DSSU Cosmic Redshift-Distance Relation

Converting the Cosmic Redshift into Distance for the Cellular Universe

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ABSTRACT

In an ordered universe such as the Dynamic Steady State Universe[1] (DSSU), in which ***space is regionally dynamic***, there arises the need for a radically different ***cosmic redshift-distance relation***. A brief and selective overview of the new DSSU cosmology is presented. The key point is emphasized that while space *does* expand —and in doing so gives rise to the cosmic redshift— the universe itself does ***not*** expand. Reference is made to the cellular structure of the universe —the structure which astronomer Jaan Einasto was among the first to recognize— and the supporting *Voronoi cellular model of the universe*. The observed cellular structure, interpreted by DSSU cosmology, is the manifestation of dual-dynamic space involving space expansion and contraction. A relevant cosmic-redshift expression, applicable to this type of universe, is developed; then transformed into a *cosmic redshift-distance relation*. This equation is then graphically compared to the Friedmann model (using the Mattig equation) that is used by most astronomers. The resulting graph is unequivocal; in excellent agreement with the data from Supernovae Type 1A. The new equation is shown to be valid for both near and far cosmic-distances ***without changing any parameters***. And because of the inherent nature of the Voronoi structure and the constancy of fundamental physical laws and the lack of distance-dependent parameters, it is possible to extrapolate the new redshift-distance relation to Z=10 and beyond. The final graph compares the DSSU with a Friedmann universe (with $\Omega_0 = 0.35$) for Z up to 100.

KEYWORDS: Cosmology; Large-scale structure of the Universe; Redshift; Cosmic distance scale; 98.80.-k; 98.65.Dx; 98.62.Py; 98.80.Es.

1 INTRODUCTION.

Supernovae provide astronomers with a powerful method for gauging cosmic distance —a method that is independent of the usual redshift technique that leads to a recession-velocity distance. Essentially, the characteristic decay pattern of the luminosity of supernovae events is used to determine the distance. In 1998, when the method was refined and pushed to the extreme, it was found, to almost everyone's surprise that the luminosity-distance and the corresponding redshift-distance did not agree. The universe, it seems, is accelerating its own expansion! Supported by corroborating studies, and unable or unwilling to explore meaningful alternate explanations, the consensus of astronomer/cosmologists gradually shifted towards the realization that the universe is ruled, not by gravity, but by the so called cosmological constant (the Lambda effect) or some form of mysterious energy which causes *space* and the universe to expand. This energy has now become the main component of the standard model of the universe, popularly known as the hot Big Bang Inflation model, and technically known as the ΛCDM (Lambda Cold Dark Matter) model.

The distance data extracted from Type 1A Supernovae did not agree with the Big Bang redshift-distance equation. This should have alerted cosmologists that something —something at the fundamental level— is seriously wrong with their standard model. Model replacement, unfortunately, was not an option; so theorists came up with a repair patch. The Big Bang (BB) model was modified by reintroducing something called inflation.

Inflation is the hypothetical hyper-lightspeed expansion of the BB universe that supposedly occurred during its first few moments of existence. It was originally incorporated into the standard model in the 1980s to solve mainly two problems. One was the flatness of the universe problem described as the *riddle of why the universe is neither dramatically open nor closed, but appears to be almost perfectly balanced between these states.* Why is the universe balanced between continuing its big-bang expansion (making it an open universe) on the one hand and initiating a big-crunch collapse (making it a closed universe) on the other? [2] Expressed in terms of the geometric concept of curved space the flatness problem becomes: *the riddle of why the universe is neither positively curved nor negatively curved, but appears to be almost perfectly flat* as if it were a Euclidean-space universe. The hypothetical solution: By literally inflating the universe —making it vastly bigger than the visible portion— its curvature, whether positive or negative, becomes stretched to the extent of imperceptibility and, therefore, of simply appearing to be geometrically flat. The other problem that inflation was intended to solve is known as the *horizon riddle*: Why does the BB universe exhibit large-scale homogeneity when the primordial material was supposed to be rather clumpy?

Anyway, in 1998 astrophysicists turned once more to the idea of inflation. But by introducing a new episode of inflation astrophysicists have deepened the mystery of their universe. To the long standing mystery of dark matter (it goes back to 1933!) there is now the new mystery of dark energy —the force-effect driving the inflation!

> *"The next quest is to explore what the dark energy is and how it affects the expansion of the universe. ... It adds to the puzzle we already face with non-baryonic dark matter and makes the universe quite an enigmatic place."* — astrophysicist, Bruno Leibundgut[3]

In a nutshell, here is how mainstream cosmology got to this "enigmatic place": The fateful first step came with the adoption of the expanding-universe model. Second, the questionable hypothesis of inflation was introduced to deal with the flatness and horizon mysteries inherent in the expanding-universe. (And this was long, long, before the 1998 challenge of acceleration.) Third, supernovae data reveal the distance equation is wrong and are interpreted as indicative of an accelerating universe. Fourth, a repeat episode of inflation is invoked to explain acceleration. And lastly, the search is now on for the 'dark energy' that is supposedly driving the inflation (adding to the long running search for that other mystery stuff, dark matter). Mainstream cosmology arrived at its enigmatic world-view through a sequence of speculative hypotheses.

But is all this really necessary? ... If all we wish to do is to explain cosmic distance, then certainly not. If all we wish to do is have a redshift-distance equation that agrees with a highly accurate independent method (Supernovae Type 1A luminosity method) then all we need is a cellular model. After all, is it not well established that the observable cosmos is cellularly structured on the largest scale?

This paper will show that the universe with its preponderance of expanding space can be absolutely flat on the cosmic scale (no curvature) irrespective of the average density and still agree with the Supernovae distances. Despite the fact that the Cellular Universe (based on DSSU theory) does not use the conventional expansion-of-the-universe concept, there is unequivocal agreement with the redshift-distance curve determined by the various Supernovae studies.

Since DSSU theory represents a radically new cosmology its main features need to be explained.

2 BRIEF OVERVIEW OF DSSU THEORY

2.1 Rejecting Unscientific Extrapolations

Although DSSU Theory encompasses Einstein's relativity theories it rejects the historic Einstein-based cosmologies (Einstein 1917, DeSitter 1917, Lemaître 1927-1929, Friedmann 1922-1924, and others). DSSU Theory considers the application of *general relativity* to the universe as a whole to be an unscientific extrapolation of what is essentially a ***local theory*** of ***regional space*** and contained matter. The rejection of the extrapolation of *general relativity* is by no means a new idea. Historian and cosmologist Helge Kragh tells us that,

> *Although Lemaître's catastrophic theory built on general relativity, some rival cosmologies denied that Einstein's theory could be applied to the universe as a whole and argued that cosmology should be presented in a theoretical framework that did not rely on extrapolations of ordinary physics.*[4]

These rival cosmologies, united in their rejection of the Einstein extrapolation, included Edward Milne's *kinematic relativity*, W. H. McCrea's *Newtonian cosmology* and Paul Dirac's *large-number cosmology* as well as others of lesser stature. And the main reason why the challengers failed?

