ASTRONOMICAL REDSHIFTS REINTERPRETED AND COSMIC SOLUTIONS

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A viscosity-related photon redshift with no frequency dependence eliminates the need for any expansion of space and alters the velocity-related factor in the Hubble constant. The hypothesized structure of photons suggested here leads to a new explanation for why tired light may be the major contributor to the redshift observations of celestial objects. The result is a need for reinterpretations of the size of our big bang, its age, the size of our part of the universe compared with that beyond our big bang and the need for dark matter or dark energy. A new 'empty' space universal constant is uncovered and a relationship between the viscosity component of the current Hubble constant H_o and the fine structure constant α is suggested. Solutions for some of the cosmic problems in the standard model are suggested.

Keywords: Redshift; Viscosity redshift; Velocity redshift; Distance; Hubble Constant; Cosmology; Galaxies; Expansion; Universe; Fine Structure Constant; Dark matter; Dark energy; Arrow of time; Steady state; Inflation; Black hole; Flatness;

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Introduction

Current orthodoxy is that there are three components to the redshift of celestial objects, due to gravitation, relative velocity and the expansion of space. The latter component is routinely accepted because the $\boldsymbol{Z}$ shift of many stars and galaxies implies that they would otherwise have relative speeds greater than light speed.

The case for redshift due to distance, so called 'tired light', has been posited before in terms of a quadratic distance relationship locally [1] [2] or everywhere [3] or with some frequency dependence [4].

What is proposed here is a far simpler linear form of tired light, where every motion of every particle is opposed by a form of viscosity reducing its energy. The specific case of how this physically affects photons will be explained later. For now, only the outcome, that each move of one Planck length $\boldsymbol{R_s}$ along its path by a photon suffers a fractional energy loss $\boldsymbol{F}$ regardless of the frequency of the photon.

The further proposition following on from this new treatment of tired light is that this effect completely replaces the $\boldsymbol{Z}$ shift of the expansion of space. Furthermore, relative speed above $\boldsymbol{c}$ of any physical object within the viscous environment is excluded in this model, along with the universe being only three physical dimensions and flat, with the result that the physical size of our big bang is changed, altering the need for dark matter and dark energy.

The starting point

The starting point is the energy loss by a photon emitted at frequency $\boldsymbol{W_e}$ moving between two points a distance $\boldsymbol{D}$ apart where $\boldsymbol{D} = \boldsymbol{d}\,\boldsymbol{R_s}$ and the fractional energy loss is $\boldsymbol{F} = \boldsymbol{f}/\boldsymbol{R_s}$ with the observed frequency $\boldsymbol{W_o}$

$$W_e - W_o = F\,D\,W_o$$

The value of $\boldsymbol{f}$ is a constant in the same way that $\boldsymbol{c}$ is a constant, although in reverse impact. It is a minimum measureable value in 'empty' space, but takes a higher value where $\boldsymbol{c}$ is restricted by matter. So when a photon is near a black hole, its maximum speed will be close to zero, although this is still the local $\boldsymbol{c}$, but the value of $\boldsymbol{f}$ will be high. In the case of photons passing through space over very long distances, the value of $\boldsymbol{f}$ can usually be treated as a constant just as is the case for $\boldsymbol{c}$.

The viscosity redshift $\boldsymbol{Z_c}$ of such a photon will be

$$Z_c = f\,d$$

This has no reliance on the frequency of the photon, only how far it has travelled. However, although each step of photon travel $\boldsymbol{R_s}$ has the same value for all photons, when converted into how much each is affected over a wavelength, the values of $\boldsymbol{f}$ have to be treated differently for different emission or observation frequencies. Note that it is this consideration of photon wavelengths that is shown later to be the wrong framework in which to consider the energy loss.

For two photons of different emission frequencies W_{e1} and W_{e2} , observed at the same distance D, their energy losses will be

$$W_{e1} - W_{o1} = F_1 D W_{o1}$$

$$W_{e2} - W_{o2} = F_2 D W_{o2}$$

and the Fs are now differentiated between the two. If the two are emitted at the same distance away, then unless they have the same W_e, they will have different values of F_1 and F_2.

This may seem like frequency dependence, but it is only because in looking at the energies of the photons we supposedly need to know their frequency or wavelength differences. When considering only the distance that the photons travel between emission and observation, they experience the same fractional energy loss due to viscosity so that the ratio of W_e/W_o is the same in both cases – which is to say they have the same viscosity redshift. They may have different absolute values of energy loss, $W_e - W_o$, but the same ratio W_e/W_o .

Combining redshifts

When considering how to apportion how much energy loss in a photon is due to viscosity or due to relative velocity it first needs to be considered how the total is arrived at.

Since the F values vary when considering frequency differences, depending on absolute emission and observation frequencies, it is not feasible to just add or subtract frequencies because the addition or subtraction changes each fractional relationship individually. Both viscosity and velocity effects are acting at the same time (plus gravitational effects as well, ignored here) and they start from the same emission frequency and end at the same observation frequency.

The solution is the same as is done for the effect of the expansion of space, that is to product the ratios of the frequencies, or more usually the (Z+1) factors, such that, ignoring gravitational Z_g and expansion of space Z_e redshifts, the relationship will be

$$(Z_t + 1) = (Z_v + 1)(Z_c + 1)$$

where Z_t is the total Z shift of the object, Z_v its velocity redshift and Z_c its viscosity redshift.

The usual treatment of the Z_e of expansion of space is that $Z_e = Z_v$, so that the total effect without any viscosity redshift is $Z_t = (Z_v+1)^2$.

Comparing these different versions of Z_t gives rise to different potential outcomes for the rates of post-big bang outward motion of our big bang constituents.

1 If $Z_e = 0$ and $Z_c = 0$

There is no explanation for the redshifts observed that imply relative velocities above light speed - although using the relativistic form of velocity redshift

$$1+Z = ((1+b)/(1-b))^{0.5}$$

where $b = v/c$, would enable large redshifts as v approaches c, but would do so over very small cosmological distances.

2 If $Z_e = 0$ and $Z_v \sim 0$ and Z_c = any

The stars and galaxies would have no overall large relative velocities nearby and almost all the redshifts would be due to tired light, thus mainly proportional to the distance to each object. This might allow for the supposedly observed change in Hubble constant, although a slower post-big bang motion would suggest a longer lifetime of our big bang. The apparent change in that rate might possibly be between those components which are mostly part of our big bang and those beyond it.

3 If $Z_e = 0$ and the Z_v and Z_c components of each redshift were split between the total in some fraction.

The result would be complex in that there would be reasonable velocities up to a maximum of c, beyond which all the redshift would be due to viscosity. The fraction for each observation would be different and the underlying overall viscosity factor ***f*** would have to be pinned down in order to separate out the velocity part.

Failed Big Bangs

Of greater complexity is that the hypothesis proposed here is of our big bang is as one successful event amongst many failed big bangs and means that it will not be immediately clear whether an object under observation is part of those pre-existing relatively stationary objects through and past which our own big bang constituents are travelling, or one of those travelling constituents. Once beyond our big bang CMB distance, it will only be viscosity redshift that will be observed.

