ACCELERATING UNIVERSE – THE SURPRISING DISCOVERY DUE TO AN UNDISCOVERED ASPECT

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ABSTRACT

The comparison of redshift-distance relationship for high and low redshift supernovae has revealed the surprising transition of Universe's expansion from deceleration to acceleration. The expansion rate for local supernovae is found to be higher with low redshifts as compared to the expansion rate for remote supernovae with high redshifts. Since observed redshifts provide direct estimate of recession velocities in order to determine the expansion rate (km s^{-1} Mpc^{-1}) of the local and the remote Universe, therefore, it is very disturbing to find that low recession velocities indicate acceleration (faster rate of expansion), whereas high recession velocities indicate deceleration (slower rate of expansion). In this paper I unravel an undiscovered aspect that perfectly mimics cosmic acceleration. The analysis is based on the redshift-distance relationship plotted for 580 type Ia supernovae from the Supernova Cosmology Project, 7 additional high redshift type Ia supernovae discovered through the Advanced Camera for Surveys on the Hubble Space Telescope from the Great Observatories Origins Deep Survey Treasury program, and 1 additional very high redshift type Ia supernova discovered with Wide Field and Planetary Camera 2 on the Hubble Space Telescope.

Key words: cosmology: theory – dark energy.

1 INTRODUCTION

The research conducted by the High-Z Supernova Search Team (Riess et al. 1998) and by the Supernova Cosmology Project team (Perlmutter et al. 1999) by using type Ia supernovae as standard candles resulted into a very surprising discovery that made the team members win the 2011 Nobel Prize in Physics. By comparing the brightness of the very distant supernovae with the brightness of the nearby ones, distant supernovae were found to be 10% to 25% dimmer than the nearby supernovae; this indicated that the distances to those remote supernovae were larger than expected. A surprising feat was found being displayed by the Universe, a feat that was so extraordinary that the remarkable results obtained were not even expected. It was the remarkable discovery of Universe expanding at an accelerating rate. A research that was aimed at observing the expected deceleration of the Universe was welcomed by something completely unexpected.

A mysterious energy of unknown origin rightfully coined as dark energy is considered responsible for accelerating the Universe's expansion. According to Durrer (2011), "our single indication for the existence of dark energy comes from distance measurements and their relation to redshift. Supernovae, cosmic microwave background anisotropies and observations of baryon acoustic oscillations simply tell us that the observed distance to a given redshift is larger than the one expected from a locally measured Hubble parameter".

The expansion history of the Universe is depicted by the Hubble diagram as shown in Figure 1 (plotted by using the Supernova Cosmology Project data for 580 type Ia supernovae from Union 2 (Amanullah et al. 2010) and Union 2.1 (Suzuki et al. 2012), 7 additional high redshift type Ia supernovae discovered through the ACS (Advanced Camera for Surveys) on the Hubble Space Telescope from the GOODS (Great Observatories Origins Deep Survey) Treasury program (joint work conducted by Giavalisco et al. 2004 and Riess et al. 2004), and 1 additional very high redshift type Ia supernova discovered with WFPC2 (Wide Field and Planetary Camera 2) on the Hubble Space Telescope (Gilliland et al. 1999)).

The observed deviation from redshift-distance linearity in Figure 1 indicates an accelerating Universe since the distances to the remote supernovae are larger than expected with respect to the nearby ones. The value of slope (or the expansion rate measured in km s^{-1} Mpc^{-1}) is higher for the local structures and lower for the remote structures, suggesting that the Universe is accelerating now (locally) and was decelerating in the past (remotely). "A purely kinematic interpretation of the SN Ia sample provides evidence at the greater than 99% confidence level for a transition from deceleration to acceleration or, similarly, strong evidence for a cosmic jerk" (Riess et al. 2004).