> *Whatever their differences, all these cosmological theories agreed that the universe was expanding and that it had a definite age.* —Helge Kragh[5]

Even the steady state (SS) models of Fred Hoyle, Herman Bondi and Thomas Gold accepted the premise that the universe was expanding. The SS, the BB, and the others, all agreed on the one principle that prevented them from attaining a functional simplicity and inevitability that is the hallmark of a successful theory.

2.2 The Non-Expanding Universe

This is where the DSSU, the most recent rival cosmology, is truly different. **It rejects both the Einstein extrapolation and the concept of the expansion of the entire universe.** It is possible to give many arguments against universe-wide expansion. One, however, should suffice.

The Universe (the real universe, not the model one) does NOT expand. Perfectly valid principles of cosmology say it can't. In science you simply cannot pick and choose fundamental principles. Principles are valid not because they have been proven valid, but rather because they are reasonable and no one has been able to disprove them. All who have explored the subject agree that the Universe cannot have a *cosmic edge*. This means there cannot be a region beyond the Universe. Unless one can come up with a comprehensible reality-based answer to the question, *What does an expanding universe expand into?* then one must face the reality that the Universe is already FULLY EXPANDED —always has been, always will be.

<table>
<tr><th colspan="6">THEORY COMPARISON</th></tr>
<tr><th>THEORY</th><th>Time</th><th>Space</th><th>Gravity</th><th>Lambda</th><th>Space Expansion</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>NEWTON:</td><td>objective & physical</td><td>Euclidean geometry</td><td>force</td><td>force</td><td>whole universe</td></tr>
<tr><td>EINSTEIN:</td><td colspan="2">curved geometry</td><td>spherical curvature</td><td>hyperbolic curvature</td><td>whole universe</td></tr>
<tr><td>DSSU:</td><td>process</td><td>absolute & dynamic aether-space</td><td>negative inhomogeneous flow (inflow)</td><td>positive inhomogeneous flow (outflow)</td><td>REGIONAL</td></tr>
</table>

Table 1. Comparison of three classes of physics, each leading to a dramatically different universe. Of particular interest to the present paper is the treatment of space expansion. In DSSU theory it is postulated that space expansion is regional, NOT UNIVERSAL. Space expands only in the interior of cosmic cells —interior regions familiarly known as voids.

While the mathematical proof of an expanding-and-bounded universe necessitates a truly formidable mathematical universe; it *does not* necessitate any sort of real universe.

Indeed, with mathematics it is possible, if one is appropriately gifted, to manipulate the *model* universe in highly imaginative ways (witness the many cosmologies based on *general relativity*). But a powerful arbiter awaits the resulting construction of symbols. ***Reality*** is the master that restrains the applicability of mathematics. Mathematics does not dictate reality. It is the physical process, elevated to physical law, that determines the usefulness of mathematical constructions; mathematical constructions do not necessarily determine the laws of physics. One must conclude that a 4-dimensional sphere is not something real. A hypersphere of positively curved space cannot be a real universe; and neither can a hyperspace construction of negatively curved space. Higher dimensional geometry and topology when misapplied turn into a mathematical trick to circumvent the *cosmic edge principle*.

2.3 Gravitation Theory

There is another difference —a supreme difference— one that elevates DSSU theory to the status of a *new cosmology*. As a comprehensive model, DSSU Cosmology incorporates the causal mechanism of gravitation. No other model, whether historic or contemporary, makes such a claim. The Newtonian theory, by Newton's own admission, gives no hint of the cause of the “gravitational force.” Einstein's theory of general relativity, the gold-standard of gravitation theory and based on 4-dimensional geometry, ***lacks a causal mechanism***. Geometry is never a cause. Geometry is but a description —albeit a highly accurate one.

The key component of *any* theory of the Universe must —without exception— focus on a theory of gravitation. Gravitation is undeniably the most important feature of a cosmos theory. All the models worthy of discussion conform to this requirement. Now here is the problem: gravitation involves action (the act of two objects moving towards each other); an action requires a cause. Newton and Einstein have shown, with varying degrees of accuracy, how to describe the action; but they were unable to show the cause. No universe model incorporates a cause of gravity, no cosmos theory makes such a claim (except one).

The grave implication for the field of astrophysics/cosmology is that in the absence of the root cause of gravitation a model or a theory cannot possibly be complete. Mainstream cosmology is missing an essential process. All expanding universe models are therefore gravely flawed.

2.4 A Theory of Space

The DSSU is a universe of absolute space —a *space* with dynamic properties. *Space* in our new cosmology may be described in these terms: Philosophically it is the essence of the universe, technically it is the quantum foam (of quasi-real precursors), and for practical usage it is aether-space (as detected by D. C. Miller[6] and confirmed by others). DSSU space acts and can be acted upon. For a comparison, the Newtonian universe has absolute space defined by Euclidean geometry. But Newtonian space is quite useless —it does not act and cannot be acted upon. It simply serves as a boundaryless container for celestial objects. As for universe models based on Einstein's relativity, the existence of absolute space is denied; instead, *space* is defined by its curved geometry.

For the purpose of the present paper the dynamic properties of space are not important —except for the fact that **space expansion** is the cause of the cosmic redshift. Furthermore, space expansion is contained and confined by cosmic-sized cells which are treated as static structures packed together in a Euclidean array. One should, however, avoid thinking of the cells as being packed together ‘IN’ space, since they actually CONSTITUTE space. Technically speaking, the cosmic cells are boundary-sharing units of dual-dynamic quantum-foam in a Euclidean universe.

2.5 Infinite Universe

A universe that is based on absolute space (unlike a universe based on geometrodynamic curvature) must address the issue of infinity. Is the universe limited or limitless in size? ... A universe of aether-space has only one option; it must be infinite. It cannot be otherwise. A finite universe has a boundary; a boundary that divides what is in the universe from what is outside the universe; presenting a clear violation of the universe-is-everything principle which requires that everything that IS, including boundaries and *that* which the boundaries divide, must all be part of the Universe.

By being infinite, the DSSU dispenses with cosmology's biggest problems: the cosmic edge, flatness and horizon riddles, inflation, and acceleration.

DSSU theory is summarized in Table 1 and is compared to the Newtonian and Einstein classes of theories.

2.6 Cellular Universe

The last column of Table 1 specifies **space expansion**. The mode of space expansion determines whether a universe is cellular or not. Let us skip over the details of the cell structure and address the important question, *How is it possible for the Universe to be filled with expanding space, without the Universe itself expanding?* It turns out to be surprisingly simple.

Space expansion is contained within cosmic sized 'bubbles' —*aether-space* expands within, yet the structures themselves DO NOT expand (see Fig. 1). While *aether-space* within the cosmic cells expands, the boundaries between cells serve to limit the expansion. In fact the boundaries reverse the expansion by absorbing the space flow —by ***contracting*** the *aether-space* that constitutes the flow. The effects of ***space expansion*** (familiarly known as Lambda, Λ) and its dynamic opposite, ***space contraction*** (familiarly known as gravitation), together, produce an endless flow of *space* along with comoving mass. And since the cells with their dual-dynamic space do not expand, then neither does the Universe.

