Relative Universe

A special theory of gravitation

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Abstract: Gravitation is the relative density of space-time caused by a mass of an object. There are three aspects of gravitation. First, related to an object. Gravitation can cause changes in the velocity of an object. Second, related to a photon, gravitation can change the frequency of a photon. Third, related to differences in the result of observation. Different observers of the same object observation can yield different results. Gravitation cause 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 of every object that attracts every other object. The value of gravitational force is directly proportional to the product of their mass and inversely proportional to the square of the distance between them.

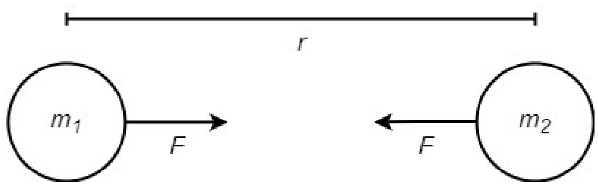

Figure1

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

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

F is the force between two objects.

G is the gravitational constant.

m_1 and m_2 are the mass of objects.

r is the distance between two objects.

g is the gravitation.

2. POTENTIAL ENERGY AND KINETIC ENERGY

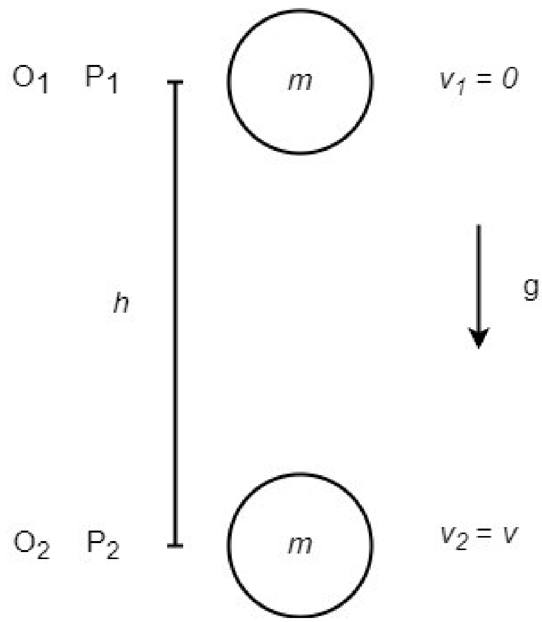

Figure 2

O_1 is Observer1, O_2 is Observer2, P_1, is Position1, P_2 is Position2, and h is height between P_1 and P_2. Object with mass m is dropped at position P_1. Initial velocity V is $V_1 = 0$. The object then free-falls to position P_2. At P_2 velocity of 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 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 $E_k = \frac{1}{2}mv^2$.

Total energy, potential energy add 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 BECAUSE OF DIFFERENCE IN POSITION OF OBSERVER

According to Einstein's special theory of relativity, mass is equal 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.

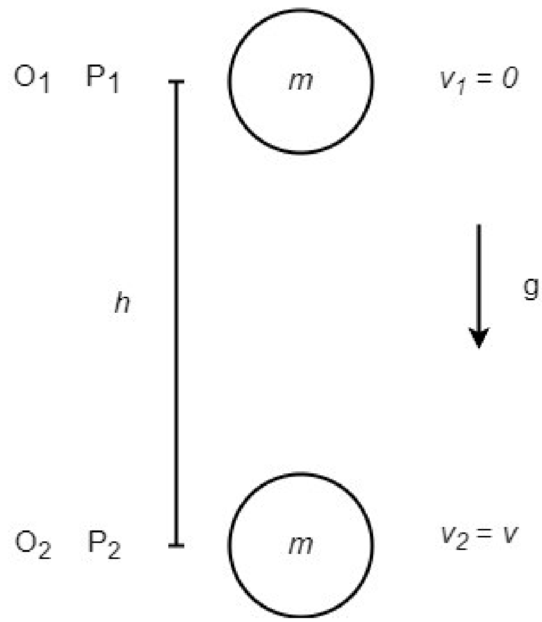

Figure 3

See figure 3

Observer O_1 is at position P_1. 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 $v = 0$

so

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

$E_p = mgh$, because $h = 0$ then $E_p = 0$, E_p is potential energy

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

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 $v = v$

$E_r = mc^2$

$E_p = -mgh$,

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

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 $v = 0$

$E_p = mgh$,

$E_k = \frac{1}{2}mv^2$ $E_k = 0$ 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 $mgh = \frac{1}{2}mv^2$

