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Research Article

REVISE OF THE COSMOLOGICAL CONSTANT: DARK ENERGY, DARK MATTER, AND THE ACCELERATED EXPANSION OF THE UNIVERSE

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Abstract

Recently, due to the latest discovery by the Jame Webb Telescope, the cosmological constant equation H is incomplete, since it can't solve the James Wd measuring difference problem, which means the conventional Hubble constant needs to be revised. The standard cosmological model explains the Universe's large-scale evolution through the interaction of matter, radiation, dark matter, and dark energy. Within this framework, the conventional cosmological constant is commonly associated with the energy density of the vacuum and is used to account for the Universe's observed accelerated expansion. However, the physical interpretation of Λ remains unsettled, particularly because the observed magnitude of dark energy is extraordinarily large compared with theoretical estimates of vacuum energy. This paper examines the conceptual relationship among cosmological distance, recession velocity, dark matter, dark energy, and the cosmological constant. Since the recent discovery of the cosmic, results have differed significantly, so the conventional Hubble constant may need to be corrected or even revived. To address this issue, we propose an innovative new Cosmo constant relation with Dark Energy/Dark Matter as a new L_0Cosmo constant to revive and revise the Hubble constant. In addition, this paper further distinguishes dark matter from dark energy: dark matter contributes gravitationally to structure formation and cosmic deceleration, whereas dark energy is associated with the acceleration of cosmic expansion. A ρ density-ratio parameter may be introduced as a phenomenological diagnostic; the new ratio should be identified as the flexible cosmological density constant (Appendix 1).

Keywords: Cosmological constant, Dark energy, Dark matter, Cosmic expansion, Hubble parameter, Cosmological distance, vacuum energy.

INTRODUCTION

The discovery that the expansion of the Universe is accelerating represents one of the most significant developments in modern cosmology. In the framework of the standard ΛCDM model, this acceleration is attributed to dark energy, often represented mathematically by the cosmological constant, Λ. Although the model provides an effective description of a wide range of observations, the fundamental nature of dark energy remains unknown. The conceptual difficulty is not merely observational. It also concerns the relationship between geometry, dynamics, and energy in general relativity. Cosmological distance is not simply equivalent to the product of a fixed length scale and a velocity. Rather, the measured distance between two objects depends on the definition of distance, the expansion history of the Universe, and the spacetime geometry through which light travels. Similarly, the recession velocity of a distant galaxy is not always equivalent to an ordinary Newtonian velocity.The purpose of this paper is to clarify the physical meaning of several related quantities and to develop a more rigorous version of the proposed relationship among cosmological distance, expansion velocity, dark matter, and dark energy.

The paper assume that dark matter and dark energy are interchangeable. In addition, it emphasizes their different dynamical roles and considers whether a density-based ratio can be used as a meaningful parameter in a phenomenological model.

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DISCUSSION

Due to the latest discovery by the Jame Webb Telescope, the cosmological constant H is incomplete, since it can't solve the James Wd measuring difference problem, which mean the conventional Hubble constant need to be revived. Although the Hubble constant has been a useful tool for scientists for more than a century, due to the new discoveries from the Jame Webb Space Telescope, the Hubble model and Hubble constant are questionable, and several distinctions are necessary for the argument to be physically precise. Our novel conceptual strength of the proposed framework is that it connects cosmic acceleration to the changing density balance between matter and dark energy. As the Universe expands, matter becomes diluted because its density scales as a^{-3}. A cosmological constant, by contrast, maintains an approximately constant density. The ratio between the two components consequently increases, allowing dark energy to dominate the Universe's late-time dynamics.

In general relativity, Λ has dimensions of inverse length squared, whereas ρ_Λ/ρ_m is dimensionless. The ratio may be used as a diagnostic parameter and can explicit dimensional conversion and theoretical derivation.

So, our new novel expression $d = L_0 v$ is dimensionally can conceptually complete to explain the nowadaysCosmo expansion, where L_0 is defined as a new constant proportionality factor. Which can be have a more appropriate cosmological relation expansion, which is cause by the Dark Energy, so the new novel cosmo constant is

$$L_0 = \frac{DE\ (DarkEnergy)}{DM\ (DarkMatter)}$$

Which can be represented as a more flexible cosmological constant with reference to the factor of the expansion velocity.So,$L_0\ mutiple\ v$ is essential. The new formulation of the Cosmological constant using the L_0 Cosmological equation is $d = L_0 v$

New Novel Model of the Cosmological distance and expansion velocity

A new novel cosmo constant expression:

$$d = L_0 v$$

Where, d represent the distance,
v represent the velocity with speed of light,
L_0 represent the new cosmo constant.

