Relative Universe

A special theory of gravitation

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Abstract: Gravitation is the relative density of space-time caused by the mass of an object. There are three aspects of gravitation. First, it is related to an object. Gravitation can cause changes in the velocity of an object. Second, it is related to a photon, gravitation can change the frequency of a photon. Third, it is related to differences in the result of observation. Different observers of the same object can yield different results. Gravitation causes differences in the period of an event, differences in the length of an object, and differences in the mass or energy of an object.

Keywords: Expanding universe, Pseudo movement, Relative universe, Special theory of gravitation.

1. INTRODUCTION

According to Newtonian mechanics, gravitation is the force that every object exerts on every other object. The value of the gravitational force is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

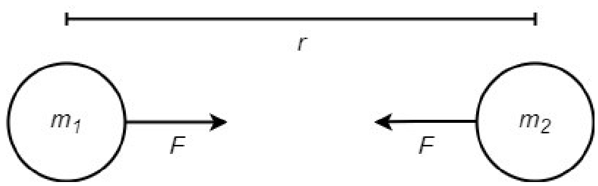

Figure1

$$F = G\frac{m_1 m_2}{r^2}$$

Where

F is the force between two objects.

G is the gravitational constant.

m_1 and m_2 are the masses of the objects.

r is the distance between the two objects.

If the value of object m_1 is much higher than object m_2, there is an equation for gravitation.

$$g = G\frac{m_1}{r^2}$$

Where

g is gravitation.

2. POTENTIAL ENERGY AND KINETIC ENERGY

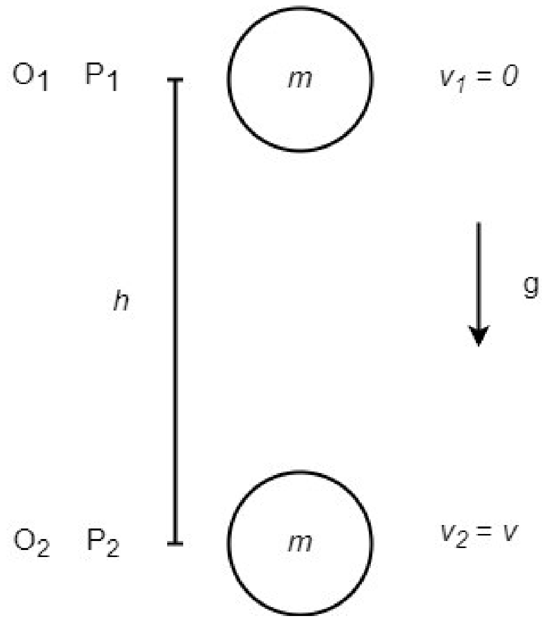

Figure 2

O_1 is Observer1, O_2 is Observer2, P_1 is Position1, P_2 is Position2, and h is the height between P_1 and P_2. An object with mass m is dropped at position P_1. The initial velocity V is $V_1 = 0$. The object then free-falls to position P_2. At P_2 the velocity of the object is $V_2 = V$.

The object has potential and kinetic energy. Potential energy is energy held by an object because of its height. Kinetic energy is a form of energy held because of its motion.

$$E_p = mgh$$

E_p is potential energy, m is the mass of the object, g is gravitation and h is the height of the object.

$$E_k = \frac{1}{2}mv^2$$

E_k is kinetic energy, m is the mass of the object, and v is the velocity of the object.

When the object is dropped from a height there is a change in energy from potential energy to kinetic energy.

When the position of the object is at P_1 $E_p = mgh$ and $E_k = 0$ because $V = 0$.

When the position of the object is at P_2 $E_p = 0$ because $h = 0$ and $E_k = \frac{1}{2}mv^2$.

The total energy consisting of potential energy and kinetic energy is constant. There are only changes in the forms of energy.

$$mgh_1 + \frac{1}{2}mv_1^2 = mgh_2 + \frac{1}{2}mv_2^2$$

3. DIFFERENCE IN TOTAL ENERGY DUE TO DIFFERENCE IN OBSERVER POSITION

According to Einstein's special theory of relativity, mass is equivalent to energy, $E = mc^2$, where *E* is the energy of an object, *m* is the mass of an object, and *c* is the speed of light. The total energy of an object consists of rest mass energy and kinetic energy. When the speed of an object is much less than the speed of light then Newton's equation for kinetic energy $E_k = \frac{1}{2}mv^2$ is still valid.

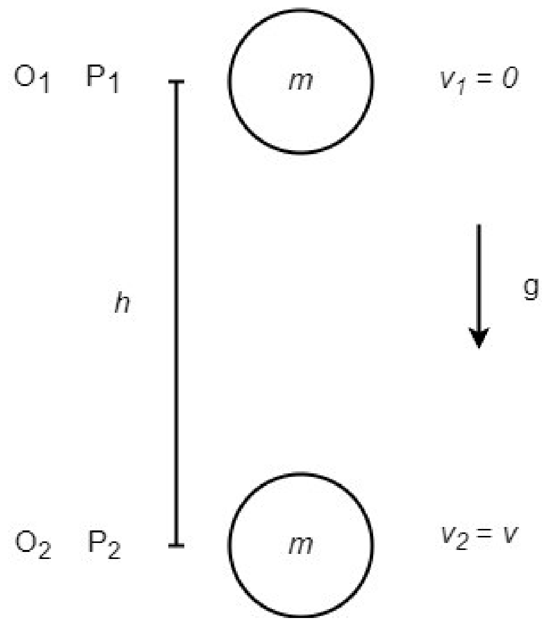

Figure 3

See Figure 3

Observer O_1 is at position P_1, and observer O_2 is at position P_2.

From the viewpoint of observer O_1 when the position of the object is at P_1.

$h = 0$ and $v = 0$.

Therefore

$E_r = mc^2$, where E_r is the rest energy.

E_p is potential energy $= mgh$. Because $h = 0$ then $E_p = 0$,

$E_k = \frac{1}{2}mv^2$, and because $v = 0$ then $E_k = 0$

The total energy $= mc^2 + mgh + \frac{1}{2}mv^2 = mc^2$ or $E_t = E_r$

When the position of the object is at P2.

