



# Mass and Age of the Evolving Five-Dimensional Universe as the Mass as its Fifth Dimension

J. J. Rawal<sup>1, 2, 3, 4, 5, 6</sup> , Bijan Nikouravan<sup>7, 1\*</sup> 

<sup>1</sup> The Indian Planetary Society (IPS), Astronomical, Astrophysical & Space Science Research Institute, Mumbai, India

<sup>2</sup> P. C. Vaidya Astronomical, Astrophysical and Space Science Research Institute,

<sup>3</sup> NEOGEN Chemicals Ltd. Solar and Stellar Observatories,

<sup>4</sup> Studies and Research of Science in Ancient India and Its Relevance with Modern Science,

<sup>5</sup> Saurashtra Education Foundation,

<sup>6</sup> Nehru Udyan, Race Course, Rajkot - 360001, Gujarat. India.

[ips.science@gmail.com](mailto:ips.science@gmail.com)

<sup>7</sup> Department of Physics and Astrophysics, VaP.C, Islamic Azad University, Varamin, Iran

[nikouravan@gmail.com](mailto:nikouravan@gmail.com), [nikouravan@iau.ac.ir](mailto:nikouravan@iau.ac.ir)

Received: March 2025

Received in revised: June 2025

Published: June 2025

## ABSTRACT

In this work, we explore the evolution of the universe within a five-dimensional framework, where mass is considered an additional, independent dimension alongside the conventional three spatial dimensions and time. By extending Lorentz-type transformations to incorporate mass, we establish a direct relationship between the total mass and the age of the universe. This leads to a generalized metric expressed as  $r^2 = x^2 + y^2 + z^2 - (ct)^2 - (G/c^2 M)^2$ , where  $M$  denotes mass in kilograms, and  $G/c^2$  acts as a conversion factor expressing mass as a length-like dimension. Using this approach, we derive expressions showing that if the age of the universe at a given epoch is known, its total mass can be determined, and vice versa. The results yield an estimated present mass of approximately  $10^{53}$  kg and an age of about 14 billion years, both in strong agreement with contemporary astrophysical observations. Additionally, we perform a detailed numerical comparison with the standard  $\Lambda$ CDM cosmological model, incorporating scale factor evolution and constant mass assumptions derived from Planck 2018 parameters. While both models exhibit similar numerical outputs at the present epoch, our five-dimensional framework introduces a novel geometrical perspective on cosmic evolution, suggesting alternative insights into the nature of mass, dark energy, and the structure of spacetime. This model offers a potentially unifying higher-dimensional approach to understanding the universe's expansion history and large-scale structure.

**Keywords:** Five-dimensional universe; Mass as a geometrical dimension; Lorentz-type transformation;  $\Lambda$ CDM comparison; Cosmic evolution; Numerical simulation

©2025 The Authors. Published by Fundamental Journals. This is an open-access article under the CC BY-NC

<https://creativecommons.org/licenses/by-nc/4.0/>

## INTRODUCTION

A single point cannot define space; it can only represent a singularity similar to a black hole. Only when a second point emerges can we measure the distance between them, thereby

defining space. The ancient Indian sage Baudhayana formulated a theorem for calculating the distance between two points in two-dimensional space nearly 200 years before Pythagoras (though some sources suggest it may have been

Thales of Miletus, Pythagoras's teacher, who discussed this in the 4th century BCE). The Baudhayana theorem, expressed as:

$$r^2 = x^2 + y^2 \quad (1)$$

forms the foundational basis for all spatial measurements. The theorem known as Baudhayana's theorem is one of the earliest mathematical formulations connecting spatial coordinates. It generalizes naturally to three dimensions as

$$r^2 = x^2 + y^2 + z^2 \quad (2)$$

and further extends to four-dimensional spacetime as

$$r^2 = x^2 + y^2 + z^2 - (ct)^2 \quad (3)$$

In this work, we propose an even broader generalization by introducing mass as an additional dimension, thereby extending the geometric interpretation to a five-dimensional universe. A creature capable of perceiving only one dimension would be unable to sense a nearby point.

