

Quantum theory of gravitation

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„Imagination is more important than knowledge“

Albert Einstein

ABSTRACT

In the paper, the outline of a new quantum theory of gravitation is presented. The energetic states of a material body, stable and unstable, are described. Characteristics of a body motion in a gravitation-inertia space-time has been given. It has been proved that all the time both gravitation and inertia are co-existent, independent on the position of a moving object. This is the reason of that two-link name of the space-time. A thorough in-depth analysis of the problem made it possible to state that so called the law of common gravity is a hyperbolic approximation of a proper course of inertia force. Therefore the mentioned courses have only two common points. One of them, the initial point belongs also to the course line of the gravity force, constant on the whole length of space-time. This theory is adequate in character and thus generally does not corresponds with the existent classical theory of gravitation.

Keywords: Gravitation; Space-time; Potential; Potential field; Principle of energy conservation

1. INTRODUCTION

Our common knowledge about the gravitation is quite large. To say more, it is rich with the variety of interpretations of this phenomenon. May be this is the reason it cannot be recognized as closed, having a uniform structure, without any lacks. These lacks should be completed with a new adequate cognitive material [1-6]. Knowledge is very important, but the imagination is even more important (see: aphorism by A. Einstein). There are limits of knowledge but imagination seems to have no limits. The Authors would like to get out of the limits in view of presentation our own look at that natural phenomenon which is gravitation. As introduction, it is worth admitting some observations and remarks on the existent theory of gravitation. It is stated that the inertia mass is equal to the gravitation mass. It might be this differentiation is not needed on the cognitive way. Thoughts have been directed to inertia and gravitation of a mass, whereas it should be related to the acceleration. There are accelerations of inertia and gravitation. The inertia acceleration results from inertia of a material body being in the range of the earth sphere. The gravitation acceleration is the consequence of reacting just the planet on this material body. Inertia is an inclination of a body to accept a stable state [7]. Gravitation is the ability of Earth to attract material bodies

[8]. There are apparent differences in both these mental magnitudes, being the phenomena as well. Such a determination of these magnitudes results from resenting them by senses. It is worth adding that all material magnitudes of human world have been classified. It was presented in a scientific essay [9] and the monograph [10]. Thus both inertia and gravitation are significant in the body motion towards the Earth. This description will be adequate if in the reality the description both phenomena will be taken into account. In consequence, the value of the gravity acceleration will be described by a lower number. Up till now the gravity acceleration only was considered, neglecting the inertia acceleration in its loading point. This is why the gravity force used to be divided into determined components apart from that procedure is not in agreement with the gravity nature. The gravity force has univocally determined direction and a sense, and cannot be divided into any components. That procedure can be done in case of inertia force which is the product of a body mass and its acceleration. One cannot agree with the statement that gravitation is just the bend of space-time [11]. This bend is the result of synergy of gravitation and rotary motion of the earth globe. They are only some exemplary to supplement the essential remarks on existent knowledge of the gravitation. Limited frames of this paper make it impossible to discuss all detailed problems connected with the matter. They are of great importance to reveal the problems.

2. STABLE STATE OF A MATERIAL BODY IN THE CIRCUM-EARTH SPACE: FIRST COSMIC VELOCITY

Such a state of a material body takes place if it is on a stable static potential field and at the same time on the kinematic field of that type. Therefore an energetic equilibrium with the equality of centrifugal and gravity forces takes place with the stress on co-existence of the former one with inertia force. Let us consider the motion of a body of mass m on the trajectory of radius r_o (Fig. 1). This is a circle orbit situated just above the Earth surface. Its radius is comparable with the average radius of the planet r_z , and it is placed in the equator plane. The orbit forms a stable static potential field SSPF, and the trace of rotating plane – kinematic potential field KPF. Therefore a body is always on the cross-roads of these fields: still/motionless and moving with a uniform motion at velocity v_{os} which used to be called the first cosmic velocity v_l . That is a velocity which should be applied to the body, tangent to the Earth surface, so that it runs close over its surface (assuming lack of atmosphere) [12-14].

