

# Elimination of Mass as a Dimensional Placeholder in the T0 Model: Towards Truly Parameter-Free Physics

December 2, 2025

## Abstract

This paper demonstrates that the mass parameter  $m$ , which appears in the T0 model formulations, serves exclusively as a dimensional placeholder and can be systematically eliminated from all equations. Through rigorous dimensional analysis and mathematical reformulation, we show that the apparent dependence on specific particle masses is an artifact of conventional notation rather than fundamental physics. The elimination of  $m$  reveals the T0 model as a truly parameter-free theory, based solely on the Planck scale, providing universal scaling laws and eliminating systematic distortions from empirical mass determinations. This work establishes the mathematical foundation for a complete ab-initio formulation of the T0 model, requiring no external experimental inputs beyond the fundamental constants  $\hbar$ ,  $c$ ,  $G$ , and  $k_B$ .

## Contents

|       |   |   |
|-------|---|---|
| 1     | Introduction                                | 3 |
| 1.1   | The Problem of Mass Parameters              | 3 |
| 1.2   | Dimensional Analysis Approach               | 3 |
| 2     | Systematic Mass Elimination                 | 3 |
| 2.1   | The Intrinsic Time Field                    | 3 |
| 2.1.1 | Original Formulation                        | 3 |
| 2.1.2 | Mass-Free Reformulation                     | 4 |
| 2.2   | Field Equation Reformulation                | 4 |
| 2.2.1 | Original Field Equation                     | 4 |
| 2.2.2 | Energy-Based Formulation                    | 4 |
| 2.3   | Point Source Solution: Parameter Separation | 4 |
| 2.3.1 | The Mass Redundancy Problem                 | 4 |
| 2.3.2 | Parameter Separation Solution               | 5 |
| 2.4   | The $\xi$ -Parameter: Universal Scaling     | 5 |
| 2.4.1 | Traditional Mass-Dependent Definition       | 5 |
| 2.4.2 | Universal Energy-Based Definition           | 5 |
| 3     | Complete Mass-Free T0 Formulation           | 6 |

|       |   |    |
|-------|---|----|
| 3.1   | Fundamental Equations . . . . .                     | 6  |
| 3.2   | Parameter Count Analysis . . . . .                  | 6  |
| 3.3   | Dimensional Consistency Verification . . . . .      | 6  |
| 4     | Experimental Implications . . . . .                 | 6  |
| 4.1   | Universal Predictions . . . . .                     | 6  |
| 4.1.1 | Scaling Laws . . . . .                              | 7  |
| 4.1.2 | QED Anomalies . . . . .                             | 7  |
| 4.1.3 | Gravitational Effects . . . . .                     | 7  |
| 4.2   | Elimination of Systematic Biases . . . . .          | 7  |
| 4.2.1 | Problems with Mass-Dependent Formulations . . . . . | 7  |
| 4.2.2 | Advantages of the Mass-Free Approach . . . . .      | 7  |
| 4.3   | Proposed Experimental Tests . . . . .               | 7  |
| 4.3.1 | Multi-Scale Consistency . . . . .                   | 7  |
| 4.3.2 | Energy-Dependent Anomalies . . . . .                | 8  |
| 4.3.3 | Geometric Independence . . . . .                    | 8  |
| 5     | Geometric Parameter Determination . . . . .         | 8  |
| 5.1   | Source Geometry Analysis . . . . .                  | 8  |
| 5.1.1 | Spherically Symmetric Sources . . . . .             | 8  |
| 5.1.2 | Non-Spherical Sources . . . . .                     | 8  |
| 5.2   | Universal Geometric Relations . . . . .             | 8  |
| 6     | Connection to Fundamental Physics . . . . .         | 9  |
| 6.1   | Emergent Mass Concept . . . . .                     | 9  |
| 6.1.1 | Mass as an Effective Parameter . . . . .            | 9  |
| 6.1.2 | Resolution of Mass Hierarchies . . . . .            | 9  |
| 6.2   | Unification with Planck-Scale Physics . . . . .     | 9  |
| 6.2.1 | Natural Scale Emergence . . . . .                   | 9  |
| 6.2.2 | Scale-Dependent Effective Theories . . . . .        | 9  |
| 7     | Philosophical Implications . . . . .                | 10 |
| 7.1   | Reductionism to the Planck Scale . . . . .          | 10 |
| 7.2   | Ontological Implications . . . . .                  | 10 |
| 7.2.1 | Mass as a Human Construct . . . . .                 | 10 |
| 7.2.2 | Universal Energy Monism . . . . .                   | 10 |
| 8     | Conclusions . . . . .                               | 10 |
| 8.1   | Summary of Results . . . . .                        | 10 |
| 8.2   | Theoretical Significance . . . . .                  | 11 |
| 8.3   | Experimental Program . . . . .                      | 11 |
| 8.4   | Future Directions . . . . .                         | 11 |
| 8.4.1 | Immediate Research Priorities . . . . .             | 11 |
| 8.4.2 | Long-Term Goals . . . . .                           | 11 |
| 9     | Final Remarks . . . . .                             | 12 |

