

Dark energy does not exist

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Abstract

Currently, the Λ CDM model is considered the standard cosmological model. In this model, based on the observed magnitude-redshift relationship of high-redshift Type Ia supernovae, most astrophysicists believe that approximately 70% of the matter in the universe exists in the form of unknown dark energy. This remains a hypothetical conclusion. This assumption is made to ensure that if the CMB is a remnant of the Big Bang, then the mass of cosmic plasma must be less than 5% of the critical mass of the universe. Zheng demonstrated that a better interpretation of the CMB is: the CMB is a product of thermal equilibrium between high-temperature cosmic plasma and the cosmic radiation field in local universe space. Therefore, theoretically it is unnecessary to limit the mass of cosmic plasma. Observations have shown that today, most baryons in the universe still exist in the form of high-temperature ionized gases, diffused throughout space to form cosmic plasma. The mass density of cosmic plasma can be as large as the critical mass density. The Compton scattering effect of cosmic plasma will cause the observed dimming effect of high-redshift Type Ia supernovae. Thus, the requirement that the mass of cosmic plasma must be less than 5% of the critical mass of the universe is theoretically unnecessary and conflicts with observations. Therefore, no unknown dark energy exists in the universe.

Full Text

Preamble

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Dark energy does not exist

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Abstract

Currently, the Λ CDM model is considered the standard cosmological model. In this framework, based on the observed magnitude-redshift relationship of high-redshift Type Ia supernovae, most astrophysicists believe that approximately 70% of the universe's matter content exists in the form of unknown dark energy. However, this is merely a hypothetical result. The assumption is made specifically to ensure that the cosmic microwave background (CMB) can be interpreted as a remnant of the Big Bang, which requires the mass of cosmic plasma to be less than 5% of the universe's critical mass. Zheng (2021) demonstrated that a superior interpretation of the CMB is that it represents a thermal equilibrium product between high-temperature cosmic plasma and the cosmic radiation field in local universe space. Consequently, limiting the mass of cosmic plasma is theoretically unnecessary. Observations indicate that today, most baryons in the universe still exist as high-temperature ionized gases, diffused throughout space to form cosmic plasma. The mass density of this cosmic plasma could be as large as the critical mass density. The Compton scattering effect of this plasma would cause the observed dimming of high-redshift Type Ia supernovae. Therefore, limiting the cosmic plasma mass to less than 5% of the critical mass is both theoretically unnecessary and observationally untenable. As a result, there is no unknown dark energy in the universe.

Key words: cosmology: theory -cosmological model -cosmic plasma -dark matter

1 Introduction

The observed cosmic microwave background (CMB) is currently thought to be a remnant of the Big Bang. In fact, this was merely a conjecture proposed by Gamow et al. in the 1940s, based on the assumption that space is now transparent at the wavelengths of this radiation. There exists no hard evidence for this idea, either observationally or theoretically (Peebles 2017). Nevertheless, this concept has become an important cornerstone of the Λ CDM cosmological model (Peebles and Ratra Bharat 2003).

Sunyaev and Zel'dovich (1980) actually demonstrated that even the cosmic plasma in a rich galaxy cluster can distort the perfect blackbody spectrum of the CMB. In the Λ CDM model, to ensure that the CMB remains a Big Bang remnant, the mass of cosmic plasma is constrained to be less than 5% of the universe's critical mass; otherwise, the observed CMB spectrum would not maintain its perfect blackbody form.

However, observations have shown that today, most baryons in the universe still exist as high-temperature ionized gases, diffused throughout space to form cosmic plasma (Fukugita et al. 1998). There could be a very large baryon mass in plasma within the voids, and its emission may have already been observed—plasma at a temperature of 2×10^6 K matches a component of the diffuse soft

X-ray background (Wang & McCray 1993). This means that limiting cosmic plasma to less than 5% of the critical mass conflicts directly with observations.

Zheng (2021) showed that a better interpretation of the CMB is that it represents a thermal equilibrium product between high-temperature cosmic plasma and the cosmic radiation field in local universe space. Therefore, limiting the mass of cosmic plasma is theoretically unnecessary.

When using the magnitude-redshift relation of Type Ia supernovae to determine cosmological parameters, Riess et al. (1998) and Perlmutter et al. (1999) found that the observed brightness of high-redshift supernovae is fainter than expected. To explain this observed dimming, astronomers assumed that the cosmological constant must exist and be positive, representing mysterious dark energy.