The *Dynamic Steady State Universe* consists of cosmic cells —approximately 300 million lightyears in diameter— within which Lambda is distinctly positive. Although the space expands in the interior (the void) of the cells, ***the cells themselves do not increase in size***. At the boundaries of the cells, where gravity dominates, space expansion is reversed. The cells maintain equilibrium; consequently the Universe does not expand. The cellular universe may be thought of as having a non-real Euclidean background space in which real structured space[7] performs its dual dynamics —space expansion and space contraction.

This paper deals with an important consequence of space expansion across a cellular array: the logarithmic growth of cosmic redshift. (The important question of why space expansion and space contraction DO NOT cancel the cosmic redshift, in spite of the fact that they are processes in equilibrium, is answered in a Paper currently in-preparation.)

DSSU theory embraces an uncompromising fact: The wonderful match between observation and theory is best achieved when one's theory holds that the universe is more or less statically cellular and the universe is correspondingly non-expanding.

3 THE FUNDAMENTAL PROBLEM WITH THE EXPANDING-UNIVERSE PARADIGM

It has been stated that in "BB cosmology there must have been a transition from [a] matter-dominated epoch to the current epoch with the dark energy's domination."[8] That is to say, there must have been a transition from ***deceleration*** to ***acceleration***. And this is said to have occurred "recently" between $0.5 < Z < 1.0$ (between 5 and 8 gigayears ago). Stated another way, the equation that describes the universe ***has changed!*** If we are to believe this, we must, respectfully, ask: Doesn't this mean that the laws of physics governing the universe have 'recently' changed?!

To say, in answer, that the universe is evolving (usually evolving into whatever is convenient for one's theory) simply underscores the weakness of the BB paradigm. The problem with inflation models in particular and expansion universes in general is that they represent a violation in the stability of the laws of physics. These models lead to irresolvable complexities and ever more variability (allowing an infinity of choices of equations of state) in their attempts to circumvent the traditional and sound argument that only in a universe eternally the same can the laws of nature remain invariant.

> *As the physical laws cannot be assumed to be independent of the structure of the universe, and conversely the structure of the universe depends upon the physical laws, it follows that ... it is only in such a universe that there is any basis for the assumption that the laws of physics are constant ...* —H. Bondi and T. Gold[9]

If natural laws are to be invariant then any model in which the rate of inflationary expansion varies with time and location in the universe cannot reflect reality. Any model in which the density varies with time and location (of some large region) in the universe likewise cannot reflect reality.

But if the model's fundamental laws are permitted to change, then its laws are not truly fundamental. When a model fails to adhere to fundamental laws anomalies appear.

As noted earlier, during the 1990s a major anomaly was found in the cosmic redshift. There was a breakdown in the redshift versus the distance relationship, evidenced by the observations of distant Type 1A Supernovae. The observations indicated that these 'standard candles' are about 25% to 30% dimmer than expected.[10]

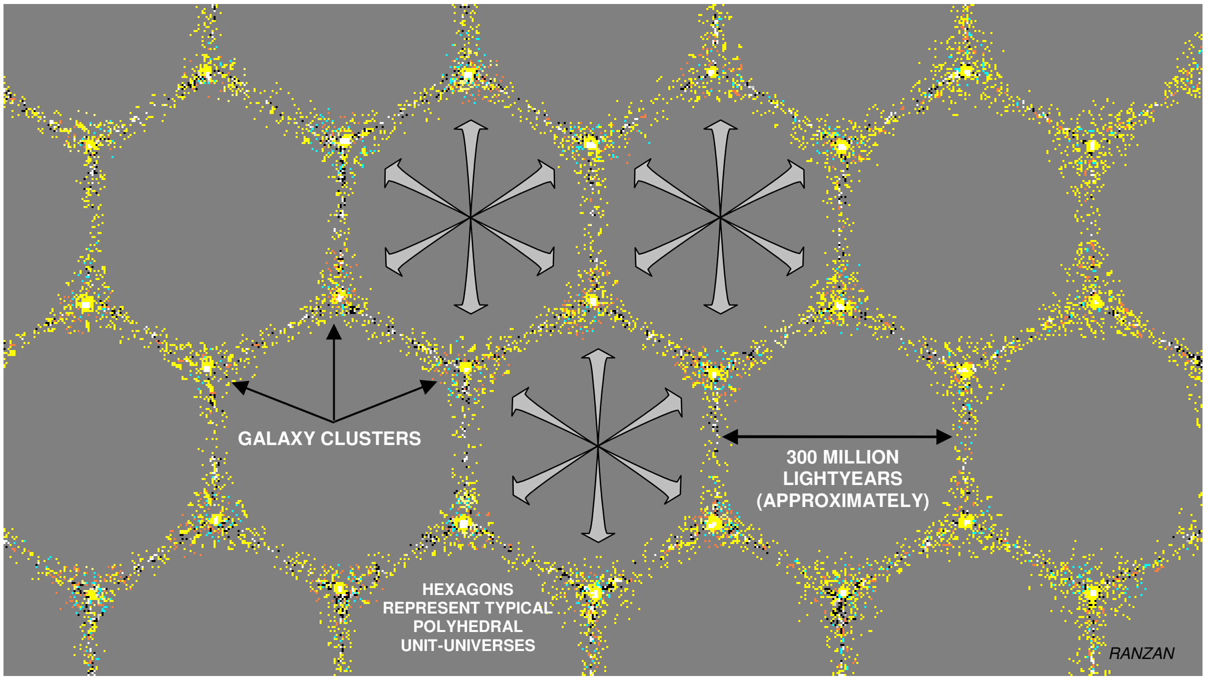


Fig. 1. The *Dynamic Steady State Universe* consists of the simultaneous, but spatially-separated, expansion and contraction of space. These balanced dynamic processes produce a more or less static polyhedral pattern. According to DSSU theory and astronomical observations, our Universe is *cellularly structured*. Although the space expands in the interior (the void) of the cells, in general ***the cells themselves do not increase in size***. At the boundaries of the cells, where gravity dominates, space is contracting. The cells maintain equilibrium; consequently ***the universe does not expand.***

The resolution of the redshift-distance anomaly lies within the regional nature of space expansion and the cellular structures that define these regions.

