Galactic Rotational Velocities Explained by Relativistically Stable Orbits that Spiral Outward at Increasing Distance as Predicted by Explanation for Gravity

William E. Rush werush7@gmail.com

July 9, 2015

Abstract

It is proposed that the strong force is the force of space. Development of this concept leads to the prediction that the mass of all matter increases as the universe expands. This mass (energy) increase is absorbed from space and leads to the force of gravity. The rate of mass increase necessary to bring about the known force of gravity is calculated. A relationship between matter mass increase and matter length increase is developed and then used to calculate the rate of increase of matter length. This same rate of increase in length applies to all other lengths and orbits including galactic orbital distance. This fractional expansion rate is determined to be $Gm/c(r)^2$ where m and r are mass and radius of some smallest particle of definable dimensions. If m and r of a proton is chosen, this equation predicts that gravitational orbits double in length approximately every 45-85 million years. Orbits within galaxies, with orbital periods of hundreds of millions of years, will therefore be outward spirals as measured by time zero length, though orbital distances will always be measured as unchanging. Higher orbital speeds are required to maintain these spiral orbits than the orbital speeds required to maintain circular orbits at the same orbital radii. Calculations within show that for a typical galaxy (M31) at typical galactic distances of about 15 - 30 kpc, the galactic orbits increase in radius, or can be considered to "accelerate" outward, at approximately the same acceleration rate as the gravitational acceleration rate required to hold stars in a circular orbit at the observed rotational velocity. These equivalent accelerations are near the MOND critical value of 10^{-10} m/sec^2. This may explain the anomaly of galactic rotational velocities without dark matter. The concepts proposed here require that the fundamental constants change with the expanding universe; however, if the principle of relativity (not the theory) is embraced, then this requires that these physical and fundamental constants are linked such that they appear to remain unchanged.

1 Introduction

The following concepts will be explored in this paper:

- The energy densities of space and matter are directly related.
- The relationship of space and matter coupled with the expanding universe results in a continuous increase in the energy of all matter. This energy increase is taken from space thereby resulting in the action of gravity.
- The strong force and the force of gravity are manifestations of the primal force of space.
- The mass and radius of all particles of matter, as well as the fundamental "constants", change in a relativistic manner with the expansion of the universe and the resulting change in space density. This results in all gravitational orbits being outward spirals that are not directly detectable for relativistic reasons and explains the observed galactic orbital velocities without invoking dark matter.
- Due to the relationship between space and matter, the density of matter is limited. By this hypothesis black holes can exist but the density of black holes is limited and a singularity of infinite density cannot exist.

2 HYPOTHESIS

The current theory of gravity is essentially the theory introduced by Einstein in the theory of general relativity. This currently accepted idea is that matter warps space and this warping of space brings about the effect of gravity. This accepted idea about gravity will be combined here with the almost universally accepted belief that the universe including space is expanding.

In order to develop the space - matter relationship, matter and space must be viewed in a very simplistic manner. It is proposed that space is filled with points or waves of energy. It is further proposed that these points or waves of energy are traveling at the speed of light and can transfer energy and momentum upon collision.

The structure of matter must also be redefined in the simplest possible way. Matter, or some small element of matter, will for simplicity of calculation, be defined as a sphere. Further, the points or waves of energy that comprise this matter sphere are also traveling at the speed of light and are hypothesized as being the same as those of space except that they are bound within the matter sphere or rotating around the circumference of the matter sphere. In standard physics theory it is the strong force that holds atoms together. It is proposed however that the underlying force that holds the matter sphere together is the force of space itself.

Relative Energy Density of Matter and Space: To pursue the hypothesis, the relative space energy density required to hold a matter sphere together will be calculated. The constituents of the matter sphere are best modeled as bound waves of light. The deflection of light in a gravitational field is twice the deflection of matter in a gravitational field. This relationship can be restated as the outward acceleration of a bound wave of light is half the outward acceleration of a particle of matter gravitationally bound in the same orbit. This same ratio of accelerations should also hold for the force of space given its relationship with gravity that will be presented. In Calculation 1 the outward acceleration of the matter constituents (as bound waves of light) are equated to the inward force of space to calculate the relative energy densities of matter and space (All detailed calculations are shown in Section 7). The outcome of this calculation, using essentially the ideal gas law modified for the deflection of light, is that **the energy density of matter is twice the energy density of space**.

