Measuring gravitational constant and the main the Earth, the Sun and the Moon parameters

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Gravitational constant was found by determining gravitation between the Earth and the located on the equator standard-copy of weight in system SI situated at the distance of the Earth radius. Gravity acceleration of one gram of a body has been found. The main parameters of the Earth, the Sun and the Moon have been found due to the fact that any body, with smaller mass, moving along the orbit around the central body with larger mass experiences not only the attraction of this body but also centrifugal force that repulses the given body from the central one. The peculiarities of measuring body parameters in various points of the Universe have been shown.

Keywords: body, gravitational constant, weight, mass, gravity acceleration, distance, velocity, gravitation force, centrifugal force, density.

I. INTRODUCTION

The development of science and technology has radically changed the outlook of the mankind. The use of modern methods and devices in studying the Universe made it possible to find the answers to a number of questions concerning the structure and functions of the Solar System and the Universe as a whole. The Earth gravity acceleration has been found experimentally.

Geometric dimensions of different bodies, the distance to them, average orbital velocities as well as photos of visible bodies have been found with the help of optical telescopes.

Their chemical composition and temperature have been found with the help of spectral analysis.

American astronauts have delivered the samples of lunar soil to the Earth. Automatic space stations have investigated the surface and the atmosphere of Venus, Mars and other bodies of the Solar System.

However, a number of other actual questions haven't been answered yet. The question of anomal displacement of Mercury perihelion, irregular acceleration of Encke comet, secular acceleration of the Moon the nature of dark matter, etc. are among them.

Numerous attempts to answer these questions weren't successful.

The reason of such a situation may be attributed to insufficient foundation of the existing gravitation theories.

II. THE STATEMENT OF THE PROBLEM

While analysing the results of the research one should mention the following main advantages of the work performed:

- the discovery of the law of free falling by G. Galilei in 1604;
- the discovery of centrifugal force by Ch. Huygens in 1659;
- the hypothesis of I. Bernoulli about the relations between the notions of weight and mass;
- determining gravity acceleration of the Earth;
- determining velocity of bodies;
- determining the distances between bodies.

In spite of the advantages one should mention the following basic disadvantages of the work done:

- the investigations were directed to the identification of the notions of weight and mass and were insufficiently grounded;
- it's rather difficult to deduce the force dimensionability from I. Newton formula of gravitation;
- gravitational constant was obtained in a rather doubtful way;
- the methods of determining weight, mass, gravity acceleration, density, etc aren't sufficiently grounded;
- the anomal displacement of Mercury perihelion, irregular acceleration of Encke comet, secular acceleration of the Moon and other anomalies haven't been explained;
- the nature of dark matter hasn't been explained.

In the connection with the above mentioned the problems of research are:

- to work out a new theory of gravitation and its mathematical apparatus;
- to measure gravitational constant by objective method;
- to measure the main parameters of the Earth, the Sun and the Moon;
- to measure gravitational forces between the Sun and the Earth, the Earth and the Moon;
- to measure the main body parameters in different points of the Universe;
- to explain the anomal displacement of Mercury perihelion, irregular acceleration of Encke comet and other anomalies;
- to explain the nature of dark matter.

III. RESULTS

The new gravitational theory was based on gravitation formula the conclusion from which will be given in another work.

$$F_{1-2} = \sqrt{G}\frac{\sqrt{G}\frac{M_1 g_2}{R_{1-2}} + \sqrt{G}\frac{M_2 g_1}{R_{1-2}}}{R_{1-2}} = G\frac{M_1 g_2 + M_2 g_1}{R_{1-2}^2}, \quad (1)$$

where F_{1-2} is gravitation force between the first and the second bodies, $gcms^{-2}$;
G is gravitation constant, cm^2;
M_1 is the first body mass, g;
M_2 is the second body mass, g;
g_1 is the first body acceleration of gravity, cms^{-2};
g_2 is the second body acceleration of gravity, cms^{-2};
R_{1-2} is the distance between the first and the second bodies, cm.

In order to verify gravitation formula (1) practically the main parameters of the Earth, the Sun and the Moon were found. The obtaining of the parameters started with finding gravitation between the Sun and the Earth. In this case it was assumed that some known parameters of the Sun, the Earth and the Moon and other bodies have to be checked up additionally.

CGS system of units and NASA data [1] were used in the investigations.

First, the Earth parameters were defined more precisely. The Earth mass M_{EAR} might be found by the formula of the second law in mechanics. However, to do this it was necessary to find the Earth weight P_{EAR} beforehand on the basis of the expected Earth density $\rho_{EAR} = 3.45\ gcm^{-2}s^{-2}$.

It was considered expedient to make some changes in the methods of determining parameters of different bodies.

