The Flow of Spacetime is Supporting the Orbital Speeds of Galactic Stars

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Introduction:

This paper is proposing an alternate hypothesis to dark matter.

First, we need to propose quantum properties and then test their predictions with 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. Therefore, we need to observe the results of quantum interactions at much larger scales, such as gravity between the Earth and our Sun, or gravity on a galactic scale.

The mechanics of the proposed flow gravity will be discussed in diagrams and with mathematics.

Main Paper:

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

Quantum Property 1: Spacetime is digital and consists of incredibly small atoms. In Loop Quantum Gravity theory (Ref. 14) they are called spin networks. They are close to Plank'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 fast voids of the Universe, where gravitons interact with neutrinos and photons to create space pixels. Eighty percent of the Universe consists of empty voids. Ref. 1

Quantum Property 3: Spacetime is constantly being absorbed inside stars, planets, black holes, and by gases. When gravitons interact with fermions, space pixels are absorbed.

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.

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 and accelerating relative to each other. The flow of spacetime will move adjacent celestial objects relative to other nearby celestial objects. The flow of spacetime will drag stellar matter and gas molecules along.

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

Observable Property 2: 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.

First kind of gravity: Newtonian gravity at the scale of the solar system. Newton's gravity is predominant at scales less than ½ a light year. Newton's equations correctly predict the orbits of the planets and satellites.

Observable Property #3: 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 flowing through the planet and is replacing spacetime lost within the planet. The planet is being pushed towards the sun and is thereby creating centripetal acceleration to maintain its orbit. We call this **Newtonian gravity.**

The mass distribution in a solar system is quite different from a galactic system, with our Sun containing 99.84% of its mass. The flowrate of spacetime varies as the inverse of the square law. The result of most of the mass being located in the Sun is that the orbital speeds of the planets vary as the inverse of the square of the distance from the Sun, resulting in 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 velocity flowing towards our Sun at the radius of the Earth's orbit:

Data used NASA Ref. 5

Orbital velocity of Earth around the Sun; v = 107,000 km/hour = 29.7 km/s

Distance of Earth from Sun; r = 149.6 x 10^6 km

Δt = 1 day = 24 hours x 3,600 sec = 86,400 sec

Orbital period of Earth; P = 365.25 days

$\Delta\alpha$ = (2π radians x 1 day) / (365.25 days) = 0.01720 radians

cos α = cos 0.01720 = 0.99985208

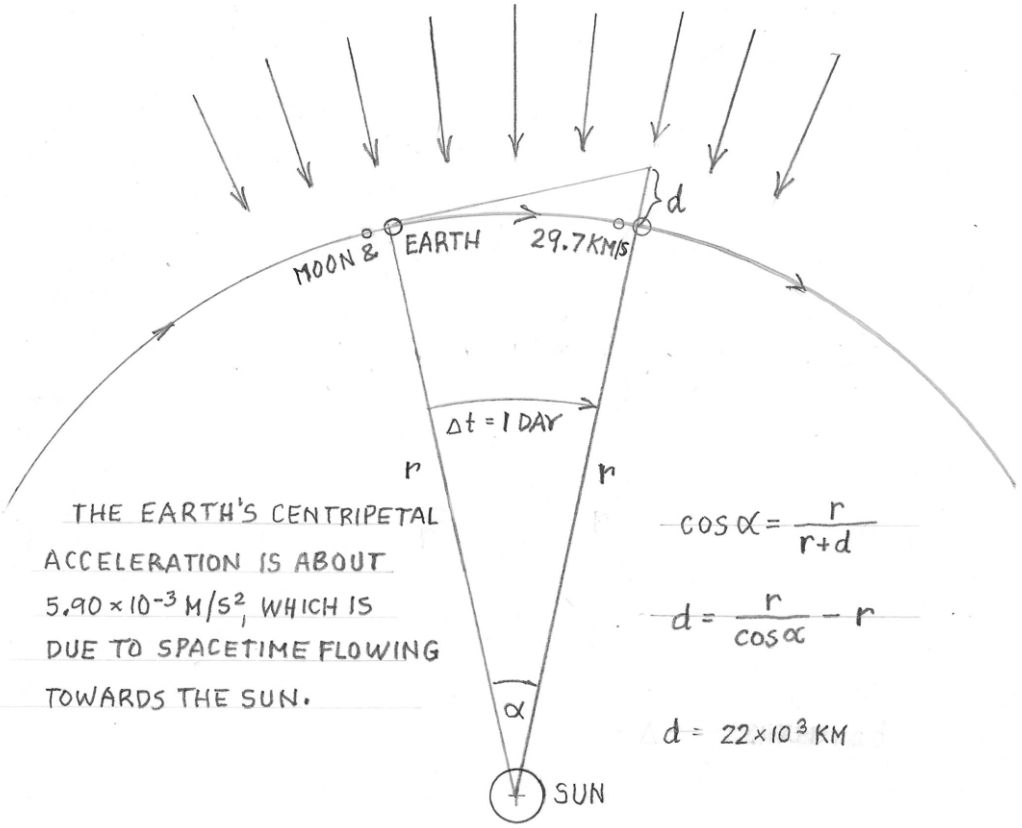
$\Delta d = (r / \cos \alpha) - r$ = (149.6 x 10^6 km / 0.99985208) – 149.6 x 10^6 km =

