

**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  $E_0 = 7.398$  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  $\alpha$ )
- A **length scale** (from  $\ell_P$ )
- **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.  $\ell_P$  is only one of many possible length scales
2. Only the specific Planck length yields the correct G-value
3.  $\ell_P$  and  $G$  are both manifestations of the same geometry
4.  $\ell_P$  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:**  $\ell_P$  is the natural bridge between fundamental geometry and human measures - not a circular definition!

| Level                 | Parameter                           | Status               |
|-----------------------|-------------------------------------|----------------------|
| 1. Experimental Basis | $\alpha, \ell_P$                    | Measured             |
| 2. SI Conventions     | $\mu_0, e, k_B, N_A$                | Defined              |
| 3. Derived Constants  | $c, \varepsilon_0, \hbar, G$        | Calculated           |
| 4. Planck Units       | $t_P, m_P, E_P, T_P$                | Derived              |
| 5. Atomic Constants   | $r_e, \lambda_{C,e}, a_0, R_\infty$ | Derived              |
| 6. All Others         | $\sigma, b$ , 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** ( $\alpha$  and  $\ell_P$ ) 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