The mass of a body M was found by the formula

$$M = \frac{P}{g}, \quad (2)$$

where M is the mass of a body, g;
P is the weight of a body, $gcms^{-2}$;
g is gravity of acceleration of a body, cms^{-2}.

The weight of the body P was determined by the formula

$$P = Mg, \quad (3)$$

where P is the weight of a body, $gcms^{-2}$;
M is the mass of a body, g;
g is gravity of acceleration of a body, cms^{-2}.

The weight of the body P was obtained by the formula

$$P = \rho V, \quad (4)$$

where P is the weight of a body, $gcms^{-2}$;
ρ is density of a body, $gcm^{-2}s^{-2}$;
V is the volume of a body, cm^3.

The density of a body ρ was found by the formula

$$\rho = \frac{P}{V}, \quad (5)$$

where ρ is density of a body, $gcm^{-2}s^{-2}$;
P is the weight of a body, $gcms^{-2}$;
V is the volume of a body, cm^3.

Gravity acceleration of body g was determined by the formula

$$g = \frac{P}{M}, \quad (6)$$

where g is gravity of acceleration of a body, cms^{-2};
P is the weight of a body, $gcms^{-2}$;
M is the mass of a body, g.

The weight of the Earth P_{EAR} was found as the product of the proposed Earth density ρ_{EAR} by the Earth volume V_{EAR} by formula (4)

$$P_{EAR} = \rho_{EAR} V_{EAR} = 3.45 \times 1.087 \times 10^{27}\ gcms^{-2} = = 3.75 \times 10^{27}\ gcms^{-2}.$$

The mass of the Earth M_{EAR} was obtained as the relation of the Earth weight P_{EAR} to gravity acceleration of the Earth g_{EAR} by formula (2)

$$M_{EAR} = \frac{P_{EAR}}{g_{EAR}} = \frac{3.75 \times 10^{27}}{980.665}\ g = 3.824 \times 10^{24}\ g.$$

The Earth gravity acceleration g_{EAR} was determined as the relation of the Earth weight P_{EAR} to the Earth mass M_{EAR} by formula (6)

$$g_{EAR} = \frac{P_{EAR}}{M_{EAR}} = \frac{3.75 \times 10^{27}}{3.824 \times 10^{24}} cms^{-2} = 980.665 cms^{-2}.$$

After the determination of the Earth parameters there appeared the opportunity to find gravitational constant. Gravitational constant G was determined by obtaining gravitation force F_{1-2} between the mass of the first body M_1 and the mass of the second body M_2, that are situated at the distance R_{1-2} by formula (1).

In the process of determining the Earth parameters gravity acceleration of 1g of a body g_1^M was found.

Gravity acceleration of 1g of a body g_1^M was found by the formula

$$g_1^M = \frac{g}{M}, \quad (7)$$

where g_1^M is gravity acceleration of 1g of a body, $cmg^{-1}s^{-2}$;
g is gravity acceleration of a body, cms^{-2};
M is the mass of a body, g.

Gravity acceleration of 1g of a body g_1^M was found as the relation of the Earth gravity acceleration g_{EAR} to the Earth mass M_{EAR} by formula (7)

$$g_1^M = \frac{g_{EAR}}{M_{EAR}} = \frac{980.665}{3.824 \times 10^{24}}\ cmg^{-1}s^{-2} = = 2.5645 \times 10^{-22}\ cmg^{-1}s^{-2}$$

The results obtained below show that gravity acceleration of 1g of a body g_1^M is a physical constant, characterizing the masses of all the bodies in the Universe [2].

It became possible to find gravity acceleration g, of any body with the help of gravity acceleration of 1g of a body g_1^M.

Gravity acceleration of a body g was found by the formula

$$g = M g_1^M, \quad (8)$$

where g is gravity acceleration of a body, cms^{-2};
M is the mass of a body, g;
g_1^M is gravity of acceleration of 1g of a body, $cmg^{-1}s^{-2}$.

The Earth gravity acceleration g_{EAR} was determined as the product of the Earth mass M_{EAR} by gravity acceleration of 1g of a body g_1^M by formula (8)

$$g_{EAR} = M_{EAR} g_1^M = = 3.824 \times 10^{24} \times 2.5645 \times 10^{-22}\ cms^{-2} = 980.665\ cms^{-2}.$$

As a result the equation with two unknowns, F_{1-2} and G was obtained. Gravitational constant G was determined by replacing in formula (1) gravitation force between the first body with the mass M_1 and the second body with the mass M_2 F_{1-2}, placed at the distance of R_{1-2} by the force of gravitation between the first body with the mass M_1 equal to 1g and the second body with the mass M_2, equal to 1g and placed at the distance of one centimetre $F_{1-2} = 6.67 \times 10^{-8}\ cm^3 g^{-1} s^{-2}$, found by H. Cavendish. However, trying to find gravitation forces between different bodies led to absurd results. It was necessary to get rid of one of the two unknowns. In this case it was assumed that any second body with smaller mass M_2, and moving along the orbit round the first central body with larger mass M_1 experiences the gravitation force of the second body to the first one F_{1-2}.