$h = -h$ and $v = v$

$E_r = mc^2$

$E_p = -mgh$,

and $E_k = \frac{1}{2}mv^2$

The total energy $= mc^2 - mgh + \frac{1}{2}mv^2 = mc^2$ or $E_t = E_r$

because $mgh = \frac{1}{2}mv^2$.

From the viewpoint of observer O_2 when the position of the object is at P_1:

$h = h$ and $v = 0$

$E_p = mgh$,

and $E_k = \frac{1}{2}mv^2$ $E_k = 0$ because $v = 0$.

And total energy $= mc^2 + mgh + \frac{1}{2}mv^2 = mc^2 + mgh$ or $E_t = E_r + E_p$, because $v = 0$.

When the position of the object is at P_2,

$h = 0$ and $v = v$.

$E_p = mgh$, $E_p = 0$

and $E_k = \frac{1}{2}mv^2$

and total energy $= mc^2 + mgh + \frac{1}{2}mv^2 = mc^2 + \frac{1}{2}mv^2$, because $h = 0$

or total energy $E_t = E_r + E_k$

or total energy $E_t = E_r + E_p$

because $mgh = \frac{1}{2}mv^2$ or $E_p = E_k$.

Observer	Total energy		Difference in the total energy
	Position object at P_1	Position object at P_2	
O_1	$E_t = E_r$	$E_t = E_r + E_k - E_p = E_r$	No
O_2	$E_t = E_r + E_p$	$E_t = E_r + E_k$ or $E_t = E_r + E_p$ Because $E_k = E_p$	No
Difference in the total energy	Yes	Yes	

Table 1

We can see that the cause of the difference in total energy is the position of the observer, not the position of the object

4. LIGHT AND GRAVITATION

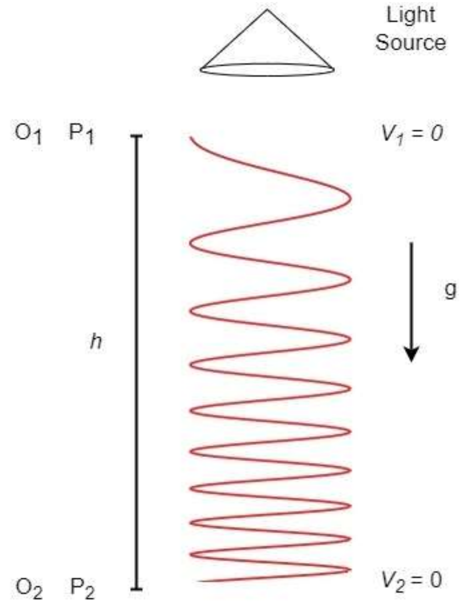

Figure 4

When light is directed from position P_1 to P_2, there is a change in the frequency of the light. Observer O_2 at position P_2 will detect a higher frequency of light than the frequency detected by observer O_1 at position P_1

From the viewpoint of observer O_1 at position P_1

$$v = v_1$$

$$T_1 = \frac{1}{v_1}$$

$$\lambda_1 = \frac{c}{v_1}$$

$$E_1 = hv_1$$

From the viewpoint of observer O_2 at position P_2

$$v = v_2$$

$$T_2 = \frac{1}{v_2}$$

$$\lambda_2 = \frac{c}{v_2}$$

$$E_2 = hv_2$$

$v_1 < v_2$, $\lambda_1 > \lambda_2$, $T_1 > T_2$, and $E_1 < E_2$

v is the light frequency.

h is the Planck constant.

λ is the light wavelength.

T is the wave period of light.

Compared to observer O_1 at position 1, observer O_2 at position 2 observes that the wave period of the light is slower, the wavelength is shorter and the energy is higher.

Observer	Wavelength	Frequency	Period	Energy
O_1	λ_1	v_1	T_1	$E_1 = hv_1$
O_2	λ_2	v_2	T_2	$E_2 = hv_2$
Comparison	$\lambda_1 > \lambda_2$	$v_1 < v_2$	$T_1 > T_2$	$E_1 < E_2$

Table 2

Note that the light observed by observers O_1 and O_2 is the same light and from the same source. The difference in wavelength, frequency and period is due to differences in the position of the observers.

5. GRAVITATION AS THE RELATIVE DENSITY OF SPACE-TIME

There are three aspects of gravitation. First, related to an object, gravitation can cause changes in the velocity of an object. Second, related to photons, gravitation can change the frequency of photons. Third, related to the difference in the result of observation. Different observers of the same object observation can yield different results. Gravitation causes differences in the period of an event, differences in the length of an object, and differences in the mass or energy of an object.

From sections 3 and 4 we see that there are differences in the total energy of objects and differences in wavelength, frequency, period, and energy of photons. The differences are because of the difference in the position of observers. I introduce gravitation *d* as the relative density of space-time. The value of *d* is the ratio of the total energy of an object observed from different positions. The value of *d* is relative. The closer the position of the observer to a high-mass object the higher the value of *d*. Figure 5 is the visualization of the relative density of space-time *d*. Darker color means a higher value of relative density of space-time *d*. The closer the position to the high-mass object the darker the color.

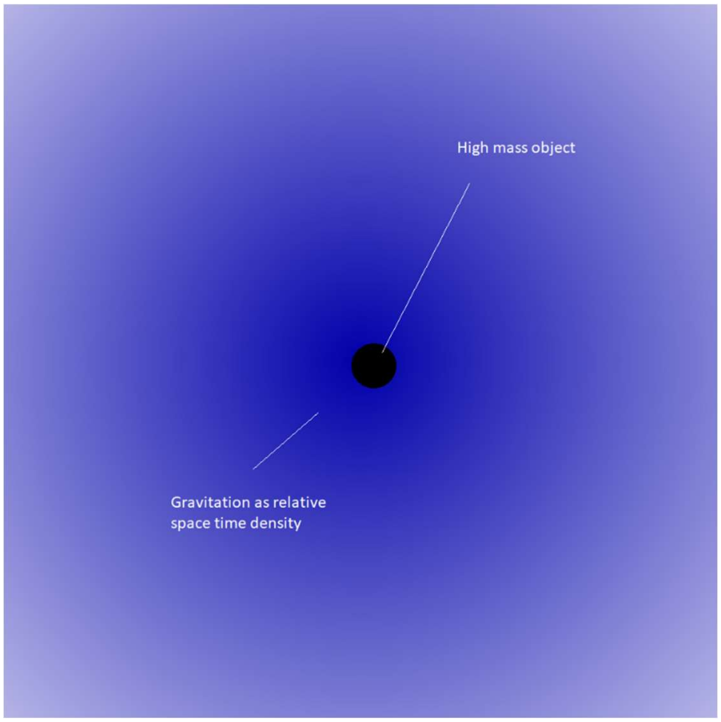

Figure 5

d is the relative value of space-time density. It can be seen as the relative value of total energy, relative time interval, or relative length of an object.

