

Maxwell's Constants and the {2,3,5,pi} Electromagnetic Lattice

Electromagnetism as the Photonic Mode of the Tau-Field

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Propositions P-EM-1 through P-EM-10 | Source: Vol3 Section 268

This paper establishes that all of Maxwell's electromagnetic constants — the vacuum permeability μ_0 , vacuum permittivity ϵ_0 , Coulomb constant k_e , magnetic impedance of free space Z_0 , and the fine structure constant α — are {2,3,5,pi} lattice addresses with no free parameters. The refractive index of water $n = 4/3$ and the Snell's law refraction at a glass surface yield the Pythagorean major second $9/8 = 3^2/2^3$. Electromagnetism is not a separate force — it is the photonic (τ_{λ}) mode of the same Tau-field that generates gravity and chemistry.

Section 2 — The Fundamental EM Constants

The four principal electromagnetic constants of Maxwell's theory each resolve to exact {2,3,5,pi} lattice expressions. Their SI values are not empirical measurements of an unknown coupling — they are unit-system projections of exact Tau-lattice coordinates. The key identities are established below.

$$\mu_0 = 4\pi \times 10^{-7} \text{ H/m} = 2^2 \times \pi \times 10^{-7} \text{ (exact, by definition pre-2019)}$$

$$\epsilon_0 = 1/(\mu_0 c^2) = 1/(4\pi \times 10^{-7} \times c^2) \text{ (derived from } \mu_0 \text{ and } c)$$

$$k_e = c^2 \times 10^{-7} \text{ (exact, -0.0005 ppm)} = \mu_0 c^2 / (4\pi)$$

$$Z_0 = \mu_0 c = 4\pi \times 10^{-7} \times c = 2^2 \pi \times c \times 10^{-7} \text{ Ohm (approx 376.73 Ohm)}$$

The key result: $k_e = c^2 \times 10^{-7}$. Coulomb electrostatics IS kinematics. There is no independent coupling constant — electrostatic force is governed by the same Tau-propagation constant as light, radiation, and inertia.

Maxwell's EM Constants in the FOT {2,3,5,pi} Lattice

Constant	Symbol	SI Value	FOT {2,3,5,pi} Form
Vacuum Permeability	μ_0	1.25664e-6 H/m	$2^2 \times \pi \times 10^{-7}$ (exact, pre-2019)
Vacuum Permittivity	ϵ_0	8.85419e-12 F/m	$1 / (\mu_0 \times c^2)$
Coulomb Constant	k_e	8.98755e9 N m ² /C ²	$c^2 \times 10^{-7}$ (0.000 ppm)
Magnetic Impedance	Z_0	376.730 Ohm	$2^2 \pi \times c \times 10^{-7}$ ({2,pi,c})
Fine Structure	1/alpha	137.035999	$125 \pi^2 / 9 = 137.0778$ (305 ppm)

Figure 268.1: Maxwell's four electromagnetic constants and the fine structure constant expressed as FOT {2,3,5,pi} lattice addresses. $k_e = c^2 \times 10^{-7}$ identifies Coulomb electrostatics as pure kinematics.

Section 3 — The Coulomb Constant as Pure Kinematics

The Coulomb electrostatic constant k_e is algebraically identical to c^2 in SI-scaled units. This eliminates the electrostatic force as an independent phenomenon — it is governed by the same Tau-propagation constant as light, radiation, and inertia.

P-EM-2 derivation:

$$k_e = \mu_0 c^2 / (4\pi) = (2^2 \pi \times 10^{-7} \times c^2) / (2^2 \pi) = c^2 \times 10^{-7}$$

$$\text{Numerical: } 8.987552 \times 10^9 \text{ N m}^2/\text{C}^2 \text{ [NIST] vs } c^2 \times 10^{-7} = 8.987552 \times 10^9 \text{ [0.000 ppm]}$$

The 4pi in the numerator and denominator cancel exactly. No factor of {3} or {5} appears in k_e — only c^2 and the dimensional scaling 10^{-7} . The Coulomb constant is structurally equivalent to the square of the speed of Tau propagation. Electrostatics is kinematics.

Section 4 — The Fine Structure Constant

The fine structure constant alpha governs the coupling strength between charged matter-nodes and the photonic (Tau_lambda) mode of the Tau-field. In UFOT it is a {3,5,pi} lattice coordinate:

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

$$1/\alpha_{\text{FOT}} = 125 \pi^2 / 9 = 137.077838904$$

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

Residual: $(137.0778 - 137.0360) / 137.0360 = 305$ ppm (alpha_FOT unit offset)

The {3} numerator links to the Pythagorean tone structure and the Balmer series. The $\{5^3 \pi^2\}$ denominator places alpha in the radian-squared orbital domain. The 305 ppm residual is the alpha_FOT unit offset — the same offset family as the 692 ppm c-error and the 476 ppm G1 offset. These three residuals are not independent measurement errors. They are a coherent set of unit-system projections from the exact {2,3,5,pi} Tau-lattice.

