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Our Universe Expands

With the Arrow of Time

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Abstract

There are no such entities as dark matter or dark energy and, indeed, there can be no future for our universe with an accelerated rate of expansion. A new closed model for the expansion of our universe predicts correctly all astronomical measurements so far presented with no free parameters for adjustments to fit the data. Our universe is more complex than anticipated by Einstein. This has already been made clear by the inability to unify quantum physics with classical physics, The many problems encountered by general relativity (GR) in trying to account for the expansion also attest to that complexity and in particular, the collapse of the universe with the third (k = 1) option of the Friedmann equations. There can be only one correct model, so the vision of the new expansion model began with the complete abandonment of GR and a search for what makes our universe expand. The reality of space and its production rate takes center stage in the new model. New concepts of geometry and higher-dimensional spaces with a new arrow of time came into being which solved many other long-standing fundamental problems. Only algebra and beginning calculus were needed to develop the new model. The new model is described in detail in a new self-published Book 3 just coming off the press and the highlights are described in the following paper. Normally cosmology papers are written about incomplete models with free parameters and the authors minimize the number of equations. The opposite approach was used for the closed model in this Book 3. In 112 pages, nine present fixed data are presented with 50 equations and 58 figures so the reader could reproduce any, or all, of the predictions.

I Introduction

If one is convinced that general relativity (GR) cannot account for the expansion of our universe and an alternate cosmology is needed, how should one go about deriving the correct theory? Those problems and failures of past models signal the theoretical pot-holes to be avoided but offer little guidance to new concepts. Although there are still some severe fundamental problems, past scientific measurements has shown no haphazard behavior of nature, but reasonable behavior explained by mathematical equations in terms of our constants of nature, such as the gravitational constant, G, the speed of light, c, and Planck's constant, h. But nature does not behave according to what units we pick for our measurements.

In Reference [1], the vital clues needed to construct the new model are called Planck's natural units which he added in an appendix to his seminal paper [2] and announced his new Planck constant, h, ($\hbar = h/2\pi$ = 1.0546x10^{-27} cm^2 g^{-1} s^{-1}):

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$l_p = 1.6162 \text{x} 10^{-33}$ cm, $t_p = 5.3911 \text{x} 10^{-44}$ s, $m_p = 2.177 \text{x} 10^{-5}$ g..

Note the extremely small size of Planck's natural length, l_p and Planck's natural time t_p. Both are many orders of magnitude too small to be measured. Here at the start of a new model of our universe, which astronomers tell us is of present radius about R_0 = 4400 Mpc [~ $1.4 \text{x} 10^{28}$ cm] and age of about 13.7 Gy [~$4.3 \text{x} 10^{17}$ s], one finds these tiny constants. They must be trying to tell us something. So we will go one step further and convert to dimensionless numbers such as; for length r, $N_r = r/l_p$; time t, $N_t = t/t_p$; and mass m, $N_m = m/m_p$.

The Planck density, $\rho_p = m_p / l_p^3$, with $c = l_p/t_p$ and $G = c^2 l_p/m_p$, gives, $G\rho_p t_p^2 = 1$. Could it be that if ρ_p and t_p were replaced by their real values, would this grouping give us a new *Law of the Expansion*? The answer is, yes, $G\rho t^2 = 3/32\pi$ [1].

Now consider how to make it geometrically *impossible* for a new expanding universe to collapse. The mathematicians have a geometry called N-spheres where the time derivative of the ball-cavity inside the sphere $\dot{V}_{N+1}$ is proportional to the surface volume V_N, that is, $\dot{V}_{N+1} = V_N \dot{R}$. An ordinary N = 2, 3-D expanding rubber balloon follows this rule. So do the N=3 volumes; $V_4 = (1/2)\pi^2 R^4$ and $V_3 = 2\pi^2 R^3$ for a 4-D ball.