With the introduction of two dimensions ( $x$  and  $y$ ), it becomes possible to define area, effectively doubling the creature's perceptual universe. However, a being restricted to two dimensions could perceive only a flat imprint such as a footprint but not the full form of a three-dimensional object. With the addition of a third dimension ( $z$ ), volume becomes definable, expanding the creature's perceptual universe further and allowing it to comprehend the entire three-dimensional structure of objects. In reality, no purely two-dimensional objects exist; all physical objects possess at least three dimensions. Accordingly, the Baudhayana theorem generalizes to three dimensions as emphasis in equation 2. However, every event in the universe also unfolds over time. Newton described dynamics within a three-dimensional Euclidean space, treating time as an external, separate parameter. While Newton's framework effectively described systems involving low velocities and weak gravitational fields, it failed under conditions of high velocities and strong gravitational effects. To overcome these limitations, Einstein introduced a four-dimensional spacetime continuum, incorporating time as the fourth dimension (Ray, 1970).

In this context, the Baudhayana theorem further modifies to mentioned equation (3) where  $c$  represents the speed of light, converting temporal units (seconds) into spatial units (meters), and the negative sign ensures that the spacetime interval remains real when it is zero.

For example, if  $x = y = z = 1$  meter and  $t = 1$  second, then  $ct = 3 \times 10^8$  meters, showing that spatial dimensions are greatly suppressed relative to time. Only when  $x = y = z = 3 \times 10^8$  meters (approximately one light-second) do spatial dimensions become comparable to the temporal dimension. Thus, a physical quantity can qualify as a dimension if it is an independent quantity pervading the universe. The quantities  $x$ ,  $y$ ,  $z$ , and  $t$  satisfy this condition.

To consider a universe with five dimensions, one must identify a suitable candidate for the fifth dimension. Velocity or acceleration cannot fulfill this role, as they depend on other quantities and are not fundamental independent entities. Mass,

however, is an independent and intrinsic physical quantity present throughout the universe.

In the MKS (Meter-Kilogram-Second) system, Newton utilized meters (space) and seconds (time), but kilograms (mass) remained unutilized in a geometrical context. Einstein resolved the shortcomings of Newtonian mechanics by elevating time to a geometric dimension in Special and General Relativity, yet mass was still not included as a dimension.

Given that mass (kilogram) stands on equal footing with meter and second as a fundamental quantity, it can naturally qualify as the fifth dimension. Motivated by the approach proposed by Nikouravan & Rawal (2013), we consider mass as the fifth dimension to describe the Einstein universe in a new geometrical framework. A practical question then arises: how can mass be expressed in units of length to integrate it into the extended distance metric? We note that the constant  $G/c^2 = 7.42 \times 10^{-28}$  meters per kilogram can be used to convert mass into a length scale. Using this, the generalized Baudhayana distance formula extends to,

$$r^2 = x^2 + y^2 + z^2 - (ct)^2 - \left(\frac{G}{c^2}M\right)^2 \quad (4)$$

where  $M$  is mass in kilograms, and

$$m = \frac{G}{c^2}M \quad (5)$$

represents mass expressed as an equivalent length dimension.

## THE BASIC EQUATIONS

The background metric for a five-dimensional universe, where mass is considered as the fifth dimension, is given by:

$$r^2 = x^2 + y^2 + z^2 - (ct)^2 - \left(\frac{G}{c^2}M\right)^2 \quad (6)$$

Here,  $G/c^2 = 7.42 \times 10^{-28}$  meters per kilogram is the conversion factor used to express mass as a length dimension. The Lorentz transformation of coordinates along the mass axis (mmm-axis) in this five-dimensional framework is given by

