Cosmic-Redshift Distance Law Without *c* and Without *H*

Removing the speed of light and the Hubble constant from the redshift-distance formula

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ABSTRACT: Cosmologists have long sought to remove the speed-of-light term from the equation for cosmic distance (the cosmic redshift-distance law). Within the context of expanding-universe models, the endeavor required determining the scaling factor R and its past, present and future rates of change. No one has ever succeeded. In fact, theorists have found it necessary to add various density parameters (Ω) to an increasingly complex distance equation. The approach in this paper is to reject the unscientific extrapolation of general relativity —the extrapolation that leads to universe-wide expansion— and, instead, to recognize that general relativity is, as originally intended, strictly a local theory; and acknowledge that the universe, in agreement with all observations, is cellular and non-expanding. I use the *Dynamic Steady State Universe* (DSSU) which is a cosmic model *sui generis* and is based on the concept of *space expanding in a non-expanding universe*. A cosmic redshift-distance relation is easily derived and is **not dependent on R, not on Ω, not on c, and not on H_0**. Remarkably it gives practically the same distance curve as the currently favored model —the flat ΛCDM ($\Omega_M = 0.25$, $\Omega_\Lambda = 0.75$) version of an expanding universe.

KEYWORDS: Cosmology, cosmic distance scale, cosmic redshift, cellular structure, Dynamic Steady State Universe, DSSU, supernova

1. INTRODUCTION

We must sometimes doubt what everybody is sure about.
–Cosmologist, Edward R. Harrison

In the early 1920's the Russian mathematician Alexander Friedmann discovered that space could not remain static. His equations predicted that space had to either expand or contract. That same decade witnessed the discovery of what was, in time, understood to be the evidence of space expansion. The German astronomer Carl Wirtz in 1922, the American cosmologist Howard Robertson in 1928, and the American astronomer Edwin Hubble in 1929, discovered a relationship between cosmic redshift and cosmic distance. It was a relationship in which the apparent-recession velocity of galaxies increased in proportion to the estimated distance of those galaxies.[1]

Here was the early evidence that space expands; but the meaning of the evidence was ambiguous and Edwin Hubble warned about taking the expansion interpretation too far when he stated, in his 1936 paper, "... expanding models are a forced interpretation of the observational results."[2]

The warning was ignored. Besides, it was already too late. By 1929 Georges Lemaître had already extrapolated the expansion of space into the expansion of the whole universe. Seemingly unconcerned with the philosophical unsoundness of the idea, practically everyone in this field of study adopted it. Even Einstein committed himself when, in 1932, he abandoned his original 1917 non-expanding universe and collaborated with Willem de Sitter in fabricating the "Einstein-DeSitter Universe" (which became the textbook standard model). The expanding-universe model now had the backing of the century's greatest scientific mind. It was the start of the twentieth century's very own cosmology bubble; it seemed everyone with a serious interest in the subject wanted to join the expansion craze. In 1951 the Church of Rome formalized its support for the expanding-universe model with a Papal endorsement (issued by Pope Pius XII who reigned during the period 1939-1958). No doubt the Church found the big-bang genesis-scenario to be a glorious affirmation of primordial fire-and-brimstone chaos and the Biblical Genesis. The violently expanding-universe became the blessed theory —the chosen theory of cosmology.

The "bubble" in the enthusiasm for expansion reached its full-blown state during the 1960s. The cosmic background radiation was discovered and immediately drafted as the essential evidence of the early phase of the expansion of the whole universe. The notion of the expansion of the universe became the consensus view.

During this decades-long expansion craze no one in the astrophysics community, it seems, opposed the extrapolation of the phenomenon of space-expansion into the phenomenon of whole-universe expansion. Year after year, no opposition, no dissenting voice. Across the Western World, no heretical outcry, no unorthodox opinion. The devotion to the expanding universe was so deep that in 2006 the theoretical astrophysicist and author Dan Hooper was able to claim that he had never met a cosmologist who disagreed with this basic view, including the evolutionary history of the universe that the expansion implies.[3]

What is truly amazing, and to some degree disturbing, is that there was no great debate! Although there have always been debates contesting the different modes and types of whole-universe expansion models (in fact, they clutter up the space-science journals even now in the 21st century) there has never been a serious debate between the two opposing cosmologies —the expanding universe versus the non-expanding universe. This is a gross error of omission. Let me state it in precise terms: There has never been a debate in which the expanding-space expanding-universe is pitted against the expanding-space non-expanding-universe.

The model used in this article is NOT an expanding universe. The model that I use rejects the conventional unscientific extrapolation and for this reason it is deemed unpublishable in conventional cosmology and astrophysics journals. Even though the model represents a natural universe, a universe based on embarrassingly obvious physics, the current astrophysics paradigm precludes its publication. It is a situation where faith-based dogma is weightier than natural law. ... It is for this reason you are reading a cosmology / astrophysics paper in a non-specialized physics journal.

The *phenomenon of the expansion of space* is the acknowledged central pillar of the science of the universe. The expansion of space (and its natural opposite, the contraction of space) represents a real process firmly rooted in real physics. The expansion of the universe, however, is unrestrained speculation.

The following discussion uses real physics to explore and achieve a long-standing goal in astrophysics.

2. NATURE'S PREFERRED ARRANGEMENT

Cosmology is undergoing a scientific revolution, producing the first theory of the universe that might actually be true.
–J. R. Primack & N. E. Abrams, *The View from the Center of the Universe*

Our Universe is a composition of everything it contains, and all that it contains is structured into some form of discrete units. Within the scale of the unimaginably small, the universe consists of quasi-real quantum units as well as real quantum units. On the threshold of the microscopic scale there are units called atoms and molecules. Moving up the size-scale there are living units called cells — ranging from the barely-living viral cells through a diverse collection of biological structures. There are non-living cells evident in many crystal structures. Crystalline minerals are composed of units of the fourteen *Bravis Lattices*. Under certain naturally occurring conditions ordinary ice becomes prismatic-cellular —forming what is known as *candled ice*. On the familiar scale there are mudflats which, when sun-baked and dehydrated, crack into polygonal cells. The tundra of the Canadian north, in response to the expansion-and-contraction effect of the freeze-thaw cycle, forms a characteristic cellular terrain. When hot magma cools it sometimes forms prismatic cells of striking regularity as exemplified by the geological feature known as the *Giant's Causeway* in Northern Ireland. Even the sun's surface is divided into cells (called thermal convection cells). On the astronomical scale, galaxies are undoubtedly the most majestic of discrete units; and galaxy clusters are structured into cosmic cells in ways we are just beginning to recognize.

If everything ***in*** the Universe is in this manner divided into units, why not likewise the Universe itself? Should we not consider that the *space* of the Universe and the gravitational field may be divided into enormous cells on a cosmic scale? Should we not seriously investigate the probability that the very Universe itself is partitioned in some fundamental way? —that our Universe is a cellular universe? [a]

It seems a reasonable proposal. It is, after all, nature's preferred arrangement. The only necessary ingredients for cellularizing the universe are the ubiquitous processes of space expansion and space contraction. Matter itself is ancillary. In this simplification, matter in the form of luminous stars and galaxies serves only to highlight the boundaries of the cells formed by the dynamics of space.

All that is needed to "cellularize" the universe is an orderly arrangement of space-expanding regions and space-contracting regions. But here is a surprise. The simple concept of a cellularized universe has never been explored! —at least not by Academic Cosmology!

A search of the literature will find no true cellular models —only quasi-cellular ones.

Probably the first attempt at a cellular design was the *Cartesian universe* (designed by René Descartes in the 17th century). It is more of a historical model than anything else; and yet with its aether-like space in dynamic motion it was definitely on the right track.

The *Bubble model* of Alan Guth and the *Chaotic Inflation* model of Andreï Linde are highly speculative. With names suggestive of instability (think bursting bubbles) and chaotic randomness, it comes as no surprise

[a] In compliance with conventional usage "universe" refers to a model or theory of the Universe, while "Universe" refers to the particular universe we live in and are a part of.

that they make no meaningful predictions. Their ability to explain the Universe and its phenomena are severely limited.

Most universe models treat the Cosmos as a single cell —as some monolithic expanding universal cell. All are based, one way or another, on the logically unsound concept of the *expansion of the whole universe*. Steady-state expansion, accelerated expansion, or hyper-expansion (inflation), it makes no difference —they all share a logical flaw.

Let us take a brief look at the processes that sustain cells.

