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Type Ia Supernovae Hubble Diagram Reveals a Static Universe

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Abstract

This paper represents a direct continuation of the groundbreaking study, *Quantum Redshift Effect of Photon*. A review of Hubble diagrams of SNe Ia (Type Ia supernovae) published by various researchers reveals that interpreting the Hubble redshift as evidence of cosmic expansion is fundamentally flawed. Comparisons of different redshift mechanisms in physics suggest that the quantum redshift effect of photons is the dominant factor influencing the redshifts observed in cosmology. By applying redshift and extinction corrections to the redshift-distance modulus function, a new function is established. Utilizing two data points from the existing Hubble diagram of SNe Ia, the Hubble constant and the extinction rate are determined. These constants are then incorporated into the corrected redshift-distance modulus function to quantitatively characterize its behavior. The newly developed function demonstrates a quantitative match with the Hubble diagram, which represents the statistical mean curve of the redshift-distance modulus relationship for SNe Ia. This alignment provides compelling evidence that the redshift observed in SNe Ia is directly attributable to the quantum redshift effect of photons. Thus, the statistical mean curve of the redshift-distance modulus for SNe Ia strongly supports the idea that the quantum redshift effect of photons is the primary cause of the Hubble redshift. Observational data on SNe Ia support this effect, thereby decoupling the relationship between the Hubble redshift and both the Doppler effect and the cosmological gravitational field equations of general relativity. This discovery has led to the abandonment of the cosmic scale factor and related cosmological parameters, including the deceleration factor, dark matter density, dark energy density, cosmic curvature, and the cosmological constant. It strongly challenges the current cosmological perspective that the universe is expanding at an accelerating rate due to dark energy, effectively rejecting the theory of cosmic expansion. The quantum redshift effect theory of photons, formerly known as the Tired Light hypothesis, is a novel concept that has not yet gained widespread acceptance but is poised to offer an explanation for the cosmic redshift of photons. Cosmology must incorporate the quantum redshift effect to resolve the century-old Hubble redshift problem.

Keywords: SNe Ia (Type Ia supernovae), Hubble diagram, redshift-distance modulus, quantum redshift effect, Hubble redshift, Tired Light hypothesis, cosmological gravitational field equations, dark energy, time dilation

1. Introduction

In contemporary cosmology, there is a strong inclination to align various observed phenomena and data with the model of an expanding universe.

In 1929, the American astronomer Edwin Hubble made a groundbreaking discovery regarding the increasing wavelength of light emitted by galaxies through systematic observations of their spectra. This significant finding built upon the work of earlier astronomers. In the mid-19th century, the Austrian physicist Christian Doppler proposed the Doppler effect, which provided a theoretical framework for understanding spectral shifts. Subsequently, in the early 20th century, the American astronomer Vesto Slipher observed systematic redshifts in the spectra of several galaxies. Hubble then combined these observations with measurements of galaxy distances and formulated what is now known as Hubble's Law. This law states that the recession velocity of galaxies is directly proportional to their distance from Earth. Hubble's discovery fundamentally altered the previously held view of the universe as a static entity.

Hubble's redshift fundamentally arises from the stretching of light wavelengths, resulting in spectral lines shifting toward longer wavelengths. This phenomenon can be explained through two primary mechanisms:

Doppler Redshift:

This occurs due to the relative motion of galaxies receding from Earth. As these galaxies move away, their light wavelengths are stretched, leading to a redshift. The redshift is proportional to the distance of the galaxies; in other words, galaxies that are farther away exhibit greater recession speeds.

Cosmic Redshift:

This phenomenon is a result of the expansion of the universe, which stretches spacetime itself. As photons travel through this expanding space, their wavelengths are elongated, reflecting the dynamic growth of the cosmos.

Together, these mechanisms explain the redshift observed in distant galaxies and underscore the universe's expanding nature.

Then, alternative explanations for the Hubble redshift emerged.

In 1929, Swiss astronomer Fritz Zwicky introduced the "Tired Light hypothesis." This theory proposes that the redshift observed in light occurs because photons lose energy through interactions with the medium they traverse, rather than being a result of cosmic expansion. Zwicky suggested that photons experience energy loss due to scattering or absorption throughout their cosmic journey, leading to a gradual increase in their wavelengths. The hypothesis was meant to support the static universe model, opposing the concept of an expanding universe. However, it faced two significant challenges: it could not satisfactorily explain observed time delay effects—such as the correlation between the light curves of SNe Ia and their redshift—and it was inconsistent with observations of the Cosmic Microwave Background (CMB) radiation.

In 1948, Fred Hoyle, Hermann Bondi, and Thomas Gold proposed the steady-state universe model. This model suggests that the universe has neither a beginning nor an end, with matter being continuously created to maintain a constant average density. They argued that redshift is not due to cosmic expansion but rather the result of the energy decay of photons as they travel greater distances—this concept is known as the 'Tired Light' hypothesis. This theory rejects the idea of a Big Bang origin and asserts that the universe has always existed, remaining homogeneous and unchanging.

During the 1960s and 1980s, American astronomer Halton Arp proposed the intrinsic redshift hypothesis. He argued that redshifts are not solely caused by distance; instead, they might arise from the intrinsic physical properties of celestial bodies, such as the evolutionary stages of young galaxies, or from unknown quantum effects. By observing nearby celestial objects—including quasars and galaxies that appear to be connected—Arp challenged the universality of Hubble's Law. However, his hypothesis was not accepted by the mainstream scientific community due to a lack of reproducible observational evidence and inconsistencies with standard spectral analysis.

The Tired Light Hypothesis is largely rejected by mainstream scholars, mainly because it lacks physical mechanisms to support its claims. When photons interact with matter, they are either absorbed or scattered, which changes their direction of propagation. Is there any physical effect that can reduce a photon's frequency or extend its wavelength without altering its direction? So far, physics has not identified any phenomenon in which a photon's wavelength increases during a particle collision while keeping its original propagation direction unchanged.

During the 1970s and 1980s, astronomers gradually recognized that SNe Ia are photometrically consistent, establishing them as standard candles. This was demonstrated in a 1973 study by Tammann et al., which examined the relationship between their luminosity and light curves. SNe Ia, which result from the explosions of white dwarfs, display remarkable stability in their absolute magnitude, with an intrinsic brightness of about -19.3 magnitudes. This reliability has earned them the designation of "cosmic standard candles" for measuring distances to faraway galaxies. As standard candles, SNe Ia have been crucial in constructing the Hubble diagram. Through theoretical advancements and improvements in observational techniques, they have become essential tools in cosmological research.

Since 1998, core researchers, including Saul Perlmutter, Brian P. Schmidt, and Adam G. Riess, have established SNe Ia as standard candles, creating the Hubble diagram for SNe Ia. This milestone in cosmological research proposed the concept of the universe's accelerating expansion, which requires support from dark matter and dark energy.

Dark energy remains a subject of considerable debate, with the most significant controversies focusing on its nature. Key questions include: Does dark energy truly exist? What is its essence? Can it be studied in a laboratory on Earth or in a space laboratory? Some theoretical physicists question whether the universe is indeed expanding at an accelerating rate. Is dark energy responsible for this acceleration, or is general relativity not applicable on cosmic scales? Could the theory itself be flawed?

This paper raises several questions and explores some new ideas:

1) Is the systematic redshift observed in Type Ia supernovae truly caused by the expansion of the universe?

2) Does the Hubble diagram of Type Ia supernovae accurately correspond with the cosmological gravitational field equations of general relativity?

3) Is the redshift-distance modulus relationship of Type Ia supernovae dependent on the existence of dark matter and dark energy?

4) Does the quantum redshift effect align precisely with the Hubble diagram of Type Ia supernovae?

2. Review of the Hubble Diagram of SNe Ia

2.1 Hubble Diagram of 50 SNe Ia

Standard candles are essential tools in cosmology for measuring distances in the universe. The High-z Supernova Search Team (HSST)[1], led by Brian Schmidt and Adam Riess, was launched in 1994, while the Supernova Cosmology Project (SCP)[2], led by Saul Perlmutter, was initiated in 1988. Both teams selected Type Ia supernovae as standard candles due to their consistent brightness. By 1998, they had observed over 50 distant Type Ia supernovae [3][4], providing a solid data foundation for further research on supernovae.

In the 1990s, the prevailing belief in cosmology was that the expansion of the universe was slowing down due to gravitational forces. However, two independent research teams discovered that SNe Ia in distant galaxies appeared dimmer than expected. According to the standard candle principle, when an object's brightness is dimmer than anticipated, it indicates that the object is farther away. This observation revealed that these supernovae were in galaxies that were actually receding faster than predicted, suggesting that the universe's expansion is accelerating. This groundbreaking discovery was celebrated as a significant milestone in cosmology. Previous models, based on Friedmann's equations, assumed that the universe was composed of ordinary matter and dark matter, leading to a decelerating expansion. However, the new theory of accelerating expansion required the introduction of dark energy, a mysterious repulsive force that counteracts gravitational pull. The simplest explanation for dark energy is the cosmological constant Λ, a concept that Einstein proposed in 1917.

The introduction of dark energy propelled the development of the Lambda-Cold Dark Matter (ΛCDM) model, which has since become the prevailing standard in cosmology.

The SCP results indicate the proportion of matter $\Omega_M \approx 0.3$ and the proportion of dark energy$\Omega_\Lambda \approx 0.7$.

The results of the HSST analysis also indicate the proportion of matter $\Omega_M \approx 0.28$ and the proportion of dark energy$\Omega_\Lambda \approx 0.72$.

Their results are highly consistent.

By integrating Type Ia supernovae data with Cosmic Microwave Background (CMB) and Baryon Acoustic Oscillations (BAO), researchers have precisely determined $H_0 \approx 70\mathrm{km}(\mathrm{s} \cdot \mathrm{Mpc})$, the cosmic curvature $k = 0$, and the cosmological equation constant $w =- 1$.

The ΛCDM model describes two phases of cosmic expansion. In the first phase, from 0 to 5 billion years after the Big Bang, the gravitational effects of dark matter and ordinary matter predominated, causing the expansion of the universe to slow down. In the second phase, from 5 to 13.7 billion years after the Big Bang, dark energy became the dominant force, leading to an acceleration in the universe's expansion.

Leading cosmologists assert that this discovery holds significant implications; it challenges the traditional notion of "cosmic deceleration" and demonstrates that dark energy is the dominant force in the universe. This breakthrough has established the ΛCDM model (Cosmological Constant + Cold Dark Matter) as the gold standard in cosmology. The model has successfully explained key observations, such as the cosmic microwave background (CMB) and the formation of large-scale structures. As a result, it has become the foundation of 21st-century cosmology.

