The Expanding Universe Model Fails the Test: Towards a New Cosmological Paradigm

Paul A. LaViolette*
The Starburst Foundation
Niskayuna, NY

Abstract:

The no-evolution, static universe tired-light model and the no-evolution concordance expanding universe cosmology are compared to observational data on six cosmology tests. The tired-light model is shown to make a superior fit on all tests. Also the supernova light curve test is shown to be flawed by selection effect biases; hence claims for cosmological time dilation due to expansion are unsupported. Furthermore the finding that the cosmological redshift values are quantized, that the microwave background radiation is much smoother than was originally thought, the presence of periodicity in the distribution of galaxy clusters, the difficulty in accounting for the WHIM, and the existence of galaxies at z ~ 12 all pose insurmountable problems for the concordance cosmology. It is concluded that the big bang theory does not provide a feasible explanation for the origin of the universe. The alternative cosmology of subquantum kinetics is discussed as a viable substitute. It predicts tired-light redshifting (in intergalactic space), continuous matter creation, MOND-like gravity fields, and a source of energy for the CMBR. It also predicts cosmological photon blueshifting (negative H_o) in the vicinity of galaxies and galaxy clusters, thereby explaining the Fingers of God effect and Kaiser pancaking effect, and also predicts excess redshifting for photons passing through cosmic voids thereby explaining their elongation in redshift space. It accounts for the large intrinsic redshifts of quasars, their ejection from galactic cores, and subsequent transformation into companion galaxies in support of Halton Arp's quasar evolution model.

* email: plaviolette@starburstfound.org

1. A History of the Tired-Light Model

In the past there have been two competing interpretations of the cosmological redshift phenomenon, the standard interpretation asserting that it is a recessional Doppler effect due to the expansion of space-time, and the competing view that the universe is not expanding and that the redshift is instead due to a "tired-light" energy loss which photons undergo on their journey through space. These two models are most equitably compared to cosmological test data by refraining from introducing ad hoc evolutionary corrections. As shown in the next section, when the no-evolution expanding universe hypothesis and no-evolution tired-light model, are compared to data on multiple cosmology tests, the tired light model consistently makes a superior fit.

Before examining this evidence it is useful to review the historical background of the tired-light model. The notion that the cosmological redshift may be a non-Doppler phenomenon in which photons continuously undergo an energy-depletion or "aging" effect has been around for some time. Maxwell's [1,2] original electromagnetic wave equation contained the energy damping term $\sigma_0 \mu_0 (\partial\varphi/\partial t)$, where σ_0 and μ_0 represented the electrical conductivity and magnetic permeability of background space. In 1921, Nernst [3–5] put forth the idea in an astronomical context, proposing that Olber's paradox might be resolved if photons were assumed to undergo nonconservative energy damping during their journey through intergalactic space. Like Maxwell's damped EM wave, in Nernst's version the photon's lost energy physically disappeared from the universe. In 1990, Vigier proposed a non-energy-conserving tired-light model in which photons lose energy through energy dissipating interactions with stochastic vacuum fluctuations [6}. The subquantum kinetics (SQK) physics methodology discussed in Section 4 also predicts a non-conservative tired-light effect for photons traveling through intergalactic space [7,8].

In addition, energy conserving tired-light mechanisms have also been proposed in which the lost radiation is conceived to remain in the universe as low grade heat. For example, as a way of interpreting the discovery of the redshift-distance relation that Hubble published in 1929, seven months later Zwicky published in the same journal a theory proposing an energy-conserving mechanism in which photons were assumed to have a nonzero rest mass and to lose energy as a result of a gravitational drag resulting from their interaction with ambient matter [9]. Alternatively, Pecker and Vigier in 1986 suggested that cosmological photons have a nonzero rest mass and lose energy through their interaction with a bath of φ-particles having masses much smaller than that of an electron [10]. Also in 1990, Marmet proposed an energy loss mechanism involving energy-conserving photon scattering from intergalactic hydrogen nuclei that has some basis in laboratory experiments [11–13]. He has convincingly shown that photon interactions with intergalactic gas would produce no angular deflection and hence no image blurring. Also Zheng [14] has proposed that "soft photon" scattering from intergalactic electrons can cause redshifting. However, both of these scattering theories have difficulty explaining the redshifting of radio frequency spectral lines since an intergalactic medium of hydrogen gas or electron ions does not scatter radio waves in the same manner as visible wavelengths. This criticism, however, does not apply to most non-conservative tired-light mechanisms. The SQK tired-light effect, for example, can be adjusted to have an undetectably small wavelength dependence. Also since its photons lose energy without radiating a secondary photon, they undergo no recoil and suffer no angular deflection. For an early review of tired-light mechanisms see Narlikar [15].

According to the tired-light model, the energy loss that a photon undergoes is given as:

$$E(r) = E_0 e^{-\beta r}. \qquad (1)$$

where β represents the energy attenuation rate that the photon experiences during the course of its journey. Relation (1) implies that photon wavelength λ should increase exponentially with distance as:

$$\lambda(r) = \lambda_0 e^{\beta r} \tag{2}$$

and that photon redshift, z, should vary with distance as:

$$z(r) = \Delta\lambda/\lambda_0 = e^{\beta r} - 1, \tag{3}$$

where λ_0 is the wavelength of the photon at the time of emission. For small propagation distances such that $\beta r \ll 1$, Equation (3) may be approximated by the linear redshift-distance relation:

$$z = \beta r\ . \tag{4}$$

By making the substitution $\beta = H_0/c$, where H_0 is the Hubble constant, Equation (4) is transformed into the Hubble redshift-distance relation. Redshift-distance studies indicate that the Hubble constant should have a value of 72 ± 8 km/s/Mpc [16]. Some calculate it to be as low as 62 ± 1 km/s/Mpc. Here we adopt the conventional value of 72 ± 8. Expressed as an attenuation coefficient, this is equivalent to a photon energy loss rate of β = 7.4% per billion light years (bly) travel distance. When multiplied by the factor $c = 3.17 \times 10^{-17}$ bly/s to express it in time units, this energy change rate equals $\mu = -\beta c = -2.3 \times 10^{-18}$/s, which is about 10 orders of magnitude smaller than the current laboratory observation limit. Nevertheless such a small amount of energy change has very important consequences from a cosmological standpoint. The alternative to these tired-light interpretations, and the more widely held view, is the hypothesis that well-separated galaxies are receding from one another and that the cosmological redshift is instead a Doppler effect arising from a continual expansion of space-time. Thus any test of the tired-light cosmology against available data must necessarily include a comparison with this standard expanding universe interpretation.

These two alternative cosmological hypotheses, the no-evolution tired-light hypothesis and the no-evolution expanding universe hypothesis are compared below against data on several cosmology tests: the angular-size-redshift test, the Hubble diagram test, the galaxy number-count-magnitude test, and the Tolman surface brightness test. As will become apparent, on *all tests* the no-evolution tired-light model exhibits superior performance. That is, it makes the best fit to the data with the fewest number of assumptions. The no-evolution expanding universe cosmology is able to fit the data only if numerous *ad hoc* assumptions are introduced which specify the presence of *major* evolutionary effects, e.g., evolution in galaxy cluster size, galaxy angular size, galaxy radio lobe size, galaxy luminosity, galaxy surface brightness, and galaxy number density. The tired-light relation, on the other hand, fits the data reasonably well without requiring such major corrections. Thus the tired-light cosmology is preferred because of its overall simplicity.

Finally, we must discuss these two competing cosmologies in the context of the redshift quantization phenomenon. Although not a cosmological test *per se*, this effect is something that any candidate cosmology must address; see Section 3.

2. Cosmology Tests Favor the Static Universe Hypotheses

The Angular-Size-Redshift Test. The first cosmological test we will consider is the angular-size-redshift test. In one version of this test, the angular statistic, θ, is derived by observing the angular separations between bright galaxies in a cluster, as seen projected on the plane of the sky, and calculating the corrected harmonic mean of these separations. This θ value is then plotted against the cluster's redshift [17-21]. One suitable θ–z data set is that published by Hickson and Adams for a set of 94 galaxy clusters and which includes clusters at moderately high redshifts reaching up to $z = 0.46$ [21]. LaViolette [8] subsequently plotted the linear Hubble relation, the no-evolution tired-light model, and the no-evolution expanding universe prediction against the Hickson-Adams data set . This comparison is reproduced here as Figure 1. The first of these, the Hubble relation model, assumes that space is static and Euclidean, that galaxy clusters do not change their size appreciably over long look-back times, and that redshift varies linearly with distance as $r = z/\beta$. For flat space, cluster angular size θ and distance r are related as:

$$\theta = d_0/r, \tag{5}$$

where $d_0 = 1.88$ mly is the measured intrinsic size of a typical cluster. The linear z-r dependence proposed by the Hubble relation may be expressed in terms of θ as:

$$\theta = k/z, \tag{6}$$

where $k = \beta d_0 = H_0 d_0/c = 1.38 \times 10^{-4}$, β specifying either the rate of attenuation of the

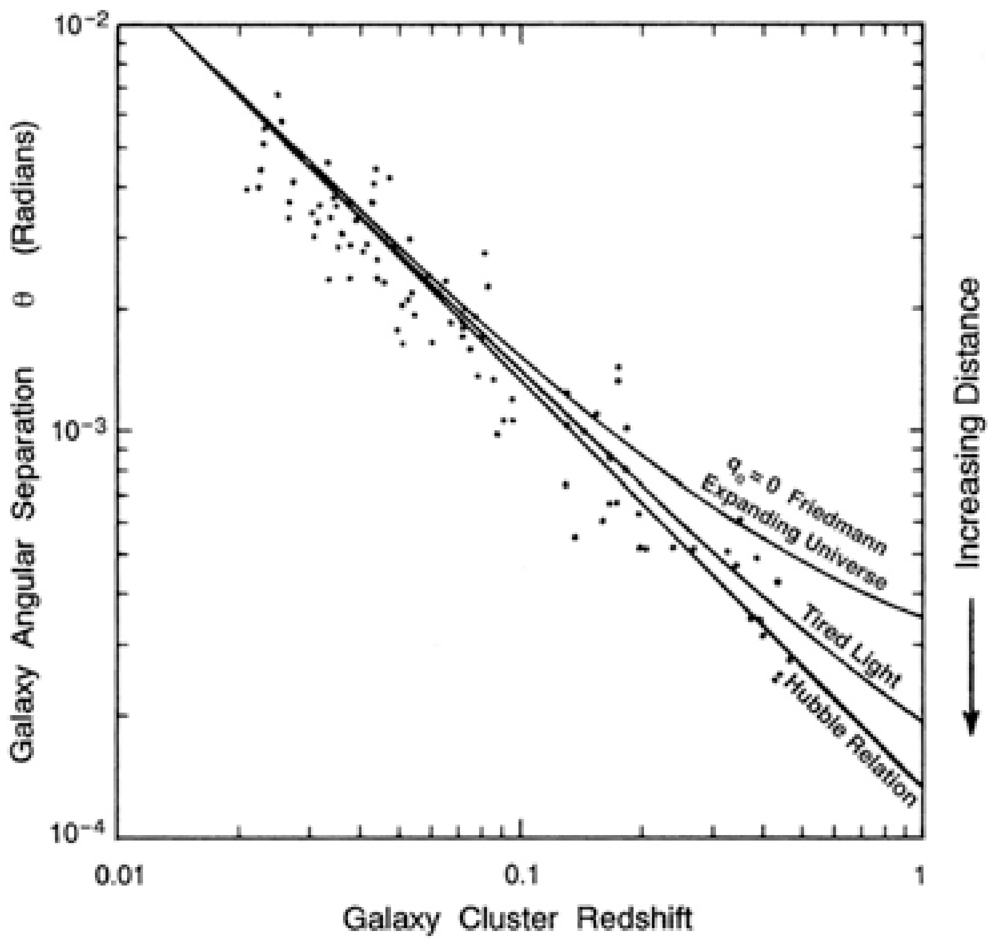

Figure 1. Harmonic mean angular separation for the brightest galaxies in a cluster plotted vs. redshift for 94 galaxy clusters. The no-evolution tired-light model makes a far better fit to the data than the no-evolution $q_0 = 0$ Friedmann model assuming universal expansion (LaViolette [8] using data from Hickson and Adams [18].).

photon's energy with distance or the rate of increase of the photon's wavelength with distance. For the Hubble constant, we adopt the conventionally accepted value $H_0 = 72$ km/s/Mpc, and set $d_0 = 0.573 \pm 0.12$ Mpc, which is consistent with the intrinsic size value reported by Hickson for nearby galaxy clusters [17]. This linear angular-size-redshift Hubble relation (6) is plotted in Figure 1 as the lower line.

The second hypothesis, the no-evolution, tired-light model, is identical to that described above with the exception that a logarithmic term is introduced in the denominator in accordance with the nonlinear z-r relation specified as: $r = \ln(1+z)/\beta$, an equation derived from Equation (3). The θ–z relation for the tired-light cosmology is therefore given as:

$$\theta = k/\ln(1+z)\,, \tag{7}$$

where k is the same as in (2). This tired-light relation, is seen in figure 1 to diverge upward from the $1/z$ Hubble relation at high redshifts.

The third cosmology tested is the no-evolution, Friedmann expanding universe model having a $q_0 = 0$ deceleration parameter and a $\Lambda = 0$ cosmological constant. The θ–z dependence for this model is given as [21]:

$$\theta = \frac{k(1+z)^2}{z(1+z/2)}\,, \tag{8}$$

where k is again constrained to be the same as in Equation (2). This appears in Figure 2 as the upper most diverging solid line. This prediction is almost indistinguishable from that of a cold dark matter (ΛCDM) cosmology with $\Omega_M = 0.3$ and $\Omega_\Lambda = 0.7$ which Goldhaber, et al. [22] have used in interpreting their supernova data.

In a Friedmann model, the value of the deceleration parameter is equal to the value of the cosmological density parameter σ_0 which is determined from estimates of the mean mass density of the universe ρ_0 according to $q_0 = \sigma_0 = 4\pi G\rho_0/3H_0^2$. However, based on a variety of observations it may be concluded that unless "hidden mass" is present, q_0 should have a relatively low value. An early study by Gott et al. quotes a value of about 0.03 for q_o [23]. Bahcall cites a somewhat higher value of 0.16 ± 0.05 [24]. Consequently, it is permissible to consider q_0 to be essentially zero in the absence of an ad hoc hidden mass assumption and to adopt Relation (8) as being a reasonable representation of a no-evolution, expanding universe model.

To test the fit of these three models, a variance-like statistic ΔV was determined for each model curve as follows. The observed θ value was subtracted from the model predicted θ value for that redshift, these $\Delta\theta$ residuals were normalized relative to the θ value predicted by Relation (6), each normalized residual was then squared, and all values were summed together for the 94 data points giving:

$$\Delta V = \sum (\Delta\theta_i/\theta_i)^2\,. \tag{9}$$

The "variances" determined in this way for the linear $\theta \propto 1/z$ model, the tired-light model, and the expanding universe model were found to be in the ratio 1:1.2:5.0. Repeating the calculation for the 31 most distant clusters ($z > 0.1$) give relative variance ratios of 1 : 1.4 : 10. Thus due to their lower variances, the static, Euclidean cosmologies are significantly favored over the $q_0 = 0$ expanding universe model. The linear $1/z$ relation exhibits a slightly lower variance than the tired-light model. However, at the high-z end of the sample the difference between these two predictions is so slight compared to the intrinsic scatter of the sample that it is better to say that they fit the data about equally well.

Increasing the value of q_0 does not help the expanding universe model since this causes the θ–z curve to move upward at high z, not downward. Working with 88 θ–z data points, a subset of the Hickson-Adams data base, Hickson finds that a Friedmann model having a cosmological constant equal to zero ($\Lambda = 0$) makes its best fit to the data for a *negative* q_0 value of $q_0 = \sigma_0 = -0.9 \pm 0.2$ [19]. However, such a Friedmann model is unrealistic since it requires a negative mass density, i.e., that the gravitational force field be repulsive, rather than attractive. Relaxing the restriction that Λ be zero does not help either. For example, Hickson and Adams show that for a positive deceleration parameter, $q_0 > 0$, their data make the best match to a $\Lambda \neq 0$ model having an even greater negative mass density of $\sigma_0 = -4.3$ [22]. By comparison, the ΛCDM cosmology of Goldhaber, et al., mentioned earlier, predicts a far smaller negative mass density ranging from only 0 to -0.2. It approximates closely to the $q_0 = 0$ model and hence also does not fit as well as the tired-light cosmology.

One way to save the expanding universe cosmology is to introduce the assumption that galaxy clusters were larger at earlier epochs and that they have been gradually collapsing. However, Hickson finds that expected rates of cluster collapse would succeed in changing q_0 by only ≈ 0.1, far short of the required amount [19]. It has been speculated that the Friedmann model's apparent discrepancy with the data could be resolved if dynamic friction effects are sufficiently intense in very high density clusters so as to lead to shorter cluster relaxation times [22]. But this proposal is countered by Tifft's observation that galaxies show relatively weak gravitational interaction with their more distant cluster neighbors [25]. Thus, unless special *ad hoc* evolutionary assumptions are introduced, whose basis is questionable, it must be concluded that the expanding universe postulate is not consistent with the data. A static, Euclidean universe exhibiting tired-light behavior and minimal cluster evolution, then comes out as being the better choice on this particular test.

Another kind of angular size redshift test judges distance based on the apparent angular size of the galaxy. Buitrago, et al. [26] and Trujillo, et al. [27] have both measured the radii of massive galaxies ($M > 10^{11}\ M_\odot$). Both samples combined comprise about 913 galaxies that extend out to redshift z = 3. They classify galaxies in their sample as being either disc-like or spheroid-like, the disc-like fraction, having a Sersic ellipticity index of less than 2.5, comprises about three fourths of the sample. They also divide their galaxy sample into a number of redshift categories and for each redshift group determine an average angular effective galaxy radius which they normalize to the effective angular radius of a sample of nearby galaxies in the range z = 0 to 0.2. Table 1 combines the data from both authors for disc-like galaxies. This includes data from the redshift categories of Trujillo: z = 0.2 – 0.5, 0.5 – 0.8, 0.8 – 1.1, 1.1 – 1.4, 1.4 – 1.7, and 1.7 – 2.0, and of Buitrago: z = 1.7 – 2.0, 2.0 – 2.5, and 2.5 – 3.0.

Compared to the disc-like galaxies in the sample, the spheroidal galaxies exhibit much greater size evolution, i.e., increase in size with decreasing redshift, which also happens to be consistent with the predictions of the SQK physics methodology; see LaViolette, Ch. 8 [28]. Since size evolution is seen to be minimal for disc-like galaxies, data for such galaxies is more appropriate as an angular-size-redshift statistic for the present cosmology test which compares cosmologies with evolution assumptions omitted. To remove the ΛCDM cosmology assumption built into these reported values, which assumes $H_o = 70$, $\Omega_M = 0.3$, $\Omega_\Lambda = 0.7$, the normalized angular effective radii for disk-like galaxies (Table 1, column 2) were multiplied by the angular size distance for z = 0.1, i.e., d = 1.241 billion light years, and divided by the angular size distance corresponding to that particular redshift group.