Large Redshifts

It is clear that to ensure large velocity redshifts are included correctly, it is the relativistic Z_v that must be used in our formulae. This means that

$$Z_v + 1 = ((1+b)/(1-b))^{0.5}$$

which reduces to the usual

$$Z_v \sim v/c$$

at small v/c.

As a component of the total redshift, this use of the relativistic velocity formula provides an increasing slope above the linear viscosity component, so a graph of the expected total redshift will be linear to around $v/c < 0.1$ and then bend increasingly upwards until the velocity component ceases at the end of our big bang where there will be a step change back to the linear viscosity line.

This is not an issue because, as mentioned, the underlying hypothesis is that the universe is not only our big bang, but extends further outwards in volume to previous failed big bangs, many beyond our current view. Both within our current post-big bang volume and beyond there are embedded black holes and galaxies that were failed big bangs and acted as frameworks through which and around which our own post-big bang constituents have passed or coalesced around. This is a view of the universe as an eternal mixture of big bangs and steady state.

This hypothesis explains many unusual coincidences of different redshift objects 'within close proximity' as studied [5], the unusual number of early galaxies at large sizes, the change in value of the Hubble constant at high Z and would reduce the need for dark matter or dark energy explanations, especially if all galaxies were at smaller distances from us.

This latter possibility is not investigated further here and the accepted proper distances to stars and galaxies are considered correct. However, further work will be undertaken to confirm or deny these distances.

The value of Z_c is not bounded and will have a maximum only at the furthest observable distance from source to an observer, suggesting that the greatest Z_c shift observed beyond the CMB boundary will be a good estimate for the possible limit to the size of the observable universe, because such observed light would have been travelling longer than since our big bang occurred. Additionally, without any expansion of space, there is no issue of light having to overcome any expansion effect.

The frequency around the 2.725k temperature of the CMB only relates to our successful big bang, not to the previous events. Assuming that the initial emission frequency of our big bang was the Planck energy E_s and the CMB energy at E_c the estimate of our own distance D_c from its centre of occurrence would be

$$E_s/E_c - 1 = f\,D_c$$

However, it is not clear if it is correct to assume the initial energy of emission was the Planck energy and the accepted CMB Z shift suggests a much lower value, generally with photons initially generated around 3,000 C. The difference between these two assumptions is very large and depends on when photons actually formed in sufficient quantities to produce the CMB.

Finding f

One method to uncover the value of f would be to assume that since overall there is a redshift observed in astronomical observations following approximately the Hubble constant relationship at low Z, it is likely that there is some form of simple factor at work, but that it is due to velocity and viscosity in total (ignoring lateral motion and, as before, expansion of space and gravitational redshifts) and those two parts need to be split out.

The Hubble relationship $H_o = v/D$ in the new redshift reinterpretation would be replaced by a New Hubble term N. From before, the relationship at low velocity is that

$$v/c = Z = H_oD/c = fD$$

so that $H_o = f/c$

Now instead we say that, using f_L here in Ly^{-1} rather than the initial f in R_s^{-1} for simplicity

$$N = f_L/c$$

And retain H_v for the now much smaller velocity component of Z_t.

Taking the current best central observation value for H_o , 70 kms^{-1} Mpc^{-1}, as the value for N leads to an estimate for f_L using the observations of the type 1 Seyfert galaxy 2E 3934 [6] as an example.

$$(Z_t +1) = (Z_v+1)(Z_c+1)$$

$$= (Z_v+1)(f_L\, D_x+1) = (Z_v+1)(Nc\, D_x+1)$$

$$Z_t = 0.06147$$

$$f_L = Nc = 7.15896 \times 10^{-11}\ Ly^{-1}$$

This can be compared with the distance calculated assuming Z_v to be zero as

$$D_{calc} = Z_t/f_L = 8.59 \times 10^{8}\ Ly$$

Which is only 17% larger than the actual observed proper distance D_x

$$D_x = 7.79 \times 10^{8}\ Ly \text{ comoving}$$

$$= 7.34 \times 10^{8}\ Ly \text{ proper}$$

So the conclusion could be drawn that there is a velocity component and its value using N and f_L will be

$$(1+Z_v) = 1.008485$$

And $v_x = 0.008485\ c$

So the new value for H_v would be

$$H_v = v_x/D_x = 1.156 \times 10^{-11}\ Ly^{-1}$$

Or, in usual units $H_v = 11.3$ Kms^{-1} Mpc^{-1}

or $H_v/H_o = 0.16$

This implies, admittedly from only one example, that the main component of total redshifts is the viscosity component and that the velocity component is much slower than currently estimated.

However, since H_v is linear in v and D, it will fail at high velocities and so the relationship needs to be adjusted with

$$Z_v +1 = [(1+v/c)/(1-v/c)]^{0.5}$$

Or the reverse

$$v/c = ((Z_v + 1)^2-1)/((Z_v + 1)^2 +1)$$

so

$$H_{rel} = ((Z_v + 1)^2-1)/((Z_v + 1)^2 +1)c/D$$

Using the latter results in a small lowering of the relative velocity of the Seyfert galaxy in the example to $v_x = 0.008449\ c$ and a consequent small lowering in the new H_v to 1.151×10^{-11} Ly^{-1}.

The estimate of f_L also provides a size for our big bang, if there was one, since, from before

$$E_s/E_c - 1 = f_L\, D_c$$

With this energy ratio and the value f_L, the distance D_c from the origin of our big bang can be calculated as

$$D_c = (4.904 \times 10^{9}/3.762 \times 10^{-23} -1)/ 7.15896 \times 10^{-11}$$

$= 1.82 \times 10^{42}$ Ly

From the size of our big bang, its age can be calculated as

$$\boldsymbol{T_c} = \boldsymbol{D_c}/\boldsymbol{c} = 6.07 \times 10^{33} \text{ Years}$$

which is a bit longer than current accepted calculations.

Using the currently accepted value for the CMB ***Z*** shift of 1090 and current interpretations, results in a distance to that event of $\boldsymbol{D_{CMB}} = 1.4 \times 10^{12}$ Ly in the new interpretation, just a small fraction of the potential overall size of the universe, if the Planck energy is the starting energy and our CMB started from a lower energy.

Using the accepted CMB ***Z*** shift and its inferred size for our part of the universe compared with the new possible size of the whole universe suggests that our part represents only around 5×10^{-91} of the whole volume.

Graphic inferences

What can be inferred from Graph 1 in the References section is that this hypothesis leads to slower relative velocities of our big bang constituents such that none have reached even 0.5***c*** by the currently accepted comoving distance to the CMB of 4.6×10^{9} Ly.

The scale of the graph is such that the Seyfert galaxy used in the example calculations is just inside the first point, so that the acceleration in total ***Z*** is only just appearing. The usual use of linear ***H*** up to ***Z*** around 0.1 extends only as far as the third point.

Also it is possible to see clearly that the two lines of $\boldsymbol{Z_c}$ and $\boldsymbol{Z_t}$ represent two different classes of objects. One set is moving away from us and the other is not. This means that two objects at the same ***Z*** value may be at different distance from us, or alternatively that two objects at the same distance may have different ***Z*** values.

