

The Mechanism of Gravity is the Flow of Spacetime

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Introduction:

The advice given by scientists on creating a new hypothesis on gravity is to first propose quantum properties and then compare the predictions of the proposed quantum properties to observations at different cosmological scales. It probably will be impossible to ever directly observe one interaction of a graviton with matter, due to the extremely weak interaction energy. Therefore, we need to observe the results of proposed quantum interactions at much larger scales, such as gravity on a galactic scale.

This paper makes six assumptions of quantum interactions and the nature of the gravitational quantum field. It then states expected observational properties at scales of the Universe and at scales of galaxies, such as the recession of galaxy clusters and the flat rotation curves of stars in galaxies. The mechanics of the proposed flow gravity will be discussed in text, by diagrams and with mathematics. Its predictions will be compared to known cosmological observations. It turns out that gravity is not a pull, but a push. **Gravity is a flow of spacetime.**

(The next paper will describe an experiment to determine whether or not gravity is a pull or a push.)

Main Paper:

Section 1 How does Flow gravity fit into other theories of gravity

Newton's gravity has no mechanism, but it has simple and tested equations which are valid at the scale of the solar system. Modified Newtonian Dynamics, MOND, describes gravity in the weak field regime, but does not propose a gravitational mechanism. General Relativity describes gravity as spacetime curvature. It reframes gravity not as a force, as Newton did, but as a consequence of mass and energy warping the fabric of four dimensional spacetime. General Relativity is an extension of Special Relativity and incorporates acceleration. General Relativity is essential in explaining gravity in strong gravitational fields, like those near black holes.

Flow gravity posits that the warping is due to increased flowrate of spacetime into massive objects. Flow gravity and MOND are alternate gravitational hypotheses to Dark Matter. Flow gravity does not replace **the mathematics** of Newtonian gravity, MOND, Special Relativity, or General Relativity. The mathematics of GR is very complex, maybe simpler equations can be invented by using Navier-Stokes equations. Also, General Relativity does not predict the flat rotation curve of outer stars in spiral galaxies.

MOND is necessary to explain the orbital speeds of stars in spiral galaxies. Flow gravity is necessary to give a physical basis for the strong gravitational regime and the weak gravitational regime. The strong gravitational regime exists within the solar system due to strong flow of spacetime toward and into a sun. The weak gravitational regime exists due to the much weaker flow of spacetime into our galaxy.

General Relativity, GR, remains the overwhelmingly accepted theory of gravity. GR requires the existence of dark matter and dark energy to explain discrepancies between gravitational effects and the distribution of visible matter. The problem is that dark matter has not been found. In GR, the warping of spacetime is described as due to the presence of mass and energy. This curvature dictates that objects follow geodesic paths. These paths can also be described by flow gravity.

Tensor-Vector-Scalar gravity, TeVeS, modifies the law of gravity itself to achieve a better fit with observations on galactic scales. TeVeS was specifically developed by Jacob Bekenstein as a relativistic generalization of MOND without dark matter. TeVeS proposes multiple fields: a metric tensor, a vector field and a scalar field. Flow gravity fits into MOND and TeVeS by proposing the flow of spacetime as a simple mechanism of gravity.

The need for dark matter was created by the misapplication of Newton's equation of "universal" gravitation at the scales of a galaxy. This inverse square law reduces the force of gravity at galactic scales too much. When gravity is "measured" by the rotation curves of galactic stars, different mathematics was needed and Modified Newtonian Dynamics was proposed. As stated before, Flow gravity gives a gravitational mechanism for both MOND and Newtonian gravity. Since gravity is a varying flow of spacetime, it adapts to all distance scales.

Section 2 Quantum Properties [1]

Properties of spacetime at the quantum level are proposed below, just as Newton first defined space, time, inertia, force, action-reaction, and gravity on the solar system scale.

Quantum Property 1: Spacetime is digital and consists of incredibly small particles. In Loop Quantum Gravity theory they are called spin networks. [2] They are close to Planck's length; 1.6×10^{-35} m. **Space pixels** is the name we gave in this paper.

Quantum Property 2: Spacetime is constantly being created in the vast voids of the Universe, where gravitons interact with neutrinos to create space pixels. The temperature of

spacetime is cold enough for neutrinos and gravitons to interact. Eighty percent of the Universe consists of empty voids. Ref. [3]

Quantum Property 3: Spacetime is constantly being absorbed inside stars, planets, black holes, and by gases. When space pixels are absorbed by baryons, gravitons are created and emitted. Inside stars the temperature of spacetime is much too hot for gravitons and neutrinos to interact.

Quantum Property 4: Spacetime flows from the vast reaches of the cosmos, where space pixels are being created, into galaxies, where space pixels are being absorbed within stars, black holes, and planets.

Quantum Property 5: Spacetime is incompressible at low speeds, such as in most locations in the Milky Way galaxy. At speeds nearing the speed of light, spacetime is compressible, as when flowing into neutron stars and black holes.

Quantum Property 6: Neutrinos are created within stars, by various nuclear reactions, such as when two protons form deuterium, a positron, and a neutrino.

The above quantum properties cannot be observed directly, but their cumulative effects can be observed at the scale of the solar system, by observing the speeds of the galactic stars, and by observing the expansion of the universe.

What was the logic in proposing that gravitons, neutrinos, and photons interact to create space pixels in the expansive voids? What is in the voids? Spacetime, gravitons, neutrinos, and photons. What is happening in the voids? They are expanding. Can this interaction be ever experimentally duplicated? Probably never. But the cumulative effect of these interactions can be observed by galaxy superclusters moving away from us, with the speed of recession being directly proportional to its distance, a relationship quantified by the Hubble constant.

What was the logic in proposing that spacetime is absorbed in galaxies? Matter is being kept together in galaxies. If spacetime is somehow lost or absorbed inside galaxies, then matter will tend to be kept together. What could cause this continuously? Spacetime is being absorbed inside stars and gravitons are being emitted.

The idea that space pixels are being created and absorbed is not unlikely. For example, photons are created when an electron transitions to a lower energy level within an atom, releasing energy in the form of a photon. Photons are absorbed when an electron absorbs energy and transitions to a higher energy level.

Section 3 Observable Properties: [1]

Observable Property #1: Expansion of the Universe. Since space pixels are being created in the vast reaches of the voids, the relative distances between different galactic clusters are increasing, as measured by the Hubble constant. The galactic clusters are displaced; they are receding from us and are accelerating away from each other.

