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Starlight, Time, and the New Physics

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Abstract

A novel solution to the creationist light-travel-time problem is presented. The concept requires new physics—Carmeli's cosmological relativity. But that physics has been successfully shown to apply to the large-scale structure of the universe. In order for the new physics and Einstein's physics to apply over their respective domains it is required that the universe underwent enormous expansion that produced massive time dilation on earth, at the center of the physical universe, at some point in the past. This assertion is justified by observational evidence and it is postulated that the time dilation occurred during the Creation week, on Day 4, resulting from the expansion of the fabric of space as God created the galaxies of the cosmos.

Keywords

Starlight-travel-time problem, Cosmology, Redshift periodicity, Large-scale structure of the universe

Introduction

The Bible tells us that the earth was created four days before the creation of the stars in the universe. It also reveals the time when our oldest ancestor Adam lived—God created him only two days after the stars on the fourth day of Creation week. So considering the size of the universe, questions arise: "How did Adam see the stars?" Or, "How do *we* see distant stars?" For creationists this has been one of the most difficult questions to solve if we are to accept Genesis at face value, that is, the way the Lord Jesus and all the New Testament writers took it, as well as most of the Church Fathers and all the Reformers—as straightforward history. Even the nearest star (other than our sun) is 4.3 light-years away and most of the rest of the stars in our galaxy are hundreds to thousands, even tens of thousands, of light-years away. And *from the biblical text alone,* we cannot determine a period of time greater than about seven thousand years since the creation of the universe. Most biblical scholars conclude that the text is intended to convey to us that little more than six thousand years have passed since the creation of all things.[1]

But this would seem to mean that we would only be able to see out into space to a distance of about six thousand light-years, or about a quarter the distance to our galaxy's centre—certainly we shouldn't be able to see the cosmos with all its wonders *as we do.* Modern telescopes like the Hubble Space Telescope (HST) in orbit above earth's atmosphere have revolutionized our view of the heavens. Truly "the heavens declare the glory of God" as the psalmist tells us. But how do we see the stars and galaxies in the universe, *most* of which are much more distant than the six or seven thousand light-year limit?

Russ Humphreys attempted to provide an answer to this question with the publication of *Starlight and Time* (Humphreys, 1994) and then later with new vistas (Humphreys, 1998). Yet it still has to be demonstrated how the mechanism he suggested actually gives us the millions and billions of years of time dilation. Nevertheless, I see *Starlight and Time* as a first step towards the correct understanding of the cosmos, and towards a potential solution to the light-travel-time problem. But as Humphreys himself readily and repeatedly acknowledged, it was only the beginning.

It was, he said, meant to stimulate others to look into this new direction of creation cosmology—and it certainly achieved that. In such a "time dilation" model, the key is that the universe is only thousands of years old—but relativity leads us to ask, "*By which clock?*"[2] The answer is clear, namely that the focus of Genesis history is on *earth clocks.* From the perspective of an observer on the earth, therefore, it is possible that the entire universe can be only six thousand years old, while there is "plenty of time"

[1] This includes many so-called liberal scholars who, though they do not believe the text of Genesis to be true, readily point out what it was clearly meant to convey: six ordinary-length days, global Flood, universe thousands of years old.

[2] There is no absolute time. One cannot say, "God's time," because God is outside of time—He created time.

for light, travelling at today's constant speed in local frames of reference,[3] to cover a distance of billions of light-years. It is only necessary to show how such time-dilation would have occurred, that is, what was the mechanism that would have made earth clocks run at such different speeds to cosmic clocks?

A New Approach

Humphreys' approach involved effects that resulted from Einstein's general relativity where the usual assumptions on boundary conditions were changed. In his case, he chose a finite bounded universe, instead of the usually assumed unbounded model. His model however was four dimensional. In this paper I assume similar boundary conditions but a five dimensional universe.[4] The model chosen is that of Israeli theoretical physicist Moshe Carmeli and is extensively explained in either of his books titled *Cosmological Special Relativity* (Carmeli, 2002) or *Cosmological Relativity* (Carmeli, 2006).

Carmelian cosmology is based on the idea that the Hubble law is fundamental to the universe. This means not only do we have the usual 3 space and 1 time dimensions but also a new dimension that quantifies the velocity of the expansion of space. We see the universe expanding on the largest scales. Therefore the assumption means that it is the fabric of space that is expanding and the galaxies are going along for the ride. And astronomers measure only distance and velocity in the expanding universe. Distance is determined from the brightness or magnitude of the sources and velocity from their redshifts.

5-dimensional line element

Let us initially confine the following analysis to an expanding universe without matter. Later we will discuss the large-scale matter distribution and what bearing it has. The line element is that of cosmological special relativity (CSR) and is given by

$$ds^2 = c^2dt^2 - (dx^1)^2 - (dx^2)^2 - (dx^3)^2 + \tau^2 dv^2, \quad (1)$$

where τ is the Hubble-Carmeli time constant. The coordinate v is the Hubble expansion velocity of the cosmos, the radial speed of the expanding fabric of space; x^1, x^2 and x^3 are spatial coordinates, and t is atomic time as recorded by earth-based clocks. In this theory, the null condition $ds=0$ in equation (1) describes the Hubble expansion with no gravity, but this also requires that $dt=0$.

γ factor in special relativity

Writing $dr^2=(dx^1)^2+(dx^2)^2+(dx^3)^2$ in arbitrary spatial co-ordinates, equation (1) becomes

$$ds^2 = c^2dt^2\left(1 - \frac{dr^2}{c^2dt^2} + \frac{\tau^2}{c^2}\frac{dv^2}{dt^2}\right). \quad (2)$$

Now dividing by ds^2,

$$1 = c^2\left(\frac{dt}{ds}\right)^2\left(1 - \frac{u^2}{c^2} + \frac{\tau^2}{c^2}\left(\frac{dv}{dt}\right)^2\right), \quad (3)$$

where $u=dr/dt$. Therefore the relativistic γ factor is

$$\gamma_E = c\frac{dt}{ds} = \left(1 - \frac{u^2}{c^2} + \frac{\tau^2}{c^2}\left(\frac{dv}{dt}\right)^2\right)^{-1/2}. \quad (4)$$

And when $dv/dt \to 0$,

$$\gamma_E = \left(1 - \frac{u^2}{c^2}\right)^{-1/2}, \quad (5)$$

which is used in Lorentz transformations as per Einstein's special relativity (SR). Equation (5) results from equation (4) because SR does not deal with an expanding space; that is, v is identically zero. And we get the usual γ factor of SR, which causes strange relativistic effects (time dilation and length contraction) at high relative speeds; that is, where $u \to c$. Besides, on the local scale, the universe is not expanding now.