0.0221316 x 10^6 km = 22.13 x 10^6 m

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

256.1 m/s x 3600 s/hr /1000 m/km = 922 km/hr

SPACETIME FLOWING TOWARDS SUN AT 922 KM/HR



THE EARTH'S CENTRIPETAL ACCELERATION IS ABOUT $5.90 \times 10^{-3}\ M/S^2$, WHICH IS DUE TO SPACETIME FLOWING TOWARDS THE SUN.

$$\cos\alpha = \frac{r}{r+d}$$

$$d = \frac{r}{\cos\alpha} - r$$

$$d = 22 \times 10^3\ KM$$

SINCE THE SUN CONTAINS 99.86% OF THE MASS OF THE SOLAR SYSTEM, THE OVERWELVING FLOW OF SPACETIME IN THE SOLAR SYSTEM IS TOWARDS AND INTO THE SUN, WHERE SPACETIME IS ABSORBED.

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FIG. 1

Second kind of gravity: Currently believed to be due to the gravitational effects of dark matter, 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. 2

In this paper, the second kind of gravity is believed to be due to spacetime flowing into galaxies, and is therefore called **Flow gravity**.

Observable Property #4: The inflowing of spacetime into galaxies will offset linear momentum, effectively create centripetal acceleration and keep stars in their circular or elliptical orbits, **this mechanism maybe called scaffolding**. Please look at diagram: Fig. 2 Maintaining of Sun's Orbit by Inflowing Spacetime.

Gravity of the second kind: 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 a solar system.)

Please look again at diagram: Maintaining of Sun's Orbit by Inflowing Spacetime.

At the outer regions of the galaxy, the amount of flow of spacetime towards the center of the galaxy slightly decreases as it replaces the spacetime absorbed in stars, but its density will increase inversely as the square of the distance from the center of the galaxy. This will result in flat rotation curves of the outlying stars. Further towards the center, the many stars will absorb more and more spacetime with the velocity of spacetime deceasing and the orbital velocities of stars also decreasing. The Sun's orbital velocity and the inflow of spacetime are balanced. See diagram and calculations below:

$$d = \frac{r}{cos\ \alpha} - r$$

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 that with lower velocity will descend until its centripetal acceleration is balanced by the lower flowrate of spacetime at that orbit.

A major prediction of this hypothesis is that as the distance of a star from the center of the galaxy increases its orbital velocity must increase, exactly as observed by cosmologists. The major part of this paper will be devoted to the second kind of gravity.