While the ΛCDM model posits dark energy as a cosmological constant, there is currently no direct evidence to confirm its existence. Some theories suggest that dark energy could be the "fifth force" (a modified gravity theory) or "vacuum energy" in quantum mechanics, but none have been substantiated. The ΛCDM model's fit to high-redshift or low-redshift data is suboptimal, and it even contradicts other cosmic probes, such as gamma-ray bursts (GRBs).

2.2. Hubble Diagram of 280 SNe Ia

Scholars, including Laszlo Marosi, conducted a systematic analysis of the Hubble diagram using redshift data from 280 supernovae [5][6][7][8], leading to significant discoveries. An examination of 280 supernovae and gamma-ray burst data with redshifts z ranging from 0.0104 to 8.1 revealed that the observed Hubble diagram (the relationship between redshift and distance modulus) significantly deviates from the predictions of the ΛCDM model, particularly in the high-redshift range $z > 1$. On the contrary, the data aligns more closely with the exponential law predicted by the Tired Light theory within the static universe model.

$$z = -1 + e^{k \cdot t_s} \quad (1)$$

where, the symbol t_s represents the photon travel time. The calculated results from the ΛCDM model differ from observational values by more than 4σ, whereas the fitting error for the static model is under 1%, indicating that the latter may more accurately reflect actual cosmological behavior.

The inclusion of gamma-ray bursts (GRBs) in the Hubble diagram analysis for the first time, covering the extreme early universe $z > 5$ (traditional type Ia supernovae only reach $z \sim 2$), offers a new perspective on the evolution of the high-redshift universe.

The observed data are consistent with the static universe model.

$$\mu = 5\lg[(1+z)\ln(1+z)] + \text{Constant} \quad (2)$$

Although research indicates that the simple Tired Light hypothesis does not correspond with certain supernova samples, its generalized version performs satisfactorily. Moreover, the question of whether supernova luminosity evolves with redshift remains unresolved, which could potentially impact the interpretation of Hubble diagrams.

Supernova data from the northern and southern celestial hemispheres exhibit significant asymmetry, with the northern hemisphere providing stronger evidence for the universe's acceleration. This suggests potential systematic errors or the influence of local structures.

This study, which analyzes large-sample and wide-redshift-range data, questions the physical necessity of the universe's accelerating expansion. The static model achieves observational consistency with simpler assumptions (no dark energy, no metric expansion), thereby challenging the "standard model" status of the ΛCDM framework. Subsequent independent tests of quasars at $z \sim 7$ and GRBs further support high-redshift deviations, prompting the academic community to re-examine photometric calibration, selection effects, and new physical mechanisms (such as modified gravity).

In summary, the research by Marosi et al. has revealed fundamental contradictions between the ΛCDM model and high-redshift observations, providing a critical testbed for comparing cosmological models. While systematic errors, (such as supernova calibration and sky area bias, require further clarification, their findings have significantly prompted a reevaluation of the nature of dark energy and the cosmic expansion paradigm, necessitating the reintroduction of the Tired Light hypothesis. Notably, Marosi utilizes the "Tired Light theory" to explain redshift, employing a hypothetical "light model" that circumvents certain cosmological parameters through computational adjustments. This model introduces a redshift factor $(1+z)$ when calculating distance, yielding Equation (2). This is merely a special case of the expansion model, a clever assumption.

2.3 Hubble Diagram of 307 SNe Ia

In 2007, M. Kowalski published a paper [9] that synthesized new and historical SNe Ia data from SNLS, ESSENCE, and other sources, creating the most comprehensive dataset of 307 SN Ia at the time. The study constructed a redshift-distance modulus Hubble diagram, extending the redshift range to $z \leq 2$. This work drove the paradigm shift from single-data-set analysis to multi-source joint analysis, significantly improving the constraint precision of dark energy and the cosmological state equation constant w, approaching the parameters $w = -1$of ΛCDM. Fitting the SN Ia redshift-distance modulus relation constrains parameters such as Ω_M, Ω_Λ, and H_0, confirming the cosmic acceleration expansion with a confidence level exceeding 5σ, thereby supporting the dark energy-dominated model.

In 2008, M. Kowalski et al. published a paper [10] that systematically integrated high-redshift(z~1) supernova data, low-redshift traditional samples, and multi-source historical data for the first time, constructing the most comprehensive supernova data set of its era (comprising 307 SNe Ia). This integrated approach significantly expanded the dynamic range of the Hubble diagram, enabling broader verification of the redshift-distance relationship. Using this optimized and consolidated large-scale SN Ia sample, the study imposed substantially stronger observational constraints on cosmological model parameters—particularly those describing the universe's geometry and composition.

The core findings establish constraints on the cosmological state equation parameter w, supporting the conclusion that $w \approx -1$dark energy's behavior bears a striking resemblance to Einstein's cosmological constant Λ. This provides robust observational support for the ΛCDM (Cold Dark Matter) model. The study also more precisely determined the values of the matter density parameter Ω_M and the Hubble constant H_0 along with their respective uncertainty ranges.

The Hubble diagram in the text reveals a systematic dimming of high-redshift supernovae (compared to predictions without dark energy models), providing direct observational evidence for the accelerating expansion of the universe. The study concluded that $\Omega_M \approx 0.3$ and $\Omega_\Lambda \approx 0.7$, pinning down the dark energy fraction is approximately 70%, a landmark achievement that solidified the ΛCDM model.

2.4 Hubble diagram of 580 SNe Ia

N. Suzuki and 65 other scholars co-authored a paper [11] that utilized the SALT2 (Spectral Adaptive Light Curve Template 2) model to analyze 580 Type Ia supernovae from the updated Supernova Union 2.1 compilation. After standardizing the data, they simultaneously measured the distance modulus μ and redshift z, inputting these values into the redshift-distance modulus relationship diagram (Hubble diagram). Through mathematical analysis, they successfully fitted a curve that aligns with the flat space model described in the cosmological equations of general relativity.

Figure 1 illustrates the statistical mean curve depicting the redshift-distance modulus relationship for 580 SNe Ia, sourced from the literature [11]. This curve is commonly known as the Hubble diagram. It provides a solid foundation for the development of new theories. Given its precision, this paper adopts it as a representative sample for the Hubble diagram.

The curve corresponds to the flat universe model. Its primary objective was to constrain various cosmological parameters, including cosmic curvature k, the cosmological state equation constant w, the dark matter fraction Ω_M, the dark energy fraction Ω_Λ, and the Hubble constant H_0.

However, this paper does not conclusively establish the formula for the redshift-distance modulus function implied by this curve. Consequently, it is arguable whether interpreting this statistical mean curve as indicative of the universe's accelerating expansion constitutes a critical error, potentially misleading to cosmological studies.

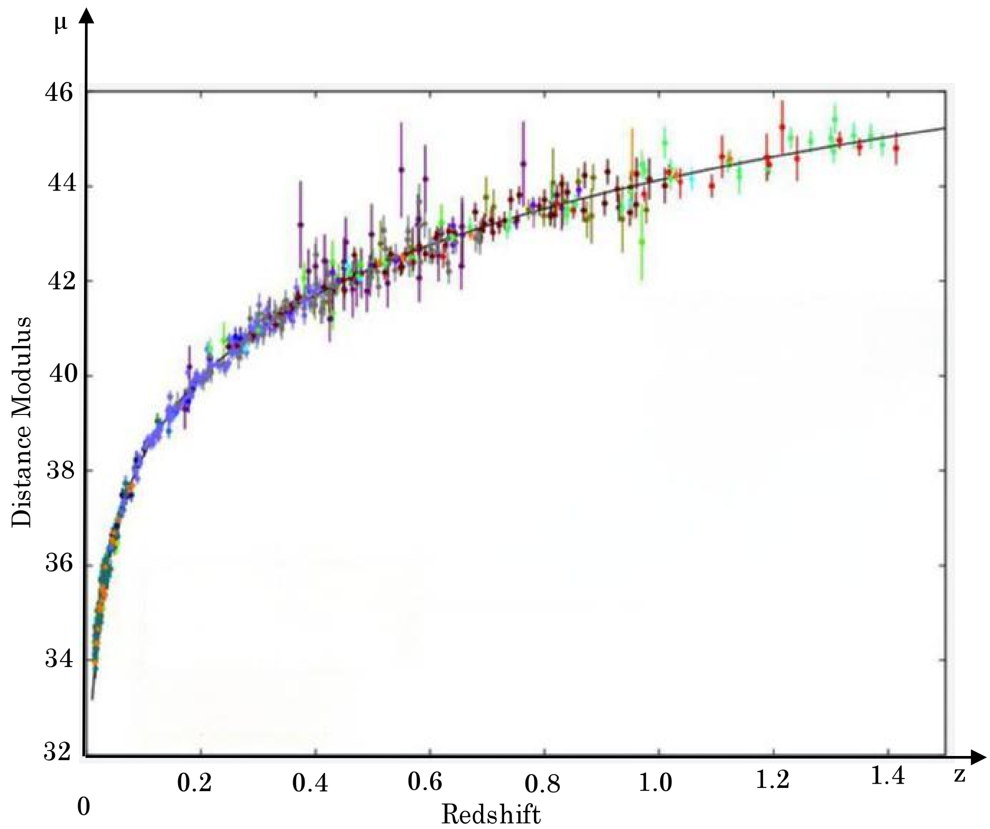

Figure 1. Researchers including N. Suzuki and 65 others utilized the SALT2 model (Spectral Adaptive Light Curve Template 2) to process 580 SNe Ia from the updated Supernova Union 2.1 compilation, standardizing them to generate a redshift-distance modulus statistical mean curve.

2.5 Hubble Diagram of 892 SNe Ia

Hartmut Traunmüller challenged mainstream cosmological models with his large-sample statistical analysis of Type Ia supernovae [12][13]. His research incorporated data from 892 Type Ia supernovae, encompassing measurements of brightness (distance modulus μ) and redshift z. This extensive sample, considered large-scale in 2018, spans a redshift range from z=0.01 to 8.1, including both nearby and high-redshift supernovae. Traunmüller utilized statistical regression analysis to identify fitting equations that more accurately reflect observational data, thereby surpassing the limitations of conventional models.

The prevailing paradigm in traditional cosmology, known as the standard model, posits that the universe consists of matter Ω_M, dark energy Ω_Λ, and curvature Ω_k. The model's distance modulus equation, which incorporates these components, leads to the central assertion that "the universe is undergoing accelerating expansion," driven by Ω_Λ an unidentified force.

