

Mathematical Appendix

Rotkotoe Unified Framework

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A. Fundamental Definitions

Symbol	Definition	Value / Description
ϕ	Golden ratio	$\phi = (1 + \sqrt{5})/2 = 1.61803398875$
ϖ	Lemniscate constant	$\varpi = \Gamma(1/4)^2 / (2\sqrt{\pi}) = 2.622057554$
$\alpha\infty$	Universal resonance constant	$\alpha\infty = \phi^{-2} = 0.38196601125$
f_0	Cosmic base frequency (hydrogen 21 cm line)	$1.42040575177 \times 10^9$ Hz
h	Planck constant	$6.62607015 \times 10^{-34}$ J·s
c	Speed of light	2.99792458×10^8 m/s
G	Gravitational constant	6.67430×10^{-11} m ³ /kg·s ²

B. Primary Equations

(1) Lemniscate Geometry

The universal curve of infinity:

$$(x^2 + y^2)^2 = 2a^2(x^2 - y^2)$$

The fundamental loop length:

$$L = 4a \int_0^1 dt/\sqrt{(1-t^4)} = 2\pi a/M(1,1/\sqrt{2})$$

where M is the arithmetic-geometric mean.

At the intersection point:

$$E_1 + E_2 = 2E_0 \text{ (constructive)}$$

$$E_1 - E_2 = 0 \text{ (destructive)}$$

$$E_{\text{total}} = E_1 + E_2\cos(\varphi) \text{ (partial)}$$

C. Geometric-Vibrational Coupling

(2) Universal Resonance Constant

$$\alpha_{\infty} = \varphi^{-2} = 0.38196601125$$

Derived geometric form:

$$\alpha_{\infty} = 2\pi^2/(\varpi\varphi) \approx 1.476$$

(where the second expression refers to the composite geometric constant sometimes used in phase calculations.)

(3) Fundamental Frequency and Wavelength

$$f_{\infty} = \alpha_{\infty}f_0 = 5.425467 \times 10^8 \text{ Hz}$$

$$\lambda_{\infty} = c/f_{\infty} = c/(\alpha_{\infty}f_0) = 0.552565 \text{ m}$$

Interpretation: λ_{∞} is the unit coherence cell of spacetime; the minimal standing-wave length of the cosmic field.

D. Energy–Mass Relations

(4) Universal Energy Quantum

$$E_0 = \alpha \hbar f_0 = 3.59495 \times 10^{-25} \text{ J} = 2.244 \text{ } \mu\text{eV}$$

(5) Complete Energy Equation

$$E = \alpha \hbar [\nu + \nu_0] = \alpha \hbar m c^2$$

or equivalently:

$$m c^2 = \alpha \hbar (\nu + \nu_0)$$

(6) Particle Quantization

All stable particle masses emerge as integer harmonics:

$$m c^2 = \nu N_{\text{part}} E_0$$

with $N_{\text{part}} = 8.561613 \times 10^8$ and $\nu = 1, 2, 3, \dots$ the toroidal mode number.

E. Derivatives and Differential Form

(7) Dual-Phase Field Equations

The universe as a dual phase function:

$$\Psi(\theta, \varphi, t) = E(\theta, \varphi, t) + G(\theta, \varphi, t)$$

with coupled oscillations:

$$\partial^2 E / \partial t^2 = -\omega_\infty^2 E$$

$$\partial^2 G / \partial t^2 = +\omega_\infty^2 G$$

where $\omega_\infty = 2\pi f_\infty = 3.409 \times 10^9$ rad/s.

The general solution:

$$\Psi(\theta, \varphi, t) = A e^{i\omega_\infty t} + B e^{-i\omega_\infty t}$$

representing opposing toroidal flows (expansive $\leftrightarrow$ convergent).

F. Derived Functions

(8) Harmonic Series

$$f_n = nf_0 ; \lambda_n = \lambda_0/n$$

$$E_n = nE_0 ; P(f) = A^2 \Sigma_n \delta(f - nf_0)$$

(9) Phase Superposition Function

$$\Phi(x,t) = \Sigma_n A_n e^{i2\pi v_0 n t}$$

All possible states coexist until observation causes collapse:

$$\text{Reality}_{\text{observea}} = |\Phi(x,t)|^2_{\text{collapsea}}$$

(10) Time-Tick Equation

$$t_0 = 1/v_0 = 0.704 \times 10^{-9} \text{ s}$$

— the fundamental cycle of existence. Time advances by phase rotation, not translation.