Graph 2 shows the same graph but using a greater distance scale so that the larger values of ***Z*** can be seen. The cut off to $\boldsymbol{Z_t}$ will be infinite, but in the graph it has been kept only to a maximum of just under ***Z*** = 20 for ease of use. The line for $\boldsymbol{Z_c}$ is shown to just keep increasing over distance. The $\boldsymbol{Z_t}$ line represents the total ***Z*** of objects moving within our big bang, a combination of $\boldsymbol{Z_v}$ and $\boldsymbol{Z_c}$, whilst the $\boldsymbol{Z_c}$-alone objects are those that pre-existed before our big bang and exist beyond its boundaries.

Objects observed above the $\boldsymbol{Z_c}$ line in Graph 2 will have outward relative velocities and those below the line inward relative velocities. For the $\boldsymbol{Z_t}$ line, those above or below will be excess or deficient velocities relative to the general motion. A mix of the above and below $\boldsymbol{Z_c}$ along a section of the line would indicate random motion and no outward motion following a big bang.

Expansion of space

Within the explanation of the physical effect of the viscosity on photons is that the hypothesis also proposes [8] [9] that the universe is composed only of one size of particle and its anti-particle and that they exist in either merged or unmerged forms. When merged, they spin, rotate, vibrate and translate and are the foundation of the universe. When they are unmerged, they form chains which then form loops and some of those loops are our fermions. This foundation means that there is only one size of particle on which everything is based and is made from. So there cannot be any expansion of space, because its foundations are all values equal to unit 1 in (adjusted) Planck units. Changing the size of the particles changes nothing, because they are the base of our units – everything would be changed proportionately and we would observe no change. Therefore space does not expand and so the only way in which redshifts could show relative speeds apparently in excess of ***c*** is because the photons are losing energy as they travel.

A second way to find *f*

Aside from assuming that $\boldsymbol{H_o}$ represents a good place to start from, the value of empty space ***f*** can also be calculated by comparing the redshift and parallax of stars or galaxies that have had both measured. A number of objects will have to be observed at random points to obtain a decent sample. Even then it will be difficult to separate out the fraction due to velocity or to viscosity. The Gaia [7] programme has many parallax observations and a comparison with objects whose redshifts have recently been observed will provide enough data to analyse for the average empty space value of $\boldsymbol{f}$.

Care will need to be taken in the redshift data because the existence of gas clouds on the photon path will increase the redshift observation, with the size of the increase dependent on both the density of the cloud and the photon path through the cloud. Similarly, voids without the average background density will result in lower comparative redshifts for photons passing through such voids.

The structure of a photon

As previously mentioned, the hypothesis is that fundamental particles and anti-particles form loops, which are the only real structures that can be observed [8] [9].

The loops comprise only one type of particle and anti-particle (a 'pair') which initially chase each other and eventually catch onto the tail of other pairs to form chains which, when a chain of three such pairs catches its own tail, form a fermion loop. Loops of other pair numbers are dark matter. More detail on why there is chasing and why dark matter cannot combine with three-pair normal matter is set out at the end of this paper.

A photon is a loop and its anti-loop rotating in the same sense merged together along the perpendicular rotational axis of the loops and the chase action then additionally acts along that axis to force the double loop up to its maximum possible speed in the local environment. We call that maximum speed $\boldsymbol{c}$ and its numerical value depends on the density of the local environment. So the balancing effect, to maintain a limitation to a maximum velocity, will be a viscosity acting on the fundamental particles/anti-particles in the loops, called meons.

The basis for the energy reduction of a photon is that the universe has, or is at its base, a background of those fundamental merged particle/anti-particle pairs before they unmerge to form loops, plus subsequently other formed loops, through which a photon travels and that together act as a form of viscosity.

It is the physical form of the photon as six partially merged pairs rotating in a loop as they translate at $\boldsymbol{c}$ that allows the same amount of energy to be lost over a given distance regardless of the frequency of the photon. The six pairs are subject to the same amount of viscosity as they move one distance $\boldsymbol{R_s}$ along regardless of the wavelength of the photon in which they can be considered to be moving in the cylindrical simile used here – although they are actually the photon itself.

Put simply here, it is the total distance that the meons move from emission of the photon to observation that matters, not how many photon wavelengths fit between those points. Regardless of the frequency of a photon, there are only six pairs in each and they experience the same viscosity loss of energy over the same distance.

The base pair of particle and anti-particle were originally merged together, vibrating, rotating and translating along with myriad others the same. This is fundamentally 'the universe' before any pairs unmerged and every subsequently formed loop has to move through it and loses energy in doing so – like travelling through a very dilute aether.

Since all the fundamental particle/anti-particle components of a loop are the same (adjusted) Planck size, they experience the same 'viscosity' of the background and so if a fermion loop has six (three pairs) or a photon twelve, merged into six, (as two loops) it does not matter what the size of the loops (their frequencies/masses) are – only how many components there are that feel the background viscosity. And it is always twelve for a photon of three pairs each loop in the two loops, regardless of the photon's frequency – this is the vital point that differentiates from previous frequency-related tired light hypotheses.

So it is the effect of viscosity on the meons that reduces energy for the photon double-loop – its rotational rate (frequency) reduces whilst its external velocity remains at c. It is the path length of the meons that matters, rather than that of the photon, although this can be ignored to some extent as explained below.

The spiral path of a meon in a photon is given by the combination of its wavelength, representing its translational distance travelled over one complete rotation, with its rotational distance. The best physical description is of a cylinder of length $2\pi R_x = L_\gamma$ whose circumference is also $2\pi R_x = L_x$. Over one rotation of the six partially merged meons, they travel around the circumference whilst moving along the cylinder, in a spiral path. The total path length over which they travel within each photon is thus

$$(2\pi R_x)^2 + (2\pi R_x)^2 = L_x^2 + D_\gamma^2 = L_t^2$$

So that the total path length of the meons L_t relative to the single photon path length D_γ is

$$L_t = (2)^{0.5} D_\gamma$$

The total path length of a photon from emission to observation is

$$D = \sum D_\gamma$$

As mentioned, this relationship does not actually matter greatly because the ratio of the meon path length to photon path length takes a constant value for all photons. Although the cylinder envisaged always has a slight enlargement towards its direction of motion, due to the energy lost reducing the photon frequency and thus expanding the rotational circumference (based on loop dynamic $h = MV_xR_x$, where M is the (adjusted) Planck mass of a meon and V_x its radial velocity in the loop), the fractional change is that factor f – which is very small.

It is thus possible to just consider the total photon path length D, the distance between emission and observation, to calculate the fraction of total energy lost for every photon regardless of the absolute numerical difference between the frequencies of emission W_e and of observation W_o.

What has confused in the past is that the observed frequency W_o of a photon appears in the energy loss formula. Attempts to square this logical circle with the distance-related-only Z redshifts have proved fruitless previously because this is not possible without a structure for the photon that enables such a property. The point that has been missed before is that it does not matter how many wavelengths are contained within a photon path between emission and observation.

