

Complete Particle Spectrum:

From Standard Model Complexity to T0 Universal Field
Comprehensive Analysis of All Known and Hypothetical Particles

Abstract

This comprehensive analysis presents the complete spectrum of all known particles in both the Standard Model and the revolutionary T0 theoretical framework. While the Standard Model requires 17 fundamental particles plus their antiparticles (34+ fundamental entities) and hundreds of composite particles, the T0 theory demonstrates how all particles emerge as different excitation strengths ε in a single universal field $\delta m(x, t)$. We provide detailed mappings of every particle type, from leptons and quarks to gauge bosons and hypothetical particles like axions and gravitons, showing how the T0 framework achieves unprecedented unification through the universal equation $\mathcal{L} = \varepsilon \cdot (\partial \delta m)^2$ with a single parameter $\xi = 1.33 \times 10^{-4}$.

Contents

| | | |
|--|--|---|
| 0.1 | Introduction: The Complete Particle Census | 2 |
| 0.1.1 | Standard Model Particle Inventory | 2 |
| 0.1.2 | T0 Theory Universal Field Approach | 2 |
| 0.2 | Complete Standard Model Particle Catalog | 3 |
| 0.2.1 | Generation Structure | 3 |
| 0.2.2 | Gauge Bosons and Higgs | 3 |
| 0.3 | T0 Theory: Universal Field Unification | 3 |
| 0.3.1 | The Revolutionary Insight | 3 |
| 0.3.2 | Complete T0 Particle Spectrum | 4 |
| 0.3.3 | Neutrinos as Limiting Case | 5 |
| 0.3.4 | Antiparticles: Elegant Unification | 5 |
| 0.4 | Comprehensive Comparison | 5 |
| 0.4.1 | Particle Count Comparison | 5 |
| 0.5 | Experimental Implications | 6 |
| 0.5.1 | Testable T0 Predictions | 6 |
| Universal Lepton Corrections | 6 | |
| Neutrino Mass Ratios | 6 | |
| 0.6 | Conclusion: The Ultimate Simplification | 6 |
| 0.6.1 | Revolutionary Achievement | 6 |
| 0.6.2 | The Elegant Truth | 7 |

0.1 Introduction: The Complete Particle Census

0.1.1 Standard Model Particle Inventory

The Standard Model of Particle Physics represents humanity's most successful theory of fundamental particles and forces, but it suffers from overwhelming complexity in its particle spectrum. The complete inventory includes:

Standard Model Complexity Crisis

Fundamental Particles: 17 types

- 6 Leptons (electron, muon, tau + 3 neutrinos)
- 6 Quarks (up, down, charm, strange, top, bottom)
- 4 Gauge bosons (photon, W^\pm , Z^0 , gluon)
- 1 Higgs boson

Antiparticles: 17 corresponding antiparticles

Composite Particles: 100+ hadrons, mesons, baryons

Total Known Particles: 200+ distinct entities

Free Parameters: 19+ experimentally determined values

0.1.2 T0 Theory Universal Field Approach

The T0 theory presents a revolutionary alternative: all particles as excitations of a single field:

T0 Universal Field Simplification

One Universal Field: $\delta m(x, t)$

One Universal Equation: $\mathcal{L} = \varepsilon \cdot (\partial \delta m)^2$

One Universal Parameter: $\xi = 1.33 \times 10^{-4}$

Infinite Particle Spectrum: Continuous ε -values

Automatic Antiparticles: $-\delta m$ (negative excitations)

All Physics Unified: From photons to Higgs bosons

0.2 Complete Standard Model Particle Catalog

0.2.1 Generation Structure

The Standard Model organizes fermions into three generations:

| Generation | 1st | 2nd | 3rd |
|------------|--|---|--|
| Leptons | e^- (0.511 MeV) ν_e (< 2 eV) | μ^- (105.7 MeV) ν_μ (< 0.19 MeV) | τ^- (1777 MeV) ν_τ (< 18.2 MeV) |
| Quarks | u (+2/3, 2.2 MeV) d (-1/3, 4.7 MeV) | c (+2/3, 1.3 GeV) s (-1/3, 95 MeV) | t (+2/3, 173 GeV) b (-1/3, 4.2 GeV) |

Table 1: Standard Model three-generation structure

0.2.2 Gauge Bosons and Higgs

| Particle | Symbol | Mass | Charge | Force |
|----------|----------|----------|---------|-----------------|
| Photon | γ | 0 | 0 | Electromagnetic |
| W Boson | W^\pm | 80.4 GeV | ± 1 | Weak (charged) |
| Z Boson | Z^0 | 91.2 GeV | 0 | Weak (neutral) |
| Gluon | g | 0 | 0 | Strong |
| Higgs | H^0 | 125 GeV | 0 | Mass generation |

Table 2: Standard Model gauge bosons and Higgs boson

0.3 T0 Theory: Universal Field Unification

0.3.1 The Revolutionary Insight

The T0 theory reveals that all particles are different excitation strengths in the same field:

All particles = Different ε values in $\delta m(x, t)$

(1)

where $\varepsilon = \xi \cdot E^2$ with the universal scale parameter $\xi = 1.33 \times 10^{-4}$.