There is an object with mass observed by observer O_1 at position 1 and observer O_2 at position 2. Observer O_1 concludes that the mass of the object is m_1 while observer O_2 concludes that the mass of the object is m_2. The relative space-time density from position 1 to position 2 is

$$d_{relative\ from\ position\ 1\ to\ position\ 2} = \frac{m_{mass\ observed\ by\ observer\ 1}}{m_{mass\ observed\ by\ observer\ 2}}$$

Or $d_{12} = \dfrac{m_1}{m_2}$

and because mass is equal to energy, $E = mc^2$ then $E_1 = m_1c^2$ and $E_2 = m_2c^2$. Therefore the relative space-time density from position 1 to position 2 is

$$d_{12} = \frac{E_1}{E_2}$$

There is an event with a time interval observed by observer O_1 at position 1 and observer O_2 at position 2. Observer O_1 concludes that the time interval of the event is t_1, while Observer O_2 concludes that the time interval of the event is t_2. The relative space-time density from position 1 to position 2 is

$$d_{12} = \frac{t_{time\ interval\ observed\ by\ observer\ 2}}{t_{time\ interval\ observed\ by\ observer\ 1}}$$

Or $d_{12} = \dfrac{t_2}{t_1}$

There is an object with length observed by observer O_1 at position 1 and observer O_2 at position 2. Observer O_1 concludes that the length of the object is l_1, while Observer O_2 concludes that the length of the object is l_2. The relative space-time density from position 1 to position 2 is

$$d_{12} = \frac{l_{lengt\ \ of\ object\ observed\ by\ observer\ 2}}{l_{length\ of\ object\ observed\ by\ observer\ 1}}$$

Or $d_{12} = \dfrac{l_2}{l_1}$

Other formulas for relative space − time density are

$d_{12} = \dfrac{1}{d_{21}}$ and $d_{21} = \dfrac{1}{d_{12}}$

$$d_{31} = d_{32}.d_{21}$$

$$d_{11} = d_{22} = 1$$

With boundary

$$0 < d_{xy} < \infty$$

6. CALCULATION OF RELATIVE DENSITY OF SPACE-TIME

Two-Step Calculation

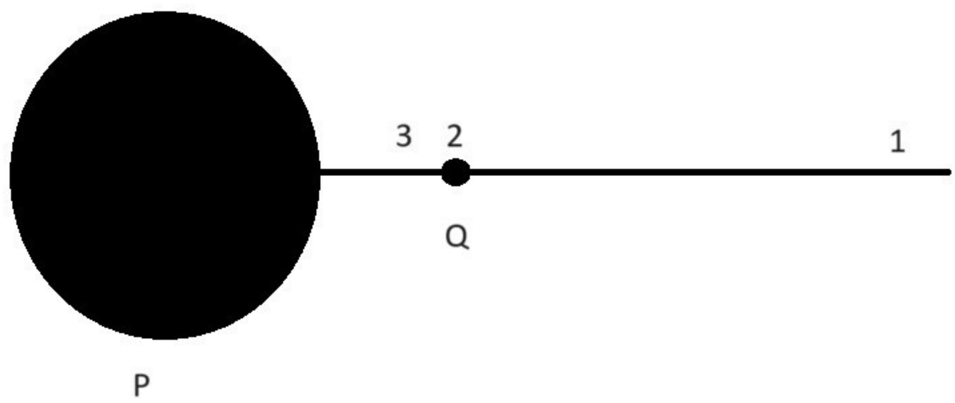

Figure 6

P and Q are objects with mass. 1, 2 and 3 are the positions of observers and the relative density of space-time.

Relative density of space-time from position 3 to 2

Calculation from position 2

Let:

$E_t =$ Total energy of object Q

d_{32} = Relative Density of Space-time from position 3 to 2

E_p = Potential energy of object Q

m_2 = Relative mass of object Q observed from position 2

M_2 = Relative mass of object P observed from position 2

r_{22} = Relative distance from object P to position 2 observed from position 2

r_{32} = Relative distance from object P to position 3 observed from position 2

$-\frac{GMm}{r}$ = Gravitational potential energy.

$$d_{32} = \frac{E_{t\ observed\ by\ observer\ from\ position\ 3}}{E_{t\ observed\ by\ observer\ from\ position\ 2}}$$

or

$$d_{32} = \frac{E_{t3}}{E_{t2}}$$

$$E_{t2} = m_2 c^2$$

$$E_{t3} = m_2 c^2 + E_{p\ (from\ position\ 3\ to\ 2)}$$

$$E_p = -\left(\frac{GM_2m_2}{r_{22}} - \frac{GM_2m_2}{r_{32}}\right)$$

$$E_p = \frac{GM_2m_2}{r_{32}} - \frac{GM_2m_2}{r_{22}}$$

$$E_p = GM_2m_2(\frac{1}{r_{32}} - \frac{1}{r_{22}})$$

$$E_p = GM_2m_2(\frac{r_{22} - r_{32}}{r_{22}r_{32}})$$

$$d_{32} = \frac{E_{t3}}{E_{t2}}$$

$$d_{32} = \frac{E_{t2} + E_p}{E_{t2}}$$

$$d_{32} = \frac{m_2c^2 + GM_2m_2\ (\frac{r_{22} - r_{32}}{r_{22}r_{32}})}{m_2c^2}$$

$$d_{32} = 1 + \frac{GM_2(r_{22} - r_{32})}{r_{22}r_{32}c^2}$$

Calculation from position 1

d_{21} = Relative density of space-time from position 2 to position 1.

m_1 = Relative mass of object Q observed from position 1.