It does not matter that a high frequency photon has a different absolute frequency difference between emission and observation to the absolute frequency difference of a low frequency photon. The point is ONLY that they travel the same distance between emission and observation. So the energy loss due to the friction or viscosity suffered by the meons comprising the photons in both cases will be the same fraction over the same distance that they cover.

The calculated value of f_L here is 7.15896 $\times10^{-11}$ Ly^{-1} and of f is 3.066 $\times10^{-61}$ Rs^{-1} or 7.568 $\times10^{-27}$ m^{-1}, each in 'empty' space over a long distance. These are obviously very small and difficult to observe at close range so would have been missed in any terrestrial experiments.

The redshift of objects at low velocity such as the Voyager spacecraft exiting our own solar system at 18 $\times10^{12}$ m from Earth would only show a Z_c shift around 1.36 $\times10^{-13}$, so not very much.

There is a viscosity effect against the motion of all loops, although they will not all be travelling at c, and so will experience a lower rate of energy loss. However, this small energy loss is enough to provide an arrow of time since no motion can be reversed without losing energy in both directions.

For a non-photon loop, or other composites made from loops, the energy lost is recovered by interaction with photons to transfer enough rotational rate from the photon to maintain their locked-in frequency (mass). This is why photons interact with other loops – to refresh frequencies, not to transmit electromagnetic forces.

A new universal constant?

Since ***f*** drives the limit on the value of local velocity that is ***c***, it is possible to say that in 'empty' space, and possibly elsewhere,

$$\boldsymbol{f}\,\boldsymbol{c} = \boldsymbol{k_s}$$

where $\boldsymbol{k_s}$ = 2.269 x10^{-18} s^{-1}. Equating this through dimensionality to an energy using ***E t*** = ***h*** provides an equivalent value for $\boldsymbol{k_E}$ = 1.503 x10^{-51} J, equivalent to a mass $\boldsymbol{m_k}$ = 1.673 x10^{-68} kg.

It may well be that $\boldsymbol{k_E}$ is a more fundamental or universal constant than either ***c*** or ***f***, in that the two always vary depending on the local density of energy or matter, whereas their product may not vary under any circumstances, possibly excluding when the photon becomes stationary exiting a black hole or when stacking in a nucleon or other loop stack.

As for the earlier discussion on total meon path length versus photon path length, it is possible to consider that the numerical value of maximum velocity ***c*** may be $\sqrt{2}$ higher since that is the distance travelled by the meons. However, this also does not matter since all that is observable is the photon path length where ***c*** is what is measured, although it does allow the meons to 'overtake' the photon velocity if the photon is travelling with its rotational plane parallel to its direction of travel.

Hubble constant relationship with *α*

It is interesting to note that the new 'empty' space mass $\boldsymbol{m_k}$ can be related to the fine structure constant ***α*** by

$$|\boldsymbol{m_k}| = \boldsymbol{h}^2 \sqrt{\boldsymbol{\alpha}/2\boldsymbol{\pi}}\ 1.118$$

and ignoring that the dimensionalities are inconsistent so that only the sizes are relevant to the comparison.

This suggests that the viscosity factor ***f*** = $\boldsymbol{k_s}/\boldsymbol{c}$ may be directly related to, if not the underlying reason why, the size of the electronic charge $\boldsymbol{q_e}$ takes the value that it does.

In order for that relationship to be exact requires only that the value of ***f***, set here at just the current best central observation value for $\boldsymbol{H_o}$, 70 kms^{-1} Mpc^{-1}, be reduced by the factor 1.118.

So this suggests that the final best value for the viscosity component of $\boldsymbol{H_o}$ could be $\boldsymbol{N_*}$ = 62.6 kms^{-1} Mpc^{-1} leading to the relationship

$$|\boldsymbol{N_*}| = (\boldsymbol{h}^2/\boldsymbol{c}) \sqrt{\boldsymbol{\alpha}/2\boldsymbol{\pi}}$$

since ***N*** is used here to represent the Hubble effect due only to viscosity. Although this value may seem very low, it possibly represents the minimum viscosity factor that underlies resistance to motion in 'empty' space and also the limit on the rotational rate of meons due to that same viscosity.

It would thus be likely that no celestial object should lie beneath the new $\boldsymbol{N_*}$ line, translated into an equivalent ***f*** value, and that all the ***Z*** component of an object above or below this line represent its relative velocity. This would require the value of ***k*** to be adjusted appropriately.

However, the Planck SI and (double-adjusted) Planck (DAPU) values of ***k*** in terms of time, distance, energy or mass equivalents is 3.066 x10^{-68} (SI) and 3.753 x10^{-51} (DAPU) on the basis of $\boldsymbol{H_o}$ at 70 kms^{-1} Mpc^{-1}. This should not be split into any component constituents except those with dimensionalities of $\boldsymbol{Y^o}$, so the constants ***h*** and α only.

The closest the current SI Planck value of ***k*** can be compounded from ***h*** and α is that

$$\boldsymbol{k} = 1.061\ \ h^2/(\frac{\alpha}{2\pi})^2$$

Double-adjusted Planck units (DAPU) are based on the elimination of ***G*** and adjustment of charge related property by $\sqrt{10^{-7}}$ for each charge $\boldsymbol{q_e}$, so that $\boldsymbol{M_*} = \sqrt{\boldsymbol{hc}}$ (DAPU) instead of $\boldsymbol{M_s} = \sqrt{\boldsymbol{hc}/\boldsymbol{G}}$ (SI) and $\boldsymbol{M_*Q_*} = \boldsymbol{h}$ with $\boldsymbol{q_e}/\boldsymbol{Q_*} = \sqrt{\boldsymbol{\alpha}/2\boldsymbol{\pi}}$.

Cosmic solutions

Some possible solutions to some of the problems identified in the standard model, plus some others not directly related, have already been mentioned above but are here explained further, based on the hypothesis outlined in the addendum. Some parts may be considered speculative, but are logical within the hypothesis.

Horizon problem – At each random unmerger of a meon pair, and other pair unmergers mutually triggered, all loops formed by such pairs are at close to the Planck energy. Collisions between loops drive inflation of loop radii along three dimensional axes to maintain internal angular momentum ***h*** of each meon in each loop. If the energy released is sufficient, then the loop radii will be large (small mass) and will be sufficient to power subsequent translational velocity away from the point of unmerger. Since the energy required to unmerge a pair is always the same, then the total energy available in the loops will always be the same. Initially the inflated loops will all have the three family mass sizes, powered by the difference between the initial and inflated loop sizes.

Each family mass size is a combination of the amount of inflation along two dimensional axes since the end result for each loop is to lie flat in the plane formed by those two axes.

All fermions of a specific type in each family end at the same energy after inflation and so the photons formed from them will also do so. So, for example, all electrons are formed on one plane and will have the same size.

Flatness problem – This is a problem only because the nature of energy has not been understood completely thus far. In the foregoing text, the term 'energy' has been used in its current form and will be used in that way except in this specific section, unless made explicit elsewhere. What is usually meant is the mass and potential energy of a particle and this is used to infer that mass energy and the effect of gravitation are 'energy'. This is not quite so.