Here, we express a relationship between cosmological distance d, a characteristic length, and an expansion velocity v. Where L_0refer to the new Cosmo constant, which is refer to the Dark Energy divided into the Dark Matter. Therefore, L_0 must have dimensions of time if the equation is to be dimensionally consistent.

In the standard Hubble expression, the standard low-redshift relation is instead written as

$$v \approx H_0 d,$$

or equivalently,

$$d \approx \frac{v}{H_0}.$$

Here, H_0 has units of inverse time and therefore provides the necessary conversion between velocity and distance. The inverse quantity,

$$H_0^{-1},$$

is sometimes called the Hubble time. It provides a characteristic timescale for cosmic expansion, although it is not, by itself, identical to the age of the Universe. But still, Hubble constant cannot solve and explain the difference in the difference of the result which is measure from the James Web Telescope.

So, here we revived the conventional H constant into a new cap L sub 0 constant, at sufficiently large distances, in the new Cosmo multi-linear relation. The expansion rate changes with cosmic time, and the observed distance depends on the cosmological parameters. A more comprehensive description with the 4-dimensional model, with 3 dimensions + 1 time (4D), is expressed as follows, L_0Cosmo equation:

$$L^2(a) = L_0^2[\Omega_r a^{-4} + \Omega_m a^{-3} + \Omega_k a^{-2} + \Omega_\Lambda],$$

A New Conceptual Model: A Novel Reformulation of the CDM Framework

Let, sub, our new novel $L_0 \propto \frac{\text{Dark Energy}}{\text{Dark Matter}}$ into, $\Lambda_0 \propto \frac{\text{Dark Energy}}{\text{Dark Matter}}$

So, our new novel proposal associates the cosmological constant can be rewritten in the CDM model as new Λ_0 constant, which:

$$\Lambda_0 \propto \frac{\text{Dark Energy}}{\text{Dark Matter}}$$

with the ratio between dark energy and dark matter.

This idea can be reformulated more rigorously. With defining the cosmological constant itself as a ratio, it is more appropriate to define a dimensionless dominance parameter:

$$\mathscr{R}_{\Lambda m}(a) = \frac{\rho_\Lambda(a)}{\rho_m(a)}.$$

For ΛCDM,

$$\mathscr{R}_{\Lambda m}(a) = \frac{\Omega_{\Lambda,0}}{\Omega_{m,0}} a^3$$

This parameter has a clear interpretation:

- $\mathscr{R}_{\Lambda m} < 1$: matter density exceeds dark-energy density.
- $\mathscr{R}_{\Lambda m} = 1$: matter and dark energy have equal densities.
- $\mathscr{R}_{\Lambda m} > 1$: dark energy exceeds matter in density.

The equality epoch occurs when

- $\rho_\Lambda = \rho_m$.

Consequently,

$$a_{\text{eq}} = \left(\frac{\Omega_{m,0}}{\Omega_{\Lambda,0}}\right)^{\frac{1}{3}}.$$

Using $\Omega_{m,0} \approx 0.32$ and $\Omega_{\Lambda,0} \approx 0.68$,

$$a_{\text{eq}} \approx 0.78.$$

So, our new expression can solve the Acceleration expansion problem of the Cosmo, where begins when the total combination $\rho + 3p/c^2$ becomes negative. For a matter-plus-Λ universe, the condition is approximately. Therefore, the transition to acceleration occurs somewhat earlier than the epoch of equal matter and dark-energy densities.

For $\Omega_{m0} \approx 0.3$ and $\Omega_{\Lambda 0} \approx 0.7$, this gives $z_{\text{acc}} \approx 0.67–0.73$. Therefore, accelerated expansion starts before the epoch when matter and dark-energy densities are equal. This is because dark energy needs to surpass roughly half of the matter density for its negative pressure to dominate, overcoming the decelerating gravitational influence of matter (Appendix 2).