The cellular structure of the universe was first described by the Estonian astronomer Jaan Einasto[11] in the 1970s: Galaxies and clusters were observed to be concentrated along cell walls and boundaries enclosing dark empty voids. It is this structure, as modeled by the DSSU theory and supported by the *Voronoi cellular model of the universe*, which makes it possible to postulate fundamental laws of physics that are truly universal — spatially and temporally. (Significantly, in the *Dynamic Steady State Universe* there are no initial or boundary conditions.) Most importantly, this structure requires a radically different cosmic-redshift expression and cosmic redshift-distance law. *A more or less uniformly cellular universe requires a logarithmic relationship between cosmic distance and cosmic redshift.*

4 SPACE EXPANSION REDSHIFT

The main piece of evidence that cosmologists use to substantiate that space is actually expanding is the redshift of light from distant galaxies. The redshift is an astronomical term that describes the shifting of the spectral lines of chemical elements towards the red end of the spectrum in comparison with a laboratory standard (the comparison being made at the time of reception of the galaxy's light). The lab standard duplicates the wavelength originally emitted by the astronomical object. Quantitatively, the redshift z is defined as the change in wavelength between the observed and the emitted, divided by the emitted wavelength. If the observed wavelength is λ_o and the emitted wavelength is λ, then the redshift is expressed as,

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

$$z = (\lambda_o - \lambda) \div \lambda = (\lambda_o / \lambda) - 1 \qquad (1)$$

Essentially, the z index is a unitless number —a measure that represents the ratio or factor by which the original wavelength has been stretched or *expanded.*

A word of warning: In BB cosmology this redshift, caused by the expansion of intervening space, is popularly converted into a recession velocity (by multiplying z by the speed of light to obtain cz). This, of course, leads to the Hubble expansion concept; the higher the redshift (the more distant the galaxy), the faster it is receding. In DSSU cosmology, however, the space-expansion redshift has no relation to receding motion. Recession velocities (other than local) are meaningless, a reflection of the fact that the universe, the DSSU, does not expand.

The ***space-expansion redshift*** is also known as the *cosmic redshift* (or *cosmological redshift*). But its cause and interpretation depend on the cosmology. In the DSSU the cosmic redshift is simply a measure of space expansion (and nothing more); in BB cosmology it is used as a measure of space expansion *as well as the expansion of the entire universe*.

Both cosmologies use the *cosmic redshift* to determine cosmic distance.

5 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 $\Delta\lambda$. 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 $\Delta\lambda/\lambda$. 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. But we do know that the size of the unit-universe (u-u) has *not* changed. The dynamic equilibrium we saw earlier in Fig. 1 is responsible for this stability of each cell and reflects the static aspect of the DSSU model.

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, the new wavelength with each passage through a u-u is given by the previous wavelength *plus* its proportional change. Since the proportional change (using idealized conditions) is always $\Delta\lambda/\lambda$, then we simply use the common factor $(1+\Delta\lambda/\lambda)$ to obtain the new wavelength. Fig. 2 shows each u-u, represented by a hexagon, providing another factor $(1+\Delta\lambda/\lambda)$ to the wavelength of the wave we are following on its journey. After passing through N unit-universes, the light wave that is finally observed has N common factors —giving us the observed wavelength λ_0.

We now use the definition of the redshift, $z = (\lambda_0/\lambda) - 1$ from (1), and substitute $\lambda_0 = \lambda\,(1+\Delta\lambda/\lambda)^N$ to obtain $z = (1+\Delta\lambda/\lambda)^N - 1$. The term $\Delta\lambda/\lambda$, being the redshift across one u-u, can be symbolized by z_{UU} and henceforth represents an empirical constant. Thus, the redshift equation for the cellularly structured universe is

$$z = (1+z_{UU})^N - 1. \tag{2}$$

Although, in the diagram, the light path is shown crossing each u-u symmetrically, a non-symmetrical oblique angle through 3-dimensional cells will not alter the validity of the redshift equation. A light path may at times pass through a long axis and at other times through a very small portion of a cell. This suggests that the N parameter should be considered not so much as the actual number of units traversed but more as the *equivalent* number of units. Also, any minor instability of the u-u size, as well as the non-uniformity of expansion within, is not important. Over multiple voids (cells) the effects tend to converge and vanish.

The non-expanding interface regions surrounding the voids *do* introduce a blueshift component; but a judicious choice of a value for z_{UU} should include the blueshift and thus z_{UU} will represent the *net* redshift across a u-u.

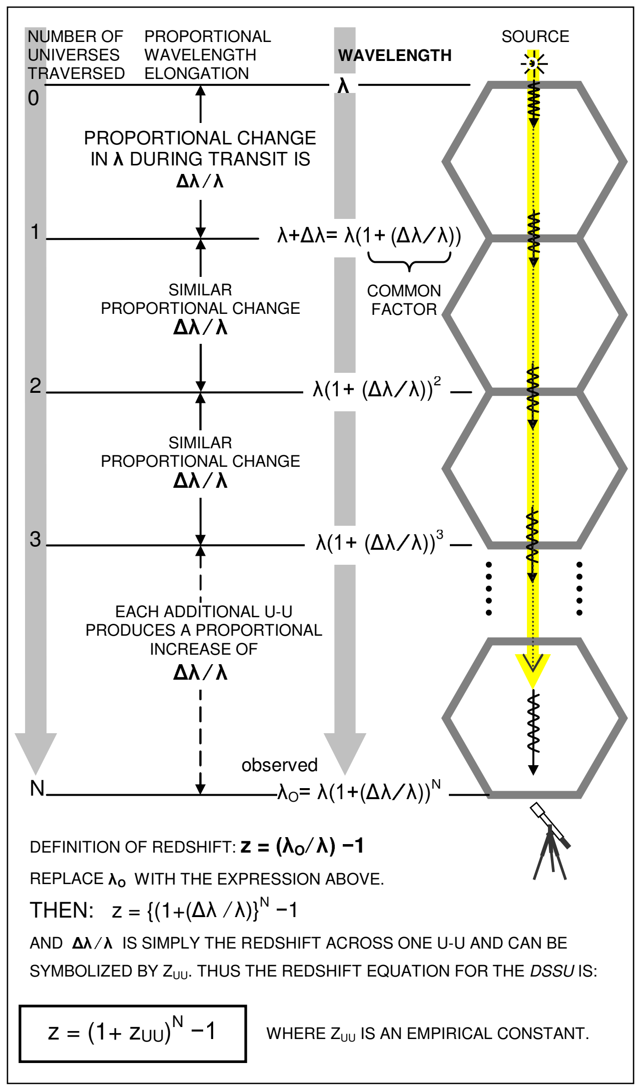


Fig. 2. ***Cosmic-Redshift equation for the DSSU*** is unique for a universe with space expanding within a static structure. Starting at the top of the diagram, each unit-universe (uu) contributes a redshift component to a quantum of radiation. Each progressively altered wavelength is the previous one *plus* its proportional change, hence the common factor $(1+(\Delta\lambda/\lambda))$.

By isolating the cell counter, N, we form an equation of distance solely in terms of redshift:

$$N(z) = \ln(1+z) \div \ln(1+z_{UU}) \,. \qquad (3)$$

This makes for an interesting, and simple, measure of distance, but not very useful for comparing with the distance scales used in BB models.

6 THE DSSU COSMIC REDSHIFT-DISTANCE LAW

6.1 Distance Across One Cell

In developing a cosmic redshift-distance law specifically for the DSSU the next step is to find a general expression for the distance across one u-u.

We know that z serves as a measure of space expansion. But z is a dimensionless number —a ratio that is meaningful only if related to some other more useful quantity. The redshift z is the fractional change in the wavelength of light that has crossed the void. But just as important is the fact that z is also a measure of the fractional increase by which space has stretched or expanded.