Observable Property #2: The flow of spacetime will actually move stars and planets. The inflowing of spacetime into solar systems and galaxies will offset linear momentum of stars, effectively create centripetal acceleration and keep stars and planets in their circular or elliptical orbits, this mechanism has been called scaffolding. The flow of spacetime will move adjacent celestial objects relative to other celestial objects. The flow of spacetime will drag gas molecules along. Please look at diagram: Figure 2 Maintaining of Sun's Orbit by Inflowing Spacetime.

Observable Property #3: The bending of starlight near the surface of a sun is due to the high rate of flow of spacetime into a sun.

Observable Property #4: The flow of spacetime is in a constant flux and will quickly adjust to the changing relative positions of stars.

Observable Property #5: The flow of spacetime is without limit in distance since it flows in from intergalactic spacetime. The equation of Newtonian gravity, is very limited in its effect at galactic scales and larger.

Observable Property #6: Gravity at recombination: spacetime was flowing in channels from slightly less dense regions to slightly denser regions. This flow of spacetime dragged gas molecules along. **Galaxy filaments in the very large-scale structure of the universe may be evidence of flows of spacetime during the very early clumping of matter.**

It is posited here, that the flow of spacetime is the most fundamental mechanism of gravity.

There are three kinds of gravity, each predominant at increasingly larger cosmological scales: Newtonian gravity, Flow gravity, and Negative gravity.

Section 4 Newtonian gravity

Newton's gravity is predominant at scales less than ½ light year. Newton's equations correctly predict the orbits of the planets and satellites. Spacetime is being absorbed within the Sun resulting in spacetime flowing into the Sun. A planet's orbit is maintained by spacetime flowing towards the sun. Spacetime is also flowing into the planet, replacing spacetime lost within the planet. The planet is being pushed by spacetime flowing towards the sun and is thereby creating centripetal acceleration to maintain its orbit. We call this **Newtonian gravity. Here M_r is the proposed property of matter of being able to absorb spacetime.**

The formula for orbital velocity of a planet is:
$$v = \sqrt{\frac{GM_r}{r}} \quad [4] \quad (1)$$

99.83% of all the mass of the solar system is located in the Sun. [5] Since the mass is concentrated in the Sun which is at the center of the solar system and since even the mass of Jupiter is only a very small percentage of the mass of the solar system, it can be seen that the orbital speeds of the planets vary inversely as the square root of the distance from the Sun.

Since GM_r is a constant, the result are lower orbital speeds of planets further away from the sun. The vast mass of the Sun overwhelmingly determines the flow of spacetime in a solar system with only one sun. (The flow of spacetime in a binary star system is quite different and much more complex.)

Calculations of spacetime flowing towards our Sun at the radius of the Earth's orbit:

Orbital velocity of Earth around the Sun; $v = 107,000 \text{ km/hour} = 29.7 \text{ km/s}$ [6]

Distance of Earth from Sun; $r = 149.6 \times 10^6 \text{ km}$ [6]

$\Delta t = 1 \text{ day} = 24 \text{ hours} \times 3,600 \text{ sec} = 86,400 \text{ sec}$

Orbital period of Earth; $P = 365.25 \text{ days}$

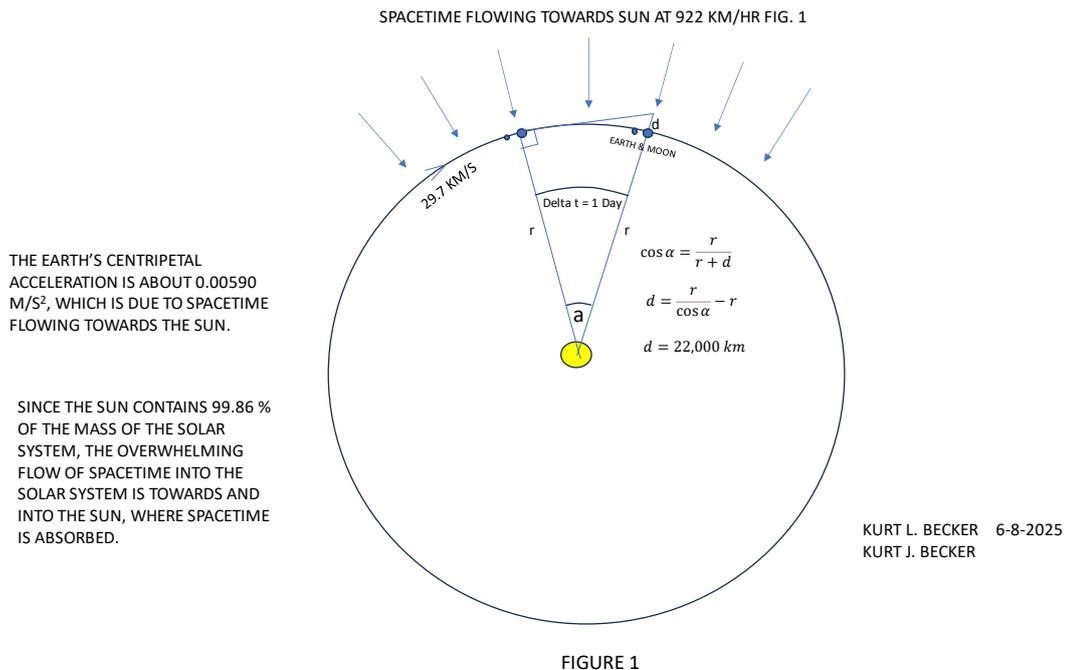
$\Delta\alpha = (2\pi \text{ radians} \times 1 \text{ day}) / (365.25 \text{ days}) = 0.01720 \text{ radians}$

$\cos \alpha = \cos 0.01720 = 0.99985208$

$\Delta d = (r / \cos \alpha) - r = (149.6 \times 10^6 \text{ km} / 0.99985208) - 149.6 \times 10^6 \text{ km} =$
 $0.0221316 \times 10^6 \text{ km} = 22.13 \times 10^6 \text{ m}$

$v_{IN} = \Delta d / \Delta t = 22.13 \times 10^6 \text{ m} / 86,400 \text{ sec} = 256.1 \text{ m/s} =$

$256.1 \text{ m/s} \times 3600 \text{ s/hr} / 1000 \text{ m/km} = 922 \text{ km/hr.}$



Section 5 Flow Gravity

Gravity of the second kind: Gravity on a galactic scale is currently believed to be due to the gravitational effects of dark matter. In this paper, the second kind of gravity is believed to be due to spacetime flowing into galaxies, and is therefore called **Flow gravity**. It is predominant at the cosmological scale of the Milky Way galaxy and galaxy clusters. Modified Newtonian Dynamics is an alternate hypothesis, which correctly predicts many of the gravitational effects in the Milky Way galaxy. Ref. [7]

Flow Gravity replaces spacetime that is being absorbed by stars and black holes. As stated in observable properties #2, and #4. The effects of gravity ascribed to dark matter is actually the effects of the flow of spacetime into a galaxy. There is no missing baryonic matter. The flow of spacetime into a galaxy will hold the stars of a galaxy together and it will create a scaffold for faster orbital velocities of its stars.

