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C Decay and the Red-Shift

BARRY SETTERFIELD

The correct approach to c decay based on the conservation of energy shows that light is emitted at a CONSTANT WAVELENGTH with the FREQUENCY PROPORTIONAL TO C. It may be wondered how a red-shift is possible from such a situation. Let it be made plain: the red-shift IS NOT DUE TO THE EFFECT OF THE CHANGE IN C ON THE ATOMIC OSCILLATORS that emit the light. It is due to the increasing permeability of free space changing the amplitude of the magnetic vector and decreasing refractive index and hence increasing optical path length. The increase in optical path length per second is the same as an increasing geometrical length per second which results in a Doppler red-shift due to recession velocity.

PRELIMINARY CONSIDERATIONS

1. Causes of Doppler Shifts

It is not usually known that the frequently observed Doppler Principle is just one part of a more generalized formula. This Principle was extended by Michelson of Moscow[1] and is mentioned in two textbooks.[2]

They point out that a change in the thickness, density, or refractive index of an intervening medium can impart a Doppler shift in the wavelength of light passing through that medium. In other words, if an inhomogeneous medium were to move across the path of a ray of light, then the inhomogeneities would impart a Doppler shift in the wavelength. Perot has verified this Doppler-Michelson formula for the case of a prism moving across the ray-path in a system using 12 prisms rotated by an electric motor.[3] Michelson points out[4] that for a prism being introduced across the path of the beam, which increases the refractive index, or increases the optical path length, or increases the light transit time across the same geometrical path length, a red-shift will occur. This was verified experimentally by Perot and is acknowledged as being the cause of some red-shifting by the sun.[5]

2. C and Conservation Laws

By way of passing it should be noted that as both the optical path length and the light travel time are increased, whether the cause be an optically denser medium or a decay in c, conservation laws will still be observed, but with differing results. In the first instance in which the optical path length is increased with a prism and no c decay is involved, then for frequency v of a wave of length X we have velocity

$$c = \nu\lambda \qquad (1)$$

and wave energy

$$E = hc/\lambda = h\nu \qquad (2)$$

Now without involving c decay we have Planck's constant h invariable, and as light enters the optically denser medium and slows down, as E = constant in (2) along with h, the result is that

$$\lambda \text{ proportional to c} \qquad (3)$$

This is the usually encountered situation in which the wavelength gets shorter with increase in refractive index and the frequency remains constant. Alternatively, with c decay we have already noted that

$$\text{h proportional to 1/c} \qquad (4]$$

but the energy content E in (2) is still constant. Therefore as the ratio

$$hc = \text{constant} \qquad (5)$$

we have from (2) that the wavelength

$$\lambda = \text{CONSTANT} \qquad (6]$$

At the same time it inevitably follows that the frequency

$$\nu \text{ proportional to c} \qquad (7)$$

Thus changing the speed of light, or what amounts to the same thing, the refractive index of a medium, in one instance causes a change in the wavelength of light, while in the other it induces a change in frequency. In each case the result is proportional to c. From this two points must be noted.

3. C Decay and Refractive Index

Firstly, the refractive index in a medium is usually defined as the ratio of the speed of light in space, c, to the speed of light in a medium c′. Thus refractive index

$$n = c/c' = RI \tag{8}$$

Jenkins and White[6] affirm that changes in permittivity ε or permeability μ of a medium, caused for example by a current upon a nonconducting dielectric, induce a change in the velocity of light through that substance and hence a change in the refractive index of the substance. In so doing they point out that the refractive index, RI, is defined as the amplitude ratios of the electric and/or magnetic vectors of light. If the electric vector E is diminished then the RI is H/E or E_1/E_2; if the magnetic vector H is decreased then the RI is E/H or H_1/H_2, where E_1 and H_1 are the initial value and E_2 and H_2 are in the medium. (If both vectors are equally affected, then the RI becomes $(E_1/E_2)^2$ or $(H_1/H_2)^2$). RI is also given as $\sqrt{(\varepsilon_2/\varepsilon_1)}$ or $\sqrt{(\mu_2/\mu_1)}$. C decay theory emphasises these changes in H, μ, and c which is thus an RI change. Thus just as a current applied to a nonconducting dielectric causes a change in c through changing ε and so changes the RI, so too, a change in c caused by a change in μ of space will produce an effective change in its index of refraction. In each case both the velocity of light changes and the amplitude of the vector changes in proportion and ε or μ change. This is an RI change by definition. Thus for a varying magnetic vector $H_1/H_2 = c/c' = \sqrt{(\mu_2/\mu_1)} = n$. That the refractive index of space is usually fixed at unity is unfortunate. What would be a better statement of truth in a changing situation is that the RELATIVE refractive indices of space and medium remains unchanged. Since Martin and Connor[7] define the relative refractive index as the ratios of the velocities of light, it is thus possible on the basis of the above discussion and (8) to define the relative refractive index of space at a given time compared with some standard at a chosen time. As the speed of light is slowing down with time it means that the relative refractive index of space is INCREASING with time since slower light speed gives higher refractive index. The reason for the changing magnetic amplitude and velocity and hence RI is the change in magnetic permeability of space with time[8] By this convention we thus have from (8) that the relative RI of space now is given by

$$N = C_{(original)}/C_{(now)} = C_0/C_n = (\mu_2/\mu_1) \qquad \text{..........................(9)}$$

For the sake of uniformity this definition of N will be retained. Thus, if we say that the original velocity was 1.5 x 10^{11} faster than c now, we put N as equal to 1.5 x 10^{11} and so state that the relative refractive index of space has altered by a factor of 1.5 x 10" due to increasing permeability μ. Theory indicates that the amplitude of the magnetic component of the electromagnetic radiation involved would also vary accordingly, just as the relative refractive index definition requires.

4. C Decay and Frequency

The second point that should be noted is the effect on the frequency of the light. Suppose a stationary source emits a light wave at time t_0 which marks the start of the wavefront that is emitted. Since the frequency ν_0 of the wave is the number of wavefronts per second that pass a given point, then the end of the wavefront will be emitted at time (t_0 + $1/\nu_0$). Now if the start of the wavefront reaches an observer at time t, the end of the wavefront reaches the observer at time t + $1/\nu^l$ where in this instance ν^1 is the frequency of the wavetrain as it passes the observer. If there has been a decay in the speed of light from the time of emission to the time of reception, it is obvious that the number of wavefronts per second that pass the observer will be less than that leaving the emitter. However, the emitted wavelength of light is constant for all values of c.[8] Thus, although we know that ν^1 is less than ν as seen from the photon's frame of reference, as the wavelength is constant we may state that for a stationary source, the distance traversed by the start of the wavefront between source and observer is equal to the distance traversed by the end of the wavefront between source and observer. Since this is the case, it also follows that for the photon's own moving frame of reference the distance covered by one wavelength at emission is the same distance covered by one wavelength at reception. Thus we have

$$\int_{t_0}^{t_0 + 1/\nu_0} c(t)\,dt = \int_{t}^{t + 1/\nu'} c(t)\,dt. \qquad \text{................(10)}$$

and since distance = velocity x time we can write (10) as

$$c(t_0) \times 1/\nu_0 = c(t) \times 1/\nu' \tag{11}$$

which upon re-arranging gives the final result that

$$\nu' = \nu_0 \times \frac{c(t)}{c(t_0)} \qquad \text{................(12)}$$

which shows that the frequency of a wave train will drop in direct proportion to the decay in the speed of light. Indeed, if the value of c at time t has dropped to 1/Nth of its value at emission we have the relation