A log-log plot of this data is presented in Figure 2 for comparison to three cosmology models. The straight solid line represents the prediction of a static Euclidean Hubble model having a linear redshift-distance variation, $\theta \propto 1/z$. The curved solid line represents the prediction of a static,

Table 1
Radius of Disk-like Galaxies vs. Redshift

(1)	(2)
z	r/r_o
0.1	1
0.35	0.9
0.65	0.69
0.95	0.67
1.25	0.61
1.55	0.48
1.85	0.38
1.85	0.44
2.25	0.39
2.75	0.31

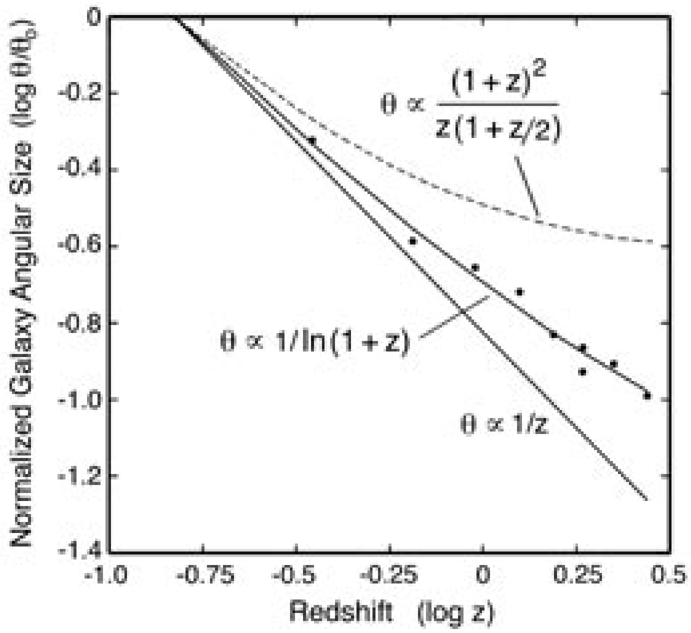

Figure 2. Log normalized galaxy size vs. log redshift for massive disc-like galaxies.

tired-light, Euclidean universe with no size evolution, $\theta \propto 1/\ln(1 + z)$. The upper curved dashed line represents the no-evolution, Friedmann expanding universe model of Equation (8) which assumes a $q_0 = 0$ deceleration parameter and a $\Lambda = 0$ cosmological constant. Of these, the tired-light prediction is seen to make almost an exact fit to the data trend. Hence we arrive at the same conclusion as for the previous angular-size redshift test, but using an entirely different angular size statistic, namely galaxy radius rather than the angular separation of galaxies in a cluster. Lopez-Corredoira [29] has performed a study of galaxy angular radii over the redshift range z = 0.2 to 3.2 and also concludes that the angular sizes for disc-like galaxies conform closely to a static, tired-light cosmology with no size evolution.

Yet another type of angular-size-redshift test utilizes radio lobe separation in double-lobed radio galaxies and quasars as the angular statistic [30,31]. Ubachukwu and Onuora conducted

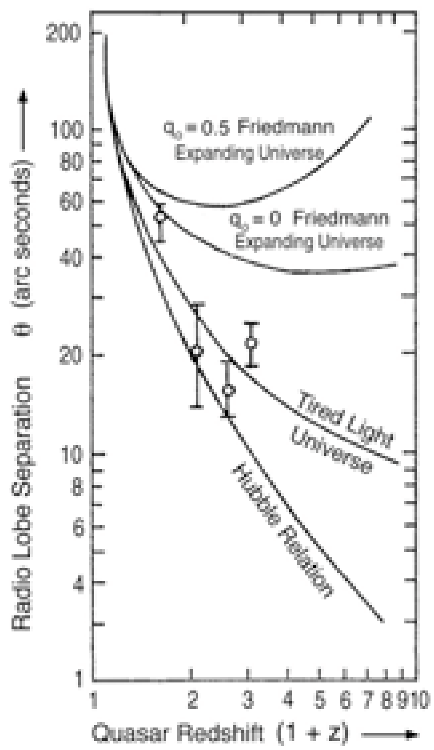

Figure 3. Median values of the angular separation of double radio lobes in quasars plotted against quasar redshift 1 + *z*. The angular data is corrected for projection effects arising from the host galaxy's inclination to the line of sight. The tired-light model is seen to make a far superior fit to the data (after Ubachukwu and Onuora [32]).

one such test which compares quasar data extending up to $z = 2.1$ to various cosmological models; see Figure 3 [32]. They concluded that the static-universe tired-light model gave the best fit. The most favorable no-evolution Friedmann model which assumes a minimally curved space with $q_0 = 0$ predicts angular separations that are high by a factor of two at $z = 2$. For the Friedmann expanding universe model to attain a fit similar to the tired-light model, strong evolutionary effects would need to be introduced. That is, it would be necessary to invoke the *ad hoc* assumption that galaxy radio lobes had larger angular separations in earlier epochs and have been gradually decreasing in size over time. However, not only does this further increase the complexity of the expanding universe cosmology vis-a-vis the tired-light cosmology, it also requires that one accept that galaxy cluster size and galactic radio lobe separation, which normally would not be expected to be related, both change over time in just the right manner so as to allow the expanding universe model to make a good fit to the data! One might indeed be justified in asking the question that Kellerman [31] has asked namely, "Are we drawing too many epicycles?" The law of parsimony would instead point to the tired-light model as the candidate model that is capable of explaining the greatest amount of data with the fewest assumptions.

Hoyle [33] has noted that Friedmann models having $q_0 > 0$ predict a minimum angular size at some finite *z*, with the expectation that observed angular size should increase with increasing *z*. For example, a $q_0 = 0.5$ Friedmann model predicts a minimum radio lobe separation of around 1 arc minute, but no such minimum is observed in the data; see Figure 3. Sandage [34] has noted that this minimum has been sought for in many observational tests but has not been found. He points out that this failure is considered by cosmologists to raise serious doubts as to whether the cosmological redshift is indeed due to a real expansion of space.

Many others have noted that the expanding universe hypothesis makes a poor fit against angular size redshift test data in both the radio, near infrared and visible parts of the spectrum. These include López-Corredoira [35], Kapahi [36], Andrews [37], Nabokov, et al. [38], and Lerner [39].

The Hubble Diagram Test. The Hubble diagram test uses galaxy apparent magnitude, m, as a distance indicator for comparison to galaxy redshift. Figure 4 plots the R-band magnitudes and redshifts of galaxies that rank brightest in their cluster. The data, consisting of 83 galaxies, is taken from Table V of the 1978 paper of Kristian, Sandage and Westphal [40]. This Hubble diagram data set is compared to the no-evolution, tired-light cosmology (solid line) and to the $q_0 = 0$ and $q_0 = 0.5$ no-evolution expanding universe predictions (dashed lines). As seen, the tired-light model makes the better fit at the high z end of the graph.

The m-z curve plotting the no-evolution tired-light prediction is taken from the following equation:

$$m = 5 \log \{ [\ln(1 + z)](1 + z)^{½}] \} + C , \qquad (10)$$

where C = 19.8. The ln (1 + z) term here is derived by taking the tired-light relation $r = (1/\beta) \times \ln(1 + z)$ and substituting it into the magnitude relation $m = 5 \log r$ + constant, with the $1/\beta$ term being absorbed into the constant. In the tired-light model galaxy dimming is due to the spontaneous diminution of photon energy with apparent luminosity varying as $\ell = L / 4\pi r^2(1 + z)$, where L is absolute luminosity [41]. Knowing that $m \propto -2.5 \log \ell$, this requires the introduction in Equation (10) of the second $(1 + z)^{½}$ term, the $L / 4\pi r^2$ being absorbed into the

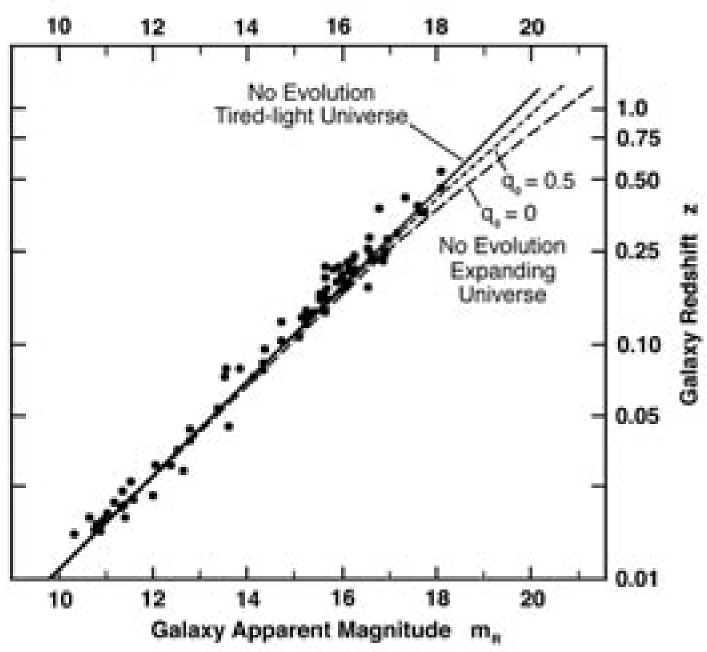

Figure 4. The Hubble diagram charts the R-band magnitude-redshift coordinates for the brightest galaxies in each of 86 clusters; data for $z < 0.7$ is taken from Kristian, Sandage and Westphal (1978) [40]. Distance from Earth increases from left to right. The data is compared with the no-evolution tired-light cosmology (solid line), the $q_0 = 0.5$ no-evolution expanding universe cosmology (short dashes), and the $q_0 = 0$ no-evolution expanding universe cosmology (long dashes).

constant.*

In the expanding universe cosmology, galaxy dimming is due both to the Doppler redshift effect and to relativistic time dilation, the latter effect causing the emitted stream of photons to spread out in time. It is also affected by the distances modeled for the galaxies, which differ from those in the tired-light cosmology. The m-z curves that plot the standard no-evolution Friedmann model predictions are based on the equations of Mattig given as:

$$m = 5 \log [z (1 + \frac{z}{2})] + C \quad (\text{for } q_0 = 0) \tag{11}$$

$$m = 5 \log \{ 2 [1 + z - (1 + z)^{1/2}] \} + C \quad (\text{for } q_0 = 0.5), \tag{12}$$

where C = 19.8. [42] At a given redshift, these expanding universe cosmologies predict magnitudes fainter than the tired-light model.

The Galaxy Number Count Magnitude Test. Another kind of cosmological test that has been used to check the predictions of cosmological models compares the differential number count, dN/dm (the number of galaxies per square degree falling in a given apparent magnitude interval dm), to the average magnitude of that interval, m. Figure 5 displays K-band data obtained up to the 25th magnitude that has been taken from Figure 1 of the paper by Totani, et al. [43] This is compared to the no-evolution, tired-light prediction (solid line), which is seen to make a relatively good fit to the data trend. The number counts for the tired-light prediction were reduced in accordance with the selection effect correction which Totani et al. give in Figure 6 of their paper. The dot-dashed line shows the uncorrected tired-light prediction.**

The expanding universe alternative predicts an additional dimming of galaxy apparent magnitude since it incorporates an additional factor of $(1 + z)$ due to the relativistic time dilation effect (the Hubble "number effect"). The $q_0 = 0.5$ expanding universe prediction is plotted as the dashed line and the accelerating expanding universe cosmology modeled with $\Omega_M = 0.2$ and $\Omega_\Lambda = 0.8$ is plotted as the dotted line. Both are taken from Figure 9 of Totani's paper and include corrections for data selection effects [43]. The $q_0 = 0$ cosmology, not shown, would plot somewhat below the accelerating universe prediction. The $q_0 = 0.5$ expanding universe cosmology which Lubin and Sandage have picked as their favored cosmology on the Tolman test, falls substantially below the dN/dm data trend on the galaxy-number-count-magnitude test. It can be made to fit the data only by introducing the ad hoc assumption that space was more densely populated with galaxies in earlier epochs and that galaxy number density has been rapidly decreasing over time. For example, galaxies would have had to be 10 times more abundant at $m_K = 22$ ($z \approx 2.3$, $t \approx 10$ billion years lookback time) as they are at present. But then this raises the question whether it is justified to assume that the spatial population density of galaxies has been varying in just the right manner so as to allow the expanding universe model to make a good fit to the data, given that the tired-light cosmology already makes a reasonably good fit. The accelerating universe model makes a better fit to the number count data but still falls below the data trend. Moreover this cosmology emerges as the less desirable alternative on the Tolman surface brightness test, which is considered next (Section 5), since it requires a very large amount of luminosity evolution to secure a good fit on that test ($\approx$1.8 magnitudes at $z = 0.9$).

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* This corrects an error in my 1986 *Ap.J.* paper which mistakenly omitted this second term in deriving the tired-light *m-z* relation for the Hubble test.

** The dN/dm vs. m dependence for a static, non-evolving Euclidean universe with no redshift dependent attenuation is represented by the sloping straight line in Figure 6. In such a universe the integral galaxy number count N would increase with the cube of distance, r: $N \propto r^3$. Galaxy brightness would decrease according to the inverse square of distance or, expressed in terms of apparent magnitude m, it would vary as: $m \propto 5 \log (r/10)$, or $r \propto 10^{0.2m}$. Combining these relations gives: $N \propto 10^{0.6m}$, or similarly for differential counts: $dN/dm \propto 10^{0.6m}$.

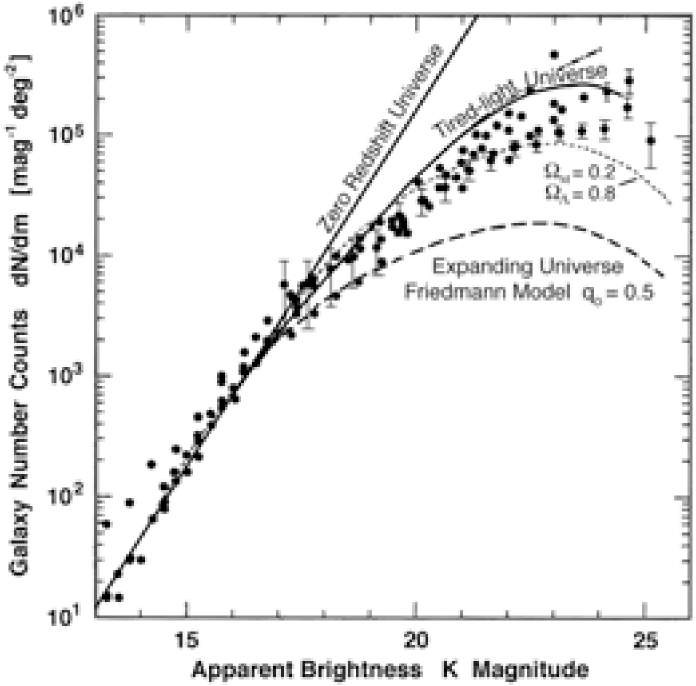

Figure 5. Differential galaxy number counts plotted against uncorrected galaxy K magnitude. Superimposed for comparison are the no-evolution, tired-light model corrected for data selection effects (solid line), the tired-light model with no correction (dot-dash line), the no-evolution, Ω(0.2,0.8) accelerating universe model with selection effect correction (dotted line), and the no-evolution, q_0 = 0.5 expanding universe model with selection effect correction (dashed line).

The Tolman Surface Brightness Test. The Tolman surface brightness test, devised in 1930 by Richard Tolman, provides another way of distinguishing the predictions of alternative cosmologies [44]. This test uses galaxy surface brightness, S, as a distance indicator for comparison to galaxy redshift. The expanding universe model predicts that surface brightness should vary as the inverse fourth power of redshift, $S \propto (1 + z)^{-4}$, one factor of $(1 + z)$ being due to relativistic time dilation, one factor being due to the Doppler redshift effect, and two factors being due to relativistic geometrical aberration [45]. The tired-light model, on the other hand, predicts an inverse surface brightness-redshift relation of $S \propto (1 + z)^{-1}$ involving just one factor of $(1 + z)$, the decline in surface brightness being due exclusively to the photon energy loss that produces the nonDoppler redshift. Consequently, the tired-light model predicts that galaxy surface brightnesses should appear far brighter than the expanding universe alternative.

In the present discussion, we consider a version of this test which Lubin and Sandage conducted in the optical part of the spectrum [46–48, 41]. Their test compared the expanding universe and tired-light cosmology predictions to the average surface brightnesses of galaxies in three high-redshift galaxy clusters having redshifts of 0.76, 0.9, and 0.92. In performing their cosmology test, they commit the same "sin" that many other cosmologists have done, which is to add evolutionary corrections to their data to allow their favored expanding universe model to make a good fit. Then once these corrections are added, they plot also the tired light model, noting that it lies further from their data set and, on the basis of this one Tolman test, they claim to have disproved the tired-light model, stating that their "Hubble Space Telescope data rule out the tired light model at a significance level of better than 10 σ".

Lubin and Sandage had considerable flexibility in adjusting the expanding universe model to fit their data. On the one hand, they had a range of expanding universe cosmologies available to them, differing from one another by the value of the deceleration parameter (e.g., q_0 = 0, 0.5, or 1). On the other hand, for a given cosmology, they had a wide range of galaxy luminosity evolution models to choose from to close the gap between theory and observation on the assumption that galaxies were brighter in primordial times to varying extents. For example, at a redshift of z = 0.9 in the R-band, they could make corrections ranging from 0.6 up to 1.7 magnitudes, a threefold difference [41]. With this wide range, they chose the q_0 = 0.5 cosmology as their best alternative and noted that closing its prediction gap required an assumed luminosity correction of ΔM (R) = 0.99 mag for the R-band data for the z = 0.92 cluster, and ΔM (I) = 0.39 mag and 0.44 mag for the I-band data for clusters at redshifts z = 0.76 and 0.9. But because of the flexibility involved in this model fitting, it is inappropriate for them to claim that they were checking the validity of the expanding universe cosmology relative to the tired-light model.

They cite the paper by LaViolette [8], which concluded that the tired-light alternative makes a better fit to data on four cosmology tests, and state that their results invalidate those earlier findings. However, to invalidate those findings, and thereby make a legitimate claim against tired-light cosmologies, they should have plotted their favored expanding universe model against data on the four tests that LaViolette had considered. If they had done so, they would have discovered very quickly that their model does not fare well on those other tests.

Their best approach would have been to use the method advocated by LaViolette [8] and plot both a no-evolution expanding universe model and a no-evolution tired-light model against their data set. When this is done and the alternatives are compared to their R-band surface brightness data, the no-evolution, tired-light cosmology is actually found to lie *closer* to the data trend than their no-evolution, expanding universe cosmologies, the tired-light model deviating by ≈0.4 magnitudes at z = 0.92, as compared with 1 magnitude for the q_0 = 0.5 cosmology and 1.2 magnitudes for the q_0 = 0 cosmology. Here the tired-light model predicts surface brightnesses that are slightly higher than the data trend, while the expanding universe cosmology predicts surface brightnesses substantially below the data trend. When compared to the I-band surface brightnesses data, the tired light prediction in this case lies further away, deviating by 0.89 magnitudes at z = 0.90, as compared with 0.45 and 0.65 magnitudes for the q_0 = 0.5 and q_0 = 0 expanding universe cosmologies.