Traunmüller's "light model" aligns perfectly with observational data: it accurately reproduces the Hubble diagrams for Type Ia supernovae and Gamma-ray Bursts, regardless of the values for cosmic curvature Ω_k, matter density Ω_M, or the cosmological constant Ω_Λ. Traunmüller's statistical analysis suggests that the equation providing the best fit does not require these parameters but instead follows a simpler form.

$$\mu = 5\lg[(1+z)\ln(1+z)] + 43.3856557 \quad (3-1)$$

or

$$\mu = 2.1714724\ln[(1+z)\ln(1+z)] + 43.3856557 \quad (3-2)$$

This equation relies solely on the redshift z. By combining $(1+z)$ with $\ln(1+z)$, it achieves precise fitting of 892 supernova observations (relative difference ≤ 0.01). This outcome is consistent with the formula

$$\mu = 44.109769z^{0.059883} \quad (4)$$

derived from Laszlo Marosi's independent study, which utilized 276 supernova data points, thus demonstrating the robustness of the conclusion.

Traunmüller's research directly addresses the fundamental contradiction in the ΛCDM model: the calculated values from traditional models fail to align with observational data, particularly in high-redshift or low-redshift regions where the values of Ω_M and Ω_Λ cannot simultaneously satisfy all observations. His proposed "light model" eliminates the need for dark energy Ω_Λ and does not assume cosmic acceleration, yet fully matches observational data. The revolutionary significance of this conclusion lies in its rejection of the necessity of "cosmic acceleration"—it demonstrates that models independent of dark energy Ω_Λ can equally explain the redshift-distance modulus relationship of supernovae.

Traunmüller's research extends beyond statistical analysis, offering a novel perspective on cosmological studies and challenging the necessity of dark energy. While contemporary models indicate that dark energy $\Omega_\Lambda \approx 0.72$ drives the universe's accelerating expansion, Traunmüller's framework disputes this idea, suggesting that dark energy might not be a fundamental component of the cosmos or that its physical properties require reevaluation.

The simplified cosmological model, featuring its concise fitting equation that incorporates solely the redshift z, challenges the "parameter redundancy" issue of the ΛCDM model. This has spurred researchers to consider more straightforward mechanisms for cosmic expansion, such as the exponential relationship between photon flight time and z in the "light model."

$$1 + z = e^{2.024\times10^{-18}t_s} \quad (5)$$

Traunmüller, by fostering a dialogue between observation and theory, transformed the precision of supernova data into theoretical constraints using large-sample statistics. This compellingly led the academic community to reassess the limitations of the ΛCDM model and provided observational support for subsequent alternative models.

In summary, Hartmut Traunmüller's groundbreaking work is characterized by his statistical analysis of large-scale supernova data. This analysis not only challenged the dominance of the ΛCDM model but also proposed a "light model"that is better aligned with observational evidence, thereby disproving the necessity of cosmic acceleration. Although his "light model"has not yet become mainstream, it has catalyzed a paradigm shift in cosmology from parameter tuning to data-driven research. This shift reminds researchers that the universe's fundamental nature might be simpler than current theories suggest, and that dark energy could be theoretical speculation rather than an observational inevitability. Such critical thinking has become a vital driving force in the evolution of cosmological research. While the Traunmüller theory avoids multiple cosmological parameters, such as Ω_M, Ω_Λ, k, and w, it still relies on the cosmic scale factor and supports the cosmological expansion hypothesis, albeit with a slower expansion rate. It adopts the redshift factor $1 + z$ as the expansion factor for both distance and time. The redshift formula $1 + z = e^{H_0 r/c}$ used in this theory originates from the Tired Light hypothesis, whose physical mechanism remains poorly understood.

2.6 Hubble Diagram of over 1,000 SNe Ia

López-Corredoira and J. I. Calvo-Torel's study [14] demonstrated that incorporating non-cosmological factors—such as intergalactic extinction, supernova luminosity evolution, and the Tired Light redshift effect—allows for fitting observational data without relying on dark energy models. Consequently, the statistical mean curve of redshift-distance modulus from supernova observation data does not necessarily align precisely with the cosmic expansion model fitted by dark energy. In contrast, the curve of the fitted cosmic model poorly matches the statistical mean curve.

2.7 Summary of Review

The majority of the aforementioned literature aligns with the statistical mean curve of the redshift-distance modulus for SNe Ia within the ΛCDM cosmological model. However, some researchers propose that redshift might arise from the Tired Light hypothesis. Examining the Hubble diagrams of SNe Ia created by various researchers, the following points are noteworthy:

1) The redshift-distance modulus theory, proposed by the Supernova Cosmology Project (SCP) and the High-z Supernova Search Team (HSST), suggests that the universe is expanding at an accelerating rate, driven by dark energy. However, alternative models have been proposed by other researchers that more accurately depict the statistical mean curve of the redshift-distance modulus, without reliance on cosmological parameters. This indicates that these parameters may not be necessary for understanding this phenomenon.

2) The statistical mean curve of SNe Ia does not perfectly align with the fitting curve of the ΛCDM cosmological model.

3) When constructing the Hubble diagram for Type Ia supernovae, all researchers acknowledge that media extinction occurs in both interstellar and intergalactic spaces.

4) Some scholars have suggested that the redshift observed in SNe Ia is a result of the Tired Light phenomenon in their studies of the Hubble diagram.

3. Redshift Physical Mechanism

Louis Marmet meticulously compiled over sixty distinct physical mechanisms proposed to explain redshift phenomena throughout astrophysics. Remarkably, 59 of these were cosmological redshift mechanisms explicitly establishing quantitative relationships between redshift and distance. Each mechanism furnished detailed mathematical models or functional relationships specifically designed for comparison and rigorous verification against observational data. In his published papers[15], he presented several highly reliable redshift-distance function plots. However, when numerically comparing these theoretical curves—which closely resemble the Hubble diagram—against the deterministic statistical mean curves derived from Type Ia supernova observations (illustrated in Figure 1), none achieved a satisfactory fit. Only the photon energy attenuation model alone closely approximates the redshift-distance modulus statistical mean curve.

The following examines four unique mechanisms, with the final one embodying the author's original contribution.

3.1Four Redshift Effects

The four redshift effects commonly discussed in physics are the Compton effect, the relativistic motion effect, the gravitational effect, and the one historically referred to as Tired Light, photon aging, or intrinsic redshift. According to the author's paper [16], this last effect is now termed the quantum redshift effect of photon.

1）Compton effect

The paper titled "Quantum Redshift Effect of Photon" posits that visible photons and X/γ-ray photons share the same shape but differ in size. Consequently, it concludes that photons of varying wavelengths exhibit distinct effects when they interact with atoms. X-rays and γ-rays travel through space, where photons may come into contact with matter. Given that photons are significantly smaller than atoms, their interactions are limited to atomic nuclei or individual electrons. The primary effect observed is the Compton effect, which results in a loss of photon energy and an increase in the photon's wavelength. During this process, photons also undergo changes in their direction of propagation.

Photons with wavelengths longer than those of X-rays interact with atoms, and there is a probability of oblique collisions (non-central collisions), resulting in Compton scattering. To address this type of collision, the Compton effect must be applied.

Assuming the rest mass of the electron is m_e， and the angular frequency of the incident photon is ω, then when the photon collides with the stationary electron, the wavelength of the photon increases by:

$$\Delta\lambda = \lambda' - \lambda = \frac{4\pi\hbar}{m_e c}\sin^2\frac{\theta}{2} \tag{6}$$

Here, c denotes the speed of light, $\Delta\lambda$ represents the wavelength increase after a photon collides with a stationary electron, λ is the photon's wavelength before collision, λ' is the wavelength after collision, and θ is the scattering angle—the angle by which the scattered photon deviates from its incident direction $0\leq\theta\leq\pi$. Consequently, during Compton scattering, photons cannot travel in straight lines. The energy loss per scattering event depends on the scattering angle θ, making the energy loss inherently unpredictable.

Although the energy loss of a photon does not equal the total energy of the photon, represented by $\hbar\omega$, when the photon deviates from the line of sight, it effectively vanishes from the beam. This deviation diminishes the number of photons, which in turn decreases the luminosity of the object and contributes to extinction.

2）Relative motion redshift effect

Redshift due to relative motion can be classified into two types: special relativity and general relativity.

Consider a point source that emits photons with a frequency ν_0 while moving relative to Earth at a velocity v. The frequency of the photons received on Earth will be

$$\nu = \nu_0 \frac{1 - \frac{v}{c}\cos\varphi}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{7}$$

This is commonly known as the Doppler effect of special relativity.

When a celestial body moves in the same direction as the observer's line of sight (with the angle φ= 0), the equation can be simplified so that

$$\nu = \nu_0 \frac{1 - \frac{v}{c}}{\sqrt{1 - \frac{v^2}{c^2}}} = \nu_0 \sqrt{\frac{1 - \frac{v}{c}}{1 + \frac{v}{c}}} \tag{8}$$

When an object moves away from the observer $v \geq 0$, the Doppler effect results in $\sqrt{(1-v/c)/(1+v/c)} < 1$ a decrease in the observed photon frequency on Earth $\nu < \nu_0$. This phenomenon is known as redshift. Conversely, when the object approaches the observer $v \leq 0$, the effect leads to $\sqrt{(1-v/c)/(1+v/c)} > 1$ an increase in the observed photon frequency $\nu > \nu_0$, corresponding to blueshift.

If the universe is expanding as a whole, it is typically described by a cosmological redshift:

$$\frac{\lambda}{\lambda_0} = 1 + z = \frac{a(t_0)}{a(t_e)} \tag{9}$$

where λ denotes the observed wavelength, λ_0 represents the initial wavelength emitted by the luminous object, and z indicates the redshift; $a(t_e)$ corresponds to the cosmic scale factor at the object's emission time, while $a(t_0)$ corresponds to the cosmic scale factor at the photon's observation time.

If the universe's expansion adheres to Einstein's cosmological gravitational field equation within the framework of general relativity, then the cosmic scale factor complies with the Friedmann equations:

$$\begin{cases} \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho + \frac{\Lambda c^2}{3} - k\frac{c^2}{a^2} & (10-1) \\ \frac{\ddot{a}}{a} = -\frac{4\pi G}{3}\left(\rho + \frac{3p}{c^2}\right) + \frac{\Lambda c^2}{3} & (10-2) \end{cases}$$

where G represents the gravitational constant, ρ signifies the density of matter in the universe, p denotes the pressure of the universe, and Λ is the cosmological constant.

These are cosmological dynamics equations, where $a(t)$ represents the cosmic scale factor. The solutions of $a(t)$ derived from equations (10-1) and (10-2) not only vary with time *t*but also depend on mechanical quantities ρ、p、k and Λ. This suggests that the estimated visible matter density may be part of ρ. As all four parameters remain unknown, it is impossible to determine $a(t)$. Conversely, if the time-dependent function $a(t)$ were known, it would impose constraints on the parameters ρ、p、k and Λ in equations (10-1) and (10-2). However, since only one function exists, the four parameters cannot be determined. Additional constraints are required to ascertain these parameters. It is evident that $a(t)$ is a highly complex function, and to date, no elementary function explicit expression has been found.

