About Tsiganok gravitation theory (TGT)

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Abstract: Tsiganok gravitation law has been discovered, Tsiganok gravitation theory and its mathematical apparatus have been worked out. The definitions of body weight and body mass have been given. Tsiganok gravitational constant has been found. Tsiganok gravity acceleration of 1.0 g of a body has been found. The Earth, the Sun and the Moon average density (specific gravity) has been found. Body parameters in various points of the Universe have been found. The Earth, the Sun, the Moon and other bodies have been weighed in the state of weightlessness without scales. The centrifugal forces of the Earth, the Moon, and other bodies have been found. The forces of gravitation between the Sun and the Earth and also between the Earth and the Moon have been determined. The validity of Tsiganok law of the universal gravitation as well as the validity of centrifugal force has been confirmed experimentally.

Keywords: body, force, law of gravity, centrifugal force, weight, mass, gravitational constant, gravity acceleration, distance, speed, density (specific gravity)

1.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 on the whole.

The Earth gravity acceleration has been found experimentally.

Geometric dimensions of different bodies, the distance to them, the 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 (determined) with the help of spectral analysis. American astronauts have delivered the samples of lunar soil to the Earth. Automatic space stations have studied the surfaces of Venus and Mars, and those of Mercury, Jupiter, Saturn and other bodies from the orbit.

However, a number of other actual questions have not been answered yet. The known list of unsolved problems of modern physics [1] is constantly growing.

Numerous attempts to reduce this list have not been successful.

The reason of such a situation may be attributed to insufficient foundation of the existing gravitation theories [2].

2. Analysis of publications

While analyzing 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[3];
- the discovery of centrifugal force by Ch. Huygens in 1659[4];
- experimental measuring the Earth gravity acceleration;
- determining velocities of bodies;
- determining the distances between various bodies.

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

- the known theories of gravitation are insufficiently grounded;
- the universally recognized definitions of the notions of weight and mass are not available;
- it is impossible to obtain dimensions of force from the product of masses and squared distance between them in the formula of Newton doubtful gravitational law[5];
- the equation in Newtonian gravitation theory $G \times \frac{M_? \times M_?}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}$ was solved by means of reducing unknown mass in its left and right sides. Moreover, the elementary rules of mathematics were violated;
- gravitational Cavendish constant from Newton doubtful gravitational law was obtained (found) a doubtful formula but not from the known experiment with a torsion balance[6];

- the methods of determining weight, mass, gravity acceleration, density (specific gravity) and other parameters aren't sufficiently grounded;
- the existence of the so-called gravitational mass and inertial mass is insufficiently grounded[7];
- the statement that all the bodies in the state of weightlessness have no weight isn't sufficiently grounded;
- the validity of centrifugal force formula isn't confirmed either theoretically or experimentally;
- the validity of the second law of motion formula isn't confirmed either theoretically or experimentally;
- the validity of Newton doubtful gravitation law and Newton doubtful gravitation theory with its mathematical apparatus aren't confirmed experimentally.

3. The problem

In connection with the foregoing the research problems consist in:
- discovering Tsiganok gravitation law, elaborating Tsiganok gravitation theory (TGT), known earlier as the new gravitation theory (the NGT) [8] and its mathematical apparatus;
- giving definition of body weight and body mass;
- defining weight and mass of the Earth, the Sun, the Moon and other bodies;
- defining gravity acceleration of the Earth, the Sun, the Moon and other bodies;
- finding gravity acceleration constant of gravity 1.0 g of the body;
- finding Tsiganok gravitational constant;
- working out a temporary standard-copy of body weight and temporary standard-copy of body mass in Tsiganok measurement system;
- finding average density (specific gravity) of the Earth, of the Sun, of the Moon and other bodies;
- finding body parameters in various points of the Universe;
- proving that all the bodies in the state of weightlessness have weight;
- proving or disapproving the existence of gravitational and inertial mass;
- finding centrifugal force of the Earth, the Moon and other bodies;
- finding the force of gravitational between the Sun and the Earth, between the Earth and the Moon;
- confirming theoretically and experimentally the validity of centrifugal force formula;
- defining the formula of the second law of motion;
- confirming theoretically and experimentally the validity of Tsiganok gravitation law, Tsiganok gravitation theory (TGT) and its mathematical apparatus.

4. Results

In the process of creation of Tsiganok gravitation theory the majority of notions and formulas were elaborated for the first time. Some known notions and formulas were defined more precisely.

Tsiganok gravitation theory (TGT) was based on Tsiganok gravitation formula (1) the derivation of which will be presented in another work.

The force of gravitation is the relation of the sum of the first body gravitation force to the second $M_1 \times g_2$ and the second body to the first $M_2 \times g_1$ to the squared distance between them R_{1-2}^2 that is measured with the help of Tsiganok gravitation law formulas (1), (2) and (3), expressed in ${gcm}/{s^2}$:

$$F_{1-2} = G \times \frac{M_1 \times g_2 + M_2 \times g_1}{R_{1-2}^2} \tag{1}$$

or

$$F_{1-2} = \sqrt{G} \times \frac{\sqrt{G}\frac{M_1 \times g_2}{R_{1-2}} + \sqrt{G}\frac{M_2 \times g_1}{R_{1-2}}}{R_{1-2}} \tag{2}$$

or

$$F_{1-2} = G \times \frac{M_1 \times g_2}{R_{1-2}^2} + G \times \frac{M_2 \times g_1}{R_{1-2}^2}, \tag{3}$$

where F_{1-2}- is the gravitation force between the first and the second bodies, ${gcm}/{s^2}$;

G - is gravitational 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 gravity acceleration, ${cm}/{s^2}$;

g_2 - is the second body gravity acceleration, ${cm}/{s^2}$;

R_{1-2}- is the distance between the first and the second bodies, cm.

Physical nature of gravitation force between the first and the second bodies will be shown in another work.

The force of gravitational between bodies obtained with the help of the formulas of Tsiganok gravitation law (TGT) (1), (2) and (3) differs sufficiently from the force in the formula of Newton doubtful gravitation law:

- the formulas (1), (2) and (3) made it possible to define of force without taking into account gravitational constant;
- the masses of bodies being attracted aren't multiplied by each other but are multiplied by the corresponding gravity accelerations and are summed up only after this;
- gravitational constant has only those value dimensions that are included in the formulas (1), (2) and (3).

Centrifugal force of the second body is the force of repulsion of the second body (the Earth, the Moon or any other material body) from the first body (the Sun, the Earth, or any other material body), equal to the force of gravitation between the first and the second bodies, equal to the relation of the product of the second body mass M_2 by the squared velocity of the second body V_2^2 to the distance from the first body to the second one R_{1-2} which is measured by the formula (4) expressed in ${gcm}/{s^2}$.

The centrifugal force of the second body (the second body weight) is the force of repulsion of the second body with mass M_2, that is located on the on the surface of the first body with mass M_1 from the first body with mass M_1, equal to the centripetal force of the second body with mass M_2 to the first body mass M_1, equal to the second body weight on the surface of the first body equal to the relation of the product of the second body mass M_2 (mass $M_{sta} = 1.0197\ g$ of standard-copy $1000.0\ {gcm}/{s^2}$ in TGT ($1.0\ kg$ in SI) or any other material body) placed on the surface of the first body with mass M_1 (the Earth, the Sun, the Moon or any other material body) by squared velocity of the second body V_2^2 (squared space velocity of the Earth $V_{ear-fcv}^2 = (7.944 \times 10^5)^2 = 6.3107 \times 10^{11}\ {cm^2}/{s^2}$, squared space velocity of the Sun $V_{sun-fcv}^2 = (4.371 \times 10^7)^2 = 1.9106 \times 10^{15}\ {cm^2}/{s^2}$, squared space velocity of the Moon $V_{moo-fcv}^2 = (2.1197 \times 10^5)^2 = 4.493 \times 10^{10}\ {cm^2}/{s^2}$ any other material body) to the distance from the first body to the second one R_{1-2} (the radius of the Earth $R_{ear} = 6.378 \times 10^8\ cm$, the radius of the Sun $R_{sun} = 6.961 \times 10^{10}\ cm$, the radius of the Moon Луны $R_{moo} = 1.7375 \times 10^8\ cm$ of any other material body), equal to $P_{sta-ear} = 1000.0\ {gcm}/{s^2}$ for the standard-copy of $1000.0\ {gcm}/{s^2}$ in TGT ($1.0\ kg$ in SI) on the surface of the Earth, equal to $P_{sta-sun} = 2.7988 \times 10^4\ {gcm}/{s^2}$ for the standard-copy of $1000.0\ {gcm}/{s^2}$ in TGT ($1.0\ kg$ in SI) on the surface of the Sun equal to $P_{sta-moo} = 263.684\ {gcm}/{s^2}$ for the standard-copy of $1000.0\ {gcm}/{s^2}$ in TGT ($1.0\ kg$ in SI) on the surface of the Moon etc., having action boundaries, aggregate state, volume, density (specific gravity), temperature, odour, taste, color and other properties, that can have various values and not having gravity acceleration, measured with the help of the formula (4), is measured with the help of dynamometer or scales expressed in ${gcm}/{s^2}$.

