The Eternality : Velocity as the component to understand the gravity

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Heraclitus : *"All things move and nothing remains still"*

Parmenides : *"Nothing comes from nothing, and therefore existence is eternal."*

Abstract

Velocity of an object can affect the gravitational acceleration. Black hole is an example where the light can form a circular orbit in the strong gravitational field. This light is moving around that causes the observer where is not in the path of the light orbit see the black hole as total darkness. In addition, when there is a high velocity of an object has been interacting with the gravitational acceleration, the object is in the micro or zero gravity relative to massive object therefor the gravitational acceleration does no longer exist.

Gravitational acceleration

Gravitational acceleration occurs on every object due to differences in intensity at each level by getting down towards the surface of a massive object will be even greater. By ignoring the air friction, all objects will accelerate in the gravitational field at the same rate in the direction toward the center of mass.

This gravitational acceleration obeys the square law where the intensity is proportional to the square of the distance from the object to the surface of the massive object.

$$\text{Intensity of gravitational acceleration} \propto \text{distance}^2 \qquad (1)$$

in 1722, Willem Jacob 's Gravesande published the results of a series of experiments which the brass balls were dropped from varying heights onto a soft clay surface. He found that a ball with twice the speed of another ball would leave an indentation four times as deep, he concluded that the correct expression for the "live force" of a body in motion.[1]

This acceleration occurs when the direction toward the center of a massive object. The direction upwards to any point in space from the center of mass, the gravity becomes deceleration and its intensity is inversely proportional to the square of the distance from the surface of the object.

$$\text{Intensity of the gravitational acceleration} \propto 1/\text{distance}^2 \qquad (2)$$

The magnitude of the intensity of gravity received by an object depends on the object position from the center of a massive object.
Gravitational acceleration could be obtained by equation below,

$a(g) = \frac{4 \text{ x } \pi \text{ x G x M}}{4 \text{ x } \pi \text{ x } r^2}$ cancelling 4 π on both sides *and we get,*

$$a(g) = \frac{\text{G x M}}{r^2} \qquad (3)$$

Gravity caused by velocity

Being stationary on the surface of the earth is the same condition as falling through an atmosphere without a deployed parachute these are considered as free fall and both equally being accelerated and follow the square law, both only gravitational acceleration acting on them and they experience 1g. If an object is at rest there is a solid object underneath this object. If an object is falling through an atmosphere there is fluid object underneath the object.

When an object moves from one point to another point in any direction inside the gravity field there is another acceleration acting on this object namely the velocity acceleration.

Each moving object will see the velocity acceleration as an effort for any object to overcome these three drag factors, they are gravitational acceleration, fluid and surface.

An aircraft and the ISS (International Space Station) Orbiting the earth are using the same principle. In order to stay in the sky or to fly they both apply thrust to overcome the drags, ISS will face the gravitational acceleration as a drag, while an aircraft experiencing gravitational and fluid drag in their environment. Although they both fly in the same principle, in order of an aircraft to fly they must apply thrust continuously while the ISS only apply thrust until the desired velocity has been obtained.

By looking at the height and the velocity of both an aircraft and ISS, then there is a significant difference between these two:

1. The average cruising altitude for a commercial aircraft ranges from 9.144 to 12.192 meters. At this altitude, air is still as a drag factor, on the other hand the ISS maintains an orbit with an altitude of between 320 thousand meters and 380 thousand meters and then at this altitude the air density is so low therefor the air is not a drag factor.
2. Typical cruising velocity for long-distance a commercial aircraft is 878-926 km/h, while the ISS moves at the velocity of 7.66 km/sec or 27,576 km/h.

If we remove the fluid drag from the system, will a commercial aircraft still require a continuously thrust in order for them to stay in the sky? The answer will be yes, so we do not see the fluid drag as a distinguishing factor between aircraft and ISS to remain in the air.

The magnitude of velocity owned by ISS is the only factor distinguishing between these two objects, its velocity of ISS does not require a thrust while ISS orbit the earth.

