A Contradiction in the Theory of Universal Expansion

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Universal expansion theory assumes that, if the cosmic redshift indicates withdrawal velocity, the withdrawal velocities of galaxies, at the observer's present time, will be proportional to their instantaneous distances and will also be proportional to the light travel distances from the galaxies to the observer. These two assumptions are shown to be contradictory, but both must be true if the expansion theory is correct. The same hidden inconsistency is found in the velocity-to-distance relationships derived relativistically from the theory, and the inconsistency can be resolved only when the rate of expansion is zero. It is therefore concluded that the universe is stationary and Euclidean and that the cosmic redshift is not expansion-related. Some possible alternative explanations for the redshift are suggested by recent observations and research.

1. Introduction

The cosmological theory of universal expansion incorporates two basic premises, each of which must be true for the theory to be correct. Either of these assumptions seems unobjectionable in itself, but the two taken together appear to be mutually contradictory. These assumptions are:

A. The cosmological principle assumes that the universe will appear the same to every observer. Accordingly, every observer will see the expanding universe around him to be isotropic and homogeneous in all directions, so that, as a matter of standard geometry, all galaxies will appear to withdraw directly away from the observer, and the ratio of withdrawal velocity to instantaneous distance will be a constant value for all galaxies at the observer's present time (Weinberg 1972, p. 407-8; Abell 1978; Schu 1983; Bondi 1961, p. 40; Peebles 1961, p. 37).

B. The relativistic concept of expansion holds that the galaxies are at rest in an expanding "substratum," or space, and that the cosmic redshift in the light waves coming from them occurs not as the result of a conventional Doppler displacement by the emitting galaxy, but as a result of the continuous four dimensional expansion of the "substratum" during the time of travel of the light waves through interstellar space (Bondi 1961, p. 24 and p. 86; Schu 1983; Peebles 1961, p. 13; Weinberg 1972, p. 416). Thus, the cumulative redshift, z, is proportional to the time of travel of the light waves, and since the speed of light is constant, it is also proportional to the distance travelled. Accordingly, the withdrawal velocity indicated by z is also proportional to the light travel distance, so that the ratio of withdrawal velocity to light travel distance will be constant for all galaxies at the observer's present time.

In its simplest form, the nature of the contradiction between these two assumptions may be demonstrated by reference to Figure 1. A

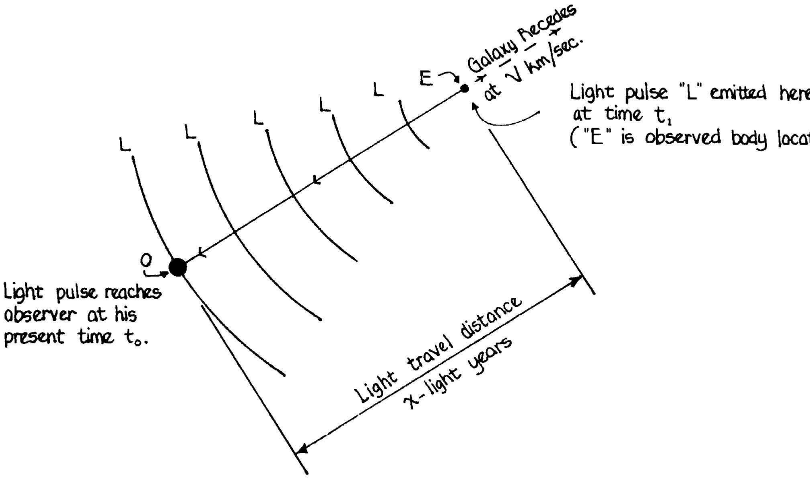

Figure 1 - Hypothetical Expansion: Velocity/Light Travel Distance
During time period t_0–t_1, light pulse L travels x light years to reach observer O. At the constant speed of light, L requires x years to travel the distance x light years.
Since light waves expand at the same rate as expanding space, their redshift z, at time t_0, depends on the time of travel, x years, and on the distance travelled, x light years. Thus, recession velocity u (which is equal to cz) also depends on light-travel distance x. Therefore, the only constant relation between recession velocity and distance will exist when u is proportional to light-travel distance x and $u/x = C$, where C is a constant.

light pulse L is emitted by a luminous body at point E at time t_1 and travels toward position O at the constant speed of light, c. If distance OE is x light years, L will take x years to arrive at the observer's post at time t_0.