$$c(t) = 1/N \times c(t_0) \qquad (13)$$

or alternatively

$$\frac{c(t)}{c(t_0)} = 1/N \qquad \text{................(14)}$$

Hence in (12) we have

$$\nu' = \nu_o/N \qquad (15)$$

This means, in effect, that despite the fact that the wavetrain was emitted at a much higher frequency (though the same wavelength as now), as the frequency drops directly proportional to the c drop, from the photon's own frame of reference the new frequency of its wavetrain will be exactly the same as the reference frequency of the same waves that the observer is using for his comparison. Thus we can write for the photon's own reference frame from (15)

$$\nu' = \nu_{\text{now}} = \nu_{\text{n}} \qquad \text{................(16)}$$

Thus in the Doppler equation where on the right hand side the term v refers to the frequency of emission, it must now be changed to read the frequency of the corresponding reference now. For example, the blue-green hydrogen line has a wavelength of about 4.861×10^{-5} cm. This wavelength would have been the same at the time of Creation, but due to a higher value for c by a factor of say 5×10^{11}, its frequency would have been 3.0857×10^{26} hertz. Today, if the beam of light suffered no other effect in transit (which is NOT the case for distant objects), the frequency of the hydrogen line would be 6.1716×10^{14} hertz, exactly the same as the laboratory standard. Thus the standard Doppler equation for the frequency of a receding object[9] where the received frequency is ν' and is given by

$$\nu' = \nu(1 - \frac{v}{c}) \qquad \text{................(17)}$$

then on the basis of (16) this must be changed to read

$$\nu' = \nu_{\text{n}}(1 - \frac{v}{c}) \qquad \text{................(18)}$$

As an aside, it might be mentioned that, though frequencies were higher in the past for light from the sun, this does NOT mean that the radiation was more penetrating or dangerous, since that property of the electromagnetic spectrum is solely dependent upon the emitted wavelength, which is constant for all c. It simply means that more waves of the same length pass by per unit time as the wave is travelling faster. It should be noted, also, that though the human eye operates on frequency, not wavelength, since its frequency receptors (electrons in atomic orbits) are themselves dependent upon the value of c (orbital velocity of electrons is proportional to c)[8] it follows that there is no nett effect, which means that the eye would see the colours just as we see them today.

5. C Decay and Optical Path Length

It is important to realise, however, that there is an ADDITIONAL EFFECT which is the same in each case and is supplementary to the above effects on frequency and wavelength. This is that a systematic increase in refractive index also results in a red-shift. An alternative way of stating it is that a medium of continually increasing optical density caused for example by increasing v continually decreases the velocity of c in that medium and the light travel time over an equal geometrical path length continually increases. This situation results in a red-shift, as Perot verified. The reason for this effect is at once apparent when it is pointed out that this is the same as the optical path length increasing such that this increase in the optical path length per second is equivalent to a velocity of recession of source and observer with the same numerical value. In other words, there are two ways in which a red-shift may be obtained. The standard method is for the geometrical distance between source and observer to increase with a constant refractive index - the effective optical path is increasing with time. The second method is for the geometrical path length travelled per second to decrease but for the refractive index to increase with time. In both cases the effective optical path length is increasing with time and the light travel time for the distance is increasing. The Doppler-Michelson equation takes account of both situations.

Before looking at the Doppler-Michelson formula in detail it is important to obtain several definitions. Martin and Connor state that **"if the speed of light is smaller, that medium is said to be optically denser".**[7] Again, Starling and Woodall state that **"optical distance. . .is measured. . .by the time of travel for the light".**[10] In other words, when a light photon takes longer to travel the same geometrical distance, the optical distance is longer as the light velocity is slower. Jenkins and White state **"If light travels more slowly its effective optical path has increased".**[11] From these three statements it is apparent that a decay in c is effectively increasing the optical path length and will therefore give rise to the experimentally observed red-shift. We have already noted the change in the velocity of light in a medium represents a change in the refractive index of the medium. The point of comparison with c decay is this: it is essentially the same as passing light through a non dispersive medium (space) of continually increasing optical density and hence refractive index because of the continually decreasing light velocity. Thus it may be considered that the refractive index of space was increasing. This means that the time taken to travel an equal geometrical distance is longer which means that the optical path length is increasing with time which is equivalent to the source and observer moving apart which results in a red-shift.

THE DOPPLER-MICHELSON FORMULA AND THE RED-SHIFT

1. The Generalised Equation

The generalised Doppler-Michelson formula is usually written as

$$\nu' = \nu \quad 1 - \frac{1}{c}\,\Sigma(L\frac{dN}{dt} + N\frac{dL}{dt}) \qquad \ldots\ldots\ldots\ldots\ldots(19)$$

where ν' is the observed frequency, ν the emitted frequency, c is the speed of light in the medium that has a refractive index N and geometrical path length is L, while dt is total time. For the c decay case we note that one change must occur immediately in relation to the emitted frequency ν. We have already pointed out that this frequency drops proportional to c so that, if the rest of the formula were ignored, the emitted frequency would become the same as the reference frequency of the observer. Hence if the speed of light has dropped to 1/Nth of its original value, so too will the frequency. Thus ν becomes ν/N, but that is the same as the reference frequency of the observer. Thus (19) must have ν changed to ν_n.

The final term in (19) is the usual one associated with the Doppler shift due to the change in the geometrical path length with time. Since that is not in question at this stage, that term may be ignored in the discussion. However, before doing so we may use it to illustrate what is being spoken about by the Doppler-Michelson formula. In equations (17) and (18) the approximate relativistic Doppler formula contains the term (v/c) which is the one giving rise to the Doppler shifting. This may be re-written as

$$v/c = \frac{dL}{dt} \times \frac{1}{c} \qquad \ldots\ldots\ldots\ldots\ldots(20)$$

where dL/dt is the change in the geometrical path length per second which is usually due to a velocity v associated with the source or observer. The value of c is the one pertaining in the medium of refractive index N over which the change is occurring. Since it is usually involving free space, N is put equal to unity and c then bears its usual value and the contracted equation is that given by (20). However, the full expanded expression is

$$v/c = \frac{N}{c}\,\frac{dL}{dt} \qquad \ldots\ldots\ldots\ldots\ldots(21)$$

This change per second in the geometrical path length inevitably results in an equal change in the optical path length per second. But there is another way in which the change in the optical path length can occur, through a change in the refractive index N. This is expressed by the first term in (19) as

$$v/c = \frac{L}{c}\,\frac{dN}{dt} \qquad \ldots\ldots\ldots\ldots\ldots(22)$$

Here we have the change per second in the refractive index as (dN/dt). For this to become the change in the optical path length per second required to give us an effective velocity, then L must be the geometrical distance over which N has changed in 1 second.