Energy is mainly a counting mechanism that refers to the rotational frequency of loops. The mass of meons is fundamental mass energy, and, if defined to be positive, has two mass-related components – positive and negative. In every loop the two are equally represented. So regardless of the frequency of rotation of a loop, its total mass energy is always zero in total. It still has a frequency and each meon still has angular momentum of ***h***, either positive or negative, for each fundamental (adjusted) Planck mass.

Alongside the positive fundamental mass energy of a loop is an equal and opposite amount of fundamental negative charge energy – not the electronic charge, but the fundamental meon charge of $\boldsymbol{q_e}/(\sqrt{\boldsymbol{\alpha}/2\boldsymbol{\pi}}/6)$ or ***Q***=***M/c.***

The four different energies can be considered as

M+	+fundamental mass energy	+mass energy
M-	+fundamental mass energy	-mass energy
Q+	-fundamental charge energy	+charge energy
Q-	-fundamental charge energy	-charge energy

Since the fundamental meon mass and charge cannot be separated, whatever the motion of the meon involves both positive fundamental mass and negative fundamental charge energies. With a positive fundamental mass meon is a negative fundamental charge and those energies are always equal and opposite and sum to zero. As well as positive and negative mass energies, there are negative and positive charge energies in a loop.

What we see as the action of gravity is exactly as in GR but when translated into loop systems, it is like the effect of the loop area floating on space – but that space is the background of merged meon pairs and other loops. The larger the loop radius, the larger the loop area and the less they depress space-time – here meaning that the interactions of the meons with the background is spread over a wider area. It is not the total mass energies of the meons in a loop that create gravity, which are always zero in total for a loop, but the effect of the separations of the meons and their mass energies interacting individually with the background.

The initial unmerger, being always at the same energy, causes the meons to spin at the same rate for all meons. Coupled with the direction of motion of the meon after unmerger, the meon will generate positive or negative $\boldsymbol{q_e}$/6 electronic charge. The unmerging pair always generates both positive and negative charge, so the sum of all charge in the universe is always zero.

The meon $\boldsymbol{q_e}$/6 charge energy is always balanced by the opposite twist (meon spin - not loop spin) mass energy. So regardless of the total electronic charge of a loop, it always has a total of these two energies equal to zero.

Thus all loops always have total positive and negative types of 'energy' of zero. The reason they interact is because only similar type energies act on each other. So the mass energy of one loop will interact with the mass energy of another loop. The charge energy of one loop will interact with the charge energy of another loop.

At distances beyond where the loops' relative orientation ceases to have effect, all that interact are the loops' charges and the gravitational effect between the two loops.

At shorter distances, the loop spin and meon-meon interactions occur and loops will stack next to each other. Stacks have to balance asymmetries in order to be stable meaning loop and anti-loop will form stacks of two loops.

Stacks of two loops which rotate opposite will have total spin of zero and will move slowly. Stacks of two loops which rotate in the same sense will have total spin of 1 and will move quickly.

Longer stacks of normal matter are threefold symmetric and require three appropriately oriented asymmetric quarks in their core and an odd number of loops overall. Leptons are threefold symmetric, so can exist in nucleon stacks, and are the reason why a neutron stack can have a stack electron ejected by an energetic neutrino to become a proton – usually described as the weak nuclear force.

So despite all the motions observed of all the particles in the universe, the total energy of the universe is always zero, regardless of how many loops, stacks, stars or galaxies there are in it. This is why there is no flatness problem – the total energy of the universe is always zero.

Structure problem – The universe is not just the constituents of our own big bang. There have been many failed big bangs before our own successful one, some of which lie within the space occupied by our big bang and act as a framework for it to coalesce around.

The existence of old galaxies in our young big bang is another consequence of pre-existing structure that formed before our own big bang and which allowed our big bang constituents to coalesce quickly.

Fermion Families – These are a simple consequence of different rates of inflation along the three different dimensional axes. Once inflation started, the loops were rapidly forced into one of the three planes of inflation, producing three family sizes for each type of fermion, each a combination of two different inflation rates.

Inflation – The change in size of loops from near Planck energy to their current sizes is what it means for loops to inflate. The difference between their initial size and final size determines whether the loops formed will escape gravitational collapse. If the loops formed are large enough (small enough mass) then the energy available to give them velocity away from the origin of unmerger will be large and a successful big bang will ensue.

If the loops are too small (large mass) then the energy released will not be enough to overcome their own gravity and the result will be a failed big bang. But the infalling loops will not reform the original merged meon pairs. Depending on the volume of loops available, either a galaxy or a black hole will form, the latter really a star made from chains.

Black holes – A black hole is not a star within which physics breaks down or where a singularity exists. Since everything within it is made from meons, whose density is the largest possible and which cannot be broken apart, everything made from meons is of lower density than the meons themselves.

Infalling loops will be stretched until they break and the result will be a chain star, where loops continually form, break and reform in different combinations.

Within a black hole it is possible for high energy photons to form and, provided they are orientated with planes parallel to the surface of the black hole, they can escape but lose most of their energy doing so. The minimum energy required to escape will be a function of the size of the black hole.

Homogeneous and isotropic universe – Whether this is the case depends on whether there was translational motion after inflation. Although the total energy of the universe is always zero, it is split into different forms of zero – meons, loops, loop stacks (nucleons), atoms, stars and galaxies.

If there was no post-big bang outwards translation, then the long distance redshift of celestial objects depends only on their distance from us. There may be local velocities, but these will be random.

If there was post-big bang outwards translation, then outside the space that contains our big bang there will be failed big bangs whose sizes may be very large and thus appear inhomogeneous. However, it would be appropriate to consider that these objects will still have total energy of zero, considering both mass and charge energies, making them homogeneous with any other volume.

Baryon asymmetry - Matter and anti-matter are differentiated only by the sign of charge. The number of degrees of freedom when considering the mirroring of the properties of a loop is larger than for simple particle properties as currently construed.

The result is that when considering what is a loop and what is an anti-loop, it is only the charge of the loop that differentiates them. So if the choice is that a positive electrostatic charge is the matter particle, then the negative charge will be anti-matter.

This system would place protons as matter and electrons as anti-matter, although the reverse would make no difference.

What this means is that matter and anti-matter do not annihilate on contact, but form neutral structures. Atoms prefer to be neutral, as do photons, and neutrinos are anyway. So these are some of the neutral structures that predominate because they represent stable forms.

Because the total charge of the universe is always created equally to be zero, this means that the amount of matter and anti-matter is always equal and baryon numbers are symmetric.

The anti-loop of a spin + ½ electron loop is a spin + ½ positron loop, making the photon a perfect spin +1 neutral matter/anti-matter composite and a battery is a matter/anti-matter device.

Dark Matter – Loops that do not have three pairs of meons are dark matter. The threefold asymmetry of a normal matter quark loop can only be balanced into stable stacks by two other threefold asymmetric loops. A quark loop and its anti-loop can be stable, as can three quark loops with the appropriately orientated asymmetries in a stack.

Loops with even number pairs will not be able to balance their asymmetries with the threefold quark asymmetries, so cannot stack with our normal matter.

