

**T0-Theory: Fundamental Principles The  
Geometric Foundations of Physics** Document 003 of  
the T0 Series

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## Abstract

This document introduces the fundamental principles of T0 theory, a geometric reformulation of physics based on a single universal parameter  $\xi = \frac{4}{3} \times 10^{-4}$ . The theory shows how all fundamental constants and particle masses can be derived from three-dimensional space geometry. Various interpretative approaches - harmonic, geometric, and field-theoretic - are presented on equal footing. The fractal structure of quantum spacetime is systematically accounted for by the correction factor  $K_{\text{fract}} = 0.986$ .

### References to Complementary T0 Formulations

T0 theory is presented in various complementary formulations:

- **Anomalous Magnetic Moments (geometric):**  
Document [018\\_T0\\_Anomalous-g2-10\\_En.pdf](#) - Geometric derivation of the g-2 anomaly with fractal geometry and torsion lattice
- **Lagrangian Formulation:**  
Document [019\\_T0\\_lagrangian\\_En.pdf](#) - Field-theoretic derivation with extended Lagrangian and mass-proportional coupling
- **Simplified Pedagogical Formulation:**  
Document [049\\_LagrangianComparison\\_En.pdf](#) - Conceptual explanation with a simple Lagrangian function
- **Cosmology and Redshift:**  
Document [026\\_T0\\_Geometric\\_Cosmology\\_En.pdf](#) - Shows how the same parameter  $\xi$  explains cosmological redshift in a static universe (see Document 026)

All formulations are consistent and lead to the same fundamental predictions.

## 0.1 Introduction to T0 Theory

### 0.1.1 Time-Mass Duality

In natural units ( $\hbar = c = 1$ ) the fundamental relation holds:

$$T \cdot m = 1 \tag{1}$$

Time and mass are dualistically linked: Heavy particles have short characteristic time scales, light particles have long ones. This duality is not merely a mathematical relation but reflects a fundamental property of spacetime. It explains why heavy particles couple more strongly to the temporal structure of spacetime.

## 0.1.2 The Central Hypothesis

T0 theory is based on the revolutionary hypothesis that all physical phenomena can be derived from the geometric structure of three-dimensional space. At its core lies a single universal parameter:

### Foundation

#### The Fundamental Geometric Parameter:

$$\xi = \frac{4}{3} \times 10^{-4} = 1.333333 \dots \times 10^{-4} \quad (2)$$

This parameter is dimensionless and contains all information about the physical structure of the universe.

## 0.1.3 Paradigm Shift versus the Standard Model

Aspect	Standard Model	T0 Theory
Free Parameters	> 20	1
Theoretical Basis	Empirical fitting	Geometric derivation
Particle Masses	Arbitrary	from quantum numbers
Constants	Experimentally determined	Geometrically derived
Unification	Separate theories	Unified framework

**Table 1:** Comparison between the Standard Model and T0 Theory

## 0.2 The Geometric Parameter $\xi$

### 0.2.1 Mathematical Structure

The parameter  $\xi$  consists of two fundamental components:

$$\xi = \underbrace{\frac{4}{3}}_{\text{Harmonic-geometric}} \times \underbrace{10^{-4}}_{\text{Scale hierarchy}} \quad (3)$$

### 0.2.2 The Harmonic-Geometric Component: 4/3

**Harmonic Interpretation:**

The factor  $\frac{4}{3}$  corresponds to the **perfect fourth**, one of the fundamental harmonic intervals:

- **Octave:** 2:1 (always universal)
- **Perfect Fifth:** 3:2 (always universal)
- **Perfect Fourth:** 4:3 (always universal!)

These ratios are **geometric/mathematical**, not material-dependent. Space itself has a harmonic structure, and 4/3 (the fourth) is its fundamental signature.

**Geometric Interpretation:**

The factor  $\frac{4}{3}$  arises from the tetrahedral packing structure of three-dimensional space:

- **Tetrahedron volume:**  $V = \frac{\sqrt{2}}{12}a^3$
- **Sphere volume:**  $V = \frac{4\pi}{3}r^3$
- **Packing density:**  $\eta = \frac{\pi}{3\sqrt{2}} \approx 0.74$
- **Geometric ratio:**  $\frac{4}{3}$  from optimal space partitioning

**0.2.3 The Scale Hierarchy:  $10^{-4}$** **Foundation****Quantum Field Theoretic Derivation of  $10^{-4}$ :**

The factor  $10^{-4}$  arises from the combination of:

**1. Loop Suppression (Quantum Field Theory):**

$$\frac{1}{16\pi^3} = 2.01 \times 10^{-3} \quad (4)$$

**2. T0-Higgs Parameter:**

$$(\lambda_h^{(T0)})^2 \frac{(v^{(T0)})^2}{(m_h^{(T0)})^2} = 0.0647 \quad (5)$$

**3. Complete Calculation:**

$$2.01 \times 10^{-3} \times 0.0647 = 1.30 \times 10^{-4} \quad (6)$$

Thus: **QFT loop suppression** ( $\sim 10^{-3}$ )  $\times$  **T0 Higgs sector** ( $\sim 10^{-1}$ ) =  $10^{-4}$   
For the detailed field-theoretic derivation see Document 019.