M_1 = Relative mass of object P observed from position 1.

r_{21} = Relative distance from object P to position 2 observed from position 1.

r_{31} = Relative distance from object P to position 3 observed from position 1.

$$M_2 = d_{21}\ M_1$$

$$r_{22} = \frac{r_{21}}{d_{21}}$$

$$r_{32} = \frac{r_{31}}{d_{21}}$$

$$d_{32} = 1 + \frac{GM_2(r_{22} - r_{32})}{r_{22}r_{32}c^2}$$

Substituting M_2 to M_1, r_{22} to $r_{21}\ r_{22}$, and r_{32} to r_{31}

$$d_{32} = 1 + \frac{Gd_{21}^3M_1(r_{21} - r_{31})}{d_{21}r_{21}r_{31}c^2}$$

$$d_{32} = 1 + \frac{Gd_{21}^2M_1(r_{21} - r_{31})}{r_{21}r_{31}c^2}$$

Multi-Step Calculation

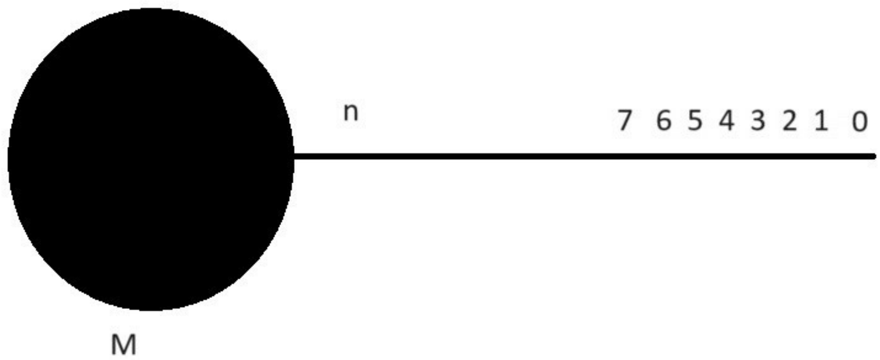

Figure 7

M is an object with mass. 0, 1, 2, 3, 4, 5, 6, 7, …n are the positions of observers and the relative density of space-time

Let:

d_{n0} = Relative density of space-time from position n to position 0.

d_{10} = Relative density of space-time from position 1 to position 0.

d_{21} = Relative density of space-time from position 2 to position 1.

$d_{n(n-1)}$ = Relative density of space-time from position n to position (n-1).

M_0 = Relative mass of object M observed from position 0.

M_1 = Relative mass of object M observed from position 1.

$M_{(n-1)}$ = Relative mass of object M observed from position (n-1).

$n \to \infty$.

$$d_{n0} = d_{10}.d_{21}.d_{32}.d_{43}.d_{54}.d_{65} \dots d_{n(n-1)}$$

For brevity let

$$P_{n0} = \frac{GM_0(r_{00} - r_{n0})}{r_{00}r_{n0}c^2}$$

$$P_{10} = \frac{GM_0(r_{00} - r_{10})}{r_{00}r_{10}c^2}$$

$$P_{21} = \frac{GM_1(r_{11} - r_{21})}{r_{11}r_{21}c^2}$$

$$P_{32} = \frac{GM_2(r_{22} - r_{32})}{r_{22}r_{32}c^2}$$

$$P_{n(n-1)} = \frac{GM_{n-1}(r_{(n-1)(n-1)} - r_{n(n-1)})}{r_{(n-1)(n-1)}r_{n(n-1)}c^2}$$

For simplicity let

P_{10}=P_{21}=P_{32}=…=$P_{n(n-1)}$

P_{10}+P_{21} + P_{32} +…+$P_{n(n-1)}$=P_{n0}

$$n = \frac{P_{n0}}{P_{10}} \; or \; P_{10} = \frac{P_{n0}}{n}$$

Relative density d from position 1 to position 0

$$d_{10} = 1 + \frac{GM_0(r_{00} - r_{10})}{r_{00}r_{10}c^2} = 1 + P_{10}$$

And furthermore.

$$d_{21} = 1 + \frac{GM_1(r_{11} - r_{21})}{r_{11}r_{21}c^2} = 1 + \frac{Gd_{10}^2M_0(r_{10} - r_{20})}{r_{10}r_{20}c^2} = 1 + d_{10}^2P_{21} = 1 + d_{10}^2P_{10}$$

$$d_{32} = 1 + \frac{GM_2(r_{22} - r_{32})}{r_{22}r_{32}c^2} = 1 + \frac{Gd_{20}^2M_0(r_{20} - r_{30})}{r_{20}r_{30}c^2} = 1 + \frac{Gd_{21}^2d_{10}^2M_0(r_{20} - r_{30})}{r_{20}r_{30}c^2} = 1 + d_{10}^4P_{32} = 1 + d_{10}^4P_{10}$$

$$\begin{aligned} d_{n(n-1)} &= 1 + \frac{GM_{(n-1)}(r_{(n-1)(n-1)} - r_{n(n-1)})}{r_{n(n-1)}r_{(n-1)(n-1)}c^2} = 1 + \frac{G(d_{(n-1)0}^2)M_0(r_{(n-1)0} - r_{n0})}{r_{(n-1)0}r_{n0}c^2} \\ &= 1 + \frac{G(d_{(n-1)(n-2)}^2)(d_{(n-2)(n-3)}^2)(d_{(n-3)(n-4)}^2) \dots d_{10}^2M_0(r_{n0} - r_{(n-1)0})}{r_{n0}r_{(n-1)0}c^2} = 1 + d_{10}^{2(n-1)}P_{n(n-1)} \\ &= 1 + d_{10}^{2(n-1)}P_{10} \end{aligned}$$

$$d_{n0} = d_{10}.d_{21}.d_{32}.d_{43}.d_{54}.d_{65} \dots d_{n(n-1)}$$

$$d_{n0} = (1 + P_{10})(1 + d_{10}^2P_{10})(1 + d_{10}^4P_{10}) \dots (1 + d_{10}^{2n}P_{10})$$