Gravitational acceleration obey square law, in terms of overcoming the gravitational acceleration as a drag. We need another acceleration and can be obtained by applying square law to the velocity so that we get velocity^2 or v^2. Then we divide this velocity square with 1 radius as the total exposure in the gravity field so that we will get the velocity acceleration

$$a(v) = \frac{v^2}{r} \tag{4}$$

Using velocity acceleration to overcome gravitational acceleration as a drag, mathematically will be

$$\frac{G \times M}{r^2} = \frac{v^2}{r} \tag{5}$$

Orbit

Acceleration is a vector physical quantity both magnitude and direction are required to define it. The direction of the gravitational acceleration is towards the center of a massive object and the direction of the velocity acceleration is direction of thrust. When the gravitational acceleration and velocity acceleration interact with each other, then the direction for both accelerations also interact and form a new direction and this new direction is what we know as the orbit.

There are two types of orbit:

1. Elliptical orbit; occurs when one of the acceleration is greater than the other acceleration at a certain point in space.
2. Circular orbit; occurs when both the direction of gravitational acceleration and of velocity acceleration equal at a certain point in space.

Because we calculate the total distance with 1 radius then we will be able to determine the angle of the orbit by comparing the gravitational acceleration to velocity acceleration and multiplying it by 1 radian

$$\text{The orbit angle} = \frac{\frac{G \times M}{r^2}}{\frac{v^2}{r}} \times 1 \text{ radian} = \frac{G \times M}{r \times v^2} \times 1 \text{ radian} \tag{6}$$

Data: [2]

Earth mass (kg)	5.9726E+24
Earth equatorial radius (m)	6,378,100
Gravity constant	6.67428E-11
1 radian	57.29583333°

Moon Max orbital velocity (m/s) 1,076
Perigee at min. distance (m) 363,300,000

Input the data into equation and the result as follows;

$$\text{The angle of orbit} = \frac{5.9726\text{E} + 24 \text{ x } 6.67428\text{E} - 11}{6{,}378{,}100 \text{ x } 1{,}076^2} \text{ x } 57.29583333° \; = 54.30014034°$$

The angle of orbit when the moon orbiting the earth at 54.28846974° suggest that velocity acceleration is slightly stronger than the gravitational acceleration so that the trajectory of the moon's orbit is elliptical. If the gravitational acceleration as a drag has been removed by velocity acceleration then this brings the consequence that the earth's gravitational acceleration is no longer exist on the moon or the moon in the state of micro or zero gravity relative to the earth.

Sun's gravitational acceleration does no longer exist on the earth and on the moon because of their velocities. When the moon has a velocity of 1.076 km/sec relative to the earth, then this cause the Moon Orbiting the earth instead of the sun.

Consider this situation, regardless of the air as resistance then when basketball player jumping and throwing a ball horizontally then the position of the player and the ball are not in the same position horizontally, the player has touched the ground while the ball is still moving on air.

On the other hand, an astronaut who was in ISS doing the same thing that is throwing the ball horizontally. The astronaut and the ball will remain in the same position it horizontally because the astronauts and the ball are in a state of micro or zero gravity.

This situation explains that earth's gravitational acceleration does no longer exist in ISS so that everything that happens in the ISS is completely different than in a state of free fall.

Bending light

When the light across the surface of the sun, we will be able to predict the acceleration velocity is very dominant compared to the gravitational velocity so the direction of the light only slightly bent by the sun's gravitational acceleration.

We can calculate the angle of light that have been bent when crossing the surface of the sun. In calculating the distance we will use the 2 radius so that the calculation is as follows,

Data : [3]
Sun mass (kg) 1.9885E+30
Sun Volumetric mean radius (m 696,000,000
Gravity constant 6.67428E-11

1 radian	206,265 arcsecond
Speed of light (m)	299,792,458

$$\text{Angle of deflaction} = \frac{2 \text{ x } 1.9885\text{E} + 30 \text{ x } 6.67428\text{E} - 11}{696{,}000{,}00 \text{ x } 299{,}792{,}458^2} = 4.24337\text{E} - 06$$