By comparing the slope and thus the expansion rate of remote and local supernovae, cosmologists have come to an important, ground-breaking conclusion that the very local Universe is accelerating, whereas the remote Universe is decelerating. "Observations of Type Ia supernovae (SNe Ia) at redshift $z < 1$ provide startling and puzzling evidence that the expansion of the universe at the present time appears to be *accelerating*" (Riess et al. 2004). It is believed that the Universe was decelerating in the past due to the gravitational attraction of matter (Riess et al. 2001, Riess 2012). "A single SN Ia at $z \approx 1.7$, SN 1997ff, discovered with WFPC2 on the *Hubble Space Telescope* (*HST*) (Gilliland et al. 1999), provided a hint of past deceleration" (Riess et al. 2004).

Why does it appear that the Universe was expanding slowly in the past (decelerating remotely) even with high recession velocities and is expanding faster now (accelerating locally) even with low recession velocities? Why are the distances to the remote supernovae larger than expected, thereby making them appear 10% to 25% dimmer than the nearby local supernovae? Could the distant supernovae appear dim due to intervening dust? Or could it be that those distant supernovae have different properties as compared to the nearby supernovae? These possibilities have already been taken into account. Dust is not a factor. Similarly, the brightness of local and remote supernovae differing due to property mismatch brought about by evolution is also not a factor.

2 THE SURPRISING TRANSITION OF UNIVERSE'S EXPANSION FROM DECELERATION TO ACCELERATION: ANALYSING THE 588 TYPE Ia SUPERNOVAE

In an expanding Universe the observed redshifts provide direct estimate of recession velocities. For instance, a redshift (z) of 0.1 corresponds to a recession velocity of 30,000 km s^{-1}. Once the redshifts and the distances are known (distances of type Ia supernovae estimated from their standard luminosities), the relation between redshift and distance is then used to determine the expansion rate (km s^{-1} Mpc^{-1}) of the Universe.

In Figure 1, the redshift of the most distant remote supernova at 41.6119 Gly is 1.7, this yields a slope of 1.2949×10^{-18} m s^{-1} m^{-1} ($\approx$ 40 km s^{-1} Mpc^{-1}) – a lower value of slope (or a slower rate of expansion) even with high recession velocity – does this imply deceleration?

On the other hand, the redshift of a very nearby local supernova that happens to fall within the linear regime of the Hubble diagram in Figure 1 at 0.2148 Gly is 0.015166, this yields a slope of 2.2379×10^{-18} m s^{-1} m^{-1} ($\approx$ 70 km s^{-1} Mpc^{-1}) – a higher value of slope (or a faster rate of expansion) even with low recession velocity – does this imply acceleration?