Consider

$$e^y = (1 + Z_1)(1 + Z_2)(1 + Z_3)(1 + Z_4) \dots (1 + Z_n)$$

Where

$Z_x \to 0$ and

$$\sum_{x=1}^{x=n} Z_x = y$$

$$d_{n0} = (1 + P_{10})(1 + d_{10}^2P_{10})(1 + d_{10}^4P_{10}) \dots (1 + d_{10}^{2(n-1)}P_{10})$$

Let

$$A = P_{10} + d_{10}^2P_{10} + d_{10}^4P_{10} + d_{10}^6P_{10} + \dots + d_{10}^{2(n-1)}P_{10}$$

$$d_{10}^2A = d_{10}^2P_{10} + d_{10}^4P_{10} + d_{10}^6P_{10} + \dots + d_{10}^{2(n-1)}P_{10} + d_{10}^{2n}P_{10}$$

$$d_{10}^2A - A = d_{10}^{2n}P_{10} - P_{10}$$

$$A(d_{10}^2 - 1) = d_{10}^{2n}P_{10} - P_{10}$$

$$A = \frac{d_{10}^{2n} P_{10} - P_{10}}{d_{10}^2 - 1}$$

$$A = \frac{d_{10}^{2n} P_{10} - P_{10}}{(1 + P_{10})^2 - 1}$$

$$A = \frac{d_{10}^{2n} P_{10} - P_{10}}{(1 + 2P_{10} + P_{10}^2) - 1}$$

$$A = \frac{d_{10}^{2n} P_{10} - P_{10}}{(2P_{10} + P_{10}^2)}$$

P_{10}^2 can be ignored because it is much smaller than $2P_{10}$.

$$A = \frac{d_{10}^{2n} P_{10} - P_{10}}{2P_{10}}$$

$$A = \frac{d_{10}^{2n} - 1}{2}$$

Substituting

$$d_{10} = 1 + P_{10}$$

$$A = \frac{(1 + P_{10})^{2n} - 1}{2}$$

Substituting

$$P_{10} = \frac{P_{n0}}{n}$$

$$A = \frac{(1 + \frac{P_{n0}}{n})^{2n} - 1}{2} = \frac{e^{(2P_{n0})} - 1}{2}$$

$$A = P_{10} + d_{10}^2 P_{10} + d_{10}^4 P_{10} + d_{10}^6 P_{10} + \ldots + d_{10}^{2(n-1)} P_{10}$$

$$d_{n0} = (1 + P_{10})(1 + d_{10}^2 P_{10})(1 + d_{10}^4 P_{10}) \ldots (1 + d_{10}^{2(n-1)} P_{10})$$

$$d_{n0} = e^A$$

Substituting

$$A = \frac{e^{(2P_{n0})} - 1}{2}$$

$$d_{n0} = e^{(\frac{e^{(2P_{n0})} - 1}{2})}$$

Where

$$P_{n0} = \frac{GM_0(r_{00} - r_{n0})}{r_{00} r_{n0} c^2}$$

For $r_{00} \rightarrow \infty$ the equation for P_{n0} can be simplified to

$$P_{n0} = \frac{GM_0}{r_{n0} c^2}$$

7. RELATIVE DENSITY OF SPACE-TIME FROM MERCURY PLANET TO EARTH.

Let

G = Gravitational constant = 6.67384 x 10^{-1} $m^3kg^{-1}s^{-2}$

M_e= Mass of the sun observed from Earth =1.98847 x 10^{30} kg

r_{me} = Distance from the sun to Mercury observed from Earth = 5.74 x 10^{10} m or 0.574x10^{11} m

r_{ee} = Distance from the sun to Earth observed from Earth = 1.496 x10^{11} m or 14.496 x10^{10} m

c = Speed of light = 3 x 10^8 ms^{-1}

The relative density d of space-time from Mercury planet to Earth is

$$d_{mercury\ eart} = d_{me} = e^{(\frac{e^{(2P_{me})}-1}{2})}$$

$$P_{me} = \frac{GM_e(r_{ee} - r_{me})}{r_{ee}r_{me}c^2}$$

$$P_{me} = \frac{6.67384 \text{ x } 10^{-1} \quad 1.98847 \text{ x } 10^{30}(1.496 \text{ x}10^{11} - 0.574 \text{ x } 10^{11})}{1.496 \text{ x}10^{11}\text{x } 5.74 \text{ x}10^{10} \text{ x } 9 \text{ x } 10^{16}}$$

$$P_{me} = \frac{12.2356136 \text{ x } 10^{30}}{77.28336 \text{ x}10^{37}}$$

$$P_{me} = 1.58321 \text{ x } 10^{-8}$$

$$d_{me} = e^{(\frac{e^{(2x\ 1.58321 \text{ x } 10^{-8})}-1}{2})}$$

Consider

$$e^n = 1 + n$$

if $|n| \ll 1$

$$d_{me} = e^{(\frac{1+\ (2x\ 1.58321 \text{ x } 10^{-8})-1}{2})}$$

$$d_{me} = e^{(\frac{2x\ 1.58321 \text{ x } 10^{-8}}{2})}$$

$$d_{me} = e^{1.58321 \text{ x } 10^{-8}}$$

$$d_{me} = 1 + 1.58321 \text{ x } 10^{-8}$$

If light with a frequency of 5 x 10^{14} Hz is emitted from Earth's orbit, then when it reaches Mercury's orbit, its frequency is $(1 + 1.58321 \text{ x } 10^{-8})$ x 5 x 10^{14} Hz = (5 x 10^{14} + 7,91605 x 10^6)Hz indicating gravitational blueshift. If light with a frequency of 5 x 10^{14} Hz is emitted from Mercury's orbit, then when it reaches Earth's orbit, its frequency is $5 \text{ x } 10^{14}/(1 + 1.58321 \text{ x } 10^{-8})$ Hz = (5 x 10^{14} - 7,91605 x 10^6)Hz indicating gravitational redshift.