γ factor in cosmological special relativity

Similarly, from equation (1) it follows that

$$ds^2 = \tau^2dv^2\left(1 - \frac{dr^2}{\tau^2dv^2} + \frac{c^2}{\tau^2}\frac{dt^2}{dv^2}\right). \quad (6)$$

Dividing by ds^2,

$$1 = \tau^2\left(\frac{dv}{ds}\right)^2\left(1 - \frac{t_c^2}{\tau^2} + \frac{c^2}{\tau^2}\left(\frac{dt}{dv}\right)^2\right), \quad (7)$$

where $t_c=dr/dv$ is cosmic time measured backwards from $t_c=0$ at the observer, but determined from the expansion. By contrast, t is the locally measured atomic time. Therefore the relativistic γ factor is

$$\gamma_C = \tau\frac{dv}{ds} = \left(1 - \frac{t_c^2}{\tau^2} + \frac{c^2}{\tau^2}\left(\frac{dt}{dv}\right)^2\right)^{-1/2}. \quad (8)$$

[3] This is the speed that any local observer would measure.

[4] With the exception of the "waters above." I don't postulate that they form the edge of the finite sphere of galaxies as Humphreys does.

When dv/dt is large compared to $a_0=c/\tau$,

$$\gamma_C = \left(1 - \frac{t_c^2}{\tau^2}\right)^{-1/2}, \tag{9}$$

which is used in cosmological transformations per Carmeli's CSR (Carmeli, 2002). This is the normal case in the cosmos in CSR. We have the analogous situation to SR but in this case the universal constant c is replaced by τ the Hubble-Carmeli time constant and the velocity (u) of a particle under consideration is replace by the cosmic time (t_c) of a galaxy in the expanding universe. The motion of the galaxies are dominated by the expansion, and local motions are negligibly small. Since $t_c=dr/dv\rightarrow\tau$, this γ-factor causes velocity dilation and length contraction analogous to that in SR.

Lorentz transformations

Since we assume Hubble law to be axiomatically true, $v\approx H_0 r$, therefore locally,

$$\frac{dv}{dt} \approx H_0 \frac{dr}{dt}. \tag{10}$$

Hence it follows that $dv/dt\rightarrow 0$ as $dr/dt\rightarrow 0$, where the latter refers to expansion of the fabric of space. We know that local space is not expanding. Therefore it follows from equation (2) that we can set $dv/dt\rightarrow 0$ in equation (4) resulting in equation (5), and hence space and time coordinates transform according to the usual Lorentz transformations in SR.

$$r' = \gamma_E (r - ut) \tag{11a}$$

$$t' = \gamma_E (t - ur/c^2) \tag{11b}$$

In cosmology, space and velocity coordinates transform by the cosmological transformation (Carmeli, 2002, p. 15, Section 2.11; Carmeli, Hartnett, & Oliveira, 2006).

$$r' = \gamma_C (r - t_c v) \tag{12a}$$

$$v' = \gamma_C (v - t_c r/\tau^2) \tag{12b}$$

Comparing the above transformations shows that the cosmological transformation can be formally obtained from the Lorentz transformation by changing t to v and c to τ. Thus the transfer from ordinary physics to the expanding universe, under the above assumption of empty space, for null four-vectors is simply achieved by replacing u/c by t_c/τ, where t_c is the cosmic time measured with respect to us now.

Time dilation

Let us now suppose that the observer is located at the centre of the expansion. Let us also represent the time interval recorded by an inertial clock, co-moving with expanding sources[5] attached to space as dT and the local earth-based atomic time interval as dt. From equation (2) we can write

$$\frac{dT}{dt} = \frac{ds}{cdt} = \gamma_E^{-1}. \tag{13}$$

Let us assume that motion through space is negligible. Therefore with $u\rightarrow 0$,

$$dt = dT\left(1 + \frac{\tau^2}{c^2}\left(\frac{dv}{dt}\right)^2\right)^{-1/2}. \tag{14}$$

At the present epoch $dv/dt=0$, because we observe no expansion. This means, except for curvature effects, which are presently ignored, clocks in the universe run at essentially the same rate as on earth. However if dv/dt was much greater than $a_0=c/\tau$ a universal "constant," it follows that $dt<<dT$. I propose that this was the case during Day 4 of Creation week and vast amounts of time passed on the galaxies expanding out from the centre of the universe with little time passing at the centre.

What we now observe in the universe is the redshifted light from the galaxies that has resulted from the expansion, not from this time dilation mechanism. The light is continuing to travel towards the earth from the distant galaxies, as it has for billions of years by cosmological clocks, but because earth clocks now run at the same rate we only observe expansion effects. The reference clocks in the cosmos are these cosmological or Hubble clocks, which can be related to redshift z by

$$\frac{t_c}{\tau} = \frac{(1+z)^2 - 1}{(1+z)^2 + 1}. \tag{15}$$

As $z\rightarrow\infty$ we are seeing back towards the beginning of time, where $t_c\rightarrow\tau\approx 13.54$ billion years. But because this observation does not take into account the episode of rapid expansion the universal constant τ more correctly describes the size of the universe, not its true age as measured by earth clocks.

One-way speed of light

We can write equation (1) as

$$ds^2 = c^2dt^2 - dr^2 + \tau^2 dv^2, \tag{16}$$

where $dr^2=(dx^1)^2+(dx^2)^2+(dx^3)^2$. Dividing equation

[5]These sources are subject to the Hubble law $\tau\, dv=dr$.

(16) by dt^2, and equating $ds = 0$ for the trajectory of a photon in *spacetimevelocity*, we get

$$\left(\frac{dr}{dt}\right)^2 = c^2\left(1+\frac{1}{a_0^2}\left(\frac{dv}{dt}\right)^2\right). \tag{17}$$

The speed of light, *c*, in equation (17) is actually the locally measured two-way speed. The speed *dr/dt* is not the measurable two-way speed of light *c* but the non-measurable one-way speed of light (Hartnett, 2002; Newton, 2001).