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 the spacetime lost. 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 replaced within stars. The actual orbital speeds of stars have been measured. Ref. 7 **It has been found that orbital velocities of stars further from the center will be higher, as being observed in the Milky Way galaxy.**

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.

A rather large time frame had to be chosen to get a cosine of at least three digits. (The T-84 calculator has 10 significant digits. Ref. 4)

Δt = 10,000 years = 10,000 x 365 x 24 x 3,600 = 3.154×10^{11} seconds

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

Orbital period of our Sun = 260 million years averaged Ref. 3

cos (0.0002417) = 0.9999999708 Ref. 4

r = Sun's galactic orbit = about 26,000 light years from center of galaxy Ref. 5

r = 26,000 ly x 9.461×10^{15} m = 2.46×10^{20} 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. also Ref. 5)

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

$V_{IN} = \Delta d / \Delta t = 7.18 \times 10^{12}$ m / 3.154×10^{11} s = 22.76 m/s = **81.95 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.

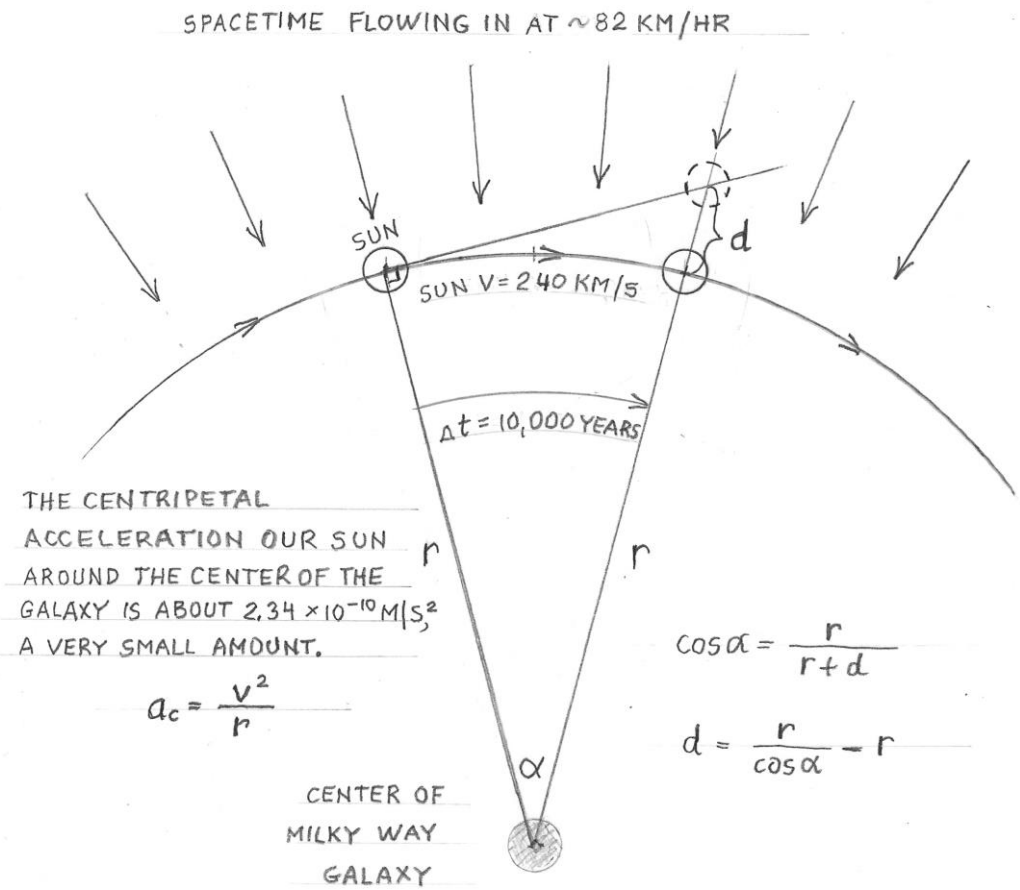
Using equation $a_c = v^2 / r$ to find the centripetal acceleration of our Sun around the center of the Milky Way galaxy:

$$a_c = v^2 / r$$

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

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

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



MAINTAINING OF SUN'S ORBIT BY INFLOWING SPACETIME

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IF SPACETIME WOULD NOT FLOW INTO A GALAXY, THE MOMENTUM OF STARS WOULD KEEP THEM MOVING IN A STRAIGHT LINE TANGENTIALLY OFF THEIR ORBITS. (NEWTON'S FIRST AND SECOND LAWS)

FIG. 2

Third kind of gravity: 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's 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.

Observable Property #5: 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 #6: The flow of spacetime is in a constant flux and will quickly adjust to the relative positions of stars, clusters, and galaxies.

The flow of spacetime continuously offsets the direction of motion of matter and the absorption of spacetime within matter tells spacetime where to flow towards. The magnitude and direction are quantified by a spacetime flow vector. The above statement based on quantum effects is equivalent to general relativity's statement that spacetime tells matter how to move and in turn matter tells spacetime how to curve.

Calculating the speed of spacetime flowing into the Earth at the distance of the Moon's orbit: Please refer to Fig. 3 and Ref. 15 Barycenter of Earth and Moon, see Fig. 3

r_1 = 4,671 km from Earth's center Ref. 9

r = 384,400 km distance of Earth to Moon Ref. 10

$r = r_1 + r_2$ $r_2 = r - r_2$ = 384,400 km – 4,671 km = 379,729 km

r_2 is the distance of center of Moon to common barycenter

P = 27.3 27.3 Earth days; sideral month Ref. 11

$\alpha = 2\pi$ rad x 0.5 day / 27.3 days = 0.11508 rad

Δt = 0.5-day x 24 hours/day x 3600 sec/hour = 43,200 sec

Cos (0.11508 rad) = 0.993386

$$\Delta d = \frac{r_2}{\cos \alpha} - r_2$$

$= 3.7973 \times 10^8 \text{ m} / 0.99339 - 3.7973 \times 10^8 \text{ m}$