The force of gravitation of the second body to the first one was obtained by the formula

$$F_{1-2} = M_2 g_{1-2}, \quad (9)$$

where F_{1-2} is gravitation force of the second body to the first one, $gcms^{-2}$;
M_2 is the mass of the second body, g;
g_{1-2} is gravity acceleration of the second body to the first one, cms^{-2}.

It was taken into consideration that the force of gravitation F_{1-2} between the first body M_1 and the second body M_2, placed at the distance R_{1-2}, obtained by formula (1), is equal to the force of gravitation of the second body with the mass M_2 to the first body with the mass M_1, F_{1-2}, found by formula (9).

By equating these two forces it was assumed that the Earth falls on the Sun. The process of falling may be imagined if a stone is thrown parallel to the Earth surface. Having covered some distance from the place of throwing the stone will fall on the Earth. If the velocity is increased the stone will cover a longer distance. The range of the stone will be determined by its initial velocity. At some definite value of velocity the stone, "falling"on the Earth, will fly all over it along a circular orbit and will return to the place of throwing. Then the cycle of "falling"will be repeated. Thus, the stone may become an artificial Earth satellite.

Having equated these two forces one can obtain the equation

$$G \frac{M_1 g_2 + M_2 g_1}{R_{1-2}^2} = M_2 g_{1-2}. \quad (10)$$

In the result of this an equation with one unknown gravitational constant G was obtained. Having solved equation (10) with regard to G we obtained

$$G = \frac{M_2 g_{1-2} R_{1-2}^2}{M_1 g_2 + M_2 g_1}. \quad (11)$$

Gravitational constant G was obtained by finding gravitation force between the Earth and placed on the equator standard-copy of weight in the system SI $F_{EAR-STA}$, situated at the distance of the Earth radius R_{EAR} by formula (1)

$$F_{EAR-STA} = G \frac{M_{EAR} g_{STA} + M_{STA} g_{EAR}}{R_{EAR}^2},$$

where $F_{EAR-STA}$ is gravitation force between the Earth and standard-copy of weight, $gcms^{-2}$;
G is gravitational constant, cm^2;
M_{EAR} is the Earth mass, g;
M_{STA} is the mass of standard-copy of weight, g;
g_{STA} is gravity acceleration of standard-copy of weight, cms^{-2};
g_{EAR} is gravity acceleration of the Earth, cms^{-2};
R_{EAR} is the Earth radius, cm.

The mass of standard-copy of the weight M_{STA} was found as the relation of the weight of standard-copy P_{STA} to the Earth gravity acceleration g_{EAR} by formula (2)

$$M_{STA} = \frac{P_{STA}}{g_{EAR}} = \frac{1000.0}{980.665}\ g = 1.0197\ g.$$

The Earth gravity acceleration g_{EAR} was found as the product of the Earth mass M_{EAR} by gravity acceleration of 1g of a body g_1^M by formula (8)

$$g_{EAR} = M_{EAR} g_1^M = = 3.824 \times 10^{24} \times 2.5645 \times 10^{-22}\ cms^{-2} = 980.665\ cms^{-2}.$$

Gravity acceleration of standard-copy of weight g_{STA} was obtained as the product of mass of standard-copy of the weight M_{STA} by gravity acceleration of 1g of a body g_1^M by formula (8)

$$g_{STA} = M_{STA} g_1^M = = 1.0197 \times 2.5645 \times 10^{-22}\ cms^{-2} = 2.615 \times 10^{-22}\ cms^{-2}.$$

This resulted in obtaining an equation with two unknowns: gravitation force between the Earth and standard-copy of the weight $F_{EAR-STA}$ and gravitational constant G. It was necessary to get rid of one of these unknowns. Gravitation force of standard-copy of the weight to the Earth $F_{EAR-STA}$ was obtained as the product of the mass as standard-copy of weight M_{STA} by the Earth gravity acceleration g_{EAR} by formula (3)

$$F_{EAR-STA} = M_{STA} g_{EAR} = \\ = 1.0197 \times 980.665\ gcms^{-2} = 1000.0\ gcms^{-2}.$$

Gravitation force between the Earth and standard-copy of weight $F_{EAR-STA}$ found by formula (1) was equated to the gravitation force of weight standard-copy to the Earth, $F_{EAR-STA}$, found by formula (3)

$$G \frac{M_{EAR} g_{STA} + M_{STA} g_{EAR}}{R_{EAR}^2} = M_{STA} g_{EAR-STA}. \quad (12)$$

This resulted in obtaining an equation with one unknown, that is gravitational constant G.

