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A Proof that Cosmos Is One! All Cosmological Parameters Can Be Described Using Only One Parameter: The Compton Wavelength

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Abstract

We demonstrate that a broad class of cosmological properties, when expressed in their simplest form, reduce essentially to the reduced Compton wavelength of the Universe. This result follows from the use of the natural unit system (the Planck unit system), together with recent breakthroughs in cosmological thermodynamics. For example, the mass, radius, and Hubble time of the Universe are all simply related to one or two divided by the reduced Compton wavelength of the critical Friedmann mass. The CMB temperature is directly related to the square root of the reduced Compton wavelength of the critical Universe, while the Hubble constant is given by the reduced Compton wavelength of the critical Universe divided by two. These relations not only substantially simplify cosmology, but also significantly increase the precision of many cosmological parameter estimates compared to the Λ-CDM model. The improvement arises because, in recent years, we have derived exact mathematical relations connecting the CMB temperature to other fundamental cosmological properties—relations that have largely gone unnoticed. We hope that increased attention to this framework will reveal the considerable progress that can be achieved along these lines.

Keywords: cosmological parameters; CMB temperature; hubble constant; hubble radius; universe mass

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1. Ancient Legends and Scriptures

It is well documented that Isaac Newton devoted considerable effort to the study of ancient philosophical, theological, and alchemical texts, seeking conceptual insights that might inform his work in natural philosophy. Among these efforts was his own translation of the Emerald Tablet, traditionally attributed to the ancient figure Hermes Trismegistus. One of the most frequently cited passages associated with this tradition appears in the Corpus Hermeticum:

> *One, then, is God. It would indeed be most ridiculous, if when thou dost confess the Cosmos to be one* — Corpus Hermeticum XI, sections 11–12, by Hermes Trismegistus

Within pantheistic traditions, nature, the universe, the cosmos, and God are regarded as identical; God is understood as a name for the universe itself. Consequently, if the universe is one, then God is one. Closely related ideas recur across a wide range of philosophical and religious traditions. It is important to emphasize, however, that such statements should not be interpreted as deliberate or literal anticipations of modern cosmology or physics. Rather, they reflect broad metaphysical perspectives that historically influenced the intellectual environment in which scientific thought developed, likely including that of Newton himself.

In this work, we adopt a similarly cautious stance. Although our results are derived entirely within a modern mathematical and physical framework, we note that certain long-standing philosophical expressions—such as the assertion that "*Cosmos to be one*"—admit a precise and limited realization in the cosmological relations developed below. Specifically, we demonstrate that several fundamental cosmological quantities reduce to a single underlying scale.

2. Bacground

It is important to understand the Λ-CDM model not can predict the CMB temperature now as for example mentioned by Narlikar and Padmanabhan [1]

> *"The present theory is, however, unable to predict the value of T at $t = t_0$. It is therefore a free parameter in SC (Standard Cosmology)."*

However, Haug and Wojnow [2,3], within the framework of $R_H = ct$ cosmology, demonstrated that the CMB temperature can be derived directly from the Stefan–Boltzmann [4,5] law. They obtained:

$$T_{cmb} = \frac{T_p}{8\pi}\sqrt{\frac{2l_p}{R_H}} \tag{1}$$

where $R_{H_t} = \frac{c}{H_t}$ denotes the Hubble [6] radius, $T_p = \frac{1}{k_b}\sqrt{\frac{\hbar c^5}{G}} = \frac{m_p c^2}{k_b}$ is the Planck temperature, and $l_p = \sqrt{\frac{G\hbar}{c^3}}$ is the Planck length (see [7,8]). The Stefan–Boltzmann law is strictly valid only for a black body, and as Müller et al. [9] have pointed out:

> *"Observations with the COBE satellite have demonstrated that the CMB corresponds to a nearly perfect black body, characterized by a temperature T_0 at $z = 0$, which is measured with very high accuracy, $T_0 = 2.72548 \pm 0.00057, \mathrm{K}$."*