Flow gravity is interstellar gravity, at distances above 1 light year between stars.

This is unlike planets in the solar system where planets further away from the Sun have lower velocities than planets closer to the Sun. This is due to the different mass distribution in a galaxy versus in the solar system.

Please look again at **FIGURE 2: Maintaining of Sun's Orbit by Inflowing Spacetime.**

$$d = \frac{r}{\cos \alpha} - r \quad (2)$$

d = displacement during time Δt

r = radius of star from center of galaxy

angle α = angle star moved during Δt

If a star acquires additional velocity, through a nearby Newtonian gravitational interaction with another star, it will move to a higher orbit with a higher velocity. This new orbit will be maintained by the higher flowrate of spacetime coming into the galaxy. A star with lower velocity will descend until its centripetal acceleration is balanced by the lower flowrate of spacetime at that orbit.

The orbital velocity of stars in a galaxy is related to the rate of flow of spacetime into a galaxy.

Mass in a galaxy is distributed in a huge number of stars and some black holes, about 200 billion stars in the Milky Way galaxy. Spacetime flows in to replace spacetime absorbed. The inflow of spacetime is somewhat higher at larger distances from the galactic center since less spacetime has yet been replaced. As spacetime flows further into a galaxy, due to volume decreasing inversely as the square of the distance to the galactic center, the velocity of the inflow will increase, but at the same time will decrease as spacetime is being absorbed within stars.

Please refer to the diagram below Fig. 2 "Maintaining of Sun's orbit by inflowing spacetime". Since data is available for our Sun, the calculations below refer to the orbital

displacement of our Sun and the velocity of inflowing spacetime at the orbital radius of our Sun.

Data used is from Our Sun: Facts: NASA Science [5]

A rather large time frame had to be chosen to get a cosine of at least three significant ending digits. (The T-84 calculator has 10 significant digits. [9])

$$\Delta t = 10,000 \text{ years} = 10,000 \times 365 \times 24 \times 3,600 = 3.154 \times 10^{11} \text{ seconds}$$

$$\Delta \alpha = (2\pi \text{ radians} \times 10,000 \text{ years}) / (260,000,000 \text{ years}) = (2\pi \times 10^4) / (2.6 \times 10^8) = 2.417 \times 10^{-4} \text{ radians} = 0.0002417 \text{ radians}$$

Orbital period of our Sun = 260 million years averaged

$$\cos(0.0002417) = 0.9999999708$$

r = Sun's galactic orbit = about 26,000 light years from center of galaxy

$$r = 26,000 \text{ ly} \times 9.461 \times 10^{15} \text{ m} = 2.46 \times 10^{20} \text{ m}$$

The Sun's mean distance from the galactic center is 24,000 to 28,000 light years. Its galactic orbit is probably not a circle, probably more complex than an ellipse. [5]

$$\Delta d = (r / \cos \alpha) - r = (2.46 \times 10^{20} / 0.9999999708) - (2.46 \times 10^{20}) = 7.18 \times 10^{12} \text{ m radially inward}$$

$$V_{\text{IN}} = \Delta d / \Delta t = 7.18 \times 10^{12} \text{ m} / 3.154 \times 10^{11} \text{ s} = 22.76 \text{ m/s} = \mathbf{81.95 \text{ km / hour}}$$

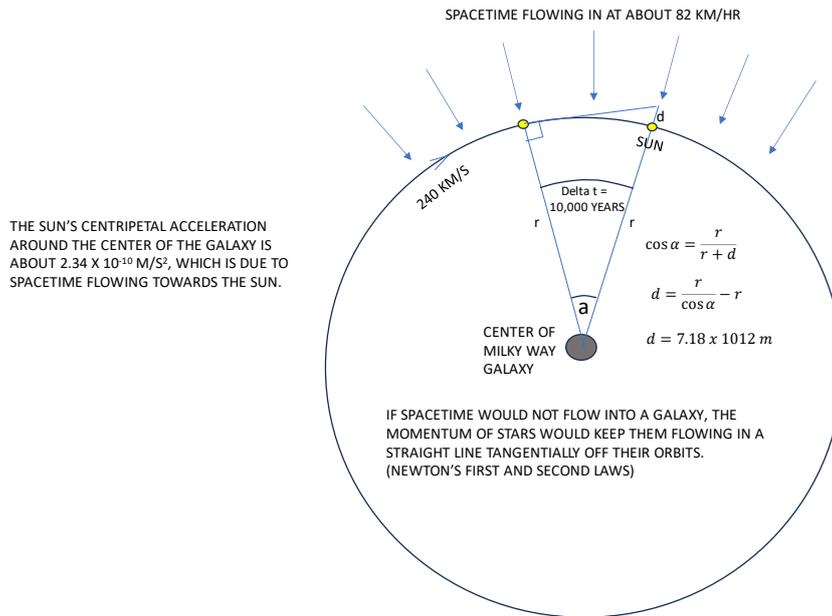
The predominant centripetal acceleration of stars in the Milky Way galaxy is due to the radial velocity of spacetime flowing into the galaxy. Its value is about 82 km/s for our Sun, at a radial distance of 2.46×10^{17} km from the center of the galaxy.

Using equation $a_c = v^2 / r$ to find the centripetal acceleration of our Sun around the center of the Milky Way galaxy:

$$a_c = v^2 / r \\ = (2.40 \times 10^5 \text{ m/s})^2 / (2.46 \times 10^{20} \text{ m})$$

$$a_c = 2.34 \times 10^{-10} \text{ m/s}^2 = 81.94 \text{ km/hour}$$

$a_c = 2.34 \times 10^{-10} \text{ m/s}^2$ is equivalent to spacetime flowing in at 22.76 m/s or 82 km/hr.



