Dirac Equation in T0 Theory: Introduction and Overview

Clifford Algebra, Spin Topology, and Geometric Integration

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Abstract

This document provides a brief introduction to the geometric interpretation of the Dirac equation within the framework of T0 theory. The Dirac equation is not fundamentally described by 4×4 matrices but by a Clifford algebra structure of spacetime. Spin-1/2 is a topological property (winding number on a torus), not a mysterious matrix property. In T0 theory, mass is determined dynamically by time-mass duality $T(x) \cdot m(x) = 1$, and the fractal dimension $D_f = 3 - \xi$ modifies the underlying metric.

For a complete technical presentation, see the main document: 051_dirac_En.pdf

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1 Overview

Integrating the Dirac equation into T0 theory requires a fundamental rethinking about the nature of Dirac matrices and spin. This brief document provides an overview of the most important concepts. For details, refer to the comprehensive technical document 051.

2 The Fundamental Insight: Clifford Algebra

2.1 The Problem with 4×4 Matrices

The standard Dirac equation is usually written as:

$$(i\gamma^\mu \partial_\mu - m)\psi = 0 \tag{1}$$

with complex 4×4 matrices γ^μ.

The question: Why 4×4 matrices? Are they fundamental?

The answer: No. The matrices are a **representation**, not the fundamental physics.

2.2 The Abstract Form

The fundamental Dirac equation is a Clifford algebra equation:

$$\boxed{(i\mathrm{e}_\mu \partial^\mu - m)\Psi = 0} \tag{2}$$

where:

- e_μ: Abstract basis vectors of spacetime (not matrices!)
- Ψ: Geometric object in the spin bundle
- Clifford rule: $\mathrm{e}_\mu \mathrm{e}_\nu + \mathrm{e}_\nu \mathrm{e}_\mu = 2g_{\mu\nu}$

The 4×4 matrices γ^μ are only **one possible matrix representation** of the abstract basis vectors e^μ.

Representation vs. Physics

Fundamental: Clifford algebra structure
Representation: 4×4 matrices (calculation tool)
The matrices are **not** the physics, but a tool for calculation.

3 Spin as Topology

3.1 The 720° Rotation

Spin-1/2 particles have the well-known property:

$$R(360°)\Psi = -\Psi \quad \text{and} \quad R(720°)\Psi = \Psi \tag{3}$$

This is **not a matrix property**, but follows directly from the Clifford algebra structure!

3.2 Winding Numbers on the Torus

In T0 theory, spin is interpreted geometrically:

$$\text{Spin-}s \longleftrightarrow \text{Winding } (n_\theta, n_\phi) \text{ with } \frac{n_\phi}{n_\theta} = 2s \tag{4}$$

Spin-1/2: Winding $(1,1)$ on the torus
The 720° rotation = traversing this winding twice
This is **pure topology**, not a mysterious quantum property!

4 T0 Integration: Overview

4.1 Fractal Spacetime

T0 theory postulates a fractal spacetime dimension:

$$D_f = 3 - \xi \quad \text{with} \quad \xi = \frac{4}{3 \times 10^4} \tag{5}$$

This modifies the Clifford algebra structure to:

$$\mathrm{e}_\mu^{\text{(frak)}}\mathrm{e}_\nu^{\text{(frak)}} + \mathrm{e}_\nu^{\text{(frak)}}\mathrm{e}_\mu^{\text{(frak)}} = 2g_{\mu\nu}^{\text{(frak)}} \tag{6}$$

4.2 Time-Mass Duality

Mass is not constant but dynamic:

$$T(x) \cdot m(x) = 1 \quad \Rightarrow \quad m(x) = \frac{1}{c^2 T(x)} \tag{7}$$

The T0 Dirac equation becomes:

$$(i\partial\!\!\!/_{\text{frak}} - m(x))\Psi(x) = 0 \tag{8}$$

4.3 Predictions

The fundamental prediction is a **ratio**:

$$\boxed{\frac{a_\tau}{a_\mu} = \left(\frac{m_\tau}{m_\mu}\right)^2 \approx 283} \tag{9}$$

This is:

- Independent of unit systems
- Independent of fractal corrections
- Testable at Belle II (2027-2028)

5 For Further Details

This brief overview covers only the most important concepts. For a complete technical presentation, see:

Main Document

Dirac Equation in T0 Theory: Geometric Integration
051_dirac_En.pdf

This document contains:

- Complete Clifford algebra formulation
- Detailed spin topology with figures
- Tetrad formalism for fractal metric
- Mass-proportional coupling and loop diagrams
- Time field dynamics in detail
- Natural vs. SI units
- Experimental tests and predictions
- Limits of the theory (honestly presented)

6 Comparison Table

Aspect	Standard Dirac	T0 Dirac
Mathematics	4×4 matrices	Clifford algebra
Spin	Matrix property	Topological winding
Mass	Constant m	Dynamic $m(x,t)$
Metric	Minkowski $\eta_{\mu\nu}$	Fractal $g_{\mu\nu}^{\text{(frak)}}$
Dimension	$D=4$	$D_f = 3-\xi$ (space)
Topology	None	Torus
Predictions	Qualitative	Testable ratios

Table 1: Comparison: Standard vs. T0 Dirac formulation

7 Core Messages

1. The Dirac equation is fundamentally a **Clifford algebra equation**, not a matrix equation
2. Spin-1/2 is a **topological property** (winding number), not a mysterious matrix property
3. In T0 theory, mass is **dynamically** determined by time-mass duality

4. The fractal dimension modifies the **geometric structure** of spacetime
5. The testable prediction is the **ratio** $a_\tau/a_\mu = (m_\tau/m_\mu)^2$

8 Summary

The geometric formulation of the Dirac equation in T0 theory:

- Replaces 4×4 matrices with fundamental Clifford algebra
- Interprets spin as topology (winding number on torus)
- Integrates fractal spacetime ($D_f = 3 - \xi$)
- Uses dynamic mass ($m(x) = 1/(c^2T(x))$)
- Makes testable ratio predictions

For the complete technical presentation:

→ `051_dirac_En.pdf`

Further Reading

T0 Theory Basics:

- Chapter 2: Xi-Narrative – Basic principles
- Chapter 3: Time-Mass Duality in QM and QFT
- Chapter 5: Predictions and Experimental Tests

Technical Details:

- 051_dirac_En.pdf – Complete Dirac integration
- g2_T0_Phenomenology.tex – Anomalous magnetic moments

Clifford Algebras in General:

- Hestenes, D. "Space-Time Algebra"
- Lounesto, P. "Clifford Algebras and Spinors"
- Doran, C. & Lasenby, A. "Geometric Algebra for Physicists"