However, their study has an inherent bias in that they chose galaxy clusters which are much less luminous than the average galaxy cluster. For example, compared to the distribution in luminosities of either the 102 clusters tabulated in the paper by Kristian, Sandage and Westphal [40] or the 119 clusters tabulated in the paper by Postman and Lauer [49], the three clusters that Lubin and Sandage had used in their surface brightness test lie near the faint limit of those luminosity ranges [50]. If the data points for the first ranked galaxies from each of the three high-z clusters analyzed by Lubin and Sandage are compared against the first ranked galaxies of the Kristian-Sandage-Westphal data set plotted in figure 4 above, they are seen to be about half a magnitude dimmer than the data trend for the other first-ranked galaxies in that data set. In performing their study, if they had instead selected brighter high-z clusters whose galaxies had more typical absolute magnitudes, the resulting data would no longer have been too faint relative to the no-evolution tired light model prediction. For example, if they had used clusters whose average R-band magnitudes were 0.4 magnitudes more luminous, the no-evolution tired-light model would have made a very good fit to the data, while the fit of the expanding universe cosmology would have worsened by 0.4 magnitudes. To match the data, the expanding universe models would then require much greater evolutionary corrections of 1.4 magnitudes for the q_0 = 0.5 cosmology and 1.6 magnitudes for the q_0 = 0 cosmology, bringing them near the range limit allowed by the Bruzual-Charlot luminosity evolution models. The no-evolution tired-light model would then emerge as the superior choice. A similar adjustment to the I-band data would similarly improve the fit of the tired-light model while at the same time worsen the fit of both expanding universe cosmologies. As in the R-band data, the tired-light model here ends up making the better fit to the data.

Also Lubin and Sandage do not introduce any corrections for light extinction due to a combination of galactic and intergalactic dust. However, both Aguirre [51,52] and Goobar et al. [53] argue that light extinction by intergalactic dust may be as high as 0.2 magnitudes at $z = 0.5$ in the case of an open universe cosmology with $\Omega_M = 0.2$ ($q_0 = 0.1$). According to Model B of the paper by Goobar et al. (Figures 9 and 10 in their paper) galaxies at a redshift of $z = 0.92$ would be dimmed by ≈0.33 magnitudes in the R band and by ≈0.3 magnitudes in the I band. Also Rowan-Robinson has proposed internal extinctions of 0.33 magnitudes for galaxies in the redshift range $z = 0.15$ to 0.8 [54]. To correct the data for dimming due to assumed dust extinction, the R-band surface brightnesses which Lubin and Sandage report for galaxies in the $z = 0.92$ cluster should be increased by 0.4 magnitudes and the I-band surface brightnesses they found for galaxies in the $z = 0.76$ and $z = 0.9$ clusters should be increased by 0.36 magnitudes, the dust extinction correction in the I-band being assumed to be slightly smaller.

Given that Lubin and Sandage used clusters in their study that are comparatively dim, it does not seem unreasonable to assume that dust extinction may be responsible, at least in part, for their faintness. With these extinction corrections, the data trends move upward by an amount sufficient to allow the no-evolution tired-light prediction to make a good fit to the R-band data set, while increasing the discrepancy of their expanding universe predictions. Even against their I-band data, which is about 0.4 to 0.5 magnitudes dimmer than their R-band data, the tired-light cosmology with dust extinction makes a better fit than the $q_0 = 0$ cosmology which lies 0.7 magnitudes further from the data trend. To be fair, the tired-light cosmology should be compared to the $q_0 = 0$ expanding universe cosmology since the $q_0 = 0.5$ cosmology requires the introduction of unsupported assumptions about the existence of hidden mass.

As mentioned earlier, to fit the Tolman surface brightness test data (with the dust extinction correction included), the expanding universe cosmology requires luminosity evolution corrections that brighten the $z \approx 0.92$ galaxies in the R-band by ≈1.6 magnitudes for $q_0 = 0$ or by ≈1.4 magnitudes for $q_0 = 0.5$. Applying these corrections to the Hubble diagram (figure 4) causes the expanding universe cosmology predictions to become brighter than the no-evolution tired-light cosmology prediction by 0.7 and 1 magnitude respectively hence to lie far to the left of the data trend. Thus considering both the Tolman and Hubble diagram tests together, the no-evolution tired-light cosmology is seen to make a more consistent fit to the high-z data.

Lubin and Sandage [41] argue that standard luminosity evolution models require that galaxies should have been brighter in primordial times and that such a luminosity evolution assumption would move the tired-light model prediction away from the data trend, instead of closer, to the model's detriment. However, their desire to apply the same luminosity evolution assumptions to the tired light model are poorly founded. For tired-light cosmologies require nonstandard models of stellar evolution. Indeed, when one adopts the tired light model as the correct alternative, galaxy distances and look-back times must substantially increase in comparison with distances predicted by the expanding universe cosmology, which necessarily affects the rate of galaxy evolution. Also static universe cosmologies lead in the direction of adopting a mechanism of *continuous matter creation*, which would drastically alter any assumptions about primordial galaxy evolution.

Lerner [55] is critical of Lubin and Sandage's claim that Tolman test data refutes the static universe, tired-light model. He has performed a repeat Tolman test whose data set includes galaxies with redshifts of up to $z = 6$ and concludes that the data is clearly compatible with the nonexpanding universe hypothesis and clearly incompatible with the expanding hypothesis, even when reasonable brightness evolution is included. Also Lerner, et al. [56] have conducted a

Tolman test using UV surface brightnesses of galaxies having redshifts as high as z ~ 5 and have concluded that their data are consistent with a static universe Euclidean tired-light model, contrary to the conclusions of Lubin and Sandage. Andrews [57] has also compared the expanding universe model and the static universe, tired-light model and has concluded that the data conclusively prove that the universe is static and not expanding. Furthermore both López-Corredoira [58] and Crawford [59] have been critical of the way the Lubin and Sandage study was performed.

Before leaving the subject of the Lubin and Sandage study, it is important to point out one of their misstatements in regard to tired-light theories. In their paper, they incorrectly suggested that the tired-light mechanism proposed by LaViolette [8] accomplished its photon energy loss through photon scattering which would cause the images of distant galaxies to blur. This is far from the truth. The tired-light mechanism proposed there involves a nonconservative photon energy loss that is predicted by the basic field equations of SQK and not through any kind of photon scattering; see Section 4 below for a further discussion.

As we have seen, in the multi-test comparison presented here, the tired-light model makes a more consistent fit to the data on six different cosmology tests. If we include the differential number count test made at radio wavelengths which was discussed in the earlier paper [8], this brings to seven the total number of tests favoring the tired-light model. Regarding the latter test, Edward Wright[60] has claimed that the no-evolution tired-light cosmology should be ruled out because it does not make a good fit to the small dip in the data trend evident for the number counts of the brightest sources, a data anomaly that comprises *one hundredth of one percent* of the total number of sources. Kellermann and others, however, have questioned whether this minor number-count deficiency of bright sources is even real, suggesting that it may be an artifact of the poor sampling statistics in that part of the data set which samples nearby galaxies. By most standards, a model that fits 99.99 percent of a data trend would be considered to be a desirable choice, especially when compared with the non-evolving $q_0 = 0$ Friedmann cosmology which fits only a small fraction of the data points ($<10^{-4}$). In response to a letter pointing out to him that his refutation of the tired-light model is supported by very few data points, he responded that "a valid theory must fit all the data, not just 99.99 percent of it" [61]. But, given that number count data is inherently stochastic, it is meaningless to distinguish 99.99 percent from 100 percent.

In summary, in interpreting the cosmology tests presented above, it is important to keep in mind that it is best to plot non-evolving cosmological models so that their performance against the various data sets can be most candidly judged. That is, the discrepancy of each model relative to the data trend becomes most apparent in the absence of evolutionary adjustments. This should not be taken to imply that galaxies do not evolve over time. Indeed, evolution is expected to occur in both the conventional big bang cosmology and to a lesser extent in the tired-light cosmology (e.g., the SQK version examined here) . Although due to the limitations inherent in knowing how much evolution actually takes place, it is best to introduce evolutionary corrections only as a last resort and to choose as the most valid model the one that requires the least correction to conform to the data. As we have seen, such a criterion leads to the tired-light model as the best alternative.

<u>Supernova Data: Evidence for Time Dilation?</u> The expanding universe cosmology hypothesizes that high redshift galaxies are receding from us at close to the speed of light and that, due to the relativistic time dilation effect, clocks in those galaxies should be ticking slower or alternatively that supernova explosions should be taking longer to occur. Astronomers associated with the Supernova Cosmology Project (SCP), Goldhaber, et al. [62], have analyzed the durations of supernovae out to a redshift of 0.83 and claim that their results indicate that supernova explosions in distant galaxies are time-dilated in accordance with the predictions of the

expanding universe cosmology. For example, Figure 6, taken from their 2001 paper, plots the light curve width factor *w* (supernova duration) as a function of redshift for 18 nearby type IA supernovae and 42 high-redshift distant supernovae. This shows light curve width increasing with redshift as 1 + *z*, as would be expected if a time dilation effect were present. They claim this is best fit by a particular ΛCDM expanding universe cosmology having cosmological parameters $\Omega_M = 0.28$ and $\Omega_\Lambda = 0.72$.

Furthermore they contend that their analysis refutes the static universe tired-light model, which predicts that supernova duration is independent of redshift since time everywhere would flow at the same rate. Here they cite the paper by LaViolette [8] as a study which their results purportedly refute. Again, like Lubin and Sandage, they make a substantial overstatement. For, if they wished to refute the conclusions of that paper, they should have plotted both their favored expanding universe cosmology and the no-evolution, tired-light model on the four cosmology tests discussed there to see which fairs best. If they had done so, they would not have made such an assertion.

But the dependence of light-curve width on supernova redshift which their data shows is likely an artifact of data selection bias, which is why a question mark has been added in Figure 6. In particular, this study is handicapped by the Malmquist bias, the tendency to preferentially detect intrinsically bright objects. As Phillips [63] has pointed out, searches for distant type Ia supernovae (z > 0.2) will clearly favor the discovery of superluminous events and this could introduce a significant Malmquist bias into the survey. At higher redshifts our telescopes necessarily sample a much greater volume of the universe and hence a much greater number of supernova-producing galaxies. In the redshift range 0.4 to 0.5, one would be surveying a volume of space that was 34 times larger than that of the local neighborhood which spans the redshift range 0 to 0.1. Going out to a redshift range of 0.7 to 0.8, this observational volume increases to 66 times greater than the local volume. Hence because the high redshift domain subtends a very large volume of space, compared with the local environment, there is a much greater probability of observing extremely luminous high-energy supernovae, which normally occur very rarely. Since the light curve of such supernovae persist much longer than those of less luminous supernovae [64], high-z supernova searches will be skewed to discovering high-luminosity, long-

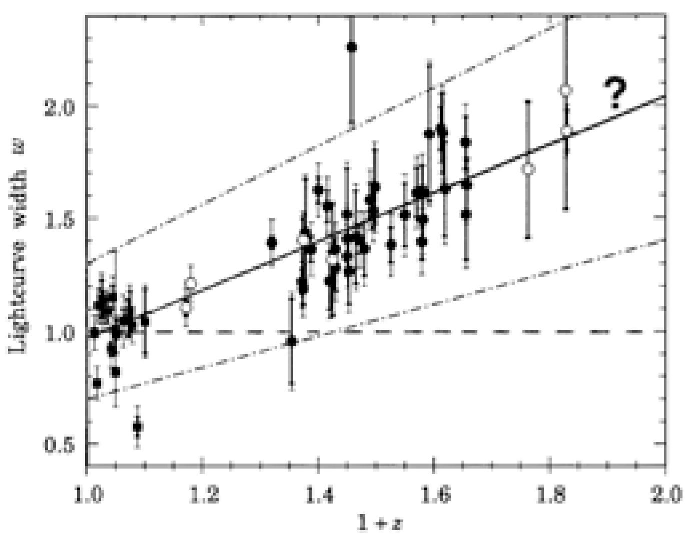

Figure 6. Observed supernova light curve width (w) vs. redshift (1 + *z*) for an expanding universe with cosmological parameters $\Omega_M = 0.28$ and $\Omega_\Lambda = 0.72$ (after Goldhaber, et al., Fig. 3). The trend line may be an artifact of selection effect biases rather than an indication of time dilation.

duration supernovae, giving exactly the result seen in Figure 6 even when time dilation is left out of the picture.

Moreover, shorter duration supernovae, being less luminous at maximum light, would not be as easily seen, especially at high redshifts where both the greater distances and greater dimming due to photon energy loss conspire to create conditions adverse to their detection. Hence there would be a tendency for supernovae with lower w values to pass undetected resulting in flux limited selection. Such flux limitation could explain why the SCP data set contains progressively fewer supernovae at progressively higher redshifts where instead progressively more supernovae should be observed due to the progressive increase in the volume of surveyable space. For example, the SCP data set contains 24 supernovae in the redshift range of 0.3 to 0.5; 13 supernovae in the redshift range of 0.5 to 0.66 (defining a volume of space 30% larger); and only 3 supernovae in the redshift range of 0.66 to 0.85 (a 210% larger space volume). It is not a question of whether this data set might be flux limited. It is clear that it *is* flux limited since there is no other explanation that could account for this kind of number drop off. Standard theories of galaxy evolution cannot explain this drop off since such theories predict that high-z galaxies were bluer and had greater star formation rates with more frequent supernovae.

The occurrence in their data of a supernova at $z = 0.46$ with a width factor of 2.26 provides evidence that some supernovae can have very long light curve durations, more than three times greater than what the time dilation assumption would predict; see the outlying data point in Figure 6 at $1 + z = 1.46$. The width of this supernova even surpasses the widths of the two supernovae having almost twice its redshift. Rather than interpreting this as a peculiar supernova that is not in the same class as the rest of the sample, we might simply be observing a supernova that is at the upper end of the spectrum in terms of luminosity and duration. Moreover, a decade after this SCP study was published, Quimby et al. [65] reported discovering supernovae that are an order of magnitude brighter than type I supernovae and that take much longer to fade away. If we were to wait long enough, such supernovae would be seen also in the local low-z neighborhood.

Although there is a tendency for brighter supernovae to last longer and to decline slower, supernovae having the same peak absolute magnitude can nevertheless have widely varying light curve decline rates, as represented by the parameter $\Delta m_{15}(B)$, the amount that the supernova's B-band apparent magnitude decreases from supernova maximum by the 15th day. In Figure 7 of his paper, Rowan-Robinson [54] has plotted $\Delta m_{15}(B)$ versus peak absolute magnitude for *local* supernovae that were first observed before their maximum and finds a large amount of data point scatter. For the same absolute magnitude, $\Delta m_{15}(B)$ can vary by up to $\pm 30\%$. If we were to study a sample of supernovae collected over a much longer time period, say over two centuries, we would most likely find an even greater amount of data scatter perhaps as large as $\pm 50\%$ since the more rarely occurring, brighter and longer lasting supernovae would have more of a chance of being seen. So to avoid a selection effect bias, a larger data scatter value of about $\pm 50\%$ would be more appropriate when interpreting data observed at high redshifts. Given this amount of data scatter and a flux limitation to observing at high redshifts, one is left to conclude that the high-z data published by Goldhaber et al. may be significantly biased toward the high width factor end of the data scatter range and could be plotting width factors that are as much as 50% too high compared to the norm.

A related problem with the SCP study is that the local neighborhood is under sampled. To get a fair sampling of supernova light curve widths in the local environment that would compare in a fair manner with what is seen at high redshifts, we would need to observe for a total of 260 years, or 65 times longer than the four-year period over which Goldhaber et al. collected their data. If the SCP group were to extend their study of the local environment for a few more centuries, quite likely they would discover supernovae that had durations just as long as the one's they observed at high redshift. Adding in these potentially observable long duration supernovae would shift the light curve width data upward toward higher *w* values.

In summary, due to the comparatively short time span for their search for local supernovae, the Supernova Cosmology Project's data set at low redshifts is biased toward charting lower *w* values. At the same time, due to flux limited sample selection effects their data set is biased at high redshifts toward charting higher *w* values. Together, these two effects conspire to produce the observed upward sloping trend line. With proper sampling, it is expected that the data would yield a flat trend line with no evidence for time dilation.

In section 4 of their paper, Goldhaber et al. briefly acknowledge that their supernova data might suffer from such a selection effect bias. David Crawford has also noted that the SCP supernova data set may be biased by selection effects that could affect the outcome of the study's time dilation conclusions [66]. John Masreliez, who is also a critic of the study's conclusions also makes a convincing case that the SCP supernova sample is flux limited and that selection effects could entirely account for the $1 + z$ rise in supernova light curve width factor [67,68]. He also notes that the positive slope in the *z*-*w* relation arising from selection effects should have added on to the slope predicted by the $1 + z$ time dilation effect, if in fact it were present, to produce a slope much steeper than 1. Since such a steep upward slope is not seen, we are left to suppose that there is no $1 + z$ correlation and that the slope is due to other factors, e.g., selection effects fortuitously mimicking the slope predicted by the expanding universe hypothesis.

One indication that we live in a cosmologically stationary, non-time-dilated universe comes from studies of gamma ray bursts. These are believed likely to be produced by supernova explosions [69]. So, if the light curves of distant supernova were in fact being time dilated, one would expect to see a similar effect in the duration of gamma ray bursts, the more distant, more highly redshifted gamma ray bursts being expected to last longer on the average. But this is not seen to be the case. It has now been established that X-ray bursts are essentially the same phenomenon as gamma ray bursts, except that they originate from much greater distances, the gamma rays in the original burst being cosmologically redshifted down to the X-ray energy band. However, the X-ray bursts are found to last about as long as gamma ray bursts [70].

Another study examined the durations of 195 Swift detected gamma ray bursts ranging out to a redshift of 8.1, yet found no evidence of time-dilation broadening in the light curves [71]. The data from this study, which is presented here in Figure 7, shows no evidence of any correlation between redshift and duration. Crawford has also examined gamma ray burst data and found no evidence for any time dilation of their light curves [72]. Quasar light curves also show no evidence of time-dilation broadening. A study published in 2010 performed a Fourier analysis of the light curves of 800 quasars which were monitored on timescales from 50 days to 28 years to see if more distant quasars exhibited longer duration outbursts [73]. Low redshift quasars ($z < 1$) were compared to high redshift quasars ($z > 1$), but no evidence for time dilation was seen. The results of these various studies not only support the tired-light prediction but also confirm the contention that the time dilation conclusions of the Goldhaber supernova study are flawed [74].

