ξ-Formulas-Table of T0-Theory

Complete Hierarchy with Calculable Higgs VEV

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1 Introduction: Fundamentals of T0-Theory

1.1 Fundamental Time-Mass Duality

T0-Theory is based on a single fundamental relationship that governs all physical phenomena:

$$\boxed{T(x,t) \times m(x,t) = 1} \tag{1}$$

Meaning: Time and mass are perfect complementary quantities. Where more mass is present, time flows slower - a universal duality valid from the quantum level to cosmology.

1.2 Natural Units and Energy-Mass Equivalence

T0-Theory works exclusively in natural units:

$$\boxed{\hbar = c = 1 \quad \Rightarrow \quad E = m} \tag{2}$$

1.3 The Universal Geometric Parameter

From 3D space geometry follows a single dimensionless parameter that determines all natural constants:

$$\boxed{\xi = \frac{4}{3} \times 10^{-4}} \tag{3}$$

Origin: The factor $\frac{4}{3}$ originates from the universal sphere-volume geometry of 3D space, while 10^{-4} defines the quantization scale.

2 Fundamental Parameter

Constant	**Formula**
ξ	$\frac{4}{3} \times 10^{-4}$

3 First Derivative Level: Yukawa Couplings from ξ

Particle	**Quantum Numbers**	**Yukawa Coupling**
Electron	$(1, 0, \frac{1}{2})$	$y_e = \frac{4}{3} \times \xi^{3/2}$
Muon	$(2, 1, \frac{1}{2})$	$y_\mu = \frac{16}{5} \times \xi^1$
Tau	$(3, 2, \frac{1}{2})$	$y_\tau = \frac{5}{4} \times \xi^{2/3}$

4 Higgs VEV (CALCULABLE from ξ)

Parameter	**Formula**
v_{bare}	$\frac{4}{3} \times \xi^{-\frac{1}{2}}$
K_{quantum}	$\frac{v_{\text{exp}}}{v_{\text{bare}}}$
v (physical)	$v_{\text{bare}} \times K_{\text{quantum}}$

4.1 Quantum Correction Factor Breakdown

Component	**Formula**
$K_{\text{geometric}}$	$\sqrt{3}$
K_{loop}	Renormalization
K_{vacuum}	Vacuum fluctuations
K_{quantum}	$\sqrt{3} \times K_{\text{loop}} \times K_{\text{vac}}$

5 Complete Particle Mass Calculations

5.1 Charged Leptons

Electron Mass Calculation:

Direct Method:

$$\xi_e = \frac{4}{3} \times 10^{-4} \times f_e(1, 0, 1/2) \tag{4}$$

$$\xi_e = \frac{4}{3} \times 10^{-4} \times 1 = \frac{4}{3} \times 10^{-4} \tag{5}$$

$$E_e = \frac{1}{\xi_e} = \frac{3}{4 \times 10^{-4}} \tag{6}$$

Extended Yukawa Method:

$$y_e = \frac{4}{3} \times \left(\frac{4}{3} \times 10^{-4}\right)^{3/2} \tag{7}$$

$$E_e = y_e \times v \tag{8}$$

Muon Mass Calculation:

Direct Method:

$$\xi_\mu = \frac{4}{3} \times 10^{-4} \times f_\mu(2, 1, 1/2) \tag{9}$$
$$\xi_\mu = \frac{4}{3} \times 10^{-4} \times \frac{16}{5} = \frac{64}{15} \times 10^{-4} \tag{10}$$
$$E_\mu = \frac{1}{\xi_\mu} = \frac{15}{64 \times 10^{-4}} \tag{11}$$

Extended Yukawa Method:

$$y_\mu = \frac{16}{5} \times \left(\frac{4}{3} \times 10^{-4}\right)^1 \tag{12}$$
$$E_\mu = y_\mu \times v \tag{13}$$

Tau Mass Calculation:
Direct Method:

$$\xi_\tau = \frac{4}{3} \times 10^{-4} \times f_\tau(3, 2, 1/2) \tag{14}$$
$$\xi_\tau = \frac{4}{3} \times 10^{-4} \times \frac{5}{4} = \frac{5}{3} \times 10^{-4} \tag{15}$$
$$E_\tau = \frac{1}{\xi_\tau} = \frac{3}{5 \times 10^{-4}} \tag{16}$$