Because the mass of cosmic plasma is limited to less than 5% of the critical mass, the total mass of the universe does not satisfy the requirement for a flat universe—that the total mass should equal the critical mass. If the total mass of cosmic plasma is not limited to 5% of the critical mass and is sufficiently large, Compton scattering by free electrons in the cosmic plasma will dim the observed brightness of high-redshift Type Ia supernovae. Numerical estimates confirm this hypothesis. Thus, Compton scattering of free electrons in cosmic plasma provides a more plausible explanation than unknown dark energy for the fainter-than-expected brightness of high-redshift supernovae. Dark energy does not actually exist in the universe. The observed Compton scattering brightness dimming effect for high-redshift supernovae is a function of redshift, and its numerical estimation is discussed in the next section.

2 Numerical Estimation of the Dimming Effect Due to Compton Scattering

To estimate the dimming effect on the apparent magnitude of a supernova due to Compton scattering, we first review the definition of a star' s apparent magnitude.

2.1 Definition of the Apparent Magnitude of a Star

The relationship between a star' s apparent and absolute magnitude was defined in early astronomy as

$$m = M - 2.5 \log \left(\frac{F}{F_0} \right)$$

where M is the absolute magnitude of the star, F is the received energy flux from the observed star, and F_0 is the measured energy flux of the same star when assumed to be at a distance of 10 pc. This means that at different luminosity distances, the variation in apparent magnitude of a standard candle is determined by the variation in the energy flux received from it.

In a flat universe, the equation for calculating the energy flux received from a standard candle as a function of luminosity distance is

$$F = \frac{L}{4\pi d_L^2}$$

where d_L is the luminosity distance, with units of 10 pc. In cosmology, 10 pc is too small as a unit for luminosity distance d_L ; usually, the unit is Mpc. Therefore, Equation (1) becomes

$$m = M + 5 \log d_L + 25$$

According to Hubble's law, the luminosity distance of a celestial object d_L is a linear function of its redshift (Hubble 1929). Thus, Equation (3) becomes (Perlmutter et al. 1997)

$$m = M + 5 \log(cz) - 5 \log H_0 + 25$$

2.2 Observations of Supernova Ia and the Proposal of Dark Energy

Riess et al. (1998) and Perlmutter et al. (1999) found that the observed apparent magnitudes of high-redshift SNe Ia are larger (fainter) than those calculated by Equation (4). According to the Friedmann-Lemaître cosmological model, most astrophysicists currently believe that the luminosity distance of a celestial object cannot be a linear function of its redshift z ; Hubble's law can only be applied to the $z \sim 0$ region. For large redshift z , $d_L \neq cz/H_0$. The luminosity distance d_L depends not only on redshift z but also on dark energy density $\Omega_\Lambda \equiv \Lambda/(3H_0^2)$, mass density Ω_M , and the Hubble constant H_0 (Carroll et al. 1992; Perlmutter et al. 1997; Riess et al. 1998; Perlmutter et al. 1999; Sullivan et al. 2011).

Perlmutter et al. (1997) proposed that in the Friedmann-Lemaître cosmological model, the luminosity distance d_L must be modified to

$$d_L(z, \Omega_\Lambda, \Omega_M, H_0) = c(1+z) \int_0^z \frac{dz'}{\sqrt{(1+z')^2(1+\Omega_M z') - z'(2+z')\Omega_\Lambda}}$$

where for $\Omega_M + \Omega_\Lambda > 1$, $\phi(x)$ is defined as $\sin(x)$ and $\kappa = 1 - \Omega_M - \Omega_\Lambda$; for $\Omega_M + \Omega_\Lambda < 1$, $\phi(x)$ is defined as $\sinh(x)$ and κ as above; and for $\Omega_M + \Omega_\Lambda = 1$, $\phi(x) = x$ and $\kappa = 1$.

Therefore, in Perlmutter et al. (1997) and Perlmutter et al. (1999), Equation (4) was modified to

$$m(z) = \mu + 5 \log D_L(z; \Omega_M, \Omega_\Lambda)$$

where $D_L \equiv d_L H_0$ is called the “Hubble-constant-free” luminosity distance, and $\mu = M - 5 \log H_0 + 25$ is called the “Hubble-constant-free” absolute magnitude. This means that in the Friedmann-Lemaître cosmological model, to explain the observed apparent brightness of high-redshift SNe Ia, there must be substantial dark energy (with negative pressure) in the universe (Perlmutter et al. 1999). So far, no physicist has been able to provide a plausible explanation for dark energy. The unexplained existence of a dominant, dark energy-like phenomenon presents a severe challenge to the standard model of cosmology and particle physics (Peebles and Ratra Bharat 2003; Riess et al. 2007). This represents a fatal flaw in the Λ CDM cosmological model.