As clarification of the relationship just calculated, it is suggested that we perceive only differences in energy; therefore space is perceived to have zero energy. The mass energy we perceive is therefore the difference in matter and space energy or one half the total matter energy.

Black Holes: There is an interesting side product of this concept. If matter has an energy density that is directly proportional to the density of space, and there are no forces that can compact energy any further, then this suggests that black holes can exist but they can be no denser than the matter sphere just postulated. Since black holes cannot be denser than the densest particles, black holes cannot be true singularities except in the relativistic sense.

Effect of Space Density Change: If the relationship between the energy density of matter and the energy density of space is valid, then matter must undergo changes as the universe expands and space energy density decreases; however, with the single relationship developed thus far, these changes cannot be quantified. There may be quantum rules that would exactly define a second relationship but no such equation could be developed here. Lacking this, the most feasible relationship will be used. It is suggested that the most feasible relationship is that the mass of a matter sphere is proportional to its surface area. With this additional relationship the effects of the expanding universe on matter can be calculated (Calculation 2). Equations 1 and 2 that result from these calculations describe the changes that occur in matter radius and mass as the universe expands and the energy density of space decreases.

$$r_T = r_0(D_0/D_T) \tag{1}$$

$$M_T = M_0(D_0/D_T)^2 \tag{2}$$

where M_0 is the matter sphere mass at time zero, M_T is the Matter sphere mass at time T, r_0 is the radius of matter sphere at time zero, r_T is the radius of matter sphere at time T, D_0 is the density of space energy at time zero and D_T is the density of space energy at time T.

It should be noted that no changes in mass or matter length or changes to any of the fundamental constants has ever been detected. Therefore for the proposed hypothesis to be correct it must be concluded that time, length, mass and fundamental constants must be linked in a relativistic manner such that they always appear to be unchanged. Scientist in the late 1800's came to the same conclusion to explain the fact that the physical parameters and fundamental equations of physics appear not to change with changes in velocity. The accepted explanation was to adopt the principle of relativity that suggests that the laws of physics remain unchanged no matter the velocity of the observer. Einstein's proof of this principle elevated this idea to a proven theory. It is proposed here that this same principle is true for observers in reference frames of different space energy density. It should be emphasized that the principle of relativity for velocity cannot be directly extended to changes in space energy density. It is however suggested here that the underlying idea behind the principle of relativity can be applied to the changes in fundamental constants due to changes in space energy density. The idea being that the constants of nature are linked such that changes are not detectable. Though not necessarily true, it is also assumed for ease of calculation that all velocities remain constant (including the velocity of light) thus linking length and time in a simple manner.

Equations 1 and 2 can be used to determine the changes in matter that occur as the universe expands. As an example consider the effects as the universe doubles in diameter and the energy density of space thereby decreases to 1/8 the original density. These equations predict that the radius of matter increases 8 fold and the mass of matter increases 64 fold. If these are to remain undetected then time must slow 8 fold and the gravitational constant G must decrease to 1/8 the time zero value. In brief, as the universe expands, matter increases in mass and becomes larger in every dimension with associated changes in the physical constants.

Gravity: To further illustrate the effects of the expanding universe on matter, consider two adjacent sectors of space. One sector contains matter (first body of matter) and the other is void of matter. The sectors of space are of constant volume as defined by units of length at time zero. As space expands, the density of space within the sectors decreases. There is thereby a net flux of space energy away from any point in space and therefore away from both sectors of space. Though both sectors of space loose space energy, the sector containing matter losses less space energy due to the increase in the mass of matter within the matter containing sector.