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MAINTAINING OF SUN'S ORBIT BY INFLOWING SPACETIME
FIGURE 2

How can the flow patterns of Newtonian gravity and Flow gravity coexist in a galaxy? Is there any observed flow pattern that is partially analogous to flows within flows? Eddies form in rivers when the main flow is disrupted by an obstacle, like a rock or a bend in the riverbank, causing a swirling circular current in the area behind the obstruction. This occurs because the obstruction creates a space devoid of downstream flow, and water tries to fill this void, resulting in a recirculating eddy. The analogy here is that the interstellar flow of spacetime is the river, and the stars are the obstructions, where the absorption of spacetime occurs.

Modified Newtonian Dynamics (MOND) can be explained by the displacement of a star by the interstellar flow of spacetime at least 2 light year away from any other star. Calculated by the authors, $9.81 \times 10^{-16} \text{ m/s}^2$ is the acceleration due to gravity between Alpha Centaury star system and our Sun. Compare this value to a_0 of $1.2 \times 10^{-10} \text{ m/s}^2$, estimated by M. Milgrom, author of Modified Newtonian Dynamics. The interstellar spacetime is in the low gravity environment, as required by MOND. [10]

Section 6 Negative Gravity

Gravity of the third kind: The expansion of the universe due to dark energy at the scales of megaparsecs (1 megaparsec equals 3.26 million light years). We will be calling it **Negative gravity**. Hubble-Lemaitre law states that the further a galaxy supercluster is away from us the faster it is moving away, with the speed of recession being directly proportional to its distance, a relation quantified by the Hubble constant. [11]

Is the expansion of the universe violating the law of conservation of energy? When the creation and absorption of spacetime is taken into account, energy may be conserved. The law of conservation of energy is also known as the first law of thermodynamics which is a cornerstone of physics. Noether's first theorem links conservation of energy to the symmetry of time translation in the universe. [12]

Section 7 Moon's Orbit

Calculating the speed of spacetime flowing into the Earth at the distance of the Moon's orbit: Please refer to **FIGURE 3** and [13] Barycenter of Earth and Moon

$r_1 = 4,671$ km from Earth's center [13]

$r = 384,400$ km distance of Earth to Moon [14]

$r = r_1 + r_2$ $r_2 = r - r_1 = 384,400 \text{ km} - 4,671 \text{ km} = 379,729 \text{ km}$

r_2 is the distance of center of Moon to common barycenter

$P = 27.3$ Earth days; sidereal month [14]

$\alpha = 2\pi \text{ rad} \times 0.5 \text{ day} / 27.3 \text{ days} = 0.11508 \text{ rad}$

$\Delta t = 0.5\text{-day} \times 24 \text{ hours/day} \times 3600 \text{ sec/hour} = 43,200 \text{ sec}$

$\text{Cos}(0.11508 \text{ rad}) = 0.993386$

$$\begin{aligned} \Delta d &= \frac{r_2}{\cos \alpha} - r_2 & (2) \\ &= 3.7973 \times 10^8 \text{ m} / 0.99339 - 3.7973 \times 10^8 \text{ m} \\ &= 3.82257 \times 10^8 \text{ m} - 3.7973 \times 10^8 \text{ m} \\ &= 0.02527 \times 10^8 \text{ m} \end{aligned}$$

$$\begin{aligned} v_{IN} &= \frac{\Delta d}{\Delta t} & (3) \\ &= 2.527 \times 10^6 \text{ m} / 4.32 \times 10^4 \text{ sec} \\ &= 0.5849 \times 10^2 \text{ m/s} \\ &= 58.49 \text{ m/s} \times 3,600 \text{ s/hr} / 1000 \text{ m/km} \\ &= 210.6 \text{ km/hr} \end{aligned}$$

$$\frac{V_{IN} \text{ at the Sun's surface}}{V_{IN} \text{ at radius of Earth's orbit}} = \frac{4\pi \times r^2 \text{ radius at Earth's orbit}}{4\pi \times r^2 \text{ radius of Sun}}$$

$$\frac{V_{IN} \text{ at the Sun's surface}}{256.1 \text{ m/s}} = \frac{(1.496 \times 10^{11} \text{ m})^2}{(6.963 \times 10^8 \text{ m})^2}$$

$$V_{IN} \text{ at the Sun's surface} = 11.82 \times 10^6 \text{ m/s}$$

This is surprisingly large, compared to $c = 3.00 \times 10^8 \text{ m/s} = 300 \times 10^6 \text{ m/s}$

A neutron star typically has a mass ranging from 1.25 to 2 times the mass of the Sun and a radius of about 10 to 15 kilometers. [16]

$$V_{IN} \text{ towards at neutron star at the radius of the Sun} = 1.5 \times 11.82 \times 10^6 \text{ m/s} = 17.73 \times 10^6 \text{ m/s}$$

$$\frac{=V_{IN} \text{ towards a neutron star at the radius of the Sun}}{V_{IN} \text{ towards neutron star when } V_{in} \text{ approaches } c} = \frac{4\pi \times r^2 \text{ at radius of } c}{4\pi \times r^2 \text{ at radius of Sun}}$$

$$\frac{17.73 \times 10^6 \text{ m/s}}{3.00 \times 10^8 \text{ m/s}} = \frac{r^2 \text{ at radius of } c}{(6.963 \times 10^8 \text{ m})^2}$$

At $1.693 \times 10^8 \text{ m/s}$ V_{IN} for a neutron star will approach the speed of light. This is far away from the neutron star's surface. Now calculations of momentum will require the Lorents factor gamma. [17] Assuming $v = 0.9999 c$

$$p = \gamma m v$$

$$p = \frac{m v}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$m = \frac{E}{c^2}$$

$$p = \frac{\frac{E}{c^2} (0.9999)}{\sqrt{1 - \frac{0.9999^2}{1}}}$$

$$p = 70.71 E/c^2 \text{ kg-m/s}$$

Momentum of spacetime at neutron star's surface is 71 times its rest mass.