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

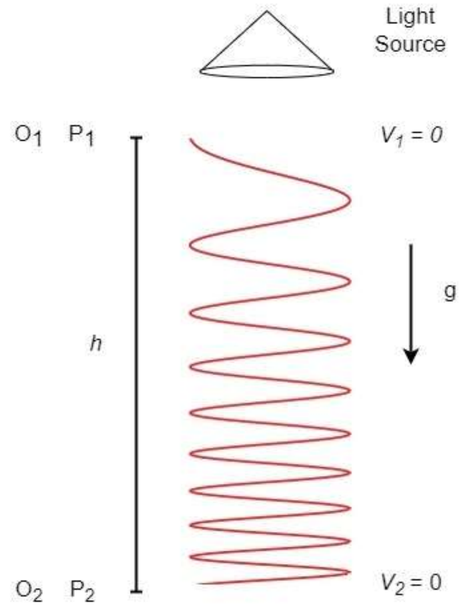

Figure 4

When light is directed from position P_1 to P_2 then there is a change in the frequency of light. Observer O_2 at position P_2 will detect the frequency of light higher 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 1 at position 1 Observer 2 at position 2 gets 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 observer O_1 and observer O_2 is the same light and the same source. The difference in wavelength, frequency and period is because of 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. Closer the position of the observer to a high-mass object the higher the value d. Figure 8 is the visualization of the relative density of space-time d. Darker color means a higher value of relative density of space-time d. Closer the position to the high-mass object darker the color.

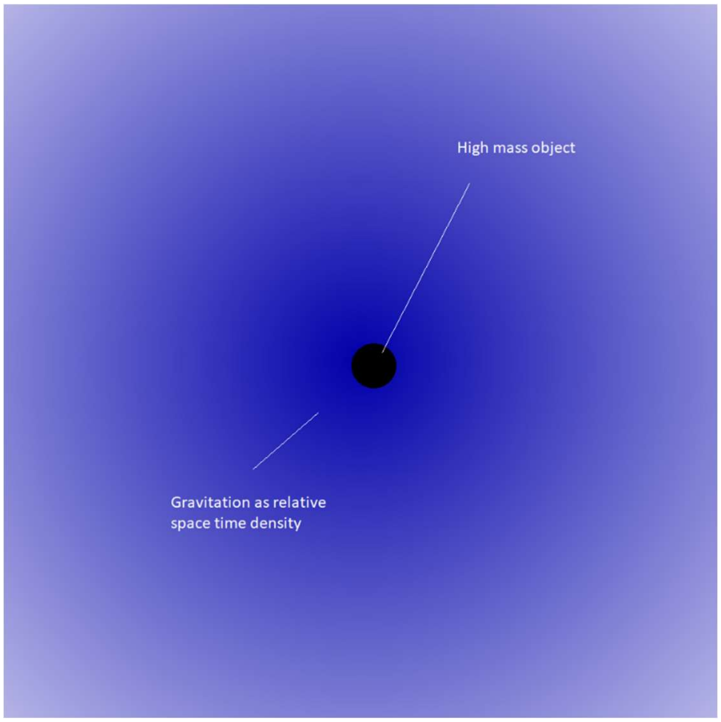

Figure 5

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

$$d_{relative\ at\ position\ 1\ to\ position\ 2} = \frac{1}{d_{relative\ at\ position\ 2\ to\ position\ 1}}$$

Or $d_{12} = \frac{1}{d_{21}}$

And $d_{21} = \frac{1}{d_{12}}$

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

$0 < d < \infty$

Let observer 1 at position 1 and observer 2 at position 2 and d as relative total energy.

$$d_{12} = \frac{E_{total\ observed\ by\ observer\ 1}}{E_{total\ observerd\ by\ observer\ 2}}$$

