

Interpreting the Universe's Expansion Redshift Data with Respect to Energy

Solomon BT^{1*} and Beckwith AW²

¹ Chairman, Xodus One Foundation, 4033 Palmwood Dr #8, Los Angeles, CA 90008, USA

² Physics Department, Chongqing University, College of Physics, Chongqing University Huxi Campus, No. 44 Daxuechen Nanlu, Shapinba District, Chongqing 401331, People's Republic of China

***Corresponding author:** Benjamin T Soloman, Chairman, Xodus One Foundation, 4033 Palmwood Dr #8, Los Angeles, CA 90008, USA, Tel: 310-666-3553; E-Mail: bts@XodusOneFoundation.org

Received: August 04, 2018; **Accepted:** September 14, 2018; **Published:** September 19, 2018

Abstract

This paper extends the Law of Consistency to include transfer, transformation, keno and spectrum consistencies. Consistency at any scale therefore falsifies any theoretical approach that breaks the conservation of mass-energy. With these it is now possible to structure the expansion redshift data and propose how to handle uncertainties in the gravitational red shifts. A review of some of the latest finding point to precision in modern methods for estimating the expansion redshift, however, significant variable bias is present and therefore, accuracy eludes us. Proposing the shape of the Universe as the surface of a sphere, it was possible to identify sources of the heteroscedastic errors. These errors are primarily due to combining age with distance. Hubble Constant is found to be 75.403.

Keywords: Hubble; energy conservation; expansion redshift; gravitational redshift; cepheids

Introduction

An alternative to the contemporary definition of a velocity-variable Einstein Relativistic Spacetime (ERS) or K_4 , $K_{4,ERS}$ (1) was proposed [1].

$$K_{4,ERS} = \{x, y, z, t\} \quad (1)$$

That spacetime keno (derived from Greek for vacuum) K_5 consists of a rich medium (2) that is different from dimensions and operates in the three-space, one-time and one-electric dimensions.

$$K_5 = \{\Gamma(V_x), \Gamma(V_y), \Gamma(V_z), \Gamma(V_t), \Gamma(V_E)\} \quad (2)$$

Citation Solomon BT, Beckwith AW. Interpreting the Universe's Expansion Redshift Data with Respect to Energy. J Space Explor. 2018;7(3):148

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This spacetime keno K_5 is accompanied by the Lorentz-FitzGerald Transformation (LFT) and Newtonian Gravitational Transformation (NGT) that exists within this spacetime, for an environment e , and are expressed by their velocity-variable rulers (3),

$$\Gamma(e) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\frac{2GM}{rc^2}}} = \frac{d_e}{d_0} = \frac{t_e}{t_0} = \frac{\epsilon_e}{\epsilon_0} \tag{3}$$

It was further proposed [1] that within spacetime, “the laws of physics are the same everywhere” can be crystallized, as the Law of Consistency, that the laws of the Universe are consistent everywhere and at every level of detail. There are two basic parts to this Law of Consistency.

The first, Transference Consistency (4), that any fundamental transformation present in spacetime $\Gamma_{s(x,y,z,t)}$ must be identically mirrored on a particle $\Gamma_{p(x,y,z,t)}$ in that local region and vice versa.

$$\Gamma_{p(x,y,z,t)} = \Gamma_{s(x,y,z,t)} \tag{Transference Consistency(4)}$$

This is the reason why gravitational fields pass through all matter.

The second, Transformation Consistency (5), that all fundamental transformations are the same everywhere even though their origins are different. Or, given ρ , the general representation for a dimension’s ruler which is only a function of velocity and not the velocity gradient is,

$$\Gamma(e) = \frac{\rho_e}{\rho_0} \tag{Transformation Consistency (5)}$$

By the Transference Consistency (4) the modification of spacetime is evident as the energy of the particle. However, the spacetime distortion, though equivalent to energy, is not energy, else gravitational fields would deplete, but they don’t. Therefore, energy is an emergent property of spacetime.

The amount of modification present in spacetime can be measured by the energy of a particle. Transfer Consistency (4) goes both ways, from spacetime to particle, and from the particle to spacetime.

This raises two questions,

- (i) If the deformed spacetime keno is not energy, then what is energy? And
- (ii) What is this spacetime keno that alters our observations of dimensions? This paper focuses on the first question.