To make it impossible for our 3-D universe to collapse, we must have particles of 4-D space generated on the bare surface of the 4-D ball and our spatial 3-D universe is just outside that vacuum activity. Normally one cannot develop dynamics from just geometry. But now one can make a calculation of the production of 4-D (and 3-D) space which can be checked later after the new model is developed with continuous time of calculus.

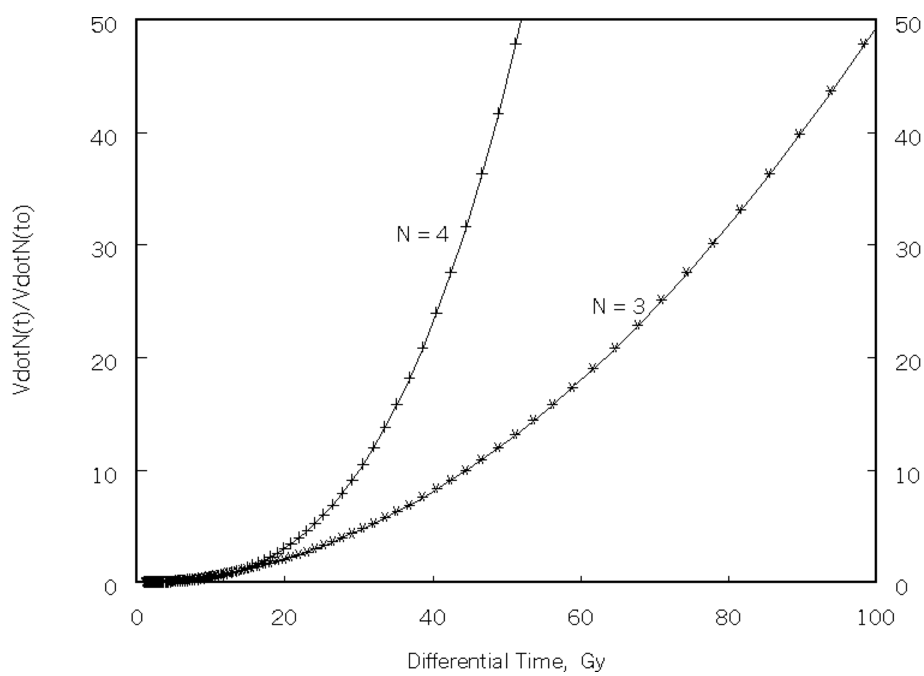

Fig. 1 For each of the volumetric flow rates, $\dot{V}_4$ *and* $\dot{V}_3$, the solid curves are the calculus calculations and the symbols are the l_p-t_p values, showing excellent agreement. In both cases, the values at time t were divided by their present value at time t_0 = 13.5 Gy.

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For the present radius of our 3-D universe, R_0 = 4388Mpc, the number of exposed 4-D cells on the present surface of the 4-D ball is $N_{30} = 2\pi^2 \left(R_0 / l_p \right)^3 = 1.16x10^{184}$. With a production rate of one new 4-D cell per exposed 4-D cell every Planck second, or $\dot{V}_{40} = N_{30}\, l_p^4 / t_p$ = 1.477x10^{96} cm^4/ s. The equivalent production of our 3-D space $\dot{V}_{30}$ = $3\dot{V}_{40}/R_0$ = 3.272x10^{68} cm^3/s = 350.1 Mpc^3/yr –a reasonable rate. In effect, time becomes discrete with cellular space. The excellent agreement with continuous time of the new model is shown graphically in Fig. 1.

This production of 4-D space on the surface of the 4-D ball is called spatial condensation (SC) of much smaller m-D spatial partials of an older pre-existing epi-universe. The 4-D ball, and our 3-D universe, started from the spontaneous production of the very first one of these 4-D spatial particles. This SC-process must occur on any foreign object in epi-space including our particles of mass in 3-D space.