The method of measuring the first cosmic velocity of the Earth, the Sun, the Moon and other bodies will be shown in another paper.

Centrifugal force of the second body (the second body weight) F_{1-2} was found by the formula

$$F_{1-2} = \frac{M_2 \times V_2^2}{R_{1-2}}, \quad (4)$$

where F_{1-2} – is centrifugal force of the second body, gcm/s^2;

M_2 – is the second body mass, g;

V_2- is average velocity of the second body, cm/s;

R_{1-2}- is the distance from the first body to the second one, cm.

It is reasonable to use formula the (4) to find the second body centrifugal force; the second body centripetal force; the second body weight on the surface of the first body having any radii; the weight of the second body immersed in a liquid or a gas on the surface of the first body having any radii.

The first body weight is the product of the first body mass M_1 (standard-copy $1000.0\ gcm/s^2$ in TGT ($1.0\ kg$ in SI) $M_{sta} = 1.0197\ g$, of the Earth mass $M_{ear} = 3.824 \times 10^{24}\ g$, of the Sun mass $M_{sun} = 1.273 \times 10^{30}\ g$, of the Moon mass $M_{moo} = 7.483 \times 10^{22}\ g$, or any other material body) by the first body gravity acceleration g_1 (gravity acceleration of the standard-copy of $1000.0\ gcm/s^2$ in TGT ($1.0\ kg$ in SI) $g_{sta} = 2.615 \times 10^{-22}\ cm/s^2$, the Earth gravity acceleration $g_{ear} = 980.665\ cm/s^2$, the Sun gravity acceleration $g_{sun} = 3.265 \times 10^8\ cm/s^2$, the Moon gravity acceleration $g_{moo} = 19.19\ cm/s^2$ any other material body), equal to standard-copy weight $1000.0\ gcm/s^2$ in TGT ($1.0\ kg$ in SI) $P_{sta} = 2.667 \times 10^{-22}\ gcm/s^2$, the Earth weight $P_{ear} = 3.75 \times 10^{27}\ gcm/s^2$, the Sun weight $P_{sun} = 4.156 \times 10^{38}\ gcm/s^2$, the Moon weight $P_{moo} = 4.136 \times 10^{24}\ gcm/s^2$ or any other material body in the space, which is measured by the formula (5), with the help of dynamometer or scales, expressed in gcm/s^2.

The first body weight P_1 was found by the formula

$$P_1 = M_1 \times g_1, \quad (5)$$

where P_1 is the first body weight, gcm/s^2;

M_1 is the first body mass, g;

g_1 is the first body gravity acceleration, cm/s^2.

It reasonable to use formula (5) for obtaining the weight of single bodies in the space.

The second body weight is the product of the second body mass M_2 (mass of the standard-copy $1000.0\ gcm/s^2$ in TGT ($1.0\ kg$ in SI) $M_{sta} = 1.0197\ g$ or any other material body), placed on the surface of the first body with mass M_1 (the Earth mass $M_{ear} = 3.824 \times 10^{24}\ g$ or any other material body having the same radius $R_{ear} = 6.378 \times 10^8\ cm$ by the gravity acceleration of the first body g_1 (the Earth gravity acceleration $g_{ear} = 980.665\ cm/s^2$ or any other material body of the same radius), equal to standard-copy $1000.0\ gcm/s^2$ in TGT ($1.0\ kg$ in SI) $P_{sta-ear} = 1000.0\ gcm/s^2$ on the surface of the Earth etc., measured by the formula (6) expressed in gcm/s^2.

The results of our further calculations showed that gravitational force between the first body mass M_1 and the second body mass M_2 F_{1-2} in the formulas (1), (2) and (3) is maximal at the contact between these bodies. The force of gravitation between the first body mass M_1 and the second body mass M_2 F_{1-2} decreases according to increasing of squared distance between them R_{1-2}^2.

The force of gravitation between the first body mass M_1 and the second body mass M_2 F_{1-2} in the formulas (1), (2) and (3) becomes equal to the formula (6) when the distance between them reaches $R_{1-2} = 2 \times 2.034 \times 10^{17}\, cm$ (squared Earth radius $R_{ear}^2 = (6.378 \times 10^8)^2 = 2 \times 2.034 \times 10^{17} cm$). Then the gravitational force between the first body mass M_1 and the second body mass M_2 F_{1-2} decreases to $0.0\, {gcm}/{s^2}$ according to the increase of the squared distance between them R_{1-2}^2. It occurs because gravitational force F_{1-2} is equal to the sum of the two forces and formula (6) is only one force.

Physical nature of the distance $R_{1-2} = 2 \times 2.034 \times 10^{17}\, cm$ and other parameters of gravitational waves (9) that are generated by all the objects in the Universe, will be shown in another work.

The second body weight P_2 was found by the formula

$$P_2 = M_2 \times g_1, \tag{6}$$

where P_2 is the second body weight, ${gcm}/{s^2}$;

M_2 is the second body mass, g;

g_1 is the first body gravity acceleration, ${cm}/{s^2}$.

It is reasonable to use the formula (6) for obtaining the second body weight on the surface of the Earth or some other material body having the same radius. To define the second body weight on the surface of the Sun, the Moon, Mars or any other body, the radius of which is longer or shorter than the Earth radius, it is reasonable to use formulas (1), (2), (3), (4) or other TGT formulas that will be shown later (in another work).

The first body weight is the product of the first body density (specific gravity) ρ_1 by the first body volume V_1 found by the formula (7) expressed in ${gcm}/{s^2}$.

The first body weight is the product of the first body density (specific gravity) the first body by body volume, expressed in ${gcm}/{s^2}$.

The first body weight P_1 of was found by the formula

$$P_1 = \rho_1 \times V_1, \tag{7}$$

where P_1 is the first body weight, ${gcm}/{s^2}$;

ρ_1 is density (specific gravity) of the first body, ${g}/{cm^2 s^2}$;

V_1 is the first body volume, cm^3.

It reasonable to use formula (7) for obtaining the weight of bodies in the space and for finding the second body weight on the surface of the first body that has different radii.

Our further calculations showed that the force of gravitation between the first and the second bodies as well as the second body weight on the surface of the first body can be obtained by the formulas (1), (2), (3) and (4).

The first body mass is the matter in the abstract form as a component of material body weight equal to the relation of the first body P_1 (standard-copy weight $1000.0\, {gcm}/{s^2}$ in TGT ($1.0\, kg$ in SI) $P_{sta} = 2.667 \times 10^{-22}\, {gcm}/{s^2}$, the Earth weight $P_{ear} = 3.75 \times 10^{27}\, {gcm}/{s^2}$, the Sun weight $P_{sun} = 4.156 \times 10^{38}\, {gcm}/{s^2}$, the Moon weight $P_{moo} = 4.136 \times 10^{24}\, {gcm}/{s^2}$ or any other material body) to gravity acceleration (gravity acceleration of the first body g_1 standard-copy $1000.0\, {gcm}/{s^2}$ in TGT ($1.0\, kg$ in SI) $g_{sta} = 2.615 \times 10^{-22}\, {cm}/{s^2}$, the Earth gravity acceleration $g_{ear} = 980.665\, {cm}/{s^2}$, the Sun gravity acceleration $g_{sun} = 3.265 \times 10^8\, {cm}/{s^2}$, the Moon gravity acceleration $g_{moo} = 19.19\, {cm}/{s^2}$ or any other material body) equal to the first l body mass (the mass standard-copy $1000.0\, {gcm}/{s^2}$ in TGT ($1.0\, kg$ in SI) $M_{sta} = 1.0197\, g$, the Earth mass $M_{ear} = 3.824 \times 10^{24}\, g$, the Sun mass $M_{sun} = 1.273 \times 10^{30}\, g$, the Moon mass $M_{moo} = 7.483 \times 10^{22}\, g$ any other non-material body), measured with the help of the temporary mass standard-copy equal to $1000.0\, {gcm}/{s^2}$ in TGT ($1.0\, kg$ in SI) $M_{sta} = 1.0197\, g$ and gravity acceleration of standard-copy $1000.0\, {gcm}/{s^2}$ in TGT ($1.0\, kg$ in

SI) $g_{sta} = 2.615 \times 10^{-22}\ {}^{gcm}/_{s^2}$, which are unchangeable for the standard-copy of $1000.0\ {}^{gcm}/_{s^2}$ in TGT ($1.0\ kg$ in SI) of the Earth, the Sun, the Moon and other bodies and having only one property of gravity acceleration and having no action boundaries, aggregate state, volume, density (specific gravity), temperature, odour (smell), color, and other properties that can have various values and is measured by the formula (8) and other TGT formulas, expressed in g.