Gravitational constant G was determined from the mass of weight standard-copy M_{STA}, gravity acceleration of the Earth g_{EAR}, the Earth radius R_{EAR}, the Earth mass M_{EAR} and gravity acceleration of the weight standard-copy g_{STA}, by formula (11)

$$G = \frac{M_{STA} g_{EAR} R_{EAR}^2}{M_{EAR} g_{STA} + M_{STA} g_{EAR}} = \\ \frac{1.0197 \times 980.665 \times (6.378 \times 10^8)^2}{3.824 \times 10^{24} \times 2.615 \times 10^{-22} + 1.0197 \times 980.665} cm^2 = \\ = 2.034 \times 10^{17}\ cm^2.$$

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Obtaining gravitational constant proved that to find it the mountains, torsional scales or lead plates aren't necessary.

Starting the determination of the Sun parameters and those of other bodies one should take into account that some of the parameters are always constant irrespective of the point of the Universe they are placed in and the value of other ones may change sufficiently. Thus, for example, weight, mass, gravity acceleration and some other parameters of a given body won't change if it is displaced to some other point of the Universe. At the same time, density and some other parameters of the same body may change radically if they are found in the conditions of other body. For example, weight and density of the given body may be found under the conditions of gravity acceleration of the same body. However, the same parameters may be obtained in the conditions of the Earth gravity acceleration or any other body. So, the density of lunar soil delivered by American astronauts to the Earth and found on the surface of the Earth under conditions of gravity acceleration of the Earth was equal to 3.34 $gcm^{-2}s^{-2}$. The density of the same lunar soil found on the surface of the Moon under conditions of the Moon gravity acceleration, as the further calculations showed, was equal to 0.065 $gcm^{-2}s^{-2}$.

These words may be illustrated by the example of obtaining the weight and density of the known standard-copy of mass equal to 1000.0 cm^3 of distilled water on the Earth surface and in the outer space. The weight of this volume of water on the surface of the Earth in the conditions of the Earth gravity acceleration P_{WAT} was 1000.0 $gcms^{-2}$.

The mass of water, M_{WAT} was found as the relation of water weight on the Earth P_{WAT} to the Earth gravity acceleration g_{EAR} by formula (2)

$$M_{WAT} = \frac{P_{WAT}}{g_{EAR}} = \frac{1000.0}{980.665}\ g = 1.0197\ g.$$

Then this water volume was taken to the outer space. In order to find the weight of water in space $P_{WAT-SPA}$ water gravity acceleration, $P_{WAT-SPA}$ was found.

Water gravity acceleration in space, $g_{WAT-SPA}$, was obtained as the product of water mass M_{WAT} by gravity acceleration of 1g of a body g_1^M by formula (8)

$$g_{WAT} = M_{WAT} g_1^M = \\ = 1.0197 \times 2.5645 \times 10^{-22}\ cms^{-2} = 2.615 \times 10^{-22}\ cms^{-2}.$$

The weight of water in space $P_{WAT-SPA}$ was found as the product of water mass M_{WAT} by water gravity acceleration in space $g_{WAT-SPA}$ by formula (3)

$$P_{WAT-SPA} = M_{WAT} g_{WAT} = \\ = 1.0197 \times 2.615 \times 10^{-22}\ gcms^{-2} = 2.667 \times 10^{-22}\ gcms^{-2}.$$

The density of water in space $\rho_{WAT-SPA}$ was obtained as the relation of water weight in space $P_{WAT-SPA}$ to water volume V_{WAT} by formula (5)

$$\rho_{WAT-SPA} = \frac{P_{WAT-SPA}}{V_{WAT}} = \\ = \frac{2.667 \times 10^{-22}}{1000.0}\ gcm^{-2}s^{-2} = 2.667 \times 10^{-25}\ gcm^{-2}s^{-2}.$$

The density of water on the Earth ρ_{WAT} was found as the relation of water weight on the Earth P_{WAT} to water volume V_{WAT} by formula (5)

$$\rho_{WAT} = \frac{P_{WAT}}{V_{WAT}} = \frac{1000.0}{1000.0}\ gcm^{-2}s^{-2} = 1.0\ gcm^{-2}s^{-2}.$$

The density of the first body, was found by formula

$$\rho_1 = \frac{\rho_{1-2} g_1}{g_2}, \quad (13)$$

where ρ_1 is the density of the first body, $gcm^{-2}s^{-2}$;
ρ_{1-2} is the density of the first body taking into account gravity acceleration of the second body, $gcm^{-2}s^{-2}$;
g_1 is gravity acceleration of the first body, cms^{-2};
g_2 is gravity acceleration of the second body, cms^{-2}.