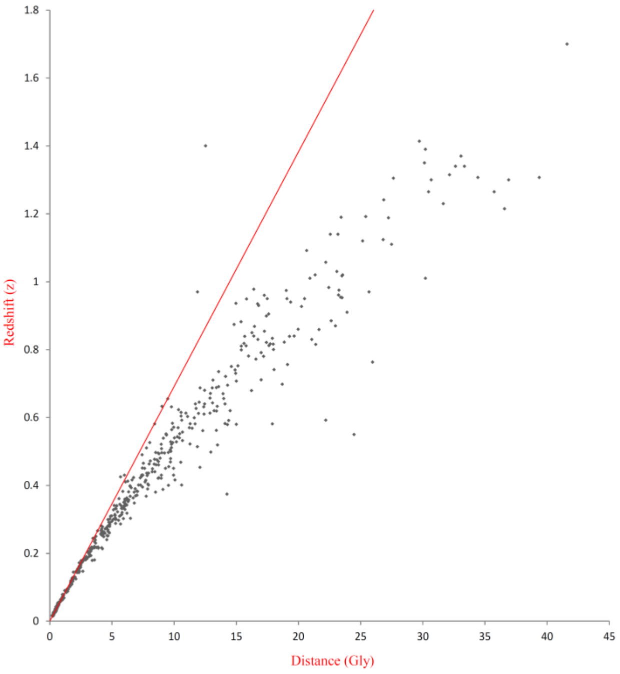

Figure 1. Redshift-distance relationship for 588 type Ia supernovae (580 type Ia supernovae plotted by using the data (Union 2 and Union 2.1) from the Supernova Cosmology Project, 7 additional high redshift type Ia supernovae discovered through the ACS (Advanced Camera for Surveys) on the Hubble Space Telescope from the GOODS (Great Observatories Origins Deep Survey) Treasury program, and 1 additional very high redshift type Ia supernova discovered with WFPC2 (Wide Field and Planetary Camera 2) on the Hubble Space Telescope). The red line indicates the linear redshift-distance relationship exhibited by the local structures. The deviation from linearity indicates an accelerating Universe since the distances to the remote supernovae are larger than expected with respect to the local supernovae. The slope is steeper for the local structures suggesting a faster rate of expansion (acceleration) and shallower for the remote structures, suggesting a slower rate of expansion (deceleration).

The redshift of the remote supernova is 112 times higher than the redshift of this very nearby local supernova. Since observed redshifts provide direct estimate of recession velocities, therefore, confidently, those recession velocities corresponding to those observed high redshifts exhibited by the remote supernovae are undoubtedly much higher.

The unit of expansion rate (km s^{-1} Mpc^{-1}) makes it evidently clear enough that there is a velocity and a distance component associated with the measurement of Universe's rate of expansion; it is this unit of measurement that helps us to compare the expansion rate of the remote and the local Universe in order to determine if the Universe is expanding at a slower rate, or at a faster rate. According to Riess et al. (2004), "It is valuable to consider the distance-redshift relation of SNe Ia as a purely *kinematic* record of the expansion history of the universe".

Such high redshift of the remote supernova does not indicate in any way a low recession velocity, or a slower rate of expansion, or deceleration due to the gravitational attraction of matter! One should therefore explain why does this remote supernova with such high recession velocity yield a lower value of slope (or a slower rate of expansion, thereby suggesting deceleration) as compared to the value of slope for the local supernova with low recession velocity and then be further away than expected?

3 ANALYSING THE SUPERNOVA SN 1995K

SN 1995K was the first and the most distant type Ia supernova discovered in 1995 by the High-Z Supernova Search Team. As compared to the nearby type Ia supernovae that happen to fall within the linear regime of the Hubble diagram as shown in Figure 2, SN 1995K happens to deviate from linearity as it is further away than expected – SN 1995K was already indicating that the Universe is accelerating. However, additional supernovae were required by the team to confirm if the Universe was accelerating or decelerating, and, it was only through further observations of additional type Ia supernovae at even larger distances that confirmed an accelerating Universe (Figure 3).

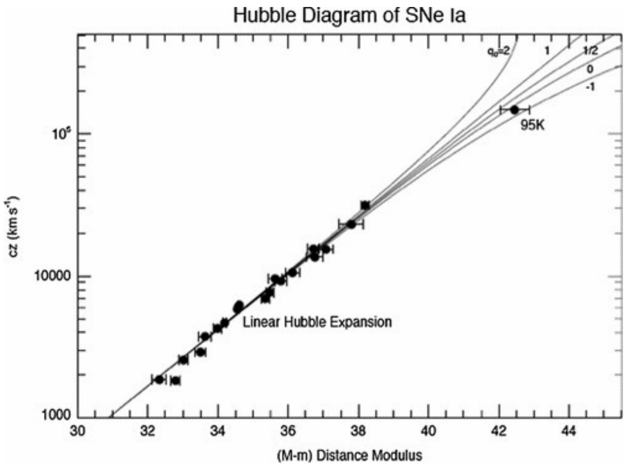

Figure 2. Velocity-distance relationship (Hubble Diagram of SNe Ia) showing SN 1995K at a redshift (*z*) of 0.479 from the proposal put forward by the High-Z Supernova Search Team. (Illustrated from Schmidt (2012), with permission from American Physical Society) (Copyright (2012), American Physical Society) https://doi.org/10.1103/RevModPhys.84.1151

In Figure 2, the redshift of SN 1995K, the most distant supernova at 9.4019 Gly is 0.479, this yields a slope of 1.6148 x 10^{-18} m s^{-1} m^{-1} (≈ 50 km s^{-1} Mpc^{-1}). On the other hand, the redshift of a nearby supernova falling within the linear regime of the Hubble diagram in Figure 2 at 0.4604 Gly is 0.0333, this yields a slope of 2.2925 x 10^{-18} m s^{-1} m^{-1} (≈ 70 km s^{-1} Mpc^{-1}).