2. Derivation of the Red-Shift Function

The main focus of our attention is now on equation (22) and its position in (19) as it relates to a changing c situation. Since the value for c that must be adopted in both of these equations is the one in the medium of travel, then it becomes at once apparent that what is required is the average value of c throughout time dt. For the case in hand the average value of L that is required bears the same numerical value as c. Accordingly, for the c decay case, we can put the abbreviation in the Doppler formula that numerically

$$v/c = dN/dt \qquad (23)$$

The numerical result of (23) may thus be substituted back into (18) to give for changing c alone, without any other effects, that

$$\nu' = \nu_n(1 - \frac{dN}{dt}) \qquad \ldots\ldots\ldots\ldots\ldots(24)$$

However, the red-shift factor, Z, is given by the standard formula

$$Z = \frac{\nu_n - \nu'}{\nu'} = \frac{\nu_n}{\nu'} - 1 \qquad \ldots\ldots\ldots\ldots\ldots(25)$$

Therefore substituting (24) in (25) we obtain

$$Z = \frac{1}{(1 - \frac{dN}{dt})} - 1 \qquad \ldots\ldots\ldots\ldots\ldots(26)$$

This formula will be useful in predicting the values of the red-shift from c decay. Alternatively, when working from observations, it will also be necessary to determine the value of c from red-shift measurements. For this purpose (26) can be re-written

$$1 - \frac{1}{1 + Z} = \frac{dN}{dt} \qquad \text{................(27)}$$

In this instance it can be noted that due to the large numbers involved we can put approximately

dN = N = c(initial)/c(now) .... (28)

and remembering

dt = T = total travel time in seconds emitter to observer ....(29)

then we have

$$1 - \frac{1}{1 + Z} = \frac{N}{T} \qquad \text{................(30)}$$

THE RED-SHIFT AND THE DECAY CURVE

We are now in a position to investigate galactic red-shifts as a measure of c that will give us some specific values to determine the upper part of the c decay curve.

1. Observational Examples

CASE 1

For the Virgo cluster a conservative value for Z would be for the closest members

Z = 0.001 (31)

There are a number of galaxies in the cluster with such a typical value. From (30) we thus have the result that

N/T = 0.000999 or about 0.001 ....(32)

Since the distance of the Virgo cluster is reasonably certain, with the closest members around **60 million LY** away,[12] it means that the integral under whatever curve or line for c decay that at time T approximates to **60** million **LY** should give a value of c in accord with (32) which is

N = c(then)/c(now) = 0.000999 T .... (33)

CASE 2

For the Coma cluster the typical value of Z is

Z = 0.023 (34)

Thus from (30) we have

N = 0.0225T (35)

The **New Concise Atlas of the Universe** places the Coma cluster at about 250 million LY so the decay integral for time T that gives this distance should give N as in (35). Beyond the Coma cluster, distance measurements become somewhat unreliable having no direct system of determination. In fact the red-shift itself is usually employed as the standard method of distance estimation. However, at the upper end of the range a useful relationship comes to light and can be used in association with the radiometric data. This is given by

CASE 3A

The maximum red-shift observed for any galaxy is about Z = 4. Early in 1983 PKS 2000 — 330 was discovered with a red-shift of Z = 3.78. In accord with (30) we have

N = 0.8 T (36)

which is probably approaching the upper maximum for visible galaxies. However, there is one further point that may be considered.

CASE 3B

There is strong evidence[13] that the 3°K background radiation is simply the x-ray background emanating from a suite of quasar objects red-shifted by a factor of about 1 million.[14] Indeed it has been pointed out that the microwave background has the energy density of red-shifted starlight and as such cannot be the remnant of any Big Bang.[15] For this to be the case for a suite of objects to be giving a background due to a consistent value of the red-shift strongly implies that a constant value for c pertained then to give a constant value for Z. This would then appear to be the upper maximum from which c has decayed. Accordingly, we have for the upper maximum value

Z = 1,000,000 (37)

and by an application of (30) we find that

N = 0.999999 T (38)

Thus in the limit we can put approximately

N = T (39)

as the final upper condition pertaining from observation. In any case (36) is obviously trending in that direction despite the discussion leading to (37).

2. The Red-Shift and Geology

Now for Cases 1 and 2 we have the situation where for a definite integral value given by T, the value of c is absolutely defined by observation of Z. If the c decay curves or lines do not approximate to this value, then something is amiss. In the situation pertaining to Case 3 we do not have an integral value from the distance since that is observationally indeterminate as Z is used to infer distance for these objects. However, for the case of (38) or (39) we have an integral value provided by the radiometric data. From this data as noted below the minimum integral from which the decay has occurred with the condition that N = T as given by (39) is 1.8 billion radiometric years, which is equivalent to 1.8 billion LY. Thus on the curve chosen, the value of T that gives the integral of 1.8 billion 'years' must also be the approximate value of N when T is stated in seconds, and hence c is fixed.

The limits on N and T, and hence c, set by the radiometric data is readily given. The Precambrian continental nuclei, the basement rocks of the geological column on earth, have a cut-off radiometric 'age' of about 1.8 billion years. This is in very close accord with the minimum radiometric age of moon rocks, which is marginally less than 2 billion.[16] Thus the minimum integral under the decay curve must be about 1.8 billion radiometric years or 1.8 billion LY of distance. The maximum value is determined by the critical element U-235, which has the shortest half-life of the naturally-occurring radioactive elements, namely 713 million radiometric years. Eicher[17] points out that the maximum number of half-lives that U-235 could have gone through is 7.8, and that assumes that all Pb-207 is radiogenic (which it may not be). This then forms an upper maximum for all radiometric clocks and gives a radiometric 'age' for the Universe of 5.56 billion 'years'. It is customary to assume that the age is greater by accounting for the abundance of U-235 on the basis of nucleogenesis and the spreading of this material by supernovae explosions. This is untenable in a c decay situation, however, and this limit must stand. Hence the upper maximum is set at 5.56 billion radiometric years or 5.56 billion LY. This is in reasonable agreement with the work of Huchra et al[18] in re-assessing the most distant objects at 5 billion LY away and a maximum possible astronomical 'age' for the Universe of 8 billion years on a linear red-shift. The non-linear red-shift indicated by c decay gives an astronomical 'age' of 6 billion years.

3. A 3°K Background

We are now in a position to determine the upper maximum of c from these figures of 1.8 and 5.56 billion 'years' coupled with the information that in the limit N approximately equals T in seconds. The third piece in the puzzle is the above observation that the 3°K background suggests that the maximum value of c was maintained at a constant value for a period of time. If we take it that c was maintained constant for just 1 day (which will give us the maximum value in the following calculations), and at the end of 1 day the decay occurred with the integral reading 5 billion 'years', then during that day all radiometric clocks 'aged' by 0.56 billion years from 5 to 5.56 b.y. This gives us a maximum value for N of $(0.56 \times 10^9) \times (365.25) = 2.045 \times 10^{11}$ which thus gives the peak value of c as being about 2×10^{11} faster than now and a decay time of near 2×10^{11} seconds. At the other end of the scale the maximum distance over which the suite of objects giving rise to the microwave background extends is given by the minimum value for the decay integral of 1.8 billion years and the period of constant c extending from objects dating radiometrically 5.56 down to 1.8 billion years. If we put this sweep of 3.76 billion 'years' and the resulting distance of 3.76 billion LY as occurring in just 1 day, we again find the maximum value of c as 1.37×10^{12}. However, the half-life of U-235 drops from 713×10^6 years down to $1/(1.3\ 7 \times 10^{12})$ of that or 0.1901 days and the 7.8 half-lives would occur in just 1.48 days. It would seem that 0.48 days added as the period covered by the decay integral is somewhat unrealistic and so the total upper maximum for N and T and hence c on this basis is around 1×10^{12}. Alternatively, if a period of constant c is set at 12 days, the value of N becomes $(3.76 \times 10^9) \times (365.25)/12 = 1.1 \times 10^{11}$. As this also equals T in seconds, a further limitation of history is imposed as this points to an origin for all radiometric dates of just 3626 years ago or 1666 BC. Accordingly the period of constant c must lie between 1 and 12 days and the value of c initially from 1×10^{11} to 1×10^{12} of c now. If we take 6 or 7 days as the fair average for the constant period as evidenced by the microwave background, then we find a value of N of close to 2×10^{11} (as in the initial example) and an origin date of just over 6000 years ago, between 4000 and 5000 BC.

