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A Simple Repudiation of the Need for Dark Energy

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Abstract

With a Big Bang, the trajectories of galaxies originate near a common point. It is simple to derive the recession velocity of a receding galaxy as a function of distance. This function is not the straight line predicted by Hubble's law. Dark energy was invoked to explain the deviation from a straight line. The deviation is simple physics.

1. Background

After retiring in 2008, I finally found the time to perform simulations for the cosmos using relativity and finite geometry. Surprisingly, my simulations yielded apparent Dark Energy, even though my simulations preserved energy.

What I am offering is a simple explanation as to why apparent Dark Energy is observed even when energy is actually conserved. Similar results were presented in the Monthly Notices of the Royal Astronomical Society [1, 2].

Hubble observed that recession velocity is proportional to distance. Hubble's Law can be expressed in the form

$$v_r \approx \frac{d}{t_p} \qquad (1)$$

where v_r is recession velocity, d is recession distance, and t_p is the age of the universe, about 14 billion years.

If the trajectories of distant galaxies are plotted backwards in time, then the distant galaxies and our own galaxy emerge from a common point in space some 14 billion years ago. Hubble's Law supports an expanding universe and the Big Bang theory. The t_p in the above equation is therefore the time from the Big Bang.

2. Summary

For galaxies originating from a Big Bang, it is easy to derive the recession velocity of a receding galaxy is a function of distance. A simple analysis produces a formula

$$v_r = \frac{d}{t_p - \frac{d}{c}} \qquad (2)$$

where v_r is recession velocity, d is recession distance, t_p is the present time, and c is the speed of light.

This formula actually agrees with Hubble's law, Equation (1) except for the inclusion of the small fraction, d/c. which is very small for neighboring galaxies. For galaxies within a billion light years, the deviation is less than 1%.

3. General Derivation—Recession Velocity Vs Distance

For galaxies originating from a Big Bang, Figure 1, the trajectory of a receding galaxy, Figure 2, is a function of time,

$$\frac{d}{t} = v_r \qquad (3)$$

where v_r is recession velocity, d is recession distance and t is time from the Big Bang.

This relationship is depicted in Figure.

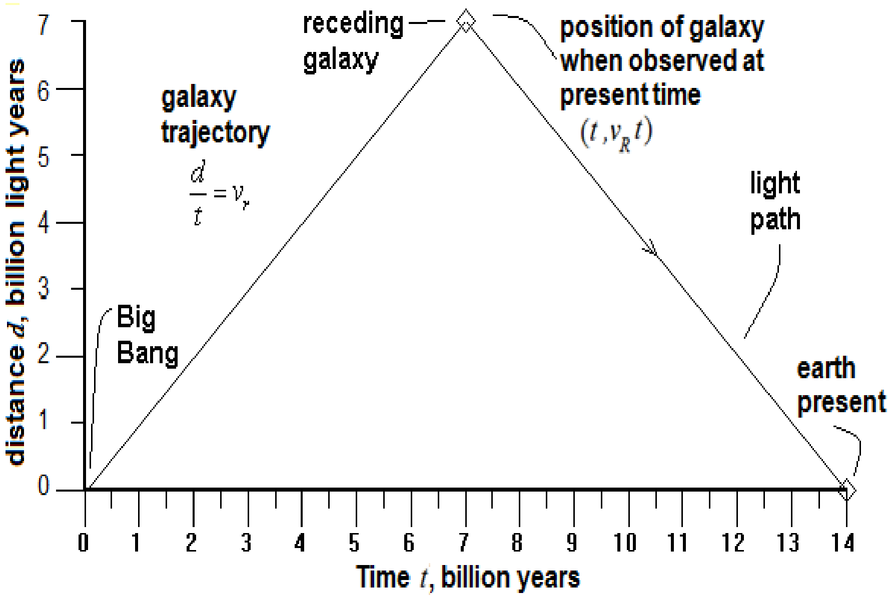

Figure-1. Galactic Distance vs Time in a Flat Universe

The receding galaxy becomes visible when emitted photons strike the earth at the present time, t_p. Because photons travel at the speed of light;

$$\frac{d}{t_p - t} = c \tag{4}$$

where d is recession distance, t is the time when the photon was emitted, t_p is the present time, and c is the speed of light.

To derive the recession velocity as is a function of recession distance, the variable t can be eliminated from the two prior equations by solving for t from Equation (1) and substituting into Equation (2),

$$\frac{d}{t_p - \frac{d}{v_r}} = c \tag{5}$$

where v_r is recession velocity, d is recession distance, t_p is the present time, and c is the speed of light.

Multiplying both sides of this equation by the denominator of the fraction,

$$d = c(t_p - \frac{d}{v_r}) \tag{6}$$

where v_r is recession velocity, d is recession distance, t_p is the present time, and c is the speed of light.

