Does the Distance- Redshift Curve of Receding Galaxies Show an Accelerating or a Decelerating Expansion of the Universe ?

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The coincidence of the Pioneer anomalous acceleration with cosmological acceleration disproves Einstein's general theory of relativity

Abstract

Some cosmologists have noted the profound coincidenceof the value of the anomalous acceleration (8.74×10^{-10} m/s^2) of Pioneer spacecraft with the value of the so-called cosmological acceleration, about which mainstream physics has been silent. The starting argument in this paper is that this may not be a coincidence and that both accelerations are manifestations of the same phenomenon.However, the anomalous acceleration of the Pioneer is negative, whereas cosmological acceleration is positive, which would be a contradiction. Therefore, both accelerations must have not only the same magnitude, but also the same sign. This leads us to question of the usual interpretation of distance-redshift curves of receding galaxies, which is based on the theory of expansion of the universe .In this paper, we will show that the universe is in decelerating 'expansion', not accelerating expansion. A decelerating force will increase the time taken for a galaxy to reach a given receding velocity, compared to the time taken according to Hubble's law.Using elementary kinematics we will show that increase in the time taken to reach a given receding velocity will increase the corresponding distance travelled.The longer the time the galaxy is in motion, the larger the distance it will travel. The effect of increase in time will always more than offset the effect of decrease in acceleration.Hubble's law is not due to expansion of the universe; it is due to a modified Newtonian law of gravity. The coincidence of the Pioneer anomalous acceleration with cosmological acceleration disproves general relativity.

Introduction

Cosmologist Michael Martin Nietohas pointed out the profound coincidence of the value of the anomalous acceleration (8.74×10^{-10} m/s^2) of Pioneer spacecraft with the value of the so-called cosmological acceleration[1]. A reasonable conclusion would be that this is not a coincidence and that the two accelerations may be manifestations of the same phenomenon. However, the anomalous acceleration of Pioneer space craft is negative, whereas cosmological acceleration is positive, which would be a contradiction. This leads us to question the traditional interpretation of the distance-redshift curve of receding galaxies, which is accelerating expansion of the universe.

Distance- Redshift curve

Let us assume nearly linear Hubble's law as shown in Fig.1. The dashed line represents expansion of the universe according to Hubble's law. The red solid line is the actual distance-redshift curve observed by astronomers, which deviates from Hubble's law at great distances.