3. DYNAMIC PROCESSES MAINTAIN CELLS

The dynamic processes, involved in the seasonal freeze-thaw cycles, sculptures the tundra region into giant polygons. The dynamic processes involved in planetary motion, including rotation, are responsible for the bands or ring-cells that characterize the atmosphere of Jupiter. The dynamics of differentially heated gases sustain the irregular cells on the Sun's surface. Laboratory experiments with thin layers of liquid, evenly heated on one side and cooled on the other, produce miniature thermal convection-cells of remarkable regularity[b] as shown in Fig. 1.

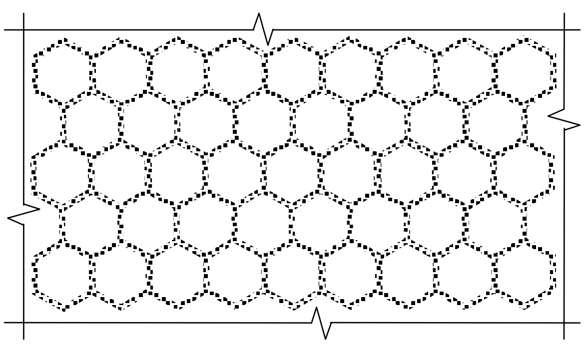

Fig. 1. Convection cells, viewed from above, reveal the flow pattern of a liquid which is being evenly heated from below. The lines in this schematic represent the surface locations where floating particles tend to aggregate.

A fluid, in which volumetric expansion occurs in some regions and simultaneous contraction occurs in others, tends to form cellular structure. The obvious example is the lab experiment involving thermal convection cells in a liquid. It should also be noted that under ideal stable conditions the surface boundaries of such cells will form a static pattern. A *dynamic* process, proceeding in a *steady state* fashion, produces a *static* configuration. (Here we make an important connection with cosmology. Notice the three terms often used in the categorization of cosmologies. This is not coincidental.)

The essential lesson provided by thermal convection cells is that the surface radial flow of fluid (on top of the cells) is strictly limited by the cell boundaries, whether of a regular shape or not. Furthermore, the cell boundaries act as sinks for the surface flow, as shown in Fig. 2.

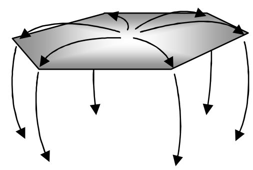

Fig. 2. Line drawing of an isolated thermal convection cell shows how the radial surface flow drains through the cell boundary. The surface radial flow is confined by the cell boundaries, which act as ***sinks***.

Now, before applying this insight to the next higher dimension we need to understand something about the dynamics of the *fluid* constituting our Universe. However one chooses to name it —space, aether, quantum foam, or essence-of-the-universe— the space fluid can do three things: It can ***expand***, it can ***contract***, it can ***flow***. This is not stating anything new; astrophysics permits all three as model components. Moreover, Einstein's theory on general relativity requires that *space* expand or contract but forbids it to remain static. What *is* new, however, is their concurrent usage.

There is no law of nature preventing *space* from expanding in one region and at the same time contracting in another.

If one ignores the contraction aspect of space and focuses primarily on its expansion aspect, as does Big Bang (BB) Cosmology, one may be tempted to claim that the Universe is expanding. Astrophysicists do this when they overextend gravity-theory and apply it to the universe as a whole. The extrapolation of Einstein's GR —a *local* theory of space, mass and energy— without limiting such extrapolation, leads to the expansion of the entire universe! Unrestricted space expansion will lead the unwary to the unrealistic Big Bang scenario (Fig. 3)!

Incidentally, it is Georges Lemaître who deserves much of the credit, or blame, for being the first to ignore the *space-contraction* aspect. His 1927-1929 expanding-universe models led the way for 20th-century Cosmology and its embrace of *a single cell universe*.

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[b] In some lab experiments the liquid is sandwiched between two glass plates maintained at different temperatures. "Often the [convection] flow pattern acquires a striking regularity. ... remarkably similar patterns are associated with convective motions in the sun." –Richard Wolfson and Jay M. Pasachoff. *Physics, Extended with Modern Physics* (Scott, Foreman and Co., 1990) p419

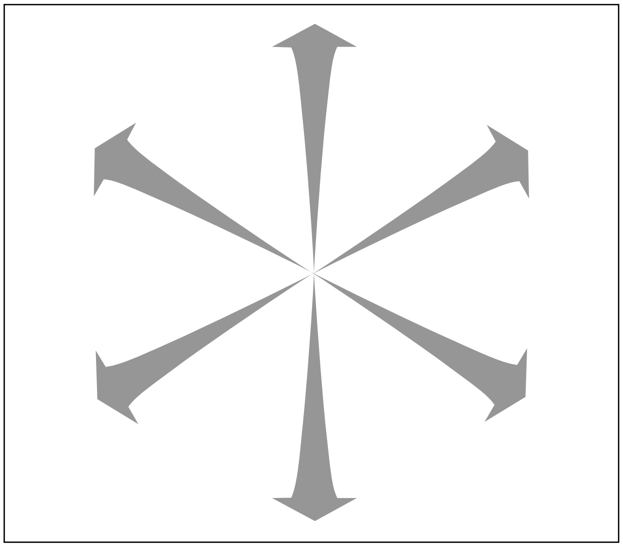


Fig. 3. In the Big Bang scenario *space* expands ***and*** the whole universe expands. The universe is, unrealistically, treated as a single supercell!

Let us now consider the multi-cell universe. *Space* is its essence fluid. *Space expansion* and *space contraction* constitute the dynamic mechanism. The expanding-space regions are known as voids, the contracting-space regions are defined by matter accreting boundaries or interfaces. Just as the surface cell, described earlier, is sustained by the upwelling of heated liquid from below, the *void* of the cosmic cell is sustained by the upwelling of new space (i.e., newly expanded space). Just as the earlier surface-cell interface marks the boundary where cooled liquid sinks or submerges, the cosmic cell *interface* marks the boundary where *space* "sinks" out of existence (i.e., space contracts). Just as the thermal convection cell has a liquid-flow that leaves floating particles behind to accumulate at the boundaries, so also the cosmic cell has space-flow; and when this flow reaches the interface and sinks out of existence it leaves behind the flotsam of galaxies to highlight the 3-dimensional tapestry of the vast cell structure.

The shape of the bubble-cells as sustained by the dynamics of space, at least under ideal conditions, is the rhombic dodecahedron and the trapezoidal-rhombic dodecahedron. They are known as closest-packed polyhedra. (In the real world there may also be cosmic scale structural flaws in an otherwise orderly geometric arrangement.)

A picture of the multi-cell universe may be assembled from these three important features: First, the cells just described with their void-like space-expanding centers and galaxy clustering boundaries form the largest scale structure of our Universe. They form a network of structures that is observable. The cellular structure is real. Second, the space *of* the cells is dynamic. Third, since the dynamic processes are also steady state processes —meaning that space expansion is in equilibrium with contraction— therefore the cells, as discrete units, do not expand. And therefore, neither does the universe.

The name for this type of universe, in which *space* expands but the universe as a whole does not, is *the Dynamic Steady State Universe* (DSSU). This equilibrium universe, consisting mostly (even overwhelmingly) of regions of expanding space, is itself not expanding. The reason it does not expand is that, quantitatively, the rate of space expansion equals the rate of space contraction. (In the jargon of astrophysics, gravity is balanced by Lambda.) This non-expanding universe model is shown in Fig. 4. Additional details may be found in the research paper, "The Story of Gravity and Lambda"[4].

The essential point for the new distance-law based on the cosmic redshift is that the twin *dynamic processes maintain the largest scale structure of the universe as a static pattern.*

4. EVIDENCE OF COSMIC CELL STRUCTURE

Our Universe is observed to be cellular; it is evidently structured as Voronoi cells.

> *Now the Voronoi cell is a polyhedron. Astronomers have ... discovered that the large-scale distribution of matter in the universe resembles a network of such polyhedra. Most galactic clusters seem to be located on the boundaries of neighboring Voronoi cells. This pattern has been called the Voronoi cell model of the universe...* –Ian Stewart[5]

The Estonian astronomer, Jaan Einasto, describes the real world in terms of "the Voronoi model, centers of voids are located randomly, and clusters [of galaxies] are placed as far from void centers as possible. ... During dynamical evolution matter flows away from the low-density regions and forms filaments and clusters of galaxies."[6]

The model and the observations are easily understood. *Space expansion* acts as a cosmological constant —a repulsion force that tries to maximize the distance between centers of expansion. Each Voronoi cell has a center of expansion, acting as a center of anti-gravity, from which space and matter are conveyed outward. The outward motion ends at the *space-contracting* boundary. The Voronoi boundaries become the highly interactive *interface* between bubble-like universes. As the space inside the cells expands, star clusters and galaxies and other objects become concentrated along the shared Voronoi boundaries.

