Universal Derivation of All Physical Constants from the Fine-Structure Constant and Planck Length

Abstract

This document demonstrates the revolutionary simplicity of natural laws: All fundamental physical constants in SI units can be derived from just two experimental base quantities - the dimensionless fine-structure constant $\alpha = 1/137.036$ and the Planck length $\ell_P = 1.616255 \times 10^{-35}$ m. Additionally, the confusion about the value of the characteristic energy E_0 in T0 theory is clarified, showing that $E_0 = 7.398\,\text{MeV}$ is the exact geometric mean of CODATA particle masses, not a fitted parameter. All common circularity objections are systematically refuted. The derivation reduces the seemingly large number of independent natural constants to just two fundamental experimental values plus human SI conventions, showing that the T0 raw values already capture the true physical relationships of nature.

Contents

0.1 Introduction and Basic Principle

0.1.1 The Minimal Principle of Physics

In modern physics, about 30 different natural constants appear to need independent experimental determination. This work shows, however, that all fundamental constants can be derived from just **two experimental values**:

Fundamental Insight

All physics needs reference scales!
Nature is dimensionally structured. To get from dimensionless relationships to measurable quantities, we need:

- An **energy scale** (from α)
- A **length scale** (from ℓ_P)
- **SI conventions** (human measures)

This is not a weakness of the theory, but a necessity of any dimensional physics!

0.1.2 Summary: Why the Circularity Objection Doesn't Apply

Final Refutation

The circularity objection is unjustified because:

1. ℓ_P is only one of many possible length scales
2. Only the specific Planck length yields the correct G-value
3. ℓ_P and G are both manifestations of the same geometry
4. ℓ_P serves as SI reference, not as G-definition
5. Without SI reference, the connection to measurable quantities would be lost
6. All established theories use fundamental scales as input
7. The mathematical hierarchy is non-circular

Conclusion: ℓ_P is the natural bridge between fundamental geometry and human measures - not a circular definition!

Level	Parameter	Status
1. Experimental Basis	α, ℓ_P	Measured
2. SI Conventions	μ_0, e, k_B, N_A	Defined
3. Derived Constants	c, ε_0, $\hbar$, G	Calculated
4. Planck Units	t_P, m_P, E_P, T_P	Derived
5. Atomic Constants	r_e, $\lambda_{C,e}$, a_0, R_∞	Derived
6. All Others	σ, b, etc.	Follow automatically

Table 1: Hierarchy of physical constants

0.2 Summary and Results

0.2.1 The Fundamental Hierarchy

0.2.2 Core Insights

Revolutionary Simplicity

1. **Only 2 experimental constants** (α and ℓ_P) suffice for all physics
2. **All other constants** are mathematical consequences
3. **SI definitions** are human conventions, not natural laws
4. **Nature is fundamentally simple**, not complicated
5. **T0 raw values** already deliver true physical relationships
6. **Fractal corrections** are only needed for absolute values