3) Gravitational redshift effect

Assuming the gravitational potential of a distant luminous celestial body is ϕ_1 relative to infinity, and that of Earth is also ϕ_2 relative to infinity, when a photon with an initial frequency ν_0 emitted by the celestial body reaches Earth with a different frequency ν ,the relationship can be derived from Newton's law of universal gravitation and the law of conservation of energy.

$$\mathrm{h}\nu + \mathrm{h}\nu\frac{\phi_2}{c^2} = \mathrm{h}\nu_0 + \mathrm{h}\nu_0\frac{\phi_1}{c^2} \tag{11}$$

Solving this equation yields:

$$\nu = \nu_0\frac{1+\frac{\phi_1}{c^2}}{1+\frac{\phi_2}{c^2}} \tag{12}$$

where the gravitational potential $\phi_1 \le 0$，$\phi_2 \le 0$.

According to Einstein's general theory of relativity, Equation (11) is modified.

$$\mathrm{h}\nu\sqrt{1+\frac{2\phi_2}{c^2}} = \mathrm{h}\nu_0\sqrt{1+\frac{2\phi_1}{c^2}} \tag{13}$$

Solving this equation yields:

$$\nu = \nu_0 \sqrt{\frac{1+\frac{2\phi_1}{c^2}}{1+\frac{2\phi_2}{c^2}}} \tag{14}$$

Equations (12) and (14) indicate that whether the photons emitted by the luminous object undergo redshift or blueshift upon reaching Earth depends on the value of the gravitational potential $\phi_1$and ϕ_2.

According to formula (12), if the gravitational potential is sufficiently negative $\phi_1/c^2 \leq -1$, then photons emitted from this object cannot reach Earth, and the object is considered a Newtonian black hole.

According to formula (14), if the gravitational potential is sufficiently negative $2\phi_1/c^2 \leq -1$, then photons emitted from this object cannot reach Earth, and the object is considered a general relativistic black hole.

4) Quantum redshift effect

The quantum redshift effect of photons is rigorously derived through the core principles of quantum mechanics once the size and shape a single photon are precisely defined[16]

Suppose a stationary point source emits photons with an initial frequencyν_0. As these photons propagate and encounter atoms, they undergo a quantum redshift effect, which can be expressed as follows:

$$\nu = \nu_0 e^{-\int_0^t H_0\, dt} = \nu_0 e^{-\int_0^r \frac{H_0}{c} dr} \tag{15}$$

If the distribution density of atoms is not uniform, then the damping rate of photons, also known as the Hubble constant, H_0 will not remain constant.

If the atomic distribution density is uniform, then the frequency of the photons received on Earth is

$$\nu = \nu_0 e^{-H_0 t} = \nu_0 e^{-\frac{H_0 r}{c}} \tag{16}$$

Equation (16) can also be expressed as

$$\frac{\nu}{\nu_0} = e^{-\frac{H_0 r}{c}} \tag{17}$$

The right-hand side of the equation above is referred to as the damping factor for the photon. As detailed in the paper "The Quantum Redshift Effect of Photon" [16], the expression for H_0

in equation (16) is

$$H_0 = \frac{3\pi}{8\alpha} c\sigma_T n_e \tag{18}$$

where α is the fine structure constant, $\sigma_T = 8\pi r_e^2/3$ is the Thomson scattering cross-sectional area of a classical electron, and n_e is the density of bound electrons along the photon's path.

Since photons encounter non-uniform atomic distributions along their propagation path, the value H_0 is not constant. However, the macroscopic statistical mean value appears constant. Thus, the value H_0 is a constant that refers to the statistical mean. In other words, while measuring individual celestial objects, the value H_0varies, but the results of measurements on a large number of objects tend toward a mean value. The commonly mentioned value H_0represents the statistical mean value of a large number of luminous celestial objects.

During their propagation, photons interact with atoms, resulting in quantum redshift effects that cause energy loss. Consequently, the frequency of the photons decreases exponentially. Equation (15) depicts the attenuation trend of photon frequencies from a single luminous source, whereas Equation (16) represents the collective attenuation trend across multiple luminous sources, reflecting the statistical mean value of photon frequency attenuation.

3.2 Integration of Redshift Effects

Since photons deviate from their original path during Compton scattering, this phenomenon is more accurately classified as a form of extinction rather than redshift. Other scattering phenomena are likewise categorized as extinction.

When both the luminous source and Earth reside within a gravitational potential, move relative to each other, and photons undergo quantum redshift along their propagation path, the combined effect of these three phenomena dictates the frequency of photons arriving at Earth as follows:

$$\nu = \nu_0 \cdot \sqrt{\frac{1+\frac{2\phi_1}{c^2}}{1+\frac{2\phi_2}{c^2}}}\ \frac{1-\frac{v}{c}\cos\varphi}{\sqrt{1-\frac{v^2}{c^2}}} \cdot \frac{a(t_e)}{a(t_0)}\ e^{-\frac{H_0 r}{c}} \tag{19}$$

In terms of wavelength, Equation (19) can be transformed into

$$\lambda = \lambda_0 \cdot \sqrt{\frac{1 + \frac{2\phi_2}{c^2}}{1 + \frac{2\phi_1}{c^2}}} \cdot \frac{\sqrt{1 - \frac{v^2}{c^2}}}{1 - \frac{v}{c}\cos\varphi} \cdot \frac{a(t_0)}{a(t_e)} \cdot e^{\frac{H_0 r}{c}} \tag{20}$$

If the relativistic transformation of spacetime is followed, the form of the above equation may differ.

Redshift is defined as:

$$z = \frac{\lambda_0 - \lambda}{\lambda_0} = 1 - \frac{\nu_0}{\nu} \tag{21}$$

Substituting Equation (20) into Equation (21) yields

$$1 + z = \sqrt{\frac{1 + \frac{2\phi_2}{c^2}}{1 + \frac{2\phi_1}{c^2}}} \cdot \frac{\sqrt{1 - \frac{v^2}{c^2}}}{1 - \frac{v}{c}\cos\varphi} \cdot \frac{a(t_0)}{a(t_e)} \cdot e^{\frac{H_0 r}{c}} \tag{22}$$

Equation (22) demonstrates that the redshift factor（1+z）of photon wavelengths depends on four fundamental effects: the gravitational effect, the Doppler effect, the cosmic expansion effect, and the quantum redshift effect of the photon. The parameters affecting the value（1+z）include the distance r, the relative velocity v and its direction angle φ, the gravitational potential ϕ_1 at the location of the luminous object, and the gravitational potential ϕ_2 at Earth's position. Additionally, if the universe is expanding, it also depends on the expansion rates $a(t_0)/a(t_e)$.

3.3 The Dominance of the Quantum Redshift Effect

Upon examining photon redshifts, it is impossible to determine their precise origin through quantitative analysis alone. In the realms of contemporary astrophysics and cosmology, the systematic redshifts observed throughout the universe are referred to as cosmic redshifts. The prevailing interpretation attributes these redshifts to motion, encompassing both the Doppler effect within the framework of special relativity and cosmic expansion redshift within the context of general relativity. While gravitational redshifts are widely recognized, they are not commonly invoked to explain cosmic systematic redshifts. Conversely, quantum redshift effects have not achieved widespread acceptance, leading to ongoing confusion in mainstream explanations about the mechanisms causing the redshifts of distant celestial bodies. According to Formula (22), various factors contribute to the determination of (1+z), with some being more significant than others.

1）For distant celestial objects, the factor $\exp(H_0 r/c)$is the dominant one. Although H_0/c is small, $\exp(H_0 r/c)$ is an exponential function of distance, making it particularly significant on large scales. For nearby galactic objects, the contribution of this factor to the redshift (1+z) may be overshadowed by the Doppler effect and therefore unnoticeable.

2） The Doppler effect manifests as either redshift or blueshift. However, while luminous celestial bodies and Earth orbit their central objects, these motions are constrained—characterized instead by their slower velocities and inconsistent directionality. These orbital movements defy categorization as systematic patterns on a cosmological scale. The relative motions of distant celestial bodies with respect to Earth exhibit neither fixed magnitude nor direction, manifesting as redshift for some objects and blueshift for others. Supernova progenitors, being stars, display stellar motions with velocities substantially below light speed. From a macroscopic, statistical viewpoint, the spectral shift caused by this factorv/c exhibits a dispersed distribution around the statistical mean value $\exp(H_0 r/c)$.

3) Gravitational redshift is an inherent physical phenomenon. Luminous celestial bodies within galaxies wield significant gravitational potential ϕ_1, whereas Earth also maintains its own distinct gravitational potential ϕ_2. The redshift or blueshift of light emitted from these celestial objects as it reaches Earth ultimately depends on the relative values of these gravitational potentials ϕ_1 and ϕ_2. For typical Type Ia supernovae, their progenitor stars are stellar objects with limited gravitational potential, satisfying this condition $|\phi_1/c^2| \ll 1$. Consequently, spectral shifts and magnitude variations caused by gravitational potential effects in celestial bodies exhibit random patterns. These effects can be treated as statistical perturbations compared to the factor $\exp(H_0 r/c)$, which tend to cancel each other out statistically. As a result, gravitational-induced spectral shifts and magnitude variations follow a diffuse distribution centered around the statistical mean value $\exp(H_0 r/c)$.

Certain objects, such as quasars, active galactic nuclei, and giant black holes, may display a significant gravitational redshift that deviates markedly from the statistical mean curve.

4） The phenomenon of cosmic redshift, which indicates the expansion of the universe, remains a hypothesis and has not been definitively confirmed. Einstein's formulation of the cosmological equation within the framework of general relativity presumed a finite and stationary universe. Upon solving this equation, it became evident that maintaining cosmic equilibrium required the introduction of an additional constant term—the cosmological constant Λ. Nonetheless, even with this constant, the solutions were unstable, allowing the universe to either expand or contract. Although Hubble's discovery of systematic redshift in extragalactic galaxies initially led Einstein to accept cosmic expansion, he continued to be conflicted about the introduction of a cosmological constant. The fundamental flaw in the cosmological equation of general relativity is its assumption of a finite universe. Current mainstream scholarship attributes systematic cosmic redshifts—those that align with the statistical mean $1+z=\exp(H_0r/c)$—to cosmic expansion. However, as the analysis shows, this redshift factor originates from the quantum redshift effect of photons.

3.4 Systematic Redshift

The systematic redshift factor $\exp(H_0r/c)$ in Equation (22) represents the quantum redshift effect, which is caused by photon collisions with atoms during their propagation through intergalactic space. This phenomenon can also be interpreted as the damping motion of photons and is independent of cosmic expansion. Consequently, this paper omits the cosmic expansion rate factor $a(t_0)/a(t_e)$. Equation (22) posits that redshift caused by cosmic expansion is fundamentally absent.