This means that any and all distances increase by a factor z.

A familiar fact is that distance traveled is equal to speed multiplied by time. Normally the distance that light travels is equal to **speed-of-light** multiplied by **time**. But this distance becomes increased by the z factor. And so in expanding space the total distance becomes,

$$\text{Distance}_{\text{TOTAL}} = (\text{lightspeed} \times \text{time}) \times (1+z). \qquad (4)$$

Although the light pulse has really only traveled a distance D **through space**, if it were somehow to return instantaneously to its starting point (a point embedded in comoving space) it would have to retrace a total distance of D plus $D \times z$.

The extra distance (the expanded distance) that 'materialized' during the travel interval is,

$$\text{Distance}_{\text{EXPANSION}} = (\text{lightspeed} \times \text{time})\, z \,. \qquad (5)$$

And by dividing by 'time' we obtain the velocity of expansion:

$$\text{Velocity}_{\text{EXPANSION}} = c\, z \,. \qquad (6)$$

We will use this important expression in a moment.

It is most fortunate that we know, reasonable well, the actual rate at which cosmic space expands. Most studies[12] since 1996 have found that across a distance of 1 million lightyears (MLY), the amount of newly expanded space is somewhere within the range of 16.9 to 24.5 km during each and every clock second. For the sake of this discussion we will select the value 18.5 km per second across 1 million lightyears. Then, likewise, across a distance of 10 MLY, the amount of expanded space is 10 times 18.5 km for every second of time.

And as a general statement, any selected distance is responsible for expanding that same {*distance* in MLY} multiplied by {18.5 km/s/MLY}. Clearly, a certain distance is responsible for a corresponding amount of *expansion velocity*.

$$\text{Distance} \times (18.5\ \text{km/s/MLY}) = \text{Expansion Velocity},$$

$$\text{Distance} = \frac{\text{Expansion Velocity}}{18.5\ \text{km s}^{-1}\ \text{MLY}^{-1}} \,. \qquad (7)$$

For the *expansion velocity*, substitute cz from (6) above. The denominator (18.5 km s^{-1} MLY^{-1}) is nothing more than the ***space expansion parameter*** H. The distance equation then becomes,

$$\text{Distance} = cz/H$$

The distance we really want is the cell diameter. Recall, the redshift across the unit-universe is z_{UU} . Thus,

$$\text{Diameter}_{\text{UU}} = cz_{UU}/H_{18.5} \qquad (8)$$

6.2 Cosmic Distance Across Multiple Cells

Now for distance measurements spanning multiple cells, it becomes a simple matter of multiplying the diameter of one unit-universe by N, the cell count.

$$\text{Distance}_{\text{COSMIC}} = \text{Diameter}_{\text{UU}} \times \text{No. of Cells}$$

$$\text{Distance}_{\text{COSMIC}} = (cz_{UU}/H) \times N \qquad (9)$$

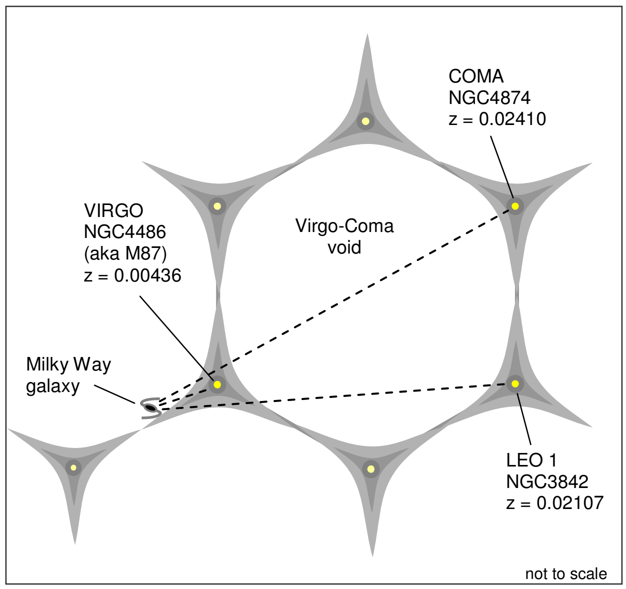


Fig. 3. Determining the redshift across a unit-universe. The difference in the z values between M87 and NGC4874 is 0.01974; the difference between M87 and NGC3842 is 0.01671. The average difference is 0.01823. The redshift across a typical unit-universe is symbolized by z_{UU} and assigned the empirical value 0.01823. (The hexagonal unit in this schematic drawing represents a polyhedral cosmic cell. Size of galaxies is greatly exaggerated.)

6.3 Cellular Universe Redshift-Distance Law

Substituting the logarithmic expression for N, eqn (3), gives the ***redshift-distance law*** for a cellular universe expressed in its most general form:

$$D(z) = \frac{cz_{uu}}{H} \times \frac{\ln(1+z)}{\ln(1+z_{uu})} \qquad (10)$$

The actual use of the equation requires one final empirically derived value —the net redshift across a single u-u.

6.4 The Net Redshift Across One Cell.

To determining z_{UU}, the net redshift for one 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 unsurpassable 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* does not move. Not ever. 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. The redshift reading of the near galaxy is subtracted from the far; then averaged. Figure 3 shows the numbers.[13] The nominal redshift across a single polyhedral cell turns out to be $z_{UU} = 0.01823$ where the subscript means 'across one **unit-universe**.'

If we want to corroborate the reasonableness of the latter redshift diameter we could simple measure the redshift (RS) across the Eridanus Cell (to which our galaxy seems to belong) by looking across the Eridanus void and measuring the RS of the Node Galaxy known as NGC541. This cD/SO radio-galaxy dominates the Cetus cluster A194 and has a RS of $z = 0.01809$ which agrees reasonably well with the previous $z_{UU} = 0.01823$ obtained for the Virgo-Coma cell.