Because we calculate the total distance with 2 radius so we will be multiplying by 2 radians so that the calculation is as follows,

$$\text{Angle of deflaction} = 4.24337\text{E} - 06 \text{ x } 2 \text{ x } 206{,}265 = 1.750511243 \text{ arcsecond}$$

Black hole

If there is an object has a mass of the sun collapsed into small object and when the light across the surface of this object, the light will form a perfect circular orbit. To get the radius we obtain using

$$\frac{\text{G x M}}{\text{r}^2} = \frac{\text{v}^2}{\text{r}} \qquad r = \frac{\text{G x M}}{\text{v}^2} \tag{7}$$

$$\text{r} = \frac{1.9885\text{E} + 30 \text{ x } 6.67428\text{E} - 11}{299{,}792{,}458^2} \text{ x } 57.29583333° = 1{,}476.687545 \text{ meter}$$

Once we get the magnitude of the radius then we can determine the magnitude of the angle deflection

$$\text{Angle of deflaction} = \frac{1.9885\text{E} + 30 \text{ x } 6.67428\text{E} - 11}{1{,}476.687545 \text{ x } 299{,}792{,}458^2} \text{ x } 57.29583333° = 57.29583333°$$

Since 57.29583333° is 1 radian for a circle therefor light orbiting black hole at distance of 1,476.692056 meter would be the circular orbit.

Time Dilation

Velocity is the only component to understand the gravity while the time is a consequence of the velocity. Velocity and time are equal but working in the opposite direction. Time laps slowly when object moves fast. Conversely, time is becoming faster when object moves slowly.

Time dilation is the elapsed time differences between the two objects due to difference in velocity and in the position of the objects in the gravity field.

Calculating the difference in the position of the objects in the gravity field, we will use the concept of equivalence. Namely equality between the magnitude of the gravitational acceleration at a certain point in the gravity field with the magnitude of velocity acceleration of an object, so the difference between these two accelerations is zero or close to zero.

According to special relativity, the speed of light is the maximum speed at the which all matter and information in the universe can travel so we will compare both objects velocity with the speed of light.[5]

Data: [4]

Earth mass (kg)	5.9726E+24
Earth equatorial radius (m)	6,378,100

Gravity constant	6.67428E-11
Earth rotation velocity (m/sec)	465
GPS satellite Altitude(m)	20,200,000
GPS satellite Velocity (m/sec)	3,870
Speed of light m/sec	299,792,458
1 day	86,400,000,000 microseconds

Elapsed time difference between two objects due to difference in velocity can be calculated as follows,
GPS satellite clock run slower than the clock at the observer being stationary on the earth so that we should compare the satellite's velocity to the velocity of light.

$$\frac{v^2}{c^2} \tag{8}$$

We input the data into the equation above, we get a value

$$\frac{3{,}870^2}{299{,}792{,}458^2}\text{x}\ \ 86{,}400{,}000{,}000 = \ 14.398 \text{ microsecond}$$

The clock being stationary on earth follows gravitational acceleration at 9.79907775932151 m/sec² which is equivalent to 7.906 m/sec. Because the earth also rotate then we will add the speed of rotation to be 8.371 m/sec. Gravitational acceleration at 20,200 km altitude is 0.56431291525976 m/sec² which is equivalent to the velocity of 3.870 m/sec².

The elapsed time for the clock stationary on earth runs slower than the clock on the GPS satellite by

$$\frac{8{,}371^2}{299{,}792{,}458^2} - \frac{3{,}870^2}{299{,}792{,}458^2}\text{ x } 86{,}400{,}000{,}000 = 52.966 \text{ microsecond}$$

By combining these two values of the elapsed time above we will get
Total elapse time $= 52.966 - \ 14.398 = 38.568$ microsecond

Thus, the orbiting clock will run faster compared to the clock stationary on earth per day by 38.568 microsecond.

References

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(5) Special relativity. Wikipedia. Web. 29 March 2015 <http://en.wikipedia.org/wiki/Special_relativity>