If there were a second body of matter between the two sectors then this body would be subject to a smaller flux of space energy on the side facing the sector containing the first body of matter. It is proposed that this inequality of space energy flux due to the expansion of the universe results in the force of gravity. From a quantitative standpoint, the inequality of mass loss between the two sectors equals the mass gain of first body of matter over the time period.

The proposed interaction that brings about the force of gravity appears to be similar to other physical theories of gravity that have been shown to violate various laws of physics. It is believed that the problems with other physical theories are avoided here due to the nature of the space - matter interaction proposed here.

Quantification of Space Expansion Rate: This concept will be taken further to quantify the expansion rate of the universe required to bring about the known gravitational force. To accomplish this imagine that there is a single matter sphere (the previously described small unit of matter) in space in the vicinity

Table 1: MATTER CHANGES WITH TIME (PROTON RADIUS is 1.2 X 10^{-15}m)

ITEM	MATTER MASS	MATTER LENGTH	UNIV LENGTH
FRACTIONAL CHANGE PER SECOND	5.17 X 10^{-16}	2.585 X 10^{-16}	.862 X 10^{-16}
TIME TO DOUBLE	43 MILLION YEARS	86 MIL YEARS	256 MILLION YEARS

Table 2: MATTER CHANGES WITH TIME (PROTON RADIUS is .87X 10^{-15}m)

ITEM	MATTER MASS	MATTER LENGTH	UNIV LENGTH
FRACTIONAL CHANGE PER SECOND	9.84 X 10^{-16}	4.92 X 10^{-16}	1.64 X 10^{-16}
TIME TO DOUBLE	22.5 MILLION YEARS	45 MIL YEARS	135 MILLION YEARS

of a much larger body of matter. As explained, the small matter sphere is subject to a net negative flux of space energy on the side toward the large body of matter due to the increase in mass of the large body. The matter sphere is assumed to be a solid object being impacted by a flux of space energy. If we then equate this flux with the momentum gain that would be expected from gravity, we can determine an equation for the rate of mass gain for matter. The calculations (Calculation 3) lead to the following equation:

$$\text{Fractional rate of mass gain of matter} = 2Gm_1/c(r_1)^2 \tag{3}$$

Here, G is the gravitational constant, m_1 is the mass of the matter sphere, c is the velocity of light and r_1 is the radius of the matter sphere.

Using Equations 1 and 2, additional equations for the fractional rate of increase in matter length and the fractional rate of increase in the radius of the universe (space) can be developed.

$$\text{Fractional rate of matter length increase} = Gm_1/c(r_1)^2 \tag{4}$$

$$\text{Fractional rate of increase in radius of the universe} = Gm_1/3c(r_1)^2 \tag{5}$$

The matter sphere discussed above is described as some small unit of matter. Perhaps some other unit of matter will be discovered in the future but for now the smallest unit of matter with defined mass and dimensions is the proton. If the properties of a proton are substituted into the last equation, the rate of mass gain of matter can be calculated. It is uncertain as to what proton radius is appropriate here so the equation above is solved for recognized extremes for proton radius. The results of this are shown in equation solutions 6 and 7 below. These fractional rates of mass gain are used with equations 3, 4 and 5 to calculate the values for the fractional rates of change for mass, length and universe shown in Tables 1 and 2.

$$\text{Fractional rate of mass gain of matter} = 5.17X10^{-16}/sec \text{ [for proton radius} = 1.2x10^{-15} \text{ meter]} \tag{6}$$

$$\text{Fractional rate of mass gain of matter} = 9.84X10^{-16}/sec \text{ [for proton radius} = .87x10^{-15} \text{ meter]} \tag{7}$$

3 Changes in Physical Constants

As implied previously, the concepts suggested here propose that all the physical constants are changing with time. As indicated in Table 1 and Table 2, matter length is changing at a rapid rate in cosmological terms. As clarification, the hypothesis predicts all matter will double in diameter every 86 million years from Table 1 and 45 million years from Table 2. Likewise the orbital distance of all orbiting objects will double over the same lengths of time. These effects are unnoticed since, as explained earlier, accepting the principle of relativity requires that for relativistic reasons our measurement yardsticks also double in size over this period and time slows to 1/2. Changes from atomic size up to changes within our solar system are probably not measurable or discernible for the reasons just described. However, if we consider very large objects, namely galaxies, the hypothesis predicts these changes in length and time may still not be directly observed but may be discernible by observing the orbital velocities within galaxies.