Section 9 Motion of a Comet

Vectors of a highly elliptical orbit of a comet in the Solar System:

Please refer to **FIGURE 4**. Highly Elliptical Orbit of a Comet

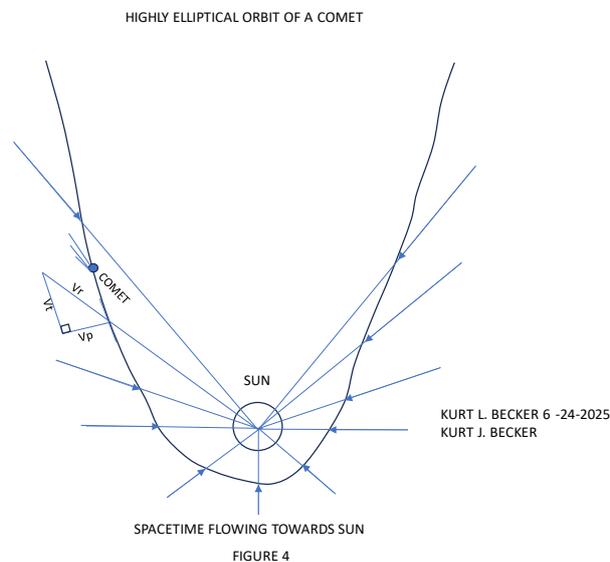
V_R = velocity vector of spacetime flowing radially towards the Sun

V_T = Tangential component of V_R to orbital path

V_P = Perpendicular component to V_T to orbital path

It can be seen that the inflowing spacetime will not only displace the comet's orbit but also increase / decrease its velocity. This also applies to planets in slightly elliptical orbits.

Heavenly bodies can move in circles, ellipses, hyperbolas, and parabolas. Probably, ellipses are the most common.



Section 10 Rotation Curve of Stars in a Galaxy

The flow of spacetime into a galaxy supports the structure of a galaxy and the orbital velocities of stars within it. It is not short-range Newtonian gravity. If spacetime would not flow into a galaxy, the linear momentum of stars would keep them moving in a straight line tangentially off their orbits. Stars would fly off into spacetime, with the galaxy eventually disappearing. But with spacetime flowing into a galaxy, the flow will keep offsetting inertia and thereby keeping stars, in their orbits.

The rotation curve of the Milky Way galaxy, a plot of orbital speeds versus distance from the galactic center, reveals a significant discrepancy between the predicted and the observed speeds, particularly at larger distances. Instead of decreasing with distance as expected, based on Newtonian gravity, the outer rotation curve remains relatively constant, forming what is called “a flat rotation curve”. That is, the orbital speeds of the outer stars stay roughly constant as distance from the galactic center decreases.

Here is an analysis of orbital speeds of stars in the Milky Way galaxy: Spacetime is flowing into the galaxy to replace spacetime being absorbed within it. Please refer to ratio (4). As spacetime flows in, the area A decreases as $1/4\pi r^2$, and the velocities must increase with smaller radii if spacetime is largely incompressible. However, some spacetime will replace the spacetime being absorbed within stars or gases within that shell. M_r is the remaining mass within radius r . **Here, the property of matter to absorb spacetime is being measured, not the Newtonian property of gravitational acceleration.**

$$v_{IN} \propto \frac{M_r}{A} = \frac{M_r}{4\pi r^2} \quad (4)$$

v_{in} , the velocity of spacetime flowing in, is proportional to the remaining mass within r and inversely proportional to the spherical area at r . v_{in} supports the orbital velocities of stars in galaxies, as shown in FIGURE 2.

At the outer regions of a galaxy, gases and stars are less dense than at the inner regions, In the outer regions, if M_r proportionally decreases as r , then the velocities of orbits of the outer stars will remain the same, resulting in a flat rotation curve.

$$a_c = \frac{v^2}{r} \quad (5)$$

$$\sqrt{a_c \cdot r} = v \quad (6)$$

$$a_c \propto v_{IN} \quad (7)$$

Equation (7) states that a_c , the centripetal acceleration of a star, is proportional to v_{IN} , the flow of spacetime towards that star. The flow of spacetime towards a star is the continuous offsetting force that bends the path of a star. It is not Newtonian attraction. **Gravity is a push, not a pull.**

Numerically it can be shown, if at the outer stars-region, M_r , the remaining mass within r , decreases by 10%, as the radius decreases by 10%, then the orbital velocity will remain the same.

$$M_R \cdot 0.90 / 4\pi \cdot (0.90 r)^2 = 0.90 M_R / 4\pi \cdot 0.81 r^2 = (0.90/0.81) \cdot (M_R / 4\pi r^2) = (10/9) \cdot (M_R / 4\pi r^2)$$

The change in v_{IN} is 1.111111 or 10/9. A change v_{IN} is proportional to a change in a_c .

$\sqrt{a_c \cdot r} = v$ Square root of product $(10/9 \cdot 9/10) = 1.0000$. This shows numerically that **an equal change in the remaining mass, M_R , and in the radius, r , will result in no change in**

v, the orbital speed of a star in a galaxy. This explains the flat rotation curves of the outer stars and gases.

Now, let's examine what will happen in an inner-stars region, where the density of stars is higher. For example, M_R decreases by 0.30% as the radius decreases by 10%. $M_R * 0.70 / 4\pi * (0.90 r)^2 = 0.70 M_R / 4\pi * 0.81 r^2 = (0.70/0.81) * (M_R / 4\pi r^2) = (0.8642) * (M_R / 4\pi r^2)$ The change in v_{IN} is close to 0.8642. A change v_{IN} is proportional to a change in a_c . $\sqrt{a_c \cdot r} = v$ Square root of product $(0.8642 * 0.90) = 0.77778$. This shows numerically that **a larger change, 30%, in the remaining mass, M_R , and with an equal change, 10%, in radius, r , will result in a smaller v, the orbital speed of a star in a galaxy. This explains the lower orbital speeds of the inner stars.**

Orbital speeds of stars in the Milky Way galaxy depend on mass distribution.