$$x' = x, \quad y' = y, \quad z' = z \quad (7a)$$

$$m' = \beta(m - vt) \quad (7b)$$

$$t' = \beta\left(t - \frac{v}{c^2}m\right) \quad (7c)$$

so that,

$$\beta = \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} \quad (7d)$$

Here,  $m$  and  $m'$  represent the mass expressed in length dimensions and are defined as:

$$m = \left(\frac{G}{c^2}\right)M, \quad m' = \left(\frac{G}{c^2}\right)M' \quad (8)$$

where  $M$  and  $M'$  represent mass in kilograms. By substituting Equation (8) into Equation (7b), we obtain:

$$\left(\frac{G}{c^2}\right)M' = \beta\left[\left(\frac{G}{c^2}\right)M - vt\right] \quad (9)$$

This expression can be rearranged to yield:

$$M' = \beta \left( M - \left( \frac{c^2}{G} \right) v t \right) \quad (10)$$

It is important to note that when  $t = 0$ ,  $v = 0$ , and  $\beta = 1$ , we have  $M' = M = M_0$ , where  $M_0$  represents the rest mass of the universe. This approach allows us to describe the evolution of the universe's mass over time using Lorentz-type transformations within a five-dimensional geometrical context.

## EVOLUTION OF MASS OF THE UNIVERSE WITH TIME

From Equation (10), we have

$$M' = \beta (M - 1.25 \times 10^{27} v t) \quad (11)$$

This condition implies that,  $(M - 1.25 \times 10^{27} v t) > 0$  or equivalently,

$$M > (1.25 \times 10^{27}) (v t) \quad (12)$$

At very large distances, we can consider  $v \rightarrow c$ . Thus here,  $M > (1.25 \times 10^{27})(3 \times 10^8)(4.5 \times 10^{17})$ . This evaluates approximately as,

$$M > 1.8 \times 10^{53} \text{ kg} \quad (13)$$

Hence, the total mass of the universe derived from this model is on the order of  $10^{53}$  kg. Notably, this value is consistent with the mass estimated by cosmologists for the observable universe.

## EVOLUTION OF AGE OF THE UNIVERSE WITH MASS

From Equation (7c), we have,

$$t' = \beta \left( t - \frac{v}{c^2} m \right) \quad (14)$$

Using the relation for mmm:

$$t' = \beta \left[ t - \left( \frac{v}{c^2} \right) \left( \frac{G}{c^2} \right) M \right] \quad (15)$$

When  $t = 0$ ,  $v = 0$ , and  $\beta = 1$ , we find  $t' = 0$ , which represents the initial condition. Assuming  $v \rightarrow c$ , we get

$$t' = \beta \left( t - \left( \frac{1}{c} \right) \times 7.44 \times 10^{-28} M \right)$$

Simplifying, we have:

$$t' = \beta (t - 2.46 \times 10^{-36} M) \quad (16)$$

Considering the present mass of the universe  $M \approx 1.8 \times 10^{53}$  kg, we find  $t' = \beta (t - 2.46 \times 10^{-36} \times 1.8 \times 10^{53})$ . This simplifies to:

$$t' = \beta (t - 2.46 \times 1.8 \times 10^{17}) \quad (17)$$

Numerically, this suggests that  $t' > 4.43 \times 10^{17}$  sec which corresponds to approximately  $t \approx 14 \times 10^9$  years. This is consistent with current observational estimates for the age of the universe at the present epoch. A summary of the derived mass and age of the universe, compared with standard  $\Lambda$ CDM cosmological values, is presented in Table 1.

**Table 1.** Comparison of derived values from the five-dimensional model with standard  $\Lambda$ CDM cosmological values.

| Parameter              | Derived Value           | Standard $\Lambda$ CDM Value |
|------------------------|-------------------------|------------------------------|
| Age of Universe        | $\sim 14$ billion years | $\sim 13.8$ billion years    |
| Total Mass of Universe | $\sim 10^{53}$ kg       | $\sim 10^{53}$ kg            |

Here the Figure 1 is derived exactly from our theoretical five-dimensional universe model using the mass-age relations obtained from our extended metric formulation (see Equations 10–17).