4 Explanation for Orbital Velocities of Galactic Stars

As an example of the effect of the rapid rate of length change, consider the orbit of stars in the Andromeda galaxy. Orbital speed of the stars within the Andromeda galaxy between 5 and 30 kpc from the galactic center remain at about 240 km/sec [1]. These orbital velocities, especially in the case of the outermost stars in this range, are much faster than is possible with the gravitational force exerted by the ordinary matter within the galaxy and these stars should start to move outward in an increasing spiral into higher orbits where gravity is even weaker eventually resulting in complete loss of gravitational contact with the galaxy. To explain this apparent anomaly, in this and other galaxies, the concept of dark matter was conceived.

The theory to be tested here is that dark matter does not exist and stars are indeed spiraling away from the galactic center; however, the proposed theory predicts that the length of all matter and the radius of all orbits increase with time. The fundamental and physical constants also change in a relativistic manner such that we perceive and measure that the physical properties of matter, such as matter diameter, remain unchanged. This means that we would measure the gravitational force on these outer galactic stars as unchanging over time despite the increasing distance from the galactic center. These orbits are therefore relativistically stable and the stars relative position in the galaxy never changes. This type of orbit may explain the high rotational speeds that are observed.

As a semi quantitative test of the proposed concept, consider Tables 3 and 4 that use rates of length expansion, from use of the two proton radii previously cited, to depict the forces on orbiting stars at various distances from the galactic center as predicted by the proposed hypothesis. The tables show the change in orbital length at one and two seconds. The column “length acceleration” is calculated using the simple expression (with zero initial velocity and one unit of time) that the change in length increase equals one half the acceleration. This is therefore an acceleration of the orbital distance not actual acceleration. After subtracting the contribution to this acceleration from the expansion of the universe predicted by this hypothesis, the result is what is termed in the tables as a “net acceleration of orbit”. Also in the table is the calculated gravitational acceleration required to hold the stars at the various distances in a stable circular orbit at 240 km/sec. We find by comparing these “accelerations” that they are equivalent at about 15 - 30 kpc at accelerations very near the critical MOND value of 10^{-10}m/sec^2 [2] as shown in Tables 3 and 4 (Note bold acceleration values in tables).

This data suggests that stars at 5 kpc are allowed only a small outward acceleration of their orbits as compared to the acceleration required for a circular orbit. Stars at this distance must rely primarily on gravity to maintain orbital position. Tables 3 and 4 show that stars at 15 - 30 kpc are allowed, or required, to accelerate outward at relatively high rates to maintain relativistically stable orbits thus accommodating the observed orbital velocity despite lesser gravitational attraction than closer stars. Orbits of stars at larger

Table 3: ORBITAL VS APPARENT ACCELERATION IN ANDROMEDA GALAXY (PROTON RADIUS IS 1.2 10 $^{-15}$m)

Radius kpc	Radius Meters	Length Increase in first second = col 2 X 2.6E-16	Length Increase in 2nd second = (col 2 + col 3) X 2.6E-16	Calculated Length Acceleration = 2X(col 4 - col 3)	Calculated Space Acceleration=.33 X col 5	Net Acceleration of Orbit = col 5 - col 6	Apparent acceleration for stable circular orbit at v = 240 Kilometers/Sec where a = v^2/r
5	1.5e+20	4.0E+04	4.0E+04 +1.0E-11	2.1E-11	6.9E-12	1.4E-11	3.8E-10
10	3.1E+20	8.0E+04	8.0E+04 +2.1E-11	4.1E-11	1.4E-11	2.7E-11	1.9E-10
15	4.6E+20	1.2E+05	1.2E+05 +3.1E-11	6.2E-11	2.1E-11	4.1E-11	1.3E-10
20	6.2E+20	1.6E+05	1.6E+05+ 4.1E-11	8.2E-11	2.7E-11	5.5E-11	9.4E-11
25	7.7E+20	2.0E+05	2.0E+05 +5.1E-11	1.0E-10	3.4E-11	**6.9E-11**	**7.5E-11**
30	9.2E+20	2.4E+05	2.4E+05 +6.2E-11	1.2E-10	4.1E-11	**8.2E-11**	**6.3E-11**
35	1.1E+21	2.8E+05	2.8E+05 +7.2E-11	1.4E-10	4.8E-11	9.6E-11	5.4E-11
40	1.2E+21	3.2E+05	3.2E+05 +8.2E-11	1.6E-10	5.5E-11	1.1E-10	4.7E-11