Meantime, during the same time interval t_0–t_1 (see Figure 2), the emitting body has receded to some location E', which is more distant from the observer. If the recession velocity is u, E will withdraw at a fraction of the speed of light equal to u/c. Consequently, since time

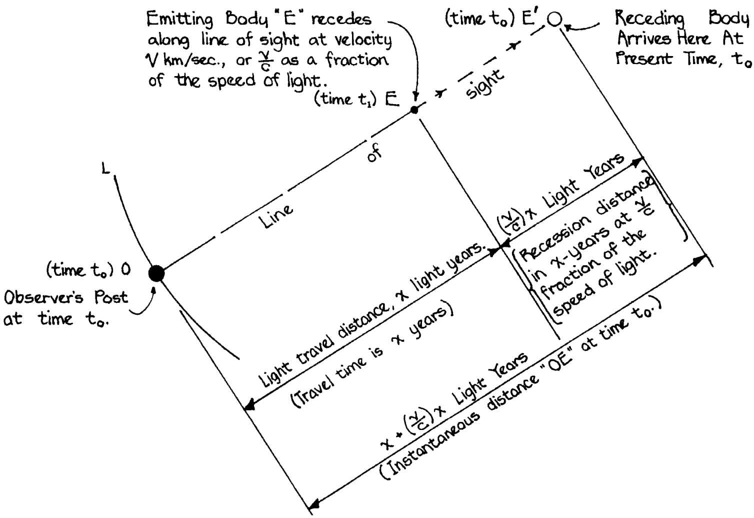

Figure 2 - Instantaneous Distance in an Expansion

While the observer's post, O, at time t_0 is x light years away from location E, the receding body E has continued to recede along the line of sight after emitting light pulse L at a time, t_1 , in the past. Since E has taken x years (numerically equal to t_0–t_1 years) to reach its present time location at E', and since it recedes at a fraction of the speed of light equal to u/c it will have receded a distance of $(u/c)x$ light years. Thus the instantaneous line-of-sight distance between observer and galaxy E is now $x + (u/c)x$ light years.

In accordance with the cosmological principle, u is in constant relation to instantaneous distance for all galaxies at time t_0 , and:

$$\frac{u}{x+\left(u/c\right)x}=K$$

where K is a constant.

interval t_0–t_1 is x years, it is clear that the distance of recession, EE', is equal to $(u/c)x$ light years. The distance travelled by light pulse L from the emission point at E to O is x, but the instantaneous distance, *D*, between the observer and the luminous body at the observer's present time t_0 is $x + (u/c)x$, or $x[1 + (u/c)]$ light years.

Now, according to assumption A, the withdrawal velocity u must be in constant proportion to the instantaneous distance OE' at time t_0 , so that:

$$\frac{u}{x\left(1+{}^{u}\!/_{c}\right)} = K ,$$

or:

$$u/x = K(1 + u/c), \tag{1}$$

where K is a constant.

Assumption B, however, requires that u be in constant proportion to the distance travelled by light pulse L, which is x light years, so that:

$$u/x = C, \tag{2}$$

where C is also a constant.

Substituting in equation (1) gives:

$$C = K(1 + u/c) \tag{3}$$

Since the ratio u/c is a variable increasing with distance from approximately zero for nearby galaxies to approximately 1 for the farthest observable bodies, equation (3) is unacceptable. That is, it equates one constant with another constant times a variable quantity, which is inconsistent (see Figure 3).

In spite of this inconsistency, it is clear that both assumptions are essential for the universe to be expanding as theorized.

Assumption A conforms with extensive astronomical observations and sky surveys which have sampled all portions of the sky and have shown galaxy distribution to be isotropic and homogeneous out to

1400 million parsecs (Abell 1978; Schu 1983; Weinberg 1973, p. 407 and 445).

Moreover, if assumption B were omitted from the theory, the indicated redshift withdrawal velocities could only be explained as conventional Doppler displacements in a three-dimensional universe. The original center of such an expansion would then lie within a observer's three dimensional world, so that an astronomer looking back in time toward that center would see an increased density of galaxies, while he would see reduced density in the opposite direction. Since no such variation in galactic distribution can be observed, it seems evident that both assumption B and assumption A must be true for a general expansion to be taking place.

