ST. JOHN BAPTIST DELLA SALE CATHOLIC SCHOOL

Physics assignment on: *General relativity*

GRADE 10C

Group 3 and 9

Group members

- ***Diana Biniam***
- ***Adonayt Megabe***
- **Meron amde**
- **Senet tsega**
- **Gelila Mamaru**
- **Wedase maream Zewdu**
- **Abigya Seyfe**
- **Yohanan Temesgen**
- **Betselot Abreham**
- **Nuhamin Eyob**

Submission date: january,12, 2023
Submitted to: teacher Aaron

General Relativity theory

general relativity theory was posted by Albert Einstein in 1915.in this theory Einstein explained that gravity arises from the curvature of space and time which is caused by massive objects. To understand general relativity, let's start with the special relativity theory since general relativity theory is the generalization of special theory of relativity.

Special theory of relativity

In this theory Einstein discovered that everything in the universe, except the speed of light has relative motion of the observer. The sun, the earth and galaxies are constantly in motion. Therefore, nothing is ever at absolute rest or absolute motion, things just move relative to each other. This is classical relativity.

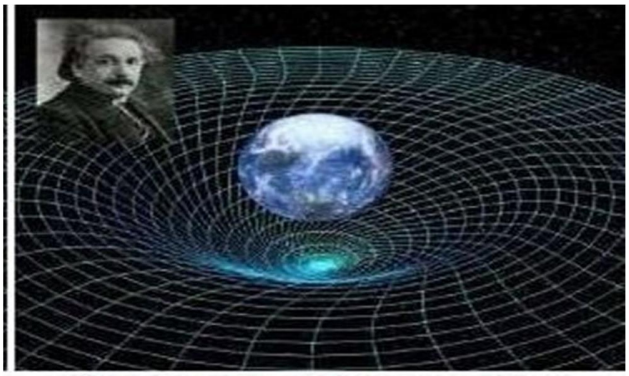
The special relativity theory is an explanation of how speed affect mass, space and time. The theory also introduced the famous formula E=mc^2.but, this theory only applies for non-accelerating objects or in the absence of gravity.

It is based on two postulates:

1) The lows of physics are the same for all reference frame moving at constant speed.

2) The speed of light is constant for all observers either moving or in state of rest.

In his special theory of relativity Einstein found that space and time are inextricably connected.



Einstein's flexible space-time

✓ **What is space time?**

The idea of space time was first described by germen Mathematician Hermann Minkowsk. Space time is a model that combines the three dimension of space and one dimension of time in to a single four dimensional fabric.it explains the unusual relativistic effect that arise from traveling near speed of light.

The equivalence principle

In 2007,Einstein imagined himself falling from a ladder and realized that while falling, the ground would not pushing him so he would be in free fall. He imagined himself in a room with no windows. On the surface of the earth he would weight whatever he weights. But imagine if the room was away from gravity moving in an upward direction with 9.8m/s^2.in that moment if he were to weigh his weight, he would weight the same as on earth. Einstein realized that the observer would not be able to tell if he is on a space ship or on the surface of the earth. This is called the equivalence principle. which means, something moving in space with no gravity has the same mass as something on earth that is not moving.

Einstein imagined that a beam of light in nonaccelerating elevator travels on a straight line. In an elevator accelerating (9.8 m/s^2) upward the beam of light will bend down. Applying the principle of equivalence, Einstein concluded that the beam of light in gravitational field must also bend down as it did in an accelerating elevator, then Einstein realized that gravity bends light. *The whole of general relativity rests on this principle.*

- ✓ **Time dilation**

One day Einstein asked himself what would happen if the car he was on was moving at a speed of light away from a clock tower and he realized that the time will appear to stop, but everyone who was outside the car see things at normal time, then he realized that if you go faster through space, the slower you move through time.

His work was highly affected by the two physicist of the time Isaac newton who notes that speed is never an absolute it's relative to something else. and the other one is James Clark Maxwell the father of electro magnetism who notes that the speed of light is constant. Einstein thought that the two ideas are in contradiction. This causes Einstein to come up with another thought experiment.

He imagined himself on a train plat form witnessing two lightning bolts strike on either side of him. now, because Einstein stands in between of the two strikes he receive the beam of light from both sides at the same time. However, it will be complicated when someone on moving train is watching it while whizzing past Einstein at a speed of light. If the speed of light conforms to the rule of relativity, then the person on the train would not witness the lightning only in logical thinking the light closer to the man would reach him first so, the measurement of the speed of light by Einstein would be different in magnitude. To get rid of the problem in measurement Einstein suggested that time itself for the man on the train must slow down for the speed of light to remain constant. This is called time dilation. According to Einstein time must slow down when you are near massive objects and moving at a speed of light.

When objects are moving close to the speed of light, not only the time slow down but, the object itself contracts. This is called length contraction.so time dilation and length contraction work together to ensure that the speed of light remains constant.