> *It appears that, on the largest scales, galaxies and galaxy clusters are not clustered in pancakes [as previously thought] but are concentrated in the interstices of enormous 'bubbles' —roughly spherical regions that are significantly underdense.* –David Layzer[7]

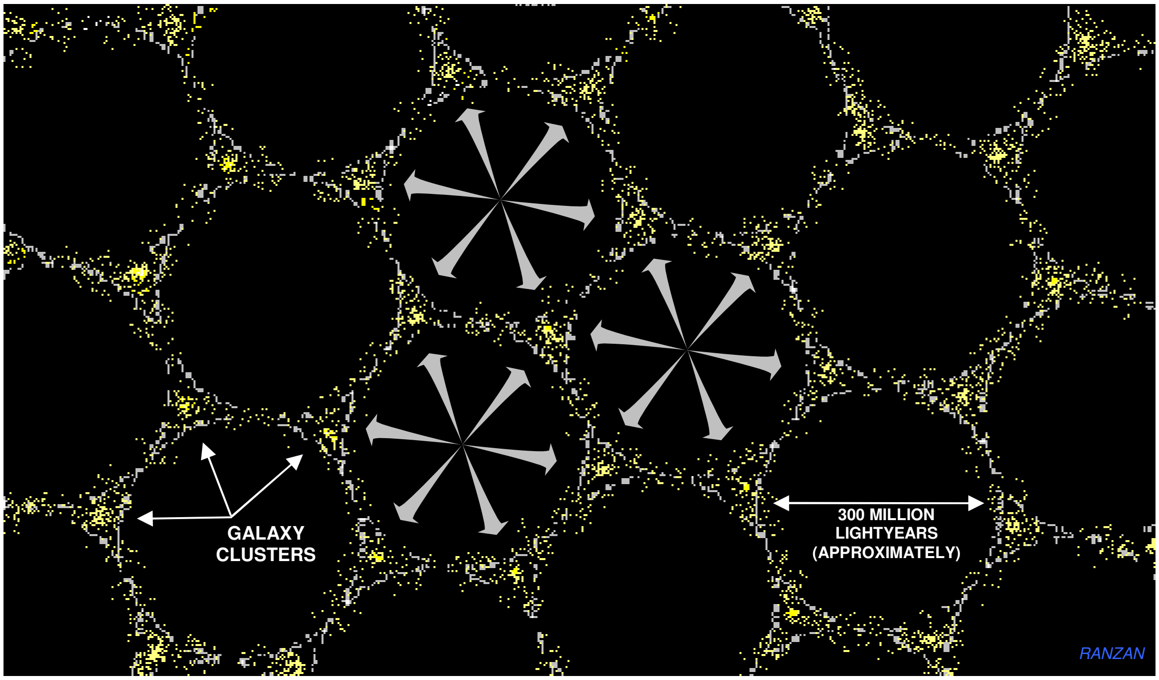


Fig. 4. In the *Dynamic Steady State* cellular universe ***space expands but the universe does not***. Dynamic processes sustain a static polyhedral pattern of unit-universes (shown here in schematic cross-section). Fluid-like *space* (and precipitating *mass*) flows radially in large regions that are strictly limited courtesy of an exquisite and perpetual balance —the quantity of space expanding equals the quantity of space contracting.

The bubble interior would be a void, but the bubble wall would be the site of vigorous activity.
–Jeremiah P. Ostriker[8]

The paradigm discovery is credited to Jaan Einasto, of Tartu Observatory, who at the 1977 International Astronomical Union meeting presented his analysis of the distribution of the several hundred galaxies for which data was then available. Einasto had found that the Universe has a cellular structure; the large scale organization of galaxies has a net-like cellular pattern with interconnected bridges of galaxies surrounding empty regions.

After many more years of dedicated research, Einasto in the year 2003 stated, "observational evidence suggests that rich superclusters and voids form a quasi-regular network of scale ~100-130h^{-1}Mpc;" and "voids between superclusters have mean diameters about 100h^{-1}Mpc." It appears the "Cellular large-scale structure may be the end of the fractal structure of the Universe."[9] In other words, the observations suggest that there are no bigger structures than the Voronoi polyhedral cells.

5. REDSHIFT AND THE MEASUREMENT OF DISTANCE

To determine the distance of a far-away galaxy, one needs two essential bits of information: (i) The state of the universe. (ii) The redshift of the light from the galaxy. For instance, in BB cosmology one needs the details of how the universe was expanding in the past during the time the light traveled to reach the Earth observers. Not an easy task. There are lots of poorly understood variables. In contrast, in DSSU cosmology the state of the universe is simply a question of cell size. With the universe structured as a cellular array (a more or less static pattern) the calculation of cosmic distance is greatly simplified.

The second factor is the *redshift*. It represents the almost magical quantity that directly encodes the expansion (and contraction) of space that the light waves encountered; and indirectly encodes the galaxy's distance.

Redshift is defined as the elongation (the shift), of an emitted electromagnetic wave, towards a longer wavelength, expressed as a fraction of the original wavelength itself. *Redshifting* is simply a stretching of the wavelengths of light or other electromagnetic radiation beamed forth by an astronomical object. A *wavelength* (λ) is the distance between successive crests of a wave. A redshift can occur in all kinds of radiation, from the very shortest gamma rays and X-rays, through to the progressively longer ultraviolet rays, visible light, infrared rays, and finally to the short and long radio waves.

If the original wavelength is known from its chemical fingerprint, or otherwise deduced, then and only then can the degree of redshift be determined and actually serve as a measure of velocity (under the Doppler interpretation) and of distance (under the expanding-space interpretation).

Astronomers use the relative displacement of specific spectral lines [c] (the chemical fingerprints) in the light

[c] A **bright spectral line** indicates a particularly abundant emission wavelength; a **dark spectral line** indicates an absence of a specific wavelength due to its absorption at or near the source.

from astronomical sources when compared with a laboratory standard here on Earth to determine a redshift value. In practice it is symbolized by z, a unitless index, and is measured as the ratio of the change in the length of a wave and its original length:

$$\text{Redshift} = \frac{\text{(observed wavelength)} - \text{(emitted wavelength)}}{\text{(emitted wavelength)}},$$

$$z = (\lambda_o - \lambda)/\lambda\,. \qquad \text{(by definition)}$$

The redshift is the essential connection to the determination of distance. The *redshift* of the light from galaxies, in one way or another, relates to the *distance* of those galaxies. This is essentially true regardless of one's theory of the universe (be it static, steady state, universal expansion, or cellular). The challenge in astrophysics has always been to find the correct relationship —one that agrees with other distance-gauging methods independent of redshift.

One finds that all the old formulations require either the speed of light or a Hubble constant, or both.

The Traditional Redshift-Distance Equations

The pioneering work of Carl Wirtz, followed by Howard Robertson, and finally Edwin Hubble led, in 1929, to the first redshift-distance relation. It became known as the basic Hubble law.

$$\text{Distance, } r = z/h\,, \tag{1}$$

with h as the constant of proportionality. It was usually interpreted as a Doppler effect, whereby the spectral shift is the result of galaxies themselves moving *through* static space. To make the interpretation explicit the numerator, unitless z, was multiplied by the speed of light c (and to be consistent the denominator, h in (1), was also multiplied by c and henceforth became the capitalized Hubble's constant H). Equation (1) became the

Classical Hubble's Law:

$$\text{distance, } r = cz/ch = v/H\,, \tag{1a}$$

where $v = cz$ is the speed of the receding (redshifted) galaxy and c is the speed of light. As long as z was small there was no problem; historically this was the case up until the 1960s. Then, z measurements were being recorded that pushed the recession speed (the $v = cz$) uncomfortably close to the speed of light. Galaxies, however, simply cannot race *through* space at such high speeds. Hence a relativistic interpretation of z was adopted; instead of having $z = v/c$ Einstein's special relativity restriction was applied to the motion of the galaxies and astronomers began using

$$z = \sqrt{(c+v)/(c-v)} - 1\,. \tag{2a}$$

This formulation of the redshift index led to the recession speed expression (found by solving the previous equation for v),

$$v = c\frac{(z+1)^2 - 1}{(z+1)^2 + 1}\,, \tag{2b}$$

and when applied to eqn. (1a), then gives the relativistic Hubble's law: [10]

Relativistic Hubble's Law

$$\text{Distance} = \frac{v}{H} = \frac{c}{H}\frac{(z+1)^2 - 1}{(z+1)^2 + 1} \tag{2c}$$

Unfortunately, this equation still represents a motion-through-space Doppler interpretation. Reality dictates that in any universe with expanding space, and this includes the BB universe, it is the *space expansion* interpretation and not the Doppler interpretation that ultimately determines the validity of any distance formulation.

