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The Accelerated Expansion of the Universe

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Abstract

We use experimental data from Distant Type 1a Supernovae to calculate the Observed Magnitude (*m* – *M*) which is the Apparent Magnitude (*m*) minus the Absolute Magnitude (*M*) for different values of the Redshift *z* which gives us the Distance Modulus. Then, we calculate the average velocity and average acceleration for different *z* values and plot them as a function of time. The expansion of the space of our 3-D Universe is exponential and it will end with a Big Bang as four 3-D Universes of which we are one will come together to form one 4-D expanding spatial Universe.

Keywords

Distance Modulus, Redshift, Accelerated Expansion, Exponentially Expanding Space, Big Bang

1. Main Text

We use the following equations:

Distance Modulus $d = 10^{(m-M+5)/5}$ pc where (*m* – *M*) is the observed magnitude in Figure 1, and Δd is the difference between two consecutive values (*m* – *M*) for *z*.

Radial Velocity $v_r(z)/c = \left\{(z+1)^2 - 1\right\} \big/ \left\{(z+1)^2 + 1\right\}$ where *z* is the Redshift and $\Delta v = v_r(x) - v_r(z)$ where *x* is the next higher value of *z*.

Average Velocity $v(\text{av.}) = \left[v_r(z) + v_r(x)\right]/2$. $\Delta t = \Delta d / v(\text{av.})$.

Average Acceleration $a(\text{av.}) = \Delta v / \Delta t$.

From Figure 1 and the equation for distance (*d*), we get the following values for Table 1.

From the equation for radial velocity, we get the following values for Tables 2-4.

Two first dimensions form half of the second dimension that join with a Big Bang to complete the second dimension.

Three second dimensions form one-third of the third dimension that join with a Big Bang to complete the third dimension.

Four third dimensions (of which we are one) form one-fourth of the fourth dimension that join with a Big Bang to complete the fourth dimension.

n, $(n - 1)$ dimensions form one-nth of the nth dimension that join with a Big Bang to complete the nth dimension [1].

Table 1. Redshift vs Distance.

z	$m - M$	d
0	20	3.09×10^{21} meters
0.2	20.7	4.26×10^{21} meters
0.4	22.3	8.90×10^{21} meters
0.6	23.4	14.77×10^{21} meters
1	24.8	28.14×10^{21} meters

Table 2. Redshift vs Radial Velocity.

z	v_r
0	0×10^8 m/s
0.2	0.54×10^8 m/s
0.4	0.96×10^8 m/s
0.6	1.32×10^8 m/s
1	1.8×10^8 m/s

Table 3. Intermediate values.

z	Δd meters	Δv m/s	v (av.) m/s	Δt Secs.	Δt Years	a (av.) m/s^2
0 to 0.2	1.17×10^{21}	0.54×10^8	0.27×10^8	4.33×10^{13}	1.37×10^6	12.5×10^{-3}
0.2 to 0.4	4.64×10^{21}	0.42×10^8	0.75×10^8	6.19×10^{13}	1.96×10^6	6.8×10^{-3}
0.4 to 0.6	5.87×10^{21}	0.36×10^8	1.14×10^8	5.15×10^{13}	1.63×10^6	7.0×10^{-3}
0.6 to 1	13.37×10^{21}	0.48×10^8	1.56×10^8	8.57×10^{13}	2.72×10^6	5.6×10^{-3}

Table 4. Total Values for plotting **Figures 2-4**.

z	d (m) $\times 10^{21}$	v (av) m/s $\times 10^8$	Time (s) $\times 10^{13}$	Time (yr.) $\times 10^6$	a (av) m/s^2 $\times 10^{-3}$
0	3.09	0	0	0	0
0.2	4.26	0.27	4.33	1.37	12.5
0.4	8.9	1.02	10.52	3.33	19.3
0.6	14.77	2.16	15.67	4.96	26.3
1	28.14	3.72	24.24	7.68	31.9

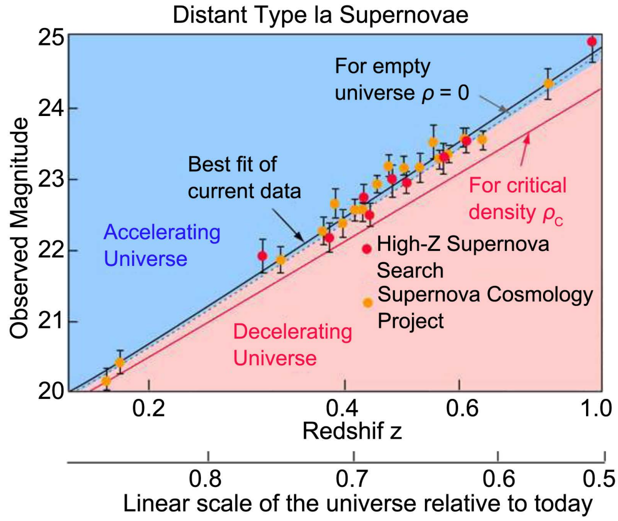

Figure 1. The accelerated expansion of the Universe [2] [3].