Motion requirement

The Law of Consistency, in particular, “at every level of detail”, requires that the energy within the transverse electromagnetic wave cannot oscillate between 0% and 100%. It must oscillate to and from somewhere. The

solution proposed [2,3] was that the electromagnetic wave's electric and magnetic vectors rotate between spacetime K_5 and subspace K_3 (x,y,z) and their projections on spacetime keno K_5 are observed as transverse waves. There are two consequences:

(i) This expands the scope of Transference Consistency (4) to between kenos (6) or Keno Consistency,

$$\Gamma_{K3(x,y,z)} = \Gamma_{K5(x,y,z,t,E)} \quad \text{Keno Consistency (6)}$$

(ii) Photon energy is the rotation of the electric and magnetic vectors between spacetime K_5 and subspace K_3 (x, y, z), but not due to these vectors' field strength. This is confirmed by the fact that photon energy E (7) is purely a function of its frequency ν .

$$E = h\nu \quad (7)$$

As proposed [3-5] the maximum electric field strength E_A is a function (8) of the photon's wavelength λ_p and electric permittivity ϵ ,

$$E_A = \frac{\lambda_p}{4\sqrt{\epsilon}} \quad (8)$$

Therefore, one infers that for energy to manifest, the motion is a requirement.

Local distance phenomenon

A Ni field is a spatial gradient of real or latent velocities that are orthogonal to the direction of the acceleration. This acceleration, governed by (9), is in the direction of increasing orthogonal velocities. Gravity is a Ni field as one observes that a satellite's orbital velocity increases as the radius of the satellite's orbit decreases, and the gravitational acceleration increases as this radius decreases. Within spacetime Ni field forces [6-8] are governed by the massless formula for gravitational acceleration (9) and is valid for mechanical and electromagnetic forces.

$$g = \tau c^2 \quad (9)$$

where τ is the spatial gradient of the time dilation transformation or change in time dilation transformation, divided by the distance r of this change. Noting that the time dilation transformation is the ratio of t_v/t_0 per LFT and NGT. That is, (9) is the universal mathematical descriptor of acceleration for macro forces.

Denoting δE the change in energy, δT the change in this time dilation transformation t_{v1}/t_0 to t_{v2}/t_0 across a distance δr from r_1 to r_2 that results in a change in velocity of a particle of mass m , from v_1 to v_2 , from (9) gives,

$$g\delta r = \delta Tc^2 \quad (10)$$

By the classical velocity-acceleration-distance equation,

$$v_2^2 = 2g\delta r + v_1^2 \tag{11}$$

Or

$$\delta E = mg\delta r \tag{12}$$

From (10) and (12),

$$\frac{\delta E}{\delta T} = mc^2 \tag{13}$$

That is, by (9) and (10), spatial displacement is a necessary requirement for a particle to gain or lose energy. The particle's energy gain/loss (13) in a deformed keno is a local phenomenon that is only dependent on the mass-energy of the particle. By mathematical induction, one can prove that this energy gain or loss is the same as the particle energies. Substituting for $E=mc^2$ gives

$$E = \frac{\delta E}{\delta T} \text{ or } \delta E = E\delta T \tag{14}$$

Noting (5) that transformations present are independent of their origins, a particle's energy, and thus its structure, is enclosed by its own local set of transformations governed by the particle structure keno K_p and obeys Keno Consistency (6). It was proposed that this particle keno is the Variable Electric Permittivity (VEP) matter evidenced as binding energy, but much work remains [3].

Therefore, one infers that for energy to manifest, spatial displacement is a requirement.

Local probabilistic phenomenon

Using the Probabilistic Wave Function [2-5,8], an alternative to the Schrödinger Wave Function, it was shown [5] that the 1-dimensional deformation of subspace (15) along the orthogonal radius r_p of the photon motion, determined by this photon energy is given by (16),

$$K_{3,SS} = \{x, y, z\} \tag{15}$$

$$\frac{dr_p}{dE_p} = 4\sqrt[4]{2}E_p^2 \left(\frac{1}{r_p}\right) \tag{16}$$

That is, Transformation Consistency exists in the subspace keno $K_{3,SS}$. In the presence of non-linear transformations, such as NGT, the probabilistic deformation with respect to increasing photon energy is given by (17)

$$\frac{dP_N}{dE_p} = \left(\sqrt{\frac{hc}{4\sqrt{\epsilon}E_A}} \frac{1}{r_p}\right) \left(\frac{1}{E_p}\right) \tag{17}$$

where P_N is the non-modulated (by the wave function) photon probability at a distance r_p from the z-axis of photon propagation. Like NGT in spacetime, there exists an equivalent non-linear transformation in subspace. That is, it is possible to modulate probabilistic density in subspace, the equivalent of acceleration in spacetime.

The common denominator, energy, has different effects on different kenos depending on the properties of the keno. In spacetime, motion displacement is governed by velocity and acceleration, and in subspace, translocation is governed by probability and density, respectively.

That is, there are two known types of physical displacement, motion displacement, and translocation. Both are governed by vectoring (velocity and probability) and modulation (acceleration and density).