BB theory is based on a *universal space expansion* interpretation; that is, the cosmic redshift is due to the expansion of space. Widely separated but comoving galaxies —stationary *in* expanding space— receive each other's electromagnetic radiation as redshifted radiation. The radiation propagates through the expanding space, and during the journey all wavelengths are continually stretched. This redshift is determined by the amount of universe-wide expansion according to the *expansion redshift law*

$$z = (R_0/R) - 1\,, \tag{3a}$$

where R is the value of the *scaling factor* at the time of emission and R_0 is the value at the time of reception. (One may simply think of R as the distance to the galaxy at the moment when the light was emitted and R_0 as the distance when the light is finally received.) Once the expansion redshift of a distant galaxy has been measured, the ratio R_0/R tells us how much the BB universe has expanded during the time in which the light from the galaxy has been traveling towards us. For instance, a redshift of $z = 1.5$ means that the universe has grown by 50 percent.[11]

By treating R and R_0 as emission distance and reception distance, a simple redshift-distance equation follows.

$$R_0 = R\,(z+1)\,. \tag{3b}$$

But, since no one knows the scaling factor of the past —the R in the equation— or its rate of change, *this equation is of little use to astronomers*. The problem is that no one has ever found a way to measure R. Even more worrying is the fact that its actual existence has never been specifically verified. It might simply be a mathematical construct.[12, 13]

The scaling-factor problem underscores an annoying complication inherent in universal BB expansion —the dual-distance complication. It is important to realize that in standard cosmology there are actually two distances associated with a remote galaxy. Proponents of BB methodology, and those trying to decipher it, must always distinguish between the *emission distance* (the distance from us that a galaxy was located when the light being measured was originally emitted) and the *reception distance* (the distance of the same galaxy at the present time). The galaxy has supposedly, according to BB theory, receded while the emitted light traveled towards Earth.

To surmount the problem of the scaling factor, BB astrophysicists adopted the model first proposed by Albert Einstein and Willem deSitter in 1931. *The Einstein-deSitter universe* being the simplest of all known universes is based on general relativity but with simplifying assumptions (that include a curvature constant $k = 0$, a cosmological constant $\Lambda = 0$, a deceleration term $q = ½$, and flat expanding space). Its most controversial assumption is that the density of matter in the universe happens to be precisely set to cause the universe to "close." The expansion of this universe continues forever —but is asymptotic to twice the Hubble length.

And again we have a redshift-distance equation that requires c and H_0. The Einstein-deSitter universe formulates extragalactic distance as:

Einstein-deSitter ***reception distance***

$$\text{Distance} = \frac{c}{H_0} \times 2\left(1 - \frac{1}{\sqrt{1+z}}\right) \tag{3c}$$

The Contemporary Redshift-Distance Equations

To accommodate the probability that the density of the universe is not the critical value assumed in the Einstein-deSitter model, astronomers adopted the more general Friedmann model in which the energy density may be adjusted in accordance with observations. A parameter, omega (Ω), known as the energy density ratio plays a key role. Effectively, it is a variable factor that adjusts the rate of expansion of the BB universe.

Currently popular among astronomers, and displayed on the Harvard astrophysics website,[14] the redshift-distance formula for determining proper comoving (comoving with expanding space) distance is:

The Friedmann reception-distance

$$\text{Distance} = \frac{2c}{H_0\,\Omega_0^{\,2}\,(1+z)} \{\Omega_0 z + (\Omega_0 - 2)\,[(\Omega_0 z + 1)^{1/2} - 1]\} \tag{4}$$

Mattig (1959)

which, again, requires the use of c and H_0.

In 1998, detailed analysis of the light curves from distant supernovae revealed that their distance did not match what the above equation predicted. The interpretation adopted was that there is a mysterious force, or energy, permeating the universe and that the expansion of the universe is accelerating. A more appropriate equation was drafted. The general relativity equation, in which the matter density (Ω_M), radiation density (Ω_r) and the vacuum energy (Λ) are all taken into account, was called into service. When Λ is set to zero it is called the Cold Dark Mass (CDM) model otherwise it is known as the Lambda Cold Dark Mass (ΛCDM) model. (Details are available in the paper by E. L. Wright, *A Cosmology Calculator for the World Wide Web, The Publications of the Astronomical Society of the Pacific, 2006, V.118 (850), 1711–1715.*)

The reception-distance for the CDM and the ΛCDM:

Distance =

$$\frac{c}{H_0}\int_{1/(1+z)}^{1} \frac{dR}{R\sqrt{\Omega_M / R + \Omega_r / R^2 + \Omega_\Lambda R^2 + (1 - \Omega_{TOT})}}$$

$$\approx\ (c/H_0)\ \{ z - z^2\,(1 + q_0)/2\ + \ldots \} \tag{5}$$

where Ω_M, Ω_r and Ω_Λ are the density parameters for mass, radiation and vacuum-energy respectively (of the universe at present); R is the customary scaling factor; and the deceleration parameter q_0 depends on the matter density ρ and the vacuum energy Λ. For BB cosmology, equation (5) represents the most advanced theoretical redshift-distance formula.

Each of the five formulations for distance expressed above required the inclusion of the speed of light (and the Hubble term). In fact, all Newtonian and general relativity models in which the entire universe is treated as a single cell have this requirement. However, since the cosmic redshift is caused by the expansion of space and *not* by the movement of galaxies some professionals have argued that the speed of light is irrelevant.

> *...[R]edshift does not really have anything to do with velocities at all in cosmology. The redshift is a ... dimensionless number which ... tells us the relative distance between galaxies when the light was emitted compared with that distance now [with the inclusion of the intervening expanded space]. It is a great pity that Hubble multiplied z by c. I hope we will eventually get rid of the c.*
> –M. S. Longair, 1995[15]

DSSU theory may well be the first to achieve this sought after formulation. The *new cosmology* cellular universe does not need the speed of light c as part of its unique and simple distance equation. It does, however, need a new expression for the cosmic redshift.

While the BB formulation for z depends, at least theoretically, on the ratio of cosmic scaling factors; the *new cosmology* formulation depends on the cosmic cellular structure.

6. DSSU COSMIC REDSHIFT EXPRESSION

The DSSU is structured into cosmic cells each filled with expanding space; however, the cells themselves do not expand. Let us say a galaxy is detected across a void, at the far side of one of these cosmic cells or unit-universes. The galaxy is comoving (i.e., no intrinsic motion) and emits a light ray with a wavelength λ. The intervening space is expanding and the resulting change in the wavelength will be observed as Δλ. And if the net observed redshift is $z = 0.018$ (net, after taking into account the Doppler effects of the observer's own frame of reference) then the only thing we can say for certain is that intervening space has expanded by 100 z percent or 1.8 percent since the time the light was originally emitted from the far-side galaxy (about 300 million lightyears away). This is the message provided by the 1.8 percent increase in the wavelength. The percentage amount of the increase is independent of the transit time, independent of the original wavelength, and even independent of the way the space expands (whether slowly, quickly, or in a series of jerks)! Between the time of emission and the time of reception, both the wavelength and the intervening space in the void have expanded by a certain percentage or by a factor Δλ / λ. Without some additional information we do not know how far the light wave has traveled; and we do not know how much time the transit has taken. The redshift only gives us the proportional expansion.

But, importantly, we do know that the size of the unit-universe (u-u) has not changed. We know this from the fact that *all* the expanded space is contracted and absorbed by the mass that is concentrated at the cell boundaries. Thus, we know the *state of the universe* —a 3-dimensional array of just such steady-state cells (ensuring a non-expanding universe).

The development of an appropriate redshift formula uses the basic fact that *each and every u-u induces a similar proportional elongation in the wavelength.* The elongations are successive; they are compounded. When the light wave travels through a series of unit-universes, we find that with each passage through a u-u the new wavelength is given by the previous wavelength *plus* its proportional change. Since the proportional change (using idealized conditions) is always, say, z_{UU} , then we simply use the common factor $(1+z_{UU})$ to obtain the new wavelength. Figure 5 shows each u-u providing another factor $(1+z_{UU})$ to the growing wavelength of the light as it journeys from source to detector. After passing through N unit-universes, the light wave that is finally observed has N common factors —giving us the observed wavelength (λ_0).