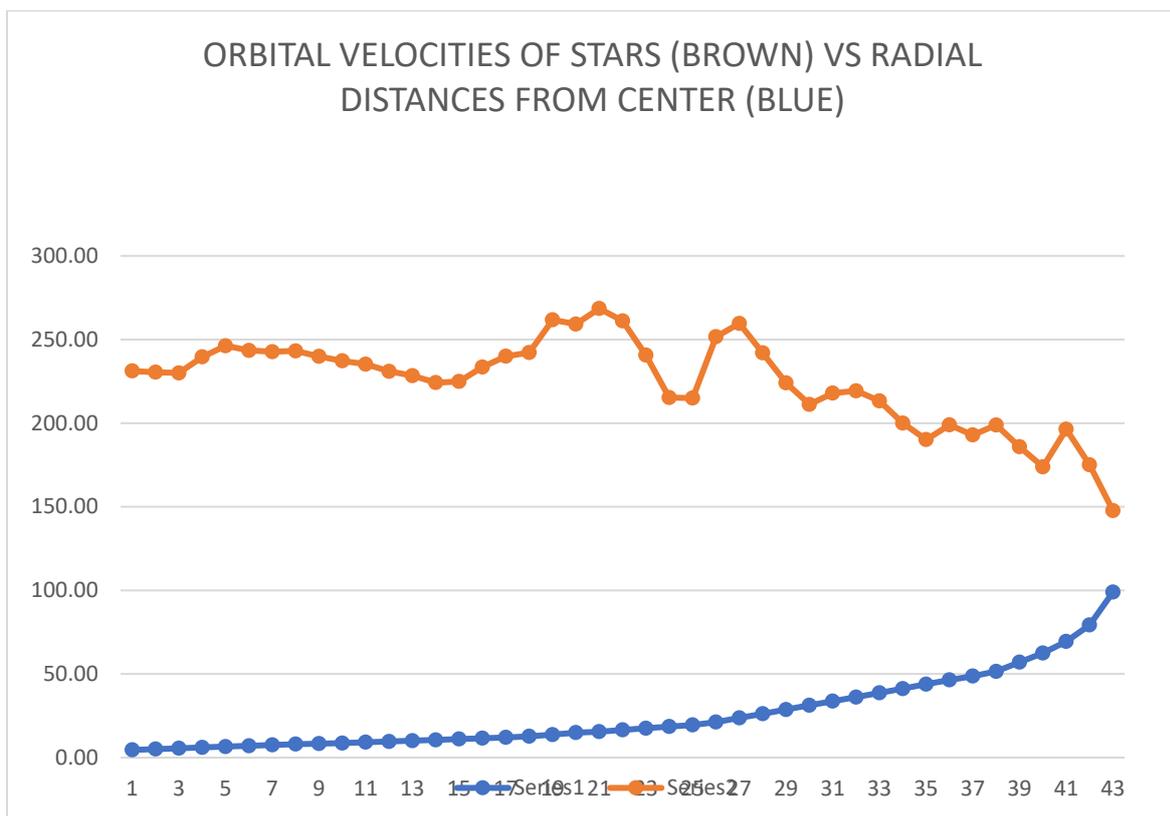
$$v = \sqrt{\frac{GM_r}{r}}$$

The above equation shows that orbital velocity depends on the square root of the ratio of the mass within radius r divided by radius r . What is different in the Milky Way galaxy than in the solar system? The mass in the galaxy is widely distributed in the stars of the galactic disk and the central bulge. Therefore, if the ratio of $\frac{GM_r}{r}$ remains the same as the radius changes, then the velocity will stay the same. If the remaining mass decreases at a faster rate than the radius, then the orbital velocity will decrease. If the remaining mass decreases at a slower rate than the radius, then the orbital velocity will increase.

All three kinds of gravity exist within the Milky Way galaxy, but at galactic scales, the predominant kind is Flow gravity. At scales less than about $\frac{1}{2}$ a light year Newtonian gravity is dominant. Negative gravity is also created within a galaxy, but it is overwhelmed by the absorption of pixels within the billions of stars.

	FORMULA USED	RADIUS R FROM CENTER OF GALAXY IN KPC	V _c ORBITAL VELOCITY OF STARS AT RADIUS R IN KM/S	SIGMA OF V _c IN KM/S	TRACER	ESTIMATE (BY AUTHORS) OF MASS WITHIN RADIUS R IN BILLION SOLAR MASSES	SPHERICAL BASE AREA R ² OF CONE IN SQUARE METERS	MASS WITHIN RADIUS R IN KG	RATIO OF MASS WITHIN RADIUS R TO BASE AREA OF CONE AT R (PROPORTIONAL TO V _{IN})
						(B4*3.086*10 ¹⁹) ²	F4*1.989*10 ³⁰ *10 ⁹	H4/G4	
BULGE RADIUS		3.00				23.00			
		4.60	231.24	7.00	HI	36.00	2.0152E+40	7.1604E+40	3.5533E+00
		5.08	230.46	7.00	HI	36.81	2.4576E+40		2.9791E+00
		5.58	230.01	7.00	HI	37.62	2.9652E+40	7.4826E+40	2.5234E+00
		6.10	239.61	7.00	HI	38.44	3.5437E+40	7.6457E+40	2.1576E+00
		6.57	246.27	7.00	HI	39.26	4.1108E+40	7.8088E+40	1.8996E+00
		7.07	243.49	7.00	HI	40.07	4.7603E+40	7.9699E+40	1.6743E+00
		7.58	242.71	7.00	HI	40.88	5.4718E+40	8.1310E+40	1.4860E+00
		8.04	243.23	7.00	HI	41.70	6.1561E+40	8.2941E+40	1.3473E+00
SUN'S ORBIT		8.34	239.89	5.92	PCRG	42.50	6.6241E+40	8.4533E+40	1.2761E+00
		8.65	237.26	6.29	PCRG	43.20	7.1256E+40	8.5925E+40	1.2059E+00
		9.20	235.30	5.60	PCRG	43.90	8.0606E+40	8.7317E+40	1.0833E+00
		9.62	230.99	5.49	PCRG	44.60	8.8134E+40	8.8709E+40	1.0065E+00
		10.09	228.41	5.62	PCRG	45.30	9.6956E+40	9.0102E+40	9.2931E-01
		10.58	224.26	5.87	PCRG	46.43	1.0660E+41	9.2349E+40	8.6630E-01
		11.09	224.94	7.02	PCRG	47.03	1.1713E+41	9.3543E+40	7.9865E-01
		11.58	233.57	7.65	PCRG	47.63	1.2771E+41	9.4736E+40	7.4183E-01
		12.07	240.02	6.17	PCRG	48.23	1.3874E+41	9.5929E+40	6.9143E-01
		12.73	242.21	8.64	PCRG	48.83	1.5433E+41	9.7123E+40	6.2932E-01
		13.72	261.78	14.89	PCRG	49.43	1.7927E+41	9.8316E+40	5.4844E-01
PEAK		14.95	259.26	30.84	PCRG	50.03	2.1285E+41	9.9510E+40	4.6751E-01
		15.52	268.57	49.67	HKG	50.63	2.2939E+41	1.0070E+41	4.3900E-01
		16.55	261.17	50.91	HKG	51.23	2.6085E+41	1.0190E+41	3.9064E-01
	17.56	240.66	49.91	HKG	51.73	2.9366E+41	1.0289E+41	3.5038E-01	