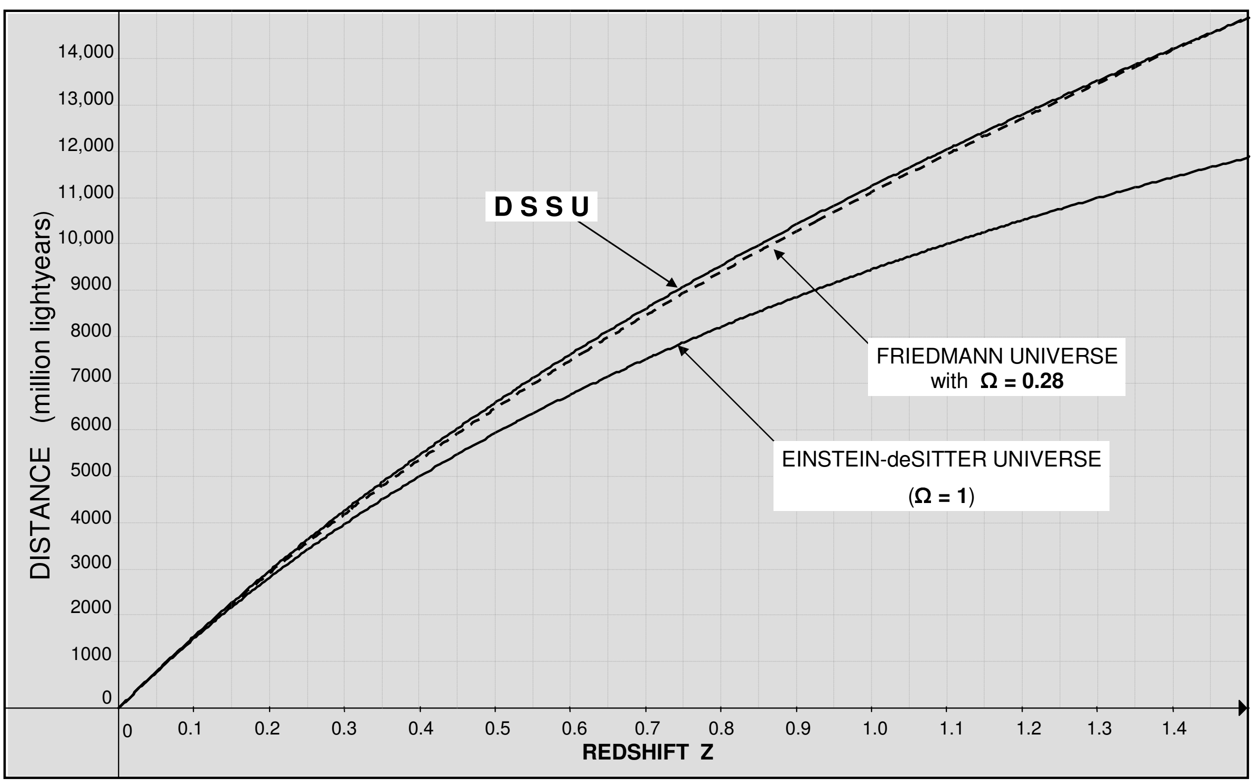
6.5 DSSU Redshift-Distance Equation

Before making a graph of eqn (10), we insert the known values: $c = 300{,}000$ km/s; $z_{UU} = 0.01823$; and $H = 18.5$ km s^{-1} MLY^{-1}; so that,

$$D(z) \approx 296 \text{ MLY} \times [\ln(1+z) \div \ln(1.01823)] \,. \quad (11)$$

Notice that the nominal diameter of a cell is 296 MLY.

It is all too easy to overlook the fact that *the redshift* is the miraculous quantity that codes the distance. It is the z-index, meticulously gathered by the astronomers with the aid of sophisticated instruments, which allows us to calculate distance. Specifically, z determines N using eqn (3); and N together with the *cell diameter* then give us the cosmic distance.



Graph 1. ***Redshift-Distance relations*** for DSSU (top), for the Friedmann universe with $\Omega = 0.28$ (dashed), and for the Einstein-deSitter universe in which $\Omega = 1$ (bottom) are plotted for z values up to 1.5. Notice that the DSSU is in excellent agreement with the Friedmann curve ($\Omega = 0.28$) which itself was calibrated in concordance with the Type 1A Supernova data. The relevant equations are detailed in the following graph (Graph 2).

7 A GRAPHICAL COMPARISON WITH THE FRIEDMANN UNIVERSE

Let us now compare the cellular universe with the Friedmann type of expanding universe. The simplest version is the Einstein-deSitter universe and for many years it served as the basic standard for the BB model. It uses the following redshift-distance equation for *reception distance*:

$$\text{Distance} = \frac{2c}{H_0} \times \left(1 - (1+z)^{-1/2}\right) \qquad (12)$$

It is applicable to a flat expanding universe that neither accelerates nor re-collapses. (Note, in BB cosmology the *H* is more than just a space expansion constant, it also serves as a proportionality constant between *distance* and *recession velocity*.)

Friedmann universes can be expressed in terms of the matter density of the universe. The density parameter, Ω, defined as the ratio of the matter density observed (or estimated) within our universe, to the theoretical critical density —the density required to "close" the universe and halt its expansion— is used in a convenient expression of cosmic-redshift distance. According to the Harvard Center for Astrophysics website[14] the equation for the *proper comoving distance* (the reception distance) is:

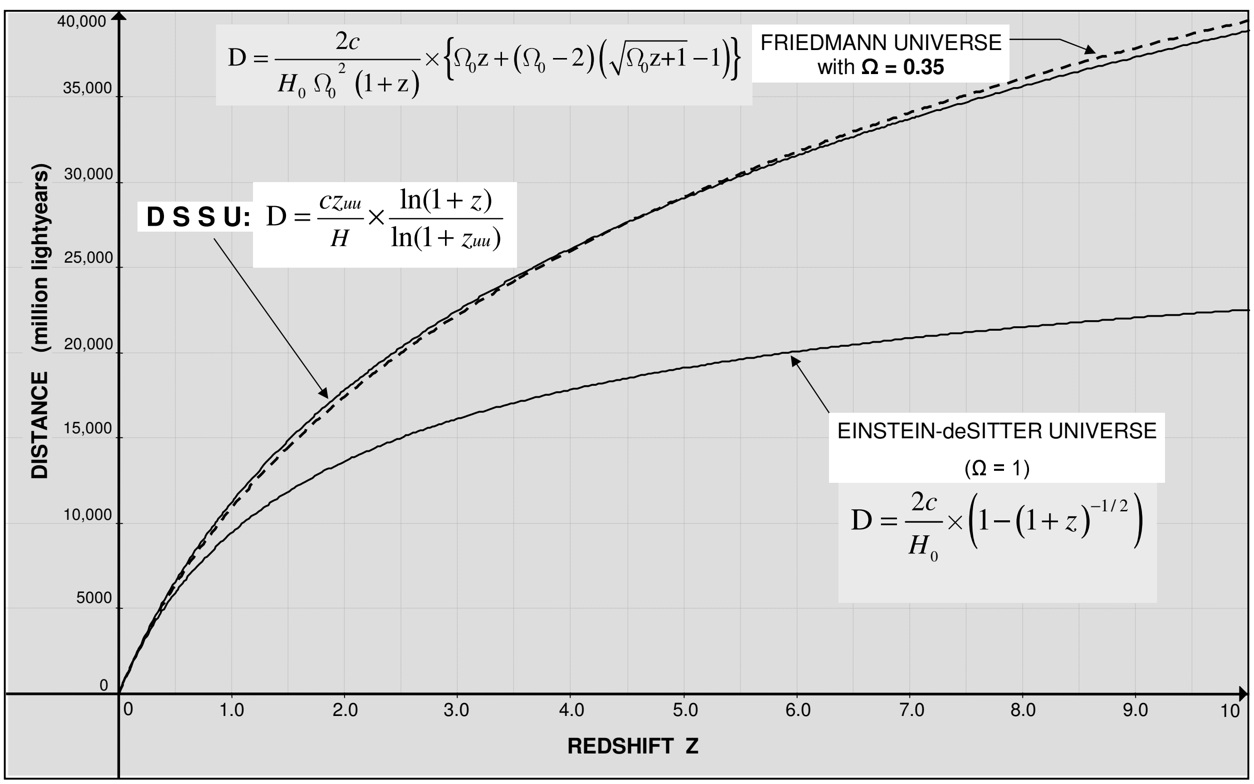
$$\text{Distance} = \frac{2c}{H_0\,\Omega_0^2\,(1+z)}\,\{\Omega_0 z + (\Omega_0 - 2)\,[(\Omega_0 z + 1)^{1/2} - 1]\}$$

Mattig (1959) (13)

Notice that when the *energy density* Ω_0 is set equal to 1.0 in (13), one obtains the basic Einstein-deSitter eqn (12). The Einstein-deSitter is simply a universe having critical density.

