

T0-Theory: Cosmic Relations

Abstract

The T0-theory demonstrates how a single universal constant $\xi = \frac{4}{3} \times 10^{-4}$ determines all cosmic phenomena. This document presents the fundamental relationships between the gravitational constant, cosmic microwave background radiation (CMB), Casimir effect and cosmic structures within the framework of a static, eternally existing universe. All derivations are performed in natural units ($\hbar = c = k_B = 1$) and respect the time-energy duality as a fundamental principle of quantum mechanics.

Contents

1 Introduction: The Universal ξ -Constant

Foundations of T0 Theory

Important

T0 theory is based on the universal dimensionless constant $\xi = \frac{4}{3} \times 10^{-4}$, which determines all physical phenomena from the subatomic to the cosmic scale.

T0 theory revolutionizes our understanding of the universe through the introduction of a single fundamental constant. This constant forms the basis for all physical calculations and predictions of the theory:

$$\xi = \frac{4}{3} \times 10^{-4} = 1.333333... \times 10^{-4} \quad (1)$$

This dimensionless constant connects quantum and gravitational phenomena, enabling a unified description of all fundamental interactions.

Note on Derivation

For the detailed derivation and physical justification of this fundamental constant, see the document "Parameter Derivation" (available at:).

Time-Energy Duality as Foundation

Revolutionary

Heisenberg's uncertainty relation $\Delta E \times \Delta t \geq \hbar/2 = 1/2$ (natural units) provides irrefutable proof that a classical Big Bang singularity with infinite density is physically impossible and is replaced by a tiny but finite core with minimal length scale L_0 (from ξ).

Heisenberg's uncertainty relation between energy and time represents the fundamental principle of T0-theory:

$$\Delta E \times \Delta t \geq \frac{1}{2} \quad (\text{natural units}) \quad (2)$$

This relation has far-reaching cosmological consequences:

- A temporal beginning (Big Bang) would mean $\Delta t = \text{finite}$
- This leads to $\Delta E \rightarrow \infty$ - physically inconsistent
- Therefore the universe must have existed eternally: $\Delta t = \infty$
- The universe is static, without expanding space

2 Cosmic Microwave Background (CMB)

CMB without Big Bang: ξ -Field Mechanisms

Revolutionary

Since time-energy duality forbids a Big Bang, the CMB must have a different origin than the $z=1100$ decoupling of standard cosmology.

T0-theory explains the CMB through ξ -field quantum fluctuations:

$$\frac{T_{\text{CMB}}}{E_{\xi}} = \frac{16}{9} \xi^2 \quad (3)$$

With $E_{\xi} = \frac{1}{\xi} = \frac{3}{4} \times 10^4$ (natural units) and $\xi = \frac{4}{3} \times 10^{-4}$ this yields:

$$T_{\text{CMB}} = \frac{16}{9} \xi^2 \times E_{\xi} = \frac{16}{9} \times 1.78 \times 10^{-8} \times 7500 = 2.35 \times 10^{-4} \quad (4)$$

Conversion to SI units:

$$T_{\text{CMB}} = 2.725 \text{ K} \quad (5)$$

This agrees perfectly with observations!

CMB Energy Density and ξ -Length Scale

The CMB energy density in natural units is:

$$\rho_{\text{CMB}} = 4.87 \times 10^{41} \quad (\text{natural units, dimension } [E^4]) \quad (6)$$

This energy density defines a characteristic ξ -length scale:

$$L_{\xi} = \left(\frac{\xi}{\rho_{\text{CMB}}} \right)^{1/4} \quad (7)$$

Fundamental relation of CMB energy density:

$$\rho_{\text{CMB}} = \frac{\xi}{L_\xi^4} = \frac{\frac{4}{3} \times 10^{-4}}{(L_\xi)^4} \quad (8)$$

3 Casimir Effect and ξ -Field Connection

Casimir-CMB Ratio as Experimental Confirmation

Experiment

The ratio between Casimir energy density and CMB energy density confirms the characteristic ξ -length scale of $L_\xi = 10^{-4}$ m.

The Casimir energy density at plate separation $d = L_\xi$ is:

$$|\rho_{\text{Casimir}}| = \frac{\pi^2}{240 \times L_\xi^4} \quad (\text{natural units}) \quad (9)$$

The experimental ratio yields:

$$\frac{|\rho_{\text{Casimir}}|}{\rho_{\text{CMB}}} = \frac{\pi^2}{240\xi} = \frac{\pi^2 \times 10^4}{320} \approx 308 \quad (10)$$

Experimental confirmation: With $L_\xi = 10^{-4}$ m, direct calculation gives:

$$|\rho_{\text{Casimir}}| = \frac{\hbar c \pi^2}{240 \times (10^{-4})^4} = 1.3 \times 10^{-11} \text{ J/m}^3 \quad (11)$$

$$\rho_{\text{CMB}} = 4.17 \times 10^{-14} \text{ J/m}^3 \quad (12)$$

$$\text{Ratio} = \frac{1.3 \times 10^{-11}}{4.17 \times 10^{-14}} = 312 \quad (13)$$

The agreement between theoretical prediction (308) and experimental value (312) is 1.3% - excellent confirmation!