4. Decay Curve Determined

The red-shift data in conjunction with the radiometric data thus give the following points on the decay curve:

I (a) For T giving an integral of 60 x 10^6 LY, N = 0.001T

(b] For T giving an integral of 250 x 10^6 LY, N = 0.0225 T

(c) In the limit, N has the approximate value N = T at c (max).

II From the 3°K background there is the probable result that

(a) c (max) is about 200,000 million times c now.

(b) total decay time is of the order of 6000 years or so.

From these results it should be apparent that the initial part of the decay curve has been determined by OBSERVATION and **not** by extrapolation. The curve that fits best all 3 data sets (c observations, radiometric data and red-shift data) is the cosec^2 decay.

THE BEHAVIOUR OF THE RED-SHIFT FUNCTION

1. Graphing the Function

From the above approach it should be plain that the cosmological red-shifts that are observed are readily explainable by c decay rather than by Universal expansion. Indeed, the observed red-shifts fit the Doppler-Michelson formula as applied to c decay in equations (26) and (30) extremely well and in so doing confirm the cosec^2 decay patterning for light velocity. Under these conditions it would seem that any residual movement between progressively more distant galaxies or clusters therefore contribute a very marginal portion to the total red-shift value, whether that motion be approaching or receding from us.

Using equations (26) and (30) in conjunction with the cosec^2 decay curve (which supplies us with a good distance estimate for a given Z for the more remote objects where such measurements are unreliable), it is possible to graph the red-shift function. Table 1 lists the distances at which specific values of Z occur along with the speed of light at the time of emission and N. Also listed is the change in Z per million LY at the various distances which has some important implications. The function is graphed in Fig. 1.

2. Essential Characteristics of the Function

The top graph in Fig. 1 that gives the change in the red-shift Z per million LY indicates that there are basically two main regions to the red-shift function. These two regions are visible on the main graph at the bottom of Fig. 1. There is the region of a reasonably fast increase in Z (by currently held standards) out to about 1200 million LY beyond which the function sweeps up for an extremely steep climb in the interval out to about 1600 million LY. In the first region the change in Z per million LY maximises at about 0.002 but climbs to 0.02 at about 1.5 billion LY — a ten-fold increase. According to the function, the most distant quasar is just a little further out than this at near 1.55 billion LY. Beyond that limit the red-shift increases dramatically as it climbs up to the plateau of Z = 1 million at about 1.8 billion LY. At 1.7153 billion LY there is a predicted change in Z of 0.086 per light year. It would appear that this is one reason that objects of Z greater than about 4 are hard to find coupled with technical difficulties. The dramatic rise in Z over an extremely short distance will make it difficult to discover objects in this region. They are certainly there, but the increasing effect of the smearing due to the red-shift change will act as an effective 'cutoff just prior to the plateau of Z = 10^6 where every object has the same Z value that gives rise to the 3°K background. This plateau extends back from 1.8 billion LY to the limits of the observable universe.

3. The Missing Mass and the Red-Shift

It is well known that in clusters of galaxies the relative motion of the components determine the stability of the clusters. If this motion is too high then the chains of gravity will be insufficient to hold the cluster together and it will disrupt.[19] It is discovered that for many clusters the relative motions are so high that they will disrupt and astronomers have sought a solution to the dilemma by looking for the 'missing mass' that will hold the clusters together.

The change in c approach gives a different perspective on the problem and would seem to supply at least part of the solution. The relative motion of the component galaxies is measured by a comparison of their red-shifts. Because the recession 'velocity' from the red-shift for some members is significantly larger than for others, it is assumed that these galaxies are "runaways" that will escape from the system. The red-shift function behaviour provides at least part of an answer that leaves the problem dramatically reduced.

Large clusters of galaxies such as the Coma cluster or the Ursa Major cluster have diameters of the order of 20 million LY across.[20] Though they contain upwards of 1000 members there still seems to be insufficient mass to hold them together because of

Table 1.

Distance In 10^6 LY	N C(original)/C(now)	Value of C_0 cm/sec	Z	$\Delta Z/10^6$ LY (Hubble Const. H = 0.0001 or 100 Km/sec per M.Pc)
60	2.366×10^{8}	7.093×10^{18}	0.0012	
100	6.571×10^{8}	1.969×10^{19}	0.0034	0.00006
150	1.479×10^{9}	4.434×10^{19}	0.0077	0.00009
200	2.629×10^{9}	7.882×10^{19}	0.0138	0.00012
250	4.107×10^{9}	1.231×10^{20}	0.0217	0.00016
300	5.914×10^{9}	1.773×10^{20}	0.0316	0.00020
350	8.049×10^{9}	2.413×10^{20}	0.0434	0.00024
400	1.051×10^{10}	3.151×10^{20}	0.0575	0.00028
450	1.331×10^{10}	3.989×10^{20}	0.0739	0.00033
500	1.643×10^{10}	4.925×10^{20}	0.0929	0.00038
550	1.988×10^{10}	5.959×10^{20}	0.1146	0.00043
600	2.366×10^{10}	7.092×10^{20}	0.1394	0.00050
650	2.776×10^{10}	8.323×10^{20}	0.1677	0.00057
700	3.220×10^{10}	9.653×10^{20}	0.1998	0.00064
750	3.696×10^{10}	1.108×10^{21}	0.2364	0.00073
800	4.206×10^{10}	1.261×10^{21}	0.2780	0.00083
850	4.748×10^{10}	1.423×10^{21}	0.3255	0.00095
900	5.323×10^{10}	1.596×10^{21}	0.3799	0.00109
950	5.931×10^{10}	1.778×10^{21}	0.4424	0.00125
1000	6.571×10^{10}	1.970×10^{21}	0.5148	0.00145
1050	7.245×10^{10}	2.172×10^{21}	0.5992	0.00169
1100	7.951×10^{10}	2.384×10^{21}	0.6985	0.00199
1150	8.691×10^{10}	2.605×10^{21}	0.8164	0.00236
1200	9.463×10^{10}	2.837×10^{21}	0.9585	0.00284
1250	1.027×10^{11}	3.078×10^{21}	1.1324	0.00348
1300	1.111×10^{11}	3.329×10^{21}	1.3495	0.00434
1350	1.198×10^{11}	3.590×10^{21}	1.6274	0.00556
1400	1.288×10^{11}	3.861×10^{21}	1.9952	0.00736
1450	1.382×10^{11}	4.142×10^{21}	2.5034	0.01016
1500	1.479×10^{11}	4.432×10^{21}	3.2498	0.01492
1550	1.579×10^{11}	4.733×10^{21}	4.4502	0.02400
1600	1.682×10^{11}	5.043×10^{21}	6.6953	0.04490
1650	1.789×10^{11}	5.363×10^{21}	12.383	0.11375
1700	1.899×10^{11}	5.693×10^{21}	55.198	0.8563
1710	1.922×10^{11}	5.761×10^{21}	160.16	10.495
1715	1.933×10^{11}	5.794×10^{21}	2596.5	487.2
1715.3	1.9334×10^{11}	5.796×10^{21}	28,504	86,356
1800	1.9335×10^{11}	5.7965×10^{21}	1 Million	Zero
2850	1.9335×10^{11}	5.7965×10^{21}	1 Million	Zero

the relative motions suggested by the red-shift. In the case of the Coma cluster with an average red-shift of about 0.023 and a "velocity of recession" of the order of 7000 km/sec,[21] we find members with velocity differences of hundreds of km/sec. If we take the maximum difference in the velocities they would come close to, say, 1000 km/sec. On this basis it is stated that there is only 1/7th of the mass needed to hold the cluster together.

