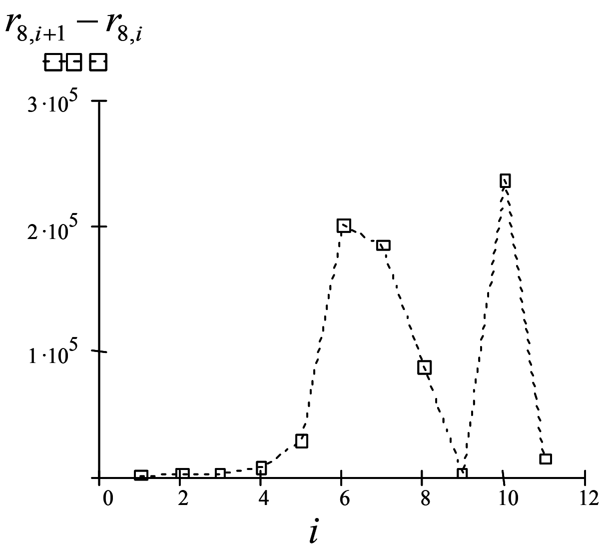


Fig.15 r - distances $r_{8,i+1} - r_{8,i}$ between the orbits of satellites of Neptune.

It is possible to show, that for systems of satellites Jupiter, Saturn, Uranus and Neptune "resonant" expressions similar to invariant (2) take place.
Really, let's consider parameters g_k^* and $T_{\otimes,k}^*$ defined by means of expressions:

$$g_k^* \equiv 2\cdot\sum_i \frac{2C}{T_{k,i}} \equiv \frac{2C}{T_{\otimes,k}^*}; \quad \Leftrightarrow \quad \sum_i \frac{1}{T_{k,i}} = \frac{1}{2T_{\otimes,k}^*} \; ; \; (13)$$

We also shall define by means of equations (13) some parameter R_k^* by formula, which formally corresponds to the Newtonian law of gravitation:

$$R_k^* \equiv \sqrt{\gamma\, m_k / g_k^*} \; . \qquad (14)$$

Having made calculations R_k^* and $T_{\otimes,k}^* = 2C/g_k^*$ by means of using (13) and (14), it is possible to be convinced that gravitational radius of major planets of Solar system- Jupiter, Saturn, Uranus and Neptune is defined by equation:

$$R_{k.g} = \frac{m_k\gamma}{C^2} \cong R_{k,gr}^* = \frac{2R_k^{*\,2}}{CT_{\otimes,k}^*} \; . \qquad (15)$$

Really, having executed calculations by means of using (13) and (14) for satellites systems of major planets of Solar system - Jupiter, Saturn, Uranus and Neptune, it is possible to be convinced in validity of the following relations for planet Jupiter:

$$\sum_{i=1}^{59} \frac{2C}{T_{5,i}} \cong 1.025\cdot 10^7 \cong \frac{g_5^*}{2}\frac{\text{cm}}{\sec^2}; \; \Rightarrow g_5^* \cong 2.05\cdot 10^7 \frac{\text{cm}}{\sec^2}; \qquad (16a)$$

$$T_{\otimes,5}^* = \frac{2C}{g_5^*} \cong 2925 \sec << T_{\otimes,5} \cong 35430 \sec \; ; \qquad (16b)$$

$$R_5^* \cong 786\cdot 10^5 \text{ cm} << R_5 \cong 71400\cdot 10^5 \text{ cm} \; ; \qquad (16c)$$

$$R_{5,g}^* = \frac{2R_5^{*\,2}}{CT_{\otimes,5}^*} \cong 140.9 \text{cm} \cong R_{5,g} ; \qquad (16d)$$

for planet Saturn:

$$\sum_{i=1}^{37} \frac{2C}{T_{6,i}} \cong 2.138\cdot 10^7 \cong \frac{g_6^*}{2}\frac{\text{cm}}{\sec^2}; \; \Rightarrow g_6^* \cong 4.276\cdot 10^7 \frac{\text{cm}}{\sec^2}; \qquad (17a)$$

$$T_{\otimes,6}^* = \frac{2C}{g_6^*} \cong 1402 \sec << T_{\otimes,6} \cong 36840 \sec \; ; \qquad (17b)$$

$$R_6^* \cong 297\cdot 10^5 \text{ cm} << R_6 \cong 60400\cdot 10^5 \text{ cm} \; ; \qquad (17c)$$

$$R_{6,g}^* = \frac{2R_6^{*\,2}}{CT_{\otimes,6}^*} \cong 42.1 \text{cm} \cong R_{6,g} \, . \qquad (17d)$$

for planet Uranus:

$$\sum_{i=1}^{24}\frac{2C}{T_{7,i}}\cong 1.566\cdot 10^{7}\cong\frac{g_7^*}{2}\frac{\text{cm}}{\sec^2};\ \Rightarrow g_7^*\cong 3.132\cdot 10^{7}\frac{\text{cm}}{\sec^2};\quad (18a)$$

$$T_{\otimes,7}^*=\frac{2C}{g_7^*}\cong 1914\sec << T_{\otimes,7}\cong 38940\sec\ ;\quad (18b)$$

$$R_7^*\cong 137\cdot 10^{5}\ \text{cm} << R_7\cong 23800\cdot 10^{5}\ \text{cm}\ ;\quad (18c)$$

$$R_{7,g}^*=\frac{2R_7^{*\,2}}{CT_{\otimes,7}^*}\cong 6.5\,\text{cm}\cong R_{7,g}\,.\quad (18d)$$

for planet Neptune:

$$\sum_{i=1}^{12}\frac{2C}{T_{8,i}}\cong 0.806\cdot 10^{7}\cong\frac{g_8^*}{2}\frac{\text{cm}}{\sec^2};\ \Rightarrow g_8^*\cong 1.6\cdot 10^{7}\frac{\text{cm}}{\sec^2};\quad (19a)$$

$$T_{\otimes,8}^*=\frac{2C}{g_8^*}\cong 3720\sec << T_{\otimes,8}\approx 54000\sec\ ;\quad (19b)$$

$$R_8^*\cong 206\cdot 10^{5}\ \text{cm} << R_8\cong 22300\cdot 10^{5}\ \text{cm}\ ;\quad (19c)$$

$$R_{8,g}^*=\frac{2R_8^{*\,2}}{CT_{\otimes,8}^*}\cong 7.6\,\text{cm}\cong R_{8,g}\ \ .\quad (19d)$$

Here $T_{\otimes,k}$ is the period of rotation of a seen surface of k - th planet.