Even number pair loops require an even number of loops in a stack to balance their internal asymmetries. For opposite rotating even number pair loops in a stack, they also do not have the attribute of a non-zero total spin that any odd-number loop stack will have, since all loops have ± ½ ***h*** each.

To make neutral threefold symmetric loop stacks requires something external to balance their charge and non-zero overall spin. The only loop capable of doing so is the electron loop whose charge is the same size as the quark stack charge and whose spin is the same size as the quark loop stack total spin.

This means that threefold symmetric loops can form atoms so that they can be neutral in all aspects. This is not the case for even-number symmetric loop stacks, so they cannot form atoms.

Threefold symmetry is the lowest asymmetric system that can form atoms and so is what makes chemically interesting particle systems of any big bang, failed or successful.

Fivefold symmetric systems may exist, but they are much less likely to form because it is more difficult to make and keep unbroken longer chains and loops.

The ratio of the probability of making threefold loops versus all the other-number loops will be a measure of the ratio of normal to dark matter.

Dark matter photons will be stable and indistinguishable from normal photons, except in stacking with normal matter loops, since all loops have the same spin.

This means that dark matter does not form atoms and its stable states will be charge neutral loops and loop stacks whose only interaction with normal matter will be via gravitation or impact.

Zero Point energy and vacuum energy – Vacuum energy is a special case of zero point energy, which is the lowest state of any system. In the case of the universe, the background which the universe is made of, separate from the more generally moving loops, has two components.

One is the merged meon pairs as the base state. The second is a loop and anti-loop with opposite spins which have stacked, called zerons. These have no net charge or spin and their only property as a whole is their observable mass.

These exist centred at all points in space and are responsible for the Casimir effect when two plates disrupt the ability of zerons of radius larger than the plates' separation to remain in place. The result is that the net effect of the displaced and surrounding undisrupted zerons push the plates together or alternatively that there is a deficit in the pressure keeping the plates open due to the net lack of zerons between them.

The other main effect of zerons is to act as the underlying physical reality of quantum pair creation. Here an external impact dislodges a zeron, which splits into its constituent loop and anti-loop for some period of time. The 'energy' of each of these loops is related to their frequencies ***w***, and is ½ ***hw***, which will depend on the original impact energy. A zeron that already exists is dislodged, split and then reforms. Nothing new is created.

So at each point in space exists zerons of all radii, ready to be split up temporarily by impact. This is the basis for the vacuum energy of ½ ***hw***. There is no vacuum.

Redshift observational effects – As mentioned earlier, the factor ***f*** is the average over very long distances. The actual minimum value will be very difficult to measure because the density of the background and other features like gas clouds in the path of any specific photon will always be largely unknown.

It is likely that in the voids between galaxies, the value of ***f*** will be so comparatively small compared with the average over the whole path that it could be considered to be a blue shift – the absence of average viscosity being the same as observing the photon at a lesser redshift than its distance travelled would suggest. This would imply that photon paths across voids will have lower relative redshifts the longer their path through the void – an ellipsoid interpretation of a circular void, with long axis along the direction of observation.

The opposite will be the case for photons passing through gas clouds or intervening galaxies. Here the density of the background will be greater than average through the cloud. The redshift observations from photons traversing the cloud would all imply further than actual distance with relative extra distance proportional to the distance actually travelled through the cloud. The result would be a banana-type interpretation of a circular cross section cloud, with the banana shifted symmetrically away from the observer.

Magnetic monopoles – There are none because there are only the two fundamental properties, beyond the three dimensional size of the meons, of fundamental mass and charge. Magnetism is due the relative motion of opposite charges which will always require at least two meons.

Dark energy – Dark energy is not vacuum energy. Given the uncertainties in the reason why observations appear to show increased $\boldsymbol{H_o}$ beyond some distance it may or may not be needed. The increasing velocities of our big bang constituents at longer distances produces a natural upward curve to the total value of $\boldsymbol{H_o}$ over distance, which may provide a better fit to the data than dark energy or accelerating $\boldsymbol{\Lambda}$.

There is no reason in the hypothesis suggested here to require dark energy, given that there are only two fundamental forces, due to mass and charge, from which all the others are derived.

Expansion of space – Is not possible since the basic fundamental building blocks from which all loops and composite structures are made do not change size and are always equal to the (double-adjusted) Planck mass. It is not needed because the non-frequency dependent viscosity redshift replaces it.

Gravitational constant - ***G*** is a dimensionless ratio set by SI units, eliminated by adjustment of SI mass and length units to form DAPU units. It is not required in any physical formulae when using DAPU units and so cannot be adjusted to make cosmic data fit observations better.

Gravity and charge - The strength of gravity and charge is the same. It is the loop rotational rate (particle mass) versus the meon spin rate (one-sixth electron charge) that provides different sizes of energy and thus actual effect.

QM versus GR – It is beyond this explanation to delve into quantum mechanics other than to delineate that the difference between the systems is whether or not the motion of meons is subject to viscosity. Where meons experience viscosity, they are limited to maximum velocity of ***c***, have an arrow of time and a time dependency. When the meons do not experience viscosity, they have no maximum speed, achieve non-locality and do not have observable time dependency.

The result is that the two systems are incompatible and there are no environments in which meons can be both subject to, and not subject to, the effects of background viscosity.

Electromagnetic force – Photons do not transmit forces (other than by impact). The background transmits forces through merged pairs forming loose chains being dragged by individual meons in loops and in turn dragging non-chain meon pairs. These loose chain components rotate, spin and vibrate to form magnetic or gravitational field lines and are responsible for frame dragging.

Photons interact with loops to transfer frequency in order to maintain the sizes of non-photon loops that were locked-in by inflation. Photons stack alongside electrons to change their energies when moving between atomic orbitals by forming a stack of the correct energy, and are ejected when decaying.

Because of viscosity, eventually all photon frequencies and loop rotational rates will fall to zero and loops will revert to chains, then meon pairs as all energy is returned to the background from which it originally arose. But since the total mass and charge energy is always zero, there will always be sufficiently chaotic motion to set off other unmerging events at some future time and place within the universe.

Cosmological constant $\boldsymbol{\Lambda}$ – Since this is associated with the vacuum energy of space, it will have the value of the two components of the background, the zerons plus the almost zero net energy of the merged meon pairs.

The value of ½ ***hw*** for each zeron loop, plus any merged pair component, is in line with observations for the ‘vacuum’ energy of space, despite there being no vacuum.

Since there is no expansion of space, there is no need for a cosmological constant to balance it. However, the actual background does provide a mass energy density, although the total of mass and charge energies is always zero.

Omega Lambda $\boldsymbol{\Omega_\Lambda}$ - the ratio between the energy density due to the cosmological constant and the critical density of the universe actually should only refer to our big bang component. In any case, since the total energy, as opposed to the mass-related energy, of the universe is zero then $\boldsymbol{\Omega_\Lambda}$ is zero. $\boldsymbol{\Omega_\Lambda}$ should instead refer only to the mass-related energy density of our big bang.

So our big bang may or may not continue its outwards velocity, lower than currently accepted since the main redshift component is due to viscosity.