What is the c decay solution? At the distance of the Coma cluster of around 250 million LY with Z = 0.023, we find from Table 1 that the change in Z per million LY is 0.00016. With the cluster diameter taken as around 20 million LY then we would expect a red-shift variation of 0.0032 across the cluster. This corresponds to an apparent velocity variation of 960 km/sec which is close to that observed. Under these circumstances it might be concluded that the cluster is stable and the actual motions within the cluster are small.

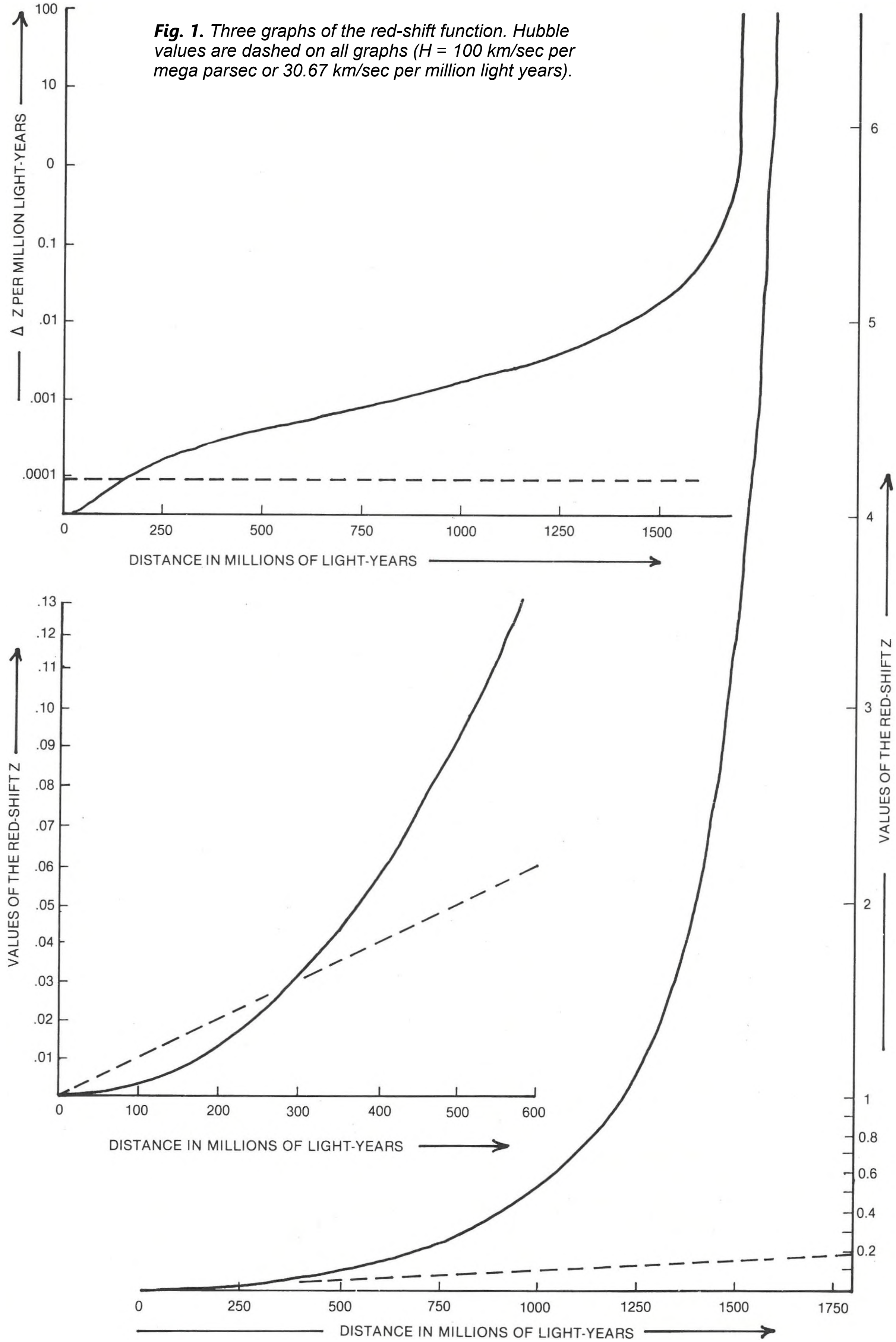

Fig. 1. *Three graphs of the red-shift function. Hubble values are dashed on all graphs (H = 100 km/sec per mega parsec or 30.67 km/sec per million light years).*

4. Red-Shift Anomalies

(a) Nearby Red-Shift Anomalies

Possibly the most well-known group of interacting galaxies is Stephan's Quintet. Four of the members have their values of Z measured as ranging from Z = 0.019 up to Z = 0.022 with the corresponding 'velocities' being 5700 to 6700 km/sec. Ambartsumian argued that these figures showed the group to be "dynamically unstable".[22] From the middle graph of Fig. 1 it may be deduced that the group could simply be at distances ranging from 240 million to 250 million LY away. That is to say that they could be stationary relative to each other and spread over a distance of 10 million LY and the 'velocity' difference due to c decay. As there are a number of examples of 'bridges' between galaxies over a million LY long[23] this decay approach offers a solution to the problem and preserves the stability of the system.

With the currently held values for Hubble's Constant, H, this approach is not possible. There are two schools of thought for H at the moment. One places it at 100 km/sec per Mega parsec or 30.67 km/sec per million LY.[24] The other group puts it at 15 km/sec per million LY.[25] On these figures the group is dispersed over a distance of 32.6 million LY or 65.2 million LY respectively, or one is forced to the conclusion that there is an actual velocity of separation of about 1000 km/sec involved. The maximum separation on the c decay approach is a much more moderate 10 million LY if ALL the difference in Z is attributed to c decay. If SOME is attributed to this cause and the rest to actual velocity the members are even closer.

The story does not end there, however, as the Burbidges observed somewhat later that the fifth member of the group only had a red-shift of Z = 0.0026 or a velocity equivalent of 800 km/sec. They assumed that either (1) the fifth member was unrelated to the others and was foreground object or (2) that it had been explosively expelled from the group. The graph of Fig. 1 suggests that (1) is probably the correct choice and that NGC 7320 (the fifth member) is at a distance of 85 million LY from us or about 155 million LY away from the others in the group. Sandage's value for H puts this component at 325 million LY closer than the others which emphasises the problem (and in passing would tend to indicate with other similar evidence, c decay aside, that H should bear a higher value). This aspect is highlighted by the work of Arp and R. Allen in 1973 and 1970 respectively where both concluded that from the distribution of neutral hydrogen and other physical characteristics of the system the whole group must be closer to us than the 400 million LY currently conceded by the argument based on the red-shift velocity from the value of H. This is almost twice the distance suggested by the c decay analysis.

(b) Mid-Distance Anomalies

Wallace Sargent has examined a group of three galaxies called VV159. Two of the members have a red-shift of Z = 0.035 which is usually interpreted as a velocity of recession of 10,500 km/sec, while the third member "is tearing away at 13,200 km/sec with a red-shift of 0.044." The possibility is mentioned that this third member may simply be much further away where the actual red-shift recession is 13,200 km/sec[26] and hence not part of the group at all. The choice is thus between either (1) a velocity difference in the group of 2,700 km/sec or (2) a separation of 88 million or 176 million LY depending on the value adopted for H.