II Fundamental Problems of Physics

If our particles of mass in our 3-D space are being bombarded with these m-D particles of epi-space, perhaps that bombardment is also a new source of gravity where large mass M dimples the surface of the 4-D ball and a small probe mass m at distance r is *pushed* (not pulled by attraction) toward mass M by its epi-bombardment. Can such a new *non-attractive* source of gravity be derived just from Newton's equation? The answer is yes, as was presented in the author's first paper submitted to viXra.org {3}.

Using Planck's natural units and new physical concepts, it seems that a number of fundamental problems can be solved even before the new SC-model is developed. Are there more such fundamental problems? What about that horrific fundamental problem of quantum theory? If the fluctuations are cut off at the Planck level, quantum theory predicts that the vacuum energy is a factor of 10^{123} greater than all of the mass energy, mc^2 of our universe? Indeed, an even more fundamental problem: What is energy? What motion in our universe constitutes energy? The term "pure energy" appears now and then, but never a discussion of what motion energy is.

III Energy

Start with the most difficult: what motion accounts for Einstein's mass energy, mc^2? A particle of mass in our 3-D universe is a foreign object in the outer epi-space, so it must support spatial condensation. Assume the SC- epi- process is sufficiently complicated that the epi-universe must stay in contact through arriving columns of the proper mix of the smaller m-D particles. Then energy is simply, $E = \dot{N}_4 \hbar$, where $\dot{N}_4$, the rate of production of 4-D spatial particles, has units of inverse time and Planck's modified constant, $\hbar$, has units of energy times time. Those columns extend some distance back into epi-space, and for kinetic energy, that is, velocity of the mass itself, those columns are at an angle with respect to the radius R, and its inertia to change in velocity is due to resistance to change of the arrival angle of the columns of arriving m-D epi-particles. $E = \dot{N}_4 \hbar$ can be set equal to all forms of energy.

Now consider the case of vacuum energy. The SC-model predicts exactly the same horrific excess of vacuum energy, 10^{123}, over mass energy as quantum theory but with a difference. In the SC-vacuum case, a new 4-D particle is being produced every Planck second on each exposed 4-D particle on the bare surface of the 4-D ball. The columns of arriving m-D particles try to get started but they are promptly cut off by the next 4-D particle produced and only virtual particles are produced which quickly vanish Thus $E = \dot{N}_4 \hbar$ holds for vacuum energy but vacuum energy has no mass. Einstein's $E = mc^2$ does not apply to vacuum energy. Are there other new SC-concepts?

IV Dark Mass Replaces Dark Matter

Dark matter does not exist. Some decades ago, before the paradigm shift to an accelerating universe, and astronomers were correctly trying to build models of a decelerating universe, they discovered that the rotational curves of spiral galaxies indicated excess (x10) mass past the optical radius. They promptly assumed, and still claim, it is a variant form of matter since it interacts only gravitationally with normal baryonic mass. Their early assumption was wrong and particle physicists have found no evidence of such particles.

In the SC-model this excess mass (x8) is a variant 4-D particle and scales with the expansion as R^{-2} instead of R^{-3} for ordinary matter. It is called "x-stuff" or "dark mass" and its properties are very important to the success of the SC-model. Dark mass is not even in our 3-D universe but on the bare surface of the 4-D ball and that is why it does not interact with ordinary matter. It is rejected by the 4-D ball just as ordinary mass and responds to the new source of gravity as does ordinary mass. Even though the density of dark-mass decreases in the future, as it must, the total mass of dark mass continues to increase as shown in Fig. 2.