It tells us the speed of the expansion with respect to local earth-based atomic clocks. Notice if *dv/dt* is zero we get the usual limiting speed *c* of SR. However, if *dv/dt* was extremely large in the past in the vicinity of earth, as it now appears to be in the cosmos, which is in our past, then the one-way speed of light also was much larger then.

The apparent effect on the one-way speed of light *dr/dt* is really the direct result of *time dilation*. The actual measurable speed of light has not changed. It is *time* that is the variable in these equations, and as a result *only appears* to be producing enormous theoretical changes in the one-way speed of light, as seen by the observer. The actual speed of light is always the two-way speed *c* and is constant.

From equation (16) it may be noted that this result is true in general for any coordinate system. In the real universe I consider the case of spherically symmetric coordinates, but it should be remembered that the time dilation is not the result of the choice of a coordinate frame. However the argument here is two fold. Observations (discussed below) indicate that the earth is in a special place. And as a result of this time dilation would have specifically occurred between *earth clocks* and clocks in the rest of the universe, such that earth clocks ran much slower than cosmic clocks while the universe was being rapidly stretched out.

Spherically Symmetric Isotropic Universe

In a spherically symmetric isotropic expanding (Hartnett, 2005a) universe, evenly filled with matter of density Ω, it can be shown that for a photon trajectory:

$$\left(\frac{dr}{dt}\right)^2 = c^2\left(1+(1-\Omega)\left(\frac{r}{c\tau}\right)^2\right)\left(1+\frac{1}{a_0^2}\left(\frac{dv}{dt}\right)^2\right) \tag{18}$$

where the effects of adding matter have been included in equation (17). Here Ω is the averaged matter density of the universe expressed as a fraction of the critical density. The additional term results from solving Carmelian 4D *spacevelocity* representation of the large scale structure of the universe.

At the current epoch anywhere in the universe equation (17) holds. That means that the local physics is determined solely by SR, as expected, because *dv/dt* measured against local clocks is zero. However at past epochs *dv/dt* is non-zero and CSR must be applied instead. When matter is added, on a sufficiently large scale, the situation changes and we use equation (18). This means equation (18) is only really valid in a neighbourhood of a universe that is spherically symmetric around the origin—hence it must involve an isotropic matter distribution. Homogeneity is not required.

So what is the shape of the universe and is it valid to use equation (18), which was obtained with the assumption that we are observers at the centre of the physical universe characterized by an isotropic distribution of matter. If it could be shown that the matter distribution was homogeneous then the equation would still hold but the assumption of uniqueness would not.

What Do We Observe in the Universe?

Do we see a homogeneous distribution of matter? This is a very difficult question to answer, because the usual method of measuring the distances to large collections of very distant galaxies relies on the Hubble law. But the exact form of the Hubble law at high redshift (that is, large distances) depends heavily on the particular details of the assumed cosmological model.

Nevertheless there have been a couple of large-scale mapping projects that take a slice of the heavens and project it onto a plane. These projects use the Hubble law and the brightness of the galaxies to create a map. The 2dF Galaxy Redshift Survey (2dFGRS) (http://www.aao.gov.au/2df/), a joint UK–Australian project, sampled about two hundred thousand galaxies in 2 degree slices above and below the plane of the Galaxy. Figure 1 shows a map of the measured galaxies as a function of distance from the apex, which represents the observer on earth. Another, the Sloan Digital Sky Survey (SDSS) (http://www.sdss.org), in 2003 announced the first measurements of galactic structures more than a billion light years across and mapped about two hundred thousand galaxies in 6% of the sky. A portion of these are shown in Figure 2 projected onto a plane. Now more than six hundred thousand have been mapped.

It would appear from these maps that the assumption of homogeneity cannot be supported. These maps are sliced in the plane of the earth's equator and look like two slices of pizza. The both sections of the 2dFGRS map are shown in Figure 1 but only half of the SDSS map in Figure 2. The small dots, each representing a galaxy, appear to form into enormous

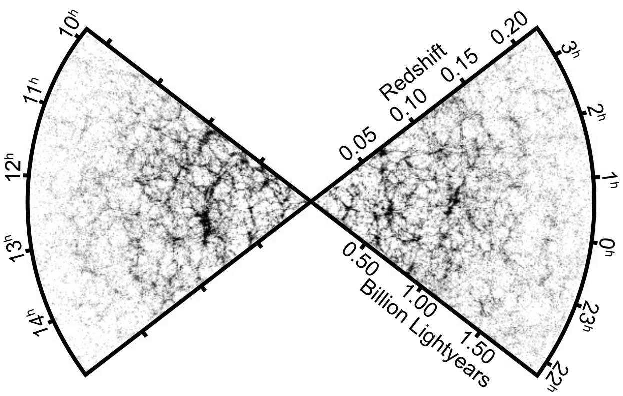

Figure 1. 2dF Galaxy Redshift Survey (2dFGRS) map: each point showing the position of galaxies with respect to earth at the apex. The 2dFGRS obtained spectra for 245,591 objects, mainly galaxies, brighter than a nominal extinction-corrected magnitude limit of $b_J=19.45$. Reliable redshifts were obtained for 221,414 galaxies. Credit: the 2dF Galaxy Redshift Survey team. http://www2.aao.gov.au/2dFGRS.

concentric structures centred on the middle (or the tip of the "pizza slice"), where our galaxy is located. The left side of Figure 1 and Figure 2 more clearly show not only concentric but also circular structures centred on our galaxy than do earlier maps. These are both maps of approximately the same region of space. This result is more than an artefact of the sampling technique because the density distribution of galaxies is expected to increase with distance in a big bang universe, as one looks back in time, until an expected decrease in number is observed due to the fact that the galaxies get too dim to be seen. In these maps,