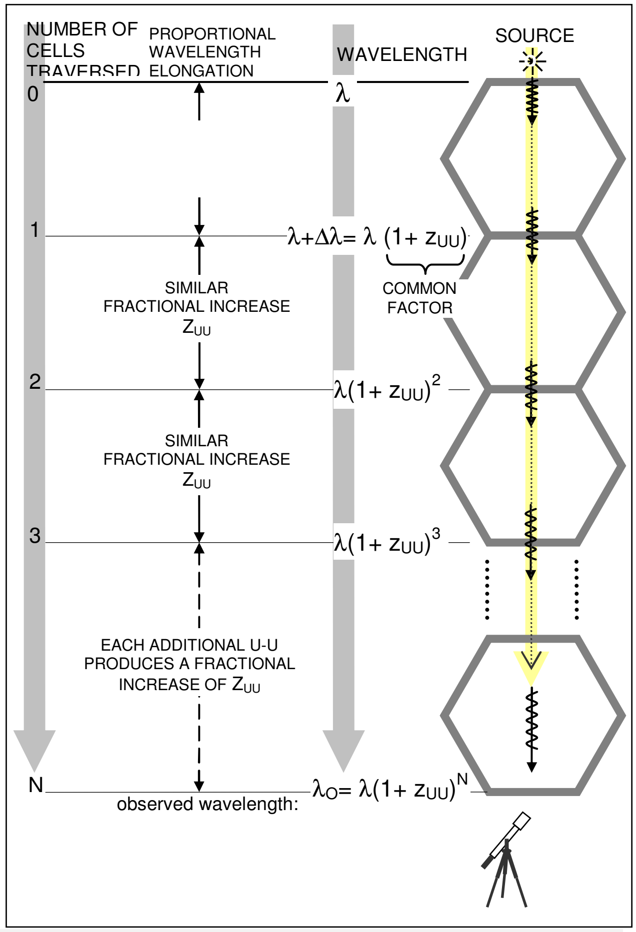


Fig. 5. ***Wavelength elongation and cosmic redshift in a cellular non-expanding universe***. The first column gives the cosmic cell number that the source light-wave traverses. The second column gives the incremental wavelength elongation (Δλ) caused by the expanding space within each cell or *unit-universe* (u-u). The third column shows the expression for the wavelength (λ) with its accumulated incremental elongations. The right-hand column shows a schematic series of cosmic cells along a hypothetical line-of-sight. Each u-u contributes a redshift component to a quantum of radiation. Each u-u, in succession, stretches the wave it receives by the factor z_{UU} before passing it on to the next u-u. The expression for the finally detected wavelength is substituted into the definition of the redshift z,

$$z = (\lambda_o - \lambda)/\lambda ,$$

giving the redshift equation for the DSSU:

$$z = (1+z_{uu})^N - 1, \tag{6}$$

where z_{uu} is an empirical constant and N is the number of cells.

Next we use the definition of the redshift, $z = (\lambda_0 - \lambda) / \lambda$, and substitute $\lambda_0 = \lambda(1+ z_{UU})^N$ to obtain the cosmic redshift equation (for the cellular universe) in its basic form,

$$\boxed{z = (1+z_{uu})^N - 1. \qquad (6)}$$

7. DSSU AND THE MEASUREMENT OF DISTANCE

By isolating the cell counter, N, in (6) we form an equation of distance solely in terms of redshift. Then the distance according to the number of cells between us and the light source is:

$$N = \frac{\ln(1+z)}{\ln(1+z_{uu})} . \tag{7}$$

N equals the natural log of $(1+z)$ divided by the natural log of $(1+z_{UU})$.

Although the space constituting the cells is dynamic and definitely not Euclidean, an array of such cells is more or less static —and *is* Euclidean. Distances inside a cell are relative, distances across one or more cells are absolute. Expressed another way, since the nodes surrounding each polyhedral cell are stationary "points" in the universe, any distance from one node to another node is Euclidean. Thus, the nature of the structure of the DSSU allows for a cosmic distance equation that could not be simpler.

$$\text{Distance}_{\text{COSMIC}} = (\text{no. of cells}) \times (\text{cell diameter}),$$

$$= N \times \text{Dia.}_{\text{UU}} .$$

As a general principle we state,

The Cellular Universe Redshift-Distance Law:

$$D(z) = \frac{\ln(1+z)}{\ln(1+z_{\text{UU}})} \times \text{Dia.}_{\text{UU}} . \tag{8}$$

There are two unknown quantities; two measurable parameters which are necessary to calibrate the new metric.

First consider z_{UU} the redshift across a single cell. We select stationary galaxies on opposite sides (near side and far side) of a "nearby" cell. Most useful are the non-rotating supergiant galaxies, the ones that astronomers label *cD* in recognition of their unmistakable size and unmistakable brightness and cluster dominating stature. In DSSU cosmology they are the *nodal galaxies* which reign supreme at the various vertices of each polyhedral cell. A true *nodal galaxy* marks a stationary "point" and does not move. For the near-side, the nodal galaxy M87, the core galaxy of the Virgo Cluster, provides an obvious choice. On the far side NGC4874 (in Coma cluster A1656) as well as NGC3842 (in Leo 1 cluster A1367) are easily recognized as nodal supergiants. The region between Virgo and Coma-Leo is the space expanding void, which may be considered to be typical in size. The redshift reading of the near galaxy is subtracted from the far; then averaged. The difference in the z values between M87 and NGC4874 (difference is 0.01974); and the difference between M87 and NGC3842 (difference is 0.01671). The average difference is 0.01823. For the balance of this paper z_{UU} is assigned the empirical value 0.01823.

Next we need the diameter of a representative cell. But how do we measure such an enormous distance? Geometric methods such as trigonometric parallax, the gold standard for astronomical distances, are completely useless. The distance scale we are involved with is beyond astronomical —we are exploring the cosmic realm where distances are scaled in hundreds of millions of lightyears. The scale is far beyond the familiar interplanetary, vastly greater than the interstellar, and even dwarfs the intergalactic —it is the ultimate scale of intergalaxy-clusteral distance. It is a grand scale that involves distances which we cannot fully comprehend —but we pretend, and we imagine, and more. We venerate the awesome immensity of the cosmic cells by naming them "unit-universes."

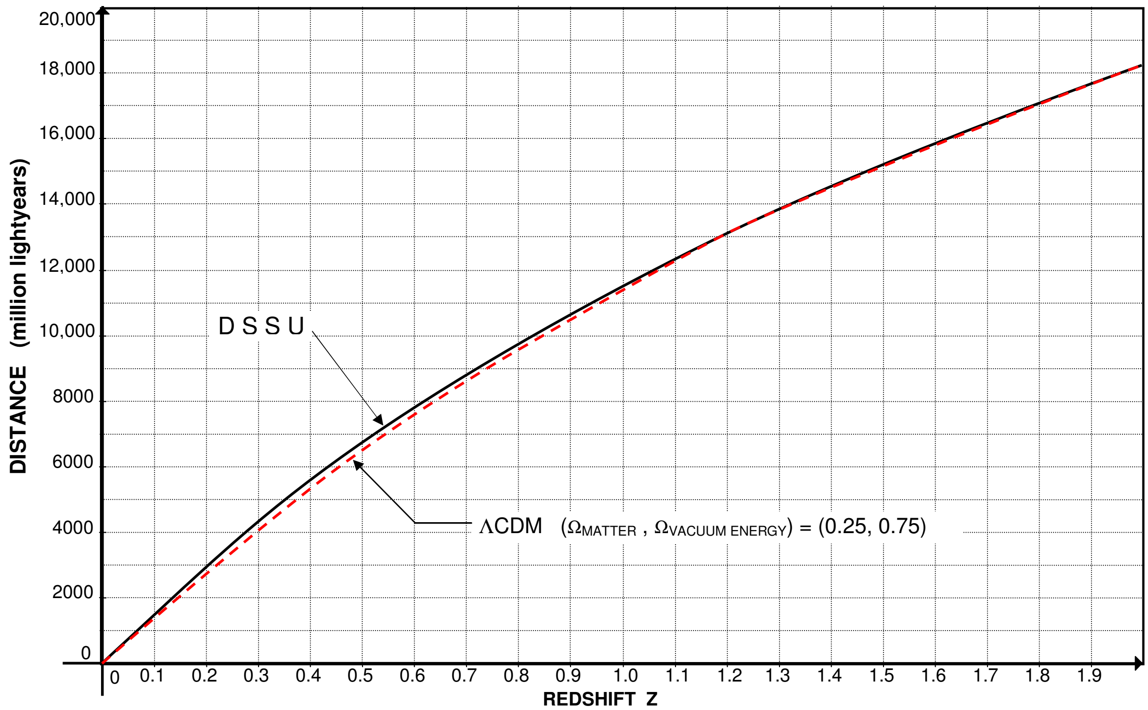
In determining the unit-universe diameter the use of so called "standard candles" promises to be the most rewarding. Much depends on what one chooses as a standard. One method is to assume that all nodal supergiants have identical absolute brightness; then by comparing this with an individual supergiant's apparent brightness through the application of the inverse-square law it is possible to compute the distance. Astrophysicist Edward Wright describes it as *the brightest galaxy in a cluster of galaxies* method. Another method is to use nodal supergiants as standard candles of physical size (instead of brightness). Distance can then be computed by measuring the angle subtended by a galaxy-of-interest of the same class (and comparing with the standard).