The density of water on the Earth $\rho_{WAT-EAR}$ was found as the relation of the product of space water density $\rho_{WAT-SPA}$ by the Earth gravity acceleration g_{EAR} to space water gravity acceleration in space $g_{WAT-SPA}$ by formula (13)

$$\rho_{WAT-EAR} = \frac{\rho_{WAT-SPA} g_{EAR}}{g_{WAT}} = \\ = \frac{2.667 \times 10^{-25} \times 980.665}{2.615 \times 10^{-22}} gcm^{-2}s^{-2} = 1.0\, gcm^{-2}s^{-2}.$$

Such calculations are necessary for comparing parameters of various bodies with analogical parameters of the Earth or any other body.

After finding the main Earth parameters and gravitational constant it became necessary to obtain two unknown parameters of the Sun. The parameters of the Sun and other bodies of the Solar System, the galaxy the Milky Way and the Universe as a whole could be determined by formulas (2), (3) and (4), for example.

However, the delivery of the soil samples from all these bodies to the Earth is impossible without visiting them. Besides, a lot of bodies are in the state of plasma or are black holes which makes approaching them also impossible. So, taking into consideration, that $g = Mg_1^M$, formula (1) was written in such a form

$$F_{1-2} = G\frac{M_1 g_2 + M_2 M_1 g_1^M}{R_{1-2}^2}. \quad (14)$$

This resulted in obtaining an equation with two unknowns: F_{1-2} and M_1. It was necessary to get rid of one of these two unknowns. In this case it was assumed that any body having smaller mass and moving along the orbit round the central body having larger mass, experiences not only the attraction of this body but also centrifugal force that repulses the given body from the central one.

Centrifugal force F_{1-2} was found by the formula

$$F_{1-2} = \frac{M_2 V_2^2}{R_{1-2}}, \quad (15)$$

where F_{1-2} is centrifugal force of the second body, $gcms^{-2}$;
M_2 is the mass of the second body, g;
V_2 is the average orbital velocity of the second body, cms^{-1};
R_{1-2} is the distance from the first body to the second one, cm.

Thus, gravitation force F_{1-2} found by formula (1) was equated to the centrifugal force F_{1-2} found by formula (15)

$$G\frac{M_1 g_2 + M_2 M_1 g_1^M}{R_{1-2}^2} = \frac{M_2 V_2^2}{R_{1-2}}. \quad (16)$$

Having solved equation (16) with regard to M_1 one obtains

$$M_1 = \frac{R_{1-2} V_2^2 M_2}{G(g_2 + M_2 g_1^M)}. \quad (17)$$

With the help of formula (17) one can find the unknown parameters of a body by the known parameters of another body.

First of all it was necessary to establish if the left side of the equation is equal to the right side. Taking into account that $g = Mg_1^M$ formula (16) was written down as follows

$$G\frac{M_1 M_2 g_1^M + M_2 M_1 g_1^M}{R_{1-2}^2} = \frac{M_2 V_2^2}{R_{1-2}}. \quad (18)$$

Taking into consideration that $2Gg_1^M = 1.04324 \times 10^{-4} cm^3 g^{-1} s^{-2}$, as well as the fact that $V_B^M = M_1 \times 1.04324 \times 10^{-4}$ (this is to be shown further), formula (18) was given in such a form

$$V_B^M = R_{1-2} V_2^2, \quad (19)$$

where V_B^M is the constant of gravitation field of a body mass, $cm^3 s^{-2}$.

With regard to $V_B^M = R_{1-2} V_2^2$ formula (18) is the following

$$\frac{M_2 R_{1-2} V_2^2}{R_{1-2}^2} = \frac{M_2 V_2^2}{R_{1-2}}. \quad (20)$$

If R_{1-2} in the left side of equality (20) is reduced, then it's possible to get two completely identical formulas. It means, that gravitation formula (1) including G, M_1, M_2, g_1, g_2 and R_{1-2}^2 is equal to centrifugal force formula (15) containing M_2, V_2^2 and R_{1-2}.

From our point of view it proves the validity of new gravitation formula (1). It is rather difficult to obtain such an equality while equating I. Newton gravitation law to Ch. Huygens centrifugal force.

For practical verification of formula (1) there was found gravitation force between the Sun and the Earth $F_{SUN-EAR}$. If $g = Mg_1^M$ formula (14) has the following form

$$F_{SUN-EAR} = G\frac{M_{SUN} g_{EAR} + M_{EAR} M_{SUN} g_1^M}{R_{SUN-EAR}^2},$$

where $F_{SUN-EAR}$ is gravitation force between the Sun and the Earth, $gcms^{-2}$;
G is gravitation constant, cm^2;
M_{SUN} is the Sun mass, g;

M_{EAR} is the Earth mass, g;
g_{EAR} is the Earth gravity acceleration, cms^{-2};
g_1^M is gravity acceleration of 1g of a body, $cmg^{-1}s^{-2}$;
$R_{SUN-EAR}$ is the distance from the Sun to the Earth, cm.