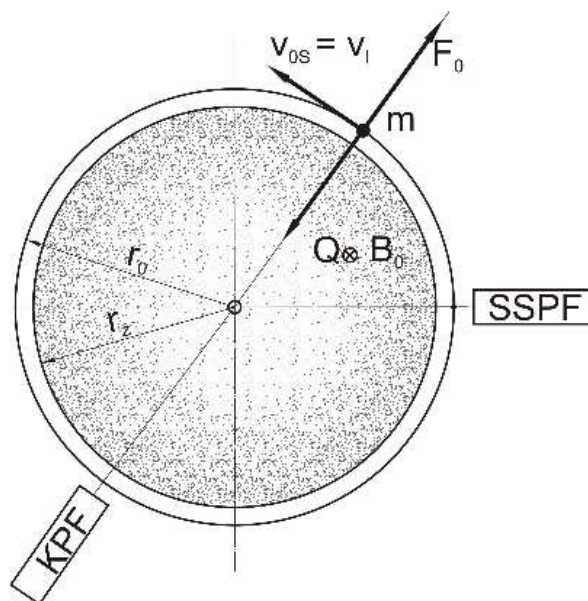


Fig. 1. A body on the circular orbit in a stable energetic state

The condition of the force equilibrium of that body takes the form:

$$F_0 = Q \otimes B_0 \quad (1).$$

Symbol F_0 denotes here a centrifugal force, Q – is the gravity force, and B_0 – is inertia force (the first one used to be called centrifugal inertia force, the third one as centripetal inertia force). In this case the role of the centripetal force is played also by the gravity force Q , which co-exists with force B_0 . The co-existence state of these two forces is denoted by symbol \otimes .

By developing further the condition (1) through the definition determination of the forces F_0 and Q one obtains:

$$m\omega^2 r_0 = mg \quad (2)$$

where ω is the angular velocity of kinematic potential field, g is the earth gravitation (other magnitudes have been named above).

Introducing further dependence of the first cosmic velocity v_I on the angular velocity ω_0 and the orbit radius r_0 , that is:

$$v_I = \omega_0 \cdot r_0 \quad (3)$$

it is finally obtained:

$$v_I = \sqrt{gr_0} \quad (4).$$

One may also write down that energetic state of the body by transforming the formula (1) after introducing the dependence (3) to the form:

$$mv_I^2 = mgr_0 \quad (5).$$

The product of mass and the square of the first cosmic velocity is a measure of kinematic energy, that is the kinematic potential $V_k^{(0)}$ on zero (initial) potential field. The product on the right side of equation (5) is an initial gravity potential $V_Q^{(0)}$. It is worth adding that the energetic state is also determined by the inertia potential $V_B^{(0)}$. Thus in reference to the energetic equilibrium there also this co-existence takes place, meaning $V_Q^{(0)} \otimes V_B^{(0)}$. This sort of equilibrium may be finally written down as:

$$V_k^{(0)} = V_Q^{(0)} \otimes V_B^{(0)} \quad (6).$$

If one takes it in the form of the principle of energy conservation, the following analytic dependence is obtained:

$$\sum_{i=1}^3 V_i = V_k^{(0)} + V_Q^{(0)} + V_B^{(0)} = idem \quad (7)$$

with two last potentials being the measures of different sorts of the static energy, contrary to the first term which represents the measure of kinematic energy.

At this stage of considerations, the cognitive accent is apparent, proving of the quantum nature of gravitation. Then the body may be carried out on the next orbit, where it will take different unstable energetic state. And this is to be the subject of further analyses.

3. FORCE COURSES IN GRAVITATION-INERTIA SPACE-TIME: THIRD COSMIC VELOCITY

For the body to take a position on the next, neighboring orbit, it should be thrown away from the former orbit with a determined initial velocity. This is the second cosmic velocity v_{II} . It is worth adding here that the second orbit has a determined position in the planetary system. It should not be said that the body from the Earth surface is to be carried on the infinitely large distance; there is no sense in it. With such an approach, from gravity to classic cognitive, it is hard to notice its quantum nature.

The second cosmic velocity will be determined later. Now, as indicated by the paper title, the attention is to be concentrated on the force courses in the gravitation-inertia space-time (Fig. 2). At the beginning of motion a stable body state takes place. All forces possess equal values, and they are: the gravity force Q , inertia force B_o , and driving force F_o .