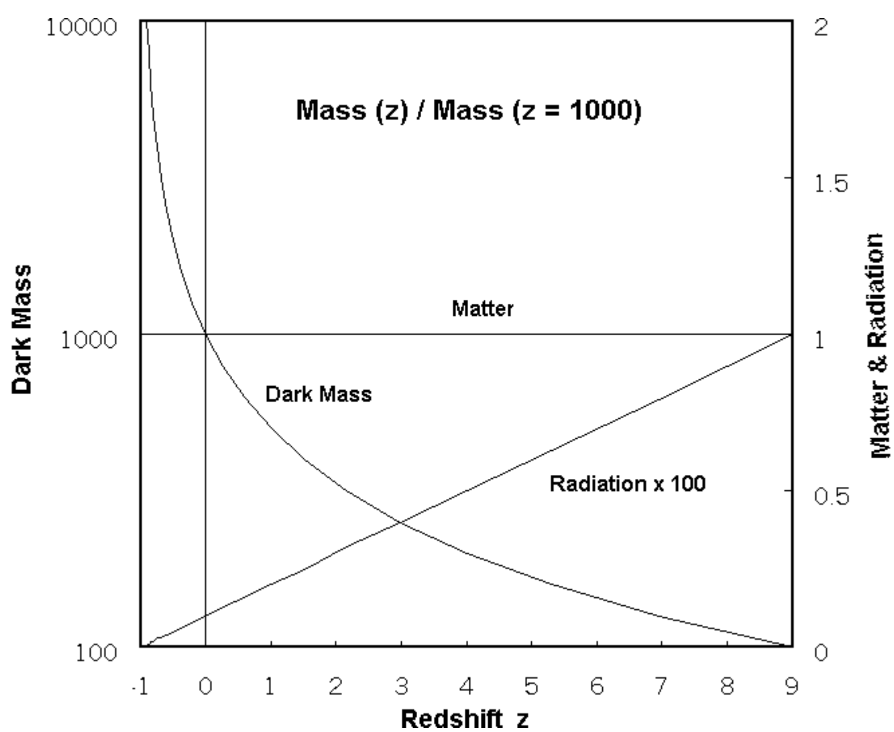

Fig.2 The change in the three components of the total mass of the universe is shown by their respective ratios to their present component mass at Z = 0. The future rapid rise of SC-dark mass will increase condensation of matter into galaxies and clusters.

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Even more amazing, one does not need to guess for the present density of dark mass, it is give by difference using the new *Law of Expansion*, $G\rho t^2 = 3/32\pi$, as,

$\rho_{x0} = \left((3/32\pi)\Big/\left(Gt_0^2\right)\right) - \rho_{r0} - \rho_{m0}$, and the total present mass density $\Omega_{m0} = 0.28$ agrees with the WMAP value [4]. The very first 4-D particle produced had to be a variant 4-D particle and some further details are given in [1].

Scaling with the radius of the universe as $\rho_x = \rho_{x0}(R_0/R)^2$, and $dM_x/dt = M_xH$, dark mass should also scale locally as $\rho_x(r) = \rho_{x0}(r_0/r)^2$ and $dM_x/dt = M_xH$. Thus the early dark mass particles were first deposited randomly when the 4-D ball was formed and they reproduce only where such particles already exist which produces growing clumps of dark mass that can form very early black holes even with no ordinary matter mass. Of course such clumps form early seeds for formation of galaxies.

V Where Did Relativity Theory Go Wrong?

If SC-theory is correct, then relativity theory is wrong for expansion. But where did it go wrong? Einstein thought our universe was static with just three spatial dimensions and he thought time was what clocks measure, and he thought photons follow geodesics. All three concepts are excellent approximations for short periods of time (century) and short distances (parsecs), but all three concepts are wrong for the enormous size, time and geometry of the expansion. Select geometry and focus on a very misleading concept that is used in present relativity theory, *comoving coordinates.* We will contrast the background, k = 1, reasoning for that concept with SC-N-sphere concept already presented.

Limited to three spatial dimensions for a closed k = 1 closed spherical universe of some thickness and present radius R_0, relativists advise that one must not think of any reality to the inside or outside of the sphere. So call both GR-non-space.

