Saint John Baptist De La Salle Catholic School

physics Group Assignment

Group 3 and Group 9

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Date of Submission; January 12, 2023

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General Theory of Relativity

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January 2023

1 Section 1

1.1 Introduction

Albert Einstein theory of general relativity completely changed the notion of the universe. It shade light on the birth of the universe, planetary orbits and black holes. It also has very practical uses, like in GPS navigation. but what exactly is this theory and why was is so revolutionary? Until the early 20Th century, physics was mostly explained in terms of Isaac Newton's laws. For Newton, gravity was a force generated by the mass of an object causing them to attract each other, heavier objects pulling others more intensely. it's why planets move around the sun. But imagine if the sun disappeared completely .

According to Newton's theory, the planets of the solar system would instantly abandon their orbits, as their would be no gravity attracting them to the sun. For Newton, gravity is a force with immediate action regardless of the distance between the bodies. But according to Einstein's calculations, light was the fastest thing in the universe. Nothing could travel faster than light, not even gravity. Light takes about 8 minutes to cover the nearly 150 million kilometers that separates the sun from the earth. So, if the sun disappeared, how could the earth go off its orbit before us earthlings stopped seeing sun light?problems like that suggested to Einstein that gravity could have different explanation than Newton thought.

Between 1905 and 1915, Einstein developed the theory of general relativity. He imagined the 3 dimensions of space and the dimension of time together as a kind of fabric surrounding us shaped by the presence of celestial bodies. He called it space-time. Imagine the sun as a heavy bowling ball placed in the middle of a trampoline dip. This curvature is what we feel as gravity. So for Einstein the earth and the other planets remain in orbit not because the sun is such a massive star that the other celestial bodies follow the curve it generates in the space-time fabric.

Now gravity is no longer considered a force of attraction between 2 bodies as Newton thought. Its an effect that space-time curvature on bodies. So according to Einsteins, what would happen if the sun disappeared? His story says,this disturbance in space time would form a gravitational wave that would travel to the planets at exactly the speed of light. That means we would see the sun go dark at the same time as the earth changes its orbit.

2 Section 2

2.0.1 main content

2.1 What is General Relativity?

General relativity, also known as the general theory of relativity and Einstein's theory of gravity, is the geometric theory of gravitation published by Albert Einstein in 1915 and is the current description of gravitation in modern physics. General relativity generalizes special relativity and refines Newton's law of universal gravitation, providing a unified description of gravity as a geometric property of space and time or four-dimensional space-time.

According to the theory of general relativity, "matter causes space to curve. It is posited that gravitation is not a force, but a curved field (an area of space under the influence of a force) in the space-time continuum that is actually created by the presence of mass."

The general theory f relativity has passed several experimental tests, including this proposed by, one test has to with understanding the rotation of axes of the planet Mercury's elliptical orbit, called the processions of the perihelion. (the perihelion is the point of closest approach to the sun.)

Another test concerns the apparent bending of light rays from distant star when they pass near the sun, and the third test is the gravitational red shift, the increase in wavelength of light proceeding out ward from a massive source. Some details of the general theory are more difficult to test, but this theory has played a central role in cosmological investigations of the structure of the universe, the formation and evolution of stars,black holes, and related matters.in recent years the theory has also been confirmed by several purely terrestrial experiments.

2.1.1 Importance of General Relativity

General relativity has developed into an essential tool in modern astrophysics. It provides the foundation for the current understanding of black holes, regions of space where the gravitational effect is strong enough that even light cannot escape. Their strong gravity is thought to be responsible for the intense radiation emitted by certain types of astronomical objects.

General relativity is also part of the framework of the standard Big Bang model of cosmology.

3 Section 3

3.1 Summary

General relativity, part of the wide-ranging physical theory of relativity formed by the German-born physicist Albert Einstein. It was conceived by Einstein in 1916.

General relativity is concerned with gravity, one of the fundamental forces in the universe. Gravity defines macroscopic behaviour, and so general relativity describes large-scale physical phenomena.

General relativity follows from Einstein's principle of equivalence: on a local scale it is impossible to distinguish between physical effects due to gravity and those due to acceleration. Gravity is treated as a geometric phenomenon that arises from the curvature of space-time.

The solution of the field equations that describe general relativity can yield answers to different physical situations, such as planetary dynamics, the birth and death of stars, black holes, and the evolution of the universe.

General relativity has been experimentally verified by observations of gravitational lenses, the orbit of the planet Mercury, the dilation of time in Earth's gravitational field, and gravitational waves from merging black holes.

4 Section 4

4.1 Reference

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