From Fig. 1, the middle graph indicates that Z = 0.035 corresponds to a distance of 320 million LY while 0.044 is only 35 million LY further out at 355 million LY. They are much closer together than either value of H might suggest on this scheme of things. It is thus possible that the red-shift is cosmological (due to c decay) and the cluster stable. However, it is also possible that SOME of the red-shift may be due to velocity differences. In this case, if the third member were only 5 million LY away from the others with a Z of 0.0375, the separation velocity would be about 1950 km/sec. If it was 10 million LY away, the velocity would be 1500 km/sec. Under these circumstances a c decay approach may be seen to moderate the problem.

(c) Distant Red-Shift Anomalies

We have seen how the rapid rise in the predicted Z function based on decay has the potential to answer many problems associated with the red-shifts of closer galaxies. The comparatively rapid rise in Z across a cluster of galaxies potentially answers one of the basic "missing mass" problems and the rise in Z across small groupings of galaxies moderates the problem of relative velocities and distances of separation. Let us turn our attention to the most distant galaxies and quasars.

Arp and Sulentic[27] note that when pairs of ordinary distant spiral galaxies are studied, in 73% of the cases the fainter galaxy has the greater red-shift. This is to be expected on the c decay model as, for similar intrinsic luminosities, the more distant galaxy will be fainter and, being more distant, will have a higher red-shift, more so than would normally be expected from the currently held values of H, thus emphasising the effect.

Again, for this model, it would generally be expected that the extraordinary, super-massive quasars would be brighter than the more ordinary galaxies at the same distance. For this reason it might be expected that 'faint' galaxies appear with quasars as is often observed. In this case the quasar-type activity has virtually ceased in the nucleus of the ordinary galaxies, but the super-massive nature of the other object continues to fuel the central activity. Unusual juxtaposition effects may also be anticipated.

Another effect may be expected to assert itself for objects lying further out than about 1.2 billion LY due to dramatically increasing Z accentuating all the above effects. From Table 1 it can be deduced that a minimum rate of change in this region will be about Z = 0.003 per million LY or an apparent 'velocity' change of 900 km/sec per million LY while the rate from 1.5 to 1.55 billion LY distance jumps to Z = 0.024 or 7,200 km/sec per million LY. For a full galaxy at that distance the red-shift difference between its leading and trailing edges as we see them would give rise to a 'velocity' difference of up to 1000 km/sec or more. Closer in the effect would be less marked. At around 1.25 billion LY the 'velocity' difference across a galaxy would only amount to 200 km/sec for an object the size of the Great Nebula in Andromeda. Effects similar to this have been observed,[28] though coupled with the fast motion of gases left over from the whirlpool process[29] as well as quasars with more than one red-shift. Perhaps this is the moment to say a little more about the quasars.

5. Quasars and the Red-Shift

The most distant objects visible (with the light now received being emitted immediately after the close of Creation Week) are the quasars. They form the vast bulk of all the radiation coming from those regions. Indeed, from the approach adopted, it is inevitable that the centre of every galaxy underwent quasar-like activity during and shortly after Creation Week. The quasars are known to be strong emitters of x-rays. Before the Einstein Observatory was launched it was known that, in an extreme case, a single quasar could generate 1000 times the energy at x-ray wavelengths as the total visible light output of a single galaxy.[30] The orbiting Observatory has now confirmed that all quasars are very strong x-ray emitters, their total radiation tending to peak at wavelengths around 10^{-7} cm to perhaps 5×10^{-8} cm, which corresponds to a frequency of 3×10^{17} hertz and 6×10^{17} hertz respectively.

The origin of the x-rays from the quasars has been mentioned as being the neutron stars left over from the supernovae explosions, as well as the supernovae themselves. It has been established, again by the Einstein Observatory, that one neutron star in the Large Magellanic Cloud, the nearby satellite of our Milky Way system, produces more x-ray power than our entire galaxy.[31] As there would be plenty of gaseous debris in the centre of each galaxy from the supernovae activity, there would be a plentiful supply of material for the neutron stars to generate the x-rays from. Furthermore, because of the whirlpool formation process,[29] the centre of each galaxy should be tightly packed with stars, as the centre has the densest concentration of material. Any gaseous debris left over from this whirlpool process would be expected to be in violent motion, aided by the fact that it would have been added to by the supernovae activity. With the concentration of dense neutron stars at the galactic centres, it would also seem reasonable to assume that many galaxies would possess a black-hole at their centres, which, with the maelstrom of gaseous activity, would power further large quantities of x-rays to be emitted. Such violent gaseous motion has been detected even in our own galactic centre just recently, along with the suggestion of an accompanying black-hole and an intense concentration of stars, 10 million of them being crammed into a distance of 1 light year.[32]

It is logical to assume that this quasar-type activity was at least as intense and possibly more so during the period of Creation Week covered by the red-shift factor of Z = 1 million. From the interval of space covered by Z = 1 million down to, say Z = 1 or perhaps something less, we can expect practically every galaxy to contribute its peak radiation on the x-ray — ultraviolet border around 10^{-7} cm wavelength to the whole ensemble of objects that occupied that region. The result would be the x-ray background that is observed. This is in accord with the proposal of Margon.[33]

ACTUAL VELOCITIES AND THE DOPPLER-MICHELSON FORMULA

It will have been noticed in the foregoing that translational and rotational velocities are taken as if they will register unchanged by the red-shift equation. In other words, a velocity of approach of 100 km/sec will still register as that despite the change in the speed of light in the Doppler-Michelson formula. The reason for this becomes very apparent when equation (19) is examined in detail again. Here we are talking about the actual change in the geometrical path length per second, an actual velocity

$$v = \frac{dL}{dt} \qquad \text{................(40)}$$

In the usual formulation the effect is taken up in the term v/c as in (17) or (18). However, in the full expression given by (19) it includes the refractive index term N so that we have instead of just v/c the actual term Nv/c or in its full form N(dL/dt)(l/c). As stated in the case of (20) and the following discussion, the value of c is the one pertaining in a medium of refractive index N where N is defined as in (9). Since this is the case we can put this value of c as c* and the value of N as N* where by the definition in (9) we have then the relevant term (N/c)(dL/dt) become

$$\frac{N^*}{c^*}\left(\frac{dL}{dt}\right) = \left(\frac{c^*}{c_{now}}\right)\left(\frac{1}{c^*}\right)\left(\frac{dL}{dt}\right) = \left(\frac{1}{c_{now}}\right)\left(\frac{dL}{dt}\right)$$
$$= v/c \qquad (41)$$

Thus from (41) it becomes apparent that the c terms cancel to leave the final result as the velocity of motion compared with the present velocity of light. In other words, as the value of c drops, the signature of the velocity of motion is transmitted through unchanged, and a rotational velocity of 50 km/sec as recorded from some distant object, from which c has decayed, is in fact a rotational velocity of 50 km/sec.