$= 3.82257 \times 10^8 \text{ m} - 3.7973 \times 10^8 \text{ m}$

$= 0.02527 \times 10^8 \text{ m}$

$$v_{IN} = \frac{\Delta d}{\Delta t}$$

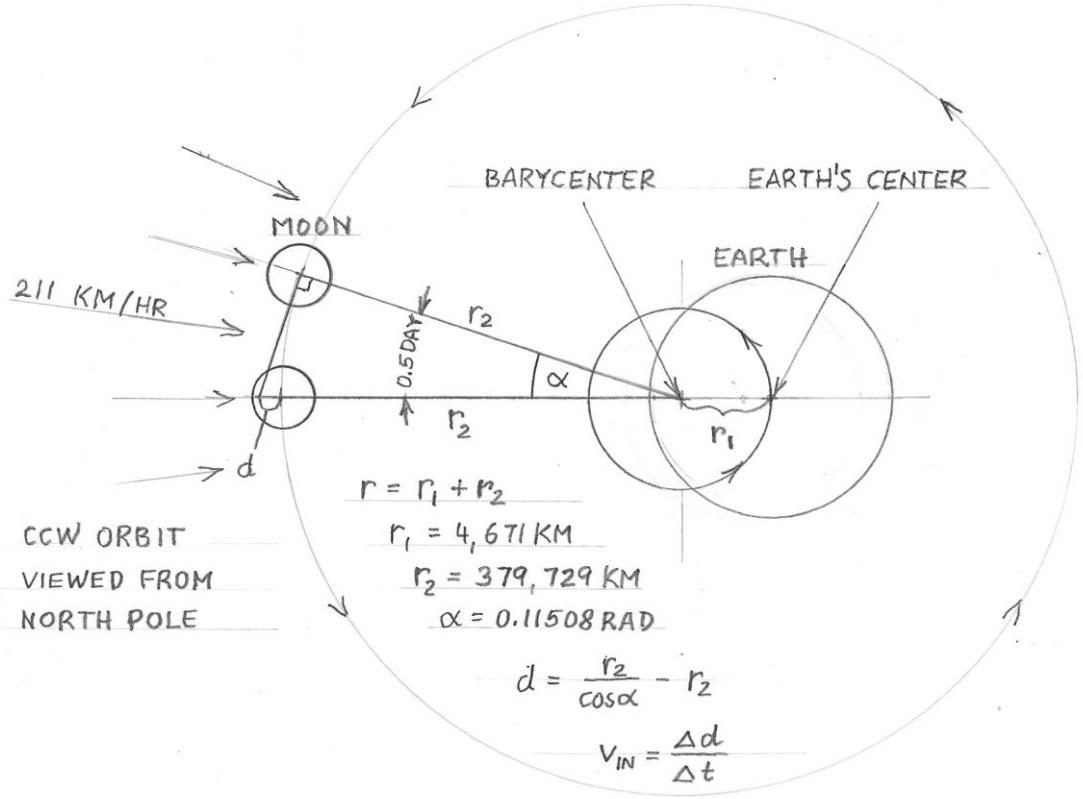
$= 2.527 \times 10^6 \text{ m} / 4.32 \times 10^4 \text{ sec}$

$= 0.5849 \times 10^2 \text{ m/s}$

$= 58.49 \text{ m/s} \times 3{,}600 \text{ s/hr} / 1000 \text{ m/km}$

$= 210.6 \text{ km/ hr}$

BARYCENTER OF EARTH AND MOON



MOON'S ORBIT AROUND COMMON BARYCENTER

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BOTH MOON AND EARTH ORBIT THE SUN TOGETHER.
THE ORBIT OF THE MOON IS LOCAL MOTION RELATIVE TO EARTH.

Fig. 3

We must also consider extreme cases of spacetime flowing into extremely dense stars. The case of spacetime flowing into a neutron star will be examined:

The velocity of spacetime flowing into a star varies directly with its mass and inversely with the square of its distance from its surface. As stated before, the property of mass considered here is its ability to absorb spacetime. Spacetime is mostly incompressible. Spacetime has a minimum vacuum energy due to fluctuations in the many quantum fields that fill it. Ref. 12

$$v_{IN} \propto \frac{M_R}{A} = \frac{M_R}{4\pi r^2} \qquad \textbf{E \#7}$$

Mass of Sun $M_R = 1.989 \times 10^{30}$ kg Ref. 5

The inflowing spacetime is directly proportional to the mass.

r = distance of Earth from the Sun

$r = 1.496 \times 10^{11}$ m Ref. 8

v_{IN} at radius of Earth's orbit = 922 km/hr = 256.2 m/s Ref. Calculations for Fig. 1

$r_{SUN} = 6.963 \times 10^8$ m Ref.5

v_{IN} varies inversely with the radii squared

It is assumed that spacetime is almost incompressible.

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

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

V_{IN} at the Sun's surface = 11.82×10^6 m/s

This is surprisingly large, compared to $c = 3.00 \times 10^8$ 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. Ref.13

