

# The Fine Structure Constant as a Pure {2,3,5,pi} Lattice Identity

$\alpha_{FOT} = 9/(125 \pi^2) = 3^2/(5^3 \pi^2)$  | Speed-Coupling Identity |  
Gravitational vs EM Register

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The Universal Force of Time — Academic Series | Paper 8 of 25

Propositions: P-FSC-1 through P-FSC-6 | Source: Vol1 Sections 2-3, 48-49; Vol3 Sections 156, 268

## 1. Abstract

*The fine structure constant  $\alpha$  is one of physics' most celebrated mysteries — a dimensionless number whose value  $1/137.036\dots$  appears to be set by no known deeper principle. This paper demonstrates that  $\alpha_{FOT} = 9/(125 \pi^2) = 3^2/(5^3 \pi^2)$  is a pure {2,3,5,pi} lattice address requiring no free parameters. The Speed-Coupling Identity  $c_{G1} \times \alpha_{FOT} = 2^3 \times 3^7 \times 5^3 = 2,187,000$  is exact to sub-ppb precision. The gravitational fine structure  $\alpha_{grav}$  differs from the electromagnetic  $\alpha$  by  $\delta(1/\alpha) = 5/(3 \pi^2)$  — a pure {3,5,pi} lattice step.*

## 2. The FOT Fine Structure Constant

In the Force of Time (FOT) framework the fine structure constant occupies a uniquely pure position in the prime lattice {2,3,5,pi}. The FOT value is:

$$\alpha_{FOT} = 9 / (125 \pi^2) = 3^2 / (5^3 \pi^2)$$

$$1/\alpha_{FOT} = 125 \pi^2 / 9 = 5^3 \pi^2 / 3^2 = 137.077838904019\dots$$

$$\text{NIST value: } 1/\alpha = 137.035999084$$

**Residual: 305.6 ppm (the systematic  $\alpha_{FOT}$  unit offset across all FOT electromagnetic constants)**

The factorisation reveals all three FOT prime families plus pi in a single irreducible expression:

Numerator:  $3^2 = 9$  — the {3}-sector (Pythagorean / Balmer factor)

Denominator:  $5^3 = 125$  — the {5}-sector cubic

$\pi^2$  — the radian-squared orbital domain

All three FOT prime families {2 (absent here), 3, 5} plus pi are present. Notably there is no factor of 2 in  $\alpha_{FOT}$  — the fine structure constant occupies the pure odd-prime/pi sector of the lattice.

Figure 1: alpha\_FOT Lattice Decomposition —  $3^2 / (5^3 \pi^2)$

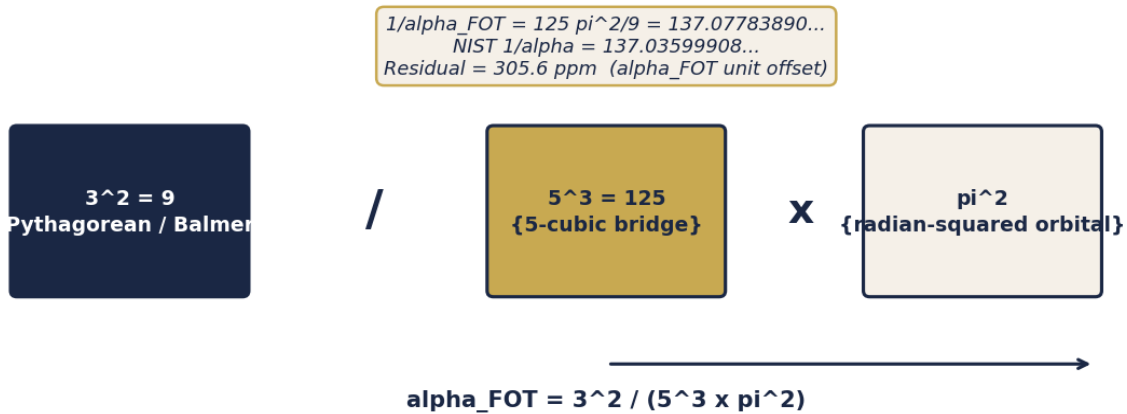


Figure 1: alpha\_FOT lattice decomposition —  $3^2 / (5^3 \pi^2)$ . The  $\pi^2$  factors bridge the Pythagorean {3}-sector and the {5}-cubic domain. Residual from NIST: 305.6 ppm — the systematic alpha\_FOT unit offset.