2. The Contradiction As Reflected In Current Theory

If the foregoing assumptions on which the expansion hypothesis is based are contradictory, the same contradiction should be reflected in the various relationships which are developed in the main body of the theory. That this is so may be demonstrated by a careful review of various texts on the universal expansion theory (Weinberg 1972; Bondi 1961; McVittie 1965).

A requirement of cosmological expansion theory is to show the relationship between the relativistic distance to a galaxy and the luminosity distance, d_L, which Hubble and other astronomers determined from astronomical observations and used to establish their constant ratio of redshift withdrawal velocities to distances. Astronomers determine this ratio by measuring the light power as well as the spectral redshift z in the light which reaches their instruments from each galaxy. They then compute the withdrawal

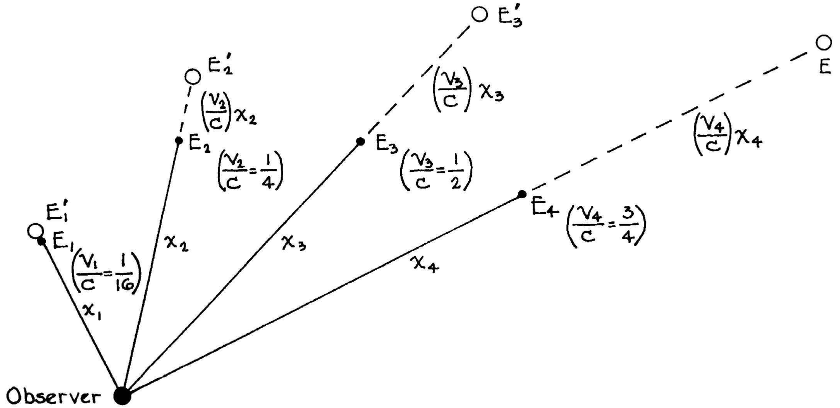

Figure 3 - Comparisons of Light Travel and Instantaneous Distances (Schematic)
E_1, E_2, E_3, and E_4 are four galaxies at times when observed light was emitted. Their widely different light travel distances (see Figure 1) are X_1, X_2, X_3, and X_4. Their fractional recession velocities [(u/c) in Figure 2], are 1/16, 1/4, 1/2, and 3/4, well within the range of observed redshift recession velocities. Accordingly, their instantaneous distances are $X_1 + (1/16)X_1$, $X_2 + (1/4)X_2$, $X_3 + (1/2)X_3$, and $X_4 + (3/4)X_4$.
Obviously, the four recession velocities cannot be in constant proportion to both the light travel distances (solid lines) and the instantaneous distances (longer dashed lines). Yet, in theory, both relations are constant, which leads to the inconsistent equation (3): $C = K(1 + u/c)$. Since C and K are constants, while u/c varies between 0 and 1, equation (3) cannot be true.

velocity cz and the luminosity distance d_L, which are used in Hubble's constant ratio cz/d_L (Weinberg 1953, p. 445-6).

The luminosity distance, d_L, of a galaxy as derived from general relativity is given as:

$$d_L = R_0^2 = \frac{r_1}{R_1} \tag{4}$$

where r_1 is the radius of the spherical light wave emitted at t_1 by a distant object and reaching the observer at time t_0, and R is the Robertson-Walker metric whose value is given as R_0 at the present time and R_1 at the time of emission (Weinberg 1953, p. 421).

Equation 4 may also be written in the form:

$$d_L = R_0 r_1 (1 + z),$$

or as

$$d_L = R_0 r_1 + R_0 r_1 z \tag{5}$$

where z is the cosmic redshift in the light waves received by the observer, and where $(1 + z) = R_0/R_1$ (Weinberg 1972, p. 416; Bondi 1961, p. 106).

It should be noted in equation (5) that z represents the redshift, or fractional increase in the length of a light wave, as it expands during the time interval t_0–t_1 due to the continuous expansion of space. Thus, if the rate of universal expansion were zero, z would be equal to zero, so that the correct distance travelled by a light wave from the point of emission to the observer would be $R_0 r_1$ light years. This distance, $R_0 r_1$ light years, corresponds to the distance x light years in Figure 1.