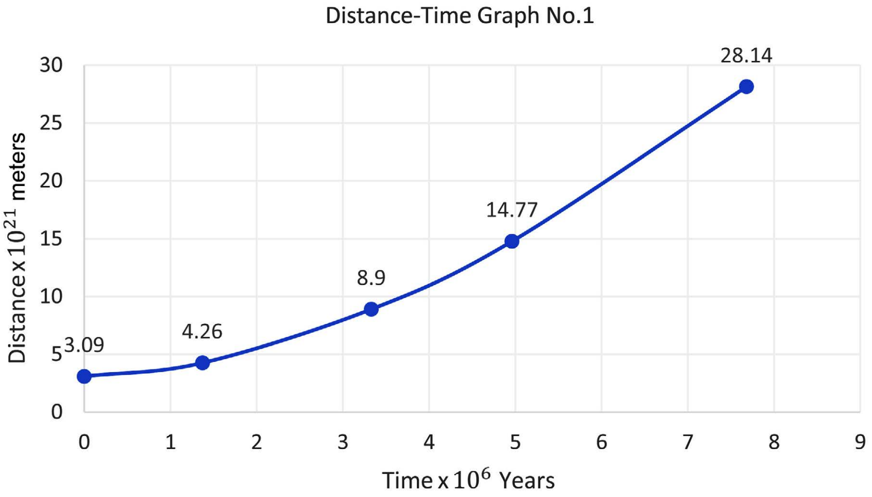

Figure 2. Distance-time graph No. 1.

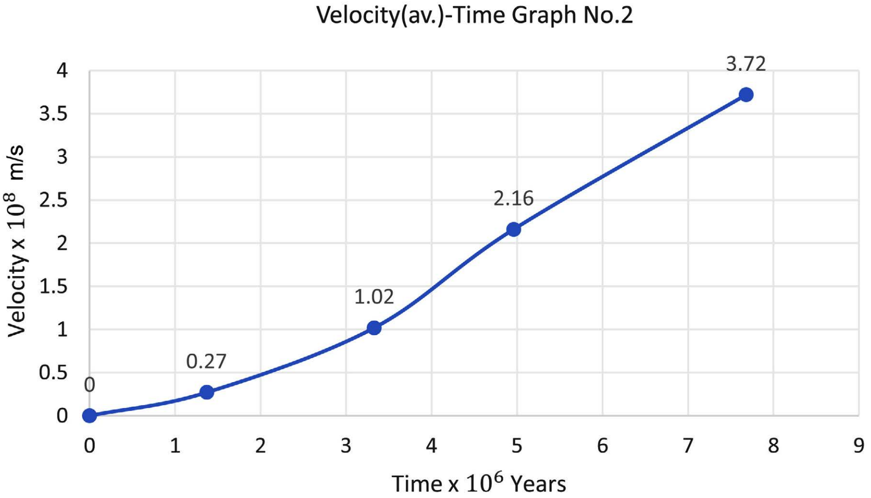

Figure 3. Velocity(av.)-time graph No. 2.

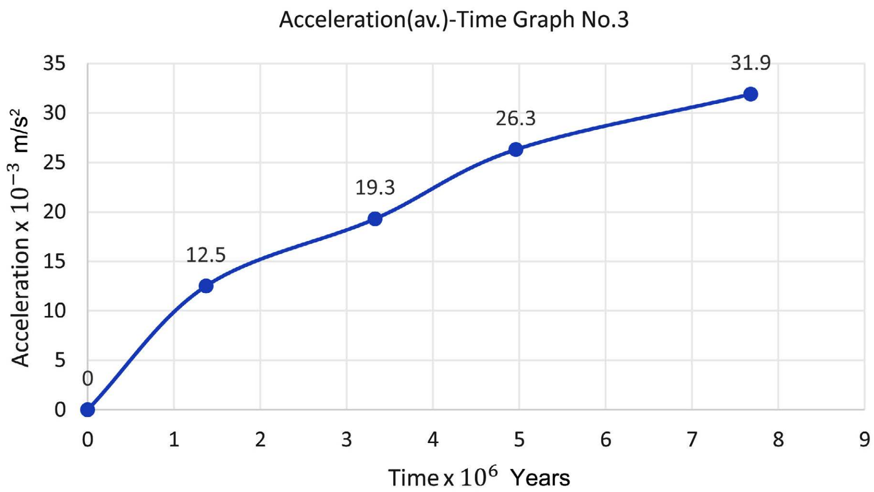

Figure 4. Acceleration(av.)-time graph No. 3.

2. Conclusion

From the Distance-Time Graph we see that space is expanding exponentially while its acceleration continues to increase. The spatial exponential expansion of the lower dimensions halts as several of the lower dimensions join with a Big Bang to form the next higher exponentially increasing spatial dimension with the lower dimensions forming the surface area of the higher dimension. This process continues until the final level of the Multiverse has been reached.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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