G. Gravitational–Quantum Bridge

(11) Rotkotoe Coupling Constant

$$\Gamma_{\infty} = \sqrt{(hG/c^3)}/\alpha_{\infty}$$

Substituting constants:

$$\Gamma_{\infty} = 1.06063 \times 10^{-34} \text{ m} = 6.56 \ell_p$$

It represents the minimum curvature radius per quantum of energy.

(12) Phase-Energy Curvature Relation

$$mc^2 = hv_{\infty} \cos \varphi$$

When $\varphi = 0 \rightarrow$ pure energy (quantum phase)

When $\varphi = \pi/2 \rightarrow$ pure curvature (gravitational phase)

H. Cosmological Scaling Laws

(13) Pythagorean Ladder

$$\Lambda_{k,m} = N\lambda_{\infty}/\sqrt{(k^2 + m^2)}$$

where $N \approx 10^{25-26}$ defines the cosmological octave number.

First five ratios:

(k,m)	$\sqrt{(k^2+m^2)}$	$\Lambda/\Lambda(1,0)$
(1,0)	1.000	1.000
(1,1)	1.414	0.707
(2,0)	2.000	0.500
(2,1)	2.236	0.447
(2,2)	2.828	0.354

Predicts the observed BAO sub-peaks in the matter power spectrum $P(k)$.

(14) Cosmic Phase Energy Density

$$\rho_{\text{ener}}\mathscr{G}_{\gamma} = \rho_0\cos^2(\tilde{\varphi})$$

$$\rho_{\text{urvature}} = \rho_0\sin^2(\tilde{\varphi})$$

$$w_e\rlap{\mathscr{H}}\!\!\!\!/\!\!\!\!/\! = \cos(2\tilde{\varphi}(t))$$

Phase evolution:

$$\tilde{\varphi}(t) = \varphi_0 + 2\pi t/T_{\infty}$$

Period of oscillation: $T_{\infty} \approx 10^{10}$ years

I. Information and Entropy

At the interference point (infinity intersection):

Maximum uncertainty:

$$\Delta x \Delta p \geq \hbar/2$$

Maximum information generation:

$$S = -\sum p_i \ln(p_i)$$

Infinite resonance quality:

$$Q = \omega_0/(2\gamma) \rightarrow \infty \text{ as } \gamma \rightarrow 0$$

J. Composite Summary

Core Constants

ϕ	$= 1.61803398875$
ϖ	$= 2.622057554$
α_{∞}	$= 0.38196601125$
f_0	$= 1.42040575177 \times 10^9 \text{ Hz}$
E_0	$= 2.244 \times 10^{-6} \text{ eV}$
λ_{∞}	$= 0.552565 \text{ m}$
Γ_{∞}	$= 1.0606 \times 10^{-34} \text{ m}$
t_0	$= 0.704 \times 10^{-9} \text{ s}$

Unified Function Set

E	$= \alpha_{\infty}[h\nu + h\nu_0] = \alpha_{\infty}mc^2$
mc^2	$= \nu N_{\text{part}} E_0$
λ_n	$= \lambda_{\infty}/n$
$\Psi(\theta, \phi, t)$	$= E + G = Ae^{i\omega t} + Be^{-i\omega t}$
Γ_{∞}	$= \sqrt{(hG/c^3)}/\alpha_{\infty}$
$\Lambda_{k,m}$	$= N\lambda_{\infty}/\sqrt{(k^2 + m^2)}$
$\text{Reality}_{\text{ofservea}}$	$= \sum A_n e^{i2\pi \nu n t} ^2_{\text{collapsea}}$

K. Interpretative Summary

Geometry → Frequency → Matter

The lemniscate geometry inherently produces periodic interference.

Duality Principle

Quantum expansion and gravitational contraction are phase-opposite states of one oscillating toroidal field.

Time as Resonance

Every moment equals one oscillation of the cosmic base frequency (0.704 ns).