Also, since z is equal to the fractional expansion of space generally during time interval t_0–t_1 (Schu 1983; Weinberg 1972, p. 416), it is clear that the product, $R_0 r_1 z$, represents the number of light years by which the distance from emitting object to observer has expanded. This expansion distance, $R_0 r_1 z$, therefore corresponds to the distance $(u/c)x$ in Figure 1.

Consequently, the sum of these two distances is the instantaneous distance separating the observer and the emitting body at time t_0, provided that space is expanding as visualized. Accordingly, since assumption A requires that galactic withdrawal velocities be in constant proportion to their instantaneous distances at time t_0:

$$\frac{R_0' r_1}{R_0 r_1 (1+z)} = K \tag{6}$$

where R'_0 is the rate of change of the metric R at time t_0 and $R'_0 r_1$ is equal to withdrawal velocity (Weinberg 1972, p. 417).

However, premise B requires that recession velocity be in constant proportion to the distance travelled by the light, so that:

$$\frac{R_0' r_1}{R_0 r_1} = \frac{R_0'}{R_0} = H_0, \tag{7}$$

where H_0 is the Hubble constant at time t_0 (Weinberg 1972, p. 441).

Substituting in equation (6) gives:

$$\frac{H_0}{1+z} = K ,$$

or

$$H^0 = K(1 + z) \tag{8}$$

It can be seen that this contradictory relation is identical in form with relation (3), since H_0 is a constant at time t_0 and since $z = \mathbf{u}/c$. This logical contradiction substantiates the inconsistency of assumptions A and B and of the theoretical relationships derived from them.

The scientific significance of this contradiction is apparent when it is recognized that, although H_0 and K are constants at time t_0, the value of z varies with the distance to each galaxy, from close to zero for nearby galaxies to approximately 1 for the most distant galaxies currently observed. Consequently, according to equation (8), the value of H_0, the Hubble constant, should vary from K, at near distances, to $2K$ at the present limits of visibility. Yet cosmological theory requires that, at the present time, both H_0 and K, as defined above, must be constant, contrary to equation (8).

3. Implications

It becomes evident that the contradiction between assumptions A and B vanishes only when the rate of universal expansion is zero. In that circumstance, the observed redshift, z, would have to be produced by some phenomenon other than expansion. The expansion distance, represented by $(u/c)x$ in equation (3) and by $R_0 r_1 z$ in equation (5), would disappear, so there would be no difference between the light travel distance and the instantaneous distance and no conflict between assumptions A and B.

Therefore, since a universal expansion can conform with astronomical observations only if assumptions A and B are both true, and since they are both true only when the expansion rate is zero, it follows that the universe cannot be expanding.

4. Other Possible Explanations For The Redshift

Of course, one still needs to explain the cause of the observed redshift in such a stationary universe. Since astronomical observations in the low redshift domain indicate that the cosmic redshift varies in direct proportion to distance, and since there can be neither a conventional Doppler displacement nor a relativistic expansion to explain the shift, it is reasonable to conclude that the redshift is generated continuously by some other cause during the course of the photon's intergalactic travel.

However, no substantive alternative has yet been produced to explain the redshift, and any possibilities can only be speculative at this time. Such speculations may well start with a reassessment of the role of gravitation in the redshifting of light waves, a role which could greatly increase based on some developing concepts.

Greater Mass Density in a Stationary Universe. There should be a substantial difference in size and mass density between an expanding and a stationary universe. This results from the difference in distance computations for receding, as opposed to stationary, galaxies. Thus, the distance to a receding galaxy at large astronomical distances is based on its luminosity distance,

$$d_L = R_0 r_1 + R_0 r_1 z$$

and, as previously discussed, this gives the instantaneous distance to the receding galaxy at the present time. The expression $R_0 r_1$ gives the distance actually travelled by light waves from galaxy to observer, while the product $R_0 r_1 z$ represents the fractional increase in the galaxy's distance which has occurred during the time of travel of the light from galaxy to observer as a result of the expansion.

The situation is different for a stationary galaxy, which always remains at the same fixed distance, the distance $R_0 r_1$. In this case, the expression $R_0 r_1 z$ in the equation for luminosity distance does not represent an actual increase in the galaxy's distance, but only an apparent increase resulting from the decreased intensity of the redshifted light reaching the observer's instruments.