2.3 A More Reasonable Explanation

In the Λ CDM model, to ensure that the CMB is a remnant of the Big Bang, the mass of cosmic plasma must be limited to less than 5% of the critical mass of the universe; otherwise, the observed CMB spectrum would not remain a perfect blackbody. However, Sunyaev and Zel’ dovich (1980) actually showed that even cosmic plasma in a rich galaxy cluster can distort the perfect blackbody spectrum of the CMB. Thus, even when the mass of cosmic plasma is limited to less than 5% of the critical mass, the problem remains unresolved.

Zheng (2021) demonstrated that a better interpretation of the CMB is that it represents a thermal equilibrium product between high-temperature ionized gases and the cosmic radiation field in local universe space. Therefore, limiting the mass of cosmic plasma is theoretically unnecessary.

If the total mass of cosmic plasma is not limited to 5% of the critical mass and is sufficiently large, Compton scattering by free electrons in the cosmic plasma will result in a small loss of received energy flux, making the observed brightness of high-redshift Type Ia supernovae weaker than expected. As an estimate, we assume that the received energy flux loss due to Compton scattering equals the received energy flux loss due to Hubble redshift. In this case, to calculate the actual energy flux received from high-redshift supernovae, Equation (2) should be modified as

$$F = \frac{L}{4\pi d_L^2 (1+z)}$$

This means that in flat universe space, for high-redshift supernovae, Equation (4) must be modified to

$$m(z) = M + 5 \log(cz) + 2.5 \log(1+z) - 5 \log H_0 + 25$$

[Figure 1: see original paper] shows the magnitude-redshift relation for high-redshift Type Ia supernovae, including the effective magnitudes of 60 supernovae and the theoretical curves calculated according to Equations (4) and (8).

The effective peak magnitudes of SNe Ia are taken from column (9) in Table 1 (black points) and Table 2 (green points) of Perlmutter et al. (1999). The red solid line corresponds to calculations using Equation (8), while the solid black line corresponds to calculations using Equation (4). In both calculations, the parameters used are: $H_0 = 70 \text{ km s}^{-1} \text{ Mpc}^{-1}$ and the absolute magnitude of SNe Ia $M = -19$.

[Figure 2: see original paper] shows the magnitude residuals fitted by the models in Figure 1. From Figures 1 and 2, it is evident that although the observations of high-redshift SNe Ia cannot be fitted by the black solid line, they are well fitted by the red solid line. This is because the black solid line is calculated using Equation (4), which does not include the effects caused by Compton scattering. This explains why Riess et al. (1998) and Perlmutter et al. (1999) found that the observed apparent magnitudes of high-redshift SNe Ia are larger (fainter) than those calculated using Equation (4). Dark energy does not exist.

3 Summary and Conclusion

In the Λ CDM model, to ensure that the observed CMB is a remnant of the Big Bang, the mass of cosmic plasma is limited to less than 5% of the critical mass of the universe. This is a fatal error in the Λ CDM model that leads most astrophysicists to believe that approximately 70% of the matter in the universe exists in the form of unknown dark energy. So far, no physicist has been able to provide a plausible explanation for dark energy.

Zheng (2021) demonstrated that a better interpretation of the CMB is that it represents a thermal equilibrium product between high-temperature cosmic plasma and the cosmic radiation field in local universe space. Therefore, limiting the mass of cosmic plasma is theoretically unnecessary and conflicts with observations.

If the total mass of cosmic plasma is not limited to 5% of the critical mass and is sufficiently large, Compton scattering by free electrons in the cosmic plasma will dim the observed brightness of high-redshift Type Ia supernovae. Numerical estimates confirm this hypothesis. Consequently, Compton scattering by free electrons in cosmic plasma provides a more plausible explanation for the fainter-than-expected brightness observed in high-redshift supernovae. Dark energy does not actually exist in the universe.

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Note: Figure translations are in progress. See original paper for figures.

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