	18.54	215.31	24.80	HKG	52.23	3.2735E+41	1.0389E+41	3.1735E-01
	19.50	214.99	24.42	HKG	52.73	3.6213E+41	1.0488E+41	2.8962E-01
	21.25	251.68	19.50	HKG	53.23	4.3004E+41	1.0587E+41	2.4620E-01
PEAK	23.78	259.65	19.62	HKG	53.73	5.3854E+41	1.0687E+41	1.9844E-01
	26.22	242.02	18.66	HKG	54.13	6.5472E+41	1.0766E+41	1.6444E-01
	28.71	224.11	16.97	HKG	54.43	7.8498E+41	1.0826E+41	1.3792E-01
	31.29	211.20	16.43	HKG	54.83	9.3240E+41	1.0906E+41	1.1696E-01
	33.73	217.93	17.66	HKG	55.23	1.0835E+42	1.0985E+41	1.0139E-01
	36.19	219.33	18.44	HKG	55.63	1.2473E+42	1.1065E+41	8.8710E-02
	38.73	213.31	17.29	HKG	56.03	1.4285E+42	1.1144E+41	7.8013E-02
	41.25	200.05	17.72	HKG	56.43	1.6205E+42	1.1224E+41	6.9264E-02
	43.93	190.15	18.65	HKG	56.83	1.8379E+42	1.1303E+41	6.1503E-02
	46.43	198.95	20.70	HKG	57.23	2.0530E+42	1.1383E+41	5.5446E-02
	48.71	192.91	19.24	HKG	57.63	2.2596E+42	1.1463E+41	5.0729E-02
PEAK	51.56	198.90	21.74	HKG	58.03	2.5317E+42	1.1542E+41	4.5590E-02
	57.03	185.88	21.56	HKG	58.43	3.0974E+42	1.1622E+41	3.7521E-02
	62.55	173.89	22.87	HKG	58.83	3.7260E+42	1.1701E+41	3.1404E-02
	69.47	196.36	25.89	HKG	59.23	4.5961E+42	1.1781E+41	2.5632E-02
	79.27	175.05	22.71	HKG	59.63	5.9842E+42	1.1860E+41	1.9819E-02
OUTER STARS	98.97	147.72	23.55	HKG	60.00	9.3282E+42	1.1934E+41	1.2793E-02



Section 11 Gravity on Earth's surface

How can the weight of a person standing on the Earth be explained by the mechanism of flow gravity? The simplest explanation is that the flow of spacetime into the Earth pushes the person to the floor.

Using the model of a satellite orbiting the Earth at 1 meter above the Earth's surface and neglecting the resistance of air, a person would need to travel at 28,472 km/hour. Living at 36 degrees latitude, the speed due to the Earth's rotation is about 1,350 km/hour. It can be seen that the person will remain solidly standing on the Earth.

Section 12 v_{in} and Shapes of Orbits

In a circular orbit, the centripetal momentum vector, v_{in} , is exactly balanced to maintain the circular orbit. It will change the direction of the orbital momentum, but will not change its speed.

In an elliptical orbit, the flow of spacetime, v_{in} , is not perpendicular to the orbital velocity of a planet or star, except at two points: the apoapsis and periapsis.

In an elliptical orbit, the linear momentum changes in both magnitude and direction, due to the changes of v_{in} relative to the path of the elliptical orbit. On one side of the ellipse, along the major axis, the orbital velocity increases and on the other side it decreases. (The planet Jupiter very slightly distorts the flow of spacetime towards Mars and Earth contributing to their elliptic orbits.) Please look at Figure 4 showing part of the elliptical orbit of a comet.

Section 13 Why are all large celestial objects spherical in shape?

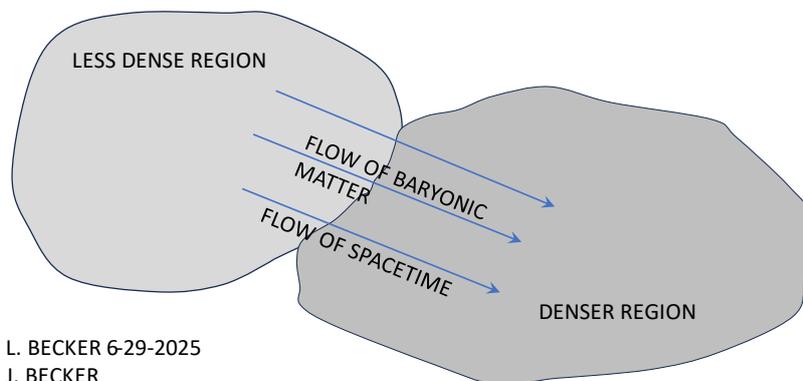
The sun, planets, gas giants, and large moons are all spherical in shape. Spacetime is constantly flowing into these objects, but at the same time spacetime is constantly being absorbed when gravitons are quickly interchanged between the closely packed particles of matter within these dense objects. Dynamically, the action of absorption of spacetime within suns and planets outpaces the inflowing spacetime.

Please refer to proposed quantum property 3 at the beginning of this paper. As spacetime pixels are constantly being removed between atoms, the atoms will be pushed together more closely. Pushing atoms together will result in a sphere, since a sphere is the shape that has the smallest ratio of surface area to volume. [18] A sphere minimizes the potential energy for a given volume. [19] Especially for suns and gas giants, no permanent surface protrusions will result. Since the sun and gas giants are rotating, their shapes are slightly oblate spheroids. On rocky planets, some limited-in-height mountains will remain, but overall, the shape of planets is spherical.

Section 14 Clumping of Matter after Recombination

Does Newton's Law of Universal Law of Gravitation correctly predict the rate of clumping of matter after recombination? (after year 380,000) The effect of Newton's gravity rapidly decreases with distance. Newton's equation does not correctly predict gravity at larger scales, such as at a galactic scale or on the scale of the universe.