The comparison of expansion rate (km s^{-1} Mpc^{-1}) for these supernovae shows that SN 1995K is expanding at a slower rate (decelerating) as compared to the nearby supernova obeying the linear Hubble expansion.

Since observed redshifts provide direct estimate of recession velocities, therefore, in Figure 2, the observed redshifts have clearly been interpreted as recession velocities by the High-Z Team. The recession velocity of SN 1995K is 14.38 times higher than the recession velocity of the nearby supernova that falls within the linear regime of the Hubble diagram. Does this imply that SN 1995K even with high recession velocity is expanding at a slower rate (decelerating) as compared to a local supernova with low recession velocity?

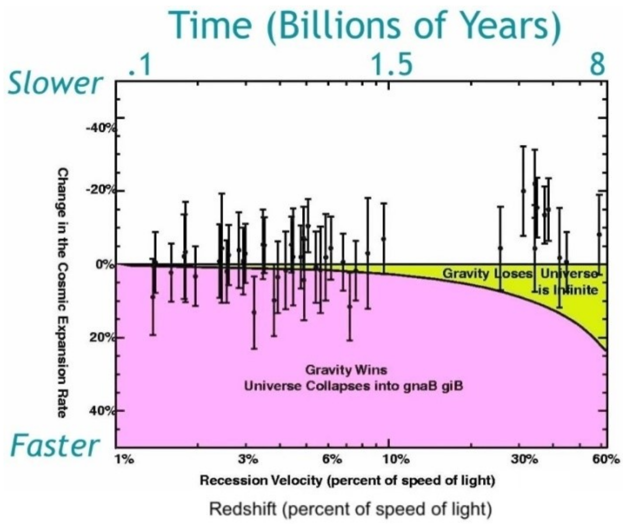

Figure 3. Observations of additional type Ia supernovae by the High-Z Supernova Search Team. The plot confirmed the result that the Universe is accelerating – remote supernovae are expanding at a slower rate (decelerating), whereas local supernovae are expanding at a faster rate (accelerating).

SN 1995K, the first and the most distant type Ia supernova discovered by the High-Z team already indicated that the Universe was accelerating, however, to confirm if the Universe was accelerating or decelerating, additional supernovae were required by the team.

Figure 3 depicts the result of additional type Ia supernovae observations at even larger distances carried out by the High-Z team that confirmed Universe's acceleration. Distant supernovae were found to be dimmer than the nearby supernovae, indicating that the distances to those distant supernovae were larger than expected.

Figure 3 clearly shows the transition of Universe's expansion from deceleration to acceleration – Universe was expanding slowly in the past (decelerating remotely) and is expanding faster now (accelerating locally).

However, if we look at the observed redshifts that provide direct estimate of recession velocities, then there seems to be a conundrum, it is very disturbing to find that recession velocities ranging from 1% to 10% of speed of light indicate a faster rate of expansion (acceleration), whereas recession velocities ranging from 30% to 60% of speed of light indicate a slower rate of expansion (deceleration).

Why is it that an object with high recession velocity is not only further away than expected, but is also yielding a lower value of slope (or a slower rate of expansion, thereby suggesting deceleration) as compared to an object with low recession velocity?

4 AN UNDISCOVERED ASPECT

It remains undiscovered that an object that begins expanding before will not only be further away than expected, but it will also yield a lower value of slope (or a slower rate of expansion) even with high recession velocity as compared to an object with low recession velocity that begins expanding comparatively later.

Logically, an object that begins expanding before has an utmost probability of being further away than expected; the observational fact, that such object, which happens to be further away than expected, yields a lower value of slope (or a slower rate of expansion) even with high recession velocity as compared to an object with low recession velocity is the most compelling evidence in favour of this undiscovered aspect.