Then they claim that if R_0 is held constant,. $\dot{R}_0 = 0$, then the distance between any two points, the comoving coordinates, scales as R/R_0 of the expansion. Davis and Lineweaver [6] take the time derivative of their expansion redshift Eq. (19) and get $dt/R(t) = -dz/R_0H(z)$ instead of $dt\big/R(t) = dz\big/\left(\dot{R}_0 - R_0H(z)\right)$. For short periods of time, $\dot{R}_0 = 0$ may be a good approximation but certainly not for global expansion. Astronomers in the far future, could not be convinced to use the R_0 at t_0 =13.5 Gy instead of their present R_0. Peacock [7] in the derivation of his Eq. (3.39) must use the same $\dot{R}_0 = 0$, but he doesn't tell. These misconception are very misleading as is Fig. 6 of [6] where the accelerating curves have returned to $\Delta z = 0$ at the present and appear to go negative in the far future as z goes to -1. The SC-curve if plotted on their Fig. 6 would remain negative but approach $\Delta z = 0$ asymptotically to z = -1.

Whether the comoving-coordinate concept survives with $\dot{R}_0 \neq 0$, will be left for others to decide That concept cannot produce sufficient luminosity distance d_L to fit the SNIa data. In the SC-model, the photons do not travel on a geodesic but on great circles of the 4-D ball as a transverse wave between 3-D electric and epi-magnetic forces.

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VI Luminosity and Photon Delay Effect

The astronomer gains much information from the redshift, z, of arriving photons from distant luminous objects in the past when our universe had a smaller radius R than its present radius R_0. The expansion redshift, z, is related to the scale factor R/R_0 by the simple equation $R_0/R = (1 + z)$. Redshift tells us the size of the universe, relative to R_0, when the photons were emitted, but not the distance they have traveled since emission..

The photon trajectory in an expanding universe is not a simple concept in the SC-model because some of the photons that enter the astronomer's telescope ($z >> 1.7$) had been traveling away from the telescope for long periods of time. During tha period of time ($z > 1.7$) the expansion takes a heavy toll on the photon's energy density, so it is a very important concept.. It is called the **P**hoton **D**elay effect (PD-effect) in the SC-model and is missed in most cosmological models.

It is easily explained from the photons point of view. Consider the packet of photons at emission distance ED = r traveling locally at velocity –c toward the telescope at r = 0. From the expansion, the distance r to the to the photons is expanding at the rate $v_c = +Hr$ and if $Hr > |-c|$, the photons have a net velocity away from the telescope or,

$$dr/dt = v_c = Hr - c.$$

At $v_c = Hr - c = 0$, the photons are at rest, relative to the telescope. The PD-effect means that no photon has ever yet completely orbited our universe. Without this effect (set v_c –c), the Cosmic Microwave Background (CMB) photons (z~11000) would orbit the small universe hundreds of times and destroy any detail of the CMB.

Next consider the world-line of the telescope (or its atoms). The integral of the above equation from the photons to the world line of the telescope gives the emission distance ED of the photons. At z = 0, ED = 0 and as z increases ED goes through a maximum at z=1.7 and then decreases as radius R gets smaller. The integration can be handled in two ways; either numerical integration or direct integration of the equation. Both were used but for the later, an often used approximation of neglect of the radiation was used by the author. Hopefully, a good mathematician can include the radiation term.

A reader familiar with measurements of the SNIa exploding stars will recognize that z = 1.7 is the present maximum redshift for measurement of those exploding stars. But why theoretically is z =1.7 predicted? Amazingly, that is a property of N-spheres for anything moving at a constant velocity on the N-surface of the N+1 ball, where $\dot{V}_{N+1}$ is proportional to V_N.

To gently introduce the reader to the concept of higher dimensional spaces in [1], a N = 2 graphic was developed at the beginning of a lady bug crawling at constant speed up an expanding rubber balloon. Then it was stated that the very same picture applies for the trajectories of photons in our N = 3 expanding universe.