Our reformulation therefore offers a useful interpretive framework, within our new L_0CDM, while preserving the standard physical meaning as the cosmological adaptable constant. To establish a genuinely new cosmological model, our proposal would be better than the conventional ones, since it specifies modified dynamical equations, that can yield more accurate observational predictions than the standard ΛCDM.

Therefore, with the above understanding, our Novel Cosmo Constant is L_0, and our new Cosmo Lmodel in the later of the expansion universes is the following equation:

$$d = L_0 v$$

Conclusion

This paper has reformulated a conceptual model concerning cosmological distance, recession velocity, dark matter, and dark energy. We utilize the ratio constant of dark energy and dark matter for the ratio expression times with the velocity, in order to explain the acceleration as the Universe expands, since matter density decreases as a^{-3}, whereas the acceleration continues. So, in the long run, the conventional standard equation, the ΛCDM model, will not be accurate to explain the observational result, as the cosmos continues to accelerate its expansion. Our new interpretation of the resulting dark-energy dominance provides a more accurate explanation for the observed late-time accelerated expansion in the cosmos. Additionally, L_0 should be interpreted as an indicator of the new cosmological constantasa replacement model of the conventional Hubble cosmological constant. So, the standard ΛCDM framework has to be revived into a new LCDM framework to represent the new observation. Hope our research can contribute to the world and society.

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Appendix 1:

Our innovative new Cosmo constant relation with Dark-Energy/Dark-Matter as a new L_0Cosmo constant to revive and revise the Hubble constant.

$$L_0 = \frac{DE_{(DarkEnergy)}}{DM_{(DarkMatter)}},$$

So, the new cosmo L_0 constant equation is:

$$d = L_0 v$$

In-addition, this paper further distinguishes dark matter from dark energy: dark matter contributes gravitationally to structure formation and cosmic deceleration, whereas dark energy is associated with the late-time acceleration of cosmic expansion. A ρ density-ratio parameter may be introduced as a phenomenological diagnostic,

$$C_\rho = \frac{\rho_{\mathrm{DE}}}{\rho_{\mathrm{DM}}},$$

this ratio should be identified as the flexible cosmological density constant. This research paper concludes by proposing that any alternative model must be tested against the established observational constraints from supernovae, baryon acoustic oscillations, the cosmic microwave background, and large-scale structure.

Appendix 2:

The equality epoch is defined by

$$\mathcal{R}(a_{\mathrm{eq}}) = 1,$$

which gives

$$a_{\mathrm{eq}} = \left(\frac{\Omega_{m0}}{\Omega_{\Lambda0}}\right)^{1/3}$$

Since $a = (1+z)^{-1}$, the corresponding redshift is

$$1 + z_{\mathrm{eq}} = \left(\frac{\Omega_{\Lambda0}}{\Omega_{m0}}\right)^{1/3},$$

and hence

$$z_{\mathrm{eq}} = \left(\frac{\Omega_{\Lambda0}}{\Omega_{m0}}\right)^{1/3} - 1.$$

For representative values $\Omega_{m0} \approx 0.3$ and $\Omega_{\Lambda0} \approx 0.7$, this yields $z_{\mathrm{eq}} \approx$ 0.33 to 0.37, depending on the adopted parameter values.

Onset of Accelerated Expansion

The equality epoch should not be confused with the onset of accelerated expansion. The latter is determined by the acceleration equation,

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3}\left(\rho + \frac{3p}{c^2}\right).$$

For a universe containing pressure less matter and a cosmological constant,

$$p_m = 0,\ p_\Lambda = -\rho_\Lambda c^2.$$

Therefore,

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3}(\rho_m - 2\rho_\Lambda).$$

The transition from decelerated to accelerated expansion occurs when

$$\ddot{a} = 0,$$

which implies

$$\rho_m >= 2\rho_\Lambda.$$

In terms of the dominance parameter, the transition condition is

$$\mathcal{R}(a_{\mathrm{acc}}) >= 2.$$

Consequently,

$$a_{\mathrm{acc}} = \left(\frac{\Omega_{m0}}{2\Omega_{\Lambda0}}\right)^{1/3},$$

and the corresponding transition redshift is

$$z_{\mathrm{acc}} = \left(\frac{2\Omega_{\Lambda0}}{\Omega_{m0}}\right)^{1/3} - 1.$$

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