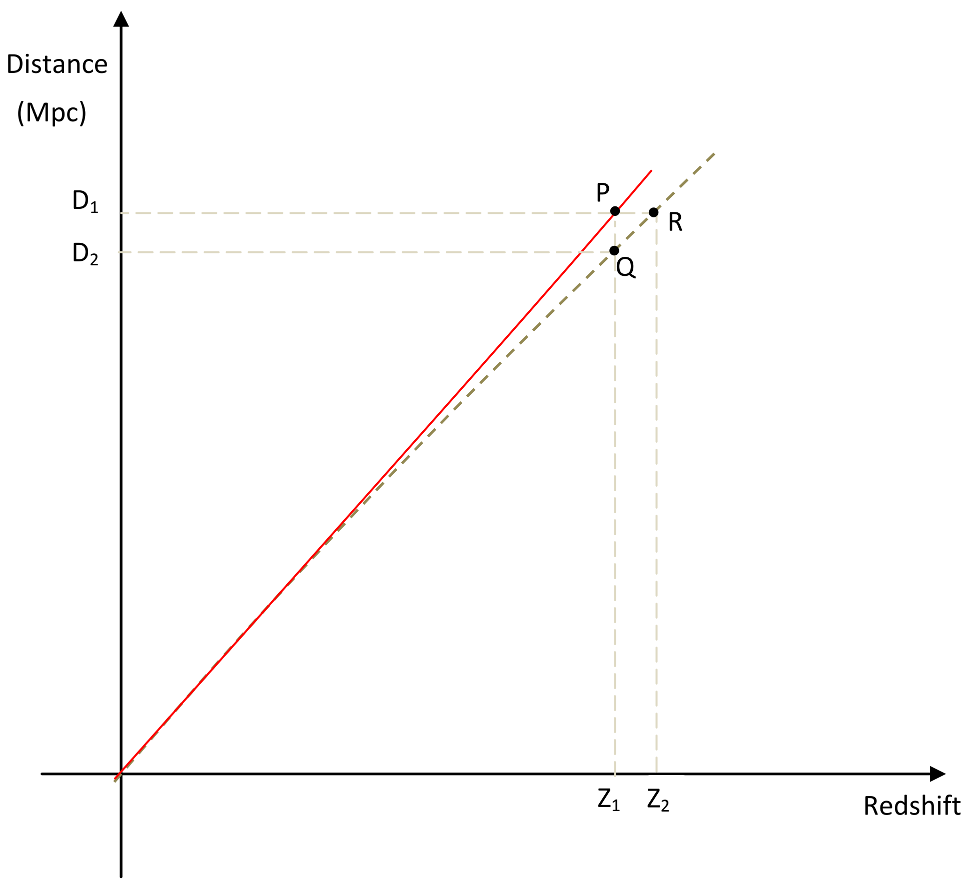

Fig. 1

Assume that the actual, observed distance of a galaxy with red shift Z_1 is equal to D_1, which is represented by point P on the red curve. The traditional interpretation is that, if the universe was in uniform (unaccelerated) expansion, the galaxy would be at distance D_2 , represented by point Q. According to Hubble's law we expect the galaxy to be at a distance D_2 , but actually the galaxy has been observed at distance D_1 . Therefore, since the galaxy has travelled greater distance than predicted by Hubble's law, the expansion of the universe must be accelerating.For a modified theory of Newtonian gravity, this is a vague conclusion because more distance travelled does not necessarily mean acceleration, as we will see below. However, according to expanding universe of general relativity, the light becomes dimmer (more distant) because the universe has been expanding at an accelerating rate since the light was emitted billions of years ago, so the light has to travel greater distance and become dimmer at the time of observation. Conversely, the light will be brighter if the expansion of the universe is decelerating.

However, this interpretation will leave another cosmological problem unsolved: the Pioneer anomaly. Given the numerical coincidence of the Pioneer anomalous acceleration with cosmological acceleration, it is reasonable to conclude that both are manifestations of the same phenomenon. Therefore, any theory that claims to explain one of these accelerations is expected to explain the other also. General relativity interprets the distance-redshift curve as an accelerating expansion of the universe, which assumes a positive acceleration. But the anomalous acceleration of the Pioneer is negative. This disproves Einstein's general relativity theory.

We will propose a modified gravity theory that can explain both accelerations. The new interpretation of the distance-redshift curve is that it shows a decelerating 'expansion' of the universe, not accelerating 'expansion'.We state that Hubble's law is not due to expansion of the universe, but due to modified gravitational law[2]. A decelerating force will cause *increase of the time* taken by a galaxy *to reach a given recession velocity*. The increase in time, in turn, will cause increase of corresponding distance travelled by the galaxy.

We can demonstrate this by a simple example. For simplicity, assume that the initial velocity of an object is zero. Assume also that the object is in uniform accelerated motion. We will consider the velocity and corresponding distance for two different accelerations.

First let

$$v_0 = 0 \ \ , \ \ a = 5\ \frac{m}{s^2} \quad , \ \ v_f = \ 50\ \frac{m}{s}$$

Since

$$v_f = v_0 + \ at \Longrightarrow v_f = \ at \Longrightarrow t = \frac{v_f}{a} = \frac{50\ \frac{m}{s}}{5\ \frac{m}{s^2}} = 10\ s$$

The distance travelled during this time will be:

$$s = v_0 t + \frac{1}{2}at^2 \ = \frac{1}{2}at^2 = \ \frac{1}{2} * 5 * 10^2 = 250m$$

Therefore, in this case, the distance travelled by the object at the moment it reaches a velocity of 50 m/s is 250 m.

Now let us assume a decelerating force component which will reduce the above acceleration to 4m/s^2. We will calculate the distance travelled just before the object reaches the same final velocity as above, which is 5m/s.

$$v_0 = 0 \ \ , \ \ a = 4 \ \frac{m}{s^2} \quad , \ \ v_f = \ \ 50 \ \frac{m}{s}$$

Since

$$v_f = v_0 + \ at \Longrightarrow v_f = \ at \Longrightarrow t = \ \frac{v_f}{a} \ = \frac{50 \ \frac{m}{s}}{4 \ \frac{m}{s^2}} \ = 12.5 \ s$$

We see that the time required to reach a velocity of 5 m/s has increased, as expected.

The distance travelled will be:

$$s = v_0 t + \frac{1}{2}at^2 \ = \frac{1}{2}at^2 = \ \frac{1}{2} * 4 * 10^2 = 312.5 \ m$$

Although a decelerating force component has been introduced, the distance travelled by the object just before it reaches a velocity of 5 m/s is greater than before. This is because *the increase in the time taken to reach the same velocity due to the decelerating force will more than offset the decrease in acceleration*.

In the above example we have assumed the simple case of uniformly accelerated motion. The analysis of the distance-redshift curve is more complicated.