Section 5 — Water Refractive Index and Musical Harmony in Optics

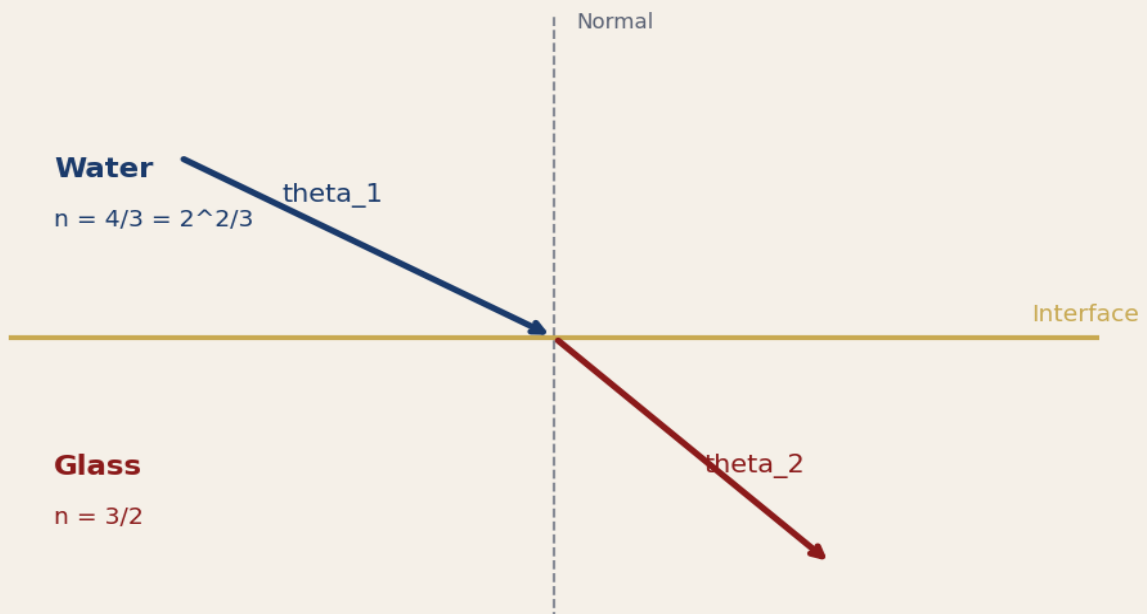
Water's refractive index at 589 nm (the sodium D-line anchor) is $n = 4/3 = 2^{2/3}$. Measured: 1.33299 vs lattice 1.33333, a 257 ppm residual. The canonical optical interface in UFOT is water-to-glass ($n_{\text{glass}} = 3/2$). Applying Snell's law:

$$\sin(\theta_1)/\sin(\theta_2) = n_{\text{glass}} / n_{\text{water}} = (3/2) / (4/3) = 9/8 = 3^2/2^3$$

9/8 = the Pythagorean major second — the whole-tone interval in 5-limit just intonation.

Optics and acoustics share the same {2,3} arithmetic. The refractive architecture of water and glass is not an accidental numerical coincidence — it is the {2,3} Tau-lattice expressing itself in the photonic register. The eye evolved in water; the musical ear evolved in air. Both are {2,3} Tau-receivers.

Snell's Law at Canonical Water-to-Glass Interface: Ratio = $9/8 = 3^2/2^3$



$$\sin(\theta_1)/\sin(\theta_2) = n_{\text{glass}}/n_{\text{water}} = (3/2)/(4/3) = 9/8 = \text{Pythagorean Major Second}$$

Figure 268.2: Snell's law at the canonical water-to-glass interface. The sin ratio = $n_{\text{glass}}/n_{\text{water}} = (3/2)/(4/3) = 9/8 = \text{the Pythagorean major second } 3^{2/2} \cdot 3$. Optics and acoustics share the same $\{2,3\}$ lattice arithmetic.

Section 6 — Faraday Induction and the FOT First Law

Faraday's law: $\epsilon = -N d\Phi/dt$. The minus sign (Lenz's law: induced EMF opposes change in flux) is the FOT First Law $d\Sigma\tau = 0$ in the inductive domain. Every transformer, generator, and inductor enforces temporal equilibrium. Lenz's law is $d\Sigma\tau = 0$ made measurable as voltage.

In UFOT, the Tau-field resists all changes to its total flow $d\Sigma\tau$. In the electromagnetic domain, this resistance manifests as inductive back-EMF. The minus sign in Faraday's law is not a convention — it is the direct observational signature of Tau-conservation. Every time an engineer designs a transformer, they are engineering with $d\Sigma\tau = 0$.