Energy is the change in physical displacement and is time invariant. This is observable in gravitational fields. The energy gained by a particle from velocity v_1 to v_2 is independent of the gravitational field strength and not dependent upon how slowly or quickly this energy is gained. Power, on the other hand, is determined by the strength of the gravitational field in that local region, and greater the strength the quicker the gain in this energy.

Structuring the expansion redshift data

In this section, the authors will scrub and structure the empirical Hubble Law (18) data to determine what useful information there is to explain the differences in the observed Hubble constant H_0 which ranges between 67.6 and 76.9 given galactic velocity v_G and galaxy distance D_G .

$$v_G = H_0 D_G \tag{18}$$

One can model the uncertainty U_H in the empirical Hubble Law data as follows,

$$U_H = \{U_G, U_S, U_I, U_T, U_E\} \tag{19}$$

Where the uncertainties in the gravitational red shifts are, (i) U_G introduced by the galaxy's mass, rotation, and plane of rotation, (ii) U_S introduced by the identifying the star and its mass that created the photon per [1,3] the isotopic gravitational constant G_i , (iii) U_I introduced by the spherical property [1] of the originating star that causes an additional redshift as the photon travels from inside the star to its surface, (iv) U_T introduced by the technology used to determine the value of the Hubble's constant, and (v) U_E introduced by the unknown factors and alters the specific value of galactic velocity in that local region. Rewriting (18) gives

$$v_G = H_0 D_G + U_H \tag{20}$$

It was proposed [1] that the Universe had to be a closed system, and therefore the total mass-energy is constant throughout the existence of the Universe. An explosion analog of the Universe implies a decelerating expansion if older and nearer galactic velocity v_G is less than younger and further galactic velocity v_G , while an accelerating

expansion reverses this chronology [9,10]. The data shows something different and hidden factors may be present. Therefore, setting aside contemporary theories about galactic expansion, is it possible to structure this data to determine a good empirical model?

See TABLE 1 [11-32] for the data used to determine a structure.

Index	Date published	Hubble constant (km/s)/Mpc	Error Range	Distance, D Mpc	Observer	Citation
1	May-16	73.24	±1.74	30	Hubble Space Telescope	[11]
2	May-01	72	±8	30	Hubble Space Telescope Key Project	[12]
3	Apr-18	73.52	±1.62	30	Hubble Space Telescope and Gaia	[13], [14]
4	Feb-18	73.45	±1.66	5	Hubble Space Telescope	[15], [16]
5	Oct-17	70	+12.0-8.0	41	The LIGO Scientific Collaboration and The Virgo Collaboration	[17]
6	Feb-15	67.74	±0.46	4,139	Planck Mission	[18], [19]
7	Jul-16	67.6	+0.7-0.6	4,139	SDSS-III Baryon Oscillation Spectroscopic Survey	[20]
8	Mar-13	67.8	±0.77	40	Planck Mission	[21- 25]
9	Oct-13	74.4	±3.0		Cosmicflows-2	[26]
10	Nov-16	71.9	+2.4-3.0	2,612	Hubble Space Telescope	[27]
11	Aug-06	76.9	+10.7-8.7	3,985	Chandra X-ray Observatory	[28]
12	Dec-12	69.32	±0.80	4,139	WMAP (9-years), combined with other measurements.	[29]
13	Jul-05	70.4	+1.3-1.4	4,139	WMAP (7-years), combined with other measurements.	[30]
14	Jul-05	71	±2.5	4,139	WMAP only (7-years).	[30]
15	Feb-09	70.5	±1.3	4,139	WMAP (5-years), combined with other measurements.	[31]
16	Feb-09	71.9	+2.6-2.7	4,139	WMAP only (5-years)	[31]
17	Jun-05	70.4	+1.5-1.6	4,139	WMAP (3-years), combined with other measurements.	[32]

TABLE 1. Hubble Constant, distance and source of data.

From this perspective, the WMAP data rows 12 to 17, can be eliminated as it produces many different values for H_0 and therefore, the true value of H_0 is masked by how the total error U_H is processed. The data shows that many different methods were used and each arrived at a different number.

The Planck Mission (row 8) and Cosmicflow-2 (row 9) data were eliminated due to mix and large size reducing the possibility of determining distance measurements; that the errors introduced by U_G , U_s , and U_l , were not

controlled for. Rows 10 to 11 were eliminated as these were large structures and suffers from all uncertainties U_G , U_S , U_I , and U_E but U_T . That leaves rows 1 to 7 for useful data.