They further demonstrated that this expression is equivalent to the CMB temperature formula heuristically proposed by Tatum et al. [10]:

$$T_{CMB} = \frac{\hbar c}{4\pi k_B \sqrt{2 R_H l_p}} \tag{2}$$

Haug and Tatum [11] subsequently argued that the CMB temperature represents the geometric mean of the minimum and maximum possible temperatures within the Hubble sphere. In particular, Haug [12] obtained $T_{cmb} = \sqrt{T_{Haw,min} T_{Haw,max}}$, where $T_{Haw,min}$ is the Hawking [13] temperature associated with the Hubble radius,

$$T_{Haw,min} = \frac{\hbar c}{k_b 4\pi R_{H_t}} \tag{3}$$

and $T_{Haw,max}$ is the Hawking temperature of a Planck-mass black hole,

$$T_{Haw,max} = \frac{\hbar c}{k_b 8\pi l_p} \tag{4}$$

The physical interpretation of this result is further developed in [14], where the universe is modeled as an extremal black-hole Carnot engine. Remarkably, both the Stefan–Boltzmann derivation and the geometric-mean argument lead to an identical expression for the CMB temperature. Since this framework provides an exact mathematical relation between the Hubble parameter and the CMB temperature—and because the CMB temperature is the most precisely measured cosmological observable—it enables a highly precise determination of the Hubble parameter. Using the Fixsen et al. [15] measurement $T_{cmb} = 2.72548 \pm 0.00057K$, Tatum et al. [16] derived $H_0 = 66.8944 \pm 0.0287\ km/s/Mpc$. This is far beyond the precession one get from the Λ-CDM model, see for example [17–23], where the most precise estimates are around $67.4 \pm 0.5\ km/s/Mpc$ (see PDG[1]).

Our analysis will be limited to $R_H = ct$ cosmology, which is an actively researched field of cosmology; see, for example, [24–29]. There are different types of $R_H = ct$ models, and the model we will focus on here is a black-hole Hubble sphere $R_H = ct$ model. The idea that the Hubble sphere can be viewed as a black hole is not new and dates back at least to a 1972 paper by Pathria [30], but it continues to be actively discussed today; see [31–38].

[1] https://pdg.web.cern.ch/pdg/2020/reviews/rpp2020-rev-astrophysical-constants.pdf

3. Simplification in Natural Units

Here we assume natural units: $G = h = c = k_b = 1$. This implies that the Planck length is $l_p = \sqrt{\frac{G\hbar}{c^3}} = 1$, and likewise the Planck temperature is $T_p = \frac{1}{k_b}\sqrt{\frac{\hbar c^5}{G}} = 1$. Consequently, the CMB temperature Equation (1) simplifies to

$$T_{cmb} = \frac{1}{8\pi}\sqrt{\frac{2}{R_H}} \tag{5}$$

Furthermore, the Hubble radius can also be written as $R_H = \frac{c\bar{\lambda}_c}{2l_p^2}$, where $\bar{\lambda}_c = \frac{\hbar}{M_c c}$ is the reduced Compton wavelength of the critical Friedmann [39] mass, $M_c = \frac{c^3}{2GH_0}$. This implies that, in the $G = h = c = k_b = 1$ unit system, one has $R_H = \frac{\bar{\lambda}_c}{2}$. Substituting this expression back into Eq. (5), we obtain

$$T_{cmb} = \frac{1}{8\pi}\sqrt{\frac{2}{R_H}} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi} \tag{6}$$

where $\bar{\lambda}_c$ is the reduced Compton [40] wavelength of the critical Friedmann mass.

This immediately implies that in natural units we must have:

$$H_0 = 32\pi T_{cmb}^2 \tag{7}$$

Table 1 shows a series of cosmological properties, and remarkably all of them depend solely on the reduced Compton wavelength of the universe. Moreover, the reduced Compton wavelength can be estimated with very high precision from the measured CMB temperature. Specifically, the reduced Compton wavelength must satisfy:

$$\bar{\lambda}_c = \left(T_{cmb} l_p \frac{8\pi k_B}{\hbar c}\right)^2 \tag{8}$$

Since the factor $\frac{k_b 8\pi}{\hbar c}$ is an exact constant—because $k_b = 1.380649 \times 10^{-23}\ J \cdot K^{-1}$, $\hbar = 1.054571817 \times 10^{-34}\ J \cdot s$, and $c = 299792458\ m/s$ are all exact constants according to NIST CODATA—the only uncertainty arises from the measured CMB temperature and the Planck length. Using the Fixsen et al. study and the NIST CODATA Planck length $l_p = (1.616255 \pm 0.000018) \times 10^{-35}\ m$, we obtain:

$$\bar{\lambda}_c = (2.33753 \pm 0.00103) \times 10^{-61} \text{ Planck lengths} \tag{9}$$