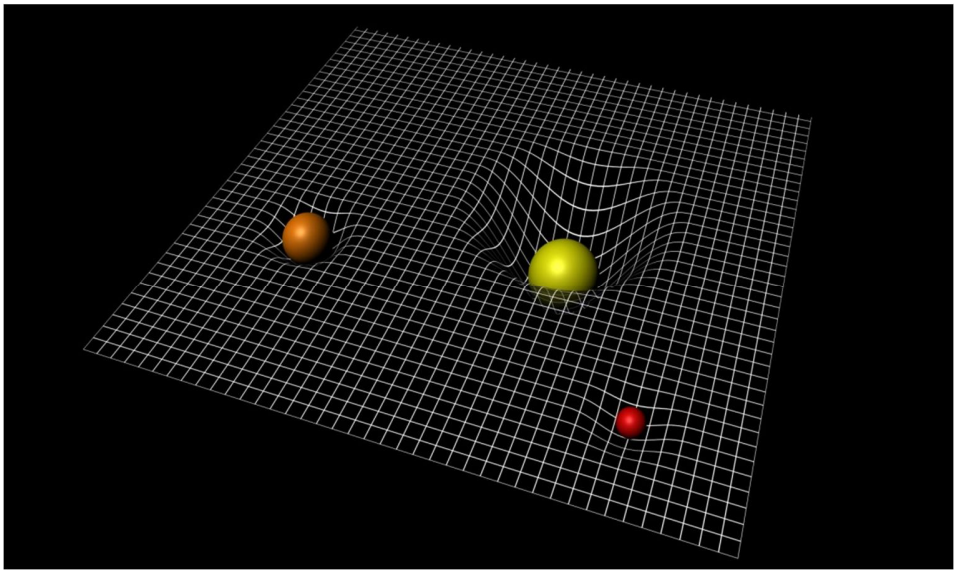
- ✓ **Time travel**

Time slows down for objects traveling close to the speed of light and time stops for objects traveling at the speed of light; it then follows that time must go

backward if objects travel faster than the speed of light. So far it has been seen that no object can travel at the speed of light. On approaching the speed of light objects start to increase in mass rather than speed and it would take an infinite amount of energy for an object to achieve the speed of light. This is why we cannot travel back in time we have simply not been able to reach greater speed than the speed of light.

Einstein realized that the special relativity which we explained previously only works for circumstances when objects are not accelerating through the universe. But, Einstein get the idea how to include gravity on his theory of special relativity after he realized the equivalence principle.

According to Einstein objects warped space time around it, causing it to become curved and as a result objects experience gravitational attraction to each other. This warped of space time explains how objects behave as they move through space.

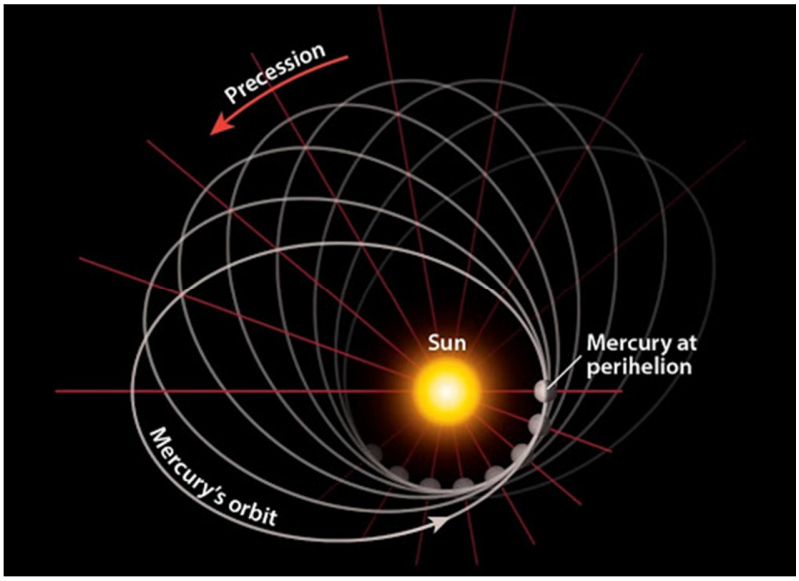


Massive objects like the sun and the earth warp the space time around them

Generally Einstein in his theory of general relativity explained that gravitational attraction is not a force that act from a distance, rather it is something that emerges from the interaction of space time and massive objects. As john wheeler

stated: ”space time tells matter how to move. Matter tells space time how to curve.” That is the concept of general relativity.

MERCURY’S PRECESSION



Mercury’s orbit is unusual. all planets orbit the sun in an ellipse. Mercury also orbit in an ellipse, but it had something called precession. it’s ellipse never closes the point of the orbit that was farthest from the sun advances a little bit every time. It’s as if the orbit itself is orbiting the sun. when Einstein applied his theory to this orbit the new theory predicted exactly the precession that mercury actually has.

Reference

www.space.com

www.science news.org

www.new scientist.com

News room.ucla.edu

iontrap umd.edu