Decelerating, static, or indeterminate universe

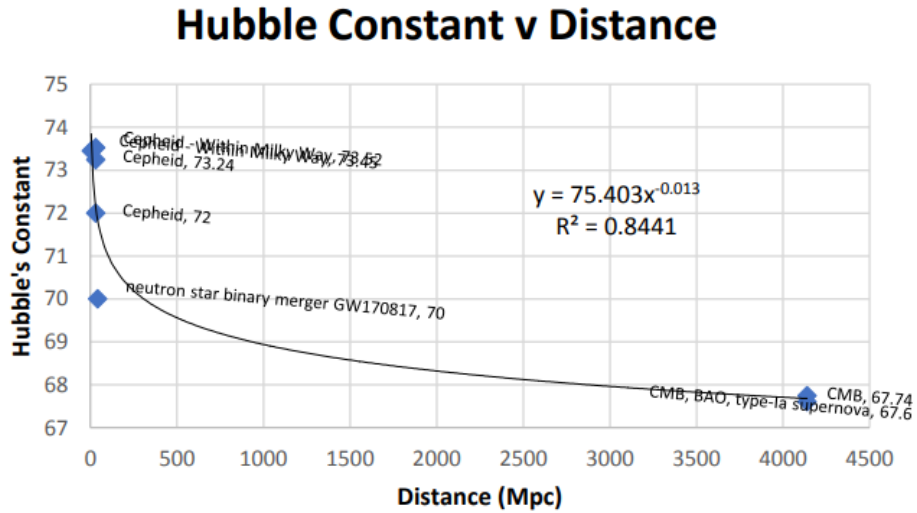


FIG. 1. Hubble Constant versus Age in Mpc.

Using linear regression, the best model fitted (21) of the data gives a regression fit of 84.4%. See FIG. 1. This analysis suggests that Cepheids are good sources of Universe expansion estimates as these reduce the uncertainty U_H due to the galactic mass, the spread of this mass, and the isotopic [1,3] gravitational constant at the time of the observation due to the local nucleosynthesis. That is, there is the need to more precisely determine what is happening rather than averaging a mass of data.

The regression equation (21), shows that the Hubble constant is a variable H_D for a given star's (age in) distance D_G from an observer (in this case Earth), in the current time is,

$$H_0 = H_D D_G^{-0.013} \tag{21}$$

$$H_D = 75.403 \tag{22}$$

Therefore, rewriting (20) gives (23),

$$v_G = H_D D_G^{0.987} + U_H \tag{23}$$

Equation 21 would explain why Hubble's constant appears to be less the older the observed photon. However, an exponent of 0.987 does not make much sense. The most likely inference is that the exponent is 1 and that the

errors in the data are heteroscedastic i.e. the error in the data is biased and these errors change with distance as evidenced by -0.013 exponents in (21). Hubble’s constant H_0 is 75.403 or,

$$v_G = H_0 D_G + U_H = 75.403 D_G + U_H \tag{24}$$

With this value for Hubble’s constant one can recalculate Λ .

Using subscripts 0 and P (for past) to identify age of the Universe at the present and in the beginning respectively, as the stars and galaxies utilized to measure this expansion (relative to the observer) gets nearer or

$$D_{G,0} \rightarrow 0, \tag{25}$$

$$v_{G,P} = U_{H,P} \qquad D_{G,P} \rightarrow 0$$

or, the expansion $v_{G,P}$ at the present time is no longer measurable, it is zero, and the uncertainty in the measurement becomes the dominant factor. That is nearby stars and galaxies are of immense value in determining the magnitude and sources of uncertainty. On the other hand, $v_{G,0}$ the expansion at the beginning of the Universe, $D_{G,0} \rightarrow 4,139$ Mpc or 13.5 billion years ago,

$$v_{G,0} = 312,093 + U_{H,0} \qquad D_{G,0} \rightarrow 4,139 \tag{26}$$

That is, spacetime as we know it formed under very energetic conditions, but that raises the question what was there before spacetime formed?

By Transfer Consistency (4) and Transformation Consistency (5), the observed original spectrum, now expansion redshifted, must be the same anywhere and anytime the photon was created (Spectrum Consistency), else this expansion redshift is noisy.

For example, it would be impossible to determine an isotope’s spectrum if the gravitational transformations did not change in a consistent manner across the isotope’s electron shell.