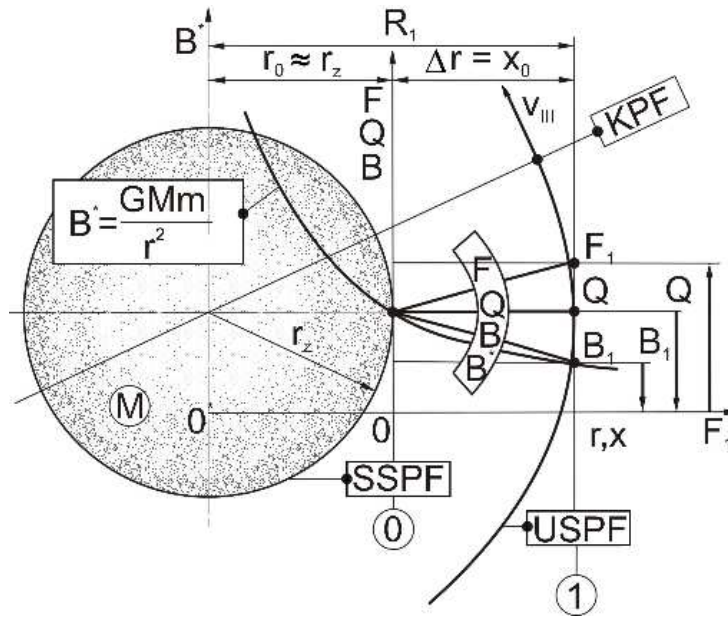


Fig. 2. Force courses in the gravitation-inertia space-time

After a transition through the space-time, once unstable force equilibrium exists, the body driving may be turned off. It may be done because the role of driving force takes over the centrifugal force which results from the rotary motion of Earth. That means the body is now on the neighboring orbit. It forms the unstable static potential field USPF, denoted by symbol 1. Earlier the body was on the stable static potential field SSPF. That field has been ascribed by other symbol 0.

Forces F_1 , B_1 may be expressed in function of the gravity force, constituting two equations comprising these two unknowns. The first equation describes the equilibrium of forces on the unstable static potential field, that is:

$$F_1 = Q + B_1 \quad (8).$$

The second equation results from the principle of energy conservation which has the following form:

$$3Q \cdot \Delta r = (F_1 + Q + B_1) \cdot \Delta r \quad (9)$$

so after making some simple operations:

$$2Q = F_1 + B_1 \quad (10).$$

The solutions of these two equations are as follows:

$$F_1 = \frac{3}{2}Q, \quad B_1 = \frac{Q}{2} \quad (11).$$

Knowing that the role of force F_1 is taken by centrifugal force, the equation (8) may be written as:

$$m\omega_z^2(r_z + \Delta r) = Q + \frac{Q}{2} \quad (12)$$

where $\Delta r = x_o$ (see Fig. 2) is the length of gravitation-inertia space-time. This length results from the late equation. After substituting that $Q = mg$, it takes the following form:

$$\Delta r = \frac{3g}{2\omega_z^2} - r_z \quad (13).$$

Now the third cosmic velocity v_{III} , may be determined, being the peripheral body velocity on that orbit. It is written by the formula:

$$v_{III} = \omega_z \cdot r_1 = \omega_z(r_z + \Delta r) = \frac{3g}{2\omega_z} \quad (14)$$

where r_1 – is the radius of the first neighboring orbit, expressed by the formula:

$$r_1 = \frac{3g}{2\omega_z^2} \quad (15)$$

as resulting straight from the formula (13).

It is worth analyzing these real force courses to compare them with those provided in the existent classical knowledge. Just to compare, in Fig. 2 the course of so called the gravitation force has been marked, resulting from the law of a common gravity by Newton. This law says that each two bodies attract reciprocally by gravitation forces with the values being in direct proportion to the product of masses of the bodies and in reverse proportion to the square of distances between the centers of their masses. Corresponding to the law the formula is visible against a background of this Figure 2. Now coming to the value of the gravitation constant G : according to [12] it equals $(6.673 \pm 0.003) \cdot 10^{-11} \text{ N} \cdot \text{m}^2 \cdot \text{kg}^{-2}$.

The gravity refers to the Earth whereas a common attraction force refers to the material bodies. The attraction force acts in the whole space-time and reveals invariable value. The action of Earth is noticed not only on the surface but it acts in each point of the space-time. The gravity force is the measure with $Q = mg$, where m – body mass, g – gravitation (Earth acceleration). The capital letter refers to the whole globe, not only to the surface.