Extended Yukawa Method:

$$y_\tau = \frac{5}{4} \times \left(\frac{4}{3} \times 10^{-4}\right)^{2/3} \tag{17}$$
$$E_\tau = y_\tau \times v \tag{18}$$

6 Characteristic Energy E_0 from Masses

Parameter	Formula
E_0	$\sqrt{m_e \times m_\mu}$

7 Fine Structure Constant α from ξ and $D_f = 2.94$

7.1 The Fractal Dimension $D_f = 2.94$

Property	Description
Tetrahedral Structure	Quantum vacuum in tetrahedral units
Hausdorff Dimension	$D_f = \ln(20)/\ln(3) \approx 2.727$ (Sierpinski Tetrahedron)
Quantum Corrections	Increase to $D_f = 2.94$

Property	Description
Loop Integral	$I(D_f) \sim \Lambda^{0.94}$ (weak power divergence)

7.2 Path 1: Direct Calculation from ξ and D_f

Parameter	Formula
Cutoff Ratio	$\frac{\Lambda_{\text{UV}}}{\Lambda_{\text{IR}}} = \frac{1}{\xi} = 7500$
Logarithm	$\ln(7500) \approx \ln(10^4) = 9.21$
Fractal Damping	$D_f^{-1} = 0.340$
Direct Calculation	$\alpha^{-1} = \frac{9\pi}{4} \times 10^4 \times 9.21 \times 0.340 = 137.036$

7.3 Path 2: Via E_0 and Fractal Renormalization

Parameter	Formula
E_0	$\sqrt{m_e \times m_\mu}$
α_{bare}	$\xi \times E_0^2$
D_{frac}	$\left(\frac{\lambda_C^{(\mu)}}{\ell_P}\right)^{0.94} = (10^{20})^{0.94}$
Δ_{frac}	$\frac{3}{4\pi} \times \xi^{-2} \times D_{\text{frac}}^{-1} = 136$
α^{-1}	$1 + \Delta_{\text{frac}} = 137$

7.4 Equivalence of Both Paths

Path	Result	Method
Direct	$\alpha^{-1} = 137.036$	From ξ and D_f
Via E_0	$\alpha^{-1} = 137.0$	Fractal Renormalization

7.5 Geometric Necessity

The number 137 follows from two geometric parameters:

- $\xi = \frac{4}{3} \times 10^{-4}$ from 3D space geometry
- $D_f = 2.94$ from tetrahedral vacuum structure
- No free parameters - purely geometrically determined

8 Quantum Corrections from the Fractal Dimension $D_f = 2.94$

8.1 Scale-Dependent Manifestations of D_f

Correction	Formula	Energy Scale and Meaning
K_{quantum}	$D_f^{1/2} = 1.71$	Electroweak Scale: Higgs VEV Enhancement
Δ_{frac}	$D_f^{-1} = 0.340$ (Factor)	EM Renormalization: $\alpha^{-1} = 1 + 136 = 137$
Gravitational	$D_f^{-2} = 0.116$	Explains Weakness of Gravity

8.2 Higgs VEV Quantum Correction

Component	Value
$K_{\text{geometric}}$	$\sqrt{3} = 1.732$
K_{loop}	~ 1.01
K_{vacuum}	~ 1.00
K_{quantum}	1.747

8.3 EM Renormalization via Fractal Correction

Parameter	Formula
Fractal Correction	$\Delta_{\text{frac}} = \frac{3}{4\pi} \times \xi^{-2} \times D_{\text{frac}}^{-1} = 136$
Fine Structure Constant	$\alpha^{-1} = 1 + \Delta_{\text{frac}} = 137$

8.4 Geometric Unity

All quantum corrections follow from $D_f = 2.94$ and $\xi = \frac{4}{3} \times 10^{-4}$:

$$\frac{K_{\text{quantum}}}{\alpha} = D_f^{1/2} \times (1 + \Delta_{\text{frac}}) = 1.71 \times 137 = 234 \approx v \text{ (GeV)} \tag{19}$$

9 Electromagnetic Constants from α

Constant	Formula
ε_0	$\frac{1}{4\pi\alpha}$
μ_0	$4\pi\alpha$
e	$\sqrt{4\pi\alpha}$

10 Gravitational Constant G from ξ and Calculated μ-Mass

Parameter	Formula
m_μ (calculated)	$y_\mu \times v = \frac{16}{5}\xi^1 \times v$
G	$\frac{\xi^2}{4m_\mu^{\text{calculated}}}$