Thus, according to (13), satellites systems of Jupiter, of Saturn, of Uranus and Neptune suppose opportunity of existence of some "resonant" conditions between satellites of these planets and by their invisible inner structures, which are rotating with sidereal periods $T_{\otimes,k}^*$. By comparing expressions (1), (2), (13), (15), (16), (17), (18) and (19) it is possible to assume, that these internal structures play a role analogous to the role of the visible surface of the Sun, which is rotating with sidereal period $T_{\otimes e}$. Probably, R_k^* - th define radiuses of the inner vortical formations of planets, which are latent inside of invisible "surfaces" of Jupiter, of Saturn, of Uranus and of Neptune and we assume, in consequence of equality of sizes $R_{k,g}^*$ and $R_{k,g}$, that they play role similar to role of the ring formation of the visible "surface" of the Sun in the range of heliographic latitudes $-16^\circ\le B\le +16^\circ$:

$$R_{k,g}^*=R_{k,g};\quad \sum_i\frac{1}{T_{k,i}}=\frac{1}{2T_{\otimes,k}^*};\quad\propto\quad \sum_{k=1}^{10}\frac{1}{T_k}=\frac{1}{2T_{\otimes e}}.\quad (20)$$

By means of using (11) it is possible to receive expression determining a scale of distances of satellites and ring formations of planets in the form similar to law of the Titius-Bode Law of planetary distances in the modified mathematical formulation presented by expression (6):

$$a_{k,i+1} = a_{k,i}\left[1+\sqrt{\frac{R_{k,g}}{a_{k,i}}}(r_{k,i+1}-r_{k,i})\right]^2 ; \Leftrightarrow R_{k,g} = \left[\frac{\sqrt{a_{k,i+1}}-\sqrt{a_{k,i}}}{r_{k,i+1}-r_{k,i}}\right]^2 . \quad (21)$$

3. GEOMETRICAL INTERPRETATION of KEPLER LAW

In this chapter we are researching an opportunity of geometrical interpretation of connections of cause and effect of functional dependence describing orbital movement of planets and their satellites by the Kepler Law.

We shall consider geometry of movement of system of two bodies in frames of axiomatics of geometry of Euclid. We shall assume the condition under which the gravitational radius of one of bodies $R_{c,gr}$ is bigger than gravitational radius $R_{k,gr}$ of the second one and in these circumstances, the small body is moving along Kepler's orbit with eccentricity ε_k with the average orbital velocity V_k :

$$\varepsilon_k = \sqrt{1-\frac{b_k^2}{a_k^2}} << 1 . \quad (22)$$

Here a_k is semi - major axis, and $b_k = a_k\sqrt{1-\varepsilon_k^2}$ is small semi axis of an elliptic orbit of small body, which is moving along Kepler's orbit.

By according to this condition of (22), the average radius of orbit of smaller body $\langle a_k \rangle$ is equal to magnitude of semi - major axis of its elliptic trajectory with high accuracy:

$$\langle a_k \rangle = \frac{a_k+b_k}{2} = a_k\frac{1+\sqrt{1-\varepsilon_k^2}}{2} \cong a_k . \quad (23)$$

Notice, the magnitude of gravitational radius of the Sun $R_{\otimes,gr} = 1.4777\cdot 10^5$ cm ; gravitational radiuses of planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto less, magnitudes of them are accordingly equal to 0.02 cm; 0.36 cm; 0.44 cm; 0,04 cm; 140.9 cm; 42.1 cm; 6.5 cm; 7.6 cm and 0.4 cm. The mean magnitudes of eccentricity ε_k of orbits of planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto approximately are equal to 0.206625; 0.006793; 0.016729; 0.093357; 0.048417; 0.055720; 0.0471; 0.087 and 0.247 accordingly. Thus, according to (22) and (23) average distance of planets from the Sun with high accuracy it is possible to present by expression:

$$\langle a_k \rangle = C\tau_k \cong a_k \ . \ (24)$$

Here C is the group velocity of propagation of signals of radiation in vacuum, τ_k is appropriate time of propagation of signals of radiation from small body up to the central, most massive body of system of two bodies.

According to the standard terminology, in those cases, where it does not cause misunderstanding, we name semi-major axis by average radius of an orbit of planet or its satellite.

Let's present Third Kepler Law, experimentally established by J.Utting [2] in the form $V_k\sqrt{a_k} = const$, in a dimensionless kind, by means of bringing in parameter of dimensionless distances r_k and definition of expression:

$$r_k \equiv \frac{C}{V_k} = \sqrt{\frac{a_k}{R_{c,gr}}} \ . \ (25)$$

Concerning expression (25) it is necessary to remark one circumstance. In accordance to tradition and within the framework of the classical mechanics, usually assume, that gravitational radius of a body with mass M may be determined by condition that all energy of a body is the gravitational energy E, defined by means of A. Einstein formula [19−20]:

$$E = MC^2 = \frac{\gamma M^2}{R_{c,gr}} \ . \ (26)$$

Here in (26) $\gamma = \frac{1}{15} \cdot 10^{-6} \frac{\text{cm}^3}{\text{g sec}^2}$ is gravitational constant.