Consciousness Coupling

Observation acts as a boundary condition enforcing phase collapse — selecting one harmonic among all superposed possibilities.

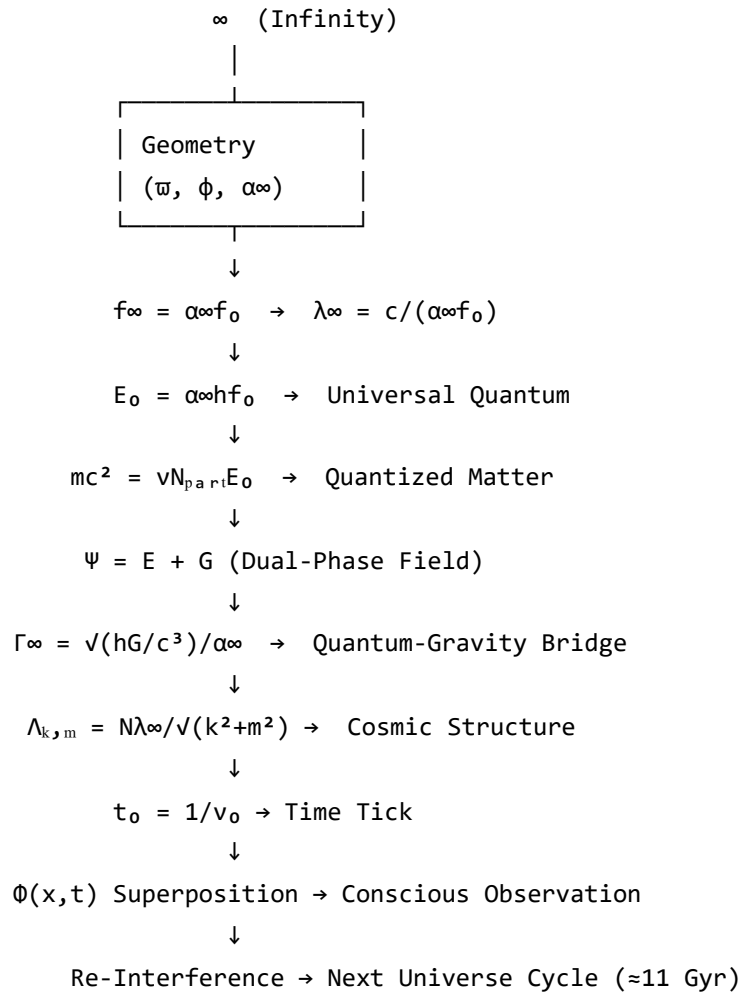
Final Unified Relation

$$\Psi_{\text{universe}}(\theta, \varphi, t) = \alpha \infty [h\nu + h\nu_0] e^{i(\theta + \varphi - 2\pi\nu_0 t)}$$

with periodic inversion every $T_{\infty} \approx 11$ billion years

L. The Rotkotoe Equation Tree

Hierarchical flow from Infinity Geometry $\rightarrow$ Quantum Energy $\rightarrow$ Cosmic Structure $\rightarrow$ Consciousness



Interpretive Hierarchy

Level	Domain	Core Equation	Meaning
1	Geometry	$(x^2 + y^2)^2 = 2a^2(x^2 - y^2)$	Infinite self-intersection
2	Frequency	$f_{\infty} = \alpha \infty f_0$	Base oscillation of universe
3	Energy	$E_0 = \alpha \infty h f_0$	Universal quantum
4	Matter	$m c^2 = v N_{\text{part}} E_0$	Quantized mass

5	Field	$\Psi = E + G$	Dual-phase torus field
6	Gravity Link	$\Gamma_{\infty} = \sqrt{(\hbar G/c^3)/\alpha_{\infty}}$	Planck-macro bridge
7	Cosmos	$\Lambda_{k,m} = N\lambda_{\infty}/\sqrt{(k^2 + m^2)}$	BAO structure
8	Time	$t_0 = 1/\nu_0$	Quantum time tick
9	Consciousness	Reality = $ \Phi ^2$	Observation collapse
10	Cycle	Period ≈ 11 Gyr	Reversal & rebirth of infinity