distances are allowed to accelerate outward at even faster rates. The fact that at typical galactic orbital distances the outward acceleration of the orbits and the apparent gravitational acceleration for a circular orbit are closely equivalent at the MOND critical value offer some validation that the concepts proposed here may explain the observed galactic orbital speeds and could explain why the MOND concept is successful at predicting these orbital speeds. While the values in the tables are not a rigorous model of the galactic orbits, they do offer evidence that supports the proposed concepts.

It was a goal to calculate the Hubble constant that would be expected from a universe matching the proposed concepts and compare this with the observed Hubble constant. This could not be accomplished due to the lack of a theory to predict the effect on light as it passes through regions of space of decreasing energy density. The proposed concepts predict that the universe is expanding at a rate almost two orders of magnitude faster than the currently accepted value. It would seem unlikely that that with this expansion rate that the proposed concepts would yield a Hubble constant close to the observed value. However, consider that the light we now see was generated in the past when time was faster the further away the galaxy being studied. When this light was generated all light frequencies were faster thus offsetting the Doppler shift due to the rapid expansion rate. In addition these galaxies in the past were smaller thus appearing more distance. This also would lead to a smaller Hubble constant. While this explanation does not offer any proof that the concepts lead to the observed Hubble constant, it does at least make a reasonable argument that it is feasible.

Table 4: ORBITAL VS APPARENT ACCELERATION IN ANDROMEDA GALAXY (PROTON RADIUS IS .87 10 $^{-15}$m)

Radius kpc	Radius Meters	Length Increase in first second = col 2 X 5E-16	Length Increase in 2nd second = (col 2 + col 3) X 5E-16	Calculated Length Acceleration = 2X(col 4 - col 3)	Calculated Space Acceleration=.33 X col 5	Net Acceleration of Orbit = col 5 - col 6	Apparent acceleration for stable circular orbit at v = 240 Kilometers/Sec where a = v^2/r
5	1.5e+20	7.6E+04	7.6E+04 +3.7E-11	7.5E-11	2.5E-11	5.0E-11	3.8E-10
10	3.1E+20	1.5E+04	1.5E+04 +7.5E-11	1.5E-10	5.0E-11	9.9E-11	1.9E-10
15	4.6E+20	2.3E+05	2.3E+05 +1.1E-10	2.2E-10	7.4E-11	**1.5E-10**	**1.3E-10**
20	6.2E+20	3.0E+05	3.0E+05+ 1.5E-10	3.0E-10	9.9E-11	2.0E-10	9.4E-11
25	7.7E+20	3.8E+05	3.8E+05 +1.9E-10	3.7E-10	1.2E-10	2.5E-10	7.5E-11
30	9.2E+20	4.5E+05	4.5E+05 +2.2E-10	4.5E-10	1.5E-10	3.0E-10	6.3E-11
35	1.1E+21	5.3E+05	5.3E+05 +2.6E-10	5.2E-10	1.7E-10	3.5E-10	5.4E-11

5 Conclusion

It is felt that a reasonable case has been made in support of the hypothesis that the force of space is responsible for the strong force and the force of gravity. Supporting evidence for this hypothesis is that the proposed concepts provide answers to the following unanswered questions in physics:

- The hypothesis leads to a physical theory of gravity that is in line with the current relativistic theory of gravity in that it still involves only the interaction of matter and space and does not obviously violate any precepts of physics.
- Concepts developed from the hypothesis offer a reasonable explanation for the galactic rotational speed anomaly. Approximate calculations from the concepts show how the observed rotational velocities for a typical galaxy are possible with only the gravitational acceleration of ordinary matter. The concepts also offer a quantitative explanation for the MOND critical value. It is proposed that the concepts given here may offer a more feasible explanation for galactic orbital velocities than dark matter.
- The proposed concepts limit the density of black holes and eliminate the issue of a singularity of infinite density.