If a ball with a mass of 2 kgs is dropped from Earth's orbit toward the sun when it reaches Mercury's orbit, its total mass is $(1 + 1.58321 \text{ x } 10^{-8})$ x 2 kgs = (2 + 3,16642 x 10^{-8}) kgs. The velocity of the ball when it reaches Mercury's orbit is

m_e= Mass of the ball at Earth's orbit = = (2 + 3,16642 x 10^{-8}) kgs

m_m= Mass of the ball at Mercury's orbit = 2 kgs

V= Velocity of the ball at mercury orbit

c= Velocity of light = 3 x 10^8 m/s

$$m_m = \frac{m_e}{\sqrt{1 - \frac{V^2}{c^2}}}$$

$$m_m^2 = \frac{m_e^2}{1 - \frac{V^2}{c^2}}$$

$$1 - \frac{V^2}{c^2} = \frac{m_e^2}{m_m^2}$$

$$-\frac{V^2}{c^2} = \frac{m_e^2}{m_m^2} - 1$$

$$\frac{V^2}{c^2} = 1 - \frac{m_e^2}{m_m^2}$$

$$V^2 = (1 - \frac{m_e^2}{m_m^2})c^2$$

$$V^2 = (1 - \frac{2^{\ 2}}{(2\ +\ 3{,}16642 \text{ x } 10^{-8})^2})c^2$$

$$V^2 = (1 - \frac{4}{(4\ +\ 12.66568 \text{ x } 10^{-8} + 10.02622\text{x } 10^{-16})})c^2$$

$10.02622\text{x } 10^{-16}$ is very small compared to $12.66568 \text{ x } 10^{-8}$and can be ignored.

$$V^2 = (1 - \frac{4}{(4\ +\ 12.66568 \text{ x } 10^{-8})})c^2$$

$12.66568 \text{ x } 10^{-8}$ is very small compared to 4 so equation can be modified.

$$V^2 = (1 - \frac{4 - 12.66568 \text{ x } 10^{-8}}{4})c^2$$

$$V^2 = (\frac{12.66568 \text{ x } 10^{-8}}{4})c^2$$

$$V^2 = 3{,}16642 \text{ x } 10^{-8} c^2$$

$$V = \sqrt{3{,}16642 \text{ x } 10^{-8}} \text{ x } 3\text{x } 10^8$$

$$V = 1.7794 \text{ x } 10^{-4} \text{ x } 3\text{x } 10^8$$

$$V = 5.33883 \text{ x } 10^4\ m/s$$

Because the value of P_{me} is very small, the calculation using the classic method will result in the same result.

$$E_k = E_p$$

$$\tfrac{1}{2}\text{m}v^2 = -\left(\frac{GMm}{r_e} - \frac{GMm}{r_m}\right)$$

$$\tfrac{1}{2}\text{m}v^2 = \frac{GMm}{r_m} - \frac{GMm}{r_e}$$

$$\tfrac{1}{2}\text{m}v^2 = GMm\ (\frac{1}{r_m} - \frac{1}{r_e})$$

$$\tfrac{1}{2}\text{m}v^2 = GMm\ (\frac{r_e - r_m}{r_e r_m})$$

$\frac{1}{2}v^2 = GM\ (\frac{r_e - r_m}{r_e r_m})$

$v^2 = 2GM\ (\frac{r_e - r_m}{r_e r_m})$

$$v^2 = \frac{2 \text{ x } 6.67384 \text{ x } 10^{-11}\ 1.98847 \text{ x } 10^{30}(1.496 \text{ x}10^{11} - 0.574 \text{ x } 10^{11})}{1.496 \text{ x}10^{11}\text{x } 5.74 \text{ x}10^{10}}$$

$$v^2 = \frac{24.47122 \text{ x } 10^{30}}{8.587041 \text{ x}10^{21}}$$

$v^2 = 2.8497845 \text{ x } 10^9$

$V = 5.33883 \text{ x } 10^4\ m/s$

In addition, there are differences in the results between observers on Earth and observers on Mercury.

Object of the observations	Result from Earth	Calculation from Mercury	Calculation result from Mercury
Mass of the sun	$1.98847 \text{ x } 10^{30}$kg	$(1 + 1.58321 \text{ x } 10^{-8})$ x $1.98847 \text{ x } 10^{30}$ kg	$1.98847 \text{ x } 10^{30}$kg + $3.14817 \text{ x } 10^{22}$kg
Distance from Mercury to the sun	$5.79 \text{ x } 10^{10}$m	$\frac{5.79 \text{ x } 10^{10}}{1+1.58321 \text{ x } 10^{-8}}$ m	$5.79 \text{ x } 10^{10}$.m – 366 m
Diameter of the sun	$1.3927 \text{ x } 10^9$.m	$\frac{1.3927 \text{ x } 10^9}{1 + 1.58321 \text{ x } 10^{-8}}$ m	$1.3927 \text{ x } 10^9$.m - 22.05 m
Average rotating the sun on axis	27 days = $2.3328 \text{ x } 10^6$s	$\frac{2.3328 \text{ x } 10^6}{1 + 1.58321 \text{ x } 10^{-8}}$ s	27 days – 0.036 s
Mass of the universe	$1.73 \text{ x } 10^{53}$kg	$(1 + 1.58321 \text{ x } 10^{-8})$ x $1.73 \text{ x } 10^{53}$ kg	$1.73 \text{ x } 10^{53}$kg + $2.739 \text{ x } 10^{45}$kg
Diameter of the universe	$93.016 \text{ x } 10^9$ light years	$\frac{93.016 \text{ x } 10^9}{1 + 1.58321 \text{ x } 10^{-8}}$ light years	$93.016 \text{ x } 10^9$ light years – 1472.64 light years

Table 3

8. LARGER DENSITY OBJECT

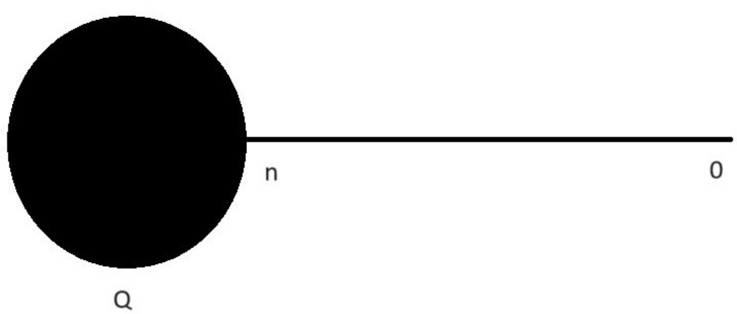

Figure 8

The object Q has a mass 2 times that of the Sun and a diameter of 3 km. Observer O1 at position 0 is at a relative distance from object Q.