As stated earlier, a particular cosmology cannot be proven or disproved on the basis of a single cosmology test. We must take a more holistic approach and view a cosmology's performance on several tests simultaneously. On the one hand, we have the supernova-light-curve-width test of Goldhaber et al. whose results are questionable due to selection effect biases and which favors a specific accelerating universe ΛCDM cosmology that does not perform well on other cosmology tests. On the other hand, we have the angular-size-redshift test, Tolman test, Hubble diagram, and number count magnitude test, all of which favor the tired-light cosmology which consistently makes a better fit to the data. The expanding universe hypothesis may be considered plausible only if it is modified to include specific assumptions regarding the evolution of galaxy cluster

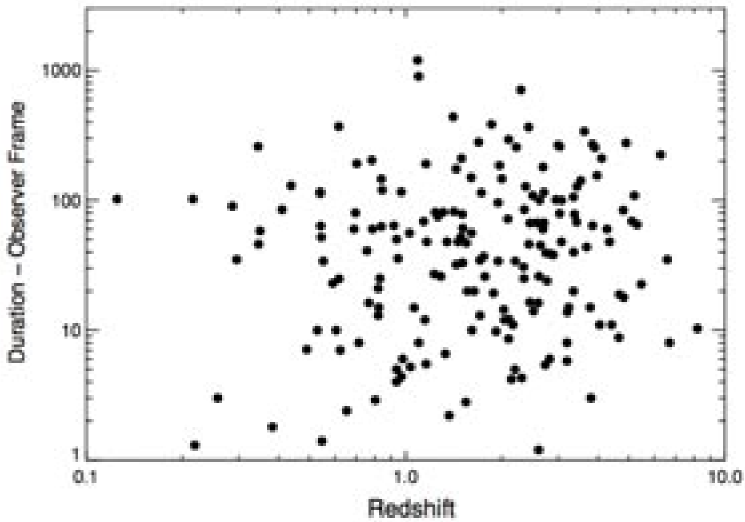

Figure 7. T90 duration vs. redshift for 195 Swift detected GRBs. Courtesy of D. Kocevski and V. Petrosian.

size, galaxy radio lobe size, galaxy luminosity, and galaxy number density. But the required assumptions are numerous, and some even worsen the fit on certain of these tests. The tired-light model, on the other hand, is preferred on the basis of its simplicity.

3. Other Problems with the Expanding Universe Hypothesis

The Redshift Quantization Effect. Tifft and Cocke found that cosmological redshifts are *"quantized,"* that they change in one sixth submultiples of $c\Delta z$ = 72.45 km/s, i.e., 12 km/s (or $\Delta z = 2.4 \times 10^{-4}$), the 24 km/s and 36 km/s harmonics being most prevalent [75–82]. After further study, Tifft concluded that these other redshift quantizations were higher multiples of either 8.05 km/s or 2.68 km/s which he then regarded as the most basic quantizations (1/9 and 1/27 of the originally discovered unit) [83]. This effect has been demonstrated most convincingly by studying differential redshifts within galaxy pairs and compact groups obtained by both radio and optical means. The existence of a 72 km/s periodicity in the data is now well established with a 10^{-6} probability that it is due to chance. These findings have more recently been confirmed by Guthrie and Napier who find 37.5 and 71.5 km/s periodicities in the redshifts of the local supercluster [84,85].

Cocke and Tifft suggest two explanations for this phenomenon. One interpretation, is that the redshifts are due to Doppler motion and that the observed quantization indicates that the expansion of the universe is quantized [80]. The second interpretation they suggest is that the universe is stationary and that the photon emission properties of atoms are quasi-stationary, with some parameter, such as the Rydberg constant, monotonically changing its value over time in discrete steps. Here they may be alluding to the variable mass theory of Narlikar [86], which also has been adopted by Arp [87], which suggests that matter is being continuously created in the universe and that the inertial mass of matter gradually increases from the time of its creation.

However, a third interpretation of the redshift quantization effect may also be conceived, namely that the observed redshift increments represent discrete steps in the decay of photon energy as photons propagate through space [8]. Thus, rather than losing energy continuously, as Relation (1) implies, photon quanta might be supposed to change their energy (and wavelength) states in an incremental fashion. If Δr is the distance an average photon travels before undergoing a redshift transition of amount Δz, then the redshift over n increments would be given as:

$$z = n\beta\Delta r. \tag{14}$$

Thus for $c\Delta z$ = 12 km/s and H_0 = 72 km/s/Mpc (β = 7.4%/bly), $\Delta r = c\Delta z/H_0 = 5.5 \times 10^5$ lt-yr. Thus a photon would travel a distance of about half a million light years before undergoing the smaller of these incremental redshifts. For extended distances (14) would be given as:

$$z = e^{n\beta\Delta r} - 1 = e^{n\Delta z} - 1. \tag{15}$$

The above equations would be substituted for Relations (4) and (3) respectively.

Discrete step-like energy transitions are a common feature of quantum level phenomena. So it is reasonable to expect that photon energy loss due to a tired-light effect would occur in discrete fashion as well. It might be imagined that for a considerable part of its journey a photon's energy remains relatively constant, but that after a given distance or time interval it enters a period of instability in which its former energy state becomes unstable. Small perturbations would then induce the photon to rapidly change to a new stable lower energy state. Another possibility is that a photon's quantum of action is metastable. That the value of Planck's "constant," h, gradually declines by a very small amount as the photon loses energy, allowing wavelength to remain constant. Then at some threshold value, it snaps back to its normal value, producing an abrupt incremental increase in the photon's wavelength.

On the other hand, if the expanding universe hypothesis is adhered to, one is forced to adopt a Doppler-shift interpretation of the redshift quantization phenomenon, which would require introducing new physics, namely that the cosmological expansion is quantized on a stupendous scale. Not only is such behavior not predicted by any standard physics theory, it is also difficult to imagine how such progressive step-like velocity differences would persist considering that they should have been smoothed out over the course of billions of years as a result of the gravitational interactions which the concordance cosmology assumes to take place between galaxies. Moreover the added assumption of quantized expansion further increases the assumptive burden of the big bang theory, a cosmology that is already overburdened with assumptions. Considering that the cosmological test results reviewed earlier favor the tired-light model over the expanding universe model, we are encouraged instead to choose the nonDoppler, tired-light interpretation of the redshift quantization effect.

One other interesting result has come from the observations of Arp [88] which show that galaxy redshifts relative to the main galaxies M31 and M81 in the Local Group and Sculptor Group are quantized in steps of approximately 72.4 km/s, matching the quantization interval that Tifft and Cocke have found for more distant galaxies. Arp reports that since the redshifts are known with a precision of about ±8 km/s, and for seven of these galaxies even more precisely, about ±4 km/s, one is led to conclude that the galaxies in these groups are unusually "quiet" (relatively motionless). Observing that galaxy redshifts in the M31 and M81 groups are distributed around the 72.4 km/s periodicity with a standard deviation of 17 km/s, Arp [89] has quite reasonably interpreted this as evidence that the peculiar motions of galaxies in these clusters can be no larger than this. This presents a strong argument that the differential redshifts of galaxies in these local groups are not due to relative motion, or to any cosmological redshift, but to some phenomenon intrinsic to these galaxies.

Origin of the Cosmic Microwave Background. The big bang hypothesis makes no rigid prediction as to the precise magnitude of its fireball expansion velocity. The theory that the cosmic microwave background radiation (CMBR) is of big bang origin requires that its fireball was expanding at just the right velocity so that its blackbody radiation field would redshift by a factor of ≈1500 down to its presently observed 2.73 K temperature. But this is just an assumption. In view of the cosmological test results discussed above which overwhelmingly favor the static universe choice, and in view of the contrived nature of this expansion velocity assumption, a big bang origin for the microwave background should no longer be regarded as a foregone conclusion.

Sawangwit, et al. [90] have found reason to doubt the standard theory of a big bang cause. They took CMBR data mapped out by WMAP (Wilkinson Microwave Anisotropy Probe), compared it with the distribution of galaxies having redshifts up to z = 0.7, and found that errors in the CMBR data were much larger than had previously been supposed. They used radio point sources to examine the effects of the WMAP signal smoothing protocol and found that the smoothing it produces is much larger than was previously believed. On this basis, they concluded that the microwave radiation background is much smoother with temperature ripples being much smaller than previously thought. This, in turn, indicates that dark matter and dark energy are not present in the universe, and raises problems with the standard big bang model which requires the presence of dark matter and energy to bolster its hypothesis that the universe is expanding at an accelerating speed. This study also looked for evidence that the CMBR experiences a residual blueshift to higher temperatures after its photons pass through galactic superclusters, a situation that would prevail if superclusters were accelerating away from one another due to cosmic expansion. They found no blueshift, thus again undermining the standard expansion model.

Ijjas, et al. [91] have published an article in *Scientific American* criticizing the concept of inflation that has long underpinned the concordant cosmological model. They note that the latest measurements of the CMBR refute the earlier simple inflation models and leave only very complex models that are able to match observation and these only by presuming the occurrence of special highly unlikely circumstances. They further note that because so many inflation models have been advanced, each making its own predictions, the inflation concept cannot be considered to constitute a testable theory, hence is not real science. A similar criticism has been made of string theory. Also Ijjas et al. note that inflation is predicted to generate primordial gravity waves but so far no such gravity waves have been found. They advocate that cosmologists should relinquish their attachment to the currently favored concordance cosmology and begin considering new ideas about how the universe began. They themselves advocate a cyclic big bang cosmology involving repeating cycles of cosmic expansion and contraction, one that does not require the assumption of inflation. However, the cosmology test results discussed in Section 2, indicate that cosmologists would spend their time more productively if they were to examine theories in which matter creation takes place in a static universe, one such theory or methodology being SQK which is discussed briefly in Section 4.

Analysis of the CMBR data has also shown that it contains a prominent dipole anisotropy, its temperature being 3.3 milliKelvin warmer in the direction of Leo and 3.3 milliKelvin cooler in the direction of Aquarius. What is embarrassing for the big bang theory is the finding that the dipole axis lies very close to the ecliptic and is oriented almost perpendicular to the direction of the Galactic center. For example the WMAP results place the dipole's hot pole at ecliptic longitude $\lambda = 171.56 \pm 0.08°$, latitude $\beta = -11.18 \pm 0.08°$, which is almost orthogonal to the Galactic center ecliptic longitude direction $\lambda = 266.84°$, deviating from perpendicular by 5.3°. When the WMAP measurement is combined with six other determinations of the dipole anisotropy direction made between 1977 and 1981, the results average to $\lambda = 172 \pm 8°$, $\beta = -1 \pm 9°$ which is consistent with a direction on the ecliptic oriented perpendicular to the Galactic center to within the margin of error. If the anisotropy is due to Earth's motion relative to the CMBR, why would we happen to be moving in this particular direction, the situation seeming to beg for a Galactic, non-velocity origin explanation. Also the dipole direction has tended to move around over the years to an extent greater than can be accounted for in terms of measurement error. This, together with its suspicious ecliptic orientation suggests that this anisotropic contribution to the CMBR may be locally generated [92].

Given the large number of cosmological test results that favor a stationary over an expanding universe (reviewed above), it is clear that we should now be looking for alternative causes of the CMBR that are plausible for stationary universe cosmologies. One such alternative theory proposed by Crawford [59,93-95] for a cosmologically static universe suggests that the CMBR is generated by secondary photons produced by very high energy electrons in the hot component of the intergalactic plasma known as the WHIM (Warm Hot Intergalactic Medium). He notes that if these photons have frequencies below the plasma frequency of the intergalactic gas, they will undergo Rutherford scattering on cooler intergalactic electrons heating them and causing the collective to emit blackbody microwave radiation at a temperature that depends on the plasma's average energy density. The diffuse X-ray background radiation is found to have a broad hump in its spectrum at energies below 400 kev; see Figure 1 of Crawford [95]. Crawford proproses that this is due to energy added from the WHIM. The higher end of the X-ray background spectrum is believed to be contributed by unresolved point sources. Crawford [93] has analyzed this portion of the X-ray spectrum and has calculated that this intergalactic plasma should have an electron density of 1.35 electrons/m^3, a temperature of 2.62 ± 0.04 billion °K, and an energy density that would yield a blackbody microwave background temperature of 3.18 K. This deviates only 16% from the measured value of 2.73 K. His calculations assume that the intergalactic gas has atomic abundances of 91.5% hydrogen and 8.5% helium, equivalent to a 27% helium mass abundance, which is somewhat higher than the 23% abundance seen in metal poor stars. By assuming a slightly different intergalactic gas composition having a lower helium abundance, the electron density is correspondingly reduced, decreasing the calculated temperature closer to the observed CMBR value. For example, a helium mass abundance of 23% would lower this prediction to about 3.05 K, and the temperature would drop further by relaxing the assumption that this gas is homogeneously distributed.

The cosmology of SQK adopts Crawford's CMBR mechanism and further goes on to explain the origin of the WHIM, i.e., how its particles were created and how they became heated into a plasma. It predicts that neutrons spontaneously nucleate throughout all space through a process of continual creation; see Section 4. Each nascent neutron would subsequently undergo beta decay, producing a relativistic electron, subrelativistic proton, and antineutrino, the electron and antineutrino carrying away the bulk of the released 782 kev. These decay remnants would form an intergalactic hydrogen gas medium and the beta particle component would collisionally transfer energy to its neighboring particles, collectively warming them up into an X-ray emitting plasma. Others who have proposed the idea of neutrons being continuously created in space include Hoyle [96] and de Turville [97], although they propose different creation mechanisms. Beta decay would necessarily play an important role in those scenarios as well.

Let us now consider whether nascent neutron beta decay would provide sufficient energy to explain the heating of the WHIM and consequent production of the CMBR. If we take a hydrogen-helium ion number density of 1.33 ions/m^3, slightly lower than the value Crawford assumed above, and a mass abundance of 23% He and 77% H (number abundance of 7% He and 93% H), this implies a proton number density of 1.24 protons/m^3. Then, if we assume that each of these protons was generated through neutron beta decay with the associated release of 780,000 electron volts of kinetic energy, we then calculate a resulting energy density of 0.97 ev/cm^3. By comparison, a 2.73 K microwave background temperature corresponds to an energy density of 0.26 ev/cm^3. Immediately, this shows that the beta decay of nascent intergalactic neutrons provides sufficient energy to power the CMBR. However, this greatly overestimates the current energy density of the CMBR since during the course of their lifetime these microwave photons would have been losing energy through nonconservative tired-light energy loss. Hence the proton and electron particle fraction of the WHIM that had been created billions of years earlier will have lost much of its acquired energy.

If for example, the WHIM had been created all at once 50 billion years ago and had been heated up at that time by its beta particle component, then figuring a tired-light energy loss rate of 0.074% per billion years, the energy density of the CMBR would have dropped 3.7 fold to its currently observed value of 0.26 ev/cm^3. However, in the case where the WHIM is being generated and heated up gradually over its lifetime, we must assume that the CMBR has been in existence for a much greater length of time to exhibit its observed energy density, perhaps even 100 billion years or more. Such long spans of time are permissible in continuous creation cosmologies since, unlike the big bang theory, they can postulate even an infinite age for the universe.

One point that should be addressed is whether this radiated microwave energy would have a blackbody spectrum considering that the space is transparent to microwaves even out to z ~ 4 or 5. This is a problem in the concordance cosmology which requires that the universe have a specific age and extent. However, SQK assumes space to be of infinite extent, and as López-Corredoira [58] notes, in an infinite universe the microwave background will exhibit a blackbody spectrum, even in the case where the universe is not opaque to microwaves. Although another possible explanation is that plasma filaments distributed throughout intergalactic space thermalize the cosmic microwave spectrum by repeatedly absorbing and reradiating microwave secondary photons [98]. So with the WHIM theory described above we again have the CMBR being of cosmic origin. The only difference is that instead of the emission arising all at once from a single big bang event, it is now understood as being continuously generated by beta decay electrons associated with the ongoing creation of matter.

Standard theory encounters difficulty in accounting for the heating of the WHIM since it relies on the expectation that the intergalactic gas that remained from the big bang fireball should long ago have cooled down sufficiently due to the expansion of space to allow matter to condense into planets and stars. The discovery that this medium is now quite hot demands that the concordance cosmology must come up with some mechanism that would have caused the initially cold intergalactic medium to be reheated. Making matters worse for the concordance cosmology, Becker et al. [99] have found that additionally the energy density of the WHIM has been increasing over the past 13 billion years, increasing most rapidly between z = 4.8 and z = 2. The concordance cosmology requires that this energy increase would have transpired in just 2 billion years from a look-back time of 12.25 billion years (z = 4.8) to a look back time of 10.25 billion years (z = 2). In the past, active galactic nuclei have been chosen as the favored heating agent. But the amount of energy required is considerable, one estimate requiring 10^{63} ergs per galaxy. If we figure that a Seyfert-type galactic core outburst typically supplies 10^{57} ergs, then one million Seyfert-like outbursts are needed to supply the required energy over this two billion year period. In other words, Seyfert-like outbursts would have to occur as frequently as once every 2000 years. But such an outburst rate is at least an order of magnitude higher than what is actually observed. One of the more liberal core explosion theories assumes that major outbursts of this magnitude occur about every 25,000 years [100,101]. Clearly, even this high a frequency is insufficient to allow the concordance cosmology to reasonably explain the heating of the WHIM.

Multi-Megaparsec Structures. Further doubt about the big bang origin of the CMBR is raised by the discovery of the phenomenal ring patterns in the high resolution WMAP data. Careful statistical analysis shows that the CMBR temperature data is not entirely random. Superimposed on the Gaussian noise one finds highly ordered patterns in the form of families of low variance concentric rings, one pattern overlying the other [102-104]. The patterns consist of very subtle variations in microwave temperature variance, the variance being at least 15 micro Kelvin lower in the circle centers as well as in their surrounding rings. Gurzadyan and Penrose who discovered these circles find that this ordering is at a 6σ significance, indicating with very high probability that the patterns are real. Some circles consist of just two concentric rings with ring spacings of as little as 2° of arc, whereas the larger ring patterns consisting of three or four concentric rings can have an overall radius of 15° to 20°. There is no way to determine their actual physical sizes since it is not possible to get a fix on their distances from us. The presence of the rings depends heavily on the particular method of data analysis that one uses and one wonders how the conclusions of Sawangwit, et al. regarding the smoothness of the WMAP data might impact this.

Gurzadyan and Penrose, the main proponents of this ring pattern discovery, explain these structures in terms of *conformal cyclic cosmology,* a version of the big bang theory that hypothesizes the past occurrence of multiple big bang expansion cycles each separated in time by a cycle of cosmic contraction [102-104]. They propose that these rings arise from our viewing microwave radiation from a preceding big bang universe era surviving and entering into the current universe era. A study carried out by Wehus and Eriksen [105] has confirmed the existence of the rings, but those authors do not feel that the conformal cyclic cosmology model is the only explanation. They state that the existence of the rings is compatible with the expectations of the standard model, and that they arise as a natural result of the presence of noise in the microwave background radiation. Gurzadyan and Penrose [103,104], however, have addressed their criticisms and have continued to defend their original interpretation.