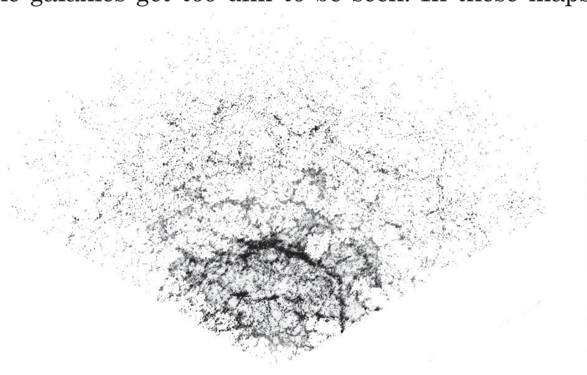

Figure 2. Sloan Digital Sky Survey (SDSS) map: each point showing the position of galaxies with respect to earth at the apex. Their distances were determined from their spectrum to create a 2 billion light-years deep 3D map where each galaxy is shown as a single point, the colour representing the luminosity. This is the top map of two halves which together show 66,976 that lie near the plane of earth's equator. Credit: Astrophysical Research Consortium (ARC) and the Sloan Digital Sky Survey (SDSS) Collaboration, http://www.sdss.org. For a more detailed and complete map, where luminosity is represented by colour, see http://www.sdss.org/news/releases/galaxy_zoom.jpg

the galaxy density seems to oscillate (decrease and increase periodically) with distance hence the circular structures. This spatial galaxy density variation can therefore only result from the fact that galaxies are preferentially found at certain discrete distances.

This evidence is showing, on a very broad scale, something that some have believed for a long time, that *the universe is isotropic but not homogeneous.* And hence the evidence would seem to indicate that the cosmological principle is wrong. That means that the universe has a unique centre. And we are somewhere near that centre (Hartnett, 2007).

Detailed Analysis

Let us analyze this further and count the number of galaxies (N) in a redshift slice (Δz) as a function of redshift z. From the 2dFGRS website we get Figure 3, which shows the expected increase in galaxy count as a function of redshift due to the increase in surface area as larger areas are taken into account with redshift. Then we see the expected decrease in number count due to the dimmer galaxies becoming less visible due to the inverse square law of illumination.

Figure 4 shows a similar plot of N vs z for the SDSS but using only 20,000 galaxies and where the data are binned with $\Delta z=0.001$. The increase in N is linear to $z=0.06$ after which it is difficult to determine due to the massive spike in number density at $z=0.08$, where we find the "Great Wall," a long dense filament of galaxies. The SDSS data used here were mostly sampled close to the plane of the celestial equator, certainly within ±10°.

Discrete redshifts

There are a number of these spikes seen in both

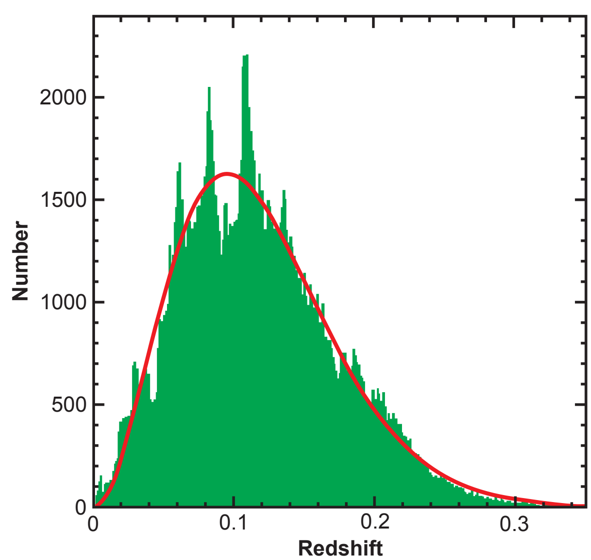

Figure 3. Galaxy number density (N) as function of redshift (z) from the 2dFGRS survey. Credit: the 2dF Galaxy Redshift Survey team.

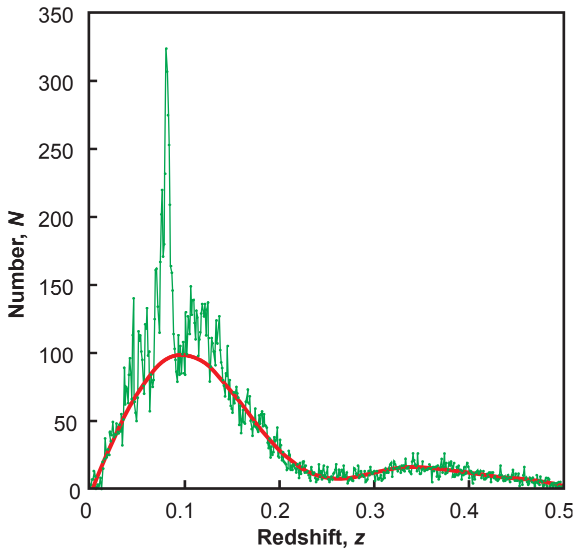

Figure 4. Galaxy number density (N) as function of redshift (z) from the SDSS survey. Bin size Δz=0.001. Only 20,000 galaxies were used in the analysis. Solid curve is a smooth polynomial fit that ignores the peaks. Credit: Astrophysical Research Consortium (ARC) and the Sloan Digital Sky Survey (SDSS) Collaboration, http://www.sdss.org.

Figures 3 and 4 indicating a preferred distance for galaxies where they tend to concentrate. This is strongly indicative of the concentric structure we see in Figures 1 and 2. In Figure 4 I have fitted a smooth polynomial to the data indicating the initial rise in number density and then followed by the expected fall off.

Then by subtracting off the polynomial the density oscillations are more clearly seen. These are shown

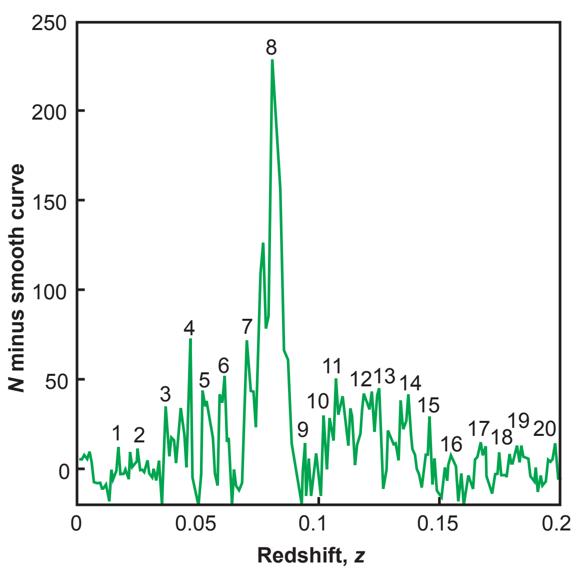

Figure 5. Galaxy number density (N) as function of redshift (z) from Figure 4 where the smooth polynomial curve has been removed. Periodic structure indicates the preferred distances galaxies lie from the earth.

