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REVIEW ON BASICS OF GRAVITY

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***Abstract*— Gravity can be defined as an attraction between two bodies. Earth gravity is one of the unique and natural phenomenon that has been on earth till the end of planet. It is basically the one of the four fundamental natural force in the universe and it is the most weakest of all of them. Earth's gravity can be defined as the result of the coupling of the motion of earth that is, rotational on his axis and other orbital motion in the form of centripetal force. The experimental value of g (acceleration due to gravity) is equal to 9.81 m/s^2. The gravity leads to attract one particle with another particle with the gravitational force and the magnitude of force is given by $F=Gm_1m_2/r^2$ and it is known as Newton's law of gravitational.**

Keywords—Gravity, Mass, Radius, Orbit, Motion, Attraction, Gravitational constant etc

I. INTRODUCTION

Let as assume a situation when we are some height of a building and having a small stone and we leave that stone form there the stone will go down freely and end up landing on ground after some seconds the effect of free fall on ground form that height is an example of gravity. Now what is gravity? Aryabhatiya, the book of great mathematician who wrote in it about the motion of earth and mentioned that earth revolves on its own axis around in the 5th century Ad.

The motion of falling object was first explained by Galileo (1564-1692) and then after that Newton gave the laws of gravity which was all the object attract to each other in the whole universe. Gravity is a force which holds in securely on the ground and also keeps the earth is motion around the sun. Due to gravity rain onto earth from sky, causes tides. It is basically gives constancy to the universe so that all the planet will be in its own gravitational field. Gravity is one of the four fundamental interactions of the universe. This is the weakest force of all the four forces, it is 10^{38} times weaker than strong force 10^{36} times weaker than the electromagnetic force and 10^{29} times weaker than the weaker force.

On earth, gravity leads to change a body with man into weight. In universe, the gravitational force or attraction of gaseous matter cause them to combine and form stars and stars into galaxies. Gravity is hence defined as the attraction force between the two bodies due to their motion.

Newton's laws of Gravitation-

Newton said that force between two bodies is directly proportional to the product of its masses and inversely proportional to the square of space between them. It was given in the year 1665 and was given as-

$$F \alpha m_1m_2/r^2$$

The law of gravitation was modified by Henry Cavendish in the year 1736 about 71 years after Newton gave his law of gravitation. Henry removed the proportionality and exchanged it with a constant called "G" or universal gravitational constant whose value equals-

$$G = 6.67\times 10^{-11}\ Nm^2/kg^2$$

It was formulated as-

$$F =Gm_1m_2/r^2$$

According to our thinking, a body which is rotating with higher orbital velocity will have higher value of acceleration due to gravity as-

We know from equation of escape velocity, sum of potential energy and kinetic energy of the body which is to escape should be greater than or equal to zero.

$$0.5mv^2 - GMm/R \geq 0$$

$$0.5mv^2 \geq GMmR/R^2 \qquad (g = GM/R^2)$$

$$0.5v^2 \geq gR$$

So we find that-

$$g \alpha v^2$$

and $$g \alpha 1/R$$

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Hence, a planet with greater speed of rotation will have more value of g.

Variation of gravity at different height-

There are variations in the value of g. The variation is small as compared but still there are changes at decimal places. There are variations when we go at height and when we go at depth.

For height condition, the variation of g is given by

$$g_h = g_o(1- 2h/ R)$$

For depth condition, the variation of

$$g_d = g_o(1-h/R)$$

Where, $g_{0=}$ 9.81m/s^2

For planets and satellites-

Speed of planet-

Let us assume that a planet with a radius of orbit be 'a' and the orbit velocity be 'v' hence-

From $F = ma$

$$mv^2 = F_g$$

$$mv^2/a = GMm/a^2$$

$$v = \sqrt{GM/a}$$

speed of planet α $1/\sqrt{a}$

Time period-

It is the time takes by planet to complete one revolution. If the orbital radius of planet is 'a' and orbital velocity is v. Then it needs to cover $2\pi a$ distance with a speed v hence-

$$T = 2\pi a/v$$

$$T = 2\pi a/\sqrt{GM/a}$$

$$T = 2\pi a^{3/2}/\sqrt{GM}$$

$$T^2 = 4\pi^2 a^3/GM$$

$4\pi^2/GM$ is constant and hence $T^2 \alpha a^3$

This was given by Johannes Kepler from the observation of Tycho Brahe.

There are three laws of Kepler known as laws of planetary motion-

(1) The path of planet or orbit of planet is elliptical not circular and it is revolving around the sun and the sun is in the Centre.

(2) This is known as the law of areas and it says that a line connecting from sun to planet sweeps out equal area at equal time that is the rate dA/dT is constant.

(3) Square of time period of any planet is proportional to cube of the orbital distance (the major axis) between sun and planet.

$$T^2 \alpha a^3$$

Escape Velocity-

As we have seen that when we throw anything upside, it goes to a maximum height and then start to fall. This is due to gravity but for rockets and satellites, when they are launched upside to go into space they don't fall down after attaining a certain height like for any other thing which falls easily at this instant.