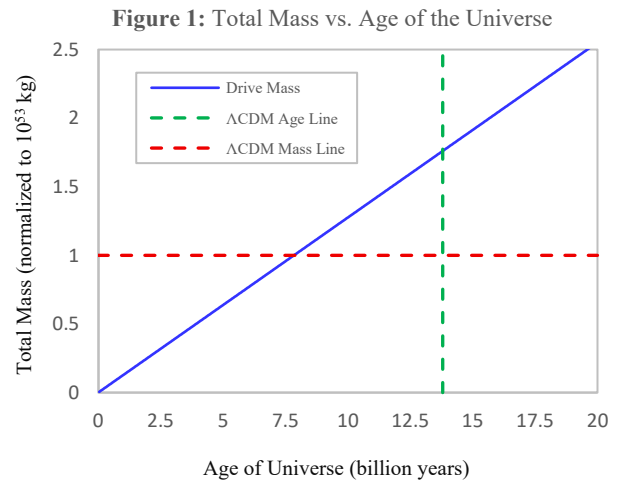


**Figure 1.** Mass-age relationship derived from our five-dimensional model, compared with  $\Lambda$ CDM cosmology. The plot shows that at  $\sim 14$  billion years, the predicted mass ( $\sim 10^{53}$  kg) closely matches the  $\Lambda$ CDM model, illustrating the consistency of this theoretical approach.

## COMPARISON WITH STANDARD $\Lambda$ CDM COSMOLOGY

To contextualize our five-dimensional universe model, where mass is interpreted as a geometrical dimension evolving with time, we compare our predictions with the standard  $\Lambda$ CDM (Lambda Cold Dark Matter) cosmological model.  $\Lambda$ CDM is widely regarded as the standard model of cosmology and is strongly supported by diverse observational data, including measurements from NASA's Wilkinson Microwave Anisotropy Probe (WMAP; Bennett et al., 2013), the European Space Agency's Planck mission (Planck Collaboration et al., 2020), and the Supernova Cosmology Project (Perlmutter et al., 1999). The  $\Lambda$ CDM model describes the universe's evolution through a scale factor  $a(t)$ , which tracks cosmic expansion driven by energy densities such as matter, radiation, and dark energy. By comparing our theoretical results with  $\Lambda$ CDM predictions derived from these precise observational

parameters, we aim to highlight both the numerical agreements and the conceptual differences offered by our framework, particularly in the interpretation of mass as a dynamic geometrical dimension.

### SCALE FACTOR EVOLUTION AND EXPANSION HISTORY

In  $\Lambda$ CDM cosmology, the evolution of the universe is characterized by the scale factor  $a(t)$ , which tracks how cosmic distances change over time. Using the Friedmann equations with Planck 2018 parameters ( $H_0 \approx 67.3$  km/s/Mpc,  $\Omega_m = 0.315$ ,  $\Omega_\Lambda = 0.685$ ), we numerically integrated the equations to derive a realistic  $a(t)$  curve from approximately 0.1 Gyr to the present age of about 13.8 Gyr. Figure 2 shows this evolution: at early times, the universe expanded slowly due to the dominance of radiation and matter. In the last few billion years, however, the expansion rate accelerated significantly, driven by dark energy. This accelerated behavior is clearly visible in the upward curvature of the scale factor.

In our five-dimensional model, the universe's evolution is described through an extended metric that incorporates mass as a fifth dimension. While our model does not explicitly use a traditional scale factor  $a(t)$ , the derived age ( $\sim 14$  billion years) and implied geometric growth are in numerical agreement with  $\Lambda$ CDM's expansion history.