QUASARS, OLBER'S PARADOX AND BACKGROUND SPECTRAL LINES

1. Quasars

As may be seen from Table 1, there is an extremely rapid rise in Z after about Z = 3 up to Z = 1 million over a distance of 300 million LY. Because of a high Z and high rate of change in Z over this distance it might be anticipated that few objects will be discovered in this region, the effect acting as a form of cut-off mechanism. Values of Z centering on Z = 2, say in the range from Z = 3 down to Z = 1 also cover a distance of about 300 million LY. The main quasar activity commences about Z = 0.5 and from there up to Z = 1.5 to give a quasar sample centering on Z = 1. There is again a distance of roughly 300 million LY from the figures in Table 1. However, in this latter group of objects the quasars are tapering off their activity, so more normal type galaxies begin to appear, and the total volume of space covered by this distance is vastly less than in the other two categories, leaving fewer examples in the region of Z = 1. The optimum volume of space for quasar-type objects thus holds the objects clustering around Z = 2 and this is what is observed in practice.[34]

2. Olbers Paradox

It should be noted that there will be some objects with very much higher values of Z, but it will probably take some searching to find them. However, it is obvious from Table 1 that there is a vast span of space encompassed by the maximum value for Z = 1 million. As pointed out earlier, the objects in there are probably similar to the quasars and hence with their peak wavelength on the ultraviolet to x-ray boundary will give rise to the 3°K background radiation through red-shifting. Because of the vast distances involved and hence a vast number of objects, it is at once apparent that there will be an approximately isotropic and homogeneous distribution, with the possibility of local variations. This seems to be what is observed. In addition it also gives a somewhat different answer to Olber's Paradox — "why is the night sky dark?" The reason is that the change in the velocity of light has so vastly red-shifted light from the most distant objects in the Universe that they have become invisible to the naked eye, though picked up in the radio region with instruments that are sensitive enough. It would thus appear that the maximum distance that light has travelled since the moment of Creation is almost 6 billion light-years, but that the most distant objects observable in the optical wavelengths will be about 1.7 billion light-years away. The most recently discovered quasar is about 1.5 billion light-years away according to the red-shift data that this model gives. A re-scaling of red-shift distance measurements for the furthest visible objects is apparently required.

3. Decaying C — Decaying Z?

It might be thought that with c changing so rapidly initially, there could be a measurable change in the red-shift of an object at these limits of observation. However, this is not the case as reflection should reveal. The light that decayed in speed over a period of 1 second initially giving rise to a red-shift, now takes 2×10^{11} seconds to pass us. If we therefore observed for a period of 100 years, then the total time that this covered initially when the drop was occurring would be

$$(100/(2 \times 10^{11})) \times (365.25 \times 24 \times 60 \times 60) \text{ sec}$$
$$= 0.01578 \text{ secs} \qquad (42)$$

If we take the maximum possible drop of roughly 1 million from Z = 1 million down to Z = 6.6 this occurred in 0.25 days = 6 hours. There was thus a change in Z of

$$10^6/(6 \times 60 \times 60) = 46.29 \text{ per second} \ldots\ldots\ldots (43)$$

But the number of seconds covered by 100 years of observation now is given by (42) and hence the change in Z is given by

$$46.29 \times 0.01578 = 0.730 \qquad (44)$$

or in other words a change of 0.0073 per year in the Z of the microwave background. This change would affect only the leading edge of the 3°K background, the first 0.01578 seconds worth in that 100 years. Thus there will be no observable change under these conditions for this or for any other object. The next maximum possible change is one of Z from Z = 6.6 down to Z = 3.0 in 6 hours which gives a change of Z of about 3×10^{-6} in 100 years of observing now. This is the expected change in Z of the most distant observed quasar to date due to the speed of light decay and is clearly insignificant.

4. Spectral Lines on the Microwave Background

With the suggestion of Professor B. Margon[35] that the microwave background is simply the x-ray background red-shifted by a factor of 1 million arises the possibility of fine tuning the exact value that c has decayed from on the basis of (30) and (38), though the results are obviously trending in the direction of (39) and so the general validity is unaffected. As the peak x-ray emission occurs at 10^{-7} up to perhaps 5×10^{-8} cm, we might expect that this would be translated into an increase in the intensity of the microwave background at corresponding wavelengths shifted by a factor of 1 million. The relevant wavelengths become 10^{-1} to 0.5×10^{-1} cm. In a brief abstract,[36] it was reported that if the explanation that the 3°K background is from the 'Big Bang' is valid, it should follow the intensity curve of a black body radiating at that temperature. However, "Spatial anomalies have already been reported, AND NOW AN EMBARRASSING BUMP HAS BEEN FOUND IN THE INTENSITY CURVE AT 0.5 TO 1.0 MILLIMETRES WAVELENGTH. No explanation for this departure has been provided. .." (by those holding to the Big Bang explanation) (emphasis added). This result tends to confirm the red-shift explanation for this microwave background, but also opens up another possibility. Though some 'smearing out' may occur, it should theoretically be possible to pick up an increase in intensity on the background corresponding to the red-shifted spectral lines. The 21 cm line of cool hydrogen should be red-shifted to about 2.1×10^{7} cm in length, which should give rise to a signal at today's value for frequency of about 1.4 kilohertz from all parts of the sky. Unfortunately, the ionosphere tends to reflect wavelengths in this range strongly and auroral noise comes down at least as far as 1.5 K Hz as does noise in the magnetosphere.[37] Solar noise comes down to 10 K Hz. Thus it would seem that the deep space environment is needed to pick up this signal. The Voyager probe can receive signals in this range, but the signal intensity is expected to be so weak as to be beyond its capacity to pick up, according to information from its designer.[38] However, in a similar way to signals from cool hydrogen, ionised hydrogen emits a signal strongly at 1.216×10^{-5} cm. This Lyman alpha line would become 12.16 cm in the 1 million-fold red-shifted microwave background. If the signal has not been smeared out and drastically weakened by this red-shifting process, it should be possible to pick up an increase in intensity in the background radiation at around this value. The precise value will depend on the exact amount of red-shifting, which in turn depends upon the initial value of c.

UNIVERSAL BEHAVIOUR

From all the foregoing it should be apparent that the observed cosmological red-shifts are readily explainable by c decay in the Doppler-Michelson formula (and a consequential cosec^2 decay patterning), rather than by Universal expansion. Any motion that the clusters of galaxies in the Universe might have thus contributed only a very small or negligible portion to the overall red-shift value, whether that motion be expansion or contraction. We are now in a position to decide what that motion is and gain some idea of its magnitude. The values of the red-shift from c decay thus present a basic picture of a more or less static universe upon which is superimposed a minor movement when compared to the c decay results. While it is true that the Scriptures affirm that the Lord "stretched out" the heavens during the early part of the Creation process (e.g. Isaiah 51:13), the c decay explanation of the red-shift precludes this occurring today except, perhaps, as a small residual movement. The only other possible motion is Universal contraction under gravity. Which of these two options is supported by observation?

1. Gravitational Collapse of Galaxy Clusters

The May 1984 edition of the ASSA **Bulletin,** p. 9 reported on scientific highlights of the last year of observing with the Anglo-Australian Telescope. Among the items summarised was the interesting statement that "A very populous super-cluster of galaxies has been found to be collapsing because of its own gravity. . .". This might indicate that the collapse option is viable, but further proof is required. Only 4 members of our Local Group of 21 listed members show a recessional velocity and two of those members are the Magellanic Clouds, satellites of the Milky Way system, in orbit around our own galaxy.[39] All the other corrected radial velocities show that we are mutually approaching each other at velocities given by a blue-shift ranging from 10 km/sec up to 130 km/sec. In other words, the group is mutually collapsing. (The correction applied was for the effect of rotation of our own galaxy on the figures of these other members.) It should be pointed out that the effects of c decay over the distance involved is giving a completely negligible effect on the figures. Again, one of the nearest clusters of galaxies outside our Local Group is the small M81 cluster at a distance of about 10 million LY. Here the red-shift due to c decay amounts to Z = 0.000034 on the basis of (26), or about 10 km/sec of apparent recessional velocity. However, M81 still shows blue-shift of 30 km/sec, which corrected for the c decay effect would be about 40 km/sec towards us. This again indicates that perhaps this nearby cluster of galaxies and our Local Cluster are mutually collapsing. Notice the figures that we have so far.

(1) A populous super-cluster is collapsing under its own gravity.
(2) Members of our Local Group of galaxies are mutually approaching.
(3) Our Local Group and the M81 group are probably approaching.