This resulted in the equation with two unknowns: gravitation force between the Sun and the Earth $F_{SUN-EAR}$ and the Sun mass M_{SUN} . It was necessary to get rid of one of these two unknowns. It was assumed that the Earth, moving along its orbit round the Sun, experiences not only attraction of the Sun but also centrifugal force repulsing the Earth from the Sun.

Centrifugal force of the Earth, $F_{SUN-EAR}$ was found the using Earth mass M_{EAR} average orbital velocity of the Earth V_{EAR} and average distance from the Sun to the Earth $R_{SUN-EAR}$ by formula (15)

$$F_{SUN-EAR} = \frac{M_{EAR}V_{EAR}^2}{R_{SUN-EAR}} = \frac{3.824 \times 10^{24} \times (2.979 \times 10^6)^2}{1.496 \times 10^{13}}\ gcms^{-2} = 2.268 \times 10^{24}\ gcms^{-2}.$$

Gravitation force between the Sun and the Earth $F_{SUN-EAR}$ found by formula (14) was equated to centrifugal force of the Earth $F_{SUN-EAR}$, found by formula (15) by formula (16)

$$G\frac{M_{SUN}g_{EAR} + M_{EAR}M_{SUN}g_1^M}{R_{SUN-EAR}^2} = \frac{M_{EAR}V_{EAR}^2}{R_{SUN-EAR}}.$$

The mass of the Sun was found using the average distance from the Sun to the Earth $R_{SUN-EAR}$, average orbital velocity of the Earth V_{EAR}, the Earth mass M_{EAR}, gravitational constant G, the Earth gravity acceleration g_{EAR} and gravity acceleration of 1g of a body g_1^M by formula (17)

$$M_{SUN} = \frac{R_{SUN-EAR}V_{EAR}^2M_{EAR}}{G(g_{EAR} + M_{EAR}g_1^M)} = \frac{1.496 \times 10^{13} \times (2.979 \times 10^6)^2 \times 3.824 \times 10^{24}}{2.034 \times 10^{17}} \times \frac{1}{(980.665 + 3.824 \times 10^{24} \times 2.5645 \times 10^{-22})}\ g = 1.273 \times 10^{30}\ g.$$

The Sun mass M_{SUN} was obtained with the help of formula (3). The force of gravitation of the Earth to the Sun, $F_{SUN-EAR}$ was found as the product of the Earth mass M_{EAR} by the Earth acceleration in its movement round the Sun $g_{SUN-EAR}$ by formula (3)

$$F_{SUN-EAR} = M_{EAR}g_{SUN-EAR} = 3.824 \times 10^{24} \times 0.593\ gcms^{-2} = 2.268 \times 10^{24}\ gcms^{-2}.$$

The force of gravitation between the Sun and the Earth $F_{SUN-EAR}$ found by formula (14) was equated to the force of gravitation of the Earth to the Sun $F_{SUN-EAR}$, found by formula (3)

$$G\frac{M_{SUN}g_{EAR} + M_{EAR}M_{SUN}g_1^M}{R_{SUN-EAR}^2} = M_{EAR}g_{SUN-EAR}. \quad (21)$$

Having solved equation (21) with regard to the Sun mass M_{SUN} we found

$$M_{SUN} = \frac{R_{SUN-EAR}^2M_{EAR}g_{SUN-EAR}}{G(g_{EAR} + M_{EAR}g_1^M)}. \quad (22)$$

The mass of the Sun M_{SUN} was found using the average distance from the Sun to the Earth $R_{SUN-EAR}$, the Earth mass M_{EAR}, the Earth acceleration in its movement round the Sun $g_{SUN-EAR}$, gravitational constant G, the Earth gravity acceleration g_{EAR}, and gravity acceleration of 1g of a body g_1^M by formula (22)

$$M_{SUN} = \frac{R_{SUN-EAR}^2M_{EAR}g_{SUN-EAR}}{G(g_{EAR} + M_{EAR}g_1^M)} = \frac{(1.496 \times 10^{13})^2 \times 3.824 \times 10^{24} \times 0.593}{2.034 \times 10^{17}} \times \frac{1}{(980.665 + 3.824 \times 10^{24} \times 2.5645 \times 10^{-22})}\ g = 1.272 \times 10^{30}\ g.$$

After finding the mass of the Sun M_{SUN}, there were found other parameters of the Sun.