The use of the stationary-point giant ellipticals as distance-gauging standard comes with a caveat. DSSU theory predicts at least four different "standard" sizes corresponding to the four different node concentrations inherent in the geometry of the cells. The four different node intensities manifest in the quantity of matter concentration which, in turn, determines the size of the dominant galaxy.

Probably the best method for measuring the cosmic cell diameter is the use of a specific type of supernova event as the standard. The method, now in common use, involves analyzing the supernova's luminosity-versus-time curve, its light profile, to extract information about its absolute brightness. This in turn permits calculating the distance. And if the distance is derived in the context of a non-expanding universe (the DSSU) then it will be *independent of the speed of light, the redshift index, and the Hubble expansion.*

The most desirable supernovae would be those in the immediate neighborhood of a node galaxy.

Pending further investigation, the tentative diameter of a typical unit-universe is 300 million lightyears. In choosing 300 Mly I have simply used a reasonable estimate based on the neighboring Virgo-Coma and Eridanus cells.



Graph 1. ***Proper distance (reception distance) curves of two world models, ΛCDM and DSSU.*** The ΛCDM model is said to agree with large scale structure, cosmic microwave background data, and supernovae data. The fact that the DSSU model also fits the data demonstrates that one does not necessarily need an expanding universe to account for proper-time distances —a static cellular model with expanding space works just as well. (ΛCDM model specs: flat, $H_0 = 20.85$ km/s/Mly, $\Omega_M = 0.25$, $\Omega_\Lambda = 0.75$, applied to eqn (5) or to Cosmic Calculator www.astro.ucla.edu/~wright/CosmoCalc.html)

8. A GRAPHIC COMPARISON

Let us now compare the DSSU cosmic distance equation,

$$D(z) = \frac{\ln(1+z)}{\ln(1+z_{UU})} \times 300\text{Mly} \qquad (9)$$

where $z_{uu} = 0.01823$,

with the currently popular cold-dark-matter-with-vacuum-energy (ΛCDM) model and expressed by eqn (5).

Comparison of Reception Distance to Z=2

Take a look at Graph 1. The agreement between the two distance curves is truly remarkable. But at first glance this should not in itself be surprising. Let us keep in mind that the ΛCDM model resulted from the use of supernovae *standard candles* (from the famous high-Z supernovae studies). The model (and specifically its distance curve) was custom designed, using its various density parameters, to fit the supernovae observations. However, a multitude of other expansion models can also be made to fit.

> *The supernovae data are consistent with a low-mass Universe dominated by vacuum energy (w = −1), but they are also consistent with a **wide range of** constant or time-varying dark energy **models**.* [emphasis added] –R. A. Knop[16]

No, what should come as a surprise is that a non-expanding universe —a flat Euclidean universe of all things— will also fit and give practically the same distance!

While a multitude of BB models will fit the distance standard dictated by the high-Z supernovae, only one, let me emphasize, ***only one cellular model will fit***.

Incidentally, the redshift scale for this graph was selected so that it would encompass all the high-Z supernovae studied. As of the end of the year 2006 no supernova has ever been measured beyond $z = 1.7$.

The claims made for the ΛCDM model include: it is "consistent with large scale structure"; "consistent with supernovae data"; and "consistent with the CMB angular power spectrum." [17]

The *New Cosmology*, the DSSU, also claims to be consistent with large scale structure and with supernovae data —and much more. As for the cosmic microwave background radiation (CMB): While the CMB is often used as the trump-card argument, it can be shown that this ubiquitous radiation does *not* necessarily require a Friedmann- or a CDM- or a ΛCDM- universe or any other type of expanding cosmos. All that is required is expanding space.

Comparison of Reception Distance to Z=10.

What appears to be a convergence of curves in Graph 1, when extended out to $z = 10$, reveals itself to be a gradual divergence. Although we are dealing with fundamentally different models, their true nature is not revealed in the *reception* distance comparison of Graph 2. Adjust one or another of the models' parameters and any segments of the two upper curves can be rendered accordant. In general, the ***fixed*** reception-distance of static cellular cosmology is in approximate agreement with the ***receding*** reception-distance of BB cosmology. This superficial compatibility is profound.

(Note that in Graph 2 the Einstein-deSitter model has been added to provide a graphic comparison between the "old" and the "new" versions of the big bang.)

The reception distance is the proper distance to the galaxy being observed. At the moment in time when a galaxy emits light waves, say from the flash of one of its stars going supernova, *that* particular galaxy is said to be at its *emission* distance. When that same flash, a billion or so years later, reaches observers here on Earth the galaxy is at the *reception* distance (and in the BB model this is always a greater distance). The distinction is fundamentally important in all expanding-universe models. In the DSSU, of course, emission and reception distances are one and the same.

It is the comparison of emission distances that is material and wherein real irreconcilable difference can be found.

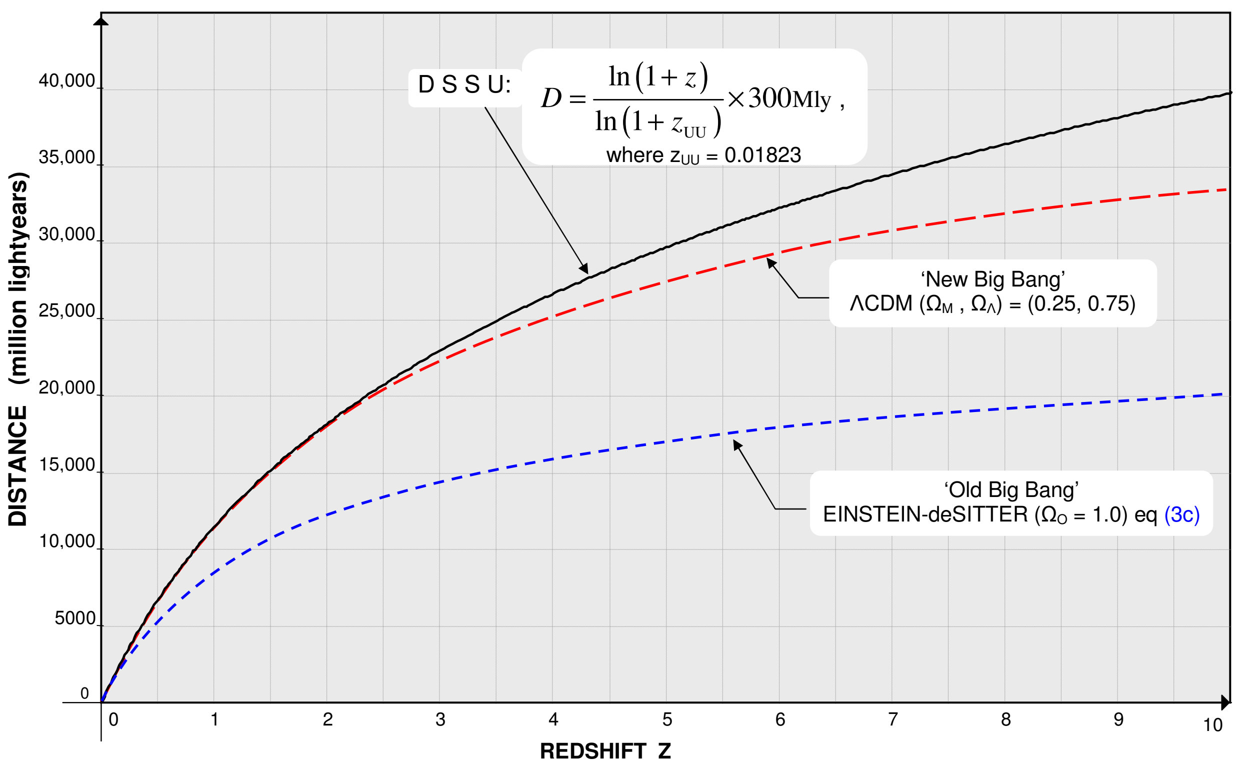
Emission Distance Comparison

When the original distance of galaxies —that is, their distance at the long-ago time of light emission— is graphed, as in Graph 3, the difference between the models is quite dramatic.