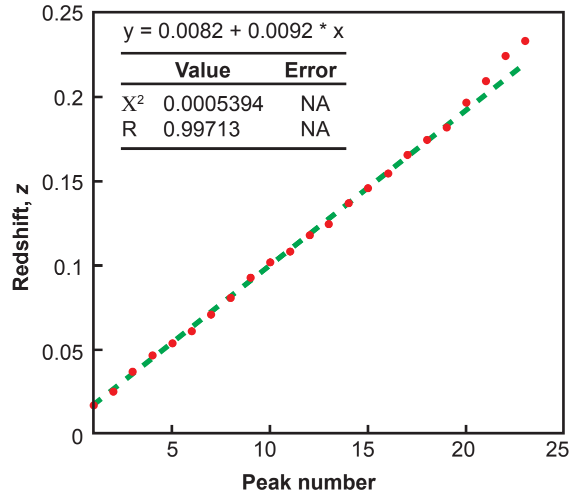

Figure 6. The redshift of the peaks in Figure 5 plotted as a function of the peak number. The broken curve is the best fit line determined from peak data up to 20. In this case the best fit interval between peaks is 0.00919±0.00003 with an offset 0.0082.

in Figure 5. There are clear peaks at 0.037, 0.047, 0.054, 0.061, 0.071, 0.081, 0.093, 0.102, 0.108 with others above and below these. In Figure 5 I have attempted to label all the visible peaks, which are plotted in Figure 6 against redshift. Then these peaks are fitted with a linear dependence on peak number (broken line in Figure 6) with an average separation of Δz=0.0092±0.0005 (curve fit error) and an offset 0.008. This interval amounts to approximately a 36 Mpc (or about one hundred million light-year) separation. This then tells us we are in a galactocentric universe with galaxies preferentially located with this radial spacing and most significantly at z=0.081, which is about 320 Mpc or about one billion light-years distant from us. The region is however dominated by the "Great Wall" where many thousand of galaxies are lined up on a great arc.

Note also the initial offset, in Figure 6, is actually somewhere between 0.008 and 0.009, because I assigned the redshift value to a Δz bin by its starting redshift, that is, the bin covers the (z, $z+\Delta z$) interval. Therefore the initial ring of galaxies should begin at approximately z=0.0085±0.0005, but only a small peak is visible at z=0.005 in Figure 5 and no peak at all near z=0.008 to 0.009. Notice also in Figure 6 I have plotted peaks above number 20 of Figure 5, taken from Figure 8. The constant spacing no longer holds where z>0.2. However we expect that the simple Hubble law linear dependence ($cz=H_0 r$) not to apply beyond z=0.2.

Also 20,000 quasars (or QSOs) were also sampled from the SDSS data set and the resulting N vs z is shown in Figure 7 where the data have been binned with Δz=0.01. However, due to strong selection effects

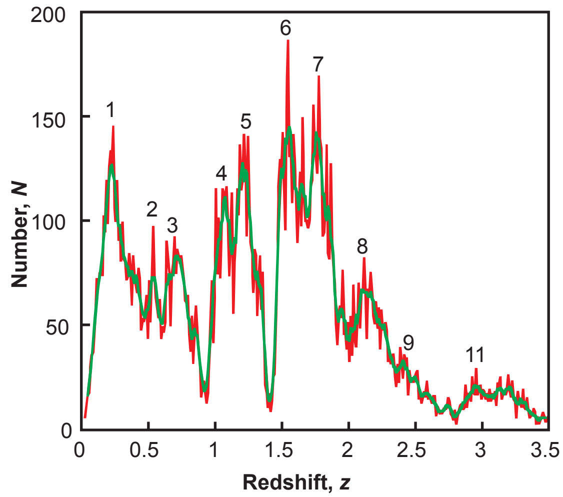

Figure 7. QSO number density (N) as function of redshift (z) from the SDSS survey. Bin size $\Delta z = 0.01$ and results shown by the black (solid red) line. The grey (green) curve on top is a smoothing function that averages five adjacent points. Only 20,000 QSOs were used in the analysis.Credit: Astrophysical Research Consortium (ARC) and the Sloan Digital Sky Survey (SDSS) Collaboration, http://www.sdss.org.

resulting from the crossover regions of the optical filters used, no real confidence can be placed in the indicated peaks and valleys. These are most probably only the result of the bandpass regions of the chosen filters. See Figure 8 where I have combined the number count for QSOs and galaxies, with the data bin size $\Delta z = 0.001$. Figure 8 is shown with a log scale on the z-axis. From this we see that the galaxies dominate at low redshift and the QSOs at high redshift, because few galaxies are reported in the sample with $z > 0.5$.

It will be seen below that a case can be argued that the low redshift quasars are more galaxy-like than

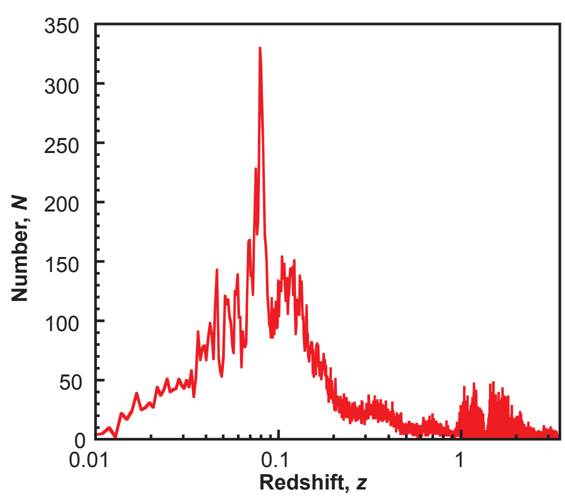

Figure 8. Combined 20,000 galaxy and 20,000 QSO number density (N) as function of redshift (z) from Figures 4 and 7 on a log scale. Bin size $\Delta z = 0.001$. QSOs dominate the high redshift region while galaxy numbers dominate at low redshift.

the very high redshift ones. Therefore the redshifts we are observing for these should correspond to those resulting from the expansion of the cosmos (Repp, 2002).