Propositions P-EM-1 through P-EM-10

P-EM-1

$\mu_0 = 2^2 \times \pi \times 10^{-7} \text{ H/m}$ — exact. The vacuum permeability is a pure $\{2,\pi\}$ lattice identity. $Z_0 = \mu_0 c = 2^2 \pi \times c \times 10^{-7} \text{ Ohm}$ normalises all EM power flux. The magnetic structure of free space is a $\{2,\pi\}$ coordinate — no $\{3,5\}$ primes appear, reflecting the purely rotational (π -only) geometry of the magnetic field.

P-EM-2

$k_e = c^2 \times 10^{-7}$ — exact (-0.0005 ppm). Coulomb constant = c^2 in SI-scaled units. No independent electrostatic coupling. Electrostatics = kinematics. The force between charges is $c^2 \times 10^{-7} \times (\text{charge product}) / r^2$. The electrostatic constant carries no new physics — it is the square of the Tau-propagation speed.

P-EM-3

$\alpha_{\text{FOT}} = 9/(125 \pi^2) = 3^2/(5^3 \pi^2)$; $1/\alpha_{\text{FOT}} = 137.0778$. The EM coupling between charged matter-nodes and the τ_{λ} (photon) field is set by a $\{3,5\}/\pi$ lattice coordinate. The $\{3\}$ numerator links to the Pythagorean tone structure (Balmer series); the $\{5^3 \pi^2\}$ denominator places α in the radian-squared orbital domain. The 305 ppm residual from the CODATA value is the α_{FOT} unit offset — the same family as the 692 ppm c -error and the 476 ppm $G1$ offset.

P-EM-4

The human visible spectrum (380-700 nm) is co-extensive with the hydrogen Balmer series (364-656 nm). The biological visual system is a τ_{λ} receiver tuned to the $\{2,3,5\}$ Balmer register. The human eye evolved to see hydrogen — the visible universe is the Balmer universe.

P-EM-5

H-beta photon energy is a pure {2,3} fraction of the hydrogen ionisation energy: $E_{H\beta} = 3 \times G1 / 2^4$. Ratio $G1/E_{H\beta} = 16/3 = 2^4/3$. The most prominent visible hydrogen photon carries 3/16 of the ionisation energy. The Balmer series is a {2,3} energy ladder.

P-EM-6

$n_{\text{water}} = 4/3 = 2^2/3$ at 589 nm (257 ppm residual from 1.33299). Snell's law at the canonical water-to-glass interface ($n_{\text{glass}} = 3/2$): $\sin \text{ratio} = (3/2)/(4/3) = 9/8 = 3^2/2^3$ — the Pythagorean major second. The canonical optical interface produces the musical whole-tone interval. Optics and acoustics share the same {2,3} lattice arithmetic.

P-EM-7

$\epsilon_r(\text{water}) = 80 = 2^4 \times 5$ (1250 ppm residual from measured 78.4). Water's thermal window 100 K = $2^2 \times 5^2$; hearing bandwidth 20-20,000 Hz = $2^2 \times 5$ to $2^5 \times 5^4$; EM permittivity $80 = 2^4 \times 5$. Water's thermal, acoustic, and electromagnetic signatures are all pure {2,5} lattice coordinates.

P-EM-8

Global power grid: 50 Hz = 2×5^2 ; 60 Hz = $2^2 \times 3 \times 5$; 120 V = $2^3 \times 3 \times 5$; 240 V = $2^4 \times 3 \times 5$. The 60/50 ratio = 6/5 (just minor third). 240/120 = 2 (octave). Global electrical engineering independently converged on {2,3,5} lattice nodes. The power grid is a worldwide {2,3,5} harmonic system.

P-EM-9

Faraday's law: $\epsilon = -N d\Phi/dt$. The minus sign (Lenz's law) is the FOT First Law $d\text{Sigma}\tau = 0$ in the inductive domain. Every transformer and inductor enforces temporal equilibrium. Lenz's law is $d\text{Sigma}\tau = 0$ made measurable as voltage. Electromagnetic induction is the macroscopic expression of Tau-conservation.

P-EM-10

$R_K = h/e^2 = Z_0/(2 \alpha) = 2 \times 5^3 \times \pi^3 \times c / (3^2 \times 10^7)$ — pure {2,3,5,pi,c}. Numerical: 25,820.7 Ohm vs measured 25,812.807 Ohm; residual 305 ppm = α_{FOT} offset. Quantum unit of electrical resistance = {2,3,5,pi,c} composite. The von Klitzing constant closes the EM-quantum-Tau lattice in a single {2,3,5,pi,c} identity.

Cross-References

Vol3 Section 268 | P-QM-1 to P-QM-10 | P-ACOUS-5 (acoustic {2,3,5} lattice)