By using expression (26), we shall substitute gravitational radius $R_{c,gr}$ in the expression for the Third Kepler Law in the formulation of Newton and as a result receive dimensionless form of the Third Kepler Law in the form of J.Utting, however here it is necessary to emphasize, that Law of Kepler in the form (25) is determined by us in (3) on the basis of empirical researches without use (26):

$$a_k^{\ 3} = \frac{\gamma M}{4\pi^2} T_k^2 ; \ \Leftrightarrow \ V_k\sqrt{a_k} = \sqrt{\gamma M} = C\sqrt{R_{c,gr}} \ . \ (27)$$

Here in (27) T_k is a period of rotating of a body with mass m around of the central body with mass $M >> m$.

In spite of formal conformity Newtonian formulations of the Third Kepler Law and of experimentally established law by J.Utting in the form $V_k\sqrt{a_k} = const$, at definition of gravitational radius with the help (26), there is a logic contradiction with expression of the Third law in a form of expression (25).

Really, the radius of the "central" body R_c exceeds its gravitational radius $R_{c,gr}$ inside which, according to the law (25) and the condition of constancy of group velocity of light in vacuum $C \cong 2.9979246 \cdot 10^{10}\ \frac{\text{cm}}{\text{sec}}$, the material form of substance should be in the condition of vacuum form of substance, that we usually name by “radiation in vacuum”, as we are sure velocity of any body $V_k \le C$. Therefore we are compelled to define the law (25) as the basic axiom, which allows determining relations of cause and effect:

$$a_k \to R_{c,gr} \quad \Rightarrow \quad V_k \to C \ . \ (28)$$

However, at formal definition of gravitational radius of a body with the help of expression (26) is implicitly supposed, that the body can be inside of its gravitational radius. This statement contradicts the condition (29), the reliability of which in Solar system is outside of any doubts:

$$V_k \le C \ . \ (29)$$

For this reason, in the given work the gravitational radius is entered into consideration phenomenologically, with the help of the theory of dimensions, according to definition of expression (25):

$$R_{c,gr} = a_k \cdot \frac{V_k^2}{C^2} \ . \ (30)$$

It was emphasized earlier and it shall be emphasized here again: in relations (25) and (30) gravitational radius is considered, as parameter describing all bodies, and thus, substance in material form, according to Third Kepler Law (25), can be only outside its gravitational radius. In particular, the visible angular size of the "central" most massive body of system, should be satisfying the condition:

$$\vartheta_c \equiv \frac{R_c}{a_k} \quad \Leftrightarrow \quad R_c \equiv a_k \vartheta_c > R_{c,gr} \ . \ (31)$$

Suppose, that at some moment of time $t = 0$, the body is in the point marked in figures 16 and 17 by letter B in the position situated in the direction of the perpendicular to semi-major axis of its elliptic orbit on the distance of "focal parameter" b_k^2 / a_k from a line of apses of the ellipse. The observer of side of point B sends the short enough radio signal with duration $\tau_s << \tau_k$ in the direction of the central body, marked in figures 18 and 19 by symbol S. To the time of arrival of this signal to the central body at $t = \tau_k$, the k - th small body will have time to move along an elliptic orbit around of the central body on distance $\Delta l_k = V_k \tau_k$ from position B to the position E corresponding to angular distance ϑ_k (Fig. 17).

Let's consider practically important case for astronomy when the distance between bodies is great and accordingly angular distance ϑ_k very small:

$$Sin\,\vartheta_k = \frac{\Delta l_k}{\rho_k} = \frac{V_k \tau_k}{C\tau_k} = \frac{V_k}{C} \equiv \frac{1}{r_k} \cong \vartheta_k << 1. \quad (32)$$

By virtue of symmetry of relative movement of both bodies, formally it is possible to consider movement of central large body around of small one and therefore we can conclude that appropriate distance of an imagined trajectory of the central body is equal to the length of a real trajectory of small body around of the central one:

$$FS = BE \equiv \Delta l_k. \quad (33)$$

The imagined trajectory of the central large body in system of coordinates of small body is shown in figures 16 and 17 by dotted line. Letter F marks the position of central body at moment of arriving of the short signal from small body in system of coordinates of small body.

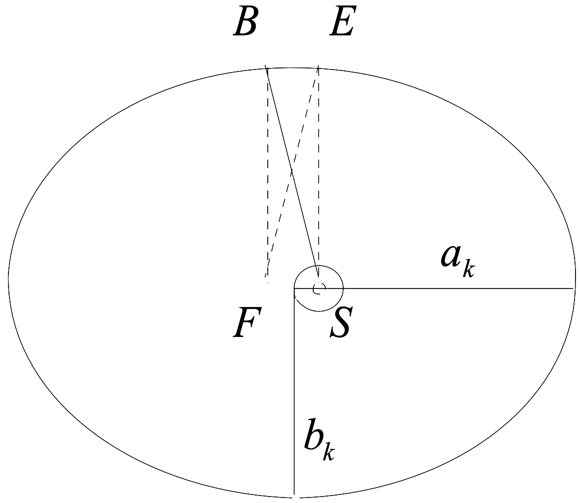


Fig.16 Geometry of movement of a body along elliptic orbit of Kepler.