Quantum redshift is the true cause of systematic redshift in cosmology, appearing as a statistical mean curve on the Hubble diagram of SNe Ia. In contrast, the redshift effects from the Doppler effect in special relativity and gravitational redshift in general relativity are extremely weak and scattered, manifesting as diffuse patterns on the Hubble diagram.

However, this can only be considered a temporary conjecture and requires verification through observational evidence.

Based on the above analysis, in Equation (22), the Doppler redshift and gravitational redshift factors can be disregarded, and the cosmic scale factor is treated as a constant, with $a(t_0)/a(t_e) \equiv 1$, retaining only one redshift factor. Thus, the sole factor contributing to the systematic redshift of the universe is

$$1 + z = e^{\frac{H_0 r}{c}} \tag{23}$$

Next, compare Equation (23) with the relevant statistical mean curve derived from observational data to assess how accurately this function aligns with the redshift-distance modulus relationship curve of Type Ia supernovae.

4. Redshift-Magnitude Formula Reconstruction

Light from distant objects must traverse a medium to reach Earth, resulting in two primary effects:

The first effect is quantum redshift, which occurs when photons collide head-on with atoms, losing a small amount of energy and continuing to travel in a straight line.

The second effect is the extinction effect, which arises from three mechanisms:

1) Resonant absorption of photons by atoms (including dust particles), followed by radiation emission that changes the direction of photon propagation;

2) Scattering caused by oblique collisions between photons and atoms, altering their trajectory;

3) Compton scattering from collisions between photons and ions or electrons, which modifies the direction of light propagation.

Other forms of scattering exist, producing identical effects. Whenever the direction of photon propagation changes, it manifests as extinction from the observer's perspective.

Photons travel through space, and if they collide with atoms, one of two phenomena must occur: either redshift or extinction. In a specific collision, these two phenomena cannot happen simultaneously.

4.1 Radiation Flux Density of Luminous Objects in a Medium-free Static Universe

Assuming there is no medium in intergalactic space, light will not undergo quantum redshift or extinction as it travels. Furthermore, if the luminous object and the observer remain relatively stationary, the observed radiation flux density will be as follows:

$$\begin{cases} \mathrm{F_0} = \dfrac{\mathrm{P_0}}{4\pi \mathrm{r_0^2}} & (24-\mathrm{a}) \\ \mathrm{F} = \dfrac{\mathrm{P_0}}{4\pi \mathrm{r^2}} & (24-\mathrm{b}) \end{cases}$$

In this formula, F denotes the flux density of the luminous celestial object as directly observed by the observer, while $\mathrm{F_0}$ represents the flux density when the star is assumed to be at a standard distance $r_0 = 10pc$. The distance r between the observed celestial object and the observer is measured in parsecs (pc), and P_0 signifies the luminous power of the celestial object.

When substituting equations (24-a) and (24-b) into the redshift-distance modulus formula to generate a Hubble diagram and comparing it with the Hubble diagram of SNe Ia, the results indicate a complete mismatch. This demonstrates that equations (24-a) and (24-b) are inconsistent with reality and require correction.

4.2 Redshift Correction

Since each photon undergoes quantum redshift as it travels and other redshift effects are neglected, the observed luminous flux density of celestial objects on Earth is determined by Equation (24-a) multiplied by the attenuation factor $\exp(-H_0 r_0/c)$, and Equation (24-b) also multiplied by the attenuation factor $\exp(-H_0 r/c)$. Consequently, Equation (24) can be revised as follows:

$$\begin{cases} F_0 = \dfrac{P_0}{4\pi r_0^2} e^{-\frac{H_0 r_0}{c}} & (25-a) \\ F = \dfrac{P_0}{4\pi r^2} e^{-\frac{H_0 r}{c}} & (25-b) \end{cases}$$

This indicates that the observed flux density diminishes not only according to the inverse square law but also experiences exponential attenuation due to the quantum redshift effect.

4.3 Extinction Correction

As a beam of photons traverses a medium, some are absorbed and scattered, preventing them from continuing along their original path. This phenomenon is known as the medium's extinction.

Consider a light beam with N photons. As it propagates, the medium absorbs and scatters photons, leading to a reduction dN in the photon count that is proportional to both the total number of photons N and the propagation time dt. The proportionality coefficient is κ referred to as the extinction rate (the combined effect of absorption and scattering). This relationship can be expressed as a differential equation.

$$dN = -\kappa N dt = -\frac{\kappa N}{c} dr \tag{26}$$

Integrating the differential equation yields:

$$N = N_0 e^{-\int_0^r \frac{\kappa}{c} dr} \tag{27}$$

In the equation, N_0 denotes the photon count at $r = 0$ the initial position. The term κ/c is referred to as the extinction coefficient.

A beam of light may contain photons of various wavelengths, each of which attenuates according to the law of extinction (27). This principle is analogous to the Bouguer-Lambert Law (Pierre Bouguer, 1729; Johann Heinrich Lambert, 1760).

The extinction rate, κ (or extinction coefficient κ/c), varies with both wavelength and medium density, indicating that κ is a function of the variables wavelength λ and distance r. However, if the subject of study is not light at a specific wavelength band but celestial objects—particularly supernovae—that emit light across various wavelengths, equation (27) can be simplified as follows:

$$\mathrm{N} = \mathrm{N}_0 e^{-\frac{\kappa}{c}r} \tag{28}$$

The variable κ in the formula can be treated as a constant that represents the statistical mean of the extinction rate. This principle is analogous to how the quantum redshift formula employs Equation (16) rather than (15), which is derived from a statistical mean perspective. Under macroscopic scales and large sample conditions, this variable κ represents a statistical mean in the universe. This is similar to the statistical mean of the photon damping coefficient represented by the symbol H_0.

The phenomenon of medium extinction inherently introduces an extinction factor $\exp(-\kappa r/c)$ into the luminous flux density formula for observed celestial objects. This leads scholars who overlook medium extinction to erroneously conclude that distant celestial bodies are not only receding from observers—indicative of cosmic expansion—but also accelerating in their recession, suggesting an accelerating cosmic expansion.

The luminous flux density is multiplied by a factor $\exp(-\kappa r_0/c)$ in (25-a) and by another $\exp(-\kappa r/c)$ in (25-b), yielding

$$\begin{cases} \mathrm{F}_0 = \dfrac{\mathrm{P}_0}{4\pi r_0^2} e^{-\left(\frac{\kappa}{c}+\frac{\mathrm{H}_0}{c}\right) r_0} & (29-\mathrm{a}) \\ \mathrm{F} = \dfrac{\mathrm{P}_0}{4\pi r^2} e^{-\left(\frac{\kappa}{c}+\frac{\mathrm{H}_0}{c}\right) r} & (29-\mathrm{b}) \end{cases}$$

This indicates that the observed luminous flux density decreases in inverse proportion to the square of the distance and also attenuates exponentially with distance due to extinction.

The extinction rate κ and photon damping coefficient H_0 in the formula are unknown. Although their values are available in the literature, this paper does not adopt them given the absence of definitive measurements, but instead determines them through the Hubble diagram of SNe Ia (Figure 1).

4.4 The Traditional Formula for the Redshift-Distance Modulus

According to its original definition, the distance modulus, or magnitude, is expressed as:

$$\mu = m - M = -2.5 \lg \frac{F}{F_0} \tag{30}$$

where μ denotes the distance modulus, m is the apparent magnitude, and M denotes the absolute magnitude, which is the magnitude at a distance of $r_0 = 10pc$（10 parsecs）. Without considering the redshift and extinction effects of the intergalactic medium, substituting equations (24-a) and (24-b) into equation (30) yields:

$$\mu = m - M = 5\lg r - 5 \tag{31}$$

This formula is too simplistic to accurately fit the Hubble diagram.

4.5 The New Formula for the Redshift-Distance Modulus

Substituting Equations (29-a) and (29-b) into Equation (30) yields the distance modulus $\mu = m - M$, expressed in terms of distance r, extinction rate κ, and the photon damping coefficient H_0.

$$\mu = -2.5 \lg \frac{F}{F_0} \tag{32-1}$$

$$= -2.5 \lg \frac{\frac{P_0}{4\pi r^2} e^{-\frac{\kappa + H_0}{c} r}}{\frac{P_0}{4\pi r_0^2} e^{-\frac{\kappa + H_0}{c} r_0}} \tag{32-2}$$

$$= 5\lg r - 5 + 2.5(\lg e)\frac{\kappa + H_0}{c}(r - r_0) \tag{32-3}$$

$$= 5\lg r - 5 + 1.085736\frac{\kappa + H_0}{c}(r - r_0) \tag{32-4}$$

Namely,

$$\mu = 5\lg r - 5 + 1.085736\left(\frac{\kappa + H_0}{c}\right)(r - r_0) \tag{33}$$

Where $r_0 = 10pc$. A comparison with Equation (31) reveals that a new term $1.085736(\kappa + H_0)(r - r_0)/c$ appears in Equation (33). This term describes the combined effects of extinction and redshift, which both contribute to an increase in the distance modulus.

When the research range $r \gg r_0$， r_0 in Equation (33) can be neglected, and Equation (33) is thus transformed into

$$\mu = 5\lg r - 5 + 1.085736(\frac{\kappa + H_0}{c})r \tag{34}$$

where c is the speed of light, and κ and H_0 are unknowns.

4.6 Determine the Values of Extinction Rate and the Hubble Constant

To determine the two unknown constants κ and H_0 in Equation (34), two data points must be selected from Figure 1 that satisfy two conditions: firstly, the readings should be relatively accurate, i.e., with minimal reading errors; secondly, the interval between these two points should be as large as possible to reduce calculation errors.

The two best data points are:

$(z_1, \mu_1) = (0.20, 40.00)$； $(z_2, \mu_2) = (1.40, 45.00)$.

Of course, the accuracy of the reading is limited by the blurriness of the diagram, which affects the reading error. The statistical curve may have an error, although small.