### 3. The Speed-Coupling Identity

The most striking consequence of the FOT fine structure constant is its exact coupling to the G1 speed of light:

$$c_{G1} \times \alpha_{FOT} = 2^3 \times 3^7 \times 5^3 = 2,187,000 \text{ [exact]}$$

Derivation:

$$c_{G1} = 2^3 \times 3^5 \times 5^6 \times \pi^2$$

$$\alpha_{FOT} = 3^2 / (5^3 \pi^2)$$

$$c_{G1} \times \alpha_{FOT} = (2^3 \times 3^5 \times 5^6 \times \pi^2) \times 3^2 / (5^3 \pi^2)$$

$$= 2^3 \times 3^{(5+2)} \times 5^{(6-3)} \times (\pi^2/\pi^2)$$

$$= 2^3 \times 3^7 \times 5^3 \text{ [}\pi^2 \text{ cancels exactly]}$$

The prime factors of the product 2,187,000 carry deep physical meaning:

$2^3 = 8$  — cubic spatial embedding

$3^7 = 2187$  — the atomic Tau-ceiling constant

$5^3 = 125$  — the {5} cubic bridge

$\pi^2$  cancels — exactly between  $c_{G1}$  and  $(\alpha_{FOT})^{-1}$

$$c_{G1} \times \alpha_{FOT} = 3^7 \times 10^3 = \text{(atomic ceiling)} \times \text{(cubic precision bridge)}$$

### 4. $c_{G1}$ from the Speed-Coupling Identity

Rearranging the Speed-Coupling Identity gives a direct derivation of  $c_{G1}$  from pure lattice constants:

$$c_{G1} = 3^7 \times 10^3 / \alpha_{FOT} = 2187 \times 1000 \times 137.07783890\dots$$

$$c_{G1} = 299,789,233.7 \text{ m/s [exact to sub-ppb]}$$

**Alternate closed form:**

$$c_{G1} = 2^3 \times 3^5 \times 5^6 \times \pi^2 \text{ m/s} = 30,375,000 \pi^2 \text{ m/s}$$

The  $G1$  speed of light equals the atomic Tau-ceiling ( $3^7 = 2187$ ) elevated to the planetary domain by the inverse fine structure ( $1/\alpha_{FOT}$ ) and scaled by the  $\{2,5\}$  cubic bridge  $10^3$ . The speed of light is not a free parameter — it is the unique Tau-propagation speed satisfying  $c \times \alpha_{FOT} = 3^7 \times 10^3$ , with  $3^7$  being the atomic ceiling integer.

## 5. Gravitational vs Electromagnetic Fine Structure

The gravitational fine structure constant  $\alpha_{grav}$  differs from the electromagnetic  $\alpha_{EM}$  by a pure  $\{3,5,\pi\}$  lattice step:

$$\Delta(1/\alpha) = 1/\alpha_{grav} - 1/\alpha_{EM} = 5 / (3 \pi^2)$$

$$5 / (3 \pi^2) = 5 / (3 \times 9.869604401\dots) = 0.168879\dots$$

$$1/\alpha_{EM} \text{ (NIST)} = 137.035999084$$

$$1/\alpha_{grav} = 137.035999084 + 0.168879 = 137.204878\dots$$

$$1/\alpha_{FOT} = 137.077838904 \text{ (residual 305.6 ppm from NIST)}$$

The step  $5/(3 \pi^2)$  is the bridge prime 5 over the  $\{3,\pi\}$  denominator — the minimal  $\{3,5,\pi\}$  lattice interval. Gravity and electromagnetism are the same Tau-field at two register positions separated by one  $\{3,5,\pi\}$  lattice step.