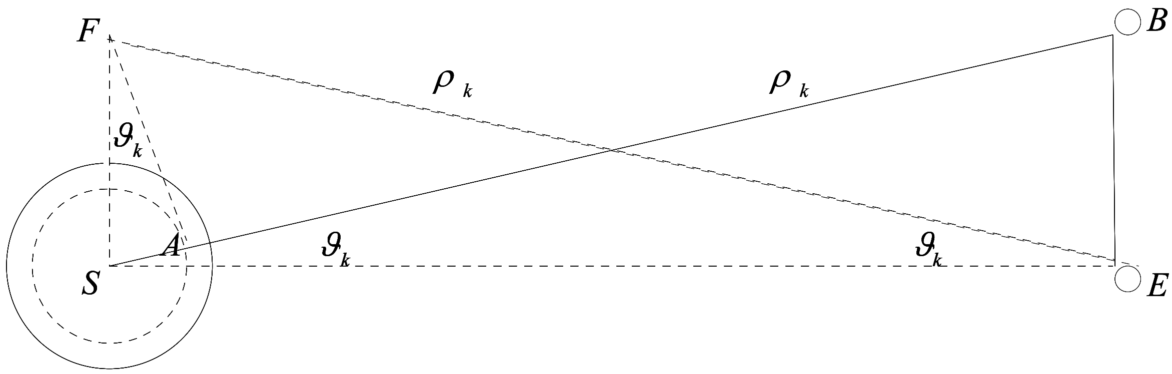


Fig.17 Fragment of figure 16.

The geometrical figure $FBES$ presents the rectangle, as small body is moving along elliptic orbit. Therefore, according to definition of an elliptic trajectory in Euclid geometry, point S and point F define positions of two focuses of an ellipse and the equality is fair:

$$BF + BS = FE + ES\,;\; BE \uparrow\uparrow FS\,;\; FB \uparrow\uparrow ES\,. \quad (34)$$

Let's lead a perpendicular from point F up to point A in the line of connecting points S and B. (Fig. 17)
It is possible to show, triangle ΔSBE is similar to triangle ΔSFA and the relation of proportionality takes place:

$$\frac{BE}{BS} = \frac{SA}{FS} \quad \Leftrightarrow \quad \frac{\Delta l_k}{\rho_k} = \frac{R_x}{\Delta l_k} = Sin\,\theta_k \cong \vartheta_k \quad \Leftrightarrow \quad \Delta l_k = \sqrt{R_x \rho_k}\,. \quad (35)$$

Here, according to (32) the condition $\vartheta_k << 1$ is taken into account and designations are used:

$$FS = BE \equiv \Delta l_k\,;\; BS \equiv \rho_k\,;\; SA \equiv R_x\,. \quad (36)$$

By means of using equalities (32), (35) and (22) it is possible to show, that the functional relations takes place:

$$\vartheta_k \cong \frac{\Delta l_k}{\rho_k} = \frac{V_k}{C} \equiv \frac{1}{r_k} = \frac{\sqrt{\rho_k R_x}}{\rho_k} = \sqrt{\frac{R_x}{\rho_k}} \cong \sqrt{\frac{R_x}{b_k^2/a_k}} = \sqrt{\frac{R_x}{a_k(1-\varepsilon_k^2)}} \equiv \sqrt{\frac{R_{k,x}}{a_k}} << 1 \ . \ (37)$$

By comparing equation (37) and expression (25) for Third Kepler in the form of Utting, it is possible to show, that the gravitational radius of the central body is defined by magnitudes of geometrical parameters $SA \equiv R_x$ and ε_k:

$$R_{k,x} \equiv \frac{R_x}{1-\varepsilon_k^2} \equiv R_{c,gr,k}; \qquad r_k \equiv \frac{1}{\vartheta_k} \equiv \frac{C}{V_k} = \sqrt{\frac{a_k}{R_{c,gr,x}}} \cong \sqrt{\frac{a_k}{R_{c,gr}}} \ . \qquad (38)$$

On the basis of the received result, taking into account expressions (25), (37), (38), (24) and, by assuming, that the body, moving with the greater speed obviously has also the big energy of movement, it is possible to draw a conclusion: energy of movement of small body, rotating around the central one along elliptic trajectory, can be characterized by a square of angle ϑ_k, which in the considered approximation is defined by magnitude of group velocity of light C, by magnitude of interval time of propagation of radiation between two bodies τ_k and by magnitude of the gravitational radius of the central body $R_{c,gr,k} \cong R_{c,gr}$ having geometrical interpretation as a piece of line AS (Fig. 17):

$$\vartheta_k^2 = \frac{1}{r_k^2} = \frac{V_k^2}{C^2} \cong \frac{R_{c,gr,k}}{a_k} = \frac{R_{c,gr,k}}{C\tau_k} \ . \ (39)$$

Notice, actually at movement of planets in Solar system, the deviations of their trajectory are observed. It is possible to prove, that these deviations of a trajectory of moving of planets and their satellites occur in such a manner, that result of multiplication of magnitude of angle $\angle SFA$ by magnitude of semi-major axis a_k is constant, characterizing the appropriate gravitational radius $R_{c,gr,k}$.

$$a_k \vartheta_k^2 = R_{c,gr,k} = const; \quad \Leftrightarrow \quad \angle SFA \equiv \vartheta_k = \frac{\Delta l_k}{a_k} = \frac{R_{c,gr,k}}{\Delta l_k} \equiv \sqrt{\frac{R_{c,gr,k}}{a_k}} \ . \ (40)$$

The angle $\angle SFA$, shown in figure 17 draws together a piece of line SA.
Really, assuming opposite statement, according to which at orbital movements of small body around the large central one, described by the Third Kepler Law in dimensionless form by expression (41), there were spontaneous changes of its semi-major axis $\delta a_k << a_k$, of velocity of orbital movement $\delta V_k << V_k$ and simultaneously - magni-

tudes of gravitational radius $\delta R_{c,gr,k} << R_{c,gr,k}$ and, thus, the body will start movement along new elliptic trajectory according to Third Kepler Law, which we shall present in form of expression (42):

$$\frac{C}{V_k} = \sqrt{\frac{a_k}{R_{c,gr,k}}} \; ; \qquad (41)$$

$$\frac{C}{V_k + \delta V_k} = \sqrt{\frac{a_k + \delta a_k}{R_{c,gr,k} + \delta R_{c,gr,k}}} \; ; \qquad V_k \sqrt{a_k} = (V_k + \delta V_k)\sqrt{a_k + \delta a_k} = const \, . \quad (42)$$