All forces come out of the force node which is also the energetic spot. Their courses bifurcate, and the forces' lines run in different directions from this center. The gravity force Q does not change its direction. The driving force F rises all the time whereas the inertia force B decreases. Particular force lines are straight until expressing them in the function of time (apart from the gravity force) when their courses will reflect curved lines, here the exponential ones.

Thus the characteristic body motion in the direction of circumearth orbit has been reduced. Only the gravity force has been taken into account and denoted by symbol B^* to differentiate it from the inertia force B . The late force has only two common points with the reality and its hyperbolic course is an approximation curve in character.

4. TIME CHARACTERISTICS OF THE BODY MOTION BETWEEN STABLE AND UNSTABLE POTENTIAL FIELDS: SECOND COSMIC VELOCITY

The truth about reality is at the source. It concerns also the phenomenon of gravitation. This truth reaches the statement: it has a quantum nature. Let us get to the source, the phenomenon of variable radial body motion in the gravitation-inertia space-time. At the same time, the uniform rotary Earth motion takes place, so the body motion is relative in character, and its trajectory will be naturally curved.

Firstly, let us turn the attention on the body motion in radial direction, and that will be a retarded motion. A differential equation, referred to the primary magnitude, which is the path length, is used to describe this phenomenon. In the assumed system (see Fig. 2), this equation takes the form:

$$dx = \pm \frac{\partial x}{\partial t} dt \quad (16)$$

where: dx – total differential of the path length, dt – total differential of time, ∂x – partial differential of the path length, ∂t – partial differential of time. The algebraic signs are the operators. The operator (+) is only formal, by confirming the physical sense of the described magnitude. The sign (–) ascribes such a meaning to the determined record.

The body motion in radial direction from the Earth will be retarded with the path length described by the equation with minus sign. Its solution takes the form [10]:

$$x = 2x_0 \left(1 - e^{-\frac{t}{T}} \right) \quad (17)$$

with $x_0 = \Delta r$ – being the length of gravitation-inertia space-time, t – time, and T – time constant.

Let us explain the course of the primary physical magnitude (path length) and the magnitudes connected with it. Fig. 3 presents positions of the determined space-times and potential fields with the compositions determining the space, time, and the limits of that retarded motion.

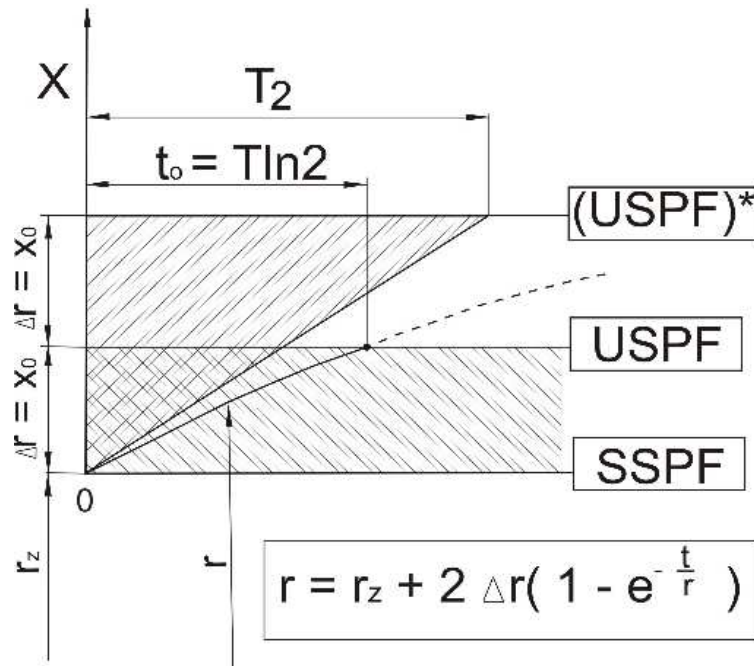


Fig. 3. Course of the body path length in the gravitation-inertia space-time

The body is thrown away from the Earth of radius r_z , of which the hull at the height of this radius forms a stable static potential field SSPF (Fig. 3). It moves through the space-time with a retarded motion and after some time it reaches the unstable static field, and this takes place on the neighboring unstable static potential field USPF. The body moves in the dotted area (Fig. 3) where the course of the path length is denoted by a solid line, and this is that proper real space-time. Beyond this one, there is the improper apparent auxiliary space-time. A non-real apparent course of the path length is marked with a dashed line. This auxiliary composition fulfils an important role by distinct separating the described phenomenon from the mathematical interpretation.