For Friedmann universes the conversion of redshift to distance depends very much on ones choice of Ω_0. But what value do we select? What value do astronomers use? ... And here is where the high-z supernovae studies become important; not only do they narrow the choice they also constrain all cosmology models that use the redshift as a distance gauge. The high-z studies represent a significant achievement in the measure of great cosmic distance — significant because it gives a measure totally independent of any redshift method. Consequently redshift distance equations can now be calibrated.

The high-Z supernovae data of the past few years confirm that the basic Einstein-deSitter equation does not reflect reality. The findings indicate that the supernovae are farther than expected —distance points fall well above the Einstein-deSitter curve. The old distance curve needed to be shifted upwards —and Ω_0 is the factor that does just that. Each supernova study concludes that one or another value of Ω_0 will provide a suitable correction, an appropriate upward shift to the distance curve.



Graph 2. ***Redshift-Distance relation*** for redshifts between 0 and 10. The parameters used in the equations are: the redshift across one unit-universe $z_{UU} = 0.01823$, the space-expansion term H and the Hubble term H_0 are both 18.5 km/s /MLY, the density ratio Ω as shown, and the speed of light $c = 300{,}000$ km/s. Within the redshift domain covered by this graph, the DSSU curve shows good agreement with the Friedmann universe (Ω = 0.35) which again is in concordance with the Supernova data.

The various high-redshift studies all conclude that the density ratio is far less than unity and that cosmic expansion is accelerating, indicating the presence of a cosmological constant (+Lambda force), or negative vacuum energy,[15] or some other form of "dark energy."

> *[One such] investigation 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)[16]

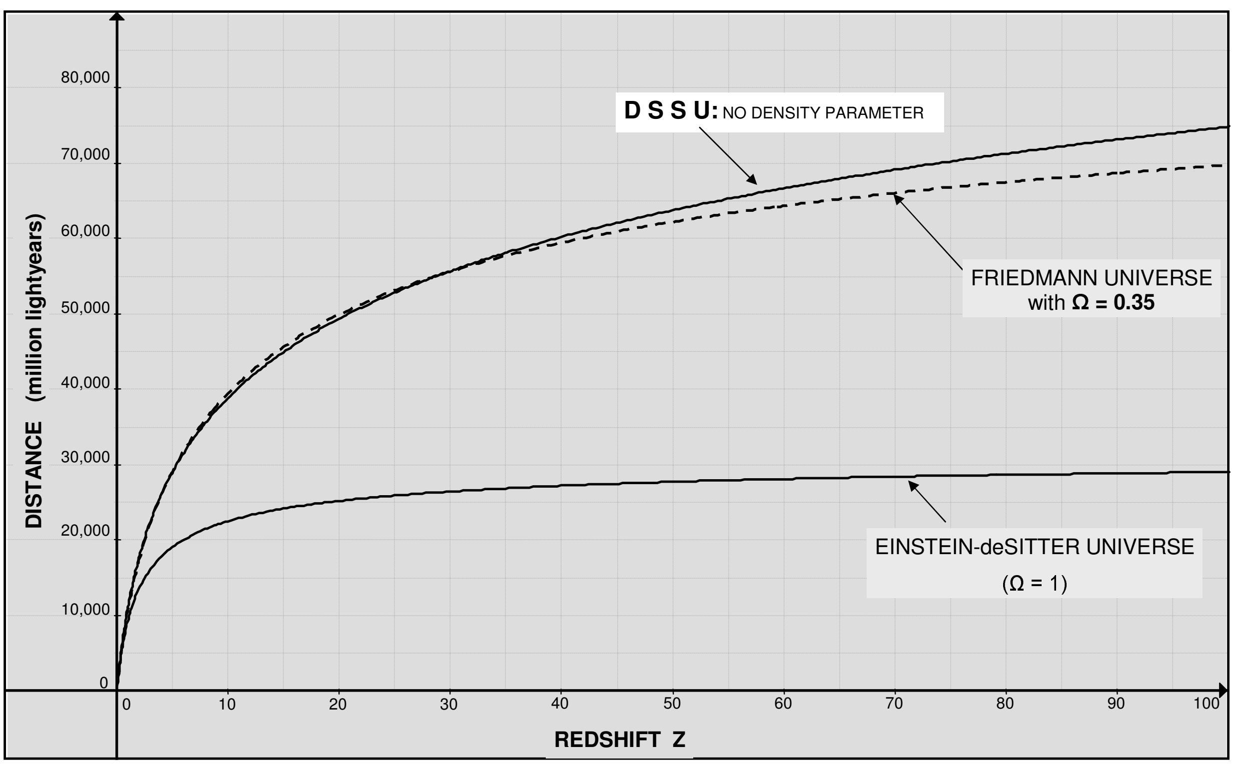
The major gap in the understanding of gravity, when considering the greater universe, is this: If the universe is divided into cells, then so also are its gravitational fields. The flaw in conventional cosmology is that it considers the gravitational field of the Cosmos to be monolithic. Burdened by the misconception, researchers have resorted to measuring and interpreting density parameters and have found that the most plausible values are $\Omega_M \approx 0.3 \pm 0.05$ and $\Omega_\Lambda \approx 0.7 \pm 0.05$ in a more or less flat universe. Where Ω_M quantifies the mass and energy tending to pull the BB universe together and Ω_Λ quantifies the energy tending to push the universe apart.

A typical conclusion is that of the Supernova Cosmology Project headed by R. A. Knop.[17] Their findings suggest that for a best-fit curve for a flat universe $\Omega_M = 0.25$ and $\Omega_\Lambda = 0.75$.

For 'flat' Friedmann universes we need only consider the 'matter' density ratio so that Ω_M serves as Ω_0 in eqn (13). When the Friedmann universe is plotted, using density values selected from within the researchers' acceptable range, 0.28 for Graph 1 and 0.35 for Graph 2, and the resulting curves are compared to the DSSU we find remarkable agreement. All the more noteworthy since the DSSU has neither a density parameter nor any other time varying parameter.