The first body mass of a body M_1 was found by the formula

$$M_1 = \frac{P_1}{g_1}, \tag{8}$$

where M_1 is the first body mass, g;

P_1 is the first body weight, ${}^{gcm}/_{s^2}$;

g_1 is the first body gravity of acceleration, ${}^{cm}/_{s^2}$.

It is reasonable to use the formula (8) for obtaining masses of any material bodies that have any radii. All the bodies in the Universe have both weight and mass simultaneously.

Body weight can be obtained by formulas as well as with the help of a dynamometer or scales in material bodies, while mass can be found only by formulas in non-material bodies. One can touch a body weight by a hand. Body mass can't be touched.

Gravity acceleration constant $1.0\ g$ of body g_1^M is the first body gravity acceleration $g_1 = 2.5645 \times 10^{-22}\ {}^{cm}/_{s^2}$, created by the first body mass $M_1 = 1.0\ g$ on its surface defined by the formula (9) and other TGT formulas, expressed by ${}^{cm}/_{gs^2}$.

Gravity acceleration constant of $1.0\ g$ of body g_1^M was found by the formula

$$g_1^M = \frac{g_1}{M_1}, \tag{9}$$

where g_1^M gravity acceleration constant of 1.0 g of body, ${}^{cm}/_{gs^2}$;

g_1 is the first body gravity of acceleration, ${}^{cm}/_{s^2}$;

M_1 is the first body mass, g.

Gravity acceleration of body g_1 is the product of the first body mass M_1 by gravity acceleration constant $1.0\ g$ of body g_1^M that is defined by formula (10) and other TGT formulas, expressed in ${}^{cm}/_{s^2}$.

$$g_1 = M_1 \times g_1^M, \tag{10}$$

where g_1 is the first body gravity of acceleration, ${}^{cm}/_{s^2}$;

M_1 is the first body mass, g;

g_1^M is gravity acceleration constant of 1.0 g of body, ${}^{cm}/_{gs^2}$.

The first body gravity acceleration is the relation on the first body weight P_1 to the first body mass M_1 defined by the formula (11) and by other TGT formulas, expressed in ${}^{cm}/_{s^2}$.

The body gravity acceleration g_1, was found by the formula

$$g_1 = \frac{P_1}{M_1}, \tag{11}$$

where g_1 is the first body gravity of acceleration, ${}^{cm}/_{s^2}$;

P_1 is the first body weight, ${}^{gcm}/_{s^2}$;

M_1 is the first body mass, g.

The methods of defining weight, mass and gravity acceleration and other parameters with the help of physical and astrophysical constants according to TGT will be shown in another work.

Density (specific gravity) of a body is the relation of the first body weight P_1 to the volume of the first body V_1, that is defined by the formula (12) and other TGT formulas, expressed in ${}^{g}/_{cm^2 s^2}$.

Density (specific gravity) of the first body ρ_1 was found by the formula

$$\rho_1 = \frac{P_1}{V_1}, \quad (12)$$

where ρ_1 is the first body density (specific gravity), $g/_{cm^2 s^2}$;

P_1 is the first body weight, $gcm/_{s^2}$

V_1 is the first body volume, cm^3.

Density (specific gravity) of the first body ρ_1 was found by the formula

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

where ρ_1 is the first body density (specific gravity), $g/_{cm^2 s^2}$;

ρ_{1-2} is the first body density (specific gravity) taking into account the second body gravity acceleration, $g/_{cm^2 s^2}$;

g_1 is the first body gravity acceleration, $cm/_{s^2}$;

g_2 is the second body gravity of acceleration, $cm/_{s^2}$.

The method of obtaining density (specific gravity) of the first body will be shown in another work.

The creation of Tsiganok gravitation theory (TGT) was carried out with the help of centimeter-gram-second system (CGS) and data of NASA [10].

First, the parameters of the Earth were defined.

The Earth mass M_{ear}, could be found by the formula (8). However, to do this it was necessary to find the Earth weight P_{ear} on the basis of the supposed density (specific gravity) of the Earth.

The Earth weight was sought proceeding from the fact that it attracts itself.

The Earth weight P_{ear} was found as the product of the supposed density (specific gravity) of the Earth $\rho_{ear} = 3.45\ g/_{cm^2 s^2}$ by the Earth volume V_{ear} by the formula (7)

$$P_{ear} = \rho_{ear} \times V_{ear} = 3.45 \times 1.087 \times 10^{27} = 3.75 \times 10^{27}\ gcm/_{s^2}. \quad (14)$$

Our further calculations showed that for defining the weights of the Earth, the Sun, the Moon and other bodies in the state of weightlessness one doesn't need scales.

The Earth mass M_{ear} was found as the relation of the Earth weight P_{ear} to the Earth gravity acceleration g_{ear} by the formula (8)

$$M_{ear} = \frac{P_{ear}}{g_{ear}} = \frac{3.75 \times 10^{27}}{980.665} = 3.824 \times 10^{24} g. \quad (15)$$

The Earth gravity acceleration g_{ear} was found as the relation of the Earth weight P_{ear} to the Earth mass M_{ear} by the formula (11)

$$g_{ear} = \frac{P_{ear}}{M_{ear}} = \frac{3.75 \times 10^{27}}{3.824 \times 10^{24}} = 980.665\ cm/_{s^2}. \quad (16)$$

In the process of determining the Earth parameters there was measured the gravity acceleration constant of 1.0 g of body g_1^M.

Gravity acceleration constant of 1.0 g of body g_1^M was found as the relation of the Earth gravity acceleration g_{ear} to the Earth mass M_{ear} by the formula (9).

$$g_1^M = \frac{g_{ear}}{M_{ear}} = \frac{980.665}{3.824 \times 10^{24}} = 2.5645 \times 10^{-22}\ cm/_{gs^2}. \quad (17)$$

The further calculations showed that this constant characterizes the masses of all the bodies in the Universe. Using gravity acceleration constant of 1.0 g of body g_1^M made it possible to find the acceleration of gravity of any body by the formula (10).

The Earth gravity acceleration g_{ear} was found as the product of the Earth mass M_{ear} by gravity acceleration constant of 1.0 g of body g_1^M by the formula (10)

$$g_{ear} = M_{ear} \times g_1^M = 3.824 \times 10^{24} \times 2.5645 \times 10^{-22} = 980.665\ cm/_{s^2}. \quad (18)$$

After measuring the Earth weight, mass and gravity acceleration it became necessary to measure gravitational constant.

Gravitational constant G was sought by determining the force of gravitation between the Earth mass M_{ear} and the mass of the standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) M_{sta} $F_{ear-sta}$, placed at the radius of the Earth R_{ear} by the formula (1)

$$F_{ear-sta} = G \times \frac{M_{ear} \times g_{sta} + M_{sta} \times g_{ear}}{R_{ear}^2}, \tag{19}$$

where $F_{ear-sta}$ is the force of gravitation between the Earth and weight standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI), $^{gcm}/_{s^2}$;

G is gravitational constant, cm^2;

M_{ear} is the Earth mass, g;

M_{sta} is the standard-copy mass 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI), g;

g_{sta} is standard-copy gravity acceleration 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) 1.0 kg in SI, $^{cm}/_{s^2}$;

g_{ear} is the Earth gravity acceleration, $^{cm}/_{s^2}$;

R_{ear} is the Earth radius, cm.

The mass of standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) M_{sta} was found as the relation of standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) P_{sta} to the Earth gravity acceleration g_{ear} by the formula (8)

$$M_{sta} = \frac{P_{sta}}{g_{ear}} = \frac{1000.0}{980.665} = 1.0197\ g. \tag{20}$$

The standard-copy gravity acceleration of the weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) g_{sta} was found as the product of the mass of standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) M_{sta} by gravity acceleration of 1.0 g тела g_1^M by the formula (10)

$$g_{sta} = M_{sta} \times g_1^M = 1.0197 \times 2.5645 \times 10^{-22} = 2.615 \times 10^{-22}\ ^{cm}/_{s^2}. \tag{21}$$

This resulted in obtaining an equation with two unknowns: the force of and gravitation between the Earth and the standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) $F_{ear-sta}$ and gravitational constant G. It was necessary to get rid of one of these two unknowns.