In the following calculations, a conversion between the unit of distance for celestial objects—the parsec (pc)—and the meter is required, and the speed of light is also taken as an appropriate approximation.

$$\begin{cases} 1\text{pc} = 3.08568 \times 10^{16}\text{m} & (35-a) \\ c = 2.99792 \times 10^{8} m/s & (35-b) \end{cases}$$

Substituting $z_1 = 0.20$ into Equation (23) yields

$$r_1 = \frac{c}{H_0}\ln(1 + z_1) \tag{36-1}$$

$$= \frac{2.99792 \times 10^{8} m/s}{H_0}\ln(1 + 0.2) \tag{36-2}$$

$$= \frac{1.77136 \times 10^{-9}\text{pc/s}}{H_0} \tag{36-3}$$

Substituting Equations (36) and $\mu_1 = 40.00$ into Equation (34) yields the result after simplification:

$$0.197953\frac{\kappa}{H_0} - 5\lg H_0 = 88.5605 \tag{37}$$

Substituting z_2=1.40 into Equation (23) yields

$$r_2 = \frac{c}{H_0}\ln(1+z_2) \tag{38-1}$$

$$= \frac{2.99792\times 10^8 m/s}{H_0}\ln(1+1.4) \tag{38-2}$$

$$= \frac{8.505695\times 10^{-9}\ \mathrm{pc/s}}{H_0} \tag{38-3}$$

Substituting Equation (38) and $\mu_2 = 45.00$ into Equation (34) yields the result after simplification:

$$0.950528\frac{\kappa}{H_0} - 5\lg H_0 = 89.4009 \tag{39}$$

Combining Equations (37) and (39) results in the system of equations

$$\begin{cases} 0.197588\dfrac{\kappa}{H_0} - 5\lg H_0 = 88.5609 & (40-1) \\ 0.950528\dfrac{\kappa}{H_0} - 5\lg H_0 = 89.4009 & (40-2) \end{cases}$$

Solving this system of equations yields the solution

$$\begin{cases} H_0 = 2.14737\times 10^{-18}/s = 66.261\mathrm{km/(s\cdot Mpc)} & (41) \\ \kappa = 2.39566\times 10^{-18}/s = 73.923\mathrm{km/(s\cdot Mpc)} & (42) \end{cases}$$

In this context, the term data $H_0 = 66.261\mathrm{km/(s\cdot Mpc)}$ is used conventionally, and strictly speaking, the damping coefficient of photons should not be theoretically interpreted as the ratio of a luminous object's recession velocity to its distance.

Substitute this set of solutions into Equation (34) to obtain

$$\mu = 5\lg r - 5 + \beta r \tag{43}$$

where

$$\beta = 1.085736\left(\frac{\kappa + H_0}{c}\right) = 1.645318\times 10^{-26}/\mathrm{m} = 5.076924\times 10^{-10}/\mathrm{pc} \tag{44}$$

According to Equation (23), express the distance r as a function of redshift z, and obtain:

$$r = \frac{c}{H_0}\ln(1+z) \tag{45-1}$$

$$= 1.396089\times 10^{26}\ln(1+z)\mathrm{m} = 4.5244133\times 10^{9}\ln(1+z)\mathrm{pc} \tag{45-2}$$

Substituting (44) and (45) into (43) yields the redshift-distance modulus relation:

$$\mu = 5.2890535\lg(1+z) + 5\lg[\lg(1+z)] + 45.08889 \tag{46}$$

Converting to the natural logarithm, the equation becomes:

$$\mu = 2.297007\ln(1+z) + 2.1714724\ln\ln(1+z) + 43.27781 \tag{47}$$

Does formula (47) fit the statistical mean curve in Figure 1? If the curve plotted by this function matches Figure 1, then the function should be considered correct. If there is a slight deviation, it should be attributed to the fact that the data points $(z_1, \mu_1) = (0.20, 40.00)$ and $(z_2, \mu_2) = (1.40, 45.00)$ may not be precise enough. The precision of these data points is highly sensitive in determining the constants and coefficients in Equation (47).

5.Numerical Verification of the Theory

Upon comparing with Hubble diagrams in numerous studies, it has been found that the curve depicted by equation (47) is in good agreement with the redshift-distance relationship of Type Ia supernovae.

5.1 Consistent with the Hubble Diagrams for Moderate Redshifts

In the depicted redshift range $z = 0 \sim 1.5$, the redshift-distance modulus diagram represented by Equation (47) is depicted as the red curve in Figure 2, aligning perfectly with the statistical curve in Figure 1. For comparison, the curve derived from Equation (3) is plotted as the blue curve in Figure 2. Although this curve also matches the statistical curve in Figure 1 well, it exhibits a slight deviation from the statistical mean curve. This indicates that Equation (47) is marginally more accurate than Equation (3). However, the two curves are so similar that they are nearly indistinguishable.

Comparing Equation (47) with Equation (3), the difference is merely nominal.

$$\Delta\mu = 0.125283\ln(1+z) - 0.107847 \tag{48}$$

When comparing the two curves, Equation (47) aligns more closely with the statistical mean curve than Equation (3), which slightly deviates from it. This suggests that Equation (3) is coincidental.

The red curve in Figure 2 aligns perfectly not only with the statistical mean curve in Figure 1 but also corresponds with the redshift-distance modulus curves (Hubble diagrams) referenced in the literature [1][2][7][9]. These curves were developed to model an accelerating expanding universe, with parameters including matter density$\Omega_M \approx 0.3$, the cosmological constant$\Omega_\Lambda \approx 0.7$, cosmic curvature $k = 0$, and the state equation constant $w = -1$.

Furthermore, within the specified redshift range$z = 0 \sim 1.5$, the red curve in Figure 2 aligns perfectly with the statistical mean curve of the redshift-distance modulus for Type Ia supernovae from the literature [17][18][19][20][21][22], and is nearly indistinguishable from the curve described by Equation (3).

The Hubble diagram in reference [17] was constructed from a statistical analysis of over 500 SNe Ia. The authors fitted the statistical mean curve to the cold dark matter cosmological model to constrain cosmological parameters, concluding that the universe is experiencing accelerated expansion driven by dark energy.

The statistical mean curve in literature [18] is considered highly consistent with the uniform expansion model of the universe. However, as a statistical evidence of accelerating expansion, it is very weak and challenges the accelerating expansion model.

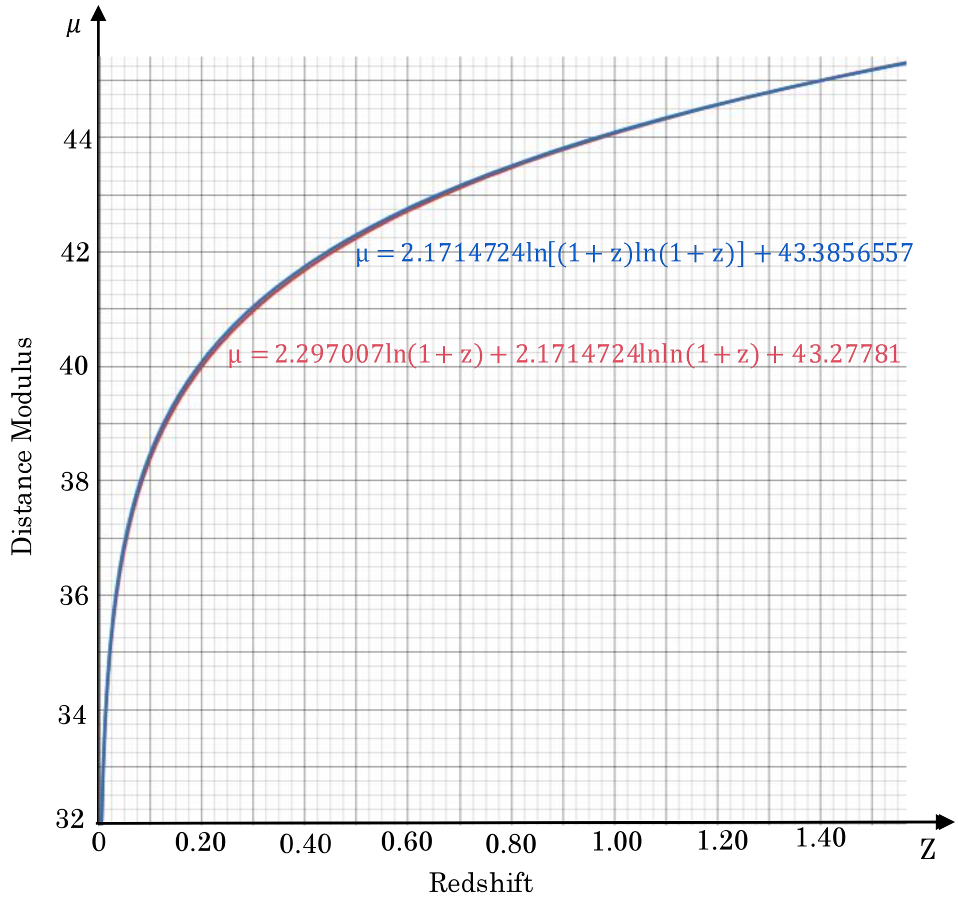

Figure 2. This is a comparison of the function graphs of the two redshift-distance modulus formulas. The red curve represents μ=2.297007ln(1+z)+2.1714724lnln(1+z)+43.27781. The blue curve represents μ=2.1714724ln(1+z)ln(1+z)+43.3856557.

Literature [19] confirms that the speed of light is constant, supporting the standard cold dark matter cosmological model.

Literature [20] presents the redshift-distance modulus statistical mean curve of SNe Ia from the Union 2 compilation, which reveals the expansion law of the universe through fitting cosmological models such as the ΛCDM model.

Study [21] constructed a Hubble diagram by analyzing 23 SNe Ia. The authors concluded that the universe is currently undergoing accelerated expansion driven by dark energy, with a previous phase of deceleration caused by the interaction between matter and dark matter, where the transition occurred at a specific redshift $z = 0.5$. However, the limited sample size resulted in significant statistical uncertainties.

In study [22], researchers statistically analyzed the redshift-distance correlation of SNe Ia, constructing a Hubble diagram. They sought to derive an elementary function for a computational formula within the ΛCDM model framework to obtain an exact solution, whereas conventional approaches typically rely on numerical integration for approximate solutions. Nevertheless, this research still depends on the cosmological model that attributes redshift to the expansion of the universe driven by dark energy.

The curve depicted in Equation (47) aligns perfectly with the redshift-distance modulus mean curve from the literature [23]. This study, which is based on five years of DES complete data, adds approximately 1,500 SNe Ia with high redshift values (z>0.1), significantly expanding the statistical foundation for cosmological research and substantially reducing statistical errors. The paper does not establish a mathematical function for the statistical mean curve. Instead, this curve is interpreted as a fitting curve for the cold dark matter cosmological model, supporting the accelerating expansion model of the universe and enhancing the precision of constraints on cosmological parameters.

5.2 Consistent with the Hubble Diagram for Low Redshift

How does equation (47) behave at the low redshift end? As shown in Figure 3, the curve described by Equation (47) within the redshift range of z=0~0.10 is in excellent agreement with the redshift-distance modulus statistical curves of low-redshift supernovae drawn in the literature [24][25][26][27].