M_0 =$3.976941 \text{ x } 10^{30}$ kg

$r_{n0} = 3000$ m

G = Gravitational constant = 6.67384 x 10^{-1} $m^3kg^{-1}s^{-2}$

c = Speed of light = 3 x 10^8 ms^{-1}

$$P_{n0} = \frac{GM_0}{r_{n0}c^2}$$

$$P_{n0} = \frac{6.67384 \text{ x } 10^{-1} \text{ x } 3.976941 \text{ x } 10^{30}}{3 \text{ x } 10^3 \text{ x } 9 \text{ x } 10^{16}}$$

$$P_{n0} = 0.983017$$

$$d_{n0} = e^{(\frac{e^{(2P_{n0})}-1}{2})}$$

$$d_{n0} = e^{(\frac{e^{(2 \text{ x } 0.983017)}-1}{2})}$$

$$d_{n0} = e^{(\frac{e^{(1.966035)}-1}{2})}$$

$$d_{n0} = e^{(\frac{7.142301-1}{2})}$$

$$d_{n0} = e^{3.07115}$$

$$d_{n0} = 21.5669$$

Rounded

$$d_{n0} = 22$$

If light with a frequency of 5 x 10^{14} Hz is emitted from position 0 toward object Q, then when it reaches position n its frequency is 22 x 5 x 10^{14} Hz = 1.10 x 10^{16} Hz. If light with a frequency of 5 x 10^{14} Hz is emitted from position n, then when it reaches position 0, its frequency is 5 x $10^{14}/22$ Hz = 22.73 x 10^{12} Hz.

For the result of object observations from position 0 and position n see the table below.

Object of the observations	Result from position 0	Result from position 0
Mass of the object Q	3.976941 x 10^{30} kg	22 x 3.976941 x 10^{30} kg = 8.74927 x 10^{31}
Diameter of the sun	1.3927 x 10^9.m	1.3927 x $10^9/22$ m = 6.3305 x 10^7.m
Average rotating the sun on axis	27 days = 2.3328 x 10^6s	2.3328 x $10^6/22$ s = 1.0604 x 10^5.s
Mass of the universe	1.73 x 10^{53}kg	22 x 1.73 x 10^{53} kg= 3.806 x 10^{54} kg
Diameter of the universe	93.016 x 10^9 light years	93.016 x $10^9/22$ = 4.228 x 10^9 light years

Table 4

9. RELATIVE UNIVERSE

From Tables 3 and 4, we can conclude that the observation of mass, length, and rotation period of an object differs depending on the position of the observer on Earth, Mercury, and other places. There are many places in the universe, and the values of the relative density of space-time differ from one place to another. Therefore, the mass, length, and period of an object differ between them. The result is that there are no absolute values of mass, length, and period of objects in the universe, only relative values. The mass and diameter of the universe are relative values observed from Earth. There are many places outside Earth with a relative value of d lower than 1, such as a location far from the star at the edge of our galaxy, or a value of d much larger than 1, as at a location at the neutron star.

10. LOCALIZATION PRINCIPLE

Observer O_1 and observer O_2 are at different positions, with O_1 at position P_1 and O_2 at position P_2. Let the relative density from P_1 to P_2 be d_{12}= 1.6 or $d_{21} = \frac{1}{d_{12}} = \frac{1}{1.6} = 0.625$.

They observe the object's carbon-12 atomic mass, quartz crystal vibration, and hydrogen atom Bohr radius at each position:

Observer O_1's results:

Carbon-12 atomic mass = 12 amu (atomic mass unit)

Quartz crystals vibrate at 32768 times per second

Hydrogen Bohr radius = 1.00054 Å (Ångström)

Observer O_2's results:

Carbon-12 atomic mass = 12 amu

Quartz crystals vibrate at 32,768 times per second

Hydrogen Bohr radius = 1.00054 Å

Localization principle: Every observer has the same result when they observe an object of the same kind at the same position.

But if observer O_1 at position P_1observes objects at position P_2 with $d_{12} = 1.6$ the results are:

Carbon-12 atomic mass = d_{21}x 12 amu = 1.6 x 12 amu = 19.2 amu

Quartz crystals vibrate at d_{12} x 32,768 times per second = 1.6 x 32768 = 52,428 times per second

Hydrogen Bohr radius = $\frac{1}{d_{12}}$ x 1.00054 Å = $\frac{1}{1.6}$ x 1.00054 Å = 0.62534 Å

And if observer O_2 at position P_2 observes objects at position P_1 with $d_{21} = 0.625$ the results are:

Carbon-12 atomic mass = d_{21}x 12 amu = 0.625 x 12 amu = 7.5 amu

Quartz crystals vibrate at d_{21} x 32,768 times per second = 0.625 x 32768 = 20,480 times per second

Hydrogen Bohr radius = $\frac{1}{d_{21}}$ x 1.00054 Å = $\frac{1}{0.625}$x 1.00054 Å = 1.600864 Å

11. PSEUDO MOVEMENT

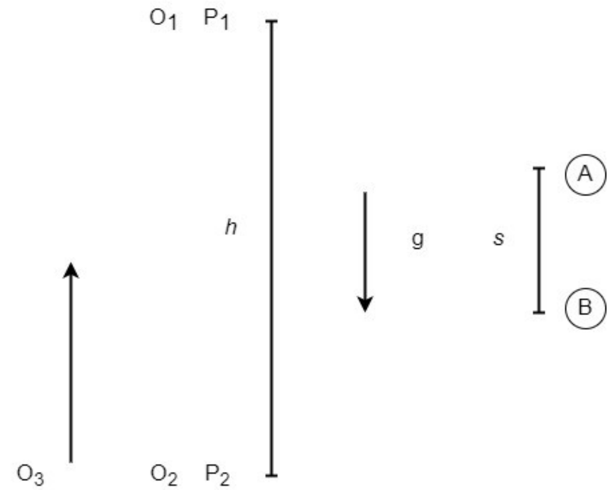

Figure 9

Observer O_1 stays still at position P_1, observer O_2 stays still at position P_2 and observer O_3 moves from position P_2 to position P_1. Object A and object B do not move.