Gravitational constant G was sought by the substitution in formula (1) the force of gravitation between the first body with mass M_1 and the second body with mass M_2 placed at the distance of R_{1-2}^2 F_{1-2} by the force of gravitation between the first body with mass $M_1 = 1.0\ g$ SI and the second body with mass $M_2 = 1.0\ g$ SI, equal to one gram and placed at the distance $R_{1-2} = 1.0\ cm$ $F_{1-2} = 6.67384 \times 10^{-8}\ ^{cm^3}/_{gcm^2}$ found by Cavendish. However, determining gravitation forces between various bodies gave absurd results each time.

Our further calculations showed that the force of gravitation in Cavendish experiment is in fact equal to $F_{1-2} = 1{,}0847 \times 10^{-10}\ ^{gcm}/_{s^2}$ and is not gravitational constant. The method of determining this force will be shown in another work.

The weight of the known standard-copy $P_{sta} = 1000.0$ $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) was necessary (for us) for obtaining gravitational constant.

Centrifugal force of weight standard-copy $F_{sta} = 1000.0$ $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) on the Earth surface $F_{ear-sta}$ was found as the relation of the product of the mass of standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) M_{sta} by the squared cosmic velocity of the Earth $V_{ear-fcv} = 7.944 \times 10^5\ ^{cm}/_{s}$ to the Earth radius $R_{ear} = 6.378 \times 10^8\ cm$ by the formula (4)

$$F_{ear-sta} = \frac{M_{sta} \times V_{ear-fcv}^2}{R_{ear}} = \frac{1.0197 \times (7.944 \times 10^5)^2}{6.378 \times 10^8} = 1000.0 \ {}^{gcm}/_{s^2}. \quad (22)$$

The method of measuring the space velocity of the Earth, the Sun, Moon and other bodies will be presented in another work.

In the process of determining gravitational constant G we proceeded from the assumption that that any second body with less mass M_2 moving round the first body with larger mass M_1 experiences not only the attraction of this body but also Huygens centrifugal force (4) that repulses the second body from the first one. Thus, the formula (1) was equated to the formula (4).

$$G \times \frac{M_1 \times g_2 + M_2 \times g_1}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}. \quad (23)$$

The force of gravitation between the Earth mass M_{ear} and the mass of standard-copy $1000.0 \ {}^{gcm}/_{s^2}$ in TGT ($1.0 \ kg$ in SI) M_{sta} $F_{ear-sta}$, found by the formula (1) was equated to centrifugal force of the weight standard-copy $1000.0 \ {}^{gcm}/_{s^2}$ in TGT ($1.0 \ kg$ in SI) on the surface of the Earth $F_{ear-sta}$, found by the formula (4)

$$G \times \frac{M_{ear} \times g_{sta} + M_{sta} \times g_{ear}}{R_{ear}^2} = \frac{M_{ear} \times V_{sta}^2}{R_{ear}}. \quad (24)$$

Equating the formula (1) to the formula (4), we proceeded from the fact that if they were not equal, then planets would fall on the Sun or fly away to the outer space.

It resulted in getting rid of one of two unknowns and obtaining an equation only with one unknown, that is with gravitational constant G.

$$G \times \frac{3.824 \times 10^{24} \times 2.615 \times 10^{-22} + 1.0197 \times 980.665}{(6.378 \times 10^8)^2} = \frac{1.0197 \times (7.944 \times 10^5)^2}{6.378 \times 10^8} \quad (25)$$

or

$$G \times \frac{3.824 \times 10^{24} \times 2.615 \times 10^{-22} + 1.0197 \times 980.665}{(6.378 \times 10^8)^2} = 1.0197 \times 980.665. \quad (26)$$

Having solved the equation (23) relatively to G we obtained

$$G = \frac{M_2 \times R_{1-2} \times V_2^2}{M_1 \times g_2 + M_2 \times g_1}. \quad (27)$$

Gravitational constant G was found proceeding from the mass of standard-copy $1000.0 \ {}^{gcm}/_{s^2}$ in TGT ($1.0 \ kg$ in SI) M_{sta}, the Earth radius R_{ear}, the squared Earth space velocity $V_{ear-fcv}^2$, the Earth mass M_{ear}, gravity acceleration of standard-copy of $1000.0 \ {}^{gcm}/_{s^2}$ in TGT ($1.0 \ kg$ in SI) g_{sta} and the Earth gravity acceleration g_{ear} by the formula (27)

$$G = \frac{M_{sta} \times R_{ear} \times V_{ear-fcv}^2}{M_{ear} \times g_{sta} + M_{sta} \times g_{ear}} = \frac{1.0197 \times 6.378 \times 10^8 \times (7.944 \times 10^5)^2}{3.824 \times 10^{24} \times 2.615 \times 10^{-22} + 1.0197 \times 980.665} = 2.034 \times 10^{17} \ cm^2. \quad (28)$$

After obtaining gravitational constant G it became clear that for this one needs neither mountain Schiehallion, torsion balance of John Michell nor lead ingots from the Spandau Citadel.

Gravitational constant – is the half area of radial section of the gravitational field as the area of the curved shape that is equal to the rectangle area with the length $R_1 = 2.034 \times 10^{17} \ cm$ and the height $R_2 = 1.0 \ cm$, which rotates with an acceleration $g_G = 1.0 \ {}^{cm}/_{s^2}$, body mass $M_1 = 1.9497 \times 10^{21} \ g$, and the gravity acceleration $g_G = 0.5 \ {}^{cm}/_{s^2}$, which is equal to $2.034 \times 10^{17} \ cm^2$, expressed in cm^2.

Physical nature meaning of gravitational constant and the methods of its determining will be shown in another work.

Measuring gravitational constant G showed that weight of standard-copy $1000.0 \ {}^{gcm}/_{s^2}$ in TGT ($1.0 \ kg$ in SI) $P_{sta} = 1000.0 \ {}^{gcm}/_{s^2}$ and the mass of standard-copy $1000.0 \ {}^{gcm}/_{s^2}$ in TGT ($1.0 \ kg$ in SI) $M_{sta} = 1.0197 g$ on the basis of the known standard-copy of $1.0 \ kg$ in SI may be used before the formation of Tsiganok measuring system is completed. Tsiganok measuring system with new constant standard-copies may replace the insufficiently grounded International System of Units (SI), Centimeter-gram-second system of units (CGS), Imperial and US customary units, etc. Moreover, most of the constant standards-copies in this system will be valid within the limits of the whole Universe, not only within the borders of separate states or the Earth. When the creation of Tsiganok measurement system is completed there must be minted the medal with the known motto of Condorcet. «for all the people, for the all times».

When starting to define the average density (specific gravity) of the Earth it was taken into account that the lightest fractions are there in the Earth centre while centrifugal force presses the heavier fractions to the Earth surface. The exact value of average density (specific gravity) of the Earth was found proceeding from the equality $M_1 \times g_2 = M_2 \times g_1$ in the formulas (1), (2) and (3).

First, there were found the Earth weight P_{ear}, the Earth mass M_{ear} and gravitational constant G with the help of the Earth supposed density (specific gravity) $\rho_{ear} = 3.4 \ {}^{g}/_{cm^2 s^2}$. In the process of calculations it was taken into account that the average distance from the Sun to the Earth $R_{sun-ear}$, the average distance from the Earth to the Moon $R_{ear-moo}$, the Earth gravity acceleration g_{ear} and some other parameters were found experimentally , so the validity of these parameters was doubtless for us. In measuring the gravitational force between the Sun and the Earth and between the Earth and the Moon and between other bodies the equality $M_1 \times g_2 = M_2 \times g_1$ in the formula (1) turned out to be violated. Only after increasing average density (specific gravity) of the Earth with $\rho_{ear} = 3.4 \ {}^{g}/_{cm^2 s^2}$ до $\rho_{ear} = 3.45 \ {}^{g}/_{cm^2 s^2}$ the equality $M_1 \times g_2 = M_2 \times g_1$, in the formulas (1), (2),and(3) was achieved. This equality made it possible to obtain the exact meaning (value) of gravitational constant $G = 2.034 \times 10^{17} \, cm^2$.