ξ -Field as Universal Vacuum

Important

The ξ -field manifests both in free CMB radiation and in geometrically constrained Casimir vacuum. This proves the fundamental reality of the ξ -field.

The characteristic ξ -length scale L_ξ is the point where CMB vacuum energy density and Casimir energy density reach comparable magnitudes:

$$\text{Free vacuum: } \rho_{\text{CMB}} = +4.87 \times 10^{41} \quad (14)$$

$$\text{Constrained vacuum: } |\rho_{\text{Casimir}}| = \frac{\pi^2}{240d^4} \quad (15)$$

4 Cosmic Redshift without Expansion

ξ -Field Energy Loss Mechanism

Revolutionary

The observed cosmic redshift arises not from spatial expansion but from energy loss of photons in the omnipresent ξ -field.

Photons lose energy through interaction with the ξ -field:

$$\frac{dE}{dx} = -\xi \cdot f\left(\frac{E}{E_\xi}\right) \cdot E \quad (16)$$

For the linear case $f\left(\frac{E}{E_\xi}\right) = \frac{E}{E_\xi}$ this yields:

$$\frac{dE}{dx} = -\frac{\xi E^2}{E_\xi} \quad (17)$$

Wavelength-Dependent Redshift

Integration of the energy loss equation leads to wavelength-dependent redshift:

Wavelength-dependent redshift:

$$z(\lambda_0) = \frac{\xi x}{E_\xi} \cdot \lambda_0 \quad (18)$$

where λ_0 is the emitted wavelength and x is the distance traveled.

This formula predicts:

- Shorter wavelength light (UV) shows greater redshift
- Longer wavelength light (radio) shows smaller redshift
- The ratio is $z_1/z_2 = \lambda_1/\lambda_2$

Experiment

Experimental test: Comparison of radio and optical redshifts

- 21cm hydrogen line: $\nu = 1420$ MHz
- Optical $H\alpha$ line: $\nu = 457$ THz
- Predicted ratio: $z_{21\text{cm}}/z_{H\alpha} = 3.1 \times 10^{-6}$

5 Structure Formation in the Static ξ -Universe

Continuous Structure Development

In the static T0 universe, structure formation occurs continuously without Big Bang constraints:

$$\frac{d\rho}{dt} = -\nabla \cdot (\rho \mathbf{v}) + S_\xi(\rho, T, \xi) \quad (19)$$

where S_ξ is the ξ -field source term for continuous matter/energy transformation.

ξ -Supported Continuous Creation

The ξ -field enables continuous matter/energy transformation:

$$\text{Quantum vacuum} \xrightarrow{\xi} \text{Virtual particles} \quad (20)$$

$$\text{Virtual particles} \xrightarrow{\xi^2} \text{Real particles} \quad (21)$$

$$\text{Real particles} \xrightarrow{\xi^3} \text{Atomic nuclei} \quad (22)$$

$$\text{Atomic nuclei} \xrightarrow{\text{Time}} \text{Stars, galaxies} \quad (23)$$

Energy balance is maintained by:

$$\rho_{\text{total}} = \rho_{\text{matter}} + \rho_{\xi\text{-field}} = \text{constant} \quad (24)$$

6 Dimensionless ξ -Hierarchy

Energy Scale Ratios

All ξ -relations reduce to exact mathematical ratios:

Table 1: Dimensionless ξ -ratios

Ratio	Expression	Value
Temperature	$\frac{T_{\text{CMB}}}{E_{\xi}}$	3.13×10^{-8}
Theory	$\frac{16}{9} \xi^2$	3.16×10^{-8}
Length	$\frac{\ell_{\xi}}{L_{\xi}}$	$\xi^{-1/4}$
Casimir-CMB	$\frac{ \rho_{\text{Casimir}} }{\rho_{\text{CMB}}}$	$\frac{\pi^2 \times 10^4}{320}$

Important

All ξ -relations consist of exact mathematical ratios:

- Fractions: $\frac{4}{3}, \frac{3}{4}, \frac{16}{9}$
- Powers of ten: $10^{-4}, 10^3, 10^4$
- Mathematical constants: π^2

NO arbitrary decimal numbers! Everything follows from ξ -geometry.

7 Experimental Predictions and Tests

Precision Measurements of Gravitational Constant

T0-theory predicts:

$$G_{\text{T0}} = 6.67430000... \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2) \quad (25)$$

This theoretically exact prediction can be tested by future precision measurements.

Casimir Force Anomalies

Experiment

Prediction: Casimir force anomalies at characteristic ξ -length scale

- Standard Casimir law: $F \propto d^{-4}$
- ξ -field modifications at $d = L_\xi = 10^{-4}$ m
- Measurable deviations through ξ -vacuum coupling

Electromagnetic Resonance

Maximum ξ -field-photon coupling at characteristic frequency:

$$\nu_\xi = \frac{1}{L_\xi} = 10^4 \text{ Hz} = 10 \text{ kHz}$$

(26)

Electromagnetic anomalies should occur at this frequency.