There is absolutely no other reason for an object with high recession velocity to yield a lower value of slope (or a slower rate of expansion) and then be further away than expected, unless it began expanding before. Plotting together the high recession velocity remote structures that began expanding before and the low recession velocity local structures that began expanding comparatively later into the Universe causes the Hubble diagram to deviate from linearity.

Comparing the slope and thus the expansion rate of high recession velocity remote structures that began expanding before into the Universe with the slope and thus the expansion rate of low recession velocity local structures that began expanding comparatively later into the Universe causes the high recession velocity remote structures to appear as if they are receding slower than expected as compared to the low recession velocity local structures.

It is important to note that even with high recession velocity, an object that begins expanding before will never yield a value of slope, or the expansion rate that is higher than the value of slope, or the expansion rate for an object with low recession velocity that begins expanding comparatively later. Comparing the slope and thus the expansion rate of such objects results into the apparent transition of Universe's expansion from deceleration to acceleration – an object with high recession velocity that began expanding before will be further away than expected and will appear to be decelerating, whereas an object with low recession velocity that began expanding comparatively later will appear to be accelerating.

It is this comparison that makes it appear that the Universe is accelerating now (locally) even with low recession velocities and was decelerating in the past (remotely) even with high recession velocities.

Requiring mysterious dark energy of unknown origin to explain this apparent transition of Universe's expansion from deceleration to acceleration has only complicated things to an unimaginable extent.

5 A SIMPLE NUMERICAL PROOF USING HIGH AND LOW VELOCITY TEST PARTICLES

Let us consider two test particles – particle A and particle B. Particle A has an extreme recession velocity of 10^6 m s^{-1}, whereas particle B has a recession velocity of just 0.4 m s^{-1}.

Initially, particle A begins expanding into the Universe. After 4 seconds, particle B begins expanding and is observed for 1 second. By the time particle B is observed for 1 second, particle A has already been expanding for 5 seconds.

Since particle A began expanding before, therefore, logically, as compared to particle B, particle A will be further away than expected.

The distance covered by particle A in 5 seconds with a recession velocity of 10^6 m s^{-1} is 5 x 10^6 m, whereas the distance covered by particle B in 1 second with a recession velocity of 0.4 m s^{-1} is 0.4 m.

The slope or the expansion rate for these particles is obtained by using the equation,

$$H = \frac{v}{D} \tag{1}$$

where H is the slope or the expansion rate, v is the recession velocity of the particles, and D is the distance covered by them. The inverse of slope or the expansion rate ($1/H$ or H^{-1}) gives back the time in seconds.

The value of slope or the expansion rate for particle A with a whopping recession velocity of 10^6 m s^{-1} turns out to be 0.2 m s^{-1} m^{-1}. On the other hand, for particle B, the value of slope or the expansion rate with a mere recession velocity of just 0.4 m s^{-1} turns out to be 1 m s^{-1} m^{-1}.

The value of slope or the expansion rate for particle A even with an extreme recession velocity of 10^6 m s^{-1} is much lower (5 times lower) than the value of slope or the expansion rate for particle B even with a mere recession velocity of just 0.4 m s^{-1}.

Does this imply that particle A with high recession velocity of 10^6 m s^{-1} is decelerating, whereas particle B with low recession velocity of 0.4 m s^{-1} is accelerating?

10^6 m s^{-1} – recession velocity of particle A is 2.5 x 10^6 times higher than the recession velocity of particle B! Such high recession velocity of particle A does not indicate in any way a low recession velocity, or a slower rate of expansion, or deceleration due to the gravitational attraction of matter!

Then why is particle A with a whopping recession velocity of 10^6 m s^{-1} yielding a lower value of slope or a slower rate of expansion, thereby suggesting deceleration as compared to particle B with a minuscule recession velocity of just 0.4 m s^{-1}?

There is absolutely no other reason for an object with such high recession velocity to yield a lower value of slope (or a slower rate of expansion) and then be further away than expected, unless it began expanding before.

As already stated, even with high recession velocity (no matter how high), an object that begins expanding before will never yield a value of slope, or the expansion rate that is higher than the value of slope, or the expansion rate for an object with low recession velocity (no matter how low) that begins expanding comparatively later.