Before discussing the distance-redshift curve, let us analyze a more complex problem. Instead of constant acceleration, we will assume an acceleration which is a linear function of time.

$$a = \ k_1 + k_2 t$$

The velocity will be:

$$v = \ \int_0^t a \, dt \ = \ \int_0^t (k_1 + k_2 t \ ) \, dt = k_1 t \ + \ k_2 \frac{t^2}{2}$$

The distance travelled will be:

$$s = \int_0^t v\,dt = \int_0^t (k_1 t + k_2 \frac{t^2}{2})\,dt = k_1 \frac{t^2}{2} + k_2 \frac{t^3}{6}$$

Let

$$v_0 = 0 \quad , \quad v_f = 100 \frac{m}{s} \quad , \quad k_1 = 1\,, k_2 = 2 \;\Rightarrow\; a = 1 + 2t$$

The time taken to reach a velocity of 100 m/s will be determined from the above formula:

$$v = k_1 t + k_2 \frac{t^2}{2} = t + t^2 \;\Longrightarrow\; t^2 + t - 100 = 0$$

$$t = \frac{-1 \pm \sqrt{1^2 - 4 * 1 * (-100)}}{2} = \frac{-1 + \sqrt{1^2 - 4 * 1 * (-100)}}{2} = \frac{-1 + \sqrt{401}}{2} = 9.5124921972504$$

The distance travelled during this time will be:

$$s = k_1 \frac{t^2}{2} + k_2 \frac{t^3}{6} = \frac{t^2}{2} + \frac{t^3}{3} = 332.1643245\, m$$

Next let us assume that there is a decelerating force component that will reduce the above acceleration by a constant value of $a_0 = 0.2$ m/s^2 .

Therefore, the acceleration in this case will be:

$$a = (1 + 2t\,) - 0.2 = 0.8 + 2t$$

Therefore, in this case

$$k_1 = 0.8\,, k_2 = 2$$

The velocity will be:

$$v = 0.8t + t^2$$

The distance travelled will be:

$$s = k_1 \frac{t^2}{2} + k_2 \frac{t^3}{6} = 0.8 * \frac{t^2}{2} + 2 * \frac{t^3}{6} = 0.4 * t^2 + \frac{t^3}{3}$$

Let

$$v_0 = 0 \quad , \quad v_f = 100 \frac{m}{s} \quad , \quad k_1 = 0.8\,, k_2 = 2 \;\Rightarrow\; a = 0.8 + 2t$$

The time taken to reach a velocity of 100 m/s will be determined from the above formula:

$$v = 0.8\,t\; +\; t^2 \;\;\Longrightarrow\;\; t^2 + 0.8\,t - 100 = 0$$

$$t = \frac{-0.8 \pm \sqrt{0.8^2 - 4*1*(-100)}}{2} = = \frac{-0.8 + \sqrt{400.64}}{2} = 9.6079968025574$$

The distance travelled during this time will be:

$$s = k_1\frac{t^2}{2} + k_2\frac{t^3}{6} = 0.8*\frac{t^2}{2} + \frac{t^3}{3} = \;\; 332.5750404\,m$$

Like the previous example of uniform accelerated motion, we see that, although there is a decelerating force component, the distance travelled is greater for $a = 0.8 + 2t$ than for $a = 1 + 2t$.

The analysis of the distance-redshift curve is much more complicated than the above examples.The key question is: will the effect of increase in the time taken to reach a given velocity more than offset the effect of decreased acceleration, as above ?

According to Hubble's law $V = H\,d$, where H is Hubble's constant and d is distance.From the Hubble's formula, the acceleration versus distance can be obtained in principle. Let us call this a_H .Assume a decelerating forcewhich will cause a constant deceleration, cosmological deceleration,a_0 . Therefore, the net acceleration will be:

$$a' = a_H - a_0$$

which isalso a function of distance.

We will not try to analyze this problem directly here, because it is complicated. However, we argue that the conclusion for the uniformly acceleratedand linearly accelerated motions above holds for this case also. This is because any complex motion, with non-constant acceleration, can be analyzed by assuming it as uniformly (or linearly)accelerated motion for infinitesimal intervals of time. Therefore, the above conclusion should also hold for motions with non-uniform acceleration.

Conclusion

According to general relativity theory, Hubble's law is due to expansion of the universe. Light from distant galaxies are dimmer (more distant) than predicted by Hubble's law because the universe has been expanding at an accelerating rate since the light was emitted billions of years ago. This means that the light is coming from a more distant source and hence will be dimmer. However, this mainstream interpretation leaves another cosmological problem unsolved: the Pioneer anomaly.The fact that although the two accelerations are almost equal in magnitude, they differ in sign is puzzling. A modified Newton's theory of gravitationinterprets the distance-redshift curve as a decelerating, not accelerating, force. A decelerating gravitational force will cause deviation of the distance-redshift curve in the upward direction. Therefore, modified Newtonian gravity can explain both phenomena: cosmological acceleration and the Pioneer anomaly. In other words, the coincidence of the anomalous acceleration of Pioneer space craft with the value of cosmological acceleration disproves the theory of universe expansion of general theory of relativity.

Thanks to God and His Mother Our Lady Saint Virgin Mary

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