The empirical gravitational spectrum redshift vindicates this thesis. That is, Spectrum Consistency (27) requires that the photon’s spectrum at origination (from a transition structure S_t whether orbital, nuclei or particle) is independent of the environmental transformations (3) present to an observer in that same environment, given all other factors held the same. Or photon energy E_p with frequency ν at origination, caused by a change in transition between states L_1 and L_2 is independent of the transformation, Γ_i present at the transition structure S_t .

$$E_p = h\nu = \Gamma_i(S_t(L_1 - L_2)) = S_t(L_1 - L_2) \qquad \text{Spectrum Consistency (27)}$$

So, is the Universe expanding? There are three possible theses:

a. Decelerating: Expansion is decelerating as nearer at 30 Mpc, older, galactic velocity v_G is 2,262 km/s and further at 4,139 Mpc, younger galactic velocity v_G is 312,093 km/s. See FIG. 2. This expansion redshift shows that the Universe appears to be cooling or decelerating.

b. Static: (23) and (24) informs that the Universe cannot be expanding in the current time, but the expansion shows that redshift is present i.e photons lose energy as they traverse the Universe. Consider the gravitational analog. The closer a photon originates from the center of the gravitational field the more redshifted it is. Could the Universe be static, and mimic this gravitational analog in a consistent manner? Such a hypothesis would explain why this “expansion” is extreme in the early age.

c. Indeterminate: Expansion is relative to the observer, and therefore it is not possible, with the current data to determine exactly how the Universe is changing. This brings us back to the earlier question. What is the shape of the Universe? Noting its “isocentric” property that the Universe appears inside-out and the observer is always at the center of the observer’s Universe.

That the beginning of the Universe, it’s youngest most distant part with the greatest relative expansion redshift, is observable furthest away from us in every direction one looks. It’s the oldest and nearest part, our current time with zero relative expansion redshift is a point closest to the observer FIG. 2.

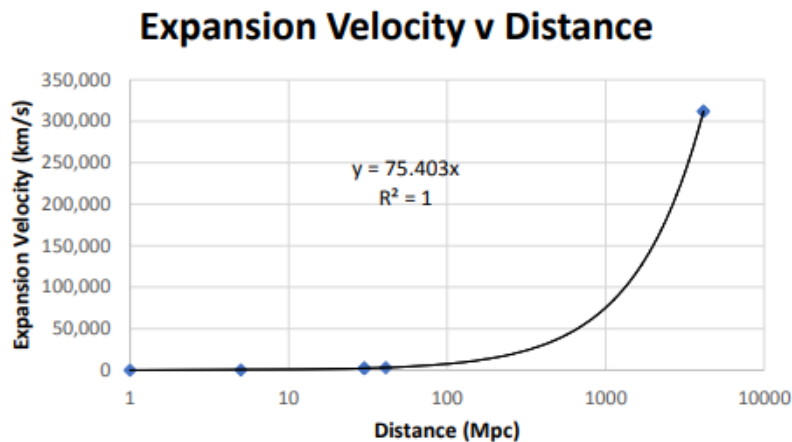


FIG. 2. Expansion Velocity (km/s) versus Distance (Mpc).

Any hypothesis about a changing Universe, needs to propose a shape of the Universe that explains this isocentric property, that

- (a) The apparent inside-out structure of the Universe
- (b) The relative redshift with respect to the age of the star or galaxy, and
- (c) The zero, relative expansion of the Universe in our current time.

As Einstein had suggested many decades ago (reference lost) the Universe as a surface of a sphere would satisfy (a) and (b). It could possibly (c) if the Universe is large enough.

Shape and constraints

Assuming that, the expansion redshift is aligned with the gravitational redshift, by the Law of Consistency, the Static Hypothesis implies that the expansion redshift adds to the gravitational redshift and therefore adds to the gravitational escape velocity. Calculating the equivalent GM (per [1, 3] the gravitational constant is a variable determined by the isotopic mass of the element) FIG. 3 shows the variation of the empirical GM across the age of the Universe. It is a function (28) of distance (current interpretation of age) of the Universe.

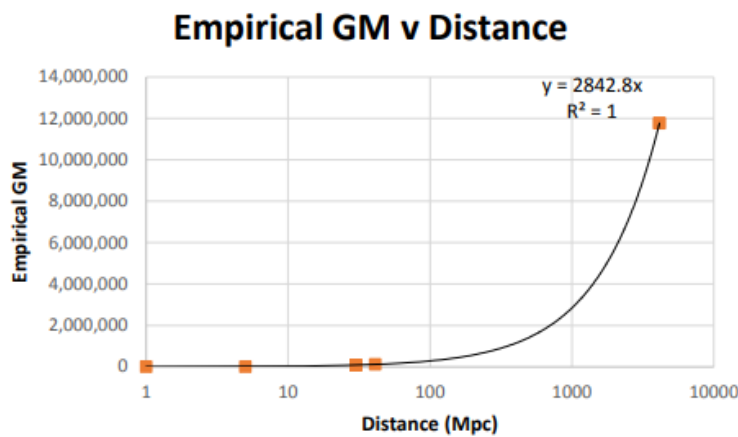


FIG. 3. Empirical GM versus Distance (Mpc).