In case of launching of rockets and satellites, theory of escape velocity comes into act, if a body wants to cross the earth's atmosphere then it needs to gain a certain value of velocity which is equal to 11.6 km/sec and in general, when the sum of potential energy and kinetic energy becomes greater than or equal to zero then at that time the velocity required to escape the atmosphere is escape velocity.

$$0.5mv^2 - GMm/R \geq 0$$

$$V \geq \sqrt{2GM/R}$$

When the value of v exceeds the value of 'c' that is speed of light, then anything starting from the object with a speed less than the speed of light will come back to the object and that object is called Black hole. Even light cannot escape from there.

Notations-

F = Gravitational force
G = Gravitational constant
g = acceleration due to gravity
T = time period
R, r = radius or distance
a = distance of major axis of the orbit
v = velocity
M = mass of earth
m = mass of any body

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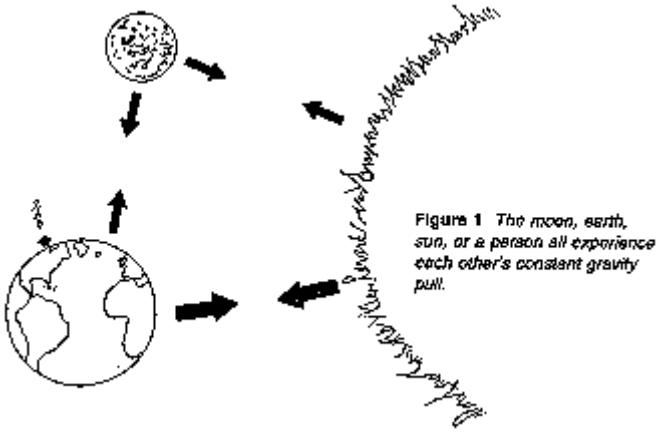

Figure 1 The moon, earth, sun, or a person all experience each other's constant gravity pull.

II. LITERATURE SURVEY

1. According to Sir Isaac Newton[1], his work in his book "The Principia"- He stated the Newton's law of Universal Gravitation as every particle attracts other particle with some force and that force is directly proportional to the product of masses of the object and inversely proportional to square of distance between the bodies.

2. According to Henry Cavendish[2] has been firstly investigated the value of gravitational force between masses in laboratory. According to his studies he was to first to find the value of gravitational constant. He gave the value of gravitational force as equal to

$$G = R^2_{earth} / M_{earth}$$

3. According to Erik Verlinde[3], in his studies he said that gravity was an entropic change which was caused due to the change in the position of the object. The entropic force was on macroscopic force which was originated in the system with more degree of randomness and hence increases the entropy and due to change in entropy, gravity is caused.

4. According to Claudine Kavanageh[4] and Cary Sneider[4], In their studies they said about the free fall of any body, how the body fall freely on earth and why they falls when they are left from some height. In his research he had made a report on the different age group asking them why anybody falls when dropped from some height. The different age group gave different answers for that. They gave different way to teach the gravity to different students of different age groups about gravity and laws of gravitation. He described gravity not visible force attracting body towards the surface and let them to free fall.

5. According to Shan Gao[5], when he studies the Verlinde theory about gravity is emerged and not fundamental he said that, Verlinde has not given any required analogy between gravity and entropic force in has example and also Verlinde's holographic screen and test particles was not satisfying all requirements for existence of entropic force in a thermodynamic system. In his paper. Shan Gao said that gravity is not on entropic force and it was fundamental.

6. According to Thibault Damours[6], he said that Einstein's theory of gravity has passed all presently performed tests with great success. Those tests had examined many characteristics of shape of general relativity. In his research, the encounter between general relativity and observational results was summarized both weak- field and strong field tests were discussed in detail. They also discussed about scalar fields having only gravitational strength coupling to matter.

7. According to Clifford M.Will[7], he said that observational test of general relativity and theoretical model for examining were reviewed. Gravitational wave damping had been finding in an amount that agrees with general relativity to move than half a percent using the Hulk Taylor binary pulsar. They tested general relativity under extensive experimental examination, only due to the reason that gravity was a basic force of nature and such more solid empirical support we can provide. In his research, he also said that the predictions of general relativity were fixed because the theory did not contain any adjustable constant so nothing could be changed. Hence every test or experiment of theory could either be potentially lead test or possible examination for physics.

8. According to Sosale Chandrasekhar[8], he said that earth's gravity could be considered as the centripetal force which was due to the pair of its rotational and orbital motion. In his experiment, he apparently exercised that object coming toward to earth , and the change of gravity with latitude were compressible by extending the above ideas (The estimated value of the above centripetal acceleration on earth was 1.4×10^2 m/s^2 , which compared reasonably with observed value of g of 9.8 m/s^2.