Another problem with the ΛCDM expanding universe hypothesis is its inability to adequately account for the regular spacing of galaxy superclusters [106]. That is, as we look further and further out into space in the direction of the north and south galactic poles, the number of galaxies per unit volume is found to alternately increase and decrease in cyclic fashion. Galaxies are seen to group into wall-like structures that are seen to be spaced from one another by about 600 million light-years along our line of site. Their wave-like pattern is seen to stretch out 5 billion light years in either direction. This poses a problem for the expanding universe theory which predicts a space-time doubling during that period. If a supercluster wave pattern did for some reason emerge, its wavelength should vary with time and be half as large 5 billion light years ago. But this is not the case. The wavelength stays constant with look-back time. This is more logically explained if galaxies, through some unspecified process, preferentially occupy certain regions of space so as to form a wave pattern of cosmic proportions and that this phenomenon occurs in a *static*, Euclidean universe. An explanation for this is presented in the next section.

<u>The Age of the Universe</u>. Another difficulty with the concordance expanding universe theory is that it predicts an age for the universe that is too short in comparison to the ages found for highest-z galaxies. For example, galaxies have recently been discovered having redshifts as high as 11.1 [107] and 11.9 [108]. According to the big bang interpretation, a galaxy at $z = 11.9$ would be seen 350 million years after the time of the big bang. This would place its existence before the beginning of the reionization epoch which is theorized to have begun about 400 million years after the big bang and to have climaxed around 570 million years after the big bang ($z = 8.8$) [109]. So this would imply that this galaxy had formed at a time when the universe was still filled with neutral hydrogen. This raises the question of how this galaxy would have had time to develop given that recent models of galaxy formation indicate that it should take a galaxy at least 750 million years to form. That is, stars would have had to start forming this galaxy prior to the beginning of the big bang! Other problems with the big bang theory and expanding universe hypothesis are explored by M. López-Corredoira [58].

4. <u>The Cosmology of Subquantum Kinetics</u>

The cosmological test data results summarized above lead inevitably to the conclusion that the universe must be globally static and that the cosmological redshift is due to a process other than recessional velocity. We find then that the big bang theory is no longer a viable theory to account for the origin of things and that we must look elsewhere for alternatives to explain the origin of matter and energy, one that does not require creation to take place all at once in a singular primordial explosive event. A preferable candidate cosmology is one in which matter is being *continuously* created in a universe that remains cosmologically static. Sir James Jeans [110] and William McCrea [111] were both led to this idea through astronomical observation. McCrea proposed that matter is continuously created throughout space, with creation being assumed to proceed most rapidly in regions of negative gravitational field potential, e.g., within stars and condensed masses. Jeans suggested that matter might pour into galactic nuclei from some other dimension. Hoyle had proposed a steady state continuous creation cosmology which adhered to the Doppler interpretation of the redshift and presumed a continuously expanding universe. However this was later disproved through its inability to fit cosmological test data. Later Hoyle and Narlikar [112] proposed a continuous creation theory that revised Hoyle's earlier theory.

Another contending cosmology is that presented by subquantum kinetics (SQK) which not only predicts intergalactic tired-light behavior, but also continuous matter creation. The physics of SQK projects that subatomic particles on occasion are able to arise spontaneously in space, and that once materialized, they serve as nucleation sites for further particle creation [7,28,113-115]. Like McCrea's theory, it predicts that matter creation should occur most rapidly in regions of negative gravitational field potential, e.g., within stars and condensed masses, and particularly within the massive objects located in galactic cores. This physics methodology was first proposed in 1985 as a new way of modeling subatomic particles and their potential fields drawing concepts from the fields of general system theory, nonlinear thermodynamics, and chemical kinetics and applying them to microphysics. Since it takes an approach very different from that of standard microphysics, the novice may require some time to get used to it.

One attractive feature of SQK is its simplicity. Coven [116] has concluded that it is preferable to standard microphysics which is laden with many assumptions. In addition, SQK has thus far had 14 of its predictions confirmed. This an impressive track record considering the short period of time that the methodology has been under development. One prediction emerging as a consequence of the cosmology is that a photon traveling through intergalactic space should undergo a nonconservative "tired-light" energy loss similar to that expressed by Relation (1). The photon's wavelength is also predicted to increase exponentially with travel distance according to logarithmic Relation (2) resulting in a rigid and testable cosmological prediction. Were this prediction not to be confirmed by observation, the result would be fatal for SQK. However, the results presented in Section 2 provide overwhelming confirmation, the tired-light model being the better choice for fitting available cosmological data. Not only does this finding demonstrate that the static universe, tired-light cosmology is the more realistic choice, versus expanding universe cosmologies, it also confirms this key prediction of SQK.*

<u>Overview of the Physics</u>. The following presents a brief overview of some aspects of the SQK cosmology. Subquantum kinetics assumes space to be occupied by a plenum of entities of unspecified small size called *etherons, which* not only diffuse through space but which also transform and react with one another in a specific way. These reactions are specified by Model G of SQK, which consists of a set of five kinetic equations specifying five reaction processes taking place between seven ether species as shown in Figure 8. Etherons would leave one ether state as they transform into the next. Collectively, these constitute the *transmuting ether*. They would define a reaction sequence that may be imagined to extend along a *transformation* dimension T as shown in Figure 9.

Spatio-temporal concentration variations in three of these species, X, Y, and G, are assumed to

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* The author's initial entry into the field of cosmology was for the purpose of checking out this redshift prediction, and it was at that time that he first learned about the tired-light theory which makes the same prediction.

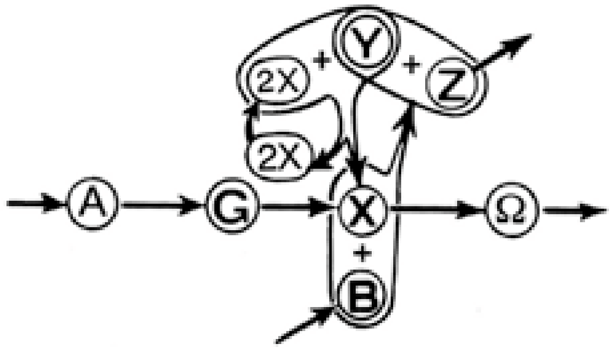

Figure 8. The Model G ether reaction system investigated by subquantum kinetics.

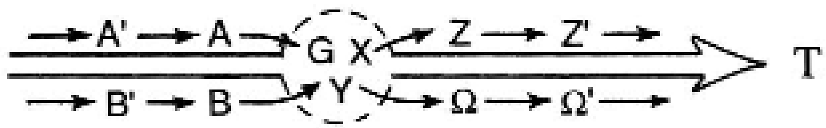

Figure 9. An expansion of the Model-G ether reaction scheme as it would appear disposed along dimension **T**. G, X, and Y mark the domain of the physical universe.

make up the quanta of our physical world. Other etheron states such as A', B', Z', and **Ω**', which happen to lie above and below these states along dimension T would reside "outside" of our physical universe. But the significant point to appreciate here is that Model G operates as an *open system*, the concentrations of G, X, and Y attaining their homeostatic values as a result of the continual input and output of reactants to those states. Etherons are assumed to be conserved in the course of their progression to new etheron states. However, the wave patterns they collectively form, which are identified with energy fluctuations and photons, can themselves exhibit nonconservative behavior in seeming violation of the First Law. But considering that the First Law only holds strictly for closed systems, in SQK such nonconservative behavior is permissible. The amount of this energy conservation "violation" turns out to be far smaller than what can be measured in the laboratory. By comparison, the energy quantum theorized to initiate the big bang explosion presents a stupendous violation of energy conservation, which big bang theorists justify by introducing the proper ad hoc assumptions.

Examples of this nonconservative behavior include the prediction that a photon should undergo a nonconservative tired-light energy loss when traveling through intergalactic space or that an electric potential fluctuation under the proper circumstances can spontaneously increase its energy and develop into a subatomic particle. The question as to where the photon's lost "energy" goes to or from where its gained "energy" comes from is a non sequitur. According to SQK, photon energy as we experience it is conceived to be an emergent phenomenon sustained from moment to moment by the workings of the postulated subquantum processes [7,28,113].

Model G yields the following three partial differential equations which describe how variable reactants G, X, and Y evolve in space and time:

$$\left.\begin{aligned}\frac{\partial G}{\partial t} &= k_1 A - k_2 G + k_{-2} X + \mathcal{D}_g \nabla^2 G \\ \frac{\partial X}{\partial t} &= k_2 G + k_4 X^2 Y - k_3 B X - k_5 X + \mathcal{D}_x \nabla^2 X \\ \frac{\partial Y}{\partial t} &= k_3 B X - k_4 X^2 Y + \mathcal{D}_y \nabla^2 Y\end{aligned}\right\} \quad (16)$$

where the capital letters represent concentrations of the ether species, the k_i represent their respective kinetic constants, and the $\mathcal{D}_i$ the diffusion coefficients describing the rate at which the species diffuse through space. For simplicity, the concentrations of the source and sink reactants A, B, Z and Ω are kept constant.

The energy potential fields that make up our physical world are identified with extremely small deviations of G, X, and Y from their homogeneous steady state values, denoted as φ_g (r,t), φ_x (r,t), and φ_y (r,t). These may be thought of as the ripples on the surface of a deep pond. Spatial variations in the φ_g potential are assumed to represent gravitational potential fields while spatial variations in the φ_x, and φ_y, potentials would represent electrostatic potential fields. These in turn form the photons and subatomic particles that make up our world. Etherons would not have charge, mass, and spin as quarks do in quark theory. These properties arise at the quantum level as characteristics of the emergent subatomic particles.

Equation system (16) may be expressed in terms of potentials, φ_g, φ_x, and φ_y, rather than concentrations, to facilitate carrying out computer simulations. As computer simulations of the Model G reaction system have shown, under the proper conditions this ether substrate will spawn soliton-like wave patterns that exhibit characteristics similar to subatomic particles [117]. Figure 10 shows three frames from a simulation of Model G depicting the emergence of a dissipative soliton which is representative of a neutron. As seen here, Model G predicts that the electric field within the proton and neutron should plateau at the particle's center and also should deploy a peripheral electric potential periodicity termed a *Turing wave* having a wavelength approximating the particle's Compton wavelength. This differs substantially from the spike-like field profile assumed in standard particle physics. But these field profile predictions, originally made in 1985 [114], were later confirmed by high energy particle scattering experiments conducted by Kelly [118] to probe the field structure within the nucleon. A computer simulation of Model G [117] which shows a fluctuation growing in size and spawning a neutron is posted at: https://www.youtube.com/watch?v=wZP9b3e-CMg.

The Gravitational Field. Simulations of Model G have also confirmed that a φ_g gradient does cause a material body (dissipative soliton) to translate through space. But the gravity fields generated by Model G, by their nature, have finite extent. That is, at great distances from a mass, the gravitational acceleration begins to drop off more rapidly than an inverse square due to the fact that the G reactant concentration, G(r), eventually plateaus to the ambient homogeneous steady state value, G_o, in the galaxy's neighborhood. Hence the field's gravity potential gradient, $\nabla\varphi_g$, would approach zero at large distances. As a result, in SQK there is no possibility for the universe to spontaneously collapse, and hence no need to add a cosmological constant. The departure of the gravity potential field from its classical 1/r relation is assumed to become noticeable at distances greater than about 10,000 light years from the source mass, this being consistent with the assumptions of the Modified Newtonian Dynamics (MOND) theory. MOND proposes that, at about a similar distance from the source mass, the gravitational acceleration drops off with distance in a logarithmic manner. The results of McGaugh, et al. [119] favor both the predictions of MOND and of SQK. They have studied the rotation curves of 153 galaxies and conclude that the orbital velocities in their sample can be accounted for just on

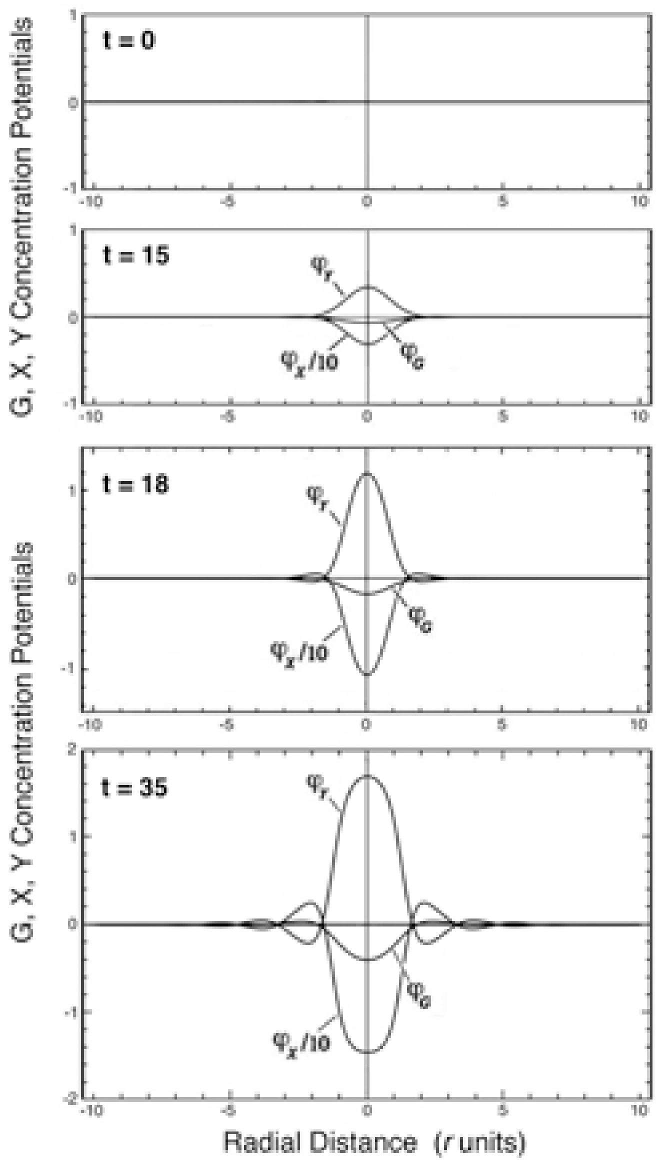

Figure 10. Sequential frames from a three-dimensional computer simulation of Model G showing the emergence of an autonomous dissipative structure particle: t = 0 the initial steady state; t = 15 growth of the positively charged core as the X seed fluctuation fades; t = 18 deployment of the periodic electric field Turing wave pattern; and t = 35 the mature dissipative structure particle maintaining its own supercritical core G-well. Simulation by M. Pulver.

the basis of their distribution of baryonic matter in the galaxy provided that at large distances gravitational acceleration a_g is assumed to decline as $a_g^{½}$, hence as 1/r rather than as $1/r^2$. They find that their orbital velocity data are not well explained by dark matter models. Subquantum kinetics predicts a similar attenuation of the gravitational force operating within a galaxy and hence avoids the need for introducing ad hoc assumptions about dark matter.

Subquantum kinetics requires that gravitational potential and gravitational mass should be bipolar and that they should correlate with electric charge polarity. In effect, it predicts the existence of a coupling between electric and gravitational fields. Einstein had attempted to accomplish such a synthesis with his general theory of relativity, but failed [120]. Yet such electro-gravitic force coupling effects do exist, as revealed in the experiments of T. Townsend Brown [121-123] also confirmed by Cornille [124,125] which show that a capacitor charged to over 30 kv is able to a generate a gravity-like force that acts on the capacitor to push it in the direction of its positively charged plate. Subquantum kinetics has a distinct advantage over conventional quantum field theory in that it is able to account for this effect.

The gravity field of SQK does not warp space as in general relativity; instead it moves bodies by affecting the etheron reactions that collectively maintain their subatomic particle wave patterns, thereby causing those patterns to migrate. Relativistic effects such as relativistic clock retardation and length contraction, gravitational lensing and gravitational time dilation emerge as corollaries of the operation of the Model G reaction system [28]. Hence, unlike general relativity, SQK forms the basis for a true unified field theory with a minimal amount of ad hoc assumptions.

It is a characteristic of Model G that, due to the stochastic nature of its ether reactions, concentration fluctuations in the G, X, and Y media will continually arise throughout space. These are similar to the zero-point energy fluctuations of quantum physics, but they differ in that they emerge either in the matter polarity {high Y, low X) or the antimatter polarity (low Y, high X), but never as paired, matter-antimatter fluctuations. Also the majority will have potential energies far less than the inertial mass equivalent of a subatomic particle. Only on rare occasions will a fluctuation arise that is large enough to surpass the critical threshold and eventually form a neutron. Simulations of Model G have shown that a positively charged fluctuation of sufficient size is able to nucleate a neutron even if its total energy is initially less than the neutron's rest mass energy. Moreover the fluctuation must be of a positive matter polarity since those of negative polarity that would normally lead to the antineutron state spontaneously self destruct, a result that follows naturally from Model G. Hence SQK is able to account for the apparent absence of antimatter galaxies, something that the big bang theory has difficulty explaining.

<u>Nonconservative Photon Behavior.</u> In SQK, the gravity field directly affects the criticality of space. Model G is a nonlinear system that can operate either in a subcritical or supercritical mode depending on the ambient gravitational potential value, $\varphi_g(r)$, relative to a critical threshold value, φ_{gc}. That is, Model G becomes subcritical when $\varphi_g(r) > \varphi_{gc}$ and supercritical when $\varphi_g(r) < \varphi_{gc}$; see Figure 11. When the reaction system is subcritical, energy fluctuations progressively regress in size, and when it is supercritical, they spontaneously amplify in size. Energy would be perfectly conserved over time only in the special case where $\varphi_g(r) = \varphi_{gc}$.

Subquantum kinetics presumes that before matter and energy quanta had emerged, the X, Y, and G concentrations were homogeneously distributed throughout space and that the ether

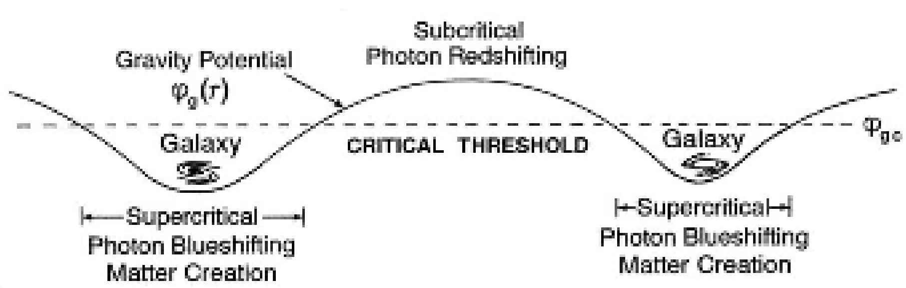

Figure 11. Photons blueshift in regions near galaxies and redshift in intergalactic space.

medium was operating in a subcritical state, very close to its critical threshold. For a fluctuation to grow and form a particle of matter, it must be of a critical size and must arise in a supercritical region, or in a subcritical region that lies close to the critical threshold. A positive polarity electric potential fluctuation that emerges will then be able to progressively grow in size, Y increasing and X decreasing until a new periodic steady state is reached with the nucleation of a nascent neutron (Figure 10). In other words, SQK predicts that neutrons should occasionally pop into existence from the ether; i.e., from *seemingly* empty space. This continuous creation process occurs as a natural consequence of the operation of the Model G reaction-diffusion system. No other assumptions are needed.