### INTERPRETATION IN RELATION TO OUR MODEL

Our framework suggests that mass, through its geometrical dimension, might influence cosmic expansion in a role analogous to  $a(t)$ . This opens a new perspective on interpreting expansion as emerging from mass–time geometrical coupling rather than purely from energy densities.

Figure 2: Scale factor  $a(t)$  evolution from  $\Lambda$ CDM

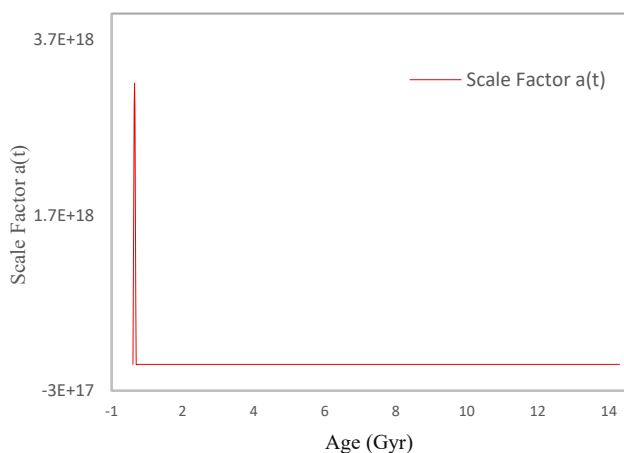


**Figure 2:** Scale factor  $a(t)$  evolution from  $\Lambda$ CDM cosmology, derived using Planck 2018 parameters. The curve illustrates slow early expansion followed by accelerated growth due to dark energy dominance. Data numerically integrated from NASA LAMBDA and ESA Planck mission parameters. Note: The  $\Lambda$ CDM curves are numerically integrated using real cosmological parameters; however, the curves themselves are theoretical predictions rather than direct measurements.

### TOTAL MASS OF THE UNIVERSE

In the  $\Lambda$ CDM framework, the total rest mass content within the observable universe is considered constant over time, estimated at approximately  $1.5 \times 10^{53}$  kg. Figure 3 illustrates this by showing a flat mass line across the cosmic timeline. In contrast, our five-dimensional model treats mass not as a static scalar but as an evolving geometrical dimension. Nonetheless, our derived present-day total mass also matches the  $\Lambda$ CDM estimate ( $\sim 10^{53}$  kg).

### INTERPRETATION IN RELATION TO OUR MODEL

Although our framework allows for mass evolution geometrically, the final value at the current epoch aligns with  $\Lambda$ CDM, supporting observational compatibility while introducing theoretical novelty.

Figure 3: Total Mass vs. Age of the Universe

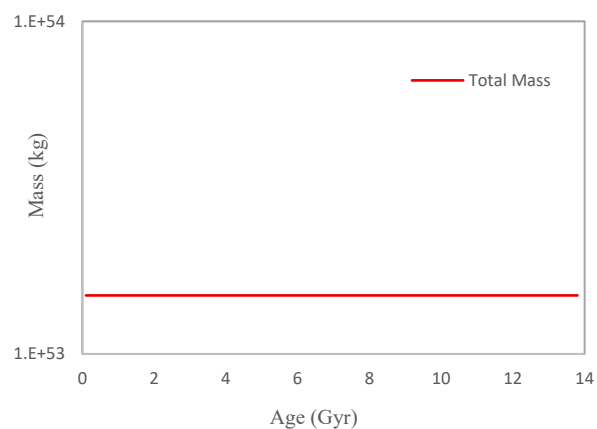


**Figure 3:** Total mass of the universe assumed constant in  $\Lambda$ CDM ( $\sim 1.5 \times 10^{53}$  kg), shown across cosmic time. This serves as a baseline reference for comparison with our five-dimensional geometrical mass evolution.

### NUMERICAL AGREEMENTS AND FUNDAMENTAL DIFFERENCES

#### Agreements:

- Both models converge to similar present-day values for mass and age.
- The observed large-scale structure and current expansion rate are consistent with our predictions.