Or $d_{12} = \frac{E_{t1}}{E_{t2}}$

And because mass is equal to energy, $E = mc^2$

$$d_{12} = \frac{m_1}{m_2}$$

d as relative time interval:

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

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

d as the relative length

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

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

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

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

$$d_{mercury\ earth} = \frac{E_{total\ observed\ by\ observer\ from\ Mercury\ Planet}}{E_{total\ observed\ by\ observer\ from\ Earth}}$$

or

$$d_{me} = \frac{E_{tm}}{E_{te}}$$

$E_{te} = mc^2$

$E_{tm} = mc^2 + E_{p\,(from\ earth\ to\ mercury)}$

$E_p = \int_{rm}^{re} \frac{GMm}{r^2} dr$

$E_p = -\frac{GMm}{r} \mid_{r_m}^{r_e}$

$E_p = -\left(\frac{GMm}{r_e} - \frac{GMm}{r_m}\right)$

$E_p = \frac{GMm}{r_m} - \frac{GMm}{r_e}$

$E_p = GMm\ (\frac{1}{r_m} - \frac{1}{r_e})$

$E_p = GMm\ (\frac{r_e - r_m}{r_e r_m})$

$d_{me} = \frac{E_{tm}}{E_{te}}$

$d_{me} = \frac{E_{te} + E_p}{E_{te}}$

$d_{me} = \frac{mc^2 + GMm\ (\frac{r_e - r_m}{r_e r_m})}{mc^2}$

$d_{me} = \frac{c^2 + GM\ (\frac{r_e - r_m}{r_e r_m})}{c^2}$

$d_{me} = 1 + \frac{GM(r_e - r_m)}{r_e r_m c^2}$

G = 6.67384 x $10^{-11} m^3 kg^{-1} s^{-2}$

M = 1.98847 x 10^{30} kg

r_m = 5.74 x 10^{10} m or 0.574x10^{11} m

r_e = 1.496 x10^{11} m or 14.496 x10^{10} m

c = 3 x $10^8\ ms^{-1}$

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

$d_{me} = 1 + \frac{12.2356136 \text{ x } 10^{30}}{77.28336 \text{ x}10^{37}}$

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

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

Table 3

7. RELATIVE UNIVERSE

From Table 3 we can conclude that the observation of mass, length, and rotation period of an object differs between Earth and Mercury. There are so many places in the universe. The values of the relative density of space-time are different from one place to another place so the mass, length, and period of an object differ between them. The result is there are no absolute values of mass, length, and period of objects in the universe. There are only relative values of mass, length, and period. Value mass and diameter of the universe are relative values observed from Earth, there are so 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 location at the neutron star.

8. LOCALISATION PRINCIPLE

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

They are observed same object. Carbon-12 atomic mass, quartz crystal vibration, and hydrogen atom Bohr radius.:

Observer O_1 result:

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

Quartz crystals vibrate at 32768 times each second

Hydrogen Bohr radius = 1.00054 Å (Ångström)

Observer O_2 result:

Carbon-12 atomic mass = 12 amu

Quartz crystals vibrate at 32,768 times each second

Hydrogen Bohr radius = 1.00054 Å

Both observer O_1 and observer O_2 have the same result when they observe an object at the same position with the object.

But if observer O_1 observes an object at position P_2 the results are:

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

Quartz crystals vibrate at $d_{1\,2}$ x 32,768 times each second = 1.6 x 32768 = 52,428 times each second

Hydrogen Bohr radius = $\frac{1}{d_{21}}$ x 1.00054 Å = $\frac{1}{1.6}$ x 1.00054 Å = 0.62534 Å

And if observer O_2 observes an object at position P_1 the results are:

Carbon-12 atomic mass = $d_{1\,2}$x 12 amu = 0.625 x 12 amu = 7.5 amu

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

Hydrogen Bohr radius = $\frac{1}{d_{21}}$ x 1.00054 Å = 1.6x 1.00054 Å = 0.60086 Å

