Big Bang

解密神秘的宇宙

Unlocking the secrets of the Universe

Abstract

*The Big Bang Theory stated that the universe is expanding. So what exactly is the relationship? With Hubble’s Law, and Einstein’s General Relativity, I can calculate the relationship between the speed an object for example a galaxy is traveling, the distance between the object and another one, and the time it takes to send a light wave from one to another. Hubble’s Law states that the velocity of a galaxy moving away from Earth varies directly with the distance between that galaxy and Earth. General Relativity explains why the same wave lengths emitted by the galaxy is received differently from Earth. Hubble’s Law has a formula: 𝑣 = 𝐻𝐷. I also used the equation of time dilation: time\_close = time\_observer to help convert it into an equation for the wave lengths. I came up with several equations to calculate the speed the a galaxy is moving away.*

Introduction

*The main thing Big Bang Theory wanted to say was the universe is expanding. The main problem in this project was how fast do things move away in the universe. First, there might be a question, how exactly does the universe expand? The Big Bang Theory says that the universe is expanding by everything moving away from each other. For example, the Milky Way galaxy is getting further with the Canis Major Dwarf Galaxy, which is a galaxy very close to the Milky Way at present. How do we notice the difference in the distance between the galaxies? We can measure it by analyzing the light waves emitted by that galaxy. Because the galaxy is moving away from Earth, the light would have to cover the same distance with longer linear distance so its wave length gets extended. When people measure the wave lengths each 10 years people will notice longer wave lengths and that means things are moving away from each other. That proves the universe is expanding. What I was working on in this project was to find out the speed the universe is expanding. At last I came up with an equation that can calculate the velocity the galaxy is moving given the value of red shift.*

Methods

*The equation for time dilation is*

*is the time for the time for the time that passed for the source. is the time it passes for the observer. is the velocity of the source. is the speed of light which is 300,000,000.*

*Another equation I used was from Hubble’s Law:*

*is the velocity an object is moving. is the Hubble’s constant which has the value of . is just the unit of it: meter per second times lightyears. is the distance from Earth to the object.*

Results

***In task 1****, I came up with the expression that calculates the distance an object travels with a given time with the speed of light. Because distance = velocity x time, so with time , speed , the distance is .*

*The wave length received: is greater than .*

*Lastly, I came up with an expression for which was*

*Because the* *is large, so the time dilation is significant in this problem.* ***In task 2****, I came up with an expression for the observer’s time.*  =

***In task 3****, I came up with an expression for :*

=

*(apply the time dilation)*

*The expression for would be :*

*And the shift would just be: since is the shift.*

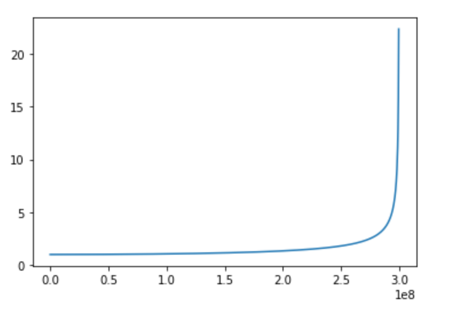
*In Figure 1, the x-axis shows the velocity of an object and the y-axis shows the redshift of the wave lengths. As shown, as velocity increases, the redshift gets greater. As the velocity gets very close to the speed of light, the redshift gets very close to infinity.*

Figure 1: velocity vs redshift

*Lastly, I used Hubble’s Law to calculate the distance from Earth to a star when there is a redshift of 1.0001. I first used*

*(derived from ) to get the velocity of that star, then used this velocity to find the distance using Hubble’s Law. At last, I got the distance of about* 652141.3059781793 *light years.*