While this evidence does not constitute definitive proof of the hypothesis, it is suggested that enough evidence has been presented to warrant further investigation of the hypothesis and concepts presented here.

6 Calculations

Calculation 1 CALCULATION OF RELATIVE SPACE - MATTER DENSITIES

If the energy components of a matter sphere were considered as particles, the centrifugal (outward) acceleration of these components would be expressed as follows:

$$a = c^2/r \tag{8}$$

For a bound wave of light the outward acceleration is half that of a particle. If the energy components of matter are considered as bound waves, their outward acceleration is therefore expressed as follows:

$$a = (1/2)(c^2/r) = c^2/2r \tag{9}$$

where a is the centrifugal (outward) acceleration, r is the radius of matter sphere and c is the velocity of the rotating energy components assumed to be the velocity of light

$$\text{The total outward force} = m_1 a = m_1 c^2/2r \tag{10}$$

$$\text{where } m_1 = \text{the total mass of matter sphere energy components} \tag{11}$$

$$\text{The outward pressure exerted by the rotating energy components } p_{matter} = force/area = \tag{12}$$

$$\frac{m_1 c^2/2r}{4\pi r^2} = \frac{m_1 c^2/2}{4\pi r^3} \tag{13}$$

For the matter sphere to be stable, the outward pressure of the matter energy components must be balanced by the inward pressure of space. Using the pressure equation from the kinetic theory of gas, the inward pressure exerted by the space (Pspace) on the walls of any cube of space = force/area

$$\text{or } P_{space} = m_{space} c^2/3L^3 = E_{space}/3L^3 \tag{14}$$

where L is length of each cube face and $m_{space}c^2$ and E_{space} is total energy of space within a cube of space and $m_1 c^2$ and E_{matter} below is the total energy of the matter sphere

Equating the inward and outward pressure on the walls of the matter sphere

$$p_{matter} = p_{space} \tag{15}$$

$$\text{or } \frac{m_1 c^2/2}{4\pi r^3} = \frac{E_{space}}{3L^3} \tag{16}$$

$$\text{simplifying } \frac{E_{matter}}{(4/3)\pi r^3} = \frac{2E_{space}}{L^3} \tag{17}$$

$$\text{or } \frac{\text{energy of matter}}{\text{volume of matter sphere}} = \frac{\text{2X energy of space}}{\text{volume of space cube}} \tag{18}$$

Energy Density of Matter = 2 X Energy Density of Space

Calculation 2 Calculation of the Effect of Space Density Change

If matter mass is proportional to the surface area of the matter sphere then

$$M_0/r_0^2 = M_T/r_T^2 \tag{19}$$

where M_0 is the matter sphere mass at time zero, M_T is the matter sphere mass at time T, r_0 is the radius of matter sphere at time zero, r_T is the radius of matter sphere at time T

Expressing in equation form the proposal that a matter sphere has twice the density of space at time zero(0) and time T

$$\frac{M_0}{4/3\pi r_0^3} = 2 * D_0 \tag{20}$$

$$\text{and } \frac{M_T}{4/3\pi r_T^3} = 2 * D_T \tag{21}$$

D_0 is the density of space energy at time zero, and D_T is the density of space energy at time T

Solving these simultaneous equations results in the following relationships:

$$r_T = r_0(D_0/D_T) \text{ and } M_T = M_0(D_0/D_T)^2 \tag{22}$$

Calculation 3 Calculation of the Fractional Rate of Mass Increase

To quantify gravity, consider a small particle of matter (perhaps a proton) under the gravitational influence of a much larger body of matter. The momentum of this smaller body imparted by gravity is calculated below beginning with the equation for gravitational force:

$$F = \frac{Gm_1m_2}{r^2} \tag{23}$$

where F is the force due to gravity, G is the gravitational constant, m_1 is the mass of small particle of matter, m_2 is the mass of large body, and r is the distance between the centers of the two bodies.