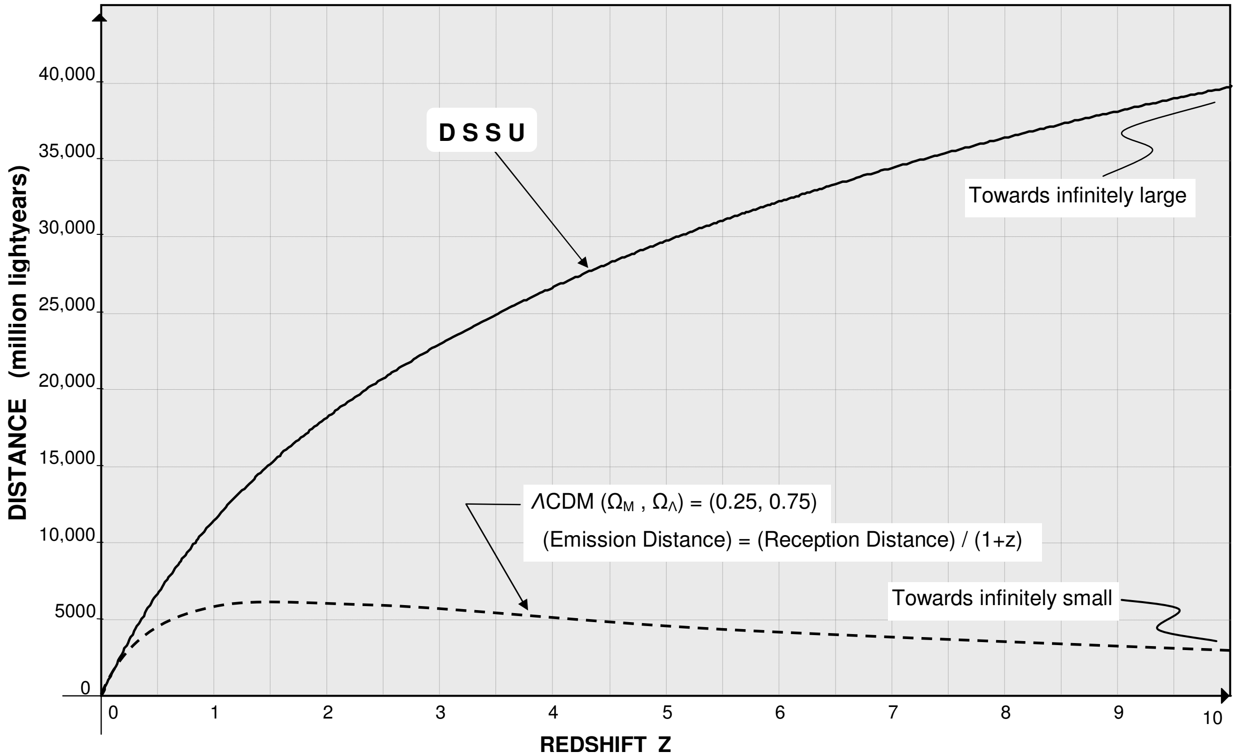
The DSSU curve has not changed. It is identical to the curve of the previous graph (Graph 2). This merely reflects the fact that DSSU galaxies don't recede. They only have relatively negligible local motion.

The BB representative curve is totally different. It initially grows with increasing z then stops, turns, and gradually decreases in distance. This is undoubtedly the representation of a strange universe. But it *is* logical. The higher the redshift, the more "distant" one is looking into the past. In the distant past the universe was younger — and a younger BB universe was naturally smaller. Thus, one would expect that galaxies were closer to us (and to each other) in the past. And this is just what the ΛCDM emission-distance curve shows. The reasoning applies to *all* BB scenarios.

The deeper and more profound reason for the dramatic difference lies in the adherence to unchanging natural law in the DSSU as opposed to the variability of natural law in BB cosmology.



Graph 2. ***Reception distance comparison*** for redshift between 0 and 10. The graph is an extension of the previous one and compares the *dynamic steady state universe* (DSSU) with the flat *Lambda cold dark matter* (ΛCDM) model and the *Einstein-deSitter* standard model. (H_0 = 20.85 km/s/Mly was used for both BB models.)



Graph 3. ***Emission distance comparison*** reveals the dramatic difference between models. The DSSU curve has not changed —emission distance at the long-ago time of light emission is the same as the reception distance ***now***. The *Λ*CDM model grows then declines reflecting the hypothesis that it was smaller in the high-Z past. The models tend towards unlimited divergence.

Numeric Example

A packet of radiation from a far-off source some 15,200 Mly away from our galaxy will be imprinted, by the time it is detected on Earth, with a redshift of 1.50; this is the case in the DSSU (Fig. 6, left side).

But in the BB interpretation when a radiation source is detected having the same imprinted redshift of 1.50, *that* source must have been 6,100 Mly away from our galaxy at the time the light was actually emitted (hence, *emission* distance). All the while that the light packet from 6,100 Mly away was traveling towards the Milky Way galaxy, the light source itself, say a giant elliptical, was traveling in the outbound direction to end up at 15,200 Mly (Fig. 6, right side).

As the model-comparison graphs show, emission distances can never agree, but reception distances can.

In the one model, the initial ray of light traveled through 15,200 million lightyears of *expanding space*. In the other model, it traveled through only 6,100 million lightyears of similarly *expanding space* —and amazingly underwent the same degree of spectral shifting! These are, of course, nominal source-to-observer distances. Obviously, the expansion of space increases the total travel distance and time. An interesting exercise would be to calculate and compare the total travel time and the actual through-space distances of the light emissions.

The heart of the difference is that no amount of tampering with parameters could ever reconcile this dual-distance complication. Needless to say the corresponding theories cannot both represent reality; one must be invalid.

Contrast of the Two Infinities

Where does the extrapolation of Graph 3 lead? What distance do we find when the redshift approaches infinity? For the DSSU, distances go on and on without end; for the BB scenario distances become smaller and smaller.

At infinite redshift, in the new cosmology, one simply finds more cells. However, at infinite redshift in the BB hypothesis, one finds a mathematical fantasy world called a *singularity* —a speck of almost nothing possessing infinite density.

The extrapolation of the curves results in the ultimate divergence: one goes to the infinitely large the other to the infinitely small.

If one had hoped of somehow escaping the incomprehensibility of infiniteness by embracing a seemingly bounded BB universe, then nothing could better illustrate the utter futility of the strategy. There is simply no escaping the reality of infinitude.

The two infinities displayed in Graph 3 cannot both represent reality; again, one must be invalid.