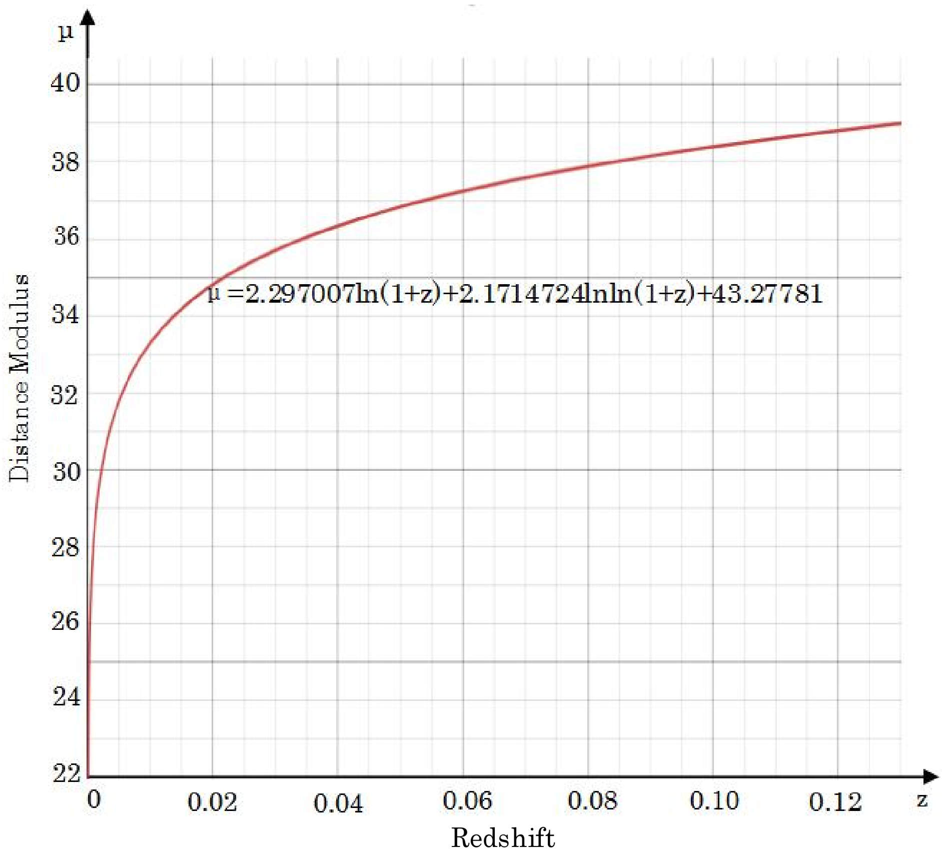

Figure 3. The function graph of the redshift-distance modulus formula μ=2.297007ln(1+z)+2.1714724lnln(1+z)+43.27781 within the low redshift range z=0~1.0.

The study in [24] examined observations of two distinct near-infrared bands for SNe Ia. The resulting Hubble diagrams showed some discrepancies, yielding a Hubble constant of approximately 72.3km/s · Mpc. However, since this study only analyzed 36 SNe Ia, minor errors may exist.

The literature [25] compiled the redshift-distance modulus statistics for 96 low-redshift type Ia supernovae and calculated that the Hubble constant is approximately 72.19km/(s · Mpc).

Study [26] constructed a Hubble diagram using observational data from 62 low-redshift SNe Ia, aiming to validate the expanding universe model driven by dark energy and to unravel the mystery of dark energy.

The literature [27] released the second batch of Type Ia supernovae data (DR2) from the Zwicky Transient Facility (ZTF), consisting of 3,628 spectrally confirmed low-redshift ($z <$ 0.3)SNe Ia, of which 2,667 met the criteria for light curve data suitable for cosmological mass determination. This sample size significantly surpasses the historical total (approximately 3,000 over the past 30 years), making it the largest and most homogeneous SNe Ia dataset to date. This milestone signifies the entry of supernova cosmology into the big data era.

5.3 Consistent with the Hubble Diagram for High Redshift

For the wide redshift range $z = 0{\sim}8$ and distance modulus $\mu = 32{\sim}52$, the redshift-distance modulus diagram produced by Equation (47) exhibits excellent agreement with the Hubble diagrams referenced in [5][6][28][29][30][31] over a broad range of redshifts and distance moduli. It also closely matches the curves plotted using the functions (3)-(5) as outlined in earlier references [12][13].

The study by [28] was pivotal in constructing a Hubble diagram for superluminous supernovae (SLSNe) with redshifts $z = 1{\sim}4$, surpassing the detection limits of traditional supernovae $z < 2$.

The redshifts of SNe Ia presented in [29] extend even further $z > 1.5$, substantially broadening the scope of the Hubble diagram and shedding light on the enigma of dark matter-dark energy coupling. Additionally, it offers high-precision support for the theory of cosmic expansion.

The study [30] broadened the construction of the Hubble diagram beyond traditional Type Ia supernovae to include gamma-ray bursts (GRBs), addressing the scarcity of data for measuring distances at high redshifts $z > 2$ in the universe. This advancement expanded the Hubble diagram's coverage from $z \approx 1.7$ to $z \approx 8.1$ GRBs, marking a significant breakthrough. Although the Hubble diagram in this paper is used to constrain cosmological parameters, the exponential nature of redshift factors suggests that the universe might be in a static state, directly challenging the necessity of the "Big Bang consensus model." This discovery has prompted the academic community to re-examine the nature of dark energy and the mechanisms driving cosmic expansion.

The study [31] reveals a systematic discrepancy between the high-redshift distance modulus and the ΛCDM model, indicating potential flaws in the ΛCDM framework and suggesting the existence of new physics.

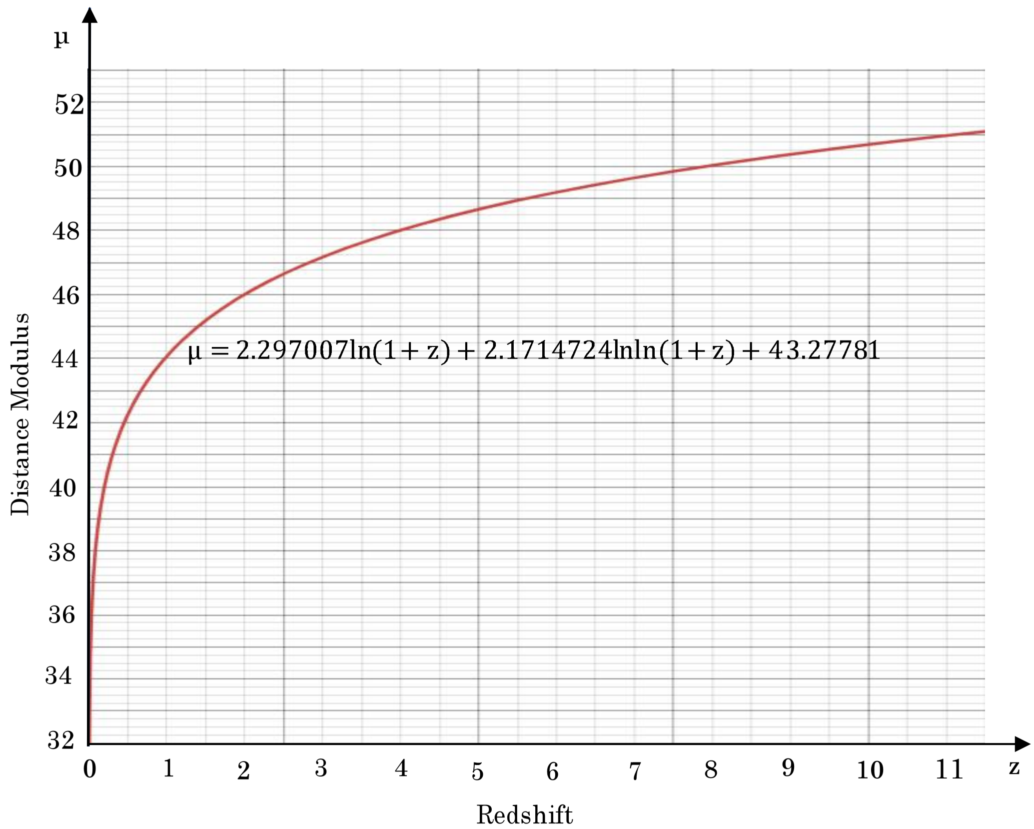

Figure 4. The function graph of the redshift-distance modulus formula μ=2.297007ln(1+z)+2.1714724lnln(1+z)+43.27781 within the high redshift range z=0~10.

Equation (47) exhibits excellent agreement with Hubble diagrams of Type Ia supernovae compiled by researchers, despite the fact that many scholars primarily plot these diagrams to fit the expanding universe model. This indicates that Equation (47) has strong applicability across a wide range of redshift values. Consequently, Equation (47) represents the true relationship between celestial redshift and distance modulus. This fully confirms that formula (29) indeed expresses the real relationship between the distance of a luminous object and its luminous flux density.

6.Discussion

6.1How is Systematic Redshift Misinterpreted as the Expansion of the Universe?

Due to the quantum redshift effect, the wavelength of photons stretches during propagation, adhering to the following laws:

$$\frac{\lambda}{\lambda_0} = 1 + z = e^{H_0 t} = e^{\frac{H_0}{c} r} \tag{49}$$

This relationship is often mistakenly assumed to be a Doppler effect, which leads to Hubble's law. If $e^{H_0 t}$ interpreted as the Doppler redshift factor $1+z=e^{H_0 t}$, the following relationship can be derived:

$$\frac{dr}{dt} = V = H_0 r \tag{50}$$

Solving this equation yields:

$$r = r_0 e^{H_0 t} = r_0 e^{\frac{H_0}{c} r} \tag{51}$$

The combination of equations (49) and (51) results in:

$$\frac{\lambda}{\lambda_0} = \frac{r}{r_0} = 1 + z = e^{H_0 t} = e^{\frac{H_0}{c} r} \tag{52}$$

This relationship seems to suggest that the distance between any two points in space is expanding exponentially. This relationship could be mistakenly applied to the expansion of the cosmic scale factor, which would naturally lead to the subsequent relationship.

$$\frac{\lambda}{\lambda_0} = \frac{r}{r_0} = \frac{a(t_0)}{a(t_e)} = 1 + z = e^{H_0 t} = e^{\frac{H_0}{c} r} \tag{53}$$

It appears that the cosmic scale factor is increasing exponentially. This scale factor is defined by equations (10-1) and (10-2). If the systematic redshift of the universe is due to motion, then the redshift-distance modulus relationship of Type Ia supernovae essentially reflects the entire cosmic dynamics, including the dark energy-driven accelerated expansion at the cosmic scale. This establishes a connection between redshift and the cosmological gravitational field equations of general relativity. By fitting with standard cosmological models, the following cosmological parameters are naturally constrained: 1) Cosmic matter density ρ or Ω_M; 2) Cosmic curvature k or Ω_k; 3) Cosmological constant Λ or Ω_Λ; 4) Constant of the cosmological state equation w. Therefore, the quantum redshift effect is often confused with the Doppler effect and frequently mistaken for the expansion of the cosmic scale factor.

However, in 1998, cosmological observations revealed that Type Ia supernovae (SNe Ia) exhibited high redshift deviations from Hubble's Law.