$$GM = 2842.806D_G \quad (28)$$

Consider that the gravitational coefficient was necessarily different in the past G_P and from what it is now G_0 due to nucleosynthesis and the arrangement of matter [1,3]. (28) can be rewritten as (29) and (30),

$$G_P M = 2842.806D_P \quad (29)$$

$$G_0 M = 2842.806D_0 \quad (30)$$

Or

$$G_P = G_0 \frac{D_P}{D_0} \quad \text{as } D_0 \rightarrow 0, G_P \rightarrow \infty \quad (31)$$

That is, using the Universe’s relative expansion, the beginning conditions are indeterminate. The physical reason for this is straightforward. The Universe is the surface of a sphere in some w dimensions, and the redshifted age is the arc distance D_i (32) where i ranges between 0 and P , on this surface, and not the radius $r_{w,i}$ of this sphere. Assuming that, there exists a set of w dimensions (w_x, w_y, w_z) corresponding to the (x, y, z) dimensions.

$$D_i = r_{w,i} \theta_i \quad (32)$$

where θ_i is the arc angle from the true center of Universe

It is now possible to reduce the noise U_H in the data, by inferring some boundary conditions:

For observable photons, the relative expansion velocity v_G cannot be greater than the velocity of light c .

$$v_G < c \quad (33)$$

Surface relative expansion necessarily implies a radial expansion $r_{w,j}$ (younger further away galaxies) to $r_{w,i}$ (older nearer galaxies) is governed by,

$$r_{w,i} > r_{w,j} \quad \text{For } i < j \quad (34)$$

$$D_i = r_{w,i}f(\theta_i) \neq D_j = r_{w,j}f(\theta_j) \quad \text{Where } \theta_i = \theta_j \quad (35)$$

That is, for two photons i and j coming from the same arc angle $\theta_i = \theta_j$ must originate from different radii $w_{w,i}$ and $r_{w,j}$ such that photon j is differently relative expansion redshifted (24) than ‘ i ’ see FIG. 4, For example, the expansion redshift of galaxy j is greater than that of the galaxy because it is closer to the origin of the Universe. However, the photons’ path distances measured are different.

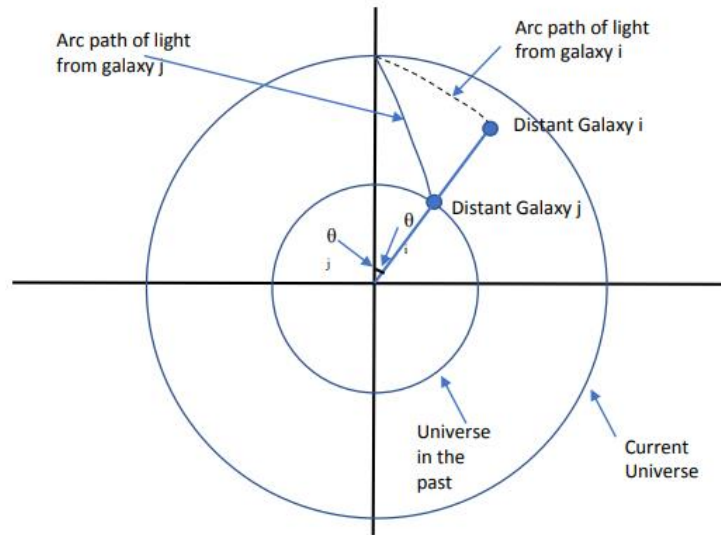


FIG. 4. Universe as the surface of a sphere at time i and j , with same arc angle.

$$D_i = r_{w,i}f(\theta_i) \neq D_j = r_{w,j}f(\theta_j) \quad \text{Where } r_{w,i} = r_{w,j} \quad (36)$$

That is, for two photons i and j coming for the same radius $r_{w,i} \neq r_{w,j}$ must originate from same arc angles θ_i and θ_j such that photon j is differently relative expansion redshifted (24) than ‘ i ’ see FIG. 5. For example, the expansion redshift of galaxy ‘ j ’ is greater than that of the galaxy ‘ i ’ because it is closer to the origin of the Universe. However, the photons’ path distances measured are the same.