One can calculate the PD-effect but how is the large expansion toll of energy loss of the delayed photons accounted for?

VII Luminosity Distance d_L

In a static universe at distance r from a source of luminosity L, the flux F of radiant energy is, $F = L/4\pi r^2$ and the distance would be $r = c(t_0 - t_{em})$. In an expanding universe, the expansion will also reduce that flux, so to account for that reduction, the distance r is increased to a distance, d_L, the luminosity distance. Keeping the static term, $c(t_0 - t_{em})$ one adds terms for a number of causes, including the expansion itself, RD-ED = (1+z)ED-ED = zED and two factors that decrease the luminosity of (1 + z) for increase of the photon wave length and the spread of the distance between photons, to get (d_L is squared),

$$d_L = \left(c\left(t_0 - t_{em}\right) + zED\right)\left(1+z\right)\big)$$

The astronomer's method of converting flux of energy to distance modulus m-M and to magnitude m is explained elsewhere [5]..

$$\text{m-M}(z) = 5\log(d_L/10\text{pc}) \qquad m(z) = \text{m-M}(z) + M,$$

where M is the absolute magnitude of the source.

One [8] of a number of SNIa data sets fit by the SC-model is shown in Fig. 3. Note that without added lambda or dark energy and no free parameters, the SC-theoretical curve does not fall considerably below the data as did the predicted curves of the two teams of SNIa astronomers of 98-99. Without properly accounting for the PD-effect and the larger d_L, they used their free parameters to adjust the content of the universe to fit the data with the un-physical consequence of a future acceleration of the expansion rate.

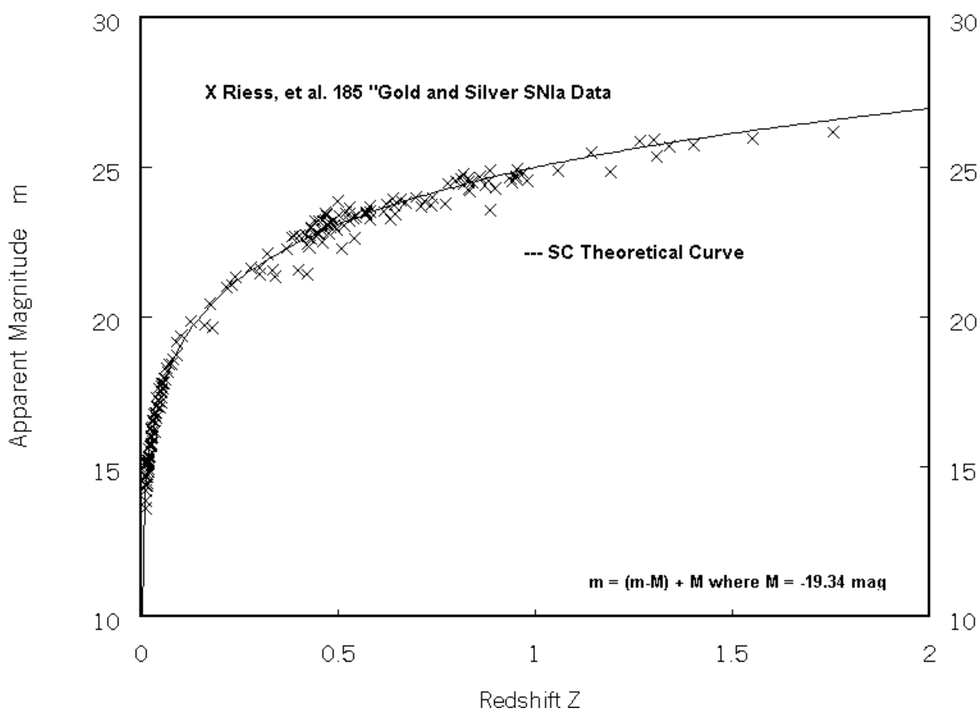

Fig. 3 Published 185 "gold and silver" SNIa data and SC-curve. No added lambda or dark energy were needed to fit the data.