The border of the late mathematic space-time is the nominal unstable static potential field (USPF)* which will determine this time constant T . Now one may define this magnitude: this is, as it results from the scheme in Fig. 3, the time of body transition on the nominal unstable static potential field with the constant invariable initial velocity v_{or} , determined by the ratio $2x_0 : T$.

By assuming as the dependent variable the radius or the distance of the body from the globe center, the equation of the path length may be written as follows:

$$r = r_z + 2\Delta r \left(1 - e^{-\frac{t}{T}} \right) \quad (18).$$

For $t = 0$ the radius r is surely the Earth radius, so $r = r_z$. Substituting to the formula (18) $r = r_z + \Delta r$ one obtains time t_0 , after which the body attains the unstable static potential field USPF, where its radial motion stops. Therefore

$$t_0 = T \ln 2 \quad (19)$$

Let us determine now the second cosmic velocity v_{II} . It directly results from the equation (18) and is simply the first derivative of the path length at the initial point. Therefore

$$v_{II} = \left(\frac{dr}{dt} \right)_{t=0} = \left(\frac{2\Delta r}{T} e^{-\frac{t}{T}} \right)_{t=0} = \frac{2\Delta r}{T} \quad (20)$$

It results that the earlier mentioned initial velocity v_{or} is the second cosmic velocity v_{II} .

The time constant T results directly from the connection of the gravity acceleration g with the initial acceleration a_{or} , or $g = a_{or}$, and this takes place on the stable static potential field SSPF (see Fig. 2). Therefore

$$g = a_{or} = \frac{2\Delta r}{T^2} \quad (21)$$

and

$$T = \sqrt{\frac{2\Delta r}{g}} \quad (22)$$

Assuming then,

$$\frac{2\Delta r}{T^2} = \frac{v_{or}}{T} = \frac{v_{II}}{T} \quad (23)$$

one obtains the dependence

$$v_{II} = \frac{2\Delta r}{T} \quad (24)$$

and after taking into consideration (22)

$$v_{II} = \sqrt{2g\Delta r} \quad (25)$$

that after substituting to the formula (13), gives as result the dependence of the second cosmic velocity from the first one, then

$$v_{II} = \sqrt{\frac{3g^2}{\omega_z^2} - 2v_I^2} \quad (26)$$

as $gr_0 \approx gr_z = v_I^2$.

One could determine the following time characteristics of the radial body motion being its kinetics. Taking into account the mass of the body, the following characteristics may be obtained, describing the dynamics of a material solid.

To concentrate on the matter, the following step will be the description of the body trajectory on the transition way to unstable energetic state where the third cosmic velocity v_{III} occurs and the body moves around the Earth without its own driving.

Superposition of the component motions: the uniform motion of Earth, and retarded body motion in its gravitation-inertia zone leads to the equation of its trajectory on the way to

orbit, which is unstable static potential field USPF. The trajectory of this body (**Fig. 4**) results from two equations of the path length, angular φ and linear r , respectively, so

$$\varphi = \omega_z \cdot t \quad (27)$$

and described by the earlier derived formula (18).