Redshift-distance modulus

If we analyze the apparent magnitudes of the galaxies in our sample, see Figure 9, we notice that brightest galaxies form a clear line that closely follows the distance modulus vs redshift dependence derived from the Carmeli-Hartnett theory (Oliveira & Hartnett, 2006). In Figure 9 the solid black curve is the magnitude-distance modulus taken from Oliveira and Hartnett (2006) with the present epoch matter density $\Omega_m = 0.04$ and the Hubble-Carmeli constant $h = 72.14\,\mathrm{kms^{-1}Mpc^{-1}}$. The curve has been scaled by the addition of –24 magnitudes, which represents the reference absolute magnitude of the brightest galaxy in the group at any one redshift value. This curve is the result of fitting the Carmeli theory to the high redshift supernova distance modulus data, which successfully describes the expanding universe without the need to include dark matter or dark energy.

The way to understand Figure 9 is with an analogy with random groups of people. If we take each group of galaxies at a given redshift then we would expect that the brightest galaxy (with smallest apparent magnitude) in each group would be about the same intrinsic brightness or absolute magnitude. This assumes all galaxies are essentially formed the same

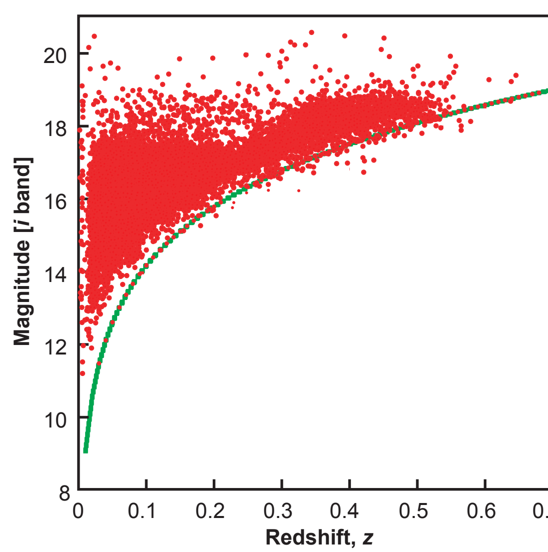

Figure 9. Apparent magnitude (i band) as function of redshift for the 20,000 sampled galaxies (grey [red] dots) of SDSS. The solid green curve is the magnitude-distance modulus taken from Carmeli-Hartnett theory with the present epoch matter density $\Omega_m = 0.04$ and the Hubble-Carmeli constant $h = 72.14\,\mathrm{kms^{-1}Mpc^{-1}}$. The curve has been scaled by the addition of –24 magnitudes, which represents the reference absolute magnitude of the brightest galaxy in the group at any given redshift value.

way. Like with the random groups of people, we would expect that the tallest person of each group would be about the same height.

Therefore from the analysis in Figure 9 we see by scaling the fitting curve by an unknown absolute magnitude value for the brightest galaxy we get a pretty good fit. There is a slight departure at low redshifts but this can be accounted for if we assume that the higher the redshift the object the younger the galaxy due to the finite travel time of the light. This means that the more distant galaxies are seen at a slightly earlier stage of their development and consequently may be brighter. In the high-z supernova studies such an effect is corrected for.

Therefore the data here is telling us that the Hubble law works well for the galaxies. What about the quasars? Figure 10 plots the same galaxy sample as in Figure 9 but with all the QSOs in the sample where $z<0.7$. Notice in this case even the low redshift quasars, up to about $z=0.4$, also seem to lay above the fit line for the brightest galaxies. But for $z>0.4$ there seems to be no correspondence with the theory. This is indicative of the Arp theory that low redshift quasars can be understood as evolving towards normal galaxies. Quasars fall on a continuum from normal galaxies at low redshifts to very active objects at high redshifts. Of course this assumes that the low redshift objects are in fact quasarlike and that they haven't been misidentified in the robotic survey.

The argument has been made that QSOs have discrete redshifts and that these are not Hubble law or distance determining redshifts (Hartnett, 2003, 2004). Possibly as suggested there is a smaller contribution that is the expansion redshift component

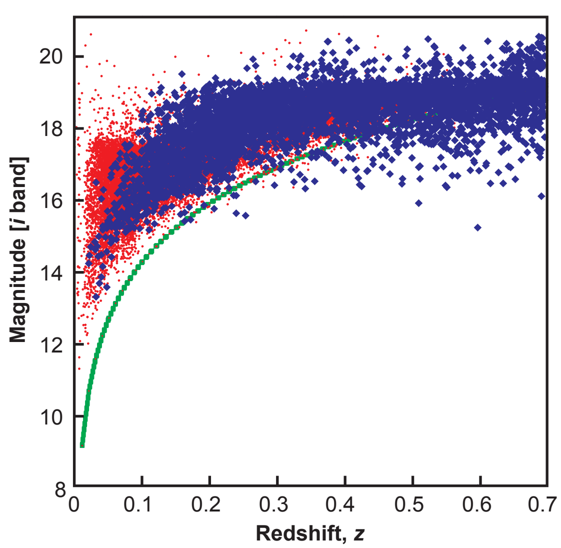

Figure 10. Apparent magnitude (*i*band) as function of redshift for all the sampled galaxies (red dots) of Figure 9 and the QSOs (blue diamonds) with redshifts $z<0.7$. The solid green curve is the same magnitude-distance modulus curve as in Figure 9.

on top of an intrinsic component due to their youth. Then the higher redshift QSOs are younger—we are seeing them closer to their moment of creation.

We may use,

$$1+z_c = \frac{1+z_{obs}}{1+z_i} \tag{19}$$

to calculate the expected redshift (z_c) of the QSO assuming that its redshift is dominated by an intrinsic component (z_i). The calculated redshift z_c may be a combination of Doppler redshift due to the quasar being ejected from a host galaxy and expansion redshift due to cosmological expansion. Here z_{obs} are the observed values of the quasar redshifts. If the cosmological redshift could be determined for the quasar, which others have done by association with a host galaxy (Hartnett, 2004), then the quasar's intrinsic redshift could be determined independently.