6.2 What is the Physical Significance of the Hubble Diagram for SNe Ia ?

Ever since Edwin Hubble discovered the redshift of extragalactic galaxies and Albert Einstein established the cosmological gravitational field equation within the framework of general relativity, Hubble's redshift has been considered evidence of the universe's expansion. All types of astronomical observation data have been interpreted within the framework of cosmic expansion.

When researchers encounter unexplained phenomena, they often seek alternative explanations by considering hypothetical physical factors. This approach has led to the formulation of theories concerning dark energy and dark matter. The hypothesis of dark energy suggests that it is an undetectable form of energy that fills space and accelerates the expansion of the universe, with precise calculations determining the relative amounts of both dark energy and dark matter. Despite their importance, both dark energy and dark matter remain undetectable by current technologies because they neither absorb, reflect, nor emit light, making them enigmatic puzzles in the field of physics. The dark energy hypothesis has become the most widely accepted explanation for various observed cosmological phenomena. However, it is crucial to acknowledge that this conclusion might stem from a misinterpretation of the Hubble diagram, implying that dark energy might not exist and that the universe may not be expanding at all.

The Hubble diagram, which depicts the relationship between redshift and distance modulus for Type Ia supernovae, aligns precisely with the mathematical function of quantum redshift effects. The cosmological redshift often discussed is not a result of the universe's expansion; rather, it originates from a phenomenon known as quantum redshift. This suggests that the fundamental nature of the Hubble diagram, which displays the correlation between redshift and distance modulus, is caused by the medium within space. This medium produces two primary effects: it induces photon redshift and leads to light extinction. Consequently, the Hubble diagram of Type Ia supernovae primarily reflects the apparent magnitude effects due to the quantum redshift of photons and the light extinction caused by the cosmic medium. Therefore, it does not inherently indicate that the universe is undergoing an accelerating expansion driven by dark energy.

6.3 Does the Type Ia Supernova Light Curve Imply a Time Dilation Effect?

This paper does not intend to delve deeply into the issue of SNe Ia light curves, but this topic is inescapable and therefore merits a brief discussion. A crucial aspect of the light curve is the concept of time dilation, also known as time stretching.

Theoretical cosmologists propose that the cosmic scale factor serves as a unified measure for both space and time. The expansion of spatial scales must correspond with the expansion of temporal scales, a phenomenon observable in the light curves of high-redshift supernovae. The light curves of high-redshift SNe Ia can act as a test for the theory of cosmic expansion.

The width of a SNe Ia's light curve at a given redshift z is $(1+z)$ a specific multiple of that at a lower redshift z=0, indicating

$$\Delta t_1=(1+z)\Delta t_2 \tag{54}$$

If the light curve of SNe Ia broadens, it would strongly support the prevailing theory of an expanding universe. However, the Tired Light Theory, which aligns with the static universe theory, posits no spatial expansion or time dilation. Consequently, the light curve of SNe Ia would not broaden, indicating an absence of time dilation. The critical question is whether the observed light curve of SNe Ia is indeed broadened.

David F. Crawford analyzed the original data, which included 586 SNe Ia from literature [32] and 2,333 SNe Ia from literature [33], to plot the light curves. He found no evidence of the light curve broadening phenomenon. The so-called light curve broadening phenomenon is attributed to fatal flaws in the statistics of SNe Ia light curves. By utilizing weighted regression statistics, the occurrence of light curve broadening can be effectively refuted. Gamma-ray burst light curve statistics also exhibit no (1+z)-fold duration broadening. These findings conclusively demonstrate that the purported light curve broadening or time dilation (1+z) phenomenon is entirely fictitious and non-existent.

The fact that the time dilation (1+z) phenomenon does not exist further refutes the view that the universe is expanding.

6.4 What is the Physical Significance of the New Theory?

1） The new significance of the Hubble constant H_0

According to Hubble's Law, redshift is a consequence of the universe's expansion. The relationship between a celestial object's recession velocity V and its distance r is described by the redshift, as explained by the Doppler effect.

$$z=\frac{V}{c}=\frac{H_0}{c}r \tag{55}$$

The Hubble constant H_0 is the ratio of velocity to distance, represented by the formula $H_0 = V/r$.

The quantum redshift effect occurs when photons collide with atoms during their journey through space, resulting in a loss of energy. The frequency of the photons decreases in accordance with a specific $\nu/\nu_0=exp(-H_0t)=exp(-H_0r/c)$ law. The constant H_0 represents the damping coefficient of photons, which is also the rate at which the frequency of photons diminishes over time; it also H_0/c signifies the attenuation coefficient of photon frequency with respect to distance.

As the distance of propagation increases, the frequency or energy of photons decreases, and the apparent magnitude of celestial bodies increases. Consequently, the magnitude formula must be adjusted to account for the quantum redshift effect.

According to formula (18) and numerical expression (41), it can be calculated that

$$n_e = \frac{8\alpha}{3\pi}\frac{H_0}{c\sigma_T} \tag{56 − 1}$$

$$= \frac{8}{3\pi \times 137.036} \times \frac{2.14737 \times 10^{-18}/\mathrm{s}}{2.99792 \times 10^{8}\mathrm{m/s} \times 6.652 \times 10^{-29}\mathrm{m}^2} \tag{56 − 2}$$

$$= 0.667/\mathrm{m}^3 \tag{56 − 3}$$

This indicates that, based on the photon damping coefficient H_0=$2.14737\times10^{-18}/\mathrm{s}$, the density of bound electrons in the universe that causes quantum redshift effects is 0.667 per cubic meter. If all these electrons are bound in hydrogen atoms, then the density of hydrogen atoms that cause quantum redshift effects in space is equivalent to 0.667 per cubic meter. At present, it is estimated that the mass density of the medium in the entire universe is equivalent to $1\sim2$ hydrogen atoms per cubic meter, so Equation (47) is consistent with reality.

2） Physical meaning of extinction rate κ

In statistical analyses of the redshift-distance modulus for SNe Ia, researchers have predominantly focused on internal galactic extinction while neglecting extinction within the intergalactic medium. This approach has led to individual extinction corrections for each SNe Ia without systematically modifying the redshift-distance modulus formula. The extinction correction proposed in this study incorporates the full path of photon propagation from luminous celestial objects to Earth, including extinction within the intergalactic medium, thereby providing a comprehensive correction to the redshift-distance modulus formula.

According to Equation (42), $\kappa = 2.39566 \times 10^{-18}/\mathrm{s}$,the number of photons attenuates in accordance with Equation (28). Should it attenuate to half its initial value, then:

$$\mathrm{e}^{-\frac{\kappa}{\mathrm{c}}\mathrm{r}} = \frac{1}{2} \tag{57}$$

The distance of light propagation is:

$$r = \frac{c \cdot \ln 2}{\kappa} = \frac{2.99792 \times 10^{8} m/s \cdot \ln 2}{2.39566 \times 10^{-18}/s} = 8.674 \times 10^{25} \mathrm{m} \qquad (58-1)$$

$$\approx 9.174738 \times 10^{9} \text{ lightyear} \qquad (58-2)$$

This indicates that a beam of light traveling for 9.174738×10^{9} lightyears or 9.174738×10^{9} years would have its photon count halved. The data demonstrates that the extinction of the cosmic space medium is extremely weak.

Regarding the nature of extinction, it encompasses a diverse array of particles: dust, molecules, atoms, or ions. The physical mechanisms driving this phenomenon—absorption, scattering, and reflection—all contribute substantially. Ultimately, any process that obstructs photons and alters their trajectory during light propagation constitutes extinction.

3） The physical significance of the new redshift-distance modulus function

The application of redshift and extinction modifications changes the functional form of the redshift-distance modulus, resulting in the creation of a new redshift-distance modulus function. By utilizing two data points from the statistical mean curve of the redshift-distance modulus for SNe Ia, two constants—the extinction rate κ and the photon damping coefficient H_0 —can be determined, as shown in Equations (41) and (42). The resulting redshift-distance modulus function (47) matches the statistics of the redshift-distance modulus relation for SNe Ia perfectly, which is certainly not coincidental.

The formula is notably simple and precise, requiring only elementary functions within Euclidean space. Photons naturally collide with cosmic media during their propagation, resulting in quantum redshift and extinction phenomena. In contrast, the cosmological gravitational field equations of general relativity are fundamentally based on imagination. Their solutions are exceedingly complex, with mathematical derivations providing only approximate solutions rather than complete elementary functions. Numerically, these solutions exhibit significant deviations from the statistical mean of the redshift-distance modulus in both low and high redshift ranges for SNe Ia. This discrepancy clearly originates from fundamental misunderstandings of redshift mechanisms, rather than mere numerical inaccuracies.

The new theory elucidates the basic physical principles that underpin the Hubble diagram for Type Ia supernovae. It identifies two phenomena occurring during the propagation of photons in space: the quantum redshift effect and the extinction effect. The Hubble diagram for Type Ia supernovae accounts solely for quantum redshift and extinction effects, thereby excluding the possibility that systematic cosmic redshifts are caused by the accelerating expansion of the universe driven by dark energy. This perspective severs the connection between Hubble redshift and the cosmological equations of general relativity.

Conclusion

An analysis of Hubble diagrams for SNe Ia reveals that their redshift-distance modulus mean curves contradict the ΛCDM cosmological model but align perfectly with the formulas for the quantum redshift effect. This suggests that the Hubble diagrams for SNe Ia provide compelling observational evidence for the photon quantum redshift effect. The systematic redshift observed in astronomical spectra is not a result of cosmic expansion but is instead caused by photon collisions with the cosmic medium. As photons traverse cosmic space, they interact with particles in the medium, resulting in two key phenomena: First, the quantum redshift effect occurs, which is manifested by the damping motion of photons, where their energy diminishes exponentially and their wavelength extends exponentially; Second, photons are absorbed and scattered by the medium, changing their direction of propagation. These interactions cause the number of photons along the line of sight to decrease exponentially, ultimately resulting in the medium's extinction effect. Both effects lead to a decrease in luminous flux density that diminishes not only inversely proportional to the square of the distance but also exponentially with distance. The modified redshift-distance modulus formula, which accounts for redshift and extinction, results in observed type Ia supernova brightness being dimmer than theoretical calculations by Saul Perlmutter, Brian Schmidt, Adam Riess, and their colleagues. The precise correspondence between quantum redshift formulas and the redshift-distance modulus relationships for SNe Ia (Hubble diagrams) eliminates the link between Hubble redshift and the cosmological gravitational field equations of general relativity, thereby discarding cosmic scale factors and related physical quantities such as the cosmic deceleration factor, dark matter, dark energy, cosmic curvature, and the cosmological state constant. This indicates that the theory of accelerating cosmic expansion driven by dark energy is not tenable. The Hubble diagram of type Ia supernova supports the view that the universe is infinite and eternally static.

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