Model G of SQK also offers a reasonable explanation for the periodic variation in the concentration of galaxy clusters which is observed to extend over billions of light years and can also account for the immense ring patterns observed in the CMBR discussed earlier. Such organized structures of multi-megaparsec dimensions could form if the concentration of either reactant A or B in Model G were to be characterized by a very large but finite diffusion coefficient, allowing its concentration to vary through space with a wavelength of cosmic proportions. So in this case, either A or B would become a fourth variable in the Model G reaction system. Since the concentrations of these reactants control the criticality of the ether, their value would determine the rate at which matter is able to materialize, the local temperature of the CMBR, and the number density of galaxies that would eventually form in that particular locale. Hence these cosmic structures could be smoking gun proof that the universe operates on a very large scale as an immense reaction-diffusion system. Such variations in criticality would also shape the structure of the universe, and ultimately be responsible for its foam-like appearance.

According to SQK, when a neutron transforms into a proton through beta decay, the φ_y potential in its core spontaneously adopts a positive bias, and the φ_x potential a negative bias, relative to their former values, this field biasing representing the creation of electrostatic charge. As a result of this biasing relative to the ambient, φ_y diffuses radially outward and φ_x diffuses radially inward, thereby establishing the proton's 1/r electric potential field [28,113]. Beta decay also involves the production of the electron beta particle as a byproduct, whose negative charge is exhibited by a downward biasing of its $\varphi_y(r)$ field and upward biasing of its $\varphi_x(r)$ field, thereby conserving charge in the transition. This transition to the nucleon's charged state, with the concomitant production of a beta particle and neutrino, would occur in stochastic fashion as a "secondary bifurcation" of Model G's primary branch mathematical solution.

Subquantum kinetics identifies a particle's inertial mass with the wavelength of its Turing wave pattern, shorter wavelengths corresponding to larger inertial masses. Spin is identified with the vortical movement of the G, X, and Y etherons around a particular axis of the particle. The concentration fluctuation that initially forms the particle may be theorized to arise as an etheron vortex which imprints its vortical motion on the particle's wave pattern. Magnetic forces would be produced by φ_y and φ_x fields that have a relative motion.

<u>The Negative "Hubble Constant."</u> Subquantum kinetics models intergalactic space as being subcritical for the most part. This leads to its prediction, mentioned earlier, that photons traveling through such subcritical regions should undergo a tired-light energy loss that varies with distance as described by Equation 1. It does not specify a particular value for attenuation coefficient β; i.e., for the rate of redshifting as a function of distance. It basically takes a modeling approach and adopts the value derived from astronomical observation. That is, Model G parameters, such as reactant concentrations, kinetic constants and diffusion coefficients, may be adjusted to give proper values for the speed of light and rate of photon energy loss in intergalactic space matching observation. The big bang theory similarly does not predict a specific value for the Hubble constant, but adopts a value based on astronomical observation.

But, tired-light redshifting is only half of the story. Subquantum kinetics also predicts that photons traveling through *supercritical* regions of space should gradually increase their energy over time; i.e., undergo cosmological blueshifting, a kind of reverse tired-light effect. This would be equivalent to the assumption that photons exhibit a negative Hubble constant in such regions of space. The relation expressing how photon energy would increase over time would be like that shown in Equation (1), but with a positive exponent. Photon blueshifting is predicted to occur within all galaxies and galaxy clusters, as well as inside planets, stars, and galactic cores. This photon blueshifting would generate an excess energy flux, termed *genic energy*, this being later confirmed by the discovery that the mass-luminosity coordinates for the major planets lie along the lower main sequence stellar mass-luminosity relation. Hence this indicates that planets and main sequence stars are powered in the same fashion by a source of energy that is neither nuclear nor primordial heat [126]. This blueshifting effect also accounts for the Pioneer effect [127]. Hence the reality of the SQK cosmological blueshifting effect has been verified independently of its application to cosmology.

5. Non-velocity Photon Blueshifting in Galaxy Clusters and Excess Redshifting in Voids

According to SQK, the value of the gravity potential at a given location in space governs the rate of photon energy nonconservation at that location, whether it be a progressive energy loss or progressive energy gain. Photons undergo redshifting in regions of space where the gravity potential is "positive", where $\varphi_g(r)$ lies above its φ_{g0} critical threshold value and undergo blueshifting in regions of space where the gravity potential is "negative", where $\varphi_g(r)$ lies below its φ_{g0} critical threshold value, as within galaxies and galaxy clusters. Let us now consider the cosmological implications of the SQK cosmological blueshifting effect, something that is predicted by neither the concordance cosmology nor by other tired-light theories.

Virgo Cluster Blueshifting. As mentioned above, SQK predicts that photons should progressively blueshift over time when transiting the gravity wells of galaxies and galaxy clusters. This is significant because no other cosmology has predicted that photon cosmological redshifting can change over to photon blueshifting in certain regions of space; i.e., adopt a negative value for the Hubble constant. Also unique is its prediction that the Hubble constant should be able to vary in amount and in sign, its value being determined by the value of the gravity potential in the photon's vicinity. As a result, SQK is able to explain a variety of "peculiar" spectral shift phenomena that otherwise would be puzzling.

As shown below, a study of the Virgo cluster confirms this unusual blueshifting prediction. The Virgo cluster, which lies about 16.5 Mpc away, is the largest galaxy cluster within 100 Mpc of our Local Group (LG). Figure 12 plots the spectral shifts of galaxies observed in and near the Virgo cluster as a function of distance for a line-of-sight directed through the cluster's center as taken from Figure 12 of the paper by Mei et al. [128]. Those authors plot their galaxy spectral shift data transformed from the heliocentric rest frame of the observer to the cosmic microwave background rest frame relative to which the Milky Way has a moderate velocity. The solid line seen here is a least squares fit redshift-distance trend line for galaxies lying outside of the immediate vicinity of the Virgo cluster, as adapted from the paper of Tonry, et al. [129]. Whereas Tonry et al. plot their data to show redshift increasing with increasing distance from Earth, here the curve is inverted to show how the frequency of a photon changes when it journeys towards Earth from a distance of 40.5 megaparsecs where the photon's redshift is arbitrarily set to zero for the purpose of illustration.

The redshift-distance relation for galaxies located both behind and in front of the cluster relative to our line of sight are seen to conform to a Hubble constant of approximately 78 ± 2 km/s/Mpc. This is close to the 72 km/s/Mpc average observed further out. Interestingly,

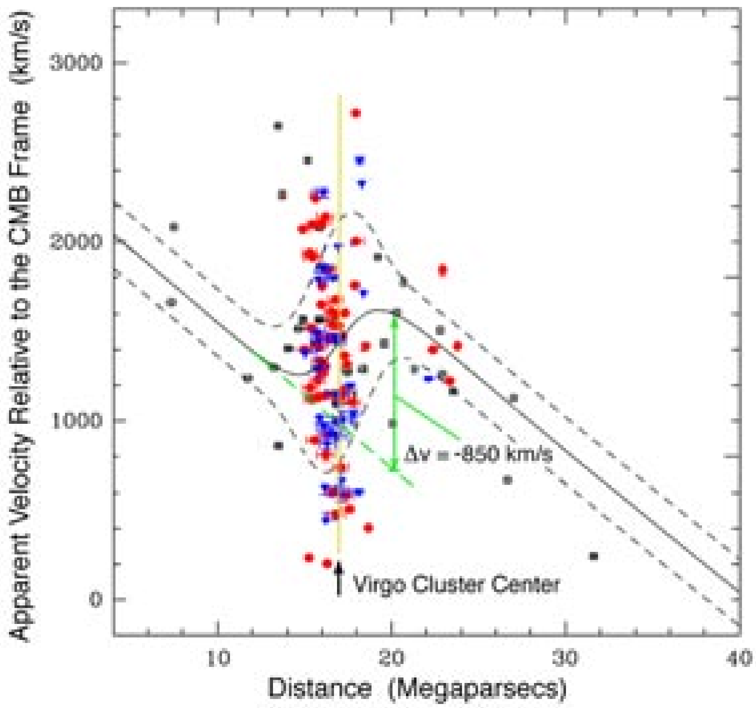

Figure 12. Tired-light redshifting and temporary blueshifting experienced by distant photons as they traverse through the Virgo cluster.

however, these two trend lines are seen to be displaced relative to one another as if the spectra of galaxies on the far side of the cluster had been collectively blueshifted! This presents an insurmountable difficulty for standard interpretations which attempt to explain the anomalous redshifts and blueshifts seen in the vicinity of the Virgo cluster as being due to the peculiar velocities of galaxies that exhibit a velocity component along our line of sight. For, if these galaxies were moving in symmetric fashion around Virgo's center of mass, one would expect an equal proportion of redshifted and blueshifted galaxies. Instead, we see that galaxies whose line-of-sight position lies close to the cluster center have an imposed blueshift bias. Neither can this discrepant blueshift be realistically explained by an assumed motion of the Local Group toward Virgo. So the observed blueshift offset remains unexplained by standard theory.

The S-shape of Virgo's redshift-distance relationship is telltale evidence that the Virgo cluster resides in an energy-amplifying supercritical region as predicted by SQK. Suppose that a photon begins its journey toward us from a distance of 40.5 Mpc initially losing energy at the rate of 8% per billion light-years travel distance, and hence redshifting at a rate of +78 km/s/Mpc. Upon nearing the Virgo cluster, and beginning around 3.7 Mpc from the cluster's center, prevailing supercritical conditions cause this redshifting trend to reverse and turn into a blueshifting trend, the redshift-distance relation within the cluster now yielding a slope of roughly -120 km/s/Mpc; see Figure 12. Once the photon has passed through the cluster and reached the side of the cluster facing the Milky Way, this blueshifting trend begins to taper off and finally reverse into a redshifting trend (left side of diagram). The redshift-distance relation on the near side of the Virgo cluster now converges to the same value it exhibited on the far side: +78 km/s/Mpc.

The total energy gain for the photons in their passage through the cluster amounts to an increase of 0.28 percent (or to an apparent velocity change of -850 km/s). This is arrived at by measuring the amount of vertical displacement between the two redshift-distance relations seen in seen in Figure 12, the relation for the photons approaching Virgo relative to that for the photons departing from Virgo. The cosmological blueshifting, at the rate of -120 km/s/Mpc, which photons undergo as they pass through the cluster, translates into a frequency blueshifting rate of $\mu = -3.9 \times 10^{-18}$/s [28]. This is about 2.5 times the photon blueshifting rate that SQK estimates for the Earth's vicinity [28].

In the SQK cosmology, each galaxy cluster resides in its own supercritical gravity well, a region where the G etheron concentration falls below its critical threshold. Such cluster gravity wells would have existed even before the emergence of the matter within them. They would have been present in primordial times due to the large scale steady state concentration inhomogeneities in the ether. For example, as mentioned earlier, such fertile regions in the ether could be created by quasi periodic variations in the B reactant concentration over a multi megaparsec scale [28]. No dark matter is required to explain the presence of such gravity wells. Once a number of galaxies self-emerge in this gravity well to form a galaxy cluster, the gravity wells produced by the baryonic matter in each galaxy will help to collectively maintain the cluster gravity well by consuming G etherons and locally lowering the cluster's collective $\varphi_g(r)$ potential. A photon traversing this cluster gravity well will undergo cosmological blueshifting at a rate that depends on the depth of the gravity well encountered, whether its trajectory takes it through the deeper central part or through its shallower more peripheral regions.

In addition, as a result of its baryonic matter, each galaxy will surround itself with a localized gravity well that will deepen the ambient potential of the cluster gravity well at the galaxy's location; the more massive the galaxy, the deeper and more extensive will be its gravity well. Upon leaving its origin galaxy, a photon would first pass through the galaxy's local supercritical gravity well and undergo a rate of cosmological blueshifting that would be proportional to the galaxy's mass. Blueshifting would continue at a somewhat lower rate as the photon traversed the surrounding galaxy cluster gravity well.

The galaxy spectra in the Virgo cluster span a range $\Delta v = 2875$ km/s. If we suppose that 950 km/s of this amount is due to the cosmological blueshift that photons acquire in passing through the Virgo supercritical region (source galaxy gravity well and cluster gravity well), this leaves a total spectral shift spread of about $\Delta v = 1525$ km/s which can be attributed to cluster kinematics; i.e., to galaxies having peculiar motions of about ±760 km/s. This is about half of Virgo's currently assumed peculiar velocity dispersion which implies a dynamical mass for Virgo that is about 25% of its currently estimated mass. This in turn reduces the need to assume the presence of large amounts of dark matter to keep the Virgo cluster together. The centripetal force exerted by the outer wall of Virgo's gravity well would also help to shepherd galaxies inward. Arp [130] has commented that there is only weak evidence that the redshifts in Virgo are quantized. This may be because the large peculiar velocities of Virgo galaxies tend to erase any quantization patterns that may be present.

Conventional practice has been to interpret Virgo cluster's blueward spectral shift kinematically, which leads to the implication that the Milky Way and local cluster galaxies are falling towards Virgo. But this spectral bias toward the blue could instead be considered as evidence of the SQK blueshifting effect operating in the Virgo cluster as was discussed above. As a result, galaxies located in the Virgo cluster would exhibit a net blueshift as their photons pass through the Virgo cluster supercritical region.

Gravitational Redshifting. In all of these examples it is important to consider also the effect of the gravitational redshift. For example, a star in a galaxy in the Virgo cluster would likely have a gravity potential that is much more negative than Earth's. Hence photons arriving from that galaxy, and which have undergone cosmological photon blueshifting on their way to us, will necessarily also exhibit a gravitational redshift that subtracts from that amount. Cappi [131] has estimated the gravitational redshift of galaxy clusters by assuming a de Vaucouleurs profile. A cluster that has a galaxy apparent velocity dispersion of ~1000 km/s is estimated to have a gravitational redshift of ~80 km/s, and for a cluster having an apparent velocity dispersion of

~1400 km/s is estimated to have a gravitational redshift of ~150 km/s. So it is apparent that this is a nonnegligible effect for some of the larger clusters. Also Stiavelli and Setti [132] have studied the radial velocity profiles of 24 individual galaxies to estimate their gravitational redshifts. As an example, two giant elliptical galaxies in the Pegasus constellation, NGC 7626 and NGC 7619 believed to have masses of 2 X 10^{12} $M_\odot$ and 10^{12} $M_\odot$, are estimated to have gravitational redshifts of 16 km/s and 7 km/s respectively.

The Fingers of God Effect and the Kaiser Effect. When the spectral shifts of cluster galaxies are mapped out in redshift space to form a wedge diagram, like that for the Virgo cluster shown in Figure 13 [133], they are found to adopt an elongated, appendage-like distribution. This is termed the *Fingers-of-God* effect since the axis of the distribution always appears to be directed towards Earth, as if by divine plan. The standard explanation is that the galaxies in the cluster have random peculiar motions with velocity components being directed both towards and away from the observer. However, in the case of the Virgo cluster, the inferred peculiar velocities are ±1450 km/s, so high that gravitational attraction due to visible matter is unable to hold the cluster together. To retain the assumption that these spectral shifts are due to peculiar velocities and to avoid the ultimate dispersal of the galaxies, the assumption is made that the cluster contains large amounts of dark matter. But this is essentially an ad hoc fix since there is no way to independently verify whether dark matter really exists.

This Doppler shift assumption runs into even more trouble when larger more distant clusters are considered. For example the wedge diagram for the Shapley supercluster shows galaxy redshifts extending from less than 1000 km/s out to 60,000 km/s. This velocity spread is so large

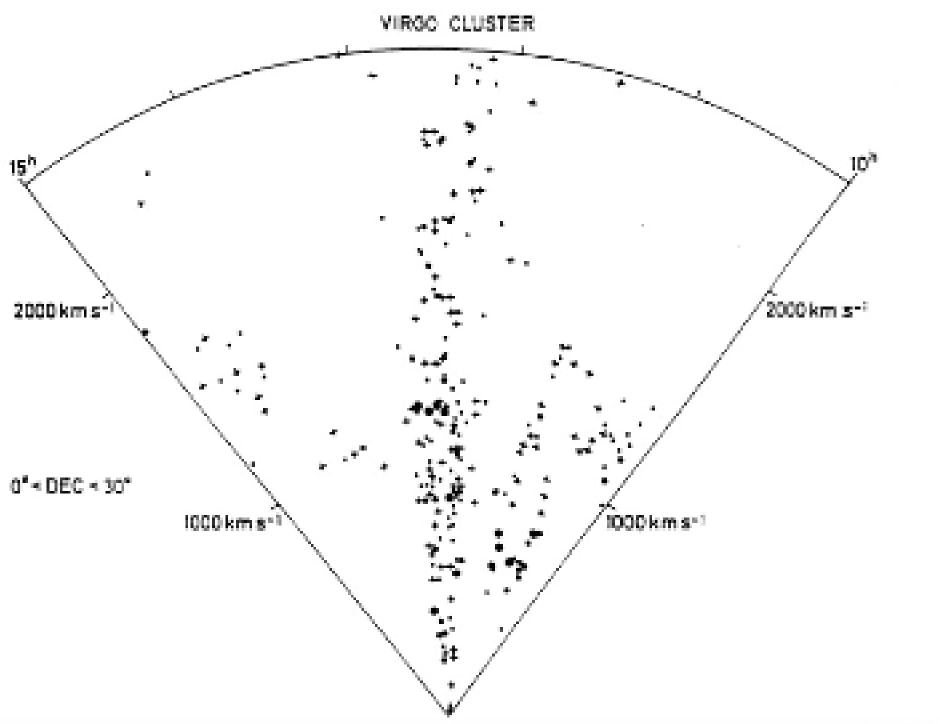

Figure 13. Wedge diagram for the Virgo cluster (after Arp, 1994). Crosses represent spiral galaxies Sc or later. Symbol size is proportional to apparent magnitude. Note the long vertical distribution of galaxies in redshift space. Galaxies situated further from the line of sight, hence toward the edge of the cluster's gravity well, display higher redshifts with a slight drift toward lower right ascension.

that assumptions about dark matter are of no help. Standard cosmology is then forced to assume that these redshifts are mainly cosmological in nature and that the cluster is shaped like an immense sausage whose axis is oriented along our line-of-sight. Using the adopted value for the Hubble constant (72 km/s/Mpc), this leads to the conclusion that the Shapley supercluster extends from the solar neighborhood out to a distance of 800 Mpc, with galaxies at the far end of the cluster receding from the cluster's low redshift galaxies at almost 20% c. Over such large distances cluster gravity fields would be ineffective at keeping the galaxies together as a cluster even if dark matter were included. So, we are asked to believe that this supercluster actually extends over this great distance and is physically oriented so that it points directly towards us. Suggestions that this orientation is due to chance are inadequate since this supercluster is just one of many galaxy clusters that exhibit highly extended Fingers of God effects. The only way to avoid the problem is to admit that the redshifts of these galaxies are not entirely Doppler in nature, which in turn requires that we abandon the expanding universe assumption.

