

# T0 Model: Complete Parameter-Free Particle Mass Calculation

Direct Geometric Method vs. Extended Yukawa Method  
With Complete Neutrino Quantum Number Analysis and QFT Derivation

## Abstract

The T0 model provides two mathematically equivalent but conceptually different calculation methods for particle masses: the direct geometric method and the extended Yukawa method. Both approaches are completely parameter-free and use only the single geometric constant  $\xi = \frac{4}{3} \times 10^{-4}$ . This complete documentation includes both the previously missing neutrino quantum numbers and the quantum field theoretical derivation of the  $\xi$  constant through EFT matching and 1-loop calculations. The systematic treatment of all particles, including neutrinos with their characteristic double  $\xi$  suppression, demonstrates the truly universal nature of the T0 model. The average deviation of less than 1% across all particles in a parameter-free theory represents a revolutionary advance from over twenty free Standard Model parameters to zero free parameters.

# Contents

## 0.1 Introduction

Particle physics faces a fundamental problem: the Standard Model with its over twenty free parameters offers no explanation for the observed particle masses. These appear arbitrary and without theoretical justification. The T0 model revolutionizes this approach through two complementary, completely parameter-free calculation methods that now include a complete treatment of neutrino masses.

### 0.1.1 The Parameter Problem of the Standard Model

Despite its experimental success, the Standard Model suffers from a profound theoretical weakness: it contains more than 20 free parameters that must be determined experimentally. These include:

- **Fermion masses:** 9 charged lepton and quark masses
- **Neutrino masses:** 3 neutrino mass eigenvalues
- **Mixing parameters:** 4 CKM and 4 PMNS matrix elements
- **Gauge couplings:** 3 fundamental coupling constants
- **Higgs parameters:** Vacuum expectation value and self-coupling
- **QCD parameters:** Strong CP phase and others

Revolution in Particle Physics The T0 model reduces the number of free parameters from over twenty in the Standard Model to **zero**. Both calculation methods use exclusively the geometric constant  $\xi = \frac{4}{3} \times 10^{-4}$ , which follows from the fundamental geometry of three-dimensional space. This complete version now contains the previously missing neutrino quantum numbers as well as the quantum field theoretical derivation.

## 0.2 Methodological Clarification: Establishment vs. Prediction

Scientific-Historical Classification The T0 model follows the proven scientific methodology of **pattern recognition and systematic classification**, analogous to the development of the periodic table (Mendeleev 1869) or the quark model (Gell-Mann 1964).

### 0.2.1 Two-Phase Development

#### Phase 1: Establishing the Systematics

1. Pattern recognition in known particle masses (electron, muon, tau)
2. Parameter determination from experimental data
3. Quantum number assignment establishment
4. Demonstration of mathematical equivalence of both methods

#### Phase 2: Unfolding Predictive Power

1. Extrapolation to unknown particles
2. Quark sector derivation from lepton patterns
3. New generation predictions
4. Experimental testing

### 0.2.2 Historical Precedent of Successful Pattern Physics

The T0 model follows the proven methodology of great physical discoveries:

## 0.3 From Energy Fields to Particle Masses

### 0.3.1 The Fundamental Challenge

One of the most impressive successes of the T0 model is its ability to calculate particle masses from pure geometric principles. While the Standard Model requires over 20 free parameters to describe particle masses, the

T0 model achieves the same precision with only the geometric constant  $\xi_{\text{geom}} = \frac{4}{3} \times 10^{-4}$ .

Particle	n	l	j	$r_i$	$p_i$	Special
<i>Charged Leptons</i>						
Electron	1	0	1/2	4/3	3/2	—
Muon	2	1	1/2	16/5	1	—
Tau	3	2	1/2	8/3	2/3	—
<i>Neutrinos</i>						
$\nu_e$	1	0	1/2	4/3	5/2	Double $\xi$
$\nu_\mu$	2	1	1/2	16/5	3	Double $\xi$
$\nu_\tau$	3	2	1/2	8/3	8/3	Double $\xi$
<i>Quarks</i>						
Up	1	0	1/2	6	3/2	Color
Down	1	0	1/2	25/2	3/2	Color + Isospin
Charm	2	1	1/2	2	2/3	Color
Strange	2	1	1/2	26/9	1	Color
Top	3	2	1/2	1/28	-1/3	Color
Bottom	3	2	1/2	3/2	1/2	Color