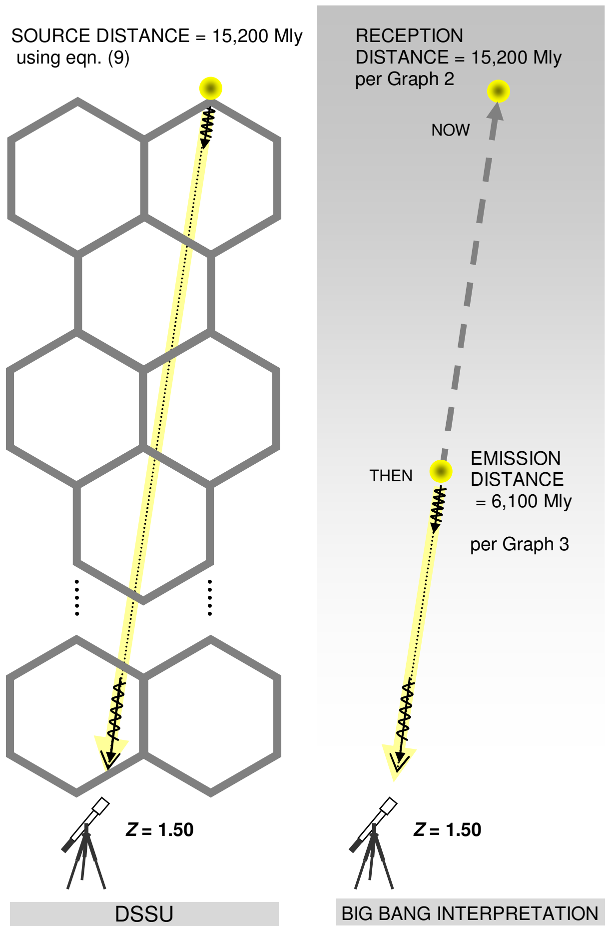


Fig. 6. *Dual-distance complication.* In DSSU cosmology, a typical galaxy has but one unchanging cosmic distance (at left). BB cosmology on the other hand requires an understanding of two cosmic distances: emission and reception (at right). Key difference of models is here revealed. In one case 15,200 Mly of expanding space accounts for a redshift of 1.50; in the other case only 6,100 Mly of expanding space accounts for an identical redshift of 1.50 . One model must be wrong. (Not to scale)

9. SUMMARY AND REFLECTIONS

*The question is not, "**Is** the universe cellular?"*
*The question is, "**How** is the universe cellular?"*
Big Bang Cosmology claims it is a single cell; observations say it is multi-cellular; the New Cosmology proves it is steady-state multi-cellular.

Extirpated Parameters

The Hubble parameter serves no purpose in DSSU cosmology. Its definition makes it incompatible with a steady state cellular universe. The Hubble term is defined as the rate of change of the universe scaling factor divided by the scaling factor R itself, or

$$H = (dR/dt) / R \,.$$

But in a universe of dynamic cells arranged in a Euclidean static array, a scaling factor serves no purpose. Its length remains constant; its rate of change is zero. Therefore the Hubble term vanishes ($H = 0$).

The stated purpose of this paper has been fulfilled —to derive a functional redshift-distance law (8) that agrees with observations and requires neither the Hubble constant nor the speed of light. Furthermore, no density parameter is required.

The New Metric

In the *new cosmology* our understanding of cosmic distance is greatly simplified since the distances to galaxies *do not change*. The distance of a source is the same *now* as the distance at the time when the light was first emitted. A source at 50 giga-lightyears will not significantly change position; it will always be at 50 giga-lightyears —limited only by its own temporal lifespan. Furthermore, the gauging of cosmic distances is *not* dependent on the Hubble term! and *not* dependent on the speed of light! The unit-universe itself serves as the Greater Universe's own natural metric. The Universe presents us with a 3-dimensional non-rectilinear grid which can serve as a natural distance scale —an immense advantage.

Unchanging Universe

Many leading scientists over the centuries, including Isaac Newton and Albert Einstein, believed that the Universe is unchanging, neither contracting nor expanding. It now turns out that on this fundamentally important point they were right after all! With the 21st-century advent of the DSSU theory it is possible to validate the view that the Universe does not expand —*only space itself expands*. While the concept may sound paradoxical, it actually has a simple explanation. Space expands within the Voronoi cells and simultaneously contracts at the Voronoi boundaries. The size of the cells does not change and neither does the greater universe.

The simple and elegant DSSU Cosmology confines and limits space expansion to the void regions. Herein lies the explanation of why the voids, for the most part, are empty. It then adds the steady-state condition that whatever expands must elsewhere contract. And, behold, theory and observation come together in remarkable agreement. Whether we like it or not, the Universe *is* a Steady State universe —an unchanging universe.

Keeping Up Appearances

Nevertheless, considerable research effort is being expended in fine tuning the BB model —in *keeping up appearances* as it were. The present situation is reminiscent of an earlier time, of an earlier cosmology. Not unlike the persistent efforts of long ago devoted to the problematic (not to mention, fundamentally wrong) geo-centric model, the present age endures its own Ptolemaic tinkering only on a grander scale and on a far more esoteric level.

Instead of fine-tuning the eccentrics, epicycles and equants of the archaic system, cosmologists in our time are busy adjusting things like density parameters (Ω_{MASS}, $\Omega_{RADIATION}$, $\Omega_{VACUUM\ ENERGY}$, Ω_{LAMBDA}, and Ω_{TOTAL}), vacuum pressure, vacuum energy and equations-of-state; as well as the Hubble term and the curvature constant. The curvature constant is now considered to be zero. And then there is *q* the deceleration term. In the year 1998 deceleration underwent a major readjustment —it became acceleration! To explain *that* flip-flop, *re-inflation* was invented. ... And all the while the complexity and strangeness of the model grows ever deeper.

> *The source of the acceleration is strongly debated, but it is clear that the energy form dominating the expansion has to have a very strange equation of state and can not be attributed to any form of known energy.* –Bruno Leibundgut[18]

Strange and exotic equations of state and new forms of energy do sound exciting. But they come with a price —the associated increased complexity and lack of comprehensibility.

> *[Referring to] this investigation that concludes that an unexplained energy is the principal component of the Universe. ... If this inference is correct, it points to a major gap in current understanding of the fundamental physics of gravity.* –John L. Tonry (2003)[19]

And if you do not fully understand the workings of gravity then you cannot possibly understand the Universe —a universe that is entirely ***structured by gravity***. This is serious stuff and is discussed in other DSSU research papers. Meanwhile, with the limited understanding John Tonry speaks of, the model tinkering continues. It continues ... still using the invalid notion of universe-wide expansion.

> *... while work continues on determining the precise rate at which the universe expands, the fact that it does expand is today as well established as, say, the fact that biological species arose through the process outlined in Darwin's theory of evolution.* –Timothy Ferris[20]

Darwin's theory is both well established and *valid* —and unassailable as it violates no principles. But universe-wide expansion, the foundation idea supporting BB cosmology, is merely well established —but *lacks validity*. It is telling that the efforts in "keeping up appearances" are becoming ever more complex. All the while, awareness grows and an inferior model, albeit well-established, cannot be sustained indefinitely.

The Fatal Flaw

It may be convincingly argued that BB Cosmology cannot claim to be a proper theory of *the* Universe since it represents a blatant violation of the *cosmic edge* principle. Any physical universe that is claimed to be expanding has a boundary which divides the "expanding universe" from the region it is expanding into. But, of course, that region beyond *the boundary* must then be part of some greater, higher, universe. And so, a single cell universe of the BB genus is an incomplete universe. In this context, the BB Model can make only one valid claim: to be a single-cell sub-universe within some larger universe.

The vulnerability of the BB model is rooted in the fact that it was designed as a mathematical universe, in which "boundaries" can be made to vanish, and not as a physical universe. It should be understood that in BB cosmology physical reality plays a subordinate roll. But physical reality cannot be made to vanish.

The fatal flaw can also be expressed in these terms: Unless one can come up with a comprehensible reality-based answer to the question, *What does an expanding universe expand into?* (and does not violate the cosmic edge principle) then one must face the reality that the Universe is already fully expanded —always has been, always will be.

In the search for ultimate reality,

mankind ventures (and necessarily so) in two opposite directions —the scale of the large, the cosmic realm, and the scale of the small, the sub-atomic realm. And the closer we come to unraveling the ultimate truths the simpler things (entities and processes) become. Continuing with this reasoning, the ultimate truth of the small and the ultimate truth of the large must be so unequivocally simple that we would readily admit "nothing could be simpler." At the same time, all else lies between these truths and belongs to the realm of complexity.

On the cosmic scale a cellular steady-state structure is as simple as it gets. No process-sustainable 3-dimensional structure is simpler; no continuous process (the balanced space expansion and space contraction) is simpler. Occam's famous razor, as a metaphorical judge of objective reality, favors the simple and elegant cellular Universe and repudiates the complex and artificial expansion model.

Astronomers have clearly established the fact that the Universe is multi-cellular. Cosmologists have responded by exploring deeper into the nature of apparent cellularity. They ask, as in the opening question of this section, "*How is the Universe cellular?*" The profound answer, one that has eluded cosmologists, is that *the Universe is both statically and dynamically cellular.* The Universe is a static array of cells; but the cells themselves are dynamical. The three-dimensional array of cosmic cells represents an approximately **static structure**. However, the individual cosmic cells are sustained by the **dynamic action of quantized space** (the steady state regional processes of expansion and contraction of dynamic space). Understand this and it is easy to understand why the new logarithmic cosmic-distance equation gives valid (verifiable) results.

□

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