Principle

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

0.1 Introduction: The Universal ξ-Constant

0.1.1 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:

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

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: https://github.com/jpascher/T0-Time-Mass-Duality/2/pdf/parameterherleitung_En.pdf).

0.1.2 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 Big Bang is physically impossible.

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

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

This relation has far-reaching cosmological consequences:

- A temporal beginning (Big Bang) would mean Δt = 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

0.2 Cosmic Microwave Background (CMB)

0.2.1 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:

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

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

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

Conversion to SI units:

$$T_{\text{CMB}} = 2.725 \text{ K} \tag{5}$$

This agrees perfectly with observations!

0.2.2 CMB Energy Density and ξ-Length Scale

The CMB energy density in natural units is:

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

This energy density defines a characteristic ξ-length scale:

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

Fundamental relation of CMB energy density:

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

0.3 Casimir Effect and ξ-Field Connection

0.3.1 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:

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

The experimental ratio yields:

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

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

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

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

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

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

0.3.2 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:

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

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

0.4 Cosmic Redshift without Expansion

0.4.1 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:

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

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

$$\frac{dE}{dx} = -\frac{\xi E^2}{E_\xi} \tag{17}$$

0.4.2 Wavelength-Dependent Redshift

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

> Wavelength-dependent redshift:
>
> $$z(\lambda_0) = \frac{\xi x}{E_\xi} \cdot \lambda_0 \tag{18}$$
>
> 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 Hα line: $\nu = 457$ THz
- Predicted ratio: $z_{21cm}/z_{H\alpha} = 3.1 \times 10^{-6}$

0.5 Structure Formation in the Static ξ-Universe

0.5.1 Continuous Structure Development

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

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

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

0.5.2 ξ-Supported Continuous Creation

The ξ-field enables continuous matter/energy transformation:

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

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

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

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

Energy balance is maintained by:

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

0.6 Dimensionless ξ-Hierarchy

0.6.1 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.

0.7 Experimental Predictions and Tests

0.7.1 Precision Measurements of Gravitational Constant

T0-theory predicts:

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

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

0.7.2 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

0.7.3 Electromagnetic Resonance

Maximum ξ-field-photon coupling at characteristic frequency:

$$v_\xi = \frac{1}{L_\xi} = 10^4 \text{ Hz} = 10 \text{ kHz} \tag{26}$$

Electromagnetic anomalies should occur at this frequency.

0.8 Cosmological Consequences

0.8.1 Solution to Cosmological Problems

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

Table 2: Cosmological problems: Standard vs. T0

Problem	ΛCDM	T0 Solution
Horizon problem	Inflation required	
Flatness problem	Fine-tuning	Geo
Monopole problem	Topological defects	De
Lithium problem	Nucleosynthesis discrepancy	Nuc
Age problem	Objects older than universe	

Table 2 – Continued		
Problem	Λ**CDM**	**T0 Solution**
H_0 tension	9% discrepancy	No H_0 i
Dark energy	69% of energy density	No

0.8.2 Parameter Reduction

> **Revolutionary**
>
> Revolutionary parameter reduction: From 25+ parameters to one!
> - Standard model of particle physics: 19+ parameters
> - ΛCDM cosmology: 6 parameters
> - T0-theory: 1 parameter (ξ)
>
> 96% reduction!

0.9 Conclusions

0.9.1 The Vacuum is the ξ-Field

> **Important**
>
> Fundamental insight of T0-theory:
> - The vacuum is identical with the ξ-field
> - The CMB is radiation of this vacuum at characteristic temperature
> - The Casimir force arises from geometric constraint of the same vacuum

- Gravitation follows from ξ-geometry
- Cosmic redshift arises from ξ-energy loss

0.9.2 Mathematical Elegance

T0-theory establishes:

1. **Universal ξ-scaling**: All phenomena follow from $\xi = \frac{4}{3} \times 10^{-4}$

2. **Static paradigm**: No Big Bang, no expansion, eternal existence

3. **Time-energy consistency**: Respects fundamental quantum mechanics

4. **Dimensional consistency**: Completely formulated in natural units

5. **Unit-independent physics**: Exact mathematical ratios

> **Revolutionary**
>
> T0-theory offers a mathematically consistent alternative formulated in natural units to expansion-based cosmology and explains all cosmic phenomena with a single fundamental constant in a static, eternally existing universe.

The agreements between theoretical predictions and experimental observations - from the exact gravitational constant through CMB temperature to the Casimir-CMB ratio - demonstrate the internal consistency and predictive power of T0-theory.

0.10   Bibliography

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