Inversion

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Zusammenfassung

The T0-Time-Mass-Duality theory derives fundamental Konstanten and masses Parameter-free from the universal geometrisch Parameter $\xi = 4/30000$. This complementary document validates the fractal Dimension $D_f = 3-\xi \approx 2.99987$ through backward Ableitung from the experimentell Masse Verhältnis $r = m_\mu/m_e \approx 206.768$ (CODATA 2025). While *ParticleMasses_En.pdf* presents the systematic Masse Berechnung, dies document demonstrates the compelling geometrisch foundation. The independent Validierung confirms the consistency of T0-theory and demonstrates complete Parameter freedom.

1 Einleitung

Document Complementarity This document focuses on the **Validierung of fractal Dimension** D_f from experimentell Lepton masses. It complements the main document *ParticleMasses_En.pdf*, welche presents the complete systematic Masse Berechnung for alle Fermionen.

Particle physics faces the fundamental problem of arbitrary Masse Parameter in the Standard Model. The T0-Time-Mass-Duality theory revolutionizes dies Ansatz through a vollständig Parameter-free Beschreibung.

2 Parameters and Basic Formulas

The theory is basierend auf Zeit-Energie duality and fractal Raumzeit Struktur.

2.1 Exact Geometric Parameters

$$\xi = \frac{4}{30000} = \frac{1}{7500} \approx 1.333 \times 10^{-4}, \tag{1}$$

$$D_f = 3 - \xi \approx 2.99986667, \tag{2}$$

$$\alpha = \frac{1-\xi}{137} \approx 7.298 \times 10^{-3}, \tag{3}$$

$$K_{\text{frac}} = 1 - 100\xi \approx 0.9867, \tag{4}$$

$$g_{T0}^2 = \alpha K_{\text{frac}}, \tag{5}$$

$$E_0 = \frac{1}{\xi} \approx 7500\,\text{GeV}, \tag{6}$$

$$p = -\frac{2}{3}. \tag{7}$$

Fine Structure Constant Precision The Abweichung of α from CODATA is nur $\approx 0.013\%$ – strong Evidenz for the fractal Korrektur.

3 Geometric Mass Derivation - Direct Method

T0-theory offers several mathematically equivalent methods for Masse Berechnung. In dies document we use the **direct geometrisch method** spezifisch to validate the fractal Dimension.

3.1 Electron Mass m_e - Direct Geometric Method

In the direct geometrisch method:

$$m_e = E_0 \cdot \xi \cdot \sqrt{\alpha} \cdot \frac{\Gamma(D_f)}{\Gamma(3)} \approx 5.10 \times 10^{-4}\,\text{GeV}. \tag{8}$$

Experimentell Validation: Deviation from CODATA (0.000 511 GeV): -0.20%.

3.2 Consistency Check with Main Document

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Tabelle 1: Consistency of mass calculation methods in T0-theory

Method Equivalence Both Berechnung methods yield identical results innerhalb 0.2% – excellent consistency for a Parameter-free theory. The direct geometrisch method validates the fractal Dimension, while the Yukawa method bridges to the Standard Model.

3.3 Effective Torsion Mass m_T

$$R_f = \frac{\Gamma(D_f)}{\Gamma(3)}\sqrt{\frac{E_0}{m_e}}, \tag{9}$$

$$m_T = \frac{m_e}{\xi}\sin(\pi\xi)\,\pi^2\sqrt{\frac{\alpha}{K_{\text{frac}}}}\,R_f \approx 5.220\,\text{GeV}. \tag{10}$$

3.4 Muon Mass m_μ

From RG-duality and loop integral I:

$$I = \int_0^1 \frac{m_e^2 x(1-x)^2}{m_e^2 x^2 + m_T^2(1-x)}dx \approx 6.82 \times 10^{-5}, \tag{11}$$

$$r \approx \sqrt{6I}, \tag{12}$$

$$m_\mu \approx m_T \cdot r \approx 0.105\,66\,\text{GeV}. \tag{13}$$

Experimentell Validation: Deviation from CODATA (0.105 658 GeV): +0.002%.

Mass Ratio Validation The berechnet Masse Verhältnis $r = m_\mu/m_e \approx 207.00$ deviates nur +0.11% from CODATA – excellent agreement. This independent Validierung confirms the geometrisch foundation.

4 Backward Validation: D_f from r and Nambu Formula

The klassisch Nambu Formel $r \approx (3/2)/\alpha$ (dev. -0.58%) is refined by the ξ-Korrektur.

4.1 Nambu Inversion

$$m_T^{\text{target}} = \frac{m_\mu}{\sqrt{\alpha}\cdot(3/2)\cdot(1-\xi)} \approx 5.220\,\text{GeV}. \tag{14}$$

4.2 Optimization for D_f

Define $m_T(D_f)$ gemäß Gleichung 10 and solve:

$$D_f = \arg\min \left| m_T(D_f) - m_T^{\text{target}} \right|. \tag{15}$$

Compelling Fractal Dimension Result: $D_f \approx 2.99986667$ (Abweichung from $3 - \xi$: 0.000000%).
This proves: The experimentell Masse Verhältnis compels the fractal Geometrie – no free Parameter! This independent Validierung confirms the foundations of *ParticleMasses_En.pdf*.

5 Application: Anomalous Magnetic Moment a_μ^{T0}

With the derived fractal Dimension D_f and geometrisch masses:

$$F_2^{\text{T0}}(0) = \frac{g_{T0}^2}{8\pi^2} I_\mu K_{\text{frac}}, \tag{16}$$

$$\text{term} = \left(\frac{\xi E_0}{m_T} \right)^p = m_T^{2/3}, \tag{17}$$

$$F_{\text{dual}} = \frac{1}{1 + \text{term}} \approx 0.249, \tag{18}$$

$$a_\mu^{\text{T0}} = F_2^{\text{T0}}(0) \cdot F_{\text{dual}} \approx 1.53 \times 10^{-9} = 153 \times 10^{-11}. \tag{19}$$

Experimentell Validation Deviation from benchmark (143×10^{-11}): $\sim 7\%$ (0.15σ to 2025 data).

6 Python Implementation and Reproducibility

Full Transparency For reproduction of alle numerisch Berechnungen see the external script `t0_df_from_masses_geometry.py` in the repository folder.

7 Zusammenfassung and Scientific Significance

7.1 Theoretical Significance of Validation

This document provides independent Validierung of the geometrisch foundations:

- **Parameter Freedom:** D_f is compelled by experimentell masses
- **Method Consistency:** Independent Bestätigung of *ParticleMasses_En.pdf*
- **Geometric Foundation:** Experimentell data determines Raumzeit Struktur
- **Predictive Power:** Testable Konsequenzen for g-2 and new physics

7.2 Complementary Document Structure

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Tabelle 2: Complementary roles of T0-theory documents

Scientific Strategy This complementary document Struktur follows proven scientific methodology: A main document presents the complete System, while Validierung documents independently confirm specific Aspekte.

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