Taking into account expressions (41) and (42), having executed some transformations in the ratio (42) consistently we shall find:

$$\frac{C}{V_k + \delta V_k} = \sqrt{\frac{a_k}{R_{c,gr,k}}}\sqrt{\frac{a_k + \delta a_k}{a_k}} \frac{1}{\sqrt{1 + \frac{\delta R_{c,gr,k}}{R_{c,gr,k}}}} = \frac{C}{V_k} \frac{V_k}{V_k + \delta V_k} \frac{1}{\sqrt{1 + \frac{\delta R_{c,gr,k}}{R_{c,gr,k}}}} \, . \quad (43)$$

It is possible to be convinced, that the equation (43) can be developed only under the condition of a constancy of parameter $R_{c,gr,k}$ during process of transition of a small body to a new orbit.

$$1 = \frac{1}{\sqrt{1 + \frac{\delta R_{c,gr,k}}{R_{c,gr,k}}}} \; ; \quad \Leftrightarrow \quad \delta R_{c,gr,k} = 0 \; ; \quad R_{c,gr,k} \neq 0 \, . \quad (44)$$

Thus, every orbit of a body strictly corresponds to the unique gravitational radius $R_{c,gr,k}$ and eccentricity of body orbit ε_k.

$$SA \equiv R_x = R_{c,gr,k}(1 - \varepsilon_k^2); \qquad \varepsilon_k << 1 \, . \qquad (45)$$

4. CONCLUSION

The carried out analysis has shown, that period of rotation of planets around of the Sun, period of rotation of satellites around of planets, the size of planets, planetary distances scale and satellites distances scale of planets in Solar system are connected

to the period of rotation and the size of the Sun. The gravitation on a surface of planets in Solar system depends on sidereal period of planets rotation along their orbits.
The carried out analysis has shown that any change of the period of rotation and effective radius of the Sun because of emissions of substance from its visible surface accompanied by flashes on the Sun, especially in its active phase, should be by the cause of changing of the effective sizes of planets of Solar system, including Earth, provoking earthquakes on planets.
Interpretation of Third Kepler Law within the framework of axiomatics of Euclid geometry allows considering gravitational radius of a body, as parameter describing complex system of its internal vortical formations having velocities near to velocity of light.
We have introduced new geometrical axiomatics in consideration, based on the Third Kepler Law by means of its using in special dimensionless form. The executed analysis has shown, that in this axiomatics the spatial distribution of planets and their satellites has spatial S - figurative distribution, not dependent on their mass and the sizes.

5. DISCUSSION

An acceleration of free falling on a surface of planets g_k together with the magnitude of radius R_k of any planet in Solar system, according to expressions (9) and (1), are defined by velocity of light C and by magnitudes $R_\otimes$, $T_{\otimes e}$, α_k and T_k. It means, that any change of the period of rotation $T_{\otimes e}$ or effective radius $R_\otimes$ of the Sun, because of emissions of substance from its visible surface, accompanied by flashes on the Sun, should be by the cause of changing of the effective sizes of planets of Solar system, including Earth, which is provoking earthquakes on planets.
It is interesting to mark some features, concerning of the moons Io, Europa, Ganimede and Callisto of Jupiter, as well as and of the Moon of Earth. Every of these moons rotate by one side to the their planets and, as a matter of fact, they represent objects, which, in some sense, are connected to their planets, because they are rotating together with their planets along identical orbits around of the Sun. They are only shared by ocean of cosmic vacuum and, in particular, the Earth Moon possibly play a role of object softening processes of occurrence of cracks in an Earth's crust at moments of increased solar activity and, thus, the size of Earth R_3 defined by expression (9) has sense of effective parameter, which belonging to a configuration and Earth and the Moon. The analogues situations take place with Io, Europa, Ganimede and Callisto.

In the given work several invariants of dynamics of Solar system, which earlier were unknown and were not described by known axiomatics, are defined by the method of systematic analyzing. In this connection, it is necessary to note, that these results raise fundamental questions of natural sciences, but do not pursue purpose of revising any theories, for example of classical dynamics, which successfully describe a number of known natural phenomena.

In this connection, it is necessary to explain a role of any theories, to which frequently we get used, substituting the world real by its models and to note the following.

The theory is separated from reality, but serves for interpretation of our experience by means of theorems of axiomatics in system of relationships of cause and effect. The exchange between the cause and by effect is possible in any axiomatics: by means of acceptance of any theorem as an axiom of theory, it is possible to prove an axiom as theorem.

Assignment of any theory consists in prediction of occurrence only already of known phenomena and value of axiomatic system consists in opportunity of interpretation of phenomena in system of relationships of cause and effect by the most of theorems of axiomatic system; the smaller part of any axiomatics usually interprets the virtual phenomena not existing in reality because of natural finiteness of the general number of axioms, which are using at designing formal systems of naturally scientific theories.

Physical laws describe model, which is the idealization of a reality. There is an essential distinction between formal mathematical systems in physics and by the reality of the Universe. For example, measuring visible angular distances between astronomical objects, we use some formal model of geometry for definition of distances up to far sources of radiation. There are no tools intended for continuous time measuring, and we count time by means of special counters of various natural periodic movements. For increase of accuracy of measurement of time we use those periods of radiation of atoms that are allowed by their nature and in any case cannot vary by us. Time for us is not continuously current, but usually we use a continuous time variable for its description.