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

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

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

At 1.693 x 10^8 m 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. Assuming v = 0.9999 c

$$p = \gamma m v$$

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

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

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

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

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

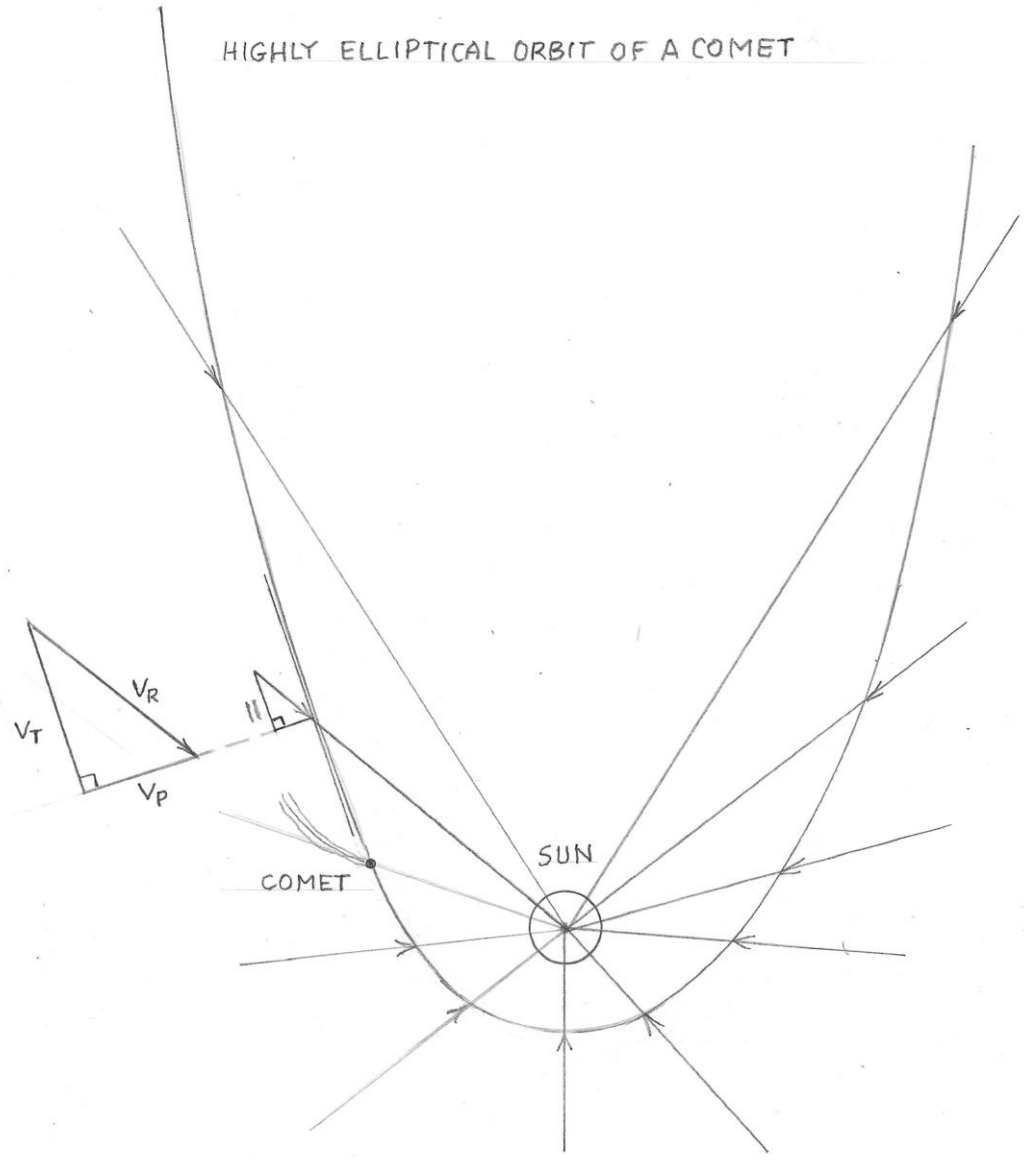
HIGHLY ELLIPTICAL ORBIT OF A COMET
V_R
V_T
V_P
COMET
SUN
SPACETIME FLOWING TOWARDS SUN
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FIG. 4

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

Please refer to Fig. 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 and to orbital path

V_P = Perpendicular component to V_T and to orbital path

It can be seen that the inflowing spacetime will not only displaces the comet's orbit but also increases 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.