In the process of calculation it was taken into account that some parameters of bodies always remain constant irrespective of the point of the Universe they are located while the value of others may change sufficiently. Thus, for example, weight, mass, gravity acceleration and some other parameters of the given body won't change if it is moved from one point of the outer space to another. At the same time, for example, density (specific gravity) and some other parameters of the same body may change sufficiently if they are found in the conditions of other body gravity acceleration. So, for example, weight and density (specific gravity) of the given body may be found in the conditions of gravity acceleration of the same body. However, these parameters may be found in the conditions of the Earth gravity acceleration or gravity acceleration of any other body. Our further calculations showed, for example, that density (specific gravity) of lunar soil, in the conditions of the Moon gravity acceleration is equal to $\rho_{moo} = 0.065 \ {}^{g}/_{cm^2 s^2}$. However, the same density (specific gravity) of lunar soil delivered by the American astronauts to the surface of the Earth in the conditions of the Earth gravity acceleration turned out to be, equal $\rho_{moo-ear} = 3.34 \, {}^{g}/_{cm^2 s^2}$.

This statement can be illustrated by the example of finding weight and density (specific gravity) of the known standard-copy of $1000.0 \ {}^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) $V_{sta} = 1000.0 \, cm^3$ of distilled water on the surface of the Earth and in the space.

The standard-copy weight $1000.0 \ {}^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) $V_{sta} = 1000.0 \, cm^3$ of distilled water on the Earth surface in the conditions of the Earth gravity acceleration is equal to $P_{sta} = 1000.0 \ {}^{gcm}/_{s^2}$.

The standard-copy mass $1000.0 \ {}^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) $V_{sta} = 1000.0 \, cm^3$ of distilled water M_{sta} was found as the relation of standard-copy weight $1000.0 \ {}^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) $V_{sta} = 1000.0 \, cm^3$ of distilled water on the Earth surface $P_{sta-ear}$ to the Earth gravity acceleration g_{ear} by the formula (8)

$$M_{sta} = \frac{P_{sta-ear}}{g_{ear}} = \frac{1000.0}{980.665} = 1.0197 \, g. \tag{29}$$

Then the standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water was delivered to the space.

The standard-copy gravity acceleration 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space g_{sta} was found as the product of standard-copy mass 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space M_{sta} by constant of gravity acceleration of 1.0 g of body g_1^M by the formula (10)

$$g_{sta} = M_{sta} \times g_1^M = 1.0197 \times 2.5645 \times 10^{-22} = 2.615 \times 10^{-22}\ ^{cm}/_{s^2}. \quad (30)$$

The standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space $P_{sta-spa}$ was found as the product of the standard-copy mass 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space M_{sta} by the standard-copy gravity acceleration 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space g_{sta} by the formula (5)

$$P_{sta\text{-}spa} = M_{sta} \times g_{sta} = 1.0197 \times 2.615 \times 10^{-22} = 2.667 \times 10^{-22}\ ^{gcm}/_{s^2}. \quad (31)$$

The results of our calculations showed that all the bodies have at the same time both weight and mass the weight in the state of weightlessness.

Density (specific gravity) of the standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space $\rho_{sta-spa}$ was found as the relations of the standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space $P_{sta-spa}$ to the standard-copy volume 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space V_{sta} by the formula (12)

$$\rho_{sta-spa} = \frac{P_{sta-spa}}{V_{sta}} = \frac{2.667 \times 10^{-22}}{1000.0} = 2.667 \times 10^{-25}\ ^{g}/_{cm^2 s^2}. \quad (32)$$

Density (specific gravity) of the standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water on the surface of the Earth ρ_{sta} was found as the relation of the standard-copy weight 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water on the surface of the Earth P_{sta} to the standard-copy volume 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water on the surface of the Earth V_{sta} by the formula (12)

$$\rho_{sta} = \frac{P_{sta}}{V_{sta}} = \frac{1000.0}{1000.0} = 1.0\ ^{g}/_{cm^2 s^2}. \quad (33)$$

Density (specific gravity) of the standard-copy 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water on the surface of the Earth ρ_{sta} was found proceeding from the standard-copy density (specific gravity) 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space $\rho_{sta-spa}$, the Earth gravity acceleration g_{ear} and the standard-copy gravity acceleration 1000.0 $^{gcm}/_{s^2}$ in TGT (1.0 kg in SI) V_{sta} = 1000.0 cm^3 of distilled water in the space $g_{sta-spa}$ by the formula (13)

$$\rho_{sta} = \frac{\rho_{sta-spa} \times g_{ear}}{g_{sta-spa}} = \frac{2.667 \times 10^{-25} \times 980.665}{2.615 \times 10^{-22}} = 1.0\ ^{g}/_{cm^2 s^2}. \quad (34)$$

Such calculations are necessary, for example, for defining density (specific gravity) of the Earth soil on the surface of the Sun, the Moon, Mars Jupiter and vice versa. Such calculations are also necessary for measuring density (specific gravity) on the surface of the Moon, Mars, Jupiter and other bodies and also in the space.

After determining the Earth parameters and the parameters of gravitational constant G the measurement of the Sun parameters started. The Sun parameters could be found by the formulas (7), (8) and (11) by analogy to the Earth parameters. However, the Sun is in the state of plasma. That's why the delivery of the samples of solar soil to the Earth is quite problematic. So, taking into account, that $g_1 = M_1 \times g_1^M$ the formula (1) was written in the following way

$$F_{1-2} = G \frac{M_1 \times g_2 + M_2 \times M_1 \times g_1^M}{R_{1-2}^2}. \quad (35)$$

This resulted in obtaining an equation with two unknowns: the force of gravitation between the first and second bodies F_{1-2} and the first body mass M_1. It was necessary to get rid of one of these two unknowns. To do this, the formula (35) was equated to the formula (4).

So, the force of gravitation between the first and second bodies F_{1-2}, found by the formula (1) was equated to centrifugal force of the second body F_{1-2} found by the formula (4).

$$G \times \frac{M_1 \times g_2 + M_2 \times M_1 \times g_1^M}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}} . \quad (36)$$

When the equation (36) relatively to M_1, was found, there was obtained

$$M_1 = \frac{M_2 \times R_{1-2} \times V_2^2}{G \times (g_2 + M_2 \times g_1^M)} . \quad (37)$$

Using the formula (37) it became possible to find the unknown first body parameters by the second body known parameters.

First of all there were the attempts to clear out whether the left side of the equation (36) is equal to the right one. Taking into account that $g_1 = M_1 \times g_1^M$ that $g_2 = M_2 \times g_1^M$ the formula (36) was written in such a form

$$G \times \frac{M_1 \times M_2 \times g_1^M + M_2 \times M_1 \times g_1^M}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}} \quad (38)$$

or

$$\frac{2 \times G \times M_1 \times M_2 \times g_1^M}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}, \quad (39)$$

Taking into account that

$$V_1^M = 2 \times G \times g_1^M = 2 \times 2.034 \times 10^{17} \times 2.5645 \times 10^{-22} = 1.04324 \times 10^{-4}\ {cm^3}/{gs^2} , \quad (40)$$

where V_1^M is body gravitational field constant of 1.0 g of body, ${cm^3}/{gs^2}$.

The formula (39) was written in the following way

$$\frac{M_1 \times M_2 \times V_1^M}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}, \quad (41)$$

or

$$\frac{M_1 \times M_2 \times 1.0432386 \times 10^{-4}}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}, \quad (42)$$

Taking into account that, as it will be shown later, $V_B^M = M_1 \times 1.04324 \times 10^{-4}$,
where V_B^M- is the body gravitational field constant, ${cm^3}/{s^2}$.

The formula (42) was written in the following way

$$\frac{M_2 \times V_B^M}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}. \quad (43)$$

Taking into account that, as it will be shown in another paper, $V_B^M = R_{1-2} \times V_2^2$, the formula (43) was written in the following way

$$\frac{M_2 \times R_{1-2} \times V_2^2}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}, \tag{44}$$

If R_{1-2} in the left side of equality (42) is cancelled, one will obtain two absolutely equal formulas

$$\frac{M_2 \times V_2^2}{R_{1-2}} = \frac{M_2 \times V_2^2}{R_{1-2}}. \tag{45}$$

It means that the formula (36), including G, M_1, M_2, g_1^M, and R_{1-2}^2 is equal to the formula (4), including M_2, V_2^2 и R_{1-2}. It means that in the process of creating Newton doubtful theory of gravitation unknown masses were cancelled when solving the equation $G \times \frac{M_? \times M_?}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}$. It also means that in the process of creating Tsiganok gravitation theory, in solving the equation (1) there were cancelled the known masses.