It is easy to think that this must make no sense, since in general nothing can be shorter than the Planck length—a point with which we fully agree (see [41–43]). However, it is important to note that the reduced Compton wavelength of the critical Friedmann mass (or of any macroscopic mass) is not a physical wavelength but a composite one. Composite Compton wavelengths are additive in the following sense (see [44]):

$$\begin{aligned}
M_c &= m_1 + m_2 + m_3 \cdots m_n \\
M_c &= \frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_2}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_3}\frac{1}{c} \cdots \frac{\hbar}{\bar{\lambda}_n}\frac{1}{c} \\
\frac{\hbar}{\bar{\lambda}_c}\frac{1}{c} &= \frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_2}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_3}\frac{1}{c} \cdots \frac{\hbar}{\bar{\lambda}_n}\frac{1}{c} \\
\bar{\lambda}_c &= \frac{1}{\sum_{i=1}^{n}\frac{1}{\bar{\lambda}_i}}
\end{aligned} \tag{10}$$

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This is also closely related to the radius of the universe and the Hubble time, which in natural units are both given by:

$$R_H = \frac{2}{\bar{\lambda}_c} = (855602 \pm 377) \times 10^{55} \text{ Planck lengths} \tag{11}$$

and

$$t_H = \frac{2}{\bar{\lambda}_c} = (855602 \pm 377) \times 10^{55} \text{ Planck times} \tag{12}$$

Both have a 1σ uncertainty of less than $\pm 0.044\%$; the Λ-CDM model cannot come close to achieving this.

Table 2 lists the same natural-unit system for the cosmological parameters and, in addition, includes a column of constants (composite constants) required to convert them into SI units.

Table 1. The table shows formulas for cosmological parameters in the SI unit system and in the natural unit system. In the natural unit system, all cosmological parameters depend only on the reduced Compton wavelength of the critical Friedmann mass, which can be extracted with very high precision from CMB temperature measurements.

	S.I unit system	Natural unit system
Reduced Compton wavelength	$\bar{\lambda}_c = \frac{\hbar}{M_c c}$	$\bar{\lambda}_c$
Mass universe	$\bar{M}_c = \frac{c^3}{2H_0 G} = \frac{\hbar}{\bar{\lambda}_c}\frac{1}{c}$	$M_c = \frac{1}{\bar{\lambda}_c}$
Hubble Constant	$H_0 = \frac{c\bar{\lambda}_c}{2l_p^2}$	$H_0 = \frac{\bar{\lambda}_c}{2}$
Hubble radius	$R_H = \frac{c}{H_0} = \frac{2l_p^2}{\bar{\lambda}_c}$	$R_H = \frac{2}{\bar{\lambda}_c}$
Hubble time	$t_H = \frac{1}{H_0} = t_p \frac{2l_p}{\bar{\lambda}_2}$	$t_H = \frac{2}{\bar{\lambda}_c}$
Universe Model	$H_0^2 = \frac{8\pi\rho_c}{3}$	$H_0^2 = \frac{8\pi\rho_c}{3} = \frac{\bar{\lambda}_c^2}{4}$
Critical density	$\rho_c = \frac{3H_0^2}{8\pi G}$	$\rho_c = \frac{3\bar{\lambda}_c^2}{32\pi}$
CMB temperature	$T_{cmb} = \frac{T_p}{8\pi}\sqrt{\frac{\bar{\lambda}_c}{l_p}}$	$T_{cmb} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi}$
CMB temperature	$T_{cmb} = \sqrt{T_{Haw,max} T_{Haw,min}}$	$T_{cmb} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi}$
CMB temperature	$T_{cmb} = \frac{\hbar c}{k_b 4\pi\sqrt{2l_p R_H}}$	$T_{cmb} = \frac{1}{4\pi\sqrt{2R_H}} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi}$
$\frac{T_{cmb}}{T_p}$	$\frac{T_{cmb}}{T_p} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi\sqrt{l_p}}$	$\frac{T_{cmb}}{T_p} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi}$
CMB and H_0 relation	$T_{cmb} = \frac{1}{8\pi}\sqrt{H_0}$	$H_0 = 32\pi^2 T_{cmb}^2 \; (k_b = 1)$
CMB density parameter	$\Omega_\gamma = \frac{\rho_\gamma}{\rho_c} = \frac{1}{5760\pi}$	$\Omega_\gamma = \frac{1}{5760\pi}$
Radiation dominant Ω	$\Omega_e = 1$	$\Omega_r = 1$
Cosmic temperature	$T = \sqrt[4]{\frac{3c^2\Omega}{8\pi G a_b}}\sqrt{H_0}$	$T = \sqrt[4]{\frac{45\Omega}{32\pi^3}}\sqrt{\lambda_c} \; (k_b = 1)$
Hubble circumference	$C = 2\pi R_H = 4\pi\frac{l_p^2}{\bar{\lambda}_c}$	$C = \frac{8\pi}{\bar{\lambda}_c}$
Hubble surface area	$A = 4\pi R_H^2 = 16\pi\frac{l_p^4}{\bar{\lambda}_c^2}$	$A = \frac{16\pi}{\bar{\lambda}_c^2}$
Hubble volume	$V = \frac{4}{3}\pi R_H^3 = \frac{32}{3}\pi\frac{l_p^6}{\bar{\lambda}_c^3}$	$V = \frac{32\pi}{3\bar{\lambda}_c^3}$
Hubble entropy	$S = \frac{4\pi R_H^2}{4l_p^2} = \frac{4\pi l_p^2}{\bar{\lambda}_c^2}$	$S = \frac{4\pi}{\bar{\lambda}_c^2}$