0.3.2 Complete T0 Particle Spectrum

Table 3: Complete particle spectrum in T0 theory

| Particle Type | Examples | ε Range | T0 Interpretation | SM Comparison |
|-----------------------|--------------------------------|-----------------------------|-------------------------------|--------------------------|
| Massless bosons | Photon (γ) | $\varepsilon \rightarrow 0$ | Limiting case of field | Gauge boson |
| Ultra-light particles | Axions, dark photons | $10^{-20} - 10^{-15}$ | Sub-threshold excitations | Dark matter candidates |
| Neutrinos | ν_e, ν_μ, ν_τ | $10^{-12} - 10^{-7}$ | Minimal field excitations | Separate neutrino fields |
| Light leptons | Electron (e^-) | $\sim 3 \times 10^{-8}$ | Weak field excitation | Charged lepton |
| Light quarks | Up (u), Down (d) | $10^{-6} - 10^{-5}$ | Confined excitations | Color-charged quarks |
| Medium leptons | Muon (μ^-) | $\sim 1.5 \times 10^{-3}$ | Medium field excitation | Heavy lepton |
| Strange particles | Strange (s), Charm (c) | $10^{-3} - 10^{-1}$ | Medium-strong excitations | 2nd generation quarks |
| Heavy leptons | Tau (τ^-) | ~ 0.42 | Strong field excitation | Heaviest lepton |
| Heavy quarks | Top (t), Bottom (b) | $1 - 10$ | Very strong excitations | 3rd generation quarks |
| Weak bosons | W^\pm, Z^0 | ~ 100 | Electroweak scale excitations | Gauge bosons |
| Higgs sector | Higgs (H^0) | ~ 7500 | Structural foundation | Scalar field |

0.3.3 Neutrinos as Limiting Case

Neutrinos deserve special attention as they represent the transition from particles to vacuum:

$$\begin{aligned}\nu_e : \quad & \varepsilon_1 \approx 10^{-12} \quad (m_1 \sim 0.0001 \text{ eV}) \\ \nu_\mu : \quad & \varepsilon_2 \approx 10^{-8} \quad (m_2 \sim 0.009 \text{ eV}) \\ \nu_\tau : \quad & \varepsilon_3 \approx 3 \times 10^{-7} \quad (m_3 \sim 0.05 \text{ eV})\end{aligned}\tag{2}$$

Physical interpretation: Neutrinos are "ghostly" because their field excitations are so weak that they barely interact with matter. They represent the boundary between detectable particles and the vacuum state.

0.3.4 Antiparticles: Elegant Unification

In T0 theory, antiparticles require no separate treatment:

$$\boxed{\text{Antiparticle} = -\delta m(x, t)}\tag{3}$$

Examples:

$$\text{Electron} : \quad \delta m_e(x, t) = +A_e \cdot f_e(x, t)\tag{4}$$

$$\text{Positron} : \quad \delta m_{e^+}(x, t) = -A_e \cdot f_e(x, t)\tag{5}$$

$$\text{Annihilation} : \quad \delta m_e + \delta m_{e^+} = 0\tag{6}$$

This eliminates the need for 17 separate antiparticle fields in the Standard Model.

0.4 Comprehensive Comparison

0.4.1 Particle Count Comparison

| Category | Standard Model | T0 Theory |
|-------------------------|-----------------------------|-------------------------------|
| Fundamental particles | 17 | 1 field |
| Antiparticles | 17 separate | Same field (negative) |
| Free parameters | 19+ | 1 (ξ) |
| Composite particles | 200+ catalogued | Infinite spectrum |
| Hypothetical particles | 100+ (SUSY, etc.) | Natural extensions |
| Dark sector | Separate particles | Sub-threshold excitations |
| Gravitons | Not included | Emergent from $T \cdot m = 1$ |
| Total complexity | Hundreds of entities | One universal field |

Table 4: Comprehensive complexity comparison

0.5 Experimental Implications

0.5.1 Testable T0 Predictions

The T0 universal field theory makes specific predictions that distinguish it from the Standard Model:

Universal Lepton Corrections

All leptons should receive identical field corrections:

$$a_\ell^{(T0)} = \frac{\xi}{2\pi} \times \frac{1}{12} \approx 1.77 \times 10^{-6} \quad (7)$$

Predictions:

$$a_e^{(T0)} \approx 1.77 \times 10^{-6} \quad (\text{new contribution}) \quad (8)$$

$$a_\mu^{(T0)} \approx 1.77 \times 10^{-6} \quad (\text{explains anomaly}) \quad (9)$$

$$a_\tau^{(T0)} \approx 1.77 \times 10^{-6} \quad (\text{testable prediction}) \quad (10)$$

Neutrino Mass Ratios

$$\frac{m_3}{m_2} = \sqrt{\frac{\varepsilon_3}{\varepsilon_2}} \approx 17, \quad \frac{m_2}{m_1} = \sqrt{\frac{\varepsilon_2}{\varepsilon_1}} \approx 10 \quad (11)$$

0.6 Conclusion: The Ultimate Simplification

0.6.1 Revolutionary Achievement

This comprehensive analysis demonstrates the T0 theory's revolutionary achievement:

The Complete Unification

From Maximum Complexity to Ultimate Simplicity:

200+ Standard Model particles



1 universal field $\delta m(x, t)$

19+ free parameters



1 universal constant $\xi = 1.33 \times 10^{-4}$

Multiple forces and interactions



1 universal equation $\mathcal{L} = \varepsilon \cdot (\partial \delta m)^2$

Same predictive power, infinite conceptual simplification!

0.6.2 The Elegant Truth

The universe does not contain hundreds of different particles with mysterious properties and arbitrary parameters. Instead, it consists of a single, universal field expressing itself through an infinite spectrum of excitation patterns.

Every “particle” we have ever discovered—from the electron to the Higgs boson, from neutrinos to quarks—is simply a different way the same field chooses to dance.

The universe is not complex—we just didn’t understand its elegant simplicity.

$\text{Reality} = \delta m(x, t)$ dancing the eternal patterns of existence

(12)

Bibliography

- [1] Pascher, J. (2025). *Simplified Dirac Equation in T0 Theory: From Complex 4×4 Matrices to Simple Field Node Dynamics.*
Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/diracVereinfachtEn.pdf>
- [2] Pascher, J. (2025). *Simple Lagrangian Revolution: From Standard Model Complexity to T0 Elegance.*
Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/LagrandianVergleichEn.pdf>
- [3] Pascher, J. (2025). *Pure Energy T0 Theory: The Ratio-Based Revolution.*
Available at: https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Elimination_Of_Mass_Dirac_LagEn.pdf
- [4] Pascher, J. (2025). *T0 Model Verification: Scale Ratio-Based Calculations vs. CODATA/Experimental Values.*
Available at: https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Elimination_Of_Mass_Dirac_TabelleEn.pdf
- [5] Pascher, J. (2025). *Pure Energy Formulation of H_0 and κ Parameters in the T0 Model Framework.*
Available at: https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/Ho_EnergieEn.pdf
- [6] Pascher, J. (2025). *Elimination of Mass as Dimensional Placeholder in the T0 Model: Towards True Parameter-Free Physics.*
Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/EliminationOfMassEn.pdf>
- [7] Pascher, J. (2025). *Simplified T0 Theory: Elegant Lagrangian Density for Time-Mass Duality.*
Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/lagrandian-einfachEn.pdf>
- [8] Pascher, J. (2025). *Deterministic Quantum Mechanics via T0-Energy Field Formulation.*
Available at: <https://github.com/jpascher/T0-Time-Mass-Duality/blob/main/2/pdf/QM-DetrmisticEn.pdf>

- [9] Particle Data Group (2022). *Review of Particle Physics*. Prog. Theor. Exp. Phys. **2022**, 083C01.
- [10] Weinberg, S. (1995). *The Quantum Theory of Fields, Volume 1: Foundations*. Cambridge University Press.
- [11] Peskin, M. E. and Schroeder, D. V. (1995). *An Introduction to Quantum Field Theory*. Westview Press.
- [12] Muon g-2 Collaboration (2021). *Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm*. Phys. Rev. Lett. **126**, 141801.
- [13] ATLAS Collaboration (2012). *Observation of a new particle in the search for the Standard Model Higgs boson*. Phys. Lett. B **716**, 1–29.
- [14] Planck Collaboration (2020). *Planck 2018 results. VI. Cosmological parameters*. Astron. Astrophys. **641**, A6.