Therefore, we should never compare the slope and thus the expansion rate of such objects, doing so, without any doubt, will result into the apparent transition of Universe's expansion from deceleration to acceleration – an object with high recession velocity that began expanding before will be further away than expected and will appear to be decelerating, whereas an object with low recession velocity that began expanding comparatively later will appear to be accelerating. Requiring mysterious dark energy of unknown origin to explain this apparent transition would only complicate things to an unimaginable extent.

It is only the result of this comparison that particle A even with an extreme recession velocity of 10^6 m s^{-1} appears to be expanding at a slower rate (decelerating) as compared to particle B with a mere recession velocity of just 0.4 m s^{-1}.

Comparing the slope and thus the expansion rate of high recession velocity object that began expanding before into the Universe with the slope and thus the expansion rate of low recession velocity object that began expanding comparatively later into the Universe causes the high recession velocity object to appear as if it is receding slower than expected as compared to the low recession velocity object.

6 A GRAPHICAL CONFIRMATION

To further confirm this undiscovered aspect graphically, it is necessary to plot the velocity-distance relationship for such scenario where an object with high recession velocity begins expanding before, and an object with low recession velocity begins expanding comparatively later. Therefore, we will consider 11 test particles that have been assigned random velocities. These particles expand consecutively (one particle after another) into the vacuum of the Universe. Based upon calculations we will then plot their velocity-distance relationship (Figure 4) to verify graphically if this undiscovered aspect perfectly mimics cosmic acceleration.

Initially, particle A (3517.60 m s^{-1}) begins expanding into the vacuum of the Universe, 0.1 second later, particle B (2983.93 m s^{-1}) begins expanding, the expansion of particle B is followed by the expansion of particle C (2648.64 m s^{-1}) after another 0.1 second. Expansion of particles continues in the same way for particle D (2496.43 m s^{-1}), particle E (2223.52 m s^{-1}), particle F (1676.20 m s^{-1}), particle G (1219.96 m s^{-1}), particle H (917.97 m s^{-1}), and particle I (768.62 m s^{-1}). Particle J (530.48 m s^{-1}) and particle K (257.85 m s^{-1}) are the last particles to expand, and they expand at the same time into the vacuum of the Universe and are observed for 1 second. By the time these last two particles expand and are observed for 1 second, particle A has already been expanding for 1.9 second, and particle B for 1.8 second, this becomes their respective observation time.

Based upon calculations, the velocity-distance relationship for these 11 test particles has been plotted in Figure 4. The plot is remarkably similar to the redshift-distance relationship for 588 type Ia supernovae plotted in Figure 1. The deviation from linearity in Figure 4 clearly indicates that remote particles are not only further away than expected, but they also happen to yield a lower value of slope, or a slower rate of expansion (deceleration) even with high recession velocities as compared to the local particles that yield a higher value of slope, or a faster rate of expansion (acceleration) even with low recession velocities.

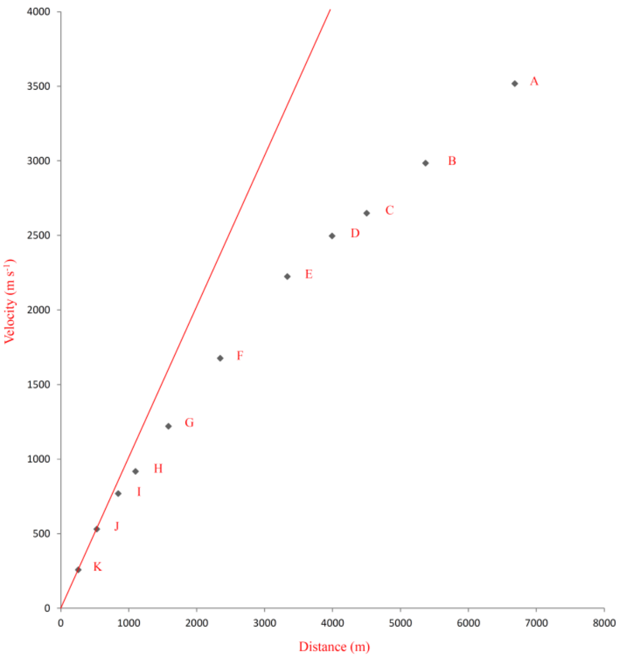

Figure 4. Velocity-distance relationship for 11 test particles expanding consecutively (one particle after another) into the vacuum of the Universe. Distances to the remote particles are larger than expected with respect to the local particles without acceleration. In other words, expansion initiated for the remote particles before it did for the local particles.