## 0.3 Fractal Spacetime Structure

### 0.3.1 Quantum Spacetime Effects

T0 theory acknowledges that spacetime exhibits a fractal structure on Planck scales due to quantum fluctuations:

#### Key Result

##### Fractal Spacetime Parameters:

$$D_{\text{fract}}^{\text{eff}} \approx 2.973 \quad (\text{effective fractal dimension, cumulative over RG running}) \quad (7)$$

$$K_{\text{fract}} = 1 - \frac{D_{\text{fract}} - 2}{68} = 1 - \frac{0.94}{68} = 0.986 \quad (8)$$

##### Physical Interpretation:

- $D_{\text{fract}} < 3$ : Spacetime is "porous" on smallest scales
- $K_{\text{fract}} = 0.986 < 1$ : Reduced effective interaction strength
- The constant 68 arises from the tetrahedral symmetry of 3D space
- Quantum fluctuation and vacuum structure effects

### 0.3.2 Origin of the Constant 68

#### Tetrahedron Geometry:

All tetrahedron combinations yield 72:

$$6 \times 12 = 72 \quad (\text{edges} \times \text{rotations}) \quad (9)$$

$$4 \times 18 = 72 \quad (\text{faces} \times 18) \quad (10)$$

$$24 \times 3 = 72 \quad (\text{symmetries} \times \text{dimensions}) \quad (11)$$

The value  $68 = 72 - 4$  accounts for the 4 vertices of the tetrahedron as exceptions.

## 0.4 Characteristic Energy Scales

### 0.4.1 The T0 Energy Hierarchy

From the parameter  $\xi$ , natural energy scales emerge:

$$(E_0)_\xi = \frac{1}{\xi} = 7500 \quad (\text{in natural units}) \quad (12)$$

$$(E_0)_{\text{EM}} = 7.398 \text{ MeV} \quad (\text{characteristic EM energy}) \quad (13)$$

$$(E_0)_{\text{char}} = 28.4 \quad (\text{characteristic T0 energy}) \quad (14)$$

## 0.4.2 The Characteristic Electromagnetic Energy

### Key Result

#### Gravitational-Geometric Derivation of $E_0$ :

The characteristic energy follows from the coupling relation:

$$E_0^2 = \frac{4\sqrt{2} \cdot m_\mu}{\xi^4} \quad (15)$$

This yields  $E_0 = 7.398 \text{ MeV}$  as the fundamental electromagnetic energy scale.

#### Geometric Mean of Lepton Masses:

Alternatively,  $E_0$  can be defined as the geometric mean:

$$E_0 = \sqrt{m_e \cdot m_\mu} = 7.35 \text{ MeV} \quad (16)$$

The difference to 7.398 MeV (< 1%) is explainable by quantum corrections.

## 0.5 The Universal Structure Equation

### 0.5.1 General Form

All physical quantities in T0 theory follow a universal pattern:

$$\boxed{\text{Physical Quantity} = f(\xi, \text{Quantum Numbers}) \times \text{Conversion Factor}} \quad (17)$$

where:

- $f(\xi, \text{Quantum Numbers})$  encodes the geometric relation
- Quantum numbers  $(n, l, j)$  determine the specific configuration
- Conversion factors establish the connection to SI units

## 0.5.2 Examples of the Universal Structure

$$\text{Gravitational Constant: } G = \frac{\xi^2}{4m_e} \times C_{\text{conv}} \times K_{\text{fract}} \quad (18)$$

$$\text{Particle Masses: } m_i = \frac{K_{\text{fract}}}{\xi \cdot f(n_i, l_i, j_i)} \times C_{\text{conv}} \quad (19)$$

$$\text{Fine-Structure Constant: } \alpha = \xi \times \left( \frac{E_0}{1 \text{ MeV}} \right)^2 \quad (20)$$

## 0.6 Different Levels of Interpretation

### 0.6.1 Hierarchy of Understanding Levels

#### Foundation

**T0 theory can be understood at different levels:**

**1. Phenomenological Level:**

- Empirical observation: One constant explains everything
- Practical application: Prediction of new values

**2. Geometric Level:**

- Space structure determines physical properties
- Tetrahedral packing as fundamental principle

**3. Harmonic Level:**

- Spacetime as a harmonic system
- Particles as "tones" in cosmic harmony

**4. Quantum Field Theoretic Level:**

- Loop suppressions and Higgs mechanism
- Fractal corrections as quantum effects

### 0.6.2 Complementary Viewpoints

**Reductionistic vs. Holistic Viewpoint:**

**Reductionistic:**

- $\xi$  as an empirical parameter that "accidentally" works
- Geometric interpretations as added afterwards

**Holistic:**

- Space-time-matter as an inseparable unity

- $\xi$  as an expression of a deeper cosmic order

## 0.7 Basic Calculation Methods

### 0.7.1 Direct Geometric Method

The simplest application of T0 theory uses direct geometric relations:

$$\text{Physical Quantity} = \text{Geometric Factor} \times \xi^n \times \text{Normalization} \quad (21)$$

where the exponent  $n$  follows from dimensional analysis and the geometric factor contains rational numbers like  $\frac{4}{3}$ ,  $\frac{16}{5}$ , etc.