# 1 Introduction

## 1.1 The Problem of Mass Parameters

The T0 model appears, as formulated in previous works, to critically depend on specific particle masses such as the electron mass  $m_e$ , proton mass  $m_p$ , and Higgs boson mass  $m_h$ . This apparent dependence has raised concerns about the model's predictive power and its reliance on empirical inputs that may themselves be contaminated by Standard Model assumptions. A careful analysis reveals, however, that the mass parameter  $m$  fulfills a purely **dimensional function** in the T0 equations. This paper shows that  $m$  can be systematically eliminated from all formulations, unveiling the T0 model as a fundamentally parameter-free theory based exclusively on Planck-scale physics.

## 1.2 Dimensional Analysis Approach

In natural units, where  $\hbar = c = G = k_B = 1$ , all physical quantities can be expressed as powers of energy  $[E]$ :

$$\text{Length: } [L] = [E^{-1}] \quad (1)$$

$$\text{Time: } [T] = [E^{-1}] \quad (2)$$

$$\text{Mass: } [M] = [E] \quad (3)$$

$$\text{Temperature: } [\Theta] = [E] \quad (4)$$

This dimensional structure suggests that mass parameters could be replaced by energy scales, leading to more fundamental formulations.

# 2 Systematic Mass Elimination

## 2.1 The Intrinsic Time Field

### 2.1.1 Original Formulation

The intrinsic time field is traditionally defined as:

$$T(\vec{x}, t) = \frac{1}{\max(m(\vec{x}, t), \omega)} \quad (5)$$

**Dimensional Analysis:**

- $[T(\vec{x}, t)] = [E^{-1}]$  (time field dimension)
- $[m] = [E]$  (mass as energy)
- $[\omega] = [E]$  (frequency as energy)
- $[1/\max(m, \omega)] = [E^{-1}]$  ✓

### 2.1.2 Mass-Free Reformulation

The fundamental insight is that only the **\*\*ratio\*\*** between characteristic energy and frequency is physically relevant. We reformulate as:

$$\boxed{T(\vec{x}, t) = t_P \cdot g(E_{\text{norm}}(\vec{x}, t), \omega_{\text{norm}})} \quad (6)$$

where:

$$t_P = \sqrt{\frac{\hbar G}{c^5}} \quad (\text{Planck time}) \quad (7)$$

$$E_{\text{norm}} = \frac{E(\vec{x}, t)}{E_P} \quad (\text{normalized energy}) \quad (8)$$

$$\omega_{\text{norm}} = \frac{\omega}{E_P} \quad (\text{normalized frequency}) \quad (9)$$

$$g(E_{\text{norm}}, \omega_{\text{norm}}) = \frac{1}{\max(E_{\text{norm}}, \omega_{\text{norm}})} \quad (10)$$

**Result:** Mass completely eliminated, only Planck scale and dimensionless ratios remain.

## 2.2 Field Equation Reformulation

### 2.2.1 Original Field Equation

$$\nabla^2 T(x, t) = -4\pi G \rho(\vec{x}) T(x, t)^2 \quad (11)$$

with mass density  $\rho(\vec{x}) = m \cdot \delta^3(\vec{x})$  for a point source.