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Table 2. The table shows cosmological parameters in the natural unit system and what constant (composite constant) they need to be multiplied with to take them into S.I. units..

	Natural unit system	Constant to transform to S.I.
Reduced Compton wavelength	$\bar{\lambda}_c$	l_p
Mass universe	$M_c = \frac{1}{\bar{\lambda}_c}$	$\frac{\hbar}{cl_p}$
Hubble Constant	$H_0 = \frac{\bar{\lambda}_c}{2}$	$\frac{c}{l_p}$
Hubble radius	$R_H = \frac{2}{\bar{\lambda}_c}$	l_p
Hubble time	$t_H = \frac{2}{\bar{\lambda}_c}$	$l_p c$
Universe Model	$H_0^2 = \frac{4\pi\rho_u}{3} = \frac{\bar{\lambda}_c^2}{4}$	$\frac{c^2}{l_p^2}$
Mass radius relation	$\frac{\bar{M}_c}{\bar{m}_p} = \frac{2}{\bar{\lambda}_c}$	l_p
CMB temperature	$T_{cmb} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi}$	$\frac{\hbar c}{k_b l_p 32\pi^2}$
$\frac{T_{cmb}}{T_p}$	$\frac{T_{cmb}}{T_p} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi}$	1
CMB density parameter	$\Omega_\gamma = \frac{\rho_\gamma}{\rho_c} = \frac{1}{5760\pi}$	1
Radiation dominant Ω	$\Omega_r = 1$	1
Cosmic temperature	$T = \sqrt[4]{\frac{45\Omega}{32\pi^3}}\sqrt{\lambda_c}\ (k_b = 1)$	$\frac{\hbar c}{k_b l_p 32\pi^2}$
Hubble circumference	$C = \frac{8\pi}{\bar{\lambda}_c}$	l_p^2
Hubble surface area	$A = 4\pi R_H^2 = 16\pi \frac{l_p^4}{\bar{\lambda}_c^2}$	l_p^4
Hubble volume	$V = \frac{4}{3}\pi R_H^3 = \frac{4\pi}{3\bar{\lambda}_c^3}$	l_p^6
Hubble entropy	$S = \frac{A}{4l_p^2} = \frac{4\pi}{\bar{\lambda}_c^2}$	1

Table 3 shows the predicted cosmological parameters in the natural unit system as well as in the SI unit system. The precision is astonishing.

Table 3. The table shows high precession cosmological predictions from collision spacetime. The Λ-CDM cannot get close to this precession in predictions.