The Sun gravity acceleration g_{SUN} was obtained as the product of the mass of the Sun M_{SUN} by gravity acceleration of 1g of a body g_1^M by formula (8)

$$g_{SUN} = M_{SUN}g_1^M = 1.273\times10^{30}\times2.5645\times10^{-22}cms^{-2} = 3.265\times10^8cms^{-2}.$$

The force of gravitation between the Sun and the Earth $F_{SUN-EAR}$ was found by formula (1)

$$F_{SUN-EAR} = G\frac{M_{SUN}g_{EAR} + M_{EAR}g_{SUN}}{R_{SUN-EAR}^2} = (1.273 \times 10^{30} \times 980.665 + 3.824 \times 10^{24} \times 3.265 \times 10^8) \times \frac{2.034 \times 10^{17}}{(1.496 \times 10^{13})^2} gcms^{-2} = 2.269 \times 10^{24} gcms^{-2}.$$

Gravitational force between the Sun and the Earth $F_{SUN-EAR}$ turned out to be equal to the Earth centrifugal force and to gravitation force of the Earth to the Sun $F_{SUN-EAR}$, which confirms the validity of formulas (1), (2), (3) and (4).

The weight of the Sun P_{SUN} was determined as the product of the Sun mass M_{SUN} by the Sun gravity acceleration g_{SUN} by formula (3)

$$P_{SUN} = M_{SUN}g_{SUN} = 1.273 \times 10^{30} \times 3.265 \times 10^8 gcms^{-2} = 4.156 \times 10^{38} gcms^{-2}.$$

The weight of the Sun taking into account the Earth gravity $\rho_{SUN-EAR}$ was found as the product of the Sun mass M_{SUN} by the Earth gravity acceleration g_{EAR} by formula (3)

$$P_{SUN-EAR} = M_{SUN} g_{EAR} = = 1.273 \times 10^{30} \times 980.665\ gcms^{-2} = 1.248 \times 10^{33} gcms^{-2}.$$

The density of the Sun ρ_{SUN} was determined as the relation of the Sun weight P_{SUN} to the volume of the Sun V_{SUN} by formula (5)

$$\rho_{SUN} = \frac{P_{SUN}}{V_{SUN}} = \frac{4.156 \times 10^{38}}{1.413 \times 10^{33}}\ gcm^{-2}s^{-2} = = 2.941 \times 10^{5}\ gcm^{-2}s^{-2}.$$

The density of the Sun with regard to the Earth gravity $\rho_{SUN-EAR}$ was obtained as the relation of the Sun weight with regard to the Earth gravity $P_{SUN-EAR}$ to the volume of the Sun V_{SUN} by formula (5)

$$\rho_{SUN-EAR} = \frac{P_{SUN-EAR}}{V_{SUN}} = = \frac{1.248 \times 10^{33}}{1.413 \times 10^{33}}\ gcm^{-2}s^{-2} = 0.883\ gcm^{-2}s^{-2}.$$

The density of the Sun ρ_{SUN} was found coming out from the Sun density taking into account the Earth gravity acceleration $\rho_{SUN-EAR}$ the Sun gravity acceleration g_{SUN} and the Earth gravity acceleration g_{EAR} by formula (13)

$$\rho_{SUN} = \frac{\rho_{SUN-EAR} g_{SUN}}{g_{EAR}} = = \frac{0.883 \times 3.265 \times 10^{8}}{980.665}\ gcm^{-2}s^{-2} = 2.94 \times 10^{5} gcm^{-2}s^{-2}.$$

The determination of the parameters of other bodies of the Solar System and the Galaxy the Milky Way was carried out after obtaining the main the Earth and the Sun parameters. The validity of equality (18) was verified on the basis of the main lunar parameters calculations based on experimental data as an example. The main parameters of the Moon were found analogically to the main parameters of the Earth on the basis of the density of lunar soil, delivered by the American astronauts to the Earth.

The weight of the Moon taking into account the Earth gravity acceleration $P_{MOO-EAR}$ was obtained as the product of lunar density taking into consideration the Earth gravity acceleration $\rho_{MOO-EAR}$ by the volume of the Moon V_{MOO} by formula (4)

$$P_{MOO-EAR} = \rho_{MOO-EAR} V_{MOO} = = 3.34 \times 2.197 \times 10^{25}\ gcms^{-2} = 7.338 \times 10^{25}\ gcms^{-2}.$$

The mass of the Moon M_{MOO} was found as the relation of the lunar weight taking into account the Earth gravity acceleration $P_{MOO-EAR}$ to the Earth gravity acceleration g_{EAR} by formula (2)

$$M_{MOO} = \frac{P_{MOO-EAR}}{g_{EAR}} = \frac{7.338 \times 10^{25}}{980.665}\ g = = 7.483 \times 10^{22}\ g.$$

In this case it was taken into consideration, that the mass of the Moon M_{MOO} found under assumption that the density of lunar soil taking into account the Earth gravity acceleration $\rho_{MOO-EAR}$, is equal to the mass of the Moon, which was obtained taking into consideration the density of lunar soil taking into account gravity acceleration of the Moon ρ_{MOO}.