### 2.2.2 Energy-Based Formulation

Replacement of mass density by energy density:

$$\boxed{\nabla^2 T(x, t) = -4\pi G \frac{E(\vec{x})}{E_P} \delta^3(\vec{x}) \frac{T(x, t)^2}{t_P^2}} \quad (12)$$

**Dimensional Verification:**

$$[\nabla^2 T(x, t)] = [E^{-1} \cdot E^2] = [E] \quad (13)$$

$$[4\pi G E_{\text{norm}} \delta^3(\vec{x}) T(x, t)^2 / t_P^2] = [E^{-2}][1][E^6][E^{-2}]/[E^{-2}] = [E] \quad \checkmark \quad (14)$$

## 2.3 Point Source Solution: Parameter Separation

### 2.3.1 The Mass Redundancy Problem

The traditional point source solution exhibits apparent mass redundancy:

$$T(x, t)(r) = \frac{1}{m} \left( 1 - \frac{r_0}{r} \right) \quad (15)$$

with  $r_0 = 2Gm$ . Substitution:

$$T(x, t)(r) = \frac{1}{m} \left( 1 - \frac{2Gm}{r} \right) = \frac{1}{m} - \frac{2G}{r} \quad (16)$$

**Critical Observation:** Mass  $m$  appears in **two different roles**:

1. As a normalization factor ( $1/m$ )
2. As a source parameter ( $2Gm$ )

This suggests that  $m$  \*\*masks two independent physical scales\*\*.

### 2.3.2 Parameter Separation Solution

We reformulate with independent parameters:

$$\boxed{T(x, t)(r) = T_0 \left(1 - \frac{L_0}{r}\right)} \quad (17)$$

where:

- $T_0$ : Characteristic timescale [ $E^{-1}$ ]
- $L_0$ : Characteristic length scale [ $E^{-1}$ ]

#### Physical Interpretation:

- $T_0$  determines the **amplitude of the time field**  $L_0$  determines the **range** of the time field
- Both derivable from source geometry without specific masses

## 2.4 The $\xi$ -Parameter: Universal Scaling

### 2.4.1 Traditional Mass-Dependent Definition

$$\xi = 2\sqrt{G} \cdot m \quad (18)$$

**Problem:** Requires specific particle masses as input.

### 2.4.2 Universal Energy-Based Definition

$$\boxed{\xi = 2\sqrt{\frac{E_{\text{characteristic}}}{E_P}}} \quad (19)$$

**Universal Scaling for Different Energy Scales:**

$$\text{Planck Energy } (E = E_P) : \quad \xi = 2 \quad (20)$$

$$\text{Electroweak Scale } (E \sim 100 \text{ GeV}) : \quad \xi \sim 10^{-8} \quad (21)$$

$$\text{QCD Scale } (E \sim 1 \text{ GeV}) : \quad \xi \sim 10^{-9} \quad (22)$$

$$\text{Atomic Scale } (E \sim 1 \text{ eV}) : \quad \xi \sim 10^{-28} \quad (23)$$

**No specific particle masses required!**

### 3 Complete Mass-Free T0 Formulation

#### 3.1 Fundamental Equations

The complete mass-free T0 system:

##### Mass-Free T0 Model

$$\text{Time Field: } T(\vec{x}, t) = t_P \cdot f(E_{\text{norm}}(\vec{x}, t), \omega_{\text{norm}}) \quad (24)$$

$$\text{Field Equation: } \nabla^2 T(x, t) = -4\pi G \frac{E_{\text{norm}}}{\ell_P^2} \delta^3(\vec{x}) T(x, t)^2 \quad (25)$$

$$\text{Point Sources: } T(x, t)(r) = T_0 \left(1 - \frac{L_0}{r}\right) \quad (26)$$

$$\text{Coupling Parameter: } \xi = 2\sqrt{\frac{E}{E_P}} \quad (27)$$

#### 3.2 Parameter Count Analysis

| Formulation               | Before Mass Elimination       | After Mass Elimination   |
|---------------------------|-------------------------------|--------------------------|
| Fundamental Constants     | $\hbar, c, G, k_B$            | $\hbar, c, G, k_B$       |
| Particle-Specific Masses  | $m_e, m_\mu, m_p, m_h, \dots$ | None                     |
| Dimensionless Ratios      | No explicit                   | $E/E_P, L/\ell_P, T/t_P$ |
| Free Parameters           | $\infty$ (one per particle)   | 0                        |
| Empirical Inputs Required | Yes (masses)                  | No                       |

#### 3.3 Dimensional Consistency Verification

| Equation         | Left Side                    | Right Side   | Status |
|------------------|------------------------------|--|--------|
| Time Field       | $[T(\vec{x}, t)] = [E^{-1}]$ | $[t_P \cdot f(\cdot)] = [E^{-1}]$                        | ✓      |
| Field Equation   | $[\nabla^2 T(x, t)] = [E]$   | $[GE_{\text{norm}} \delta^3 T(x, t)^2 / \ell_P^2] = [E]$ | ✓      |
| Point Source     | $[T(x, t)(r)] = [E^{-1}]$    | $[T_0(1 - L_0/r)] = [E^{-1}]$                            | ✓      |
| $\xi$ -Parameter | $[\xi] = [1]$                | $[\sqrt{E/E_P}] = [1]$                                   | ✓      |

Table 1: Dimensional consistency of the mass-free formulations

### 4 Experimental Implications

#### 4.1 Universal Predictions

The mass-free T0 model makes universal predictions independent of specific particle properties:

#### 4.1.1 Scaling Laws

$$\xi(E) = 2\sqrt{\frac{E}{E_P}} \quad (28)$$

This relation must hold for **all** energy scales and provides a stringent test of the theory.

#### 4.1.2 QED Anomalies

The anomalous magnetic moment of the electron becomes:

$$a_e^{(T0)} = \frac{\alpha}{2\pi} \cdot C_{T0} \cdot \left(\frac{E_e}{E_P}\right) \quad (29)$$

where  $E_e$  is the characteristic energy scale of the electron, not its rest mass.

#### 4.1.3 Gravitational Effects

$$\Phi(r) = -\frac{GE_{\text{source}}}{E_P} \cdot \frac{\ell_P}{r} \quad (30)$$

Universal scaling for all gravitational sources.

### 4.2 Elimination of Systematic Biases

#### 4.2.1 Problems with Mass-Dependent Formulations

Traditional approaches suffer from:

- **Circular Dependencies:** Using experimentally determined masses to predict the same experiments
- **Standard Model Contamination:** All mass measurements presuppose SM physics
- **Precision Illusions:** High apparent precision masks systematic theoretical errors

#### 4.2.2 Advantages of the Mass-Free Approach

- **Model Independence:** No dependence on potentially biased mass determinations
- **Universal Tests:** The same scaling laws apply across all energy scales
- **Theoretical Purity:** Ab-initio predictions solely from the Planck scale

### 4.3 Proposed Experimental Tests

#### 4.3.1 Multi-Scale Consistency

Test of the universal scaling relation:

$$\frac{\xi(E_1)}{\xi(E_2)} = \sqrt{\frac{E_1}{E_2}} \quad (31)$$

across different energy scales: atomic, nuclear, electroweak, and cosmological.