S_1 = Distance from position A to position B as observed by Observer O_1

S_2 = Distance from position A to position B as observed by Observer O_2

ΔS = Pseudo distance difference.

ΔT = Time required by observer $O_3$to travel from position P_2 to position P_1.

$V_p =$ Pseudo movement

$$S_2 = \frac{1}{d_{21}}\ S_1$$

$d_{21} > 1$ Because gravity is toward position O_2, then

$S_1 > S_2$

$\Delta S = S_1 - S_2$.

$$V_p = \frac{\Delta S}{\Delta T}$$

When Observer O_3 was at position P_2 he saw the distance from A to B as S_2. When Observer O_3 arrived at Position P_1 he saw the distance from A to B as S_1. Then Observer O_3 observed the pseudo distance difference between A and B as ΔS, and the pseudo movement as $V_p = \frac{\Delta S}{\Delta T}$.

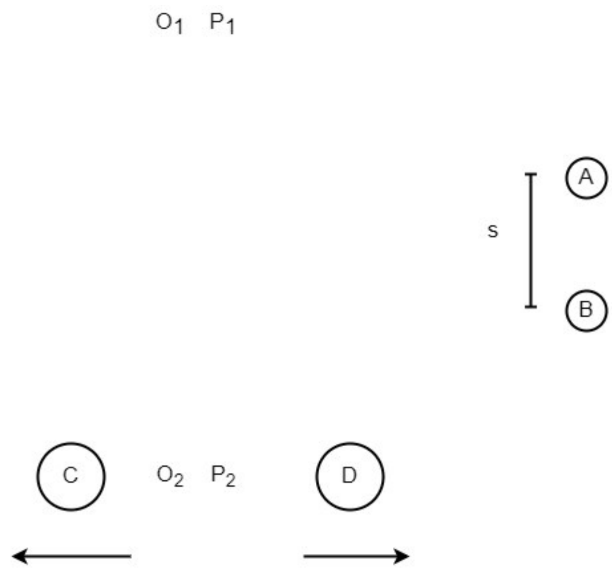

Figure 10

Observer O_1 stays still at position P_1, while observer O_2 stays still at position P_2. Object A and object B do not move. There are two objects C and D moving away from O2.

From the viewpoint of Observer O_1.

S_{1begi} = Distance of object A and object B when objects C and D begin to move away from observer O_2.

S_{1end} = Distance of object A and object B after objects C and D end moving away from observer O_2.

Because there is no change in gravitation at Observer O_1, there is no change in relative density.

$d_{end\ begin} = d_{eb} = 1$

$S_{1end} = \frac{1}{d_{eb}}\ S_{1beg}$

$S_{1end} = \ S_{1begin}$

From the viewpoint of observer O_2.

S_{2begin} = Distance of object A and object B when objects C and D begin to move away from observer O_2.

S_{2end} = Distance of object A and object B after objects C and D end moving away from observer O_2.

ΔS_2 = Pseudo distance difference.

ΔT = Time interval of objects C and D moving away from observer O_2

$V_p =$ Pseudo movement

Because of the change in the distance of objects C and D to P_2 the relative density at position P_2 changes.

$d_{end\ begin} = d_{eb} < 1$ Because objects C and D moving away from O2.

$S_{2end} = \frac{1}{d_{ab}}\ S_{2beg}$

$S_{2end} > \ S_{2beg}$

$\Delta S_2 = S_{2en} - S_{2begi}$

$$V_p = \frac{\Delta S_2}{\Delta T}$$

Observer O_2 saw that there is a pseudo distance difference with value ΔS_2, and the value of pseudo movement as $V_p = \frac{\Delta S_2}{\Delta T}$ is different from the result from Observer O_1 that there is no change in the distance between object A and object B

12. EXPANDING UNIVERSE

Since the Big Bang, our universe continues to expand. Every galaxy moves away from each other. According to section 10 the relative density caused by objects moving away from the observer is $d_{end\ begin} = d_{eb} < 1$. Let an observer on Earth observe the distance of galaxy A to galaxy B

$S_{begin} =$ Distance of galaxy A and galaxy B at the beginning of observation

$S_{end} =$ Distance of galaxy A and galaxy B at the end of observation

$v_p =$ Pseudo velocity of the expanding <u>universe.</u>

ΔT = Time interval of observation.

$v_t =$ Total velocity of the expanding universe seen by an observer.

$v_r =$ Real velocity of the expanding universe.

$d_{eb} < 1$ so there is pseudo movement.

$$S_{end} = \frac{1}{d_{eb}} S_{begin}$$

$S_{end} > S_{begin}$

$\Delta S = S_{end} - S_{begin}$

$$V_p = \frac{\Delta S}{\Delta T}$$

$v_t = v_r + v_p$

Pseudo-movement is part of the total velocity of the expanding universe seen by an observer. Pseudo-movement makes the total velocity of expansion faster than it should be.

13. DECREASING THE UNIVERSE'S MASS

There is another consequence of the expanding universe: the mass of the universe is decreasing

Let

M_b = The mass of the universe at the beginning of observation.

M_e = The mass of the universe at the end of observation.

$d_{end\ begin} = d_{eb} < 1$ because the universe is expanding.

Then

$M_e = d_{eb} M_b$,

and $M_e < M_b$

Therefore the mass of the universe is decreasing because of the expansion of the universe.

14. CONCLUSIONS

1. Gravitation is the relative density of space-time.
2. Gravitation can affect the observation results of the same object.
3 There is pseudo movement between two objects due to changes in the value of the relative density of the observer.

REFERENCES

[1.] Crowell, Benjamin, Mechanics, Light and Matter Fullerton, California, (2019).

[2.] Einstein, Albert, Relativity: The Special and General Theory, Henry Holt and Company, New York, (1920)