The SQK cosmological blueshifting effect may offer a solution. It predicts that since photons traveling towards us from galaxies either located within the cluster core or on the far side of the cluster will necessarily traverse the cluster's supercritical gravity well. Galaxies situated centrally on the far side of the cluster would be blueshifted to such an extent as to appear greatly displaced toward the observer in redshift space, adopting a very elongated appendage-like distribution, as shown in Figure 14 (left).

Subquantum kinetics also predicts why the Fingers of God redshift distribution is cusp shaped. That is, galaxies aligned with our line-of-sight to the cluster's center will be seen to exhibit the greatest displacement in redshift space with either very low redshifts, Photons coming to us from peripheral galaxies positioned on either side of the line-of-sight are predicted to undergo a lesser amount of blueshifting because their trajectories take them through the fringe of Virgo's gravity well where the ether is not as supercritical and the blueshifting rate is lower. Hence those galaxies will appear further away from us in redshift space, while at the same time the cluster will appear pancaked toward the observer, adopting the shape of an oblate ellipsoid; see Figure 14 (left). Such pancaking is in fact observed and is referred to as the Kaiser effect [134]. Standard cosmology attributes the Kaiser effect to coherent peculiar motions of the galaxies. Thus whereas the Fingers of God effect is conventionally attributed to random peculiar

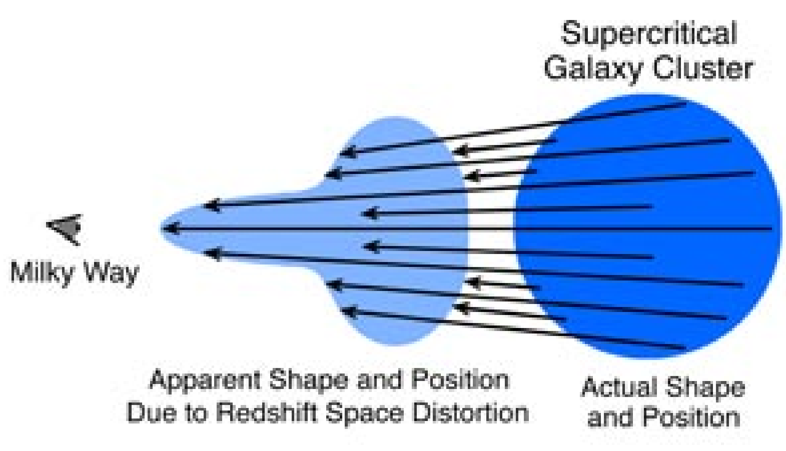

Figure 14. A typical galaxy cluster plotted in redshift space showing how the Fingers of God elongation effect and Kaiser pancaking effect are created when photons coming from the far side of an approximately spheroidal galaxy cluster undergo cosmological blueshifting during their passage through the cluster's supercritical region.

motions, just a bit further out toward the periphery of the same cluster we are asked to believe that these peculiar motions now become coherent in such a way as to explain this pancaking effect. Thus standard theory is burdened with assumptions in order to explain these effects.

Subquantum kinetics also predicts a redshift inversion effect since galaxies residing on the far side of the cluster will have their spectra blueshifted more than galaxies residing on the cluster's near side and hence would appear closer to us in redshift space. For example, blueshifted galaxies like M86 and M90, which have apparent velocities of around -350 km/s, are predicted to lie on the far side of the cluster their light traversing the entire Virgo cluster supercritical region. The Seyfert galaxy NGC 4388, which has one of the largest redshifts observed in the Virgo cluster, about +2525 km/s, would actually be situated on the near side of the cluster. If we assume that 760 km/s of this amount is due to peculiar recessional motion, 100 km/s is due to a gravitational redshift contribution due to photons climbing out of Virgo's gravity well, and 360 km/s is due to an intrinsic redshift of the sort that Arp [133] has proposed, this would leave about 1300 km/s to be attributed to a cosmological tired-light effect as the photons journeyed to us.

Cosmic Voids. Subquantum kinetics predicts that cosmic voids also should exhibit a form of the Fingers of God effect, but in this case due to excessive redshifting. Voids would be regions where the ether reactions are more subcritical than in surrounding regions of space. Hence photons traveling to us through such voids would redshift (lose energy) more rapidly than in surrounding regions of intergalactic space, causing galaxies on the void's far side to appear to lie further away from us in redshift space. This would cause the voids to appear elongated along our line of sight as shown in Figure 15. In fact, void elongation is confirmed by observation. A study of the shapes of voids concludes that they appear roughly as prolate ellipsoids with ellipticities averaging around 0.35 when plotted in redshift space [135,136]. That is, in redshift space, they will appear about 1.5 times longer in the radial direction than in the transverse direction. Like the elongation effect observed in galaxy clusters, the voids give the impression that they are all "pointing" towards us.

The standard explanation is that this distortion arises because galaxies at the void boundaries have coherent peculiar velocities causing them to move as a group away from the void's center. This though creates a mystery as to what force would be pulling them all away from these centers. Gravity itself is not strong enough unless one is willing to assume unreasonably large quantities of dark matter lurking beyond the void walls. The other suggestion that has been made to account for this phenomenon is to claim that the expanding universe deceleration parameter q_0 becomes negative inside voids, on the assumption, for example, that the void contains dark

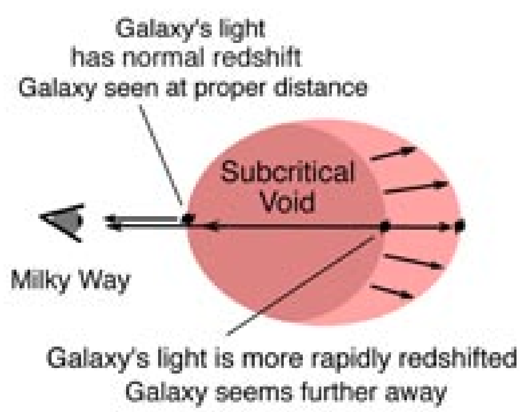

Figure 15. The apparent elongation of cosmic voids in redshift space as predicted by subquantum kinetics.

energy that causes it to expand more rapidly than surrounding regions of space [137]. However, such hypotheses are introduced ad hoc in order to explain how a spheroidal shaped void might appear elongated in redshift space. Subquantum kinetics, on the other hand, predicts this phenomenon, as well as the Fingers of God and Kaiser effects, without additional assumptions.

Voids by definition are regions with fewer galaxies. According to SQK this has occurred because subatomic particles have more difficulty nucleating there because the ether is more subcritical there. Also matter creation would proceed far more slowly there. In addition, galaxies residing in cosmic voids are found to be subluminous. Hoyle, et al. [138] have compared the luminosity distributions of distant void galaxies to distant wall galaxies and have found that on average void galaxies are dimmer; see Figure 16. Murawski [139] has studied the void between the Virgo and Coma clusters suggests that the dimming may be due to an intergalactic gas cloud causing 0.45 mag of absorption. However, according to SQK, void galaxies would be dimmer because galaxies there would form gravity wells that are less supercritical than in other regions of space, and hence due to a slower rate of photon blueshifting, stars in such galaxies would generate *genic energy* at a slower rate. Since genic energy is predicted to account for all the energy output of lower main sequence stars, and for part of the energy output of upper main sequence stars [28], the luminosity of such galaxies would accordingly be lower when compared with galaxies located in a cosmic wall where the ether environment would be more supercritical.

The Local Void, the one that is closest to us, measures about 60 Mpc in size and its nearest side lies about 2 Mpc away from us with the LG lying in the bordering cosmic wall. Some have suggested that the void is exerting a pressure on LG cluster galaxies, pushing them away toward the Virgo cluster which lies in the opposite part of the sky. Our galaxy, for example, is estimated to be moving away from the void at about 260 km/s [140]. Subquantum kinetics, on the other hand, suggests that much of the excess redshift normally attributed to peculiar galaxy recession

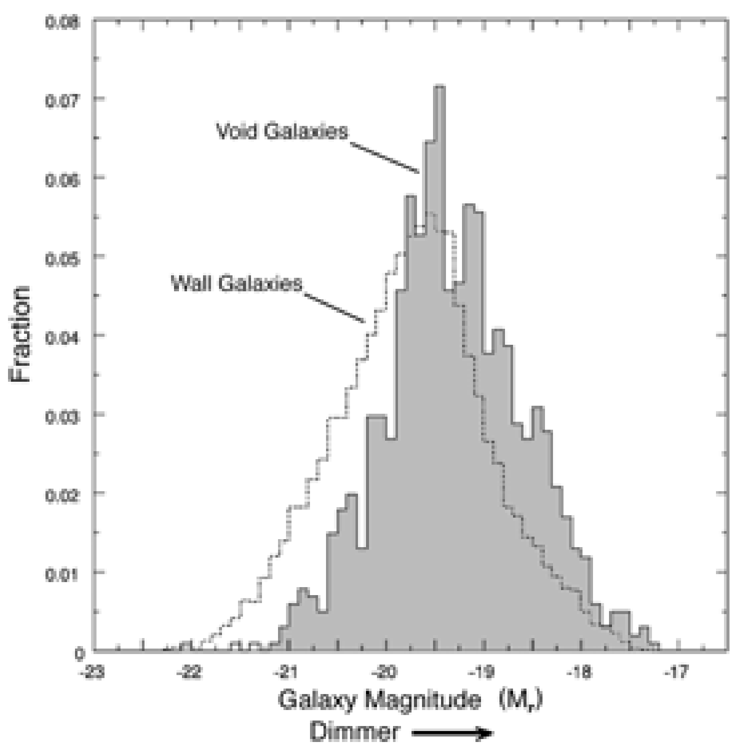

Figure 16. A comparison of the distribution of absolute magnitudes of void galaxies (shaded) to wall galaxies (after F. Hoyle, et al.).

could instead be an artifact of the excess redshifting that photons are undergoing as they journey to us through the void.

Local Blueshift Biasing. According to SQK, photons should undergo cosmological blueshifting as they pass through the supercritical gravity well of our LG cluster. Such local blueshifting is indicated by the finding that the redshift-distance regression line for dwarf galaxies, which is linear at distances greater than 2 Mpc, bends downward to negative apparent velocities as the LG cluster is approached; see Figure 17, after Karachentsev, et al. [141]. Given that zero distance along the x-axis marks the location of the LG centroid, then the downward sloping regression line projects a negative spectral shift of -140 km/s at the centroid location. For the Milky Way, which is stated to lie 0.43 Mpc from the centroid, the trend line projects a spectral shift of -75 km/s. M31 would be located at a distance of 0.35 Mpc from the centroid, but on the opposite side of the centroid from the Milky Way. The Hubble flow trend line, which is represented by the downward sloping solid line, projects a zero redshift value at a distance of ~1 Mpc from the cluster barycenter. Although, in the present context of interpreting spectral shifts in nonvelocity spectral shifts, the term "Hubble flow" would be a misnomer in that galaxies in this context would not be "flowing" away from us. The diagram also plots the spectral shifts of LG galaxies that are members of the Local Group but places those galaxies, including M31, as having an average distance from the Local Group centroid as that of the Milky Way.

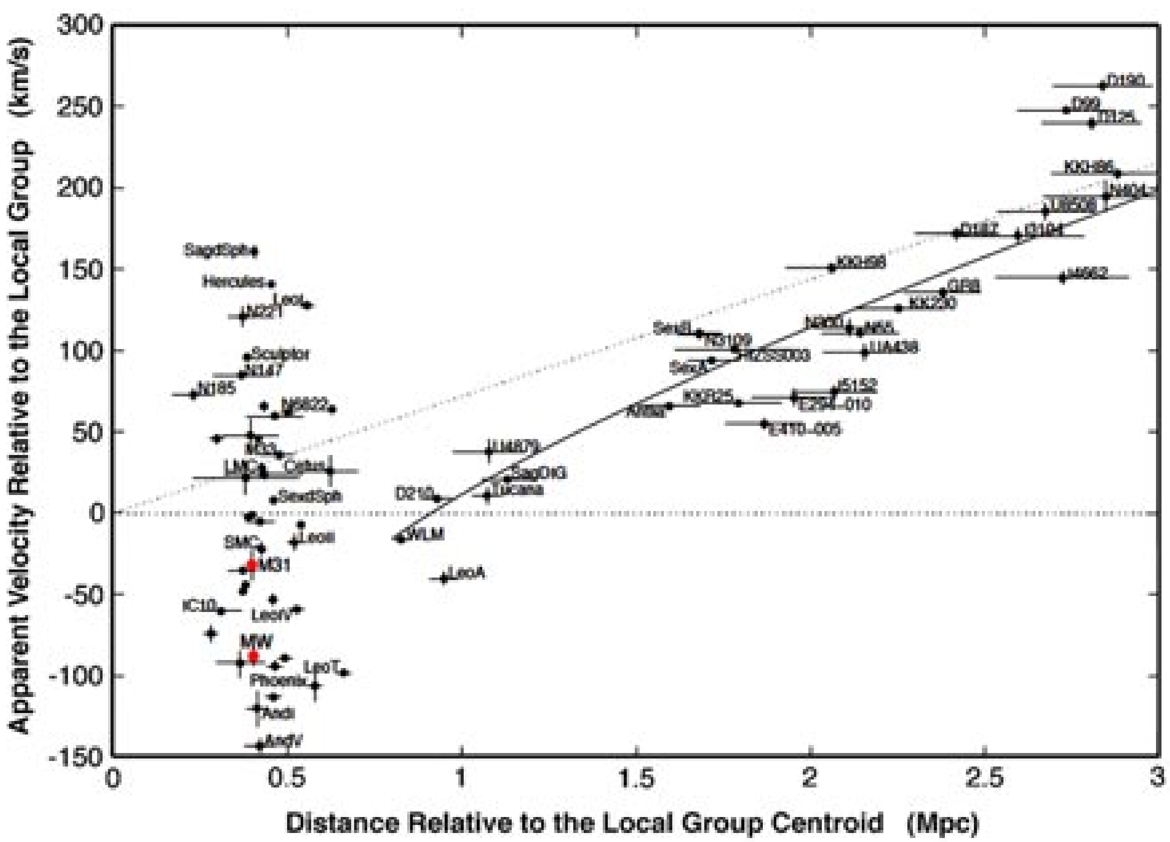

Figure 17. Spectral shifts and distances to various galaxies within 3 Mpc of the Local Group centroid (x-axis 0). The solid line plots the regression fit to the Hubble flow data. The inclined dotted line above it represents the linear Hubble relation for H_o = 78 km/s/Mpc. The horizontal line is the zero-velocity line. After Karachentsev, et al. [141]

According to SQK, the LG's supercritical region would have a radius of about 1 Mpc which is far smaller than that of the Virgo cluster which likely has a radius of about 4 Mpc. Also Virgo's gravity well would be much deeper than that of the LG which explains why the Virgo cluster exhibits a far greater degree of blueshifting. The conventional kinematic interpretation of Figure 17 is that the Hubble flow begins about 1 Mpc from the LG centroid. But, the absence of cosmological expansion in the LG is not predicted by standard big bang theory and requires ad hoc assumptions to account for it.

Another concern for the concordance cosmology is that the local Hubble Flow is so cold, galaxies having very little dispersion around their trend line, ±2 km/s. This has led Sandage [142] to comment "...the explanation of why the local expansion field is so noiseless remains a mystery." Also Karachentsev, et al. [143] write, "The most enigmatic property of the local Hubble flow turns out to be its 'coldness'." This mystery evaporates when the local Hubble flow is understood to be due to tired-light energy loss in a cosmologically static universe. In particular, in SQK the redshifting rate is related to the criticality of the ether, which changes in the vicinity of clusters or voids, but attains an average value when large distances are spanned.

Subquantum kinetics also predicts that photons coming to us from the Andromeda galaxy should be blueshifted as they successively pass through Andromeda's supercritical gravity well, the LG cluster gravity well, and finally the Milky Way's gravity well. In fact, Andromeda is seen to exhibit a substantial blueshift. Here we adopt the value of –86 km/s measured by Arp [88, 144] which is based on his conclusion that the Sun has a Galactic orbital velocity of 220 km/s [89]. Traditionally, Andromeda's blueshift has been interpreted kinematically as evidence that the galaxy has a velocity component directed toward the Milky Way. However, Arp's [88] findings that the spectral shifts of Local Group companion galaxies relative to that of M31 are quantized in 72 km/s steps with a standard deviation of ±17 km/s around those periodic values has led him to conclude that the peculiar velocities of our neighboring galaxies should be no greater than this σ value. Moreover Karachentsev's observation that the local Hubble flow exhibits a standard deviation of only ±25 km/s supports Arp's thesis. So Arp appears to be correct in his suggestion that M31's blueward spectral shift is for the most part non-velocity in origin.

The solution predicted by SQK is that Andromeda's blueshift is due to cosmological photon blueshifting taking place within the supercritical gravity wells of both the Andromeda galaxy as well as within that of our own galaxy. If we adopt the intergalactic blueshifting rate between M31 and the Milky Way as averaging -75 km/s/Mpc, we arrive at a blueshift of about 58 km/s. The remaining 28 km/s could be attributed to blueshifting occurring within M31 as well as within our own galaxy.

Nonvelocity Blueshifting Influenced by Galaxy Mass and Morphology. Arp [145] has studied galaxy groups consisting of a primary galaxy with interacting companions and has shown that companion galaxies had redshifts averaging 122±34 km/s higher than that of the dominant galaxy, i.e., higher than that of the more luminous and massive galaxy in the cluster. Regarding the spectral shift bias seen in the LG cluster, Arp [144] has stated that if the shifts are interpreted as peculiar velocities of the companions there is only one chance in 4 million that we would be viewing the cluster at a privileged time when all of its satellite galaxies happen to be collectively receding from us. Since 1970, at least 18 studies of this redshift anomaly have been carried out and all show the effect to be real. This has long been a thorn in the side of conventional astronomy since the concordance cosmology has no explanation for it. Bottinelli and Gouguenheim [146] have studied 20 galaxy groups containing 52 companion galaxies and confirmed that companion galaxies have redshifts that are systematically higher by about 90 ± 8 km/s. But, they also considered the reverse, namely the lack of redshift in the main galaxy relative to the companion galaxies, and as expected found the main galaxy's redshift is generally lower by about 90 km/s, hence blueshifted relative to the companion galaxy spectra.

Arp and Sulentic [144] have proposed that the companion galaxies are the ones with the anomalous spectral shifts, whereas SQK proposes just the opposite, that the primary galaxies instead have intrinsic blueshifts relative to their low-redshift companion galaxies According to this theory, the more massive older galaxies, such as giant ellipticals, should have deeper gravity wells and hence should undergo greater photon blueshifting than companion galaxies which are less massive and have shallower gravity wells. Also primary galaxies are usually found at the cluster's center, hence in a region of more negative gravity potential, and this in turn would cause their spectra to be blueshifted to a much greater extent.