Subtracting ct_p from both sides of the equation,

$$d - ct_p = -\frac{cd}{v_r} \tag{7}$$

Inverting both sides of the equation,

$$-\frac{v_r}{cd} = \frac{1}{d - ct_p} \tag{8}$$

Solve for v_r by multiplying both sides by $-cd$,

$$v_r = \frac{-cd}{d - ct_p} \tag{9}$$

Finally, by dividing the top and bottom of the right side equation by *c*,

$$v_r = \frac{d}{t_p - \frac{d}{c}} \quad (10)$$

where v_r is recession velocity, *d* is recession distance, t_p is the present time, and *c* is the speed of light.

For smaller cosmological distances, the fraction *d/c* is very close to zero, and the above equation agrees with Hubble's Law. For a receding galaxy within 100 billion light years, the deviation from Hubble's law is less than 1%, which is imperceptible.

4. Simple Counter Examples to Hubble's Law

Hubble's Law simply does not work for faster recession velocities. Counter examples to Hubble's Law are easy to construct.

For a thought experiment, consider another galaxy leaving the vicinity of the Big Bang with a recession velocity of 0.99*c*. According to data from the Hubble telescope, such galaxies are common. After traveling for some 7.07 billion years, the other galaxy moves away from our own galaxy some 6.93 billion light years. Being 6.93 billion light years away, it follows that light emitted at that time will take 6.93 billion years to return to our galaxy. For a recession distance of 6.93 billion years, Hubble's law predicts a recession velocity of

$$\begin{aligned} v_r &\approx \frac{d}{t_p} \\ &= \frac{6.93 billion light\, years}{14 billion years} \\ &= \frac{6.93c\, billion years}{14 billion years} \\ &= 0.495c \end{aligned} \quad (11)$$

This is half the value of 0.99*c* used in this thought experiment. The scientific world employs the concept of Dark Energy to explain the increase from 0.495*c* to 0.99*c*.

5. Simulations

Beginning with a big bang, trajectories of random galaxies are depicted in Figure-2.

Cosmological simulation results of recession velocity vs time are depicted in Figure-3. The results show apparent Dark Energy even though the simulation conserved energy. Similar results were obtained for differing cosmological models, whether infinite cosmology, finite cosmology, relativity, or Newtonian physics.

These results of these simulations and models of the shape of the universe were presented at the International Conference on Cosmology and Astronomy held in San Francisco in June 2018 [3]. Unfortunately, very few of the attendees understood the presentation.

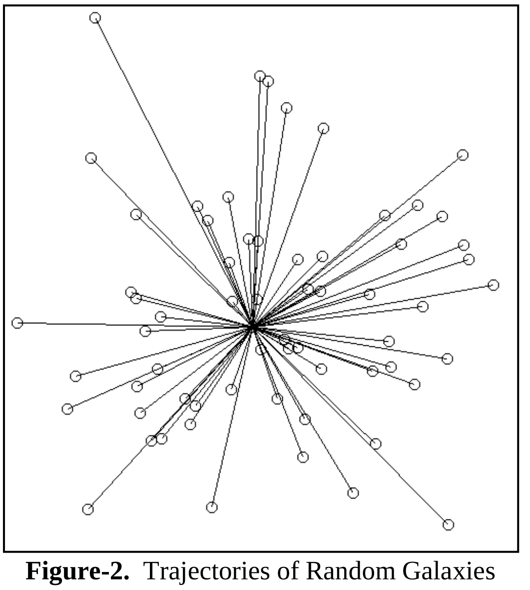

Figure-2. Trajectories of Random Galaxies

I pray that the readers will help spread the good news that physics need not abandon the law of conservation of energy.

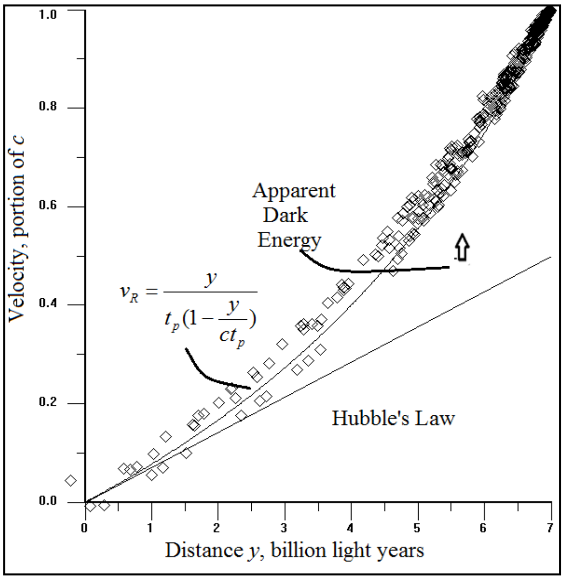

Figure-3. Simulated Recession Velocity vs Distance

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[3] Lloyd G. Allred, 2018. "Is Dark Energy an Artifact of Relativity and a Finite Universe?" In *International Conference on Cosmology and Physics, published in International Research Conference Proceedings.* pp. 624-636.