Physical nature as well as the method of determining gravitational field constant of 1.0 g body V_1^M and body gravitational field constant V_B^M will be shown in another work.

The force of gravitation between the Sun and the Earth $F_{sun-ear}$ was found to confirm the formula (1) practically. Taking into account that $g_{sun} = M_{sun} \times g_1^M$ the formula (35) was written in the following way

$$F_{sun-ear} = G \times \frac{M_{sun} \times g_{ear} + M_{ear} \times M_{sun} \times g_1^M}{R_{sun-ear}^2}, \tag{46}$$

where $F_{sun-ear}$ is the force of gravitation between the Sun and the Earth, $^{gcm}/_{s^2}$;

G is gravitational constant, cm^2;

M_{sun} is the Sun mass, g;

M_{ear} is the Earth mass, g;

g_{ear} is the Earth gravity acceleration, $^{cm}/_{s^2}$;

g_1^M is gravity acceleration constant 1.0 g body, $^{cm}/_{gs^2}$;

$R_{sun-ear}$ is the distance from the Sun to the Earth, cm.

This resulted in obtaining an equation with two unknowns: the force of gravitation 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. In this case we proceeded from the fact that the Earth moving along its orbit round the Sun experiences not only the gravitation of the Sun but also centrifugal force that repulses the Earth from the Sun.

The Earth centrifugal force $F_{sun-ear}$ was found as the relation of the product of the Earth mass M_{ear} by the squared average orbital velocity of the Earth V_{ear}^2 to the average distance from the Sun to the Earth by the formula (4)

$$F_{sun-ear} = \frac{M_{ear} \times V_{ear}^2}{R_{sun-ear}} = \frac{3.824 \times 10^{24} \times (2.979 \times 10^6)^2}{1.496 \times 10^{13}} = 2.268 \times 10^{24} \ ^{gcm}/_{s^2}. \tag{47}$$

The force of gravitation between the Sun and the Earth $F_{sun-ear}$, found by the formula (46), was equated to the Earth centrifugal force of the Earth $F_{sun-ear}$, found by the formula (47).

$$G \times \frac{M_{sun} \times g_{ear} + M_{ear} \times M_{sun} \times g_1^M}{R_{sun-ear}^2} = \frac{M_{ear} \times V_{ear}^2}{R_{sun-ear}}. \tag{48}$$

This resulted in obtaining an equation with only one unknown that is the Sun mass M_{sun}

$$2.034 \times 10^{17} \times \frac{M_{sun} \times 980.665 + 3.824 \times 10^{24} \times M_{sun} \times 2.5645 \times 10^{-22}}{(1.496 \times 10^{13})^2} = \frac{3.824 \times 10^{24} \times (2.979 \times 10^6)^2}{1.496 \times 10^{13}} \tag{49}$$

or

$$2.034 \times 10^{17} \times \frac{M_{sun} \times 980.665 + 3.824 \times 10^{24} \times M_{sun} \times 2.5645 \times 10^{-22}}{(1.496 \times 10^{13})^2} = 3.824 \times 10^{24} \times 0.5933. \tag{50}$$

The Sun mass M_{sun} was found proceeding from 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}, the gravitational constant G, the Earth gravity acceleration g_{ear} and gravity acceleration constant of 1.0 g body g_1^M by the formula (37)

$$M_{sun} = \frac{M_{ear} \times R_{sun\text{-}ear} \times V_{ear}^2}{G \times (g_{ear} + M_{ear} \times g_1^M)} = \frac{3.824 \times 10^{24} \times 1.496 \times 10^{13} \times (2.979 \times 10^6)^2}{2.043 \times 10^{17} \times (980.665 + 3.824 \times 10^{24} \times 2.5645 \times 10^{-22})} = 1.273 \times 10^{30} g. \quad (51)$$

Other Sun parameters were measured after measuring the Sun mass M_{sun} .

The Sun gravity acceleration g_{sun} was measured as the product of the Sun mass M_{sun} by gravity acceleration constant 1.0 g of body g_1^M by the formula (10)

$$g_{sun} = M_{sun} \times g_1^M = 1.273 \times 10^{30} \times 2.5645 \times 10^{-22} = 3.265 \times 10^8 \ {cm}/{s^2} . \quad (52)$$

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

$$F_{sun\text{-}ear} = G \times \frac{M_{sun} \times g_{ear} + M_{ear} \times g_{sun}}{R_{sun\text{-}ear}^2} =$$

$$= 2.034 \times 10^{17} \times \frac{1.273 \times 10^{30} \times 980.665 + 3.824 \times 10^{24} \times 3.265 \times 10^8}{(1.496 \times 10^{13})^2} = 2.269 \times 10^{24} \ {gcm}/{s^2}. \quad (53)$$

The Earth centrifugal force $F_{sun-ear}$, found by the formula (2) turned out to be equal to the force of gravitation between the Sun and the Earth $F_{sun-ear}$, found by the formula (1), which shows the validity of these formulas.

The Sun weight P_{sun} was found as the product of the Sun mass M_{sun} by the Sun gravity acceleration by the formula (5)

$$P_{sun} = M_{sun} \times g_{sun} = 1.273 \times 10^{30} \times 3.265 \times 10^8 = 4.156 \times 10^{38} \ {gcm}/{s^2}. \quad (54)$$

The Sun weight taking into account the Earth gravity acceleration $P_{sun-ear}$ was found as the product of the Sun mass M_{sun} by the Earth gravity acceleration g_{ear} by the formula (5)

$$P_{sun\text{-}ear} = M_{sun} \times g_{ear} = 1.273 \times 10^{30} \times 980.665 = 1.248 \times 10^{33} \ {gcm}/{s^2}. \quad (55)$$

The Sun density (specific gravity) ρ_{sun} was found as the relation of the Sun weight, P_{sun} to the Sun volume V_{sun} by the formula (12)

$$\rho_{sun} = \frac{P_{sun}}{V_{sun}} = \frac{4.156 \times 10^{38}}{1.413 \times 10^{33}} = 2.941 \times 10^5 \ {g}/{cm^2 s^2}. \quad (56)$$

The Sun density (specific gravity) taking into account the Earth gravity acceleration $\rho_{sun-ear}$ was found as the relation of the Sun weight taking into account the Earth gravity acceleration $P_{sun-ear}$ to the Sun volume V_{sun} by the formula (12)

$$\rho_{sun-ear} = \frac{P_{sun-ear}}{V_{sun}} = \frac{1.248 \times 10^{33}}{1.413 \times 10^{33}} = 0.833 \ {g}/{cm^2 s^2}. \quad (57)$$

The Sun density (specific gravity) ρ_{sun} was found proceeding from the Sun density (specific gravity) taking into account the Earth gravity acceleration $\rho_{sun-ear}$, the Sun gravity acceleration g_{sun} and the Earth gravity acceleration g_{ear} by the formula (13)

$$\rho_{sun} = \frac{\rho_{sun-ear} \times g_{sun}}{g_{ear}} = \frac{0.833 \times 3.265 \times 10^8}{980.665} = 2.94 \times 10^5 \ {g}/{cm^2 s^2}. \quad (58)$$

If we could take a sample of Solar soil from the Sun surface and deliver it to the Earth surface, then its density (specific gravity) would be equal to the density (specific gravity) of petroleum diesel $\rho_{diesel} = 0.832 \ {g}/{cm^2 s^2}$.

According to Newton doubtful gravitation theory, as many as 333000 masses of the Earth are necessary to obtain the mass of the Sun. In order to find the Sun gravity acceleration one needs 28 earth gravity accelerations. It means that the Sun and the Earth are made up of atomic nuclei, neutrons, electrons, etc , which have different abilities to attract. According to Tsiganok gravitation theory (TGT), 333000 Earth masses are needed to find the Sun mass and 333000 Earth gravity accelerations are needed to find the Sun gravity acceleration. It means that the Sun and the Earth are made up of atomic nuclei, neutrons, electrons, etc. that have the same ability to attract.

The Sun parameters were found with the help of the Earth centrifugal force (47). The method of obtaining the first body parameters, when there was no information about the centrifugal force of the second body rotating round the first body, with the help of physical and astrophysical constants according to TGT will be shown later (in another work).

The Earth and the Sun parameters having been measured, there were obtained the parameters of the Moon.

The Moon parameters were found in the same way as the Earth parameters on the basis of the density (specific gravity) of lunar soil delivered by the American astronauts to the Earth surface. $P_{moo-ear} = 3.34\ {}^{g}/_{cm^2 s^2}$.