This evidence would tend to indicate that collapse under gravity within the clusters of galaxies is the norm and that mutual approach due to gravitational attraction is usual on the larger scale between one cluster of galaxies and another.

2. Absolute Motion of our Local Group

However, there is an absolute reference by which this can be tested: it is the 3°K background. Hart and Davies point out[40] that a number of independent methods coupled with the observed dipole anisotropy of the microwave background all combine to indicate that the Local Group of galaxies is moving towards the Virgo cloud of galaxies at the rate of about 270 km/sec, made up an apparent motion of about 400 km/sec[41] less an intrinsic dipole anisotropy of 130 km/sec in the 3°K background.[42] These observations combine to suggest that it is the gravitational collapse option that is the correct one to consider along with c decay.

3. Mass of the Observable Universe

This latter observation is an important one. If we take the probable result from the 3°K background that c(max) is about 2×10^{11} of c(now) which gives us the value of N, then using the limit given by (39) that N = T, we find that this gravitational collapse has been occurring over a time period of about 2×10^{11} seconds. Consequently, as we have the relation that velocity v is given by acceleration a multiplied by time t thus

$$v = a\,t \tag{45}$$

then the acceleration due to the gravitational attraction of the Virgo cloud is given by

$$a = \frac{v}{t} = (2.7 \times 10^{7})/(2 \times 10^{11}) = 1.35 \times 10^{-4} \text{ cm/sec}^2 \tag{46}$$

Now this acceleration due to gravity is

$$a = \frac{GM}{R^2} \text{ hence } M = \frac{aR^2}{G} \quad \ldots\ldots\ldots\ldots\ldots\ldots(47)$$

where M is the mass of the Virgo cluster. In addition we know that density D is given by

$$D = M/V = \left(\frac{aR^2}{G}\right)/\left(\frac{4}{3}\pi R^3\right) = 3a/(4\pi GR) \quad \ldots\ldots\ldots\ldots\ldots\ldots(48)$$

where V is volume. As shown earlier, (48) is still valid in a changing c case. Accordingly the density of matter attracting the Local Group of galaxies towards the Virgo cloud can be calculated. If we accept the nearer members of the super-cluster as giving us the distance R we have a value of 60 million LY or

$$R = 5.67 \times 10^{25} \text{ cm} \quad \ldots\ldots\ldots\ldots\ldots\ldots(49)$$

If we take this value coupled with the information that the super-cluster subtends an angle of over 60° in our sky, we get the result that the centre of the cluster is probably about 80 million LY away,[43] and thus

$$R = 7.57 \times 10^{25} \text{ cm} \quad \ldots\ldots\ldots\ldots\ldots\ldots(50)$$

Taking the value for a as given in (46) and using G = 6.67×10^{-8}, we have the two possible values for D as given by substitution in (48) as

$$D = 8.52 \times 10^{-24} \text{ or } 6.38 \times 10^{-24} \text{ gm/cc} \tag{51}$$

This gives the density of matter in the Virgo super-cluster. However, as Hart and Davies point out,[44] there is a density enhancement in the Virgo cluster relative to that in the smoothed out Universe by a factor that may reach 3.5. Accordingly, we can thus estimate that the average density throughout the Universe given by dividing (51) by 3.5 is of the order of 2×10^{-24} gm/cc and a conservative estimate will be

$$D = 1 \times 10^{-24} \text{ gms/cc} \tag{52}$$

If we now take a distance of 2 billion LY as a practical limit for observation, then in the observable Universe there is a total mass of about

$$M = D \times V = 3 \times 10^{58} \text{ grams} \tag{53}$$

4. Effect of Collapse on Z

It has already been stated that the effect of gravitational collapse by this mass in the universe will be negligible on the c decay red-shift value. The maximum result of this effect can be seen closest to us in the Virgo cloud and our own motion which is the result of about 2 x 10″ seconds worth of collapse time. With greater distances the light signal that we are receiving from those objects was much closer to the time of Creation and the effect of gravitational collapse over this small time would give only a very small approach velocity superimposed on the c decay red-shift. To illustrate this, the velocity of a supposed test galaxy on the rim of the observable universe, say at 2 billion LY or 1.89×10^{27} cm, collapsing under the gravitational influence of the mass given in (53) placed at the centre of the Universe can be calculated. The acceleration is given by (47), the time t approximates to 2×10^{11} seconds, hence the velocity now at the present is given by (45) as

$$v = a\,t = (5.59 \times 10^{-4})\times(2 \times 10^{11}) = 1.1 \times 10^{8} \text{ cm/sec} \qquad (54)$$

or 1,100 km/sec which would result in a change in Z (if we could observe that object today) of

$$Z = 0.0037 \qquad (55)$$

The change in Z back then for the light that we do receive would be drastically less to the point of insignificance.

5. The Collapsing Cosmos and Black Holes

The picture that emerges is therefore one of a Universe collapsing under gravity as a whole, with each of the super-clusters of galaxies collapsing towards each other, and within those clusters, the individual galaxies moving towards the centre. In addition, the work of Prof. Townes[32] concerning the activity in the centre of our galaxy and the evidence for an accompanying black hole, indicates that the black hole is enlarging its size, and if the mass is critical, as it may be, then there is the prospect of the whole galaxy being sucked in and disappearing. Our galaxy is typical of many others. If it is happening here it will be happening in most of them. M81 shows signs of having a massive black hole powering its central nucleus as does NGC 4151.[45] Under these circumstances it would seem that the lifetime of each galaxy is limited.

This question also has significance on a larger scale than just galaxies, however. The formula for the radius of a black hole is

$$r = 2GM/c^2 \qquad (56)$$

It is shown elsewhere that the right hand side of (56) is constant for all c and so the critical radius for a black hole for a given mass M is also constant for all c. It has been shown that the Universe is contracting and so its lifetime is limited as are the lifetimes of the individual galaxies. But how critical is its mass and radius in relation to (56)? Taking the mass estimate given by (53) we find that the critical radius to form a black hole with 3×10^{58} grams of matter will be equal to or less than the value given by substitution in (56). It is therefore

$$r = 2 \times (6.67 \times 10^{-8}) \times (3 \times 10^{58})/(9 \times 10^{20}) \text{ cm}$$
$$= 4.45 \times 10^{30} \text{ cm} = 4.7 \times 10^{12} \text{ LY} \qquad (57)$$

As the radius estimated to obtain the mass was only 2×10^{9} LY it indicates that if the mass figure is correct, then the Universe is already a black hole! Landsberg and Evans[46] estimate the mass as being 2.5×10^{56} grams. This, it should be emphasised, makes no allowance for the so-called 'missing mass' required to hold clusters of galaxies together. Couderc[47] gives a similar estimate. Even on this basis the critical radius is

$$r = 3.93 \times 10^{10} \text{ LY} \qquad (58)$$

which is still greater than the usual estimates of the size of the Universe. Even if the mass estimate drops to 1.3×10^{55} grams, the Universe is still in a black hole condition on the speed of light model.

6. The Final Scenario

With the Universe collapsing and already a black hole suggested by the above considerations, its final fate is assured, as are the fates of the individual galaxies, due to the activity of the black holes that seem to be at their centres. The Scriptures give us the picture of the finale. "The earth and the heavens fled away and there was no place found for them (i.e. they disappeared from sight)", Rev. 20:11, exactly as would be the case for a collapsing black hole. Also "the heavens shall pass away with a great noise and the elements will melt with fervent heat and the heavens being on fire shall be dissolved. . .Nevertheless we look for a New Heaven and a New Earth wherein dwells righteousness" (2 Pet. 3:10-13). The above model is in accord with this picture.

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