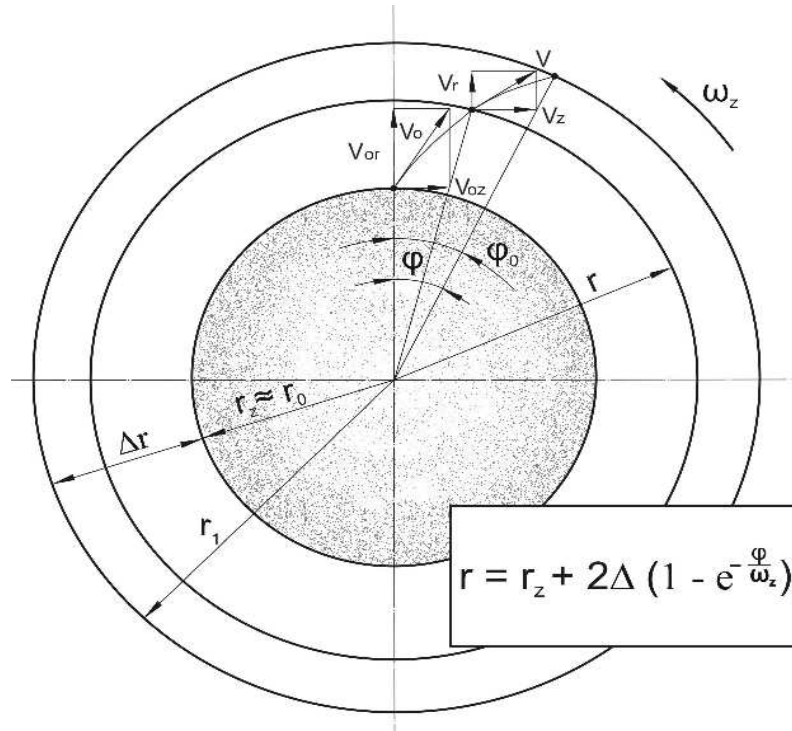


Fig. 4. Trajectory of a body in the gravitation-inertia space-time

From the equation (27), the time t is determined and by substituting it to the formula (18) as a result one obtains the dependence of type $r = f(\varphi)$, having the following form:

$$r = r_z + 2\Delta r \left(1 - e^{-\frac{\varphi}{\omega_z T}} \right) \quad (28).$$

5. CONCLUSION

In conclusion, the vectors (their positioning) of all three cosmic velocities have been confronted, together with the formulae describing them (**Fig. 5**). The comparative analysis of these formulae indicates that only the first cosmic velocity does not differ from its classical version. There are some essential differences in relation to the second cosmic velocity. The third cosmic velocity is the matter hardly mentioned by the classical mechanics although there is one worth noticing.

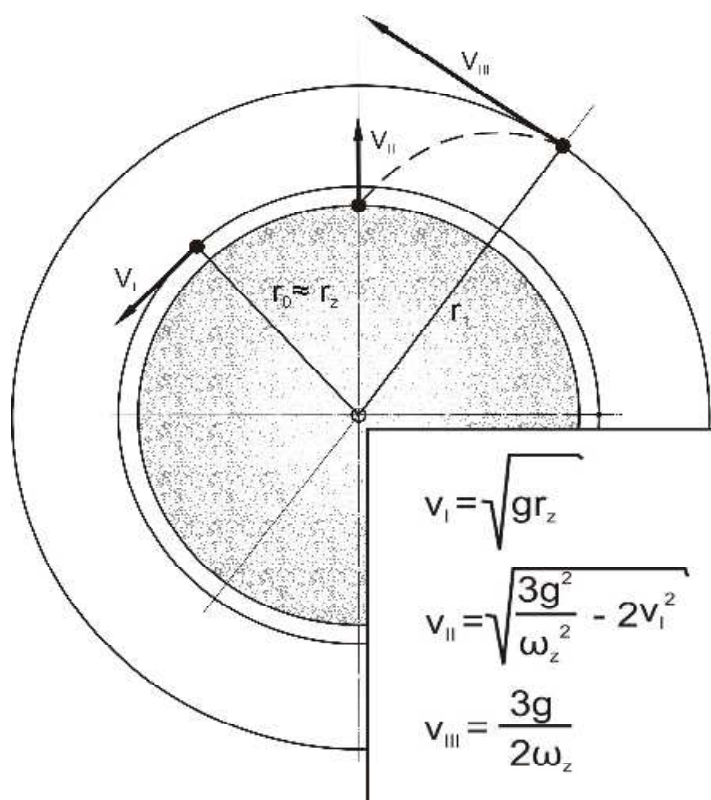


Fig. 5. Location of three cosmic velocities' vectors and the formulae describing them

In the lights of these considerations one may state that the existent law of common gravitation needs to be verified. The classical theory of gravitation should be presented more adequately, in a quantum form such as presented herewith. One may note, the gravitation possesses the quantum nature.

The presented description of the body motion in the gravitation-inertia space-time allows to develop it further. Just new non-existent characteristics of the body motion in space-time may be created. All these may enrich the knowledge of the described reality.

The presented here the quantum theory of gravitation is to complete the gap that existed on the ground of knowledge about this phenomenon. We do hope this work will supplement this part of knowledge and expand the cognition of the reality.

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