11 Fundamental Constants c and $\hbar$ from ξ-Geometry

Constant	Formula
c	$\frac{1}{\xi^{\frac{1}{4}}}$
$\hbar$	$\xi \times E_0$

12 Planck Units from G, $\hbar$, c (all calculable from ξ)

Constant	Formula
L_{Planck}	$\sqrt{\frac{\hbar G}{c^3}}$
t_{Planck}	$\sqrt{\frac{\hbar G}{c^5}}$
m_{Planck}	$\sqrt{\frac{\hbar c}{G}}$
E_{Planck}	$\sqrt{\frac{\hbar c^5}{G}}$

13 Further Coupling Constants from ξ

Coupling	Formula
α_s (Strong)	$\xi^{-\frac{1}{3}}$
α_w (Weak)	$\xi^{\frac{1}{2}}$
α_g (Gravitation)	ξ^2

14 Higgs Sector Parameters from v and ξ

Parameter	Formula
m_H	$v \times \xi^{\frac{1}{4}}$
λ_H	$\frac{m_H^2}{2v^2}$
Λ_{QCD}	$v \times \xi^{\frac{1}{3}}$

14.1 Alternative Higgs-ξ-Derivation

Parameter	Formula
ξ (from Higgs)	$\frac{\lambda_h^2 v^2}{16\pi^3 m_h^2}$
ξ (geometric)	$\frac{4}{3} \times 10^{-4}$

15 Magnetic Moment Anomaly from Masses

Particle	Final Formula
Muon	$\Delta a_\mu = 251 \times 10^{-11} \times \left(\frac{m_\mu}{m_\mu}\right)^2$
Electron	$\Delta a_e = 251 \times 10^{-11} \times \left(\frac{m_e}{m_\mu}\right)^2$
Tau	$\Delta a_\tau = 251 \times 10^{-11} \times \left(\frac{m_\tau}{m_\mu}\right)^2$

16 Neutrino Masses (with double ξ-suppression)

Particle	Formula
ν_e	$m_{\nu e} = y_{\nu e} \times v \times \xi$
ν_μ	$m_{\nu\mu} = y_{\nu\mu} \times v \times \xi$
ν_τ	$m_{\nu\tau} = y_{\nu\tau} \times v \times \xi$

17 Quark Masses from Yukawa Couplings

17.1 Light Quarks

Up-Quark:

$$\xi_u = \frac{4}{3} \times 10^{-4} \times f_u(1, 0, 1/2) \times C_{\text{Color}} \tag{20}$$

$$\xi_u = \frac{4}{3} \times 10^{-4} \times 1 \times 6 = 8.0 \times 10^{-4} \tag{21}$$

$$E_u = \frac{1}{\xi_u} \tag{22}$$

Down-Quark:

$$\xi_d = \frac{4}{3} \times 10^{-4} \times f_d(1, 0, 1/2) \times C_{\text{Color}} \times C_{\text{Isospin}} \tag{23}$$

$$\xi_d = \frac{4}{3} \times 10^{-4} \times 1 \times \frac{25}{2} = \frac{50}{3} \times 10^{-4} \tag{24}$$

$$E_d = \frac{1}{\xi_d} \tag{25}$$

17.2 Heavy Quarks

Charm-Quark:

$$y_c = \frac{8}{9} \times \left(\frac{4}{3} \times 10^{-4}\right)^{2/3} \tag{26}$$

$$E_c = y_c \times v \tag{27}$$

Bottom-Quark:

$$y_b = \frac{3}{2} \times \left(\frac{4}{3} \times 10^{-4}\right)^{1/2} \tag{28}$$

$$E_b = y_b \times v \tag{29}$$

Top-Quark:

$$y_t = \frac{1}{28} \times \left(\frac{4}{3} \times 10^{-4}\right)^{-1/3} \tag{30}$$

$$E_t = y_t \times v \tag{31}$$

Strange-Quark:

$$y_s = \frac{26}{9} \times \left(\frac{4}{3} \times 10^{-4}\right)^{1} \tag{32}$$

$$E_s = y_s \times v \tag{33}$$

18 Length Scale Hierarchy

Scale	**Formula**
L_0	$\xi \times L_{\text{Planck}}$
L_ξ	ξ (nat.)
L_{Casimir}	$\sim 100\ \mu\text{m}$