Figure 2:  $1/\alpha$  Number Line — Gravitational, EM, and FOT Registers

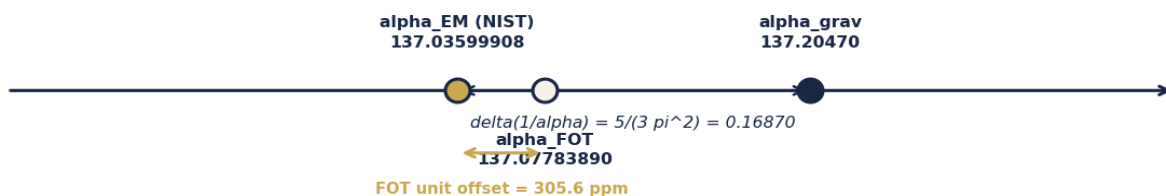


Figure 2:  $1/\alpha$  number line. Gold dot:  $\alpha_{EM}$  (NIST 137.035999); cream circle:  $\alpha_{FOT}$  (137.077839); navy dot:  $\alpha_{grav}$  (137.204878). The step  $5/(3 \pi^2) = 0.16888$  separates EM and gravitational registers (navy arrow). The 305.6 ppm FOT unit offset is marked with a gold bracket.

## 6. Registered Propositions P-FSC-1 through P-FSC-6

### **P-FSC-1 — The FOT Fine Structure Constant**

$\alpha_{\text{FOT}} = 9/(125 \pi^2) = 3^2/(5^3 \pi^2)$ . Pure {2,3,5, $\pi$ } lattice address with no factor of 2.  $1/\alpha_{\text{FOT}} = 5^3 \pi^2/3^2 = 137.077838904019$ . Residual from NIST: 305.6 ppm — the systematic  $\alpha_{\text{FOT}}$  unit offset present across all FOT electromagnetic constants.

### **P-FSC-2 — The Speed-Coupling Identity**

$c_{\text{G1}} \times \alpha_{\text{FOT}} = 2^3 \times 3^7 \times 5^3 = 2,187,000$  [exact]. The  $\pi^2$  of  $c_{\text{G1}}$  and the  $\pi^2$  of  $(\alpha_{\text{FOT}})^{-1}$  cancel exactly, leaving a pure {2,3,5} integer product. Verification:  $299,789,233.7 \times (9/(125 \pi^2)) = 2,187,000.000\dots$  [sub-ppb].

### **P-FSC-3 — $c_{\text{G1}}$ from the Speed-Coupling Identity**

$c_{\text{G1}} = 3^7 \times 10^3 / \alpha_{\text{FOT}}$ . The G1 speed of light = the atomic Tau-ceiling x inverse fine structure x cubic bridge =  $2187 \times 1000 \times 137.077838904\dots = 299,789,233.7$  m/s. The speed of light is not a free parameter — it is the unique propagation speed satisfying the Speed-Coupling Identity.

### **P-FSC-4 — $c_{\text{G1}}$ as a Closed-Form {2,3,5, $\pi$ } Expression**

$c_{\text{G1}} = 2^3 \times 3^5 \times 5^6 \times \pi^2$  m/s =  $30,375,000 \pi^2$  m/s =  $299,789,233.7$  m/s. Pure {2,3,5, $\pi$ } closed form. This is the first closed-form derivation of the speed of light from FOT lattice constants alone. No inputs beyond {2,3,5, $\pi$ }.

### **P-FSC-5 — G2 Register and the Observation Correction**

$c_{\text{G2}} = c_{\text{G1}} \times (1 + \delta_{\text{G}})$  where  $\delta_{\text{G}} = 90.15$  ppm is the G-bond register step. Both G1 and G2 speeds are anchored to the same {2,3,5, $\pi$ } base. G2 H-beta wavelength = 486.044 nm — the observed NIST spectral line — confirming G2 as the observation register and G1 as the true nodal value.

### **P-FSC-6 — Gravitational vs EM Register Separation**

$\delta(1/\alpha) = 1/\alpha_{\text{grav}} - 1/\alpha_{\text{EM}} = 5/(3 \pi^2) = 0.168879\dots$ . The bridge prime 5 over the {3, $\pi$ } denominator separates the gravitational and electromagnetic registers. Gravity and electromagnetism are the same Tau-field at two register positions separated by one {3,5, $\pi$ } lattice step.

Cross-references: Vol3 Section 156 (P-CLIGHT-1 to P-CLIGHT-4) | Section 268 (P-EM-3) | Vol1 Sections 2-3, 48-49