The person has five organs of senses, and the opportunities of them can be expanded by means of devices created by him: by telescopes, by microscopes etc. At each stage of investigation of the environmental world our knowledge are limited to our experience. The person models a part of the known phenomena of the Universe with the purpose of forecasting, if these phenomena are representing for him danger or benefit. The person in some circumstances for the various reasons can be uninterested in some phenomena, well known to him, about others and not suspect at all. The known phenomena if the reason of occurrence of them is not determined, are fixed in our memory as certain chaos. Any formal system, which we use for interpretation of a reality, is constructed in axiomatics based on several axioms and its natural information incompleteness does not allow using one theory for the description of all Universes in

some general axiomatics. The mankind owns a huge amount of formalized knowledge assisting him to be guided and survive in harmony with environmental Universe.
All theories are useful, if they explain phenomena, which interest us, the most exhaustively. The good theory should explain all phenomena, which are interesting to the person, supposing creation of possibly smaller quantity of theorems inducing statements outside of the reality of Universe.
In process of growth of our knowledge we find out, that the given real situation can be interpreted within the framework of various formal systems. In these circumstances, the situation is arising in necessity of a choice of the axiomatics having properties of uniqueness of the description of all opened phenomena, which are interesting for us. It does not mean, that we appeal to revision of all old theories, because they cannot explain some new found out phenomena. Any theory cannot explain all known natural phenomena and, certainly, those phenomena, which are unknown to us up to some moment of time. The theory of Newton, as well as, any another known theories created by the person is not exception.
From the formal point of view for resolution of a problem of N bodies in the classical mechanics there are not enough of equations.
Really, it is well known incompleteness of the classical mechanics for the solution of the N - body motion problem with intrinsic gravitation. In fact, the motion of mass point is described in Newtonian mechanics by second-order differential equations. Thus, the solutions of the N - body motion problem in three – dimensional coordinates space of $6N$ first integrals are needed. But as it turns out we are able to find only ten the first integrals, namely: energy integral, three turning moment integrals that traditionally are called area integrals and six location and velocity of the N - body system center of mass integrals; there are lack of $(6N-10)$ integrals to obtain general solution of N - bodies motion problem at conditions of theirs intrinsic gravitation.
Thus, from the formal point of view for resolution of a problem of N bodies in the classical mechanics there are not enough of equations. The absence of uniqueness of solutions of classical mechanics with its symmetry of time variable is evident. Notice, that the same situation takes place with General Theory of Relativity[19 – 20]. All early physical theories were turning round by means of Hamilton variation principle of least action and evidently incompleteness of modern astronomical mechanics is directly connected with limitations of the Hamilton principle.

According to expressions (38) and (39) parameter $\mathrm{E} \equiv \theta_k^2$ represents a square of the angle, which is embracing gravitational radius of the central body in dependence on distance $\Delta l_k = V_k \tau_k$, in dependence on the gravitational radius $R_{c,gr,k}$ and the group velocity of light C. The parameters $\mathrm{E} \equiv \theta_k^2$, $R_{c,gr,k}$ and C altogether define energy of movement and consequently the average radius a_k of an orbit of the body, rotating

around of the central body, having in system of interacting bodies the greatest gravitational radius.
Apparently, the Sun in its internal part has some system of vortical formations of field of vacuum and outside this central vacuum part is the substance with the velocity that is approximately equal group velocity of light. Probably the internal vacuum region create kernel of Sun, and the size of kernel is equal to the gravitational radius of Sun. In the process of nuclear reactions the kernel of the Sun should create more and more complex chemical structure of material ring formations of Sun and its planets, which probably in turn by similar way create the systems of their satellites. We suppose that this hypothesis is the direct consequence of the Third Kepler Law.
Probably in result of magneto hydrodynamic processes the substance of rings it is transformed to the form of planets, that are possessing by various sizes and magnitudes of orbital velocities in dependence on the energy of the vortical vacuum field formations inside of the Sun.

Really, the gravitational radiuses of the Sun $R_{c,gr,x} \cong R_{c,gr}$ depend on the number k of an orbit of planets. This dependence is reliably established owing to existence of distinctions of eccentricities of orbits of the major planets that rotate around of Sun. The equation (28) is determining inevitability of transformation of material structures to the field of radiation in vacuum, when their velocities are exceeding some limit of their magnitudes - the group velocity of light. Expressions (44), (45) testify for the benefit of two hypotheses: planets are born by the Sun and for the statement, according to which the substance in material form has system of vortical formations of field in vacuum inside of gravitational radiuses of all bodies, presenting part of raging vacuum of the Universe.
By using expression (42) it is possible to come to a conclusion, that the square of parameter r should have direct proportional dependence on the magnitude a_k:

$$r_k^2 = a_k / R_{c,gr} \equiv C\tau_k / R_{c,gr} \, . \quad (46)$$

However, our analysis has shown, that r- distributions in dependence on ***number*** of remoteness of planets and satellites from their central object with the greatest gravitational radius is characterizing by S- the figurative distributions having regular symmetric discrete structure. In this connection, concerning measurements of distances in Euclid axiomatics, we should remark. Philosophers of an antiquity knew, that a diagonal and the sides of any rectangle are incommensurable. The mention of this mysterious fact is in well-known work of Euclid "Beginnings" that have reached our times. "Beginnings" of Euclid were considered as an example of a strict deductive reasoning from times of Ancient Greece, in the modern language - an example of formal system. Only in 1882,probably under influence of discoveries in the field of chemistry and physics, Moritz Pasch (1843-1930) has formulated a fundamental axiom of Euclid geometry, which can be attributed and to all other geometrical theories, which are using a hypothesis of a continuity of lines. According to this axiom always there is a point between of two distinct ones and this point is distinct from the first two points.

If the point will be interpreted as a certain material formation, axiom of Pasch will not pass examination, because the substance has discrete structure, and each element of its material macro and micro formations is in a condition of cyclic rotation, and among neighboring atoms of substance the space fills by only field of vacuum.

In figure 18 two isosceles, rectangular triangles Δabc and Δbcd, and the equiangular triangle Δabc, disposed at angle ϑ concerning a point c are represented.

Triangles Δabc also Δbcd are similar, differ by the area twice and they are unwrapped one concerning another under at angle $\pi/4$. However the length of a hypotenuse of an isosceles triangle Δabc is defined according to theorem of Pythagoras by irrational number, more exactly by algorithm of calculation $\sqrt{2}$. According to this algorithm for calculation of length of a hypotenuse bc, probably, there will be not enough time of existence of Universe, but the hypotenuse of an isosceles triangle Δbcd is expressed by a natural integer 2.