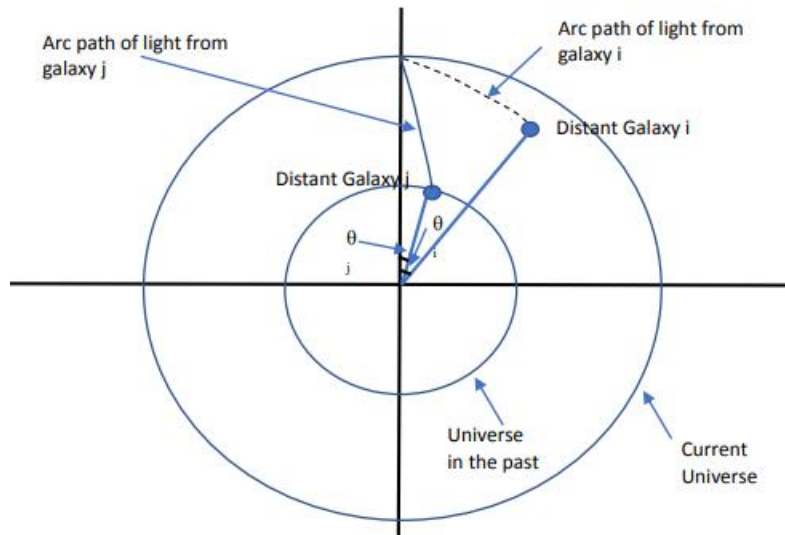


FIG. 5. The universe as the surface of a sphere at time i and j, with different arc angles

Therefore, it is clear there are several sources of errors.

The shape of the universe: The redshift observations are determined by the arc path of the Universe from a smaller radius $r_{w,j}$ to a larger radius $r_{w,i}$. If this thesis, the Universe is the surface of a sphere in the w dimensions, is correct, then the expansion observations are composed of many different radii of the Universe. This is different from current theoretical models that assume just 4-dimensional spacetime.

Measurement methodology: FIG. 4 and 5 shows that distance is the length of the path taken by the photon which is best measured by a parallax method. That the two factors present are the Universe expansion redshift due to distance and Universe age redshift due to radii.

Mirages: Much of what is observed are mirages, that galaxies are close together but have no observable gravitational interaction. FIG. 4 and 5 illustrate how a photon’s path to an observer can originate from many different “locations”, along with any radius from a past Universe structure. [9] provides a good survey of anomalous expansion redshift data, stating “Measurements of the macro universe are odd, revealing exceptions more than the rule”.

Combined factors: Heteroscedastic errors in the redshift data are due to interpreting two factors, spacetime distance and Universe structure radii, as a single factor, age-distance. These are errors in the data due to combined age (radii) and spacetime distance and can only be addressed by separating out these two factors.

Accuracy versus precision

Let us step back a little. There are three important concepts in statistics, precision or spread, accuracy, and bias. Precision refers to the closeness of two or more measurements to each other. The variations in the measurements are due to random errors. Accuracy refers to the closeness of a measured value to a known true value. That is, a

true value must be known. Bias is the tendency of a measurement to deviate in a repeatable manner from the true value due to systematic errors. Therefore, in the absence of a known true value, it is impossible to determine the bias in the measurements.

From the perspective of precision, the LIGO Scientific Collaboration and The Virgo Collaboration [10], sums it elegantly, “A plethora of methods exist to estimate H_0 , using Cepheid variables, red-giant stars, SNe, gravitational lenses, galaxies, the CMB and neutron-star mergers. The best cosmology-independent constraints come from the SH0ES Cepheid-SN distance ladder; the tightest constraints come from the Planck CMB data, assuming a standard Λ CDM cosmology.

These estimates are discrepant at the $3\text{-}\sigma$ level, corresponding to odds of 10:1 of Λ CDM being the correct model. Numerous attempts have been made to reconcile the two results through new physics or improved astrophysical, experimental and statistical modeling, yielding no compelling explanation. Here, we look to the inverse distance ladder and Gravitational Wave (GW) standard sirens to provide the independent information needed to arbitrate this tension, which we frame in a new, intuitive way using the Posterior Predictive Distribution (PPD)”.

That is, a very substantial amount of sophisticated analysis had been applied to improve the precision with the implicit assumption that this would lead to improved accuracy. However, in the absence of a known true value, it is not possible to determine the bias in these measurements. The $3\text{-}\sigma$ discrepancy strongly suggests that bias is present. The errors being heteroscedastic point to a bias that varies with undetermined factors.

The isotopic [1,3] gravitational coefficient ‘ G_i ’ thesis would imply (i) Only methods that are based on motion mechanics could provide good estimates of the total redshift, however noting that redshift analysis is now a three-variable (gravitational acceleration ‘ g ’, gravitational mass ‘ M ’, and the composite gravitational coefficient problem ‘ G_i ’) and not two-variable (‘ g ’ and ‘ M ’) problem requires additional attention to detail to determine these parameters.

Clearly, other non-motion mechanics-based methods on the distance ladder would have to be recalibrate if the isotopic gravitational coefficient thesis is correct.