Flow gravity is not limited by distance. Before recombination, the universe was not perfectly uniform. Tiny temperature fluctuations existed due to quantum mechanics. The temperatures and densities of gases after recombination were also not perfectly uniform. If the model of flow gravity is applied to the gases after recombination, slightly more space pixels were absorbed in slightly denser volumes than in slightly less dense volumes. Space pixels will flow into the denser volumes, while dragging along gas molecules. This will make dense volumes denser, increasing the absorption of space pixels leading to increase flow of spacetime into denser volumes. **There is no distance limit to this flow. Please look at Figure 5**



FLOW OF GASES AFTER RECOMBINATION

FIGURE 5

What the rate of creation of pixels of spacetime was at the time of recombination is unknown, probably low since no neutrinos were being created since no stars existed at the beginning of that epoch.

The first stars, known as Population III stars, are theorized to have been extremely massive, hot, and luminous, composed primarily of hydrogen and helium. They were likely hundreds of times more massive than the Sun and shone brightly, emitting mostly ultraviolet light. These stars played a crucial role in the early universe, seeding it with heavier elements and influencing the formation of later galaxies. [20]



“Large-scale structure of light distribution in the universe”

by Andrew Pontzen and Fabio Governato

FIGURE 6 [21]

At recombination, the universe was 1.3 billion times smaller in volume than it is today. [22]
Looking at **FIGURE 6**; **Are cosmic strings of galaxy clusters remnants of these early flows of spacetime?**

Section 15 Gravitational Lensing due to Flow Gravity

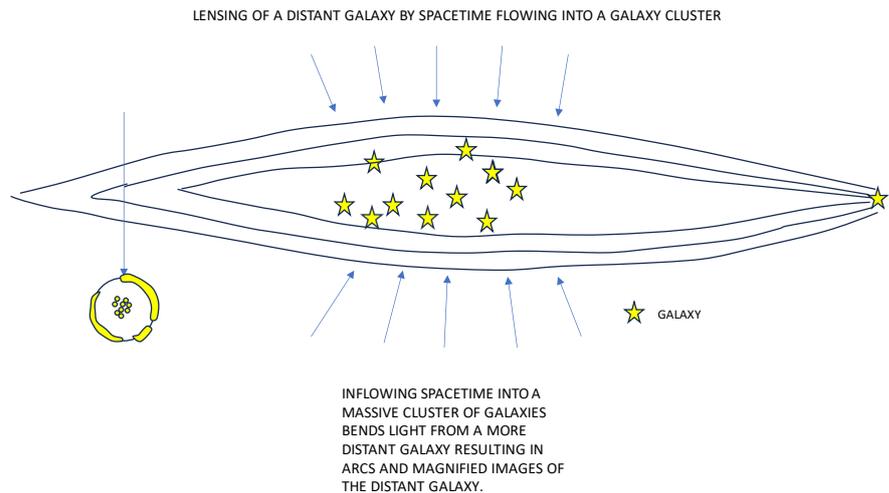
Gravitational lensing is best explained by **FIGURE 7**

NASA Science as observed by the Hubble Space Telescope [23]

Wright, Edward: Cluster Lensing: Arcs, Arclets and Shear Ref. [24]

Please refer to Observable Property #3: The bending of starlight. Over large distances, light will be slightly bent by spacetime flowing at right (or nearly right) angles to the direction of the flow of light. The effect is somewhat similar to a convex glass lens.

The alignment of the distant galaxy, the galaxy cluster, and the observer, determines the distorted, but amplified view of the distant galaxy. If all are aligned in a roughly straight line, a situation called strong lensing, rings or arcs of the distant galaxy will be seen. In less favorable alignments, called weak lensing, subtle distortions of the background galaxy are observed. Statistical analysis will be required.



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FIGURE 7

Summary:

The proposed hypotheses in this paper will not change the mathematics of Newtonian gravity, but will explain the missing mechanism of how Newtonian gravity actually works on the scale of a solar system. **Gravity is not a pull; gravity is a push.** Newtonian gravity is Flow gravity with the mass concentrated at the center, resulting in increasing orbital speeds of planets closer to the Sun.

Flow gravity on the scale of galaxies is totally different from the currently proposed model of dark matter. **The momentum vectors of stars are continuously displaced (bent) by the inflowing spacetime.** Flow gravity applies to all forms and shapes of galaxies and star clusters. **The property of mass discussed here is its ability to absorb spacetime, not its attraction to other matter.** The mechanism of Flow gravity is really very simple.

The distribution of matter within a galaxy determines the orbital speeds of its stars at various distances from its center.

It is proposed **that the observed expansion of the universe at scales above 1 megaparsec is due to the actual creation of spacetime.** Galaxy clusters are being displaced relative to other galaxy clusters due to incompressible spacetime being created.

The curvature of spacetime is mathematically described by General Relativity. The flow of spacetime may be a much simpler physical description.

In 1998, observations of distant supernovae revealed that the universe's expansion was not only happening but was actually accelerating. [25]

The flow of spacetime continuously offsets the direction of motion of matter and the absorption of spacetime within stars directs spacetime where to flow towards. The

above statement based on flow gravity is equivalent to general relativity's statement that "spacetime tells matter how to move and in turn matter tells spacetime how to curve." [26]

An experiment has been designed to determine if gravity is a pull or a push. Three **horizontal** torsion balances will measure the absorption of spacetime through three 20 kg discs. The displacement of the balances is in the **vertical direction** in the nanometer range. The torsion wires are in the **horizontal** plane. (With KEYENCE's spectral interference displacement sensors, it is possible to measure absolute distance with nanometer-level resolution.) This experiment is more difficult to perform since the torsion wires are in the horizontal plane.

The proposed experiment: If sensor 1 measures plus nanometers, sensor 2 and sensor 3 measure no change, then gravity is an attraction. If sensor 1 measures no change, sensor 2 measures minus nanometers, sensor 3 measures double the amount of sensor 2, then gravity is a flow of spacetime and causes acceleration. (The experiment has not yet been posted on viXra, pending detailed calculations and mechanical drawings.)

In **Cavendish's experiment**, gravity between two test masses were measured, and then G , the universal gravitational constant, was calculated. The displacement was in the horizontal plane. The torsional wire was in the vertical direction.

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