The Moon gravity acceleration g_{MOO} was found as the product of the Moon mass M_{MOO} by gravity acceleration of 1g of a body g_1^M by formula (8)

$$g_{MOO} = M_{MOO} g_1^M = = 7.483 \times 10^{22} \times 2.5645 \times 10^{-22}\ cms^{-2} = 19.19\ cms^{-2}.$$

The weight of the Moon P_{MOO} was determined as the product of the Moon mass M_{MOO} by the Moon gravity acceleration g_{MOO} by formula (3)

$$P_{MOO} = M_{MOO} g_{MOO} = = 7.483 \times 10^{22} \times 19.19\ gcms^{-2} = 1.436 \times 10^{24}\ gcms^{-2}.$$

The density of the Moon ρ_{MOO} was found as the relation of the weight of the Moon P_{MOO} to the volume of the Moon V_{MOO} by formula (5)

$$\rho_{MOO} = \frac{P_{MOO}}{V_{MOO}} = \frac{1.436 \times 10^{24}}{2.197 \times 10^{25}}\ gcm^{-2}s^{-2} = = 0.065\ gcm^{-2}s^{-2}.$$

The density of the Moon ρ_{MOO} was found using the Moon density taking into account the Earth gravity acceleration $\rho_{MOO-EAR}$, the Moon gravity acceleration g_{MOO} and the Earth gravity acceleration g_{EAR} by formula (13)

$$\rho_{MOO} = \frac{\rho_{MOO-EAR} g_{MOO}}{g_{EAR}} = = \frac{3.34 \times 19.19}{980.665}\ gcm^{-2}s^{-2} = 0.065\ gcm^{-2}s^{-2}.$$

The force of gravitation between the Earth and the Moon $F_{EAR-MOO}$ was found by formula (1)

$$F_{EAR-MOO} = G\frac{M_{EAR} g_{MOO} + M_{MOO} g_{EAR}}{R^2_{EAR-MOO}} = = (3.824 \times 10^{24} \times 19.19 + 7.483 \times 10^{22} \times 980.665) \times \times \frac{2.034 \times 10^{17}}{(3.844 \times 10^{10})^2}\ gcms^{-2} = 2.02 \times 10^{22}\ gcms^{-2}.$$

The force of gravitation of the Moon to the Earth $F_{EAR-MOO}$ was found as the product of the mass of the Moon M_{MOO} by the gravity acceleration of the Moon to the Earth $g_{EAR-MOO}$ by formula (3)

$$F_{EAR-MOO} = M_{MOO} g_{EAR-MOO} =$$
$$= 7.483 \times 10^{22} \times 0.272 \ gcms^{-2} = 2.035 \times 10^{22} \ gcms^{-2}.$$

The force of gravitation between the Earth and the Moon $F_{EAR-MOO}$ found by formula (1) proved to be equal to the force of attraction of the Moon to the Earth $F_{EAR-MOO}$, found by formula (3).

Centrifugal force of the Moon $F_{EAR-MOO}$ was obtained coming from the Moon mass M_{MOO}, average orbital velocity of the Moon V_{MOO} and average distance from the Earth to the Moon $R_{EAR-MOO}$ by formula (15)

$$F_{EAR-MOO} = \frac{M_{MOO} V_{MOO}^2}{R_{EAR-MOO}} =$$
$$\frac{7.483 \times 10^{22} \times (1.023 \times 10^5)^2}{3.844 \times 10^{10}} = 2.038 \times 10^{22} \ gcms^{-2}.$$

The force of gravitation between the Earth and the Moon $F_{EAR-MOO}$ was equal to centrifugal force of the Moon $F_{EAR-MOO}$, which proves the validity of formulas (1), (2), (3) and (4).

The results that were achieved prove that anomal displacement of Mercury perihelion, irregular acceleration of comet Encke, secular acceleration of the Moon and other so-called anomalities are predicted by new theory of gravitation and formula (1).

The practical application of new gravitation theory for determining the main parameters of the Earth, the Sun, the Moon and other bodies showed that the so-called dark matter doesn't exist in reality.

IV. CONCLUSIONS

The obtained results showed that:
- a new gravitation theory and its mathematical apparatus have been elaborated;
- gravitational constant has been found objectively;
- the main parameters of the Earth, the Sun and Moon have been measured;
- the forces of gravitation between the Sun and the Earth, the Earth and the Moon, which appeared to be equal to centrifugal forces of the Earth and the Moon, have been measured;
- the main parameters of bodies in different points in the Universe have been measured;
- Mercury perihelion displacement, irregular acceleration of Encke comet, secular acceleration of the Moon are predicted by the new gravitation theory and aren't anomalies;
- dark matter is the result of using by I. Newton doubtful gravitation law and doesn't exist in reality.

V. LITERATURE

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