9. According to Jiřì Kovâř[9], he said that near the black hole, the motion of an object was regulated by very strong attraction gravitational field. Electrically charged particles fell also electromagnetic force arouse due to current inside stars due potential

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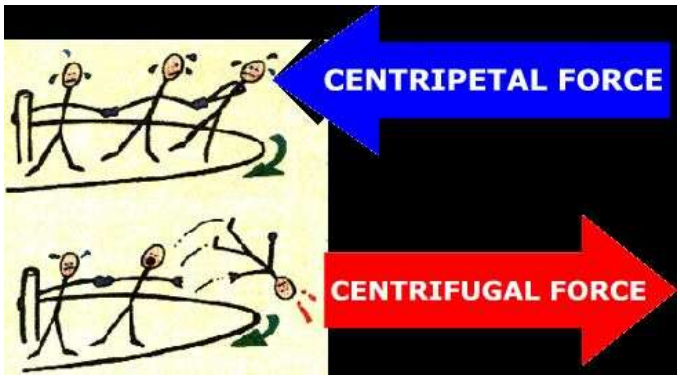
around. They found that the stable halo orbit can take place near all of the three mentioned kinds of compact object.

10. According to P.C. Peters[10], in his research and study he calculated the gravitational radiation from two point masses going around each the under their natural gravitational influencing. They involved two different methods one is multiple expansion of radiation field and second one uses inertia tensor of source.

III. CONCLUSION

In our studies, we find that gravity is one of the important natural interaction of the universe. The gravity is basically an attracting force between the bodies which attract one body towards other. When we were studying about gravity, we got to know that every celestial body in the solar system has its own gravitational field and all body induces its gravitational force on the other body. For example- our body gets induced by the gravity of earth, moon and the sun but we don't feel that. The gravity of earth works as a stabilizer to its motion in the space, as we know earth moves in an orbit around the sun with an orbital velocity of 30km/s which is a high velocity and if a body is moving with that high velocity then it could misbalance and become unstable, during circular motion two forces comes into act-

1. Centrifugal force
2. Centripetal force



Centrifugal force is the force which is imparted due to rotational motion away from the core of earth and centripetal force is the one which is imparted towards the core of earth and gravity can be taken as a centripetal force which is balancing the orbital motion of the earth.

Maximum Gravity also depends on the rotation of earth on its own axis. Let us take an example of cyclone, which is rotating at high velocity with a conic shape, base of cyclone is converging shape with a very high intensity of pressure at lower surface and lower pressure with diverging shape at higher surface. If a body gets access into that cyclone, it starts to revolve with it in the way cyclone is rotating and that body rotates till it goes towards the lower part of the cyclone. The cyclone base also called as eye behaves as a high gravitational area which attracts the body towards itself when anybody gets access to it.

The magnitude of the acceleration due to gravity is different at different places and it depends directly on the orbital velocity of the body.

In different researches and videos, we find out about black holes that they have infinite gravity and they can't even let light to escape from there. With the study of gravity, we can get to know more about black holes and we can even research over them and get to know them better.

The gravity has another part associated with it called as-

1. Anti- gravity
2. Zero- gravity
3. Micro- gravity

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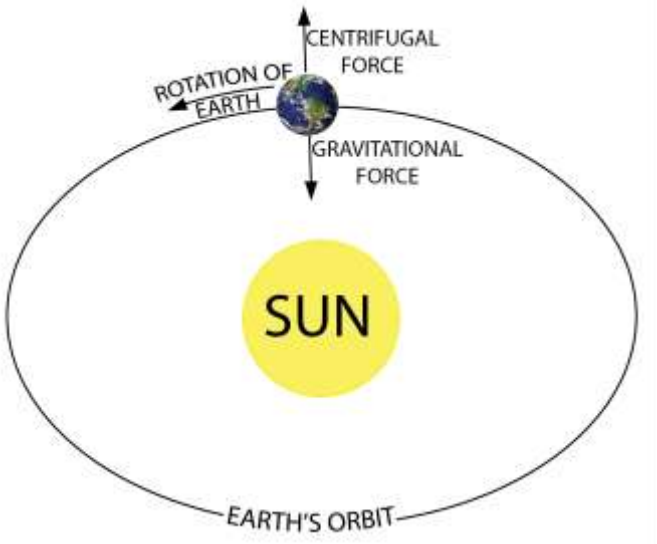
Anti- gravity is a term related to the idea of creating a gravity-less place, where one cannot experience gravity. It is also known as non- gravitational field.

Zero- Gravity is a term related to the idea of weightlessness, which is an absence of stress and strain resulting from externally applied forces.

Micro- gravity or Micro-g can be termed as almost a synonym of zero-g but indicates that gravitational forces are not zero but just very small. The symbol of microgravity is µg.



Finally, we conclude our paper by giving the definition of gravity as it is a natural phenomenon by which all things with mass are pulled towards each other. It was best described by Einstein in 1915 in his work general theory of relativity. According to him, gravity was not a force but result of curvature of spacetime caused by the uneven distribution of mass/energy.

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