Accordingly, an astronomer would presumably determine the present distance to a stationary galaxy by first measuring the intensity of its observed light and applying the inverse square law to obtain its luminosity distance, d_L. Then this value and the value of the observed redshift, z, would be applied to equation (5) for luminosity distance. For a distant galaxy near the edge of the presently observable universe, the observed z value would be close to 1, so that the resulting computation would give, approximately:

$$dL = 2\, R_0 r_1,$$

and

$$R_0 r_1 = \tfrac{1}{2} d_L$$

where $\frac{1}{2}d_L$ represents the approximate fixed distance to the stationary galaxy, if the galaxy is near the edge of the observable universe. Thus, the observable radius of the stationary universe would be about half of what it would be for an expanding universe.

Accordingly, a stationary universe should occupy a greatly reduced volume of space and should have a greatly increased density of matter within that volume. Also, at these reduced distances, the observed arc width of each galaxy would correspond to a reduced galactic diameter, with the result that the internal mass densities of galaxies would likewise be increased.

In such a stationary and comparatively dense universe, gravitational effects on light waves would presumably be multiplied and would account for a much greater shifting of the wavelengths of light from the galaxies than has been supposed previously.

Invisible Mass. As one solution for the problem of the "missing mass," it has been proposed that there may be vast quantities of invisible matter in various forms inside the galaxies and in space generally. Some evidence seems to support this possibility, and other evidence is being searched for. If these speculations should prove correct, the suspected invisible mass would augment the observable mass discussed above and would further multiply the effects of gravitation on observed light from the galaxies. Moreover, this widely dispersed matter should act to diffuse and further redshift the light.

Gravitational Effects of Black Holes and Quasars. Black holes and quasars exert tremendous gravitational effects which cannot be accounted for by any observable mass which may be associated with them. While their numbers and distances remain a matter of conjecture, there is substantial observational evidence which indicates that quasars may not be independent and extremely distant objects but may instead be found in, and closely associated with, all galaxies at all distances (Arp 1987). Other conjectures would place black holes at the centers of galaxies. If these possibilities should prove to be well founded, then the gravitational attraction exerted by galaxies would be greatly increased over that which has been attributable to the conventional bodies of mass within them.

When considering these several possibilities, it is not inconceivable that gravity may in fact produce a major portion of the redshift in the light from the galaxies.

Interaction of Space and Energy Waves. Entirely aside from possible gravitational effects, there is also the mysterious nature of interstellar space itself and the impact which that space might have on the passage of energy waves. Although the Michelson-Morley Experiment a century ago did not demonstrate the existence of the classical ether, neither did it prove conclusively that an ether does not exist in some form. Some scientists believe in an ether as a medium for the propagation of energy waves, and some recent experiments purport to show this.

If such a fluid medium, or ether, did exist, it would hardly be the totally placid, static substance which was visualized a century ago. Instead, every smallest part of it would be constantly agitated by countless energy waves of all known wavelengths and intensities emanating from all the galaxies of the universe and supplemented by the intermittent impacts of cosmic rays, supernova explosions. Moreover, each of the basic atomic particles or bits of invisible matter which are thinly scattered through interstellar space would itself interact with at least some of these converging influences. Is it, then, inconceivable that this clashing interplay of energy waves and objects should produce various perturbations and force fields within the ether just as ocean waves and currents give rise to turbulence and eddies in the presence of rocks, atolls, and irregular shorelines?

In such a hypothetical situation, it seems reasonable that the continuous flow of radiant energy from the galaxies would provide the power to maintain the perturbations of the ether, while the ether would continually absorb energy from the electromagnetic waves, which, in turn, would lose energy and become redshifted. It might be further speculated that the building energy content of this dynamic ether would in some way be swept back into the galaxies to complete a full cycle of energy exchanges, but that is beyond the scope of this discussion.

All of these ideas, of course, are nothing more than wide-eyed speculation, but they are hardly more speculative than a big bang universe which creates itself explosively out of nothing and then drains its energies endlessly away into empty space. Moreover, these present conjectures have one substantial advantage over the current expansion concept, for they have no obvious mathematical inconsistency or mechanical contradiction, while the expansion theory does.

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