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? Spacetime is 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 dynamically? Spacetime is constantly being absorbed inside stars as gravitons and matter interact and pixels (spacetime) are being absorbed.

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 observed speeds, particularly at larger distances. Instead of decreasing with distance as expected based on Newtonian gravity, the outer rotation curve remains at high speeds and is flat.

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 E #10. 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.**

$$v_{IN} \propto \frac{M_r}{A} = \frac{M_r}{4\pi r^2} \qquad \text{E \#10}$$

Vin the velocity of spacetime flowing in is proportional to the remaining mass within r and inversely proportional to the spherical area at r. Vin supports the orbital velocities of stars in galaxies.

At the outer regions of a galaxy, gases and stars are less dense than at the inner regions, In the outer regions, since M_r decreases more slowly than $4\pi r^2$ decreases, v_{IN} will remain high, ratio E #10.

A larger v_{IN}, spacetime flowing in, will support a higher v, orbital velocities of the outer stars. If Mr proportionally decreases as r^2, then the velocities of orbits of the outer stars will remain the same, resulting in a flat rotation curve. (The orbital periods will increase.)

$$a_c = \frac{v^2}{r} \qquad \text{E \#11}$$

$$\sqrt{a_c \cdot r} = v \qquad \text{E \#12}$$

$$a_c = \frac{dv_{in}}{dt} \qquad \text{E \#13}$$

a_C is centripetal acceleration, v is the tangential velocity, that is the orbital velocity, and r the radius at that velocity. **This explains the flat rotation curves of the outer stars and gases.**

Now what are the conditions at the inner, much denser regions of the galaxy? Again, refer to E #10. M_R will now decrease rapidly, resulting in a much smaller ratio and smaller v_{IN} and smaller v orbital velocities. **This explains the orbital speeds of the inner stars.**

Orbital speeds of stars in the Milky Way galaxy depend on mass distribution. The higher the density of stars, the lower the orbital speeds.

Next let us examine the orbital speeds of planets within the Solar system:

Again, please refer to E #10. Our Sun contains 99.86 % of the mass in the solar system. Ref. 9. M_r is a large constant, with the masses of Jupiter and Saturn not making much difference. It can be easily seen that the orbital velocities of the planets are totally determined by their radii from the Sun. The result is higher orbital velocities at smaller radii.

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 ½ 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.

Other Considerations:

Does Newton's Law of Universal Law of Gravitation correctly predict the rate of clumping of matter after recombination? (after year 380,000) Since it is an inverse square law, the equation implies that matter has clumped into spheres. The areas of the disks of these spheres vary inversely with the distances. If the

distances between the star and a planet in orbit around this star doubles, the area of this disk decreases by one fourth. Gravitons will miss the disks with the inverse of the square of the distance. 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.

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 destroyed 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 destruction of space pixels leading to increase flow of spacetime into denser volumes. **There is no distance limit to this flow.**

What the rate of creation of pixels of spacetime was at that time is unknown.

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. Ref. 6

These stars played a crucial role in the early universe, seeding it with heavier elements and influencing the formation of later galaxies. **Are cosmic strings of galaxy clusters a remnant of these early flows of spacetime?**

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

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 these 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 Flow gravity is the main flow of the river, the interstellar flow of spacetime, and the stars are the obstructions, where the absorption of spacetime occurs.

Summary:

The proposed hypotheses in this paper will not change the mathematics of Newtonian gravity, but they do explain the missing mechanism of how Newtonian gravity actually works on the scale of a solar system.

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 by the inflowing spacetime**. The distribution of matter within a galaxy determines the speeds of its stars.

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 spacetime being created. Since this is a continuous process a velocity of recession results, as quantified by the Hubble constant.

Keywords: Gravity, quantum gravity, dark matter, dark energy, stellar rotation curve, flow gravity.

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