8 Cosmological Consequences

Solution to Cosmological Problems

The T0 model solves all fine-tuning problems of standard cosmology:

Table 2: Cosmological problems: Standard vs. T0

	Problem	Λ CDM	T0 Solution
Horizon problem		Inflation required	Infinite causal connectivity
Flatness problem		Fine-tuning	Geometry stabilizes over infinite time
Monopole problem		Topological defects	Defects dissipate over infinite time
Lithium problem		Nucleosynthesis discrepancy	Nucleosynthesis over unlimited time
Age problem		Objects older than universe	Objects can be arbitrarily old
H_0 tension		9% discrepancy	No H_0 in static universe
Dark energy		69% of energy density	Not required

Parameter Reduction

Revolutionary

Revolutionary parameter reduction: From 25+ parameters to one!

- Standard model of particle physics: 19+ parameters
- Λ CDM cosmology: 6 parameters
- T0-theory: 1 parameter (ξ)

96% reduction!

9 Bibliography

Bibliography

- [1] Pascher, Johann (2025). *Vereinfachte Lagrange-Dichte und Zeit-Massen-Dualität in der T0-Theorie*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/129_lagrangian-einfach_De.pdf
- [2] Pascher, Johann (2025). *Simplified Lagrangian Density and Time-Mass Duality in T0-Theory*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/129_lagrangian-einfach_En.pdf
- [3] Pascher, Johann (2025). *T0-Modell: Ein vereinheitlichtes, statisches, zyklisches, dunkle-Materie-freies und dunkle-Energie-freies Universum*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/063_cosmic_De.pdf
- [4] Pascher, Johann (2025). *T0-Model: A unified, static, cyclic, dark-matter-free and dark-energy-free universe*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/063_cosmic_En.pdf
- [5] Pascher, Johann (2025). *Temperatureinheiten in natürlichen Einheiten: T0-Theorie und statisches Universum*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/061_TempEinheitenCMB_De.pdf
- [6] Pascher, Johann (2025). *Temperature Units in Natural Units: T0-Theory and Static Universe*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/061_TempEinheitenCMB_En.pdf
- [7] Pascher, Johann (2025). *Geometric Determination of the Gravitational Constant: From the T0-Model*. T0-Theory Project. https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/127_gravitationskonstante_En.pdf
- [8] Pascher, Johann (2025). *T0-Theorie: Wellenlängenabhängige Rotverschiebung ohne Distanzannahmen*. T0-Theory Project.

https://jpascher.github.io/T0-Time-Mass-Duality/2/pdf/026_T0_Geometrische_Kosmologie_De.pdf

- [9] Heisenberg, W. (1927). *On the intuitive content of quantum theoretical kinematics and mechanics*. Zeitschrift für Physik, 43(3-4), 172–198.
- [10] Planck Collaboration (2020). *Planck 2018 results. VI. Cosmological parameters*. Astronomy & Astrophysics, 641, A6. <https://doi.org/10.1051/0004-6361/201833910>
- [11] CODATA (2018). *The 2018 CODATA Recommended Values of the Fundamental Physical Constants*. National Institute of Standards and Technology. <https://physics.nist.gov/cuu/Constants/>
- [12] Casimir, H. B. G. (1948). *On the attraction between two perfectly conducting plates*. Proceedings of the Royal Netherlands Academy of Arts and Sciences, 51(7), 793–795.
- [13] Muon g-2 Collaboration (2021). *Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm*. Physical Review Letters, 126(14), 141801. <https://doi.org/10.1103/PhysRevLett.126.141801>
- [14] Riess, A. G., et al. (2022). *A Comprehensive Measurement of the Local Value of the Hubble Constant with $1 \text{ km s}^{-1} \text{ Mpc}^{-1}$ Uncertainty from the Hubble Space Telescope and the SH0ES Team*. The Astrophysical Journal Letters, 934(1), L7. <https://doi.org/10.3847/2041-8213/ac5c5b>
- [15] Naidu, R. P., et al. (2022). *Two Remarkably Luminous Galaxy Candidates at $z \approx 11\text{--}13$ Revealed by JWST*. The Astrophysical Journal Letters, 940(1), L14. <https://doi.org/10.3847/2041-8213/ac9b22>
- [16] COBE Collaboration (1992). *Structure in the COBE differential microwave radiometer first-year maps*. The Astrophysical Journal Letters, 396, L1–L5. <https://doi.org/10.1086/186504>
- [17] Sparnaay, M. J. (1958). *Measurements of attractive forces between flat plates*. Physica, 24(6-10), 751–764. [https://doi.org/10.1016/S0031-8914\(58\)80090-7](https://doi.org/10.1016/S0031-8914(58)80090-7)
- [18] Lamoreaux, S. K. (1997). *Demonstration of the Casimir force in the 0.6 to $6 \mu\text{m}$ range*. Physical Review Letters, 78(1), 5–8. <https://doi.org/10.1103/PhysRevLett.78.5>
- [19] Einstein, A. (1915). *Die Feldgleichungen der Gravitation*. Sitzungsberichte der Preußischen Akademie der Wissenschaften, 844–847.