The resulting shift in paradigm must be reversed because of the wasted thousands of theoretical man hours and tax-payer dollars, searching for a non-existent dark energy.

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VIII A Closed Correct Expansion Model

Once derived, it is a joy working with a closed correct expansion model. One can move around in the universe with a computer, both into the past when it was much smaller and into the future when it will be much .larger. When one moves to a third size from two different sizes, one had better get the same answer or the model is not correct. There is much more derived in Reference [1}, but this paper will end with a selection of one more of the 58 Figures which is labeled here as Fig. 4.

Mario Hamuy [9] concentrated much of his search for nearby (small redshift z) SNIa to try to fix their absolute magnitude, M. Now consider the radiation from these exploding stars that missed the Earth and those photons will continue to travel radially out to many other planets in the universe. Also imagine that in the far future there will be astronomers on some of those planets whose telescopes are pointed in the right direction to collect (maybe measure) that radiation. Hamay's measurements (near z = 0)and three other future telescopes are shown in Fig. 4.

Note that the luminosity distance is a universal curve. Hamuy's data plot vertically. But by the knee of the curves, the group appear as a ball and by z = 5.5 the small early difference in z has become dominant, and the computer plots them horizontally with no help from the author. The "maybe measure" caveat depends on the level of the background radiation in the far future – not the CMB, but the star-light and photon energy produced from gravitational compaction, that re-ionized the universe in the past.

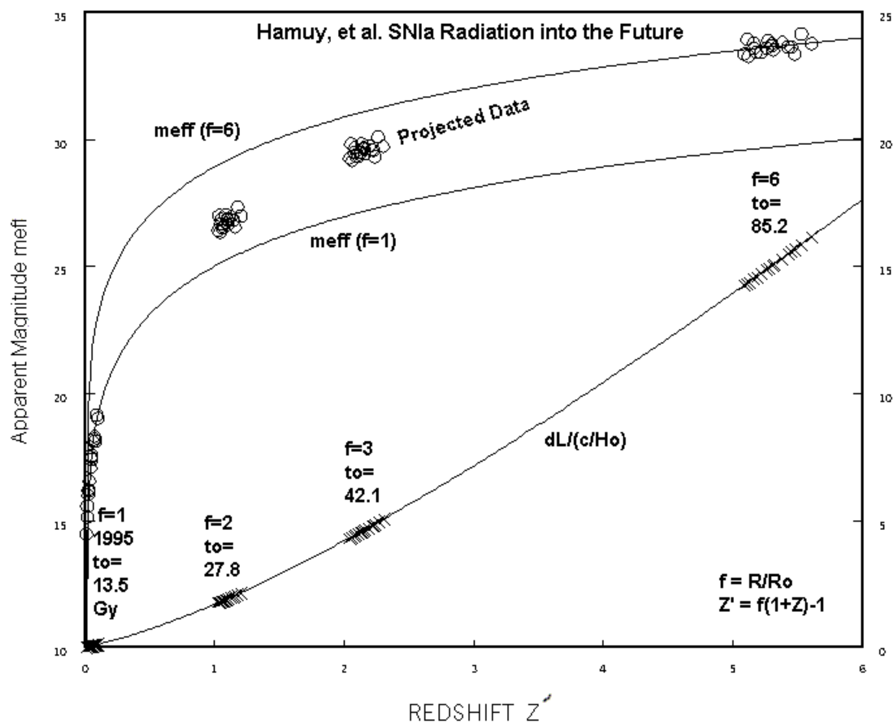

Fig. 4 The Hamuy early SNIa measurements are projected far into the future and f = R_0'/R_0. Here z' is the redshift for these future astronomers of the radiation from the distant past of these Hamuy SNIa

There are even some quantum implications in Reference [2} that may be worthy of some future papers.

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IX References

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