The value of slope for the most distant remote particle in Figure 4, that is, particle A, is 0.5263 m s^{-1} m^{-1} (a lower value of slope, or a slower rate of expansion even with high recession velocity of 3517.60 m s^{-1} – does this imply deceleration?), the inverse of this gives us the original observation/expansion time of 1.9 second.

For local particles, particle J and particle K, the value of slope (slope of the red line) turns out to be 1 m s^{-1} m^{-1} (a higher value of slope, or a faster rate of expansion even with low recession velocities of 530.48 m s^{-1} and 257.85 m s^{-1} respectively – does this imply acceleration?), the inverse of this gives the original observation/expansion time of 1 second.

The recession velocity of particle A is 6.63 times higher than the recession velocity of particle J, and 13.64 times higher than the recession velocity of particle K. Particle A still happens to yield a lower value of slope, thereby suggesting a slower rate of expansion or deceleration as compared to these two particles (not to mention again that particle A is further away than expected as compared to these two particles).

Could there be any other reason now why an object with high recession velocity would be yielding a lower value of slope, thereby suggesting a slower rate of expansion or deceleration and then be further away than expected as compared to an object with low recession velocity?

There is absolutely no other reason for an object with high recession velocity to yield a lower value of slope (or a slower rate of expansion, thereby suggesting deceleration) and then be further away than expected, unless it began expanding before.

High recession velocities of remote objects yielding a lower value of slope do not indicate their deceleration. Similarly, low recession velocities of local objects yielding a higher value of slope do not indicate their acceleration. Requiring mysterious dark energy of unknown origin to explain such transition would only complicate things to an unimaginable extent.

Since expansion began for the remote particles before it did for the local particles, therefore, remote particles are not only further away than expected, but they also yield a lower value of slope (or a slower rate of expansion) even with high recession velocities as compared to the higher value of slope (or a faster rate of expansion) for the local particles even with low recession velocities. It therefore appears that local particles are expanding at a faster rate as compared to the remote particles. One would therefore be forced into believing that local particles, as compared to the remote particles, are accelerating due to a higher value of their slope.

7 IMPORTANT ROLE OF OBSERVABLES

Observables play an important role in analysing a particular phenomenon, especially when those observables can be observed directly. For instance, the standard luminosities of type Ia supernovae help us to determine their distances, while the observed redshifts provide direct estimate of their recession velocities – the relation between redshift and distance is then used to determine the expansion rate (km s^{-1} Mpc^{-1}) of the Universe.

If it has been discovered that the Universe was expanding slowly in the past (decelerating remotely) and is expanding faster now (accelerating locally) then technically, and as observed, the expansion rate (km s^{-1} Mpc^{-1}) is higher for the local Universe as compared to the expansion rate for the remote Universe, in this case, it becomes essential to consider the redshift-distance relationship as a kinematic record signifying the expansion history of the Universe. In fact, as pointed out earlier, "It is valuable to consider the distance-redshift relation of SNe Ia as a purely *kinematic* record of the expansion history of the universe" (Riess et al. 2004). Also, according to Riess et al. (2004), "A purely kinematic interpretation of the SN Ia sample provides evidence at the greater than 99% confidence level for a transition from deceleration to acceleration".