The above analysis is telling us something quite significant. Though more research is needed, it is clear from the data that we live in a galactocentric universe. We are located in a special place. The universe we see is isotropic in the distribution of galaxies and quasars, it is definitely not homogeneous. This is the fundamental assumption in the Carmeli theory, but the Friedmann-Lemaitre (FL) theory requires it be homogeneous.

Solution to Einstein's Field Equations

Einstein himself found a static solution to his field equations, which describes the motion of particles through *spacetime*. He realized that the cosmos was unstable against gravitational collapse, and added a constant to his equations—the cosmological constant (Λ)—to maintain the galaxies in their positions. As soon as he heard of Hubble's findings that the galaxies were receding, he is reported to have said that it had been the biggest blunder of his life.

Nowadays the FL solutions of Einstein's field equations provide the usual basis upon which the redshifts of extra-galactic objects are understood in the standard big-bang, inflationary cosmologies.

Carmeli offered a new approach and also solved Einstein's field equations. His universe is described by a metric that is spherically symmetric and isotropic but not necessarily homogeneous. The isotropic galaxy distributions as seen in Figures 1 and 2 are consistent with his theory. But they are not a suitable basis for the FL models. Nevertheless FL theorists have tried retaining the FL solution, in light of the observed vast voids and long filaments of galaxy clusters seen in these maps, by taking the non-homogeneity into account, as a perturbation on the original models.

The universe, Carmeli describes in his book and published papers, could be either infinite or finite, yet *unbounded*. He discards the crucial solution—the one that involves a central gravitational potential. That is the one that means the universe is bounded, that is, has a unique centre.

However, I have extended the analysis of Carmeli and have found that the solution of Einstein field equations that he arrives at is also valid in a finite bounded universe with a unique centre and edge (Hartnett, 2006). To be consistent with the high redshift type Ia supernova measurements all that is required is that the physical radius of the universe be about equal to the visible radius, that is, $\sim c\tau$. The choice of cosmology then is ultimately personal preference, not a requirement dictated by the data.

And the solution of the Einstein's field equations also indicates that the universe can be best described as not a potential well but a potential hill as shown in Figure 11. Because the universe has expanded over time the hill was initially large but decreased very rapidly. Another way of describing it is as an expanding white hole with the Galaxy at the centre. A white hole is effectively a black hole but all matter and energy are pouring out—not in. And if the universe is finite as suggested above, then the event horizon is still a long way from us. So we can describe the universe as an expanding white hole with the Galaxy at its centre. One caution must be made though. This is a 5D universe and the potential hill is in *spacevelocity*, not *spacetime*.

Light Travel Time

In order to calculate the light travel time in the universe from light sources at the edge we need to know the speed of the photons in terms of atomic time as measured by earth clocks which have undergone a period of massive time dilation during the first days of Creation, especially on Day 4 when the Creator created the heavenly bodies. This is not the speed of light in terms of cosmic time which is always c, and since earth clocks now tick with nearly the same rate as cosmic clocks c is the locally measured value now also. So we need to know dr/dt where r is the proper distance to the source and t is atomic time units on earth.

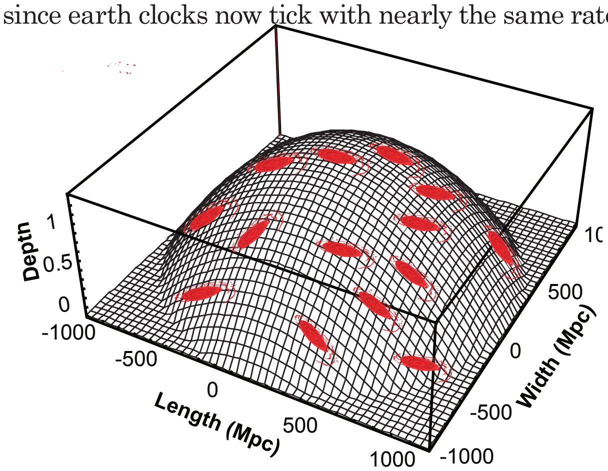

Figure 11. Our galaxy sits at the top of a potential hill with the rest of the galaxies spherically distributed around it. Schematic only: not to scale.

We have observed in equation (8) that the value of dv/dt needs to be very large at high redshifts ($z>>0$) at cosmic times $t_c>>0$, but from equation (4) it is clear dv/dt needs to be zero at the current epoch $t_c=0\,(z\approx0)$. This is best described by a step function,

$$\left.\begin{aligned} \frac{1}{a_0}\frac{dv}{dt} &\rightarrow \infty : z >> 0 \\ \frac{1}{a_0}\frac{dv}{dt} &= 0 : z \approx 0 \end{aligned}\right\} \qquad (20)$$

as shown in the solid curve in Figure 12. The function in equation (20) is shown with a finite maximum value, which at this stage we can only say was extremely large. This means that at the Creation the acceleration dv/dt was very large and then at some value of redshift $z\approx0$ the acceleration was switched to, or rapidly decreased to, zero. This switching was physically associated with the stretching of the fabric of space itself, as God spread out the heavens.

Now the function (20) can be approximated by an exponential of the form

$$\frac{1}{a_0}\frac{dv}{dt} = \left[\exp\left(\frac{\eta t_c}{\tau}\right) - 1\right]^{1/2} \qquad (21)$$

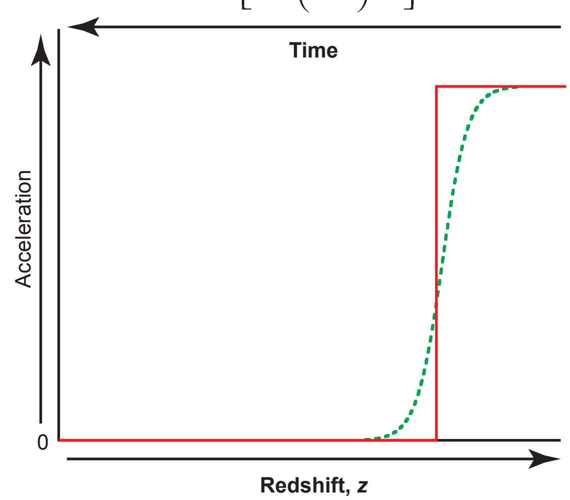

Figure 12. Acceleration defined by equation (20) is plotted against redshift or time. Redshift is indicated and increasing towards the right and time from the creation as increasing towards the left. The scale of the axes are arbitrary except for the origin. The solid curve indicates that at some time during creation the acceleration was switched from an extremely large number to zero. The broken exponential curve indicates that this may have occurred very rapidly but not instantaneously. In order to model this in equations (20)–(23) the exponential curve was chosen.

where η is a dimensionless proportionality constant that is yet to be determined. The function in equation (21) has the needed characteristics and can be related to redshift z, using equation (15). This function is also illustrated by the broken curve in Figure 13 where a maximum value has been imposed. However, for the purpose of the following calculations, equation (21) is used instead, which increases without bound as $t_c \to \tau$ or as $z \to \infty$.