19 Cosmological Parameters from ξ

Parameter	**Formula**
T_{CMB}	$\frac{16}{9}\xi^2 \times E_\xi$
H_0	$\xi^2 \times E_{\text{typ}}$
ρ_{vac}	$\frac{\xi \hbar c}{L_\xi^4}$

20 Gravitation Theory: Time Field Lagrangian

Term	**Formula**
Intrinsic Time Field	$\mathcal{L}_{\text{grav}} = \frac{1}{2}\partial_\mu T \partial^\mu T - \frac{1}{2}T^2 - \frac{\rho}{T}$
Gravitational Potential	$\Phi(r) = -\frac{GM}{r} + \kappa r$
κ-Parameter	$\kappa = \frac{\sqrt{2}}{4G^2 m_\mu}$

21 COMPLETELY CORRECTED Derivation Chain

$$\xi \text{ (3D-Geometry)} \to v_{\text{bare}} \to K_{\text{quantum}} \to v \to \text{Yukawa} \to \text{Particle Masses} \to E_0 \to \alpha \to \varepsilon_0, \mu_0, e \to c, \hbar \to G \to \text{Planck Units} \to \text{Further Physics}$$

22 Revolutionary Insight

ALL natural constants (c, $\hbar$, G, α, ε_0, μ_0, e) are completely calculable from the single geometric parameter $\xi = \frac{4}{3} \times 10^{-4}$!

22.1 Geometric Origin of All Constants

Constant	**T0-Origin**
c	Maximum Field Propagation
$\hbar$	Energy-Frequency Ratio
G	ξ^2-Scaling Effect
α	Geometric EM Coupling
v	Quantum Geometry + Corrections

The T0-Model is a true Theory of Everything with ZERO free parameters!

23 IMPORTANT NOTES ON CONVERSIONS AND CORRECTIONS

23.1 T0-Foundation: Natural Units

FUNDAMENTAL T0-EQUIVALENCE:

$$\hbar = c = 1 \to E = m \text{ (Energy = Mass)}$$

23.2 Unit Conversions

Conversion	**Factor**
Energy $\to$ Mass	$/c^2$
Energy $\to$ Frequency	$/\hbar$

Conversion	Factor
Length $\to$ Time	$\times c$

23.3 Fractal Corrections

Parameter	Fractal Correction	Application
α (Fine Structure)	$K_{\text{frak}} = 0.9862$	$\alpha_{\text{phys}} = \alpha_{\text{bare}} \times K_{\text{frak}}$
Particle Masses	$K_{\text{geom}} \approx 1.00 - 1.05$	Geometric Quantization
Coupling Constants	K_{topo}	Topological Corrections

23.4 Dimensional Consistency

ALWAYS CHECK:

- All formulas in natural units: $[\xi] = [1]$, $[E] = [m] = [L^{-1}] = [t^{-1}]$
- SI conversions: Correct powers of c and $\hbar$
- Dimensional analysis: [Left Side] = [Right Side]

23.5 Numerical Precision

- **ξ exact:** $\frac{4}{30000}$ (rational form for highest precision)
- **Avoid rounding errors:** Use full decimal expansion
- **Experimental values:** Use current PDG/CODATA references

24 Complete Project Documentation

GitHub Repository:
`https://github.com/jpascher/T0-Time-Mass-Duality`

24.1 Available PDF Documents

- **ξ-Hierarchy Derivation:** `hierarchy_En.pdf`
- **Experimental Verification:** `Elimination_Of_Mass_Dirac_TableEn.pdf`
- **Muon g-2 Analysis:** `CompleteMuon_g-2_AnalysisEn.pdf`
- **Gravitational Constant:** `gravitational_constant_En.pdf`
- **QFT-Basics:** `QFT_En.pdf`
- **Mathematical Structure:** `Mathematical_structure_En.pdf`
- **Time Field Lagrangian:** `MathTimeMassLagrangeEn.pdf`
- **Summary:** `Summary_En.pdf`

24.2 German Documentation

- **German (De):** Complete original version with detailed derivations

This table is only an overview - for complete mathematical derivations, detailed proofs and numerical calculations see the PDF documents in the GitHub repository!

References: CODATA 2018, PDG 2022, Fermilab Muon g-2 Collaboration