8 CONCLUSIONS

(1) The comparison of redshift-distance relationship for high and low redshift supernovae has revealed the surprising transition of Universe's expansion from deceleration to acceleration. The expansion rate for local supernovae is found to be higher with low redshifts as compared to the expansion rate for remote supernovae with high redshifts. Since observed redshifts provide direct estimate of recession velocities in order to determine the expansion rate (km s^{-1} Mpc^{-1}) of the local and the remote Universe, therefore, it is very disturbing to find that low recession velocities indicate acceleration (faster rate of expansion), whereas high recession velocities indicate deceleration (slower rate of expansion).

(2) The redshift of a remote supernova in Figure 1 (z = 1.7) is 112 times higher than the redshift of a local supernova (z = 0.015166), similarly, the redshift of the most distant supernova in Figure 2, SN 1995K (z = 0.479) is 14.38 times higher than the redshift of a local supernova (z = 0.0333). Since observed redshifts provide direct estimate of recession velocities, therefore, confidently, those recession velocities corresponding to those observed high redshifts exhibited by the remote/distant supernovae are undoubtedly much higher.

(3) The unit of expansion rate (km s^{-1} Mpc^{-1}) makes it evidently clear enough that there is a velocity and a distance component associated with the measurement of Universe's rate of expansion in order to determine if the Universe is expanding at a slower rate, or at a faster rate. According to Riess et al.

(2004), "It is valuable to consider the distance-redshift relation of SNe Ia as a purely *kinematic* record of the expansion history of the universe".

(4) The evidence for accelerating Universe came from measuring how the expansion rate (km s^{-1} Mpc^{-1}) has changed over time. Since expansion rate for local Universe is found to be higher than the expansion rate for remote Universe, therefore, we say that the Universe is expanding faster now and had a slower expansion in the past. This apparent transition of the Universe's expansion from deceleration to acceleration is explained by invoking dark energy – a mysterious and hypothetical energy of unknown origin. As pointed out by Durer (2011), "our single indication for the existence of dark energy comes from distance measurements and their relation to redshift".

(5) Theoretical calculation for the value of dark energy believed to be the intrinsic energy associated with empty space or the vacuum energy according to the quantum field theory results into a huge 120 orders of magnitude (10^{120}) discrepancy. This suggests that dark energy is only introduced to account for the apparent transition of the Universe's expansion from deceleration to acceleration.

(6) "Expansion of gas molecules into the vacuum by the virtue of dark energy" has never been heard off; "such claim" if considered to be true would only suggest that gas molecules do not possess any energy.

(7) It is worth noting that an experiment conducted by Sabulsky et al. (2019) by using atom interferometry to detect dark energy acting on a single atom inside an ultra-high vacuum chamber showed no trace of any mysterious energy. Dark energy believed to be stronger in high vacuum environments should have easily been detected acting on a minuscule mass – a single atom.

(8) The surprising discovery of accelerating Universe is the result of an undiscovered aspect that has been unravelled in this paper. With 100% confidence level this undiscovered aspect perfectly mimics cosmic acceleration.

(9) It remains undiscovered that an object that begins expanding before will not only be further away than expected, but it will also yield a lower value of slope (or a slower rate of expansion) even with high recession velocity as compared to an object with low recession velocity that begins expanding comparatively later. Logically, an object that begins expanding before has an utmost probability of satisfying the criteria of being further away than expected; the observational fact, that such object, which happens to be further away than expected, yields a lower value of slope (or a slower rate of expansion) even with high recession velocity as compared to an object with low recession velocity is the most compelling evidence in favour of this undiscovered aspect.

(10) There is absolutely no other reason for an object with high recession velocity to yield a lower value of slope (or a slower rate of expansion, thereby suggesting deceleration) and then be further away than expected, unless it began expanding before. Similarly, there is absolutely no other reason for an object with low recession velocity to yield a higher value of slope (or a faster rate of expansion, thereby suggesting acceleration), unless it began expanding comparatively later.

(11) Plotting together the high recession velocity remote structures that began expanding before and the low recession velocity local structures that began expanding comparatively later into the Universe causes the Hubble diagram to deviate from linearity.

(12) An object with high recession velocity that began expanding before will be further away than expected and will appear to be decelerating, whereas an object with low recession velocity that began expanding comparatively later will appear to be accelerating.

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