8 SUMMARY AND CONCLUSION

This paper points out some of the serious weaknesses, and a particularly blatant unscientific extrapolation, of the expanding-universe paradigm. An alternate cosmology is introduced, one that does not share the former's weaknesses. The DSSU model —a fundamentally different cosmology— is investigated to determine how its cosmic distances are formulated and how such distances compare with the supernovae data. Its characteristic cellular structure dictated the need for a new cosmic redshift-distance formula —one that is based on a *logarithmic relationship between cosmic distance and cosmic redshift*. The new expression is derived and graphed and found to be consistent with the supernovae data. The Friedmann curve, in comparison, seems artificial as its density parameter has to be fine-tuned and probably varies with distance. Near the relevant redshift range of the supernovae the two cosmologies seemingly agree. However, the extrapolation of the curves in Graph 3 clearly reveals there is a divergence of two fundamentally different cosmologies.



Graph 3. ***Redshift-Distance relation*** extrapolated for redshifts up to 100. This graph predicts that the Friedmann-class of models will always require an adjustment of Ω. The density parameter Ω represents one of the time and/or distance dependant parameters available to the BB model. The DSSU has no such parameters.

Our Universe is far simpler than the model which BB cosmology attempts to construct. The BB uses universe-wide expansion; the DSSU does not and simply uses regional space expansion. The BB uses parameters that vary with time and/or distance; the DSSU does not. The BB uses rules of physics that evolve; the DSSU uses laws that are unchanging. The BB denies the existence of absolute space; the DSSU embraces it and uses it to construct an ordered cellular universe.

The commonality of the two cosmologies lies in the fact that they both use the quintessential concept of space expansion (hence, they both need a space expansion parameter and sure enough both use H). And there, agreement ends. BB models make a totally unrealistic extrapolation of the observed expansion of space: an extrapolation into the expansion of the entire universe! An extrapolation that even varies with time! ... The DSSU on the other hand cannot expand. Instead, this simple and elegant cosmology ***confines and limits*** space expansion to the void regions. Herein lies the explanation of why the voids 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. In the new cellular model we have an immediate and obvious explanation for the network of voids and galaxy clusters, its regularity and ubiquitousness. Theory and observation agree on distance. The new formulation of cosmic-redshift distance agrees with the Supernovae observations —***without using any additional parameters!***

There are three general approaches to understanding the Cosmos: The first is to forget about theory and simply rely on intuition, faith, religion, divine revelation, etc. The second approach is to have a hypothesis or several hypotheses —a collection of weak theories or potential theories. The final approach, the truly scientific one, is to develop a strong theory. The key to meaningful understanding lies in the restricting of possibilities.

> *We can put this in another way. In the absence of a theory anything can happen. If we introduce a weak theory too many things can still happen. A strong enough theory has not yet been discovered.* —Dennis Sciama[18]

The ***expanding-universe model*** exemplifies theory of the *weak kind* —it allows for too many solutions. And this is especially true when one uses an incomplete theory of gravity.

> *For instance, general relativity, which is the best theory of space, time and gravitation that has so far been proposed, is ... consistent with an infinite number of different possibilities, or models, for the history of the Universe. Needless to say, not more than one of these models can be correct, so that the theory permits possibilities that are not realized in Nature. In other words, it is too wide.* —Dennis Sciama[19]

The supernovae research underscores the weakness of BB cosmology.

> *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[20]

And so, the ***expanding-universe model*** allows for too many possibilities. Its weakness is embarrassingly obvious.

In contrast, the DSSU, as a model and as a theory, is unquestionably rigid: It represents a more or less statically structured Universe that IS. It is not a universe that is something now, was something else in the past, and will be something else later. The DSSU is not a universe that transitions from one manifestation in the past to a different manifestation in the present, to then take on a new manifestation in the future. DSSU theory allows for only one solution to the mystery of the Cosmos. And this is as it should be, for in the world of physical reality there can be only one solution —*the reality solution*.

A final few words, a rather fitting concluding quotation, but read 'interim' as 'unequivocal':

> *The interim conclusion about the overall shape of space is thus 'back to basics': although mathematicians have discovered a wealth of complicated manifolds to choose from and both positive and negative curvature would have been allowed a priori, all available data so far is consistent with the simplest possible space, the infinite flat Euclidean space that we learned about in high school,* —Max Tegmark (2002)[21]

□

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NOTES AND REFERENCES

[1] The *Dynamic-Steady-State-Universe theory* was conceived in the year 2001 and first presented at the 2002 ESA/ESO/CERN Astrophysics Symposium in Munich, Germany.

[2] This is a question particularly challenging for conventional cosmology since the universe has only a fraction (about a third) of the matter needed for geometric flatness; and the mechanism of inflation itself is poorly understood.

[3] Bruno Leibundgut, *Evidence for an Accelerating Universe from Type Ia Supernovae.* Astronomy, Cosmology and Fundamental Physics; Proceedings of the ESO/CERN/ESA Astrophysics Symposium 2002 p22-23

[4] Helge Kragh, *Steady State Theory, Encyclopedia of Cosmology* Norris S. Hetherington, Editor 1993, (Garland Publishing, Inc. NY & London) p629

[5] Ibid.

[6] D. C. Miller, *Rev. Mod. Phys.* Vol: 5, 203-242 (1933)

[7] The Euclidean background space serves as an abstract frame of reference for the very real structured and dynamic space of the genus described by Reginald T. Cahill, *Dynamical 3-Space: Alternative Explanation of the 'Dark Matter Ring'* arXiv:0705.2846v1 [physics.gen-ph] 20 May 2007

[8] Bruno Leibundgut, *Evidence for an Accelerating Universe from Type Ia Supernovae* Astronomy, Cosmology and Fundamental Physics; Proceedings of the ESO/CERN/ESA Astrophysics Symposium 2002 p21

[9] Bondi, H. and Gold, T. "The steady-state theory of the expanding universe" Monthly Notices of the Royal Astronomical Society (1948), as in E. Harrison, *Cosmology, The Science of the Universe* p327

[10] Riess et al. 1998; Perlmutter et al. 1999

[11] Einasto, J., *The Structure of the Universe on 100 Mpc Scales* World Scientific Feb, 2003; and arXiv:astro-ph/0011334v1 17 Nov 2000

[12] Referring to the studies of Hubble constant as summarized at: http://cfa-www.harvard.edu/-huchra/hubble/

[13] The galaxy redshifts (heliocentric) are provided by *the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.* http://nedwww.ipac.caltech.edu/forms/z.html

[14] The Center For Astrophysics Redshift Catalog http://cfa-www.harvard.edu/~huchra/zcat/zcom.htm

[15] R. A. Knop et al. "The supernovae data are consistent with a low-mass Universe dominated by vacuum energy (w = -1), ..." arXiv:astro-ph/0309368 v1 12 Sep 2003 p40

[16] John L. Tonry et al. arXiv:astro-ph/0305008 v1 1 May 2003

[17] R. A. Knop et al. arXiv:astro-ph/0309368 v1 12 Sep 2003

[18] Dennis Sciama (*Modern Cosmology*, 1971) as in E. Harrison, *Cosmology, The Science of the Universe* p307

[19] Ibid.

[20] R. A. Knop et al. arXiv:astro-ph/0309368 v1 12 Sep 2003 p40

[21] Max Tegmark, *Measuring Spacetime, from Big Bang to Black Holes*, arXiv:astro-ph/0207199 v1 10 Jul 2002 p3