The Moon weight taking into account the Earth gravity acceleration $P_{moo-ear}$ was found as the product of the Moon density (specific gravity) taking into account the Earth gravity acceleration $\rho_{moo-ear}$ by the Moon volume V_{moo} by the formula (7)

$$P_{moo\text{-}ear} = \rho_{moo\text{-}ear} \times V_{moo} = 3.34 \times 2.197 \times 10^{25} = 7.338 \times 10^{25}\ {}^{gcm}/_{s^2}. \quad (59)$$

The Moon mass M_{moo} was found as the relation of the Moon weight taking into account the Earth gravity acceleration $P_{moo-ear}$ to the Earth gravity acceleration g_{ear} by the formula (8)

$$M_{moo} = \frac{P_{moo-ear}}{g_{ear}} = \frac{7.338 \times 10^{25}}{980.665} = 7.483 \times 10^{22}\ g. \quad (60)$$

In this case it was taken into account that the Moon mass M_{moo} found proceeding from the Lunar soil density (specific gravity) taking into account the Earth gravity acceleration $\rho_{moo-ear}$, is equal to the Moon mass found proceeding from the Lunar soil density (specific gravity) taking into account the Moon gravity acceleration ρ_{moo}.

The Moon gravity acceleration g_{moo} was found as the product of the Moon mass M_{moo} by gravity acceleration constant of 1.0 g of body g_1^M by the formula (10)

$$g_{moo} = M_{moo} \times g_1^M = 7.483 \times 10^{22} \times 2.5645 \times 10^{-22} = 19.19\ {}^{cm}/_{s^2}. \quad (61)$$

The Moon weight P_{moo} was found as the product of the Moon mass M_{moo} by the Moon gravity acceleration g_{moo} by the formula (5)

$$P_{moo} = M_{moo} \times g_{moo} = 7.483 \times 10^{22} \times 19.19 = 1.436 \times 10^{24}\ {}^{gcm}/_{s^2}. \quad (62)$$

The Moon density (specific gravity) ρ_{moo} was found as the relation of the Moon weight P_{moo} to the Moon volume V_{moo} by the formula (12)

$$\rho_{moo} = \frac{P_{moo}}{V_{moo}} = \frac{1.436 \times 10^{24}}{2.197 \times 10^{25}} = 0.065\ {}^{g}/_{cm^2 s^2}. \quad (63)$$

The Moon density (specific gravity) ρ_{moo} was found proceeding from the Moon density (specific gravity) taking into account the Earth gravity acceleration $\rho_{moo-ear}$, the Moon gravity acceleration g_{moo} and the Earth gravity acceleration g_{ear} by the formula (13)

$$\rho_{moo} = \frac{\rho_{moo-ear} \times g_{moo}}{g_{ear}} = \frac{3.34 \times 19.19}{980.665} = 0.065\ {}^{g}/_{cm^2 s^2}. \quad (64)$$

The Moon centrifugal force $F_{ear-moo}$ was found proceeding from the Moon mass M_{moo}, the Moon squared average orbital velocity V_{moo}^2 and the average distance from the Earth to the Moon $R_{ear-moo}$ by the formula (4)

$$F_{ear-moo} = \frac{M_{moo} \times V_{moo}^2}{R_{ear-moo}} = \frac{7.483 \times 10^{22} \times (1.023 \times 10^5)^2}{3.844 \times 10^{10}} = 2.038 \times 10^{22}\ {}^{gcm}/_{s^2}. \quad (65)$$

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

$$F_{ear\text{-}moo} = G \times \frac{M_{ear} \times g_{moo} + M_{moo} \times g_{ear}}{R^2_{ear\text{-}moo}} =$$

$$=2.034 \times 10^{17} \frac{3.824 \times 10^{24} \times 19.19 + 7.483 \times 10^{22} \times 980.665}{(3.844 \times 10^{10})^2} = 2.02 \times 10^{22}\, {}^{gcm}\!/_{s^2}. \quad (66)$$

The Moon centrifugal force $F_{ear-moo}$ found by the formula (65) turned out to be equal to the force of gravitation between the Earth and the Moon $F_{ear-moo}$ found by the formula (66).

$$2.034 \times 10^{17} \times \frac{3.824 \times 10^{24} \times 19.19 + 7.483 \times 10^{22} \times 980.665}{(3.844 \times 10^{10})^2} = \frac{7.483 \times 10^{22} \times (1.023 \times 10^{5})^2}{3.844 \times 10^{10}} \quad (67)$$

or

$$2.034 \times 10^{17} \times \frac{3.824 \times 10^{24} \times 19.19 + 7.483 \times 10^{22} \times 980.665}{(3.844 \times 10^{10})^2} = 7.483 \times 10^{22} \times 0.2723. \quad (68)$$

The force of gravitation between the Earth and the Moon $F_{ear-moo}$ found by the formula (66) turned out to be equal to the Moon centrifugal force $F_{ear-moo}$ found by the formula (65), which shows the validity of these formulas.

The parameters of standard-copy $1000.0\, {}^{gcm}\!/_{s^2}$ in TGT ($1.0\, kg$ in SI) $V_{sta} = 1000.0\, cm^3$ of distilled water in space, the Earth, the Sun and the Moon are shown in table 1.

Table 1

Body	P_1	M_1	g_1	ρ_1
	$(gcms^{-2})$	(g)	(cms^{-2})	$(gcm^{-2}s^{-2})$
Standard-copy $1000.0\, {}^{gcm}\!/_{s^2}$ in TGT ($1.0\, kg$ in SI) $V_{sta} = 1000.0\, cm^3$ of distilled water in space	2.667×10^{-22}	1.0197	2.615×10^{-22}	2.667×10^{-25}
Earth	3.75×10^{27}	3.824×10^{24}	980.665	3.45
Sun	4.156×10^{38}	1.273×10^{30}	3.265×10^{8}	2.941×10^{5}
Moon	1.436×10^{24}	7.483×10^{22}	19.19	0.065

In spite of the fact that the Earth and the Moon parameters were found proceeding from experimental data on density (specific gravity) of these bodies, there remained some doubts as to validity of the formulas (1), (2), (3), (4)0 and the equation (23).

In spite of the fact that the Earth and the Moon parameters were found proceeding from experimental data on density (specific gravity) of these bodies, there remained some doubts as to validity of the formulas (1), (2), (3), (4)0 and the equation (23).

It is problematic to confirm experimentally the validity of the formulas (1), (2) and (3) and to find the force of gravitation between the bodies in a laboratory on the Earth surface due to the lack of dynamometer which could fix such an insufficient force. It appeared much more simple and obvious to confirm experimentally the validity of the formula (4) with the help of a dynamometer, a rope, a body and a stop-watch. The rotation of the Earth round the Sun and that of the Moon round the Earth was replaced by the rotation of a dynamometer, a rope, a bottle filled with water by the right hand. We took into account that the distance from the first body to the second body R_{1-2}, the first body mass M_1 and the second body mass M_2 in the left and in the right sides of the equation (23) are to be equal. If centrifugal force, which will be shown by the dynamometer in the process of the experiment on rotating body with mass M_2 will, coincide with centrifugal force F_{1-2} , found by the formula (4), according to TGT, it will mean that the second body mass M_2 in the left side on the equation (23) and the second body mass M_2 in the right side of the equation (23) are one and the same mass.

A number of experiments of rotating bodies with different weight and masses using the ropes of different length were carried out while elaborating Tsiganok gravitation theory. In such conditions it was taken into account that the expression of $1.0\,kg$ in SI according to Newton doubtful gravitation theory on dynamometer is to be replaced (corrected) by $1000.0\ {gcm}/{s^2}$ in TGT, $2.0\,kg$ SI by $2000.0\ {gcm}/{s^2}$ in TGT, $3.0\,kg$ SI by $3000.0\ {gcm}/{s^2}$ in TGT etc.

It was also taken into account that it is necessary to substitute 1.0197 g in TGT to the formula (4) instead of the so-called mass of $1.0\,kg$ in SI , and 2.039g in TGT instead of $2.0\,kg$ in SI to the formula (4), etc. It was also taken into account that distance in our experiment is counted from a ring, attached to dynamometer, to the centre of gravity of body taking into account the length of dynamometer, that of the rope and the body.

The experiment on measuring centrifugal force consisted in rotating three bodies (dynamometer, rope and bottle filled with water) by the right hand. In the process of rotating these bodies having different total weights the number of rotations per minute and at different lengths of the rope was recorded (fixed) by stop watch.