This implies that the neutron star’s photon gravitational redshift would be less than currently estimated using G_E . The Universe expansion redshift would contribute a larger component to the total observed redshift, that is, neutron stars are further away than they appear to be. The lower [10] Hubble constant H_0 of 70 and would be consistent with (23) given the H_0 range of +12.0 and -8.0.

And (ii) Λ CDM is dependent on the constancy of the gravitational constant G_E . Given an isotopic gravitational coefficient G_i thesis, in the presence of nucleosynthesis, this constancy would no longer hold.

Therefore, the isotopic gravitational coefficient G_i thesis illuminates two biases

- (i) Biases at photon origination from the observed star, and
- (ii) Biases at detection through the use of theoretical models that require a time-invariant gravitational constant G_E . This justifies eliminating data between rows 8 to 17 of TABLE 1.

An alternative to the dark matter thesis

If the mass M of the Universe is constant across its age, then the gravitational constant G increases with distance back into the past or decreases with increasing age of the Universe. The isotopic [1,3] gravitational coefficient G_i could be consistent with (28). The missing mass of the Universe, as measured by GM and assuming G is a constant across age, would account for a substantial proportion of the missing mass, if at all. From [1,3] the gravitational coefficient G determined by the aggregation constant $k_{a,R}$ and the isotopic constant k_{iso} per (37),

$$k_{iso}k_{a,R} = G \quad (37)$$

where $k_{a,R} = 2.24417070379951 \times 10^{25}$, k_{iso} is given by (38), for isotope ‘i’ with mass ‘ M_i ’,

$$G_i M_i = k_{iso} \quad (38)$$

Therefore, (28) can be rewritten in terms of the number of particles n as,

$$k_{a,R} k_{iso} n = 2842.806 D_G \quad (39)$$

The proper method to solving (39) is to document each star, its composition, mass, redshifts, etc. and use a search algorithm to minimize the errors. There are two quick and dirty approaches to solving (39). First, assuming that n is essentially a constant, as mass is essentially constant, find the ratios of aggregation constant $k_{a,R}$ for the various observations ‘i’ and ‘j’ from 1 to 7 of TABLE 1, such that,

$$\frac{k_{a,R,i}}{k_{a,R,j}} = \frac{D_{G_i}}{D_{G_j}} \quad (40)$$

For the data, this ratio ranges between 6 and 138 and suggests that significant changes in the aggregation of matter, from the early Universe to the present day is partially responsible for the changes in the Universe’s expansion redshift. This is the same conclusion from the analysis of the anomalous galaxy rotations.

With regard to these anomalous galaxy rotations, it was shown [1,3] that for outward expansion, a star’s rotational radius R_B with rotational velocity V_B , before $^1H: ^4He$ nucleosynthesis and rotational radius R_A with rotational velocity V_A after $^1H: ^4He$ nucleosynthesis is given by,

$$R_A > R_B \quad (41)$$

$$V_A^2 < (G_A/G_B) V_B^2 = k_{H:He} V_B^2 \quad (42)$$

Where G_B and G_A are the composite gravitational coefficients before and after the ${}^1\text{H}:\text{}^4\text{He}$ conversion, respectively. By conservation of energy, for a star of mass m , and central galactic mass M , the total kinetic and potential energy, before T_B and after T_A must be the same,

$$T_B = mV_B^2/2 + G_B Mm/R_B \quad (43)$$

$$T_A = mV_A^2/2 + G_A Mm/R_A \quad (44)$$

And it was shown that,

$$T_A = mk_{\text{H:He}} V_B^2/2 + k_{\text{H:He}} G_B Mm/R_A \quad (45)$$

Therefore,

$$T_A < T_B \quad (46)$$

And by Conservation of Mass and Energy, there is a missing energy component $f(G_A)$ which is currently proposed as the dark matter thesis.

$$T_B = T_A + f(G_A) \quad (47)$$

As required by Transference Consistency (4) the modification of spacetime is evident as the energy of the particle. However, the spacetime distortion, though equivalent to energy, is not energy, and therefore, one observes apparent deviations from conservation of mass-energy.

Conclusion

The Law of Consistency consists of 4 parts, (i) Transferences, (ii) Transformation, (iii) Keno, and (iv) Spectrum Consistencies. Associated with this are the two requirements for energy to manifest at a particle level are, (a) motion, and (b) spatial displacement, at every level of detail. That is, the Universe is rigorously consistent at every level of detail whether at the particle level or the galactic level.

Consistency at any scale, therefore, falsifies any theoretical approach that breaks the conservation of mass-energy. As a result, using the isotopic gravitational coefficient thesis, this paper has taken a step towards proposing a shape for the Universe that could explain observed gravitational anomalies and account for biases in the measurements.

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