Thus, we have to mark the inconsistency of description of length in geometry of Euclid: the hypotenuse of an isosceles triangle Δbcd is clearly expressed by a natural integer, but hypotenuse of similar isosceles triangle Δacb is measured by irrational number in conditions of arbitrary disposition of triangles and of arbitrary choosing of measure of length.

As the unit of measurements of length of the sides and orientation of triangles in the coordinates plane is chosen by us completely arbitrarily, in the frames of Euclidian geometry filled up with irrational numbers it is possible to notice the contradiction with its axiomatics supposing uniformity and isotropy of space at turn of a geometrical figures, as the measure of length is changing. It is clear, both triangles can be easy constructed without concept about irrational numbers, and all sides of both triangles can be measured with the highest accuracy accessible to the modern person with an absolute error that is approximately equal to length of a wave of radiation of a laser-measuring instrument of length.

In Euclid geometry there is not invariance of a measure of length at turns in general case. Nevertheless, if by any way to choose a measure of length and to construct the similar triangles, shown on the right side of figure 18, that are formed by circle radiuses and by chord with a lengths of their sides are equal to several units of measure length, it is possible to show, that at turn of a triangle on any angle ϑ the measure of length will be kept.

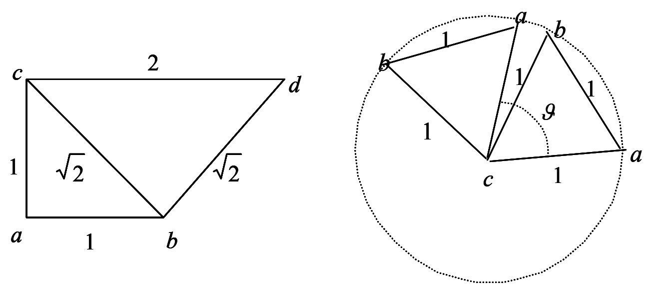


Fig.18 Not invariance of a measure of length at turns.

Thus, in the theories that are using the concept of a continuity of lines there is a problem of definition of an invariable measure of length for elements of the geometrical figures of different orientation. The reason of such situation lays in the false belief that in any geometrical formal systems the axiom of M.Pasch should be acting; in accordance to this axiom between pair of "points" always it is possible to find one more "point". Actually this axiomatics admit interpretation of substance by its theorems as a kind of continuous "base material" from which it is possible to cut off any small slice as from a cabbage pie: the model ignores probably the most important component of substance of Universe - its vacuum intangible component by means of which energy of radiation are spreading between macro and micro bodies.

At measurement of sizes of material bodies located on the Earth, we have an opportunity of direct comparison of atomic and molecular structures that are forming bodies. Bodies are including astronomical quantities of atoms and molecules, concerning which we know about huge vacuum distances between their atomic components. Sizes of cores of atoms are extremely small in comparison with distances between them. Field of vacuum energy fills the spaces between atoms. We assume that distances between atoms of body are approximately identical and therefore the sizes of bodies can be estimated by means of comparing of bodies at some stationary conditions or even by means of calculation of the quantities of atoms making molecules and more complex body structures.

Absolutely other situation arises if necessary estimations of extent of distances between macro bodies in conditions of space vacuum of the hydrogen diluted with atoms and the helium carried on space distances. A condition of measurement of space distances between bodies in vacuum with insignificant concentration of hydrogen and helium essentially others. In this case there are only two basic principle ways of measurement of distances between the bodies isolated by vacuum that are consisting in measurement of visible angular distances between them and in measurement of time during which signals of radiation carry energy from one body up to another body. The vacuum is in itself intangible and its real existence can be discovered by us only in its ability to transfer the signals carrying energy that we perceive when its power reaches organs of senses of a person. For example, we feel invisible radiation, we see light at that moment, when the appropriate portion of energy reaches our eyes, and we register arrival of invisible radio signals, when the appropriate energy reaches the radio receiver.

In conditions of necessity of an estimation of distances between macro bodies in vacuum we actually are engaged by measurement of time intervals of passage of radio of signals between bodies, using a method of their comparison with the reference period of cyclic processes that is known. For example we compare time to the period of rotation of the Sun, we compare time to the periods of signals of quantum atomic clockwork that serves as the reference. However it is necessary to recognize, that we have no information on how actually energy in vacuum is transferring between bodies and how actually energy in vacuum is transferring between atoms, because properties of vacuum are directly inaccessible to our senses organs. For example, we do not know, why in conditions of transferring of energy, the group velocity of a sound in water or metal has the certain magnitude precisely the same as the group velocity of a radio emission in vacuum.

The properties of transferring energy in vacuum between bodies and between atoms of substance in the form of sound or radiation are the general properties of both and of acoustic phenomena and of radio emission phenomena. We can discuss only indirect properties of vacuum by means of using results of supervision of the processes of transferring of energy between macro bodies or atoms and molecules of bodies and by means of supervision of the form of trajectories of movement of bodies in vacuum that at free movement of bodies represent ellipses. The parabolic curves describing falling of bodies near of planets can be considered, as small pieces of their elliptic trajectories interrupted by collision with their surface. The hyperbolic trajectories received by means of theory of Newton represent, apparently, the result of interpretation of the theorems of theory, which are not presenting real movements of bodies in space. “ The exceptions confirming a rule ”should be presented in any natural-science theory, because all formal systems inevitably are constructing by means of using of only several axioms.