So which interpretation is the more correct? The redshift quantization findings suggest that the intrinsic blueshift interpretation may be more correct. Arp and Sulentic [144] report finding a 72 km/s quantization interval when considering redshifted companions to the M31 and M81 primary galaxies. This matches the quantization interval that Tifft, Cocke, and others have reported for more distant galaxies. But no quantization is seen in either of these galaxy clusters when considering galaxies that have *blueshifted* spectra. Also Napier and Guthrie [85] have found a strong 71.1 km/s quantization in the Virgo cluster when galaxies near the core were avoided, i.e., they obtained good quantization results by avoiding galaxies having blueshifts and low redshifts. This outcome, though, may be understood from the perspective of SQK. The blueshifted galaxies would be the ones whose spectra have been most altered by cosmological photon blueshifting. Hence, any spectral quantization pattern that otherwise would have characterized the galaxy would become erased by such blueshifting which would be different for each galaxy. Only the redshifted companions, those whose rate of photon spectral shifting has been least altered by the gravity well of the cluster and primary galaxy would be the ones to reveal their tired-light quantization pattern in an "undisturbed" state. Taking into consideration the spectral quantization observations, we are led to conclude that it is more proper to regard the more massive, more blueshifted galaxies in the cluster to be the ones having the anomalous spectral shifts.

Arp and others [133, 147, 148] also report the presence of a redshift discrepancy that depends on galaxy morphology. They find that Sc and Scd "late type" galaxies have an excess redshift when compared to earlier type companion galaxies of Sa and Sb morphology. Part of this morphology-dependent redshift effect is anticipated by SQK. Sc and Scd spirals, for example, have arms that are more loosely wrapped and hence distribute their galaxy's mass over a large area thereby producing a relatively shallow gravity well in the vicinity of the galaxy's disc. Sa galaxies on the other hand, have their arms more tightly wrapped around the galaxy's bulge, hence concentrating most of their mass in a much smaller volume and resulting in a deeper gravity well. Sb galaxies have properties intermediate between Sa and Sc, but still their gravity wells would be deeper than those of Sc galaxies. Hence because Sa and Sb galaxies have deeper gravity wells, they would undergo the greater amount of photon blueshifting and hence should exhibit a smaller redshift than Sc galaxies, as is observed. However, in the larger galaxy clusters, such as the Virgo and Abell clusters, this redshift discrepancy between Sc and Sb galaxies is particularly large, of the order of 1000 km/s or more, far too great to be accounted for by differences in photon blueshifting rates within the respective galaxies. Neither does the concordance cosmology offer any suggestions.

Alternatively, Arp and Narlikar [87] have proposed a variable mass theory to account for the intrinsic redshifts of quasars and companion galaxies, linked with Arp's suggestion that the high redshift companion galaxies grew from matter that was formerly ejected from the nucleus of a nearby primary galaxy [88]. They have accordingly proposed that the subatomic particles, and in particular electrons, forming the newly created matter in these companion galaxies are initially less massive than particles making up the matter of the primary galaxy and that their inertial masses gradually increase as the companion galaxies age. Accordingly, the younger galaxies would initially have elevated Rydberg constants, causing their stellar spectra to be more redshifted as compared with to those in the primary galaxy and would gradually decrease over time to eventually approach the spectral shift of the primary galaxy as they develop into normal spiral galaxies. But, if this were the case, and assuming that the core of our Galaxy also produces new matter which it continually expels, why then do we not see high redshift absorption lines in the vicinity of Sgr A*.

6. Cosmogenesis, Quasar Evolution, and Quasar Redshifts

Arp [150] has provided extensive observational evidence of X-ray quasars being aligned within 20° of the minor axis of active galaxies with the implication that they were once ejected from the parent galaxy's core. He also has shown evidence of companion galaxies lying within a 35° cone angle of the galaxy's minor axis with a probability of one in nine million that these alignments are due to chance [133]. He concludes that the alignments indicate that quasars have been ejected from the core of the primary galaxy, the ejections occurring at spaced intervals as a result of recurrent activity of the primary galaxy's core. He finds that the following evolutionary sequence leading from quasars to companion galaxies: ejected quasar → BL Lac object → bright disturbed companion galaxy → normal companion galaxy. Accordingly he suggests that ejected quasars gradually grow in size and brightness by continuously generating and expelling gas which over time comes to form a surrounding stellar population. Eventually, the quasar is proposed to develop into a BL Lac object, which is a relatively compact body with spectral properties reminiscent of a quasar, but showing evidence of being surrounded by a fuzz. As more gas is expelled from the central condensed mass, a BL Lac object is theorized to later develop into a disturbed companion galaxy with a more extended stellar population, which later grows into a normal companion galaxy.

The above evolutionary sequence suggests that the supermassive core of the primary galaxy is continuously creating matter, some of which is expelled from the core as a stellar wind, some of which remains to increase the core's mass, and some of which is ejected as a clump of matter; i.e., a quasar, when the core is particularly active. Furthermore this matter creation process is theorized to continue within the ejected quasar, some matter being retained within the quasar to cause it to grow in size and some being expelled to eventually form a surrounding disc and spiral arms. Others who have suggested that matter is created in galactic cores and ejected to eventually form companion galaxies include Jeans [110], Ambartsumian [151,152], McCrea [111], Sersic [153], and Hoyle and Narlikar [154]. Like Arp, all arrived at their conclusions on the basis of observation.

The observational evidence that Arp has gathered suggests that galaxies proliferate in a manner that resembles asexual biological reproduction, the primary galaxy being the mother, the ejected quasar being its birthed embryo, and the companion galaxy that the quasar eventually evolves into being the daughter galaxy that develops. This scenario may sound a bit strange to astronomers. But, with the demise of the big bang theory, it will be necessary to think in different terms. The new paradigm of continuous creation will be one in which existing matter generates new matter, where galaxies birth daughter galaxies, and where the universe functions as an *open* system. In this new view, astrophysics will ultimately come to have much in common with the life sciences.

The Model G ether reaction system of SQK predicts a similar continuous creation scenario, but approaches it from the side of theory. According to SQK, neutrons are not only created from zero point energy fluctuations of critical size but also nucleate rapidly in the vicinity of existing subatomic particles, a process that has been confirmed in simulations of the Model G reaction system. Subquantum kinetics represents the rate of matter creation per unit mass M of existing matter as:

$$(dM/dt)/M = k_g \bullet \varphi_g \bullet T^{0.5}, \tag{17}$$

where k_g is the constant of proportionality, φ_g is the ambient gravitational potential, and T is the ambient temperature; see chapter 8 of LaViolette [28]. Whereas in the early universe matter creation proceeded relatively slowly as particles gradually nucleated from zero point energy fluctuations, once hydrogen had accumulated in space, had formed stars, and eventually evolved into supermassive cores, matter creation was able to proceed far more rapidly. According to relation (17), a planet should have a greater rate of matter creation per unit mass than an intergalactic hydrogen gas cloud, a star should have a still greater rate of matter creation per unit mass, and a quasar or galactic core should have by far the highest rate of matter creation per unit mass. In fact, according to one estimate, the core of our galaxy, Sgr A* comprises less than 0.01% of the Galaxy's mass, yet produces over 99.9% of the Galaxy's matter [28].

The core of a primary galaxy would not only expel quasars, but also globular clusters and dwarf spheroidal galaxies as well, both of which would harbor quasar-like bodies at their centers [28]. As Arp has noted, ejections that leave the primary galaxy have a trajectory aligned close to the galaxy's polar axis. Those that instead emerge along the galaxy's equatorial plane would become disrupted by orbiting stars, and would ultimately become entrained in the galaxy's disc. This equatorially expelled matter ultimately increases the galaxy's diameter and contributes to the formation of spiral arms. Subquantum kinetics proposes that galaxies evolve from dwarf spheroidals to dwarf ellipticals to spirals to giant ellipticals in a manner depicted by Edwin Hubble's tuning fork diagram with the exception that giant ellipticals would be a late stage of galaxy evolution developing from spiral galaxy precursors.

Subquantum kinetics proposes that the same outpouring of genic energy that is responsible for the radiation coming from quasars also provides the internal pressure necessary to allow a galactic core to fission and expel part of itself as a quasar. Standard astrophysics fails to explain this since it models a galactic core as a black hole which is only able to acquire energy by pulling in matter from its environment. The problem is that there is little evidence that matter falls into galactic cores; in most cases matter is seen to be energetically expelled. The same source of energy theorized to cause masses to be ejected from a core are also able to account for the energy that powers supernova explosions, even the very energetic hypernovae; see LaViolette, section 9.14 [28]. Standard physics leaves the source of this energy unexplained.

Another puzzle that needs explaining is the high intrinsic redshifts of quasars. In the quasar-galaxy associations which Arp has studied, the quasars are seen to have redshifts far in excess of those of the primary galaxy that had ejected them. Arp regards these as non-velocity redshifts that are intrinsic to the quasars and not Doppler shifts of cosmological origin as conventional cosmology maintains. One explanation offered by SQK is that a quasar's highly discrepant redshift is due to gravitational redshifting as its radiation emerges out of its gravity well. Hoyle [155] and Clube [156] have also proposed that quasar redshifts are of gravitational origin. According to SQK, radiation can emerge from a quasar and be seen because a quasar is not a black hole as is conventionally assumed. In SQK, a quasar is a late stage in the evolution of a star, the growth sequence being: planet → brown dwarf → red dwarf → main sequence star → mother star. A *mother star* is essentially a bare stellar core, similar to a white dwarf or neutron star, but of far greater mass in excess of the Chandrasekhar limit. Mother stars can range in mass from a few solar masses to billions of solar masses depending on how much matter they have been able to spawn.

In SQK a stellar core is unable to collapse into a black hole singularity for two reasons. First, it never stops creating energy. Not only is matter continuously created within them, thereby providing a continual supply of fuel for fusion, but more importantly they continuously generate *genic energy* due to the photon blueshifting that takes place within them. Since the rate of photon blueshifting within a star depends on its gravity potential and since the gravity potential well of a mother star is many orders of magnitude deeper than that of main sequence stars, the resulting extreme supercritical state within will cause it to produce energy in its interior at a very high rate. As the star's core radius R diminishes during collapse, the genic energy radiation pressure increases as $1/R^4$, countering the inward pull of gravity which increases only as $1/R^2$; see LaViolette, section 9.13 [28]. A core would ultimately cease its collapse at a radius where the two forces balanced. This equilibrium would be reached regardless of whether the star is non degenerate, at which point it would have evolved into a mother star.

Another reason why black holes are not able to form in SQK is because according to this physics the gravitational field potential within a subatomic particle should taper to a zero gradient at the particle's center, as shown in Figure 10. Hence as particles within a collapsing stellar core are pressed increasingly close together, the gravitational force attracting them to one another approaches zero. There is observational evidence to support such a gravity field configuration within subatomic particles. We know from the particle scattering experiments of Kelly [118] that the charge distribution within a neutron or proton rounds off in hill-like fashion at the particle's center. Also, as mentioned in Section 4, we know from the research of T. Townsend Brown and others that the gravitational and electric fields are coupled, that gravitational potential correlates with electric potential [121-125], a phenomenon also predicted by SQK. Hence given that the electric field potential plateaus at the particle's center, it follows that the gravity potential field should also plateau, just as Model G predicts.

As one example of a redshifted mother star, consider quasar 4C +37.03 which is located about 3.7° of arc from M31 along the galaxy's minor axis [157] and which has a redshift of 1.7. If this were interpreted as a gravitational redshift, it would be about 6300 times greater than the redshift of 80 km/s seen at the surface of the white dwarf Sirius B. Hence the quasar's emission line radiation would be coming from a region whose gravity potential is 6300 times more negative than Sirius B. Given that Sirius B has a mass-radius ratio of $M/R = 3.3 \times 10^{23}$ kg/m, the emission from 4C +37.03 would be coming from a region where M/R is 2.1×10^{27} kg/m. Assuming for the purpose of illustration that the quasar has a mass of $10^6\ M_\odot$, a redshift of 1.7 would be seen if its emission came from a radius of about 1.4 $R_\odot$ presumably near the star's surface. This is far smaller than the gravitationally lensed Schwarzschild radius for a one million solar mass black hole, which would lie at about 23 $R_\odot$. But in SQK such a restriction does not exist, since it proposes that gravity wells do not warp space, as general relativity proposes, so radiation would be able to emerge from a mother star and be visible, although it would be highly redshifted due to the gravitational redshift effect [28]. Since the wavelength of the redshifted line would depend on the depth in the gravity well where the emission originated, emission coming from various depths in the quasar's gravity well would cause broadening of the quasar's emission line spectrum, as is observed. If this mother star had a mass of $10^6\ M_\odot$ and a radius of 1.4 $R_\odot$, it would have an average density of 5.6×10^8 kg/m^3, which is about one fourth of the density of Sirius B.

Arp has noted that quasars ejected from the core of a primary galaxy, over time increase in diameter and decrease in redshift. He finds that an ejected quasar typically has an intrinsic redshift which ranges from about z = 2 to z = 0.3, that the growing quasar eventually evolves into a BL Lac object which would have a redshift ranging from z = 0.3 to 0.1, and then develops into a disturbed companion galaxy with a redshift ranging from z = 0.09 to 0.005. Finally, as the galaxy continues to mature, it would evolve into a more normal companion galaxy with a redshift that ranges from slightly higher than that of the main galaxy on up to z = 0.005. The progressive drop in redshift that Arp describes in the evolutionary sequence from quasar to companion galaxy could be due to the quasar's emission region migrating outward from its surface as the quasar grows in size and gradually develops into a galaxy.

But an explanation of the quasar redshifts must grapple with the finding that their spectra are quantized in increments of z = 0.3 and greater forming a redshift sequence that conforms to the Karlsson formula [158, 159]. If the intrinsic redshifts of quasars are gravitational in origin, further thought needs to be given to explain why they happen to be quantized, and why they are quantized in increments far larger than those characterizing the cosmological redshift of distant galaxies. Might this be due to the existence of metastable states in the radius of a quasar/mother star and hence in the value of the gravitational potential prevailing near its surface?

Marmet has also proposed his photon scattering explanation to account for the intrinsic redshifts of quasars as well as galaxies. So, besides the gravitational redshift mechanism, this could be another explanation for the intrinsic redshifts of quasars. Also there is the variable mass theory of Arp and Narlikar discussed in Section 5 that has been proposed to explain the high intrinsic redshifts of quasars.

7. Conclusion

Arp [160] has stated that the observational evidence against the big bang theory has become overwhelming and that the theory in reality has been toppled. This is also the conclusion arrived at in the present overview. As shown above, the no-evolution, tired-light model makes a better fit than the expanding universe hypothesis when compared to the observational data of six cosmology tests. Also it has been shown that the supernova light curve test of Goldhaber, et al. is flawed by selection effect biases. Studies of x-ray bursts and gamma ray bursts also show no evidence of time dilation with increasing redshift. So based on the current evidence which indicates that there is no time dilation one may conclude that the universe must be cosmologically stationary. Furthermore the finding that the cosmological redshift values are quantized introduces a serious impediment to the Doppler interpretation of the redshifts. The tired-light theory fares much better since discrete transitions are a common phenomenon at the quantum level. Hence it is not a very big jump to imagine that tired-light photon's also exhibit this phenomenon when they spontaneously lose energy. Arp finds that in the Local Group and Sculptor Group the differential galaxy redshifts of companion galaxies relative to the main galaxies are quantized which indicates that these companion galaxies cannot have peculiar velocities greater than ±17 km/s. This in turn presents a serious challenge to the concordance cosmology to interpret these galaxy redshifts in velocity terms.

Furthermore the finding that the microwave background radiation is much smoother than was originally thought leads to the conclusion that dark matter and dark energy are not present in the universe, which presents a significant problem for the big bang theory. Moreover since continuous creation cosmologies like SQK are able to adequately account for the microwave background radiation through the mechanism of beta particle emission from nascent neutrons, there is no need to consider a big bang as being the only explanation. The concordance cosmology also has great difficulty in explaining the heating of the WHIM, whereas beta particle emission from continuously created neutrons provides an adequate explanation. In addition, the discovery of megaparsec sized ring patterns in the cosmic background data presents a major problem to the concordance cosmology, but is easily explained by the continuous creation cosmology of SQK. Similarly, the concordance cosmology offers no explanation for the regular periodicity in galaxy cluster density that spans more than 5 billion light years, whereas this phenomenon is readily explained by SQK. The discovery of galaxies as far away as z = 11.9 also presents a serious problem for the big bang theory since such galaxies would need to be fully formed at just 350 million years after the big bang, and before the beginning of the reionization period. This implies that the stars composing this galaxy would have begun their formation before the time of the purported big bang.

The continuous creation physics of SQK has been shown to have other advantages as well. It not only predicts a tired-light effect for photons traveling through intergalactic space, but also provides a mechanism for the continuous creation of matter. While other tired-light theories account for the cosmological redshift, they do not simultaneously provide a mechanism for the creation of matter. Furthermore SQK has been shown to spontaneously produce only matter and not antimatter, something that the big bang theory fails to do. This solves the mystery of why no antimatter galaxies have been found. Moreover SQK also predicts that a galaxy's gravity potential field should eventually plateau to the local extragalactic gravity potential, beginning to depart from a Newtonian relation at distances greater than about 3 kpc in a manner similar to MOND. This not only provides an answer as to why the universe does not spontaneously undergo gravitational collapse, but also makes unnecessary assumptions about the presence of dark matter in galaxies.

In addition to the tired-light effect, SQK also predicts a photon blueshifting effect, a kind of negative Hubble constant, occurring within the gravity wells of galaxies and galaxy clusters. This effect is able to explain the blueshifting of galaxy spectra seen in clusters such as the Virgo cluster as well as within smaller clusters such as the Local Group. The same blueshifting phenomenon predicts the Fingers of God effect as well as the Kaiser pancaking effect seen when galaxy cluster spectra are plotted in redshift space. It also explains why massive primary galaxies in a cluster are blueshifted relative to their companion galaxies. Subquantum kinetics, also explains why cosmic voids appear pancaked when plotted in redshift space. It also accounts for why galaxies residing in cosmic voids are dimmer and why those located in the centers of galaxy clusters are brighter than average. Finally, it predicts a mechanism for the ejection of quasars from galactic cores and also explains why quasars have large intrinsic redshifts, which it ascribes to gravitational redshifting of their radiation. It also provides a theoretical basis for Arp's model where ejected quasars gradually evolve into companion galaxies. In summary, neither the big bang theory nor any other cosmology is able to explain so much without including numerous ad hoc assumptions.

It may be correctly said that the big bang theory has been disproved for some time now, but much of the astrophysical community has yet to become aware of the fact. The concordance cosmology is essentially a leaky ship that has had many ad hoc patches applied to keep it afloat, and its crew fears to abandon it because they are unaware that there are theories that could replace it. Another impediment is that in abandoning the big bang theory, one is inevitably led to a theory in which matter is continuously created, which in most cases requires that one abandon the tenet that the First Law is universally valid. The violation of energy conservation, however, is not a problem in SQK since this theory requires that the universe functions as an open system.

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