Multiverses – Since the meon is the only type of real particle/anti-particle and the loop is the only combinatory form, there can be no other system within the universe. The universe contains many failed big bangs as well as at least our own successful one.

There may be other successful big bangs but they will be based on the lowest asymmetry loops – threefold like ours. They may have had different inflation rates, so different loop sizes (particle masses) but will have the same charge and spin units because it takes the same amount of energy to unmerge merged meon pairs every time.

So any other big bang will have atoms and chemistry, but those will be different to ours so that we would be able to view their emission spectra as structurally different, eg due to different chemical composition of their stars.

The only limit to being so different is if there is some limitation on the amount of inflation, such that the size of our electron is at that limit beyond which no smaller mass symmetric charged loop could form.

Big Bang and Steady State - The universe is a mix of the two. However, the steady state hypothesized here does not require the creation of matter as such, since the total energy of every meon and thus every loop, star and galaxy is always zero. Whether our big bang provided sufficient mass energy to propel our constituent components outward from the initiation point, to provide continued outwards velocity, can only be confirmed once the underlying effect of the background viscosity has been identified.

Failed Big Bangs – The hypothesis suggests that unmerging events that trigger big bangs occur randomly throughout the universe. If the energy released by inflation is not sufficient, then the loops and constituents formed will collapse back to form a black hole or galaxy. Since there is no initial direction of motion for a triggered inflation, other than net outwards to provide volume for the newly enlarged loops, then the black hole or galaxy thus formed will be stationary in the universe. So all such failed big bangs will be stationary with respect to each other. So $\boldsymbol{Z}$ for such objects will be due only to distance travelled, except for the velocity of an observer with respect to the centre of our own big bang.

There is a more extreme view of failed big bangs – that there are very many of them. If the viscosity redshift is shown to be the main redshift component and all celestial object motions are random, then there can have been no general inflation or outward flow. In this case it may be that all, or most of, the galaxies we see are their own big bangs in action. This includes our own galaxy.

Given the hypothesis suggested, then all big bangs will preferentially form threefold loops and the values of $\boldsymbol{h}$, $\boldsymbol{c}$ and $\boldsymbol{\alpha}$ will be the same, the latter because it always takes the same energy to unmerge a meon pair.

The emission spectra from such other big bangs will depend on the energy levels of atoms created within those big bangs. Regardless of the nucleons formed, it is the mass of the electron $\boldsymbol{M_e}$ in that big bang that sets the base for the emission spectra $\boldsymbol{E_{e-}}$ for all atoms, being

$$\boldsymbol{E_{e-}} = ½\, \boldsymbol{M_e\, \alpha^2\, c^2} \text{ (orientation function)}/n^2$$

Where a big bang has an electron mass eg 10% higher than our own electron, then the whole emission spectra for that object will be 10% higher and thus will have a incorrect ***Z*** shift when compared with our distance expectations. Even though the spectra may follow our standard frequency spectrum structure for emissions from certain types of object, the distance to redshift relationship will be different.

It may be that the nucleons, nuclear interactions and atoms or elements that form within another big bang and their relationships to different elements will be different to our own such set, because the loops were all different sizes, and that we could tell that the underlying chemistry was different. This would lead to different starting chemical compositions for different stars in other galaxies and different rates of change of composition.

These different emission energies in different galaxies that are failed or failing big bangs could be another source of different redshifts of objects at similar distances or the same redshift for objects at different distances.

This hypothesis could mean that our own galaxy is our total big bang with the black hole at its centre the first part of the collapse with the rest to follow eventually – our galaxy could effectively be a failed or failing big bang in action.

Pre-fermions – Once the hypothesis suggested here is found to be correct, since it is based on a pre-fermion system of particles, then improved understanding of the properties of electrons and nucleons should ensue.

Conclusion

The hypothesized structure of photons leads to a new explanation for why tired light may be the major contributor to the redshift observations of celestial objects. The result is a need for reinterpretations of the size of our big bang, its age, the size of our part of the universe and that beyond our big bang and the need for dark matter and dark energy.

A new 'empty' space constant may exist whose value depends on the underlying viscosity of space and there may be a direct relationship between an adjusted minimum value, due to viscosity, of the Hubble constant and the fine structure constant.

One observable test of the relationship between the viscosity-only part of the Hubble constant N_* and α would be whether any very distant celestial objects were observed beneath that line.

Provided there is a local density made of the background constituents of merged meon pairs and other loops, then the resultant viscosity will impose a terminal velocity that is light speed. Where there is no background, there will be no density and thus no maximum speed. This environment is the quantum realm, but is beyond this addendum to explain further.

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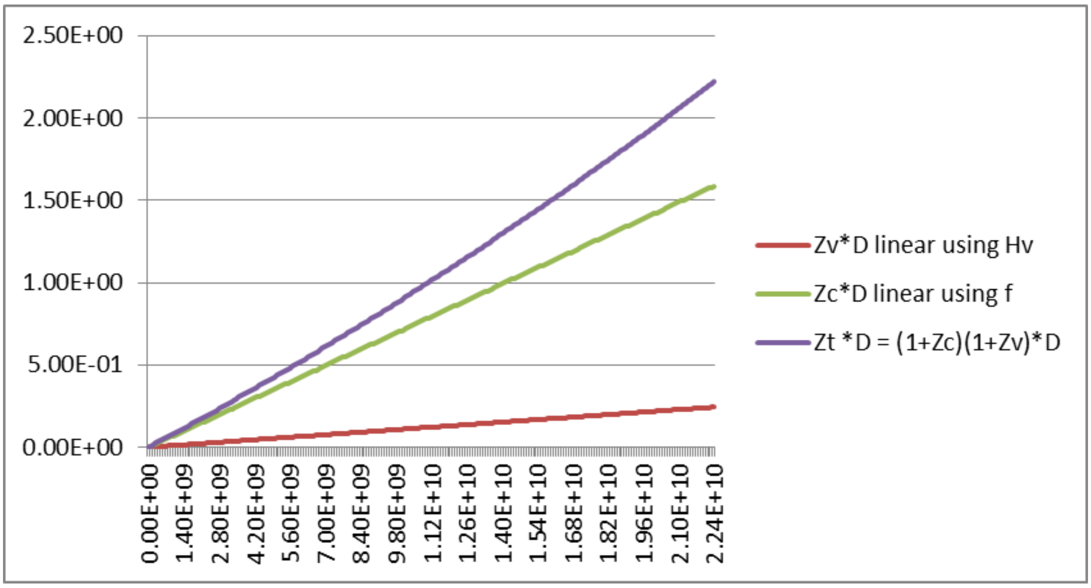
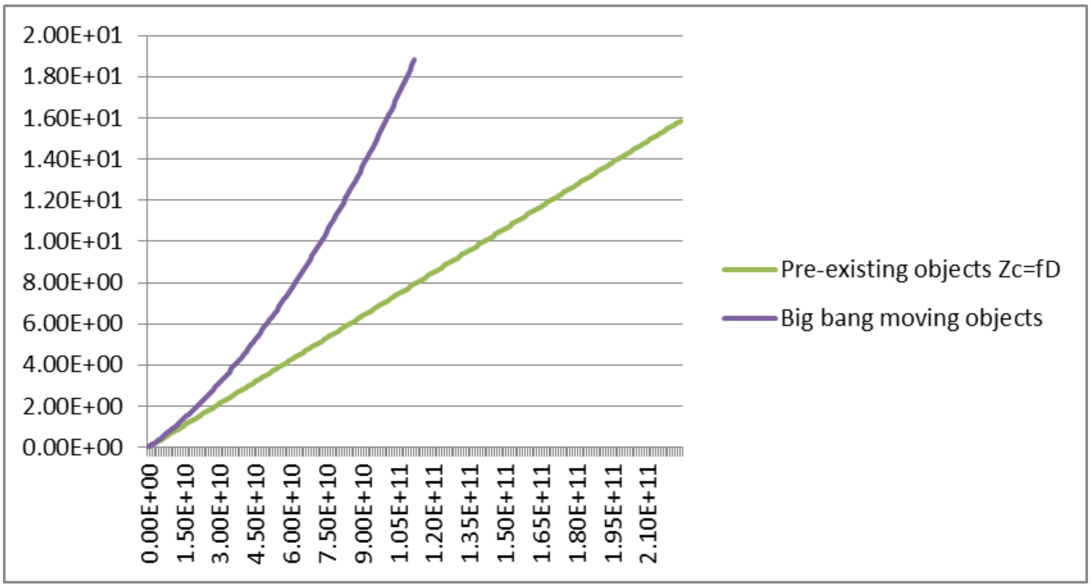