### 0.7.2 Extended Yukawa Method

For particle masses, the Higgs mechanism is additionally considered:

$$m_i = y_i \cdot v \quad (22)$$

where the Yukawa couplings  $y_i$  are calculated geometrically from the T0 structure:

$$y_i = r_i \times \xi^{p_i} \quad (23)$$

The parameters  $r_i$  and  $p_i$  are exact rational numbers that follow from the quantum number assignment of T0 geometry.

## 0.8 Philosophical Implications

### 0.8.1 The Problem of Naturalness

#### Foundation

#### Why is the universe mathematically describable?

T0 theory offers a possible answer: The universe is mathematically describable because it is **itself** mathematically structured. The parameter  $\xi$  is not just a description of nature - it **is** nature.

- **Platonic View:** Mathematical structures are fundamental
- **Pythagorean View:** "All is number and harmony"
- **Modern Interpretation:** Geometry as the basis of physics

## 0.8.2 The Anthropic Principle

### Weak vs. Strong Anthropic Principle:

#### Weak (observation-conditioned):

- We observe  $\xi = \frac{4}{3} \times 10^{-4}$  because only in such a universe can observers exist
- Multiverse with various  $\xi$  values

#### Strong (principled):

- $\xi$  has this value **because** it follows from the logic of spacetime
- Only this value is mathematically consistent

## 0.9 Experimental Confirmation

### 0.9.1 Successful Predictions

T0 theory has already passed several experimental tests and makes concrete predictions for future measurements.

### 0.9.2 Testable Predictions

#### Concrete T0 Predictions

The theory makes specific, falsifiable predictions:

1. **Neutrino Mass:**  $m_\nu = 4.54$  meV (geometric prediction, see Document 007)
2. **Anomalous Magnetic Moments:**
  - Muon:  $a_\mu \approx 1.166 \times 10^{-3}$  (Document 018, consistent with Fermilab)
  - Tau:  $a_\tau \approx 1.28 \times 10^{-3}$  (Document 018, testable at Belle II)
3. **Cosmological Parameters:**
  - Hubble Constant:  $H_0 = c \cdot C \cdot \xi \approx 99.4$  km/(s·Mpc)
  - Static universe without Dark Energy (Document 026)
  - Redshift as geometric path effect
4. **Modified Gravity** at characteristic T0 length scales

### 0.9.3 Consistency Across Different Scales

A remarkable feature of T0 theory is that the same parameter  $\xi$  explains phenomena on completely different scales:

- **Sub-atomic scale:** Anomalous magnetic moments ( $\sim 10^{-3}$ )
- **Particle physics scale:** Lepton masses, fine-structure constant
- **Cosmological scale:** Hubble constant, redshift ( $\sim 10^{26}$  m)

This consistency across more than 40 orders of magnitude is strong evidence for the fundamental nature of  $\xi$ .

## 0.10 Structure of the T0 Document Series

This foundational document serves as the starting point for a systematic presentation of T0 theory. The following documents delve into specific aspects:

- **004\_T0\_Model\_Overview\_En.pdf:** Overview of the entire T0 model
- **006\_T0\_ParticleMasses\_En.pdf:** Systematic mass calculation of all fermions
- **007\_T0\_Neutrinos\_En.pdf:** Special treatment of neutrino physics
- **008\_T0\_xi-and-e\_En.pdf:** Relationship between  $\xi$  and elementary charge
- **009\_T0\_xi\_origin\_En.pdf:** Detailed derivation of parameter  $\xi$
- **018\_T0\_Anomalous-g2-10\_En.pdf:** Geometric solution of the g-2 anomaly
- **019\_T0\_lagrangian\_En.pdf:** Field-theoretic Lagrangian formulation
- **026\_T0\_Geometric\_Cosmology\_En.pdf:** Cosmology without Dark Energy
- **049\_LagrangianComparison\_En.pdf:** Simplified pedagogical presentation

Each document builds upon the fundamental principles established here and shows their application in a specific area of physics.

## 0.11 References

### 0.11.1 Basic T0 Documents

1. Pascher, J. (2026). *Anomalous Magnetic Moments in FFGFT Theory*. Document 018.
2. Pascher, J. (2026). *T0 Theory: Lagrangian Formulation*. Document 019.
3. Pascher, J. (2026). *T0 Cosmology: Redshift as Geometric Path Effect*. Document 026.

### 0.11.2 Related Works

1. Einstein, A. (1915). *The Field Equations of Gravitation*. Proceedings of the Prussian Academy of Sciences.
2. Planck, M. (1900). *On the Theory of the Energy Distribution Law of the Normal Spectrum*. Proceedings of the German Physical Society.
3. Wheeler, J.A. (1989). *Information, physics, quantum: The search for links*. Proceedings of the 3rd International Symposium on Foundations of Quantum Mechanics.