The acceleration (a) of the small particle of matter resulting from the gravitational force is

$$a = F/m_1 = \frac{Gm_2}{r^2} \tag{24}$$

The velocity of the small particle of matter due to gravitational acceleration is, at any time, calculated as follows assuming the initial velocity is zero:

$$v = aXTime = \frac{Gm_2t}{r^2} \tag{25}$$

where v = velocity at some time t

At any time t the momentum of the smallest particle of matter p1 =

$$m_1v = \frac{Gm_1m_2t}{r^2} \tag{26}$$

The hypothesis offered here is that this gravitational momentum is brought about by a net flux of space energy impacting the small particle. This flux of space energy is brought about by the removal of space energy due to the mass gain of the larger body due to the expanding universe. The momentum of the flux of space energy necessary to bring about this particle momentum can be calculated by noting that the momentum of a small point of energy or wave that impacts a matter particle (perhaps a proton) and rebounds, or is perfectly reflected, is 1/2 the momentum gain of the matter particle; therefore:

$$\text{Space point momentum impacting the matter particle } p_2 = \frac{Gm_1m_2t}{2r^2} \tag{27}$$

The above expression quantifies the momentum of the flux of space points impacting the smallest particle of matter as a result of the increase in mass of the large body of matter. The total space point momentum due the increase in mass of the large body is therefore equal to the momentum impacting the particle of matter above divided by the fraction of frontal area covered by the smallest particle of matter as compared to the total area of a sphere of radius r (the distance between the small particle and the center of the large body of matter). This is equal to the two dimensional area of the smallest particle of matter divided by the total surface area of a sphere of space with radius r.

The fraction of total large body momentum impacting the smallest particle of matter =
particle two dimensional area / total area of sphere with radius r =

$$\frac{\pi(r_1)^2}{4\pi r^2} = \frac{(r_1)^2}{4r^2} \tag{28}$$

where r_1= radius of the small unit of matter

The total momentum caused by the increase in mass of the large body equals the total space point momentum divided by the fraction of total large body momentum impacting the small particle of mater =

$$\frac{Gm_1m_2t}{2r^2} X \frac{4r^2}{(r_1)^2} = \frac{2Gm_1m_2t}{(r_1)^2} \tag{29}$$

Recalling that the space energy points are traveling at the speed of light, the total momentum above can be expressed in the following terms

$$\frac{2Gm_1m_2t}{(r_1)^2} = m_{totalpoints}c \tag{30}$$

where $m_{totalpoints}$ = the sum of the mass of all space points through surface of sphere of r radius over time t

Solving for the total mass of the space point flux

$$m_{totalpoints} = \frac{2Gm_1m_2t}{c(r_1)^2} \tag{31}$$

$$\text{Dividing by time} \qquad MassFlux = \frac{2Gm_1m_2}{c(r_1)^2} \tag{32}$$

Recalling that the net flux of space points near a body of matter equals the mass gain of the larger body

$$\text{the rate of mass gain of } m_2 = \frac{2Gm_1m_2}{c(r_1)^2} \tag{33}$$

$$\text{Dividing by } m_2 \text{ to obtain the fractional rate of mass gain of } m_2 \; = \frac{2Gm_1}{c(r_1)^2} \tag{34}$$

NC025867

References

[1] M. S. Roberts and R. N. Whitehurst. The Rotation Curve and Geometry of M31 at Large Galactocentric Distances. *ApJ* , 201, 327 (1975)

[2] M. Milgrom. On The Use Of Galaxy Rotation Curves To Test The Modified Dynamics. *The Astrophysical Journal* , 333, 689 (1988)