The first body with total weight $P_1 = 1000.0\ {gcm}/{s^2}$ in TGT or ($1.0\,kg$ in SI) was rotated using the rope having the length of $R_{1-1} = 50.0\,cm$, the frequency of rotation $f_1 = 67.0\,rpm$, the period of rotation $T_1 = 0.8955$ s and angular velocity $V_1 = 350.82\ {cm}/{s}$.

The second body with total weight $P_2 = 1000.0\ {gcm}/{s^2}$ in TGT or ($1.0\,kg$ in SI) was rotated using the rope having the length of $R_{1-2} = 100.0\,cm$, the frequency of rotation $f_2 = 54.0\,rpm$, the period of rotation $T_2 = 1.1112\,s$ and angular velocity $V_2 = 565.49\ {cm}/{s}$.

The third body with total weight $P_3 = 1500.0\ {gcm}/{s^2}$ in TGT or ($1.5\,kg$ in SI) was rotated using the rope having the length of $R_{1-3} = 100.0\,cm$, the frequency of rotation $f_3 = 60.0\,rpm$, the period of rotation $T_3 = 1.0\,s$ and angular velocity $V_3 = 628.32\ {cm}/{s}$.

The first body mass M_1 with the total weight $P_1 = 1000.0\ {gcm}/{s^2}$ was found by the formula (8)

$$M_1 = \frac{P_1}{g_{ear}} = \frac{1000.0}{980.665} = 1.0197\,g. \qquad (69)$$

The second body mass M_2 with the total weight $P_2 = 1000.0\ {gcm}/{s^2}$ was found by the formula (8)

$$M_2 = \frac{P_2}{g_{ear}} = \frac{1000.0}{980.665} = 1.0197\,g. \qquad (70)$$

The third body mass M_3 with the total weight $P_3 = 1500.0\ {gcm}/{s^2}$ was found by the formula (8)

$$M_3 = \frac{P_3}{g_{ear}} = \frac{1500.0}{980.665} = 1.5296\,g. \qquad (71)$$

The centrifugal force of the first body with mass $M_1 = 1.0197\,g$, centre of gravity of which rotated at the distance $R_{1-1} = 50.0\,cm$ from the axis of rotation with angular velocity $V_1 = 350.82\ {cm}/{s}$ F_{1-1} was found by the formula (4)

$$F_{1-1} = \frac{M_1 \times V_1^2}{R_{1-1}} = \frac{1.0197 \times 350.82^2}{50.0} = 2509.98\ {gcm}/{s^2}. \qquad (72)$$

The centrifugal force of the second body with mass $M_2 = 1.0197\,g$, centre of gravity of which rotated at the distance $R_{1-2} = 100.0\,cm$ from the axis of rotation with angular velocity $V_1 = 350.82\ {cm}/{s}$ F_{1-2} was found by the formula (4)

$$F_{1-2} = \frac{M_2 \times V_2^2}{R_{1-2}} = \frac{1.0197 \times 565.49^2}{100.0} = 3260.79\ {gcm}/{s^2}. \qquad (73)$$

The centrifugal force of the third body with mass $M_3 = 1.5296\,g$, centre of gravity of which rotated at the distance $R_{1-3} = 100.0\,cm$ from the axis of rotation with angular velocity $V_3 = 628.32\ {cm}/{s}$ F_{1-3} was found by the formula (4):

$$F_{1-3} = \frac{M_3 \times V_3^2}{R_{1-3}} = \frac{1.5296 \times 628.32^2}{100.0} = 6038.647 \ {gcm}/{s^2}. \qquad (74)$$

In the process of rotation of each of three bodies we didn't see the dynamometer readings. However, in our dynamometer, the hand moved along the scale and in the process of rotation of these bodies we could fix its hand by a finger. When the rotation of these three bodies finished (dynamometer, rope, bottle filled with water) we could record the dynamometer readings at different masses and with rope of different lengths. Dynamometer readings coincided with theoretical calculations by the formulas (72), (73) and (74).

Then we checked the validity of Newton doubtful gravitation theory. For this we substituted in the formulas (72), (73) and (74) instead of the first body mass $M_1 = 1.0197\, g$ in TGT, the second body mass $M_2 = 1.0197\, g$ in TGT and the third body mass $M_3 = 1.5296\, g$ in TGT, the so-called masses of the first body $M_1 = 1.0\, kg$ in SI, the second body $M_2 = 1.0\, kg$ in SI and the third body $M_3 = 1.5\, kg$ in SI according to the doubtful gravitation theory of Newton and the obtained results were absurd.

The results of our calculations of the force of gravitation between the Sun and the Earth as well as between the Earth and the Moon and also the experiment on determining centrifugal force with the help of a dynamometer, a rope, a bottle filled with water made it possible to formulate some conclusions.

If the centrifugal forces of the first body F_{1-1}, the second body F_{1-2} and the third body F_{1-3}, which were found with the help of the so-called first body mass $M_1 = 1.0\, kg$ in SI, the second body mass $M_2 = 1.0\, kg$ in SI and the third body mass $M_3 = 1.5\, kg$ in SI by formulas (72), (73) and (74) according to the doubtful gravitation theory of Newton in the right side of equation $G \times \frac{M_? \times M_?}{R_{1-2}^2} = \frac{M_2 \times V_2^2}{R_{1-2}}$ aren't confirmed experimentally with the help of dynamometer, then it means inaccuracy of the same so-called masses in the left side of the equation (Newton gravitation law) and Newton gravitation theory.

If the centrifugal force of the first body $F_{1-1} = 2509.98 \ {gcm}/{s^2}$, the centrifugal force of the second body $F_{1-2} = 3260.79 \ {gcm}/{s^2}$ and that of the third body $F_{1-3} = 6038.647 \ {gcm}/{s^2}$, that was determined with the help of the first body mass $M_1 = 1.0197\, g$ in TGT, the second body mass $M_2 = 1.0197\, g$ in TGT and the third body mass $M_3 = 1.5296\, g$ in TGT by the formulas (72), (73) and (74), according to TGT in the right side of the equation (23) are confirmed experimentally with help of dynamometer then it means the validity of the same masses in the left side of the equation (Tsiganok gravitation law) and Tsiganok gravitation theory (TGT).

Practical usage of the formula (4) was impossible due to lack of the methods of finding the second body mass M_2 since 1659. Practical usage of the formula (4) has become possible only after determining (finding) the second body mass M_2 with the help of formulas (1), (2) and (3) in the result of the creation of Tsiganok gravitation theory since 2005.

The second law of motion must be formulated in the form of the formula (4) according to TGT.

On the surface of two bodies (stars, planets, planetary satellites etc.) having the same weight and mass but different radii, the weight of the standard-copy of $1000.0 \ {gcm}/{s^2}$), for example, in TGT (1.0 kg in SI) will be different.

A body immersed in a liquid or a gas experiences the action of a repulsive force that may be found by formulas (1), (2), (3) and (4) on the surface of the Earth, the Sun, the Moon and other bodies. Physical nature and the method of determining the law of floating bodies in liquids and gases (Archimedes' principle) will be shown lather (in another work).

The so-called called gravitational mass and inertial mass are in fact one and the same force. It means, that the known experiments of Eötvös, Dicke, etc. on checking the so-called weak equivalence principle were not necessary [11].

The results of our research confirmed the high professionalism of Christiaan Huygens and its lack as far as Newton, Cavendish, Einstein, etc. are concerned.

5. Conclusions.

The investigations that were carried out showed that:

- Tsiganok gravitation law has been discovered; Tsiganok gravitation theory (TGT) and its mathematical apparatus have been elaborated;
- the definitions of body weight and body mass have been given;
- the weight and masses of the Earth, the Sun, the Moon and other bodies have been found;
- the gravity accelerations of the Earth, the Sun, the Moon and other bodies have been found;
- gravity acceleration constant of 1.0 g of body has been determined;
- Tsiganok gravitational constant has been found;
- temporary standard-copy of body weight and temporary standard-copy of body mass for Tsiganok measurement system have been elaborated;
- average density (specific gravity) of the Earth, the Sun, the Moon and other bodies has been defined;
- the parameters of bodies in various points of the Universe have been found;
- the statement that all the bodies in the state of weightlessness have weight has been proved;
- it has been proved that the so-called gravitational and inertial masses are one and the same masses;
- the Earth and the Moon and other bodies centrifugal forces have been found;
- the force of gravitation between the Sun and the Earth, the Earth and the Moon have been found;
- the second law formula of motion has been determined;
- the validity of centrifugal force formula has been confirmed theoretically and experimentally;
- the validity of Tsiganok gravitational law as well as Tsiganok gravitation theory (TGT) and its mathematical apparatus have been confirmed theoretically and experimentally.

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