9. PSEUDO MOVEMENT

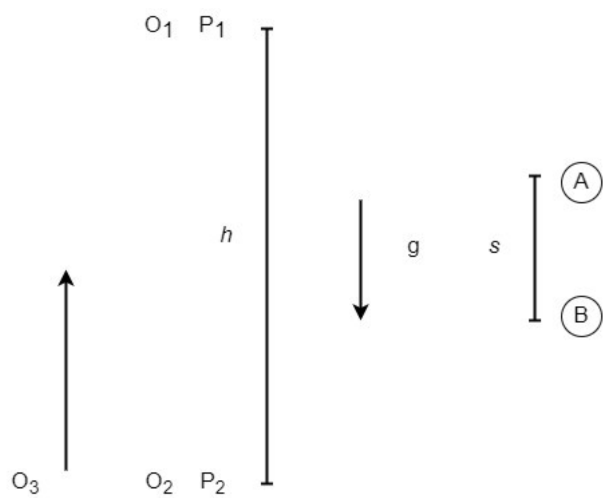

Figure 6

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 are not move.

Observer O_1 sees the distance from A to B is S_1

Observer O_2 sees distance from A to B is $S_2 = \frac{1}{d_{21}} S_1$

$S_1 > S_2$, $\Delta S = S_1 - S_2$

When Observer O_3 was at position P_2 he saw the distance from A to B is S_2. When Observer O_3 arrives at Position P_1 he saw the distance of A to B is S_1 then Observer O_3 sees the pseudo movement between A to B as ΔS.

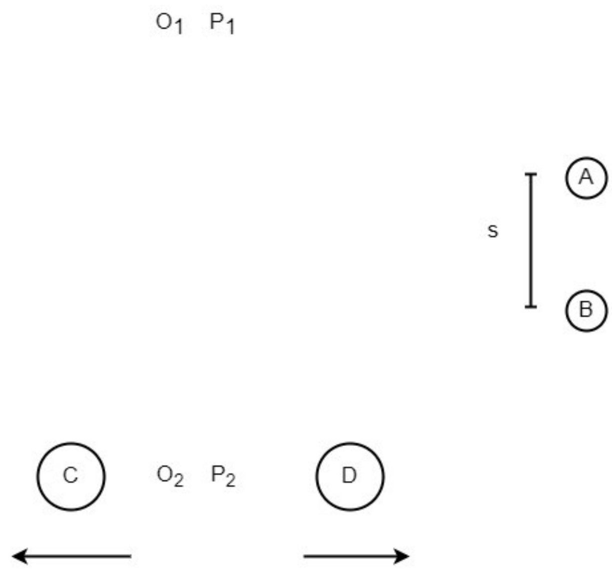

Figure 7

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

From the viewpoint of Observer O_1.

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

$d_{after\ before} = d_{ab} = 1$

$S_{1after} = \frac{1}{d_{ab}} S_{1before}$

$S_{1af} = S_{1befo}$

S_{1befo} = distance of object A and object B before object C and object D move away from observer O_2.

S_{1aft} = distance of object A and object B after object C and object D move away from observer O_2.

From the viewpoint of observer O_2.

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

$d_{after\ before} = d_{ab} < 1$

$S_{2afte} = \frac{1}{d_{ab}} S_{2before}$

$S_{2after} > S_{2before}$

$\Delta S_2 = S_{2afte} - S_{2before}$

$S_{2before}$ = distance of object A and object B before object C and object D move away from observer O_2.

S_{2aft} = distance of object A and object B after object C and object D move away from observer O_2.

Observer O_2 saw there is a pseudo movement with value ΔS_2. Different from the result from Observer O_1 that there is no change in the distance between object A and object B

10. EXPANDING UNIVERSE

Since the big bang, our universe continues expanding. Every galaxies move away from each other. According to section 9 relative density caused by object move away from observer $d_{after\ before} = d_{ab} < 1$.

$d_{ab} < 1$ cause pseudo movement.

$v_t = v_r + v_p$

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

v_r = Real velocity of expanding universe.

v_p = Pseudo velocity of expanding universe.

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

11. CONCLUSIONS

1. Gravitation is the relative density of space-time.
2. Gravitation can make a difference in the result of the observation of the same object.
3 There is pseudo movement between two objects because of 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)