### 4.3.2 Energy-Dependent Anomalies

Measurement of anomalous magnetic moments as functions of energy scale rather than particle identity:

$$a(E) = a_{\text{SM}}(E) + a^{(\text{T0})}(E/E_{\text{P}}) \quad (32)$$

### 4.3.3 Geometric Independence

Verification that  $T_0$  and  $L_0$  can be determined independently from source geometry without specific mass values.

## 5 Geometric Parameter Determination

### 5.1 Source Geometry Analysis

#### 5.1.1 Spherically Symmetric Sources

For a spherically symmetric energy distribution  $E(r)$ :

$$= t_{\text{P}} \cdot f \left( \frac{\int E(r) d^3r}{E_{\text{P}}} \right) \quad (33)$$

$$L_0 = \ell_{\text{P}} \cdot g \left( \frac{R_{\text{characteristic}}}{\ell_{\text{P}}} \right) \quad (34)$$

where  $f$  and  $g$  are dimensionless functions determined by the field equations.

#### 5.1.2 Non-Spherical Sources

For general geometries, the parameters become tensorial:

$$T_0^{ij} = t_{\text{P}} \cdot f_{ij} \left( \frac{I^{ij}}{E_{\text{P}} \ell_{\text{P}}^2} \right) \quad (35)$$

$$L_0^{ij} = \ell_{\text{P}} \cdot g_{ij} \left( \frac{I^{ij}}{\ell_{\text{P}}^2} \right) \quad (36)$$

where  $I^{ij}$  is the energy-momentum tensor of the source.

### 5.2 Universal Geometric Relations

The mass-free formulation reveals universal relations between geometric and energetic properties:

$$\frac{L_0}{\ell_{\text{P}}} = h(T$$

<sup>0</sup> <sub>$t_{\text{P}}, \text{Shape Parameters}$</sub> (37) These relations are **independent of specific mass values** and depend only on:

- Energy distribution geometry
- Planck-scale ratios
- Dimensionless shape parameters



## 6 Connection to Fundamental Physics

### 6.1 Emergent Mass Concept

#### 6.1.1 Mass as an Effective Parameter

In the mass-free formulation, what we traditionally call mass emerges as:

$$m_{\text{effective}} = E_{\text{characteristic}} \cdot f(\text{Geometry, Couplings}) \quad (38)$$

**Different Masses for Different Contexts:**

- **Rest Mass:** Intrinsic energy scale of localized excitation
- **Gravitational Mass:** Coupling strength to spacetime curvature
- **Inertial Mass:** Resistance to acceleration in external fields

All reducible to **energy scales and geometric factors**.

#### 6.1.2 Resolution of Mass Hierarchies

The apparent hierarchy of particle masses becomes a hierarchy of **energy scales**:

$$\frac{m_t}{m_e} \rightarrow \frac{E_{\text{top}}}{E_{\text{electron}}} \quad (39)$$

$$\frac{m_W}{m_e} \rightarrow \frac{E_{\text{electroweak}}}{E_{\text{electron}}} \quad (40)$$

$$\frac{m_P}{m_e} \rightarrow \frac{E_P}{E_{\text{electron}}} \quad (41)$$

**No fundamental mass parameters**, only energy scale ratios.

## 6.2 Unification with Planck-Scale Physics

### 6.2.1 Natural Scale Emergence

All physics organizes itself naturally around the Planck scale:

$$\text{Microscopic Physics: } E \ll E_P, \quad L \gg \ell_P \quad (42)$$

$$\text{Macroscopic Physics: } E \ll E_P, \quad L \gg \ell_P \quad (43)$$

$$\text{Quantum Gravity: } E \sim E_P, \quad L \sim \ell_P \quad (44)$$

### 6.2.2 Scale-Dependent Effective Theories

Different energy regimes correspond to different limits of the universal T0 theory:

$$E \ll E_P : \text{ Standard Model Limit} \quad (45)$$

$$E \sim \text{TeV} : \text{ Electroweak Unification} \quad (46)$$

$$E \sim E_P : \text{ Quantum Gravity Unification} \quad (47)$$

## 7 Philosophical Implications

### 7.1 Reductionism to the Planck Scale

The elimination of mass parameters shows that **all physics** is reducible to the **Planck scale**:

- No fundamental mass parameters exist
- Only energy and length ratios are important
- Universal dimensionless couplings emerge naturally
- Truly parameter-free physics achieved

### 7.2 Ontological Implications

#### 7.2.1 Mass as a Human Construct

The traditional concept of mass appears to be a **human construct** rather than fundamental reality:

- Useful for practical calculations
- Not present at the deepest level of the theory
- Emergent from more fundamental energy relations

#### 7.2.2 Universal Energy Monism

The mass-free T0 model supports a form of **energy monism**:

- Energy as the sole fundamental quantity
- All other quantities as energy relations
- Space and time as energy-derived concepts
- Matter as structured energy patterns

## 8 Conclusions

### 8.1 Summary of Results

We have shown that:

1. **Mass  $m$  serves only as a dimensional placeholder** in T0 formulations
2. **All equations can be systematically reformulated** without mass parameters
3. **Universal scaling laws emerge** based solely on the Planck scale
4. **Truly parameter-free theory** results from mass elimination
5. **Experimental predictions become model-independent**

## 8.2 Theoretical Significance

The mass elimination reveals the T0 model as:

### T0 Model: True Nature

- **Truly fundamental theory** based solely on the Planck scale
- **Parameter-free formulation** with universal predictions
- **Unification of all energy scales** through dimensionless ratios
- **Resolution of fine-tuning problems** via scale relations

## 8.3 Experimental Program

The mass-free formulation enables:

- **Model-independent tests** of universal scaling
- **Elimination of systematic biases** from mass measurements
- **Direct connection** between quantum and gravitational scales
- **Ab-initio predictions** from pure theory

## 8.4 Future Directions

### 8.4.1 Immediate Research Priorities

1. **Complete geometric formulation:** Development of full tensor treatment for arbitrary source geometries
2. **Quantum field theory extension:** Formulation of mass-free QFT on T0 background
3. **Cosmological applications:** Application to large-scale structure without dark matter/energy
4. **Experimental design:** Development of tests for universal scaling laws

### 8.4.2 Long-Term Goals

- Complete replacement of the Standard Model by mass-free T0 theory
- Unification of all interactions through energy scale relations
- Resolution of quantum gravity through Planck-scale physics
- Experimental verification of parameter-free predictions

## 9 Final Remarks

The elimination of mass as a fundamental parameter represents more than a technical improvement—it unveils the **true nature of physical reality** as organized around energy relations and geometric structures. The apparent complexity of particle physics with its multitude of masses and coupling constants arises from our limited perspective on more fundamental energy scale relations. The T0 model in its mass-free formulation offers a window into this deeper reality. **Mass was always an illusion—energy and geometry are the fundamental reality.**

## References

- [1] Pascher, J. (2025). *Field-Theoretic Derivation of the  $\beta_T$ -Parameter in Natural Units* ( $\hbar = c = 1$ ). Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/DerivationVonBetaEn.pdf>
- [2] Pascher, J. (2025). *Natural Unit Systems: Universal Energy Conversion and Fundamental Length Scale Hierarchy*. Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/NatEinheitenSystematikEn.pdf>
- [3] Pascher, J. (2025). *Integration of the Dirac Equation into the T0 Model: Updated Framework with Natural Units*. Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/diracEn.pdf>
- [4] Planck, M. (1899). *On Irreversible Radiation Processes*. Proceedings of the Royal Prussian Academy of Sciences in Berlin, 5, 440-480.
- [5] Wheeler, J. A. (1955). *Geons*. Physical Review, 97(2), 511-536.
- [6] Weinberg, S. (1989). *The Cosmological Constant Problem*. Reviews of Modern Physics, 61(1), 1-23.