Property	Formula and precession natural units
Reduced Compton wavelength	$\bar{\lambda}_c = (2.33753 \pm 0.00103) \times 10^{-61}$ Planck lengths
Mass universe	$M_c = \frac{1}{\bar{\lambda}_c} = (427801 \pm 188) \times 10^{55}$ Planck masses
Hubble Constant	$H_0 = \frac{\bar{\lambda}_c}{2} = (1.16877 \pm 0.00052) \times 10^{-61}$ Planck times^{-1}
Hubble radius	$R_H = \frac{2}{\bar{\lambda}_c} = (855602 \pm 377) \times 10^{55}$ Planck lengths
Hubble time	$t_H = \frac{2}{\bar{\lambda}_c} = (855602 \pm 377) \times 10^{55}$ Planck times
Critical mass density	$\rho_c = \frac{3\bar{\lambda}_c^2}{32\pi} = (1.63056 \pm 0.00143) \times 10^{-123}$ m_p per Planck volume
CMB temperature	$T_{cmb} = \frac{\sqrt{\bar{\lambda}_c}}{8\pi} =$ $(1.92371 \pm 0.000424) \times 10^{-32}$ Planck temperature degrees
Hubble circumference	$C = \frac{4\pi}{\bar{\lambda}_c} = 4\pi \times (855602 \pm 377) \times 10^{55}$ Planck lengths
Hubble surface area	$A = \frac{16\pi}{\bar{\lambda}_c^2} = (9.19927 \pm 0.00811) \times 10^{122}$ Planck areas
Hubble volume	$V = \frac{32\pi}{3\bar{\lambda}_c^3} = (2.62364 \pm 0.00347 \times 10^{183}$ Planck volumes
Hubble entropy	$S = \frac{4\pi}{\bar{\lambda}_c^2} = (2.29982 \pm 0.00203) \times 10^{122}$ Planck states
Property	Formula and precession in S.I Units
Reduced Compton wavelength	$\bar{\lambda}_c = (3.77805 \pm 0.00103) \times 10^{-96}\ m$
Mass universe	$M_c = \frac{c^3}{2GH_0} = \frac{\hbar}{\bar{\lambda}_c}\frac{1}{c} = (9.31081 \pm 0.00420) \times 10^{52}\ kg$
Hubble Constant	$H_0 = \frac{c\bar{\lambda}_c}{2l_p^2} = 66.8944 \pm 0.0287\ km/s/Mpc$
Hubble radius	$R_H = \frac{2l_p^2}{\bar{\lambda}_c} = (1.38287 + 0.00322) \times 10^{26}\ m$
Hubble time	$t_H = \frac{2l_p^2}{c\bar{\lambda}_c} = 14.616954 \pm 0.000627$ billion years
Critical mass density	$\rho_c = \frac{3H_0^2}{8\pi G} = \frac{\bar{\lambda}_c^2}{32\pi l_p^6} = (8.40531 \pm 0.0704) \times 10^{-27}\ kg/m^3$
CMB temperature	$T_{cmb} = \frac{T_p}{k_b 8\pi}\sqrt{\frac{\bar{\lambda}_c}{l_p}} = 2.72548 \pm 0.00057\ \text{K}$
Hubble circumference	$C = 2\pi R_H = 4\pi\frac{l_p^2}{\bar{\lambda}_c} = 4\pi \times (855602 \pm 377) \times 10^{55}$ Planck lengths
Hubble surface area	$A = 4\pi R_H^2 = \frac{16\pi l_p^4}{\bar{\lambda}_c^2} = (2.40311 \pm 0.00206) \times 10^{53}\ m^2$
Hubble volume	$V = \frac{4}{3}\pi R_H^3 = \frac{32\pi l_p^6}{3\bar{\lambda}_c^3} =$ $(1.10773 \pm 0.00143) \times 10^{79}$ Planck volumes
Hubble entropy	$S = \frac{A}{4l_p^2} = \frac{4\pi l_p^2}{\bar{\lambda}_c^2} = (2.29982 \pm 0.00203) \times 10^{122}$ states

Haug and Tatum [45,46] have presented many similar[2] high precise results in the SI unit system; what is truly new here is that, when we move to a natural unit system, all cosmological parameters reduce to simple functions of a single fundamental scale, depending on only one parameter—namely, the reduced Compton wavelength—and we obtain numbers of equally high precision, since we can remarkably deduce the reduced Compton wavelength of the critical Friedmann mass from the CMB temperature. As the CMB temperature is the most accurately measured parameter in the universe, this is revolutionary for high-precision physics. This result is not valid under the Λ-CDM model but holds under $R_H = ct$ cosmology. We believe it is high time for the physics community to take a closer look at this type of model.

4. Conclusion

We have demonstrated that, in a natural unit system (Planck units), all cosmological parameters are simply different expressions of the reduced Compton wavelength of the critical Friedmann mass.

[2] They have used the Dhal et al [47] CMB temperature input while we here have used the Fixsen et al [15] CMB temperature input which explain the slight difference in precission reported.

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This result is remarkable, as it implies that, so to speak, 'the Cosmos is One'. We have also demonstrated that all cosmological parameters can be predicted with extremely high precision, since recent work developed over the past few years (see in particular [45]) has established an exact mathematical relation between H_0 and the CMB temperature. This means that one can use the most precisely measured parameter in cosmology—namely, the CMB temperature—to predict all other cosmological parameters. This is not possible within the Λ-CDM model, but is possible in black hole $R_H = ct$ cosmology."

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