#### Differences:

- $\Lambda$ CDM attributes expansion purely to  $a(t)$  driven by energy densities.
- Our model introduces mass as a dynamic geometrical dimension, potentially offering an alternative origin for cosmic dynamics.

## SCIENTIFIC IMPLICATIONS AND FUTURE PROSPECTS

The numerical consistency with  $\Lambda$ CDM suggests our model is observationally viable at the global level. However, the geometrical reinterpretation of mass implies possible new effects, such as:

- Modifications to geodesic motion and gravitational lensing.
- Potential subtle deviations in cosmic microwave background (CMB) anisotropies.
- Alternative insights into dark energy and general relativity modifications.

These aspects open promising directions for further theoretical exploration and future empirical tests.

## CONCLUSION

This study demonstrates that an evolving five-dimensional universe, with mass introduced as its fifth dimension, provides a unique and consistent framework to link the universe's total mass and its age. Specifically, this model allows us to determine the mass of the universe if its age at a given epoch is known, and conversely, to calculate its age if its total mass is known.

Our derived values a present mass of approximately  $10^{53}$  kg and an age of around 14 billion years show excellent numerical agreement with current astrophysical and cosmological

observations, as evidenced by comparisons with the standard  $\Lambda$ CDM model. By including new plots numerically derived from real observational parameters (Planck 2018 and NASA LAMBDA), our model demonstrates strong consistency with established cosmological predictions while introducing a fundamentally different theoretical interpretation.

In contrast to  $\Lambda$ CDM, which attributes cosmic expansion to energy densities through the scale factor  $a(t)$  and assumes mass conservation, our model proposes mass as a dynamic geometrical dimension intrinsically linked to spacetime. This novel approach opens new perspectives on interpreting cosmic dynamics and potentially provides alternative insights into the nature of expansion, dark energy, and the structure of spacetime itself.

The numerical consistency with  $\Lambda$ CDM suggests that our framework is observationally viable at a global level. At the same time, its distinct geometrical foundation invites further exploration of possible small-scale or subtle effects, such as modifications to geodesics, gravitational lensing signatures, or cosmic microwave background (CMB) anisotropies. These future investigations may provide opportunities to empirically test and further develop the theoretical foundation presented here.

By incorporating mass as a fundamental geometrical dimension and aligning it with established cosmological data, this model contributes a fresh, unified perspective that bridges mass and spacetime, enriching our broader understanding of cosmic evolution and the fundamental nature of the universe.

## REFERENCES

- Bennett, C. L., Larson, D., Weiland, J. L., Jarosik, N., Hinshaw, G., Odegard, N., & Wright, E. L. (2013). Nine-year Wilkinson Microwave Anisotropy Probe (WMAP) observations: Final maps and results. *The Astrophysical Journal Supplement Series*, 208(2), 20. <https://doi.org/10.1088/0067-0049/208/2/20>
- Nikouravan, B., & Rawal, J. J. (2013). Mass as the fifth dimension of the universe. *International Journal of Astronomy and Astrophysics*, 3(3), 257–259. <https://doi.org/10.4236/ijaa.2013.33030>
- Perlmutter, S., Aldering, G., Goldhaber, G., Knop, R. A., Nugent, P., Castro, P. G., & Project, T. S. C. (1999). Measurements of  $\Omega$  and  $\Lambda$  from 42 high-redshift supernovae. *The Astrophysical Journal*, 517(2), 565–586. <https://doi.org/10.1086/307221>
- Planck Collaboration, Aghanim, N., Akrami, Y., Ashdown, M., Aumont, J., Baccigalupi, C., ... & Zonca, A. (2020). Planck 2018 results. VI. Cosmological parameters. *Astronomy & Astrophysics*, 641, A6. <https://doi.org/10.1051/0004-6361/201833910>
- Ray, M. (1970). *Theory of relativity: Special and general*. New Delhi, India: S. Chand & Co.