Graph 1 ***Z*** red shift versus ***D*** distance in Ly



Graph 2 ***Z*** red shift versus ***D*** distance in Ly – Z_t for moving big bang components and Z_c pre-existing ones

Addendum to the paper

This is a very short overview of how the tired light effect explained in the paper fits into a comprehensive explanation of how the universe fits together. The references in the paper give more detail.

1 The background – The meons in positive and negative forms are the only real particles in the universe. When fully or partially merged, they vibrate, rotate and translate. Myriad of these merged pairs form the background to the universe – what it is made of. Motion through the background requires energy because the meons experience the viscosity of the background. Photons pay for that energy loss by reducing frequency which makes the background pairs vibrate faster – hotter.

2 Loop formation – merged meon pairs can unmerge when a rare arrangement of the background surrounding one merged pair forces them apart. There are five significant effects

- the meons each spin, with their rubbing against the background generating a charge equal to one-sixth the electron charge whose sign is positive or negative

- the generated charge sign depends on the sign of the meon and its spiral orientation as it chases or is chased by its partner – the total charge generated by a pair is always zero

- the chasing pair are trying to reform their merged status and will catch onto the tail of other such pairs, eventually forming loops in which the meons can be viewed as a loop rotating with a frequency.

- loops of three pairs are our fermions. Loops of other number of pairs are dark matter. The ratio of the probability of forming three-pair loops to non-three-pair loops produces the ratio of matter to dark matter.

- the extra degrees of freedom when mirroring properties of loops results in the only difference between matter and anti-matter loops being their charge. So there is no matter/anti-matter asymmetry in the universe.

- the three threefold asymmetric orientations of quark loops in a stack is what we call colour and the symmetric leptons also have asymmetric chargeless versions. Loops stack to balance their asymmetries. Colour is not a force but a symmetry requirement that needs each quark to be orientated correctly with respect to the other quarks in a stack. Electron and neutrinos, being made from meons and having threefold symmetries, can exist within nucleon stacks.

3 Inflation – Initial loop formation is at Planck energies. At some point loops will collide and in order to maintain ***h*** angular momentum for each of the meons in the loop, the loop size will increase substantially as the velocity of the meons reduces. The amount of inflation, different along each of the three dimensions, produces the final loop sizes, which we call the masses of the loops.

4 Post-big bang motion – After the inflation of the loops to their final size, they may continue outwards from their point of origin. Depending on the size of inflation, the loops may be relatively large or small, corresponding to small or large masses since a larger radius loop has a smaller frequency and so a smaller what we call 'mass'. If the inflation is too small, the small-radius large-mass loops will not have enough energy to escape their own gravity and will collapse back to their point of origin forming a black hole or galaxy, depending on number of loops. This latter is a failed big bang and occurs randomly through the universe. Our big bang was successful because our loops were large-radius small-mass and had sufficient outward energy to overcome their own gravity. The difference is that the original loop formation energy at around Planck energy is transformed either into large mass loops, leaving little energy for translational outward motion, or the reverse.

5 The universe – The background which makes the universe is far larger than our own big bang. Many failed big bangs have occurred beyond our own

and will be continuing. At such large distances any relative velocities will be very small compared to closer objects and all centres of big bangs are stationary with respect to each other.

6 Photon redshift - The viscosity of the background acts on the meons. So it is only the distance that the meons travel that matters when considering viscosity energy loss. The viscosity redshift of an object travelling through space is linearly proportional to its distance travelled over long distances ***Z = FD = fd***. Where the background is denser, around stars or within gas clouds, there will be a larger than average ***f***, and where there are voids there will be a smaller than average ***f***.

7 Hubble values – In the universe, there are two classes of redshift object. One is pre-big bang objects,either outside our big bang or within our big bang around which our big bang constituents are moving. The second class is objects that are part of our big bang and are moving. The pre-existing objects within our big bang act as gravitational sinks attracting the moving gasses, stars etc as a form of framework to coalesce around. So there will be very old objects that are older than our big bang.

There will also be points where pre-existing objects really are adjacent to objects moving with our big bang. Then we will see one object with a large redshift adjacent to an object with a smaller redshift. The pre-big bang objects will have one gradient of red shift proportional almost completely to their distance from us. Our big bang objects will generally have an additional ***Z*** shift due to velocity on top of their distance from us. It may be that the low CMB value for H_o corresponds to the gradient of the underlying viscosity factor ***f***, whilst the additional velocity associated with the big bang constituents produces the higher H_o at lower distances.

8 Why photons travel at ***c*** – Unmerged meons chase each other in order to recombine. Pairs chase each other and catch onto the tail of other pairs forming chains where each meon is chasing the one in front. Eventually a chain catches its own tail to form a loop.

When a loop and anti-loop approach each other and are rotating in the same sense, they form a stack. Within the stack each positive meon in one loop will have a negative meon in the other loop. This is like a very short chain of just two meons from one loop to the other. The result is that the six of these new pairings of positive and negative meons will chase each other along the direction of their axis of rotation, whilst still rotating as part of their own loop, and will almost remerge together.

The resulting photon has each of the six new pairs chasing up to the maximum speed that it can manage within its local environment. When the environment is of low density, the speed is what we call light speed with a velocity of 2.99 $x10^8$ ms^{-1}. When the local density is very high, as round a black hole, the speed of the photon will still be ***c***, but its numerical value may be zero.

There can be more than one photon in a photon stack. Because the meons in each double-loop merge almost completely, they almost reform the original merged pairs. So a stack of photons of the same frequency will all occupy the same volume and will appear to be one photon. This confirms that their total energy is zero and that only frequency defines what is a photon or the energy of a loop.