From a comparison of the magnitudes of the terms in equation (18) the matter density term can be neglected for the purposes of calculating the light travel time in the universe in terms of earth atomic time units. It follows from equation (18) with $\Omega=1$ and equation (21) that

$$\frac{dr}{dt} = c\exp\left(\frac{\eta\, t_c}{2\tau}\right) \tag{22}$$

is the one-way speed of light; the speed light travels toward the observer at the origin of a spherically symmetric universe, determined from the proper distances which the photons travel but with respect to local earth-based atomic clocks.

Into equation (22) we can substitute $t_c/\tau \to v/c$, where v is the expansion speed. Now I make the assumption that the Hubble law ($v \approx r/\tau$) also applied at the Creation. Therefore it follows that

$$\frac{1}{c}\frac{dr}{dt} \approx \exp\left(\frac{\eta}{2}\frac{r}{c\tau}\right) \tag{23}$$

By integrating equation (23) we can calculate the distance light travelled in atomic time t:

$$t \approx \frac{2\tau}{\eta}\left[1 - \exp\left(-\frac{\eta}{2}\frac{r}{c\tau}\right)\right] \tag{24}$$

With $c=1$ light-year/year and the chosen value of $\tau=13.54$ billion years, the distance scale $c\tau=13.54$ billion light-years. The light travel time has been calculated from equation (24) using $\eta=10^{12}$ and 10^{13}, and is shown in Figure 13. For large r in equation (24) the light travel time t approaches a maximum value of $2\tau/\eta$. The result is an exponentially rising function that means light fills the universe to vast distances within one day (by earth-based clocks) assuming the value of $\eta=10^{13}$. Depending on the exact magnitude of the undetermined parameter the light travel time was only about a day as measured by earth-based clocks. See the broken curve in Figure 13.

Estimates for the size and extent of the acceleration term dv/dt may vary. At the present epoch in our local vicinity it is identically zero because of the environment of the solar system is designed for life. In the past it was enormously larger as evidenced by the cosmos, as we have seen. The acceleration was switched off during Creation week. Light from the most distant sources would have reached earth within a day (as measured by earth clocks) before that. Now about 6,000 years have passed since that time, so it takes light from those same sources an extra six or so thousand years to get here. Therefore it appears that this theory solves what has long seemed to be an intractable problem.

Conclusion

This paper presents a novel solution to the light-travel-time problem in our vast universe. The thesis is based on a relatively new and not-so-well-known 5 dimensional cosmology of Carmeli, which has been successfully applied to the large scale expansion of the universe, without the need to invoke dark matter or dark energy. The cosmology is framed in an isotropic yet not necessarily homogeneous universe, and one solution of Einstein's field equations that it permits is that of a finite expanding "white hole" with the Galaxy at the centre. Observations from the large galaxy surveys seem to indicate that we do indeed live at the centre of concentric rings of galaxies with a spacing of about one hundred million light-years. Also if Arp, Burbidge and others (Arp, Burbidge, Chu, Flesch, Patat, & Rupprecht, 2002) are right, this means those quasars are much closer than their redshift distances would indicate (Hartnett, 2005b) and hence it follows that they also are distributed on concentric rings along with the galaxies. Therefore it is both valid to apply the Carmelian cosmology as well what we observe seems to be consistent with a

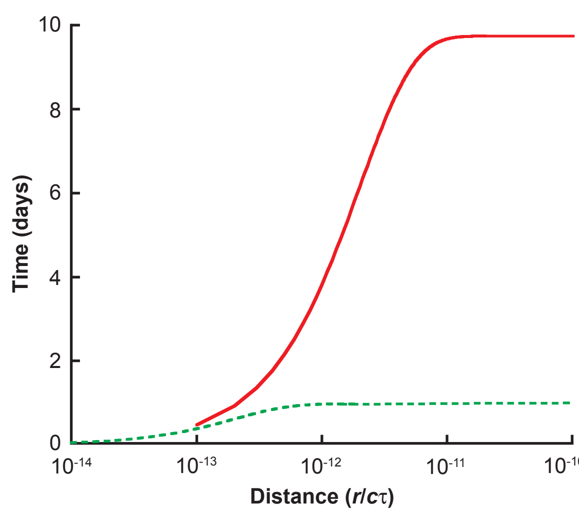

Figure 13. The light travel time (in earth days) is plotted against distance in the universe (in units of $c\tau$) for two choices of the dimensionless free parameter $\eta=10^{12}$ (solid curve) and 10^{13} (broken curve). Both curves become flat meaning that the light travels the rest of the distance to the limits of the universe in the time shown.

biblical description of the universe if one considers that the universe was made for a purpose—that is, that we are placed here at the centre to observe the Lord's glorious Creation all around us.

Therefore for Carmeli's cosmological relativity to be true on the largest scales in the universe and for Einstein's relativity to be true on the local scale, including in our solar system where it has been tested, it is required that enormous time dilation must have occurred at Creation. This resulted from massive expansion of the fabric of space itself—even at superluminal speeds, because it is space that expanded, it is not limited by the motion of particles through that space. This effect caused clocks on earth to run much much slower than clocks on the galaxies that expanded out during Creation week. The acceleration of that expansion ceased at the close of Creation week, God no longer stretched out the heavens. This meant that galactic clocks then began to run at the same rates as earth clocks. However during the days of Creation (primarily Day 4 I contend) this meant that light filled the universe—it had billions of years of cosmic time—and therefore Adam was able to see the stars when he first opened his eyes.

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