The analysis of a spatial distribution of orbits of bodies in Solar system, has shown that planets and their satellites form hierarchy of the similar subsystems having special properties of the S - figurative distribution of r - distances between each of the bodies that are moving along elliptic orbits around of the appropriate central body, which possesses by the gravitational radius prevailing in each subsystem. By taking into account these results of the analysis that demonstrate functional connection of orbital movement of bodies with the appropriate gravitational radius of their central object $R_{c,gr,k}$, it is possible to assume hypothesis that movement and spatial distribution of bodies are defined by mechanisms of interaction of their vortical vacuum formations which, apparently, should be present at any substance. In connection with this assumption it is necessary to mention known paradox. The essence of this paradox consists in the contradiction between the Law of gravitation of Newton and by data of astronomical observations, which are testifying not only about global expansion of the Universe, but also about of increasing of the size of Earth. We ought to remark that changing of the sizes of planets according of our analysis apparently are connected to solar activity, as well as the visible expansion of the Metagalaxy is connected to its rotary activity as a whole. The reason of expansion of a surface of the Earth, probably, is connected to continuous reproduction of substance in the center of the Earth in the form of hydrogen, helium and other light elements, which in process of nuclear reactions create and heavy elements of the Mandeleyeyv table.

All previous theoretical researches are based on a variational principle of least action of Hamilton and, undoubtedly, incompleteness of the modern astronomical mechanics directly is connected to restrictions of applicability of Hamilton variational principle not only in the mechanics. For example, on the base of our investigation it is possible to put forward the hypothetical statement: the substance generally represents system of interacting steady whirlwinds of a field of vacuum, and occurrence of material structures is connected to formation of its steady cyclic vortical formations. The infringement of stability of rotation of each vortical system representing a body, for instance of electron, atom, a molecule or them macro formations, should result in transition of substance in a field of vacuum according to a share of loss of rotation of its vortical a component.

Within of this hypothesis, in particular, it is possible to assume that phenomena of diffraction small bodies in experiments with electrons and molecules are representing an interaction of those parts of their components, which in part or have completely lost of their material state in result of destruction of their steady state of rotation during development of experiments and thus bodies were transformed in the form of radiation. It is possible their radiation are reflecting from parts of inhomogeneous screen because of lack of energy for creation the steady vortexes of material formations and further there is an interference of reflections of radiation from various sites of the non-uniform screen.

The inverse process, when the field of vacuum in the certain conditions accepts the material form of the numerous, of mutually connected steady whirlwinds that are forming bodies of a various chemical compound is possible. Such processes probably occur, when radiation of a substance, for example in the form of a spherical wave possesses by the enough big energy, consistently interacts with a site of plane of the vortical homogeneous structure of substance and gets the necessary turning moment due to this interaction. At absence of non-uniform structure of the screen all energy of the radiation of a bodies, which have lost a steady condition of rotation, again finds vortical material state during of process of collision with site of regular vortical structure of the homogeneous material screen. Naturally, some intervals of time for process of destruction and restoration of steady vortical formations of the material form of substance are required.

The motionless, not accelerated bodies are not observed. On the basis of results of our researches we assume that the real valid reason of the gravitational phenomena is rotation of a substance in material and vacuum form.

We make this conclusion on the basis of Third Kepler Law, which defines real significance of size of gravitational radius of bodies in mechanics and because presence of the turning moment of bodies in macro and micro world is a necessary condition of their existence.

Nowadays anybody authentically does not know an internal structure of the Sun, planets and their satellites.

The system of vortical formations in a nucleus of the Sun with average radius $R_{\otimes,gr} = 1.4777 \cdot 10^5\, cm$, probably, represents complex toroidal system of whirlwinds of vacuum close located, cooperating and enclosed each other. External parts of each whirlwind, probably, represent the vacuum vortical radiating structures rotating in limits from a seen surface of the Sun down to orbits of the main planets of Solar system. Within the framework of such hypothesis we shall consider model according to which centrifugal forces of a compact nucleus of the Sun of radius $R_{\otimes,gr}$ to any unknown us a way induce a field of gravitation $g_{\otimes e}$ on its seen surface of radius $R_{\otimes e}$ according to expression:

$$g_{\otimes e} = \frac{2C}{T_{\otimes e}} = \left[\frac{2\pi}{T_{\otimes g}}\right]^2 R_{\otimes g} \cdot$$

It is possible to express sidereal period of rotation of a surface of the central core of the Sun $T_{\otimes g}$ by the relation:

$$T_{\otimes g} = 2\pi\left(\frac{R_{\otimes g} T_{\otimes e}}{2C}\right)^{\frac{1}{2}} = \frac{2\pi R_{\otimes}}{C} \approx 14.6 \sec \cdot$$

Here the average effective gravitational radius of the Sun is determined by expression already known to us

$$\frac{R_{\otimes g}}{R_{\otimes}} = \frac{2R_{\otimes}}{CT_{\otimes e}}; \quad \Leftrightarrow \quad R_{\otimes g} = \frac{2R_{\otimes}^2}{CT_{\otimes e}} = 1.4777 \cdot 10^5 \mathrm{cm} \cdot$$

The discovered dependence of spatial distribution of planets and of their satellites in dependence on the period of rotation of the Sun leads to the idea according to which major planets both their satellites and all other bodies of the Solar system represent secondary sources of vortical formations of the Sun, that are stimulated by its energy of internal vortical rotation. The ensemble of vortical formations created by the Sun in macro and micro world interact among themselves, forming in turn own subsystems of bodies. The magnitude of gravitational radius of the central body is the biggest in each such subsystem, because the central body plays role of parent of small bodies rotating around of central one. It is interesting to investigate the reason of occurrence and interaction of steady vortical formations.

* * *

In conclusion of discussion I ought to remark the importance of the observations of activity of Sun and distribution of brightness of the Sun, in particular on the part of its heliographic poles in high - level radiation range, as well as of similar detailed researches of Earth, of red and black spots of Jupiter and other planets of Solar system, because it is a most significant problem of further investigations with the purpose of searches for opportunities of surviving of mankind in Solar system.

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P.S.

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