

Neutrino Cosmic Field Theory: Axiomatic Framework and Emergent Gravity

Final Chapter of the "Cosmic Field Theory" Trilogy (Paper 3)

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Previous Preprints: Paper 1 ([ai.viXra.org:2609.0016](https://arxiv.org/abs/2609.0016)) □ Paper 2 ([ai.viXra.org:2609.0026](https://arxiv.org/abs/2609.0026))

Abstract

This study proposes an axiomatic framework for emergent gravity and cosmology based on the phase transitions of a single neutral quantum field across three states. Philosophically and thermodynamically, the universe as a whole must maintain overall charge neutrality to sustain macroscopic geometric stability. This principle explicitly rejects models dominated by multi-polar fields or charged particles, establishing a minimalist foundation led by a neutral neutrino quantum field.

Focusing specifically on the topological scenario established in Paper 1—where a single living child-universe bubble tangentially invades a dead cosmic fluid background (V_0)—this work elevates the earlier phenomenological model into a rigorous orthogonal quantum field theory (QFT) geometry. We translate the concept of "dual aspects in a single entity" into a localized quantum field envelope $\Psi(x, t) = A_{\text{total}}(x, t)e^{i(\varphi_{\perp} + \varphi_{\parallel})}$. The "single entity" corresponds to the total amplitude spectrum A_{total} , encompassing visible baryonic matter A_b , degenerate dark matter V_2 , and excited dark energy V_1 . The "dual aspects" correspond to orthogonal phase spectra: the vertical phase $\varphi_{\perp}$ (whose spatial stress gradient emerges as gravity $\vec{g} = -k_2 \nabla \rho_{\Phi_2}$) and the transverse phase $\varphi_{\parallel}$ (whose time derivative drives dynamic dark energy).

Using the thermodynamic anchor of the observed Cosmic Microwave Background temperature $T_{\text{CMB}} = 2.73$ K calibrated in Paper 1—which fixes the foundational quantum grid spacing of the dead mother field V_0 at $\lambda_{v0} \approx 5.27$ mm and the lightest ground-state zero-point energy at $E_{v0} \approx 2.35 \times 10^{-4}$ eV—this paper advances the framework through the following first-principles breakthroughs:

- 1. Physical Nature of the Speed of Light (c_0) and Planck's Constant:** We propose that the absolute speed of light c_0 is fundamentally the intrinsic geometric propagation limit of the pure dead vacuum substrate V_0 , with effective relations indicating $c_0 \propto \rho_0^{-1/5}$. Planck's constant $\hbar$ is identified as the microscopic topological phase stiffness modulus and momentum-phase conversion constant of the V_0 mother field.
- 2. Geometric Unification of the Four Fundamental Forces:** The four forces are no longer independent entities, but rather emergent geometric phase manifestations of a single neutrino field within the V_0 medium.
- 3. Elimination of Virtual Boson Mediators:** The framework provides a geometric explanation for microscopic interactions without relying on the exchange of virtual bosons (such as virtual photons, gluons, $W^{\pm}/Z^0$ bosons, or independent gravitons).
- 4. Origin of Inertial Physics and the Equivalence Principle ($m_i \equiv m_g$):** Both inertial and gravitational masses act upon the same A_b envelope polarizing the identical V_0 mother field, thereby self-consistently establishing the absolute topological identity of the equivalence principle within the framework.

Keywords: Neutrino Field; Emergent Gravity; Parameter Calibration; Transverse Wave Packet; Effective Action; Three-Stage Thermal Lag

1 0. Notation & Symbol Nomenclature

Unified Symbol	Physical Definition & Geometric Structure in Paper 3	Correspondence & Revision from Papers 1 & 2
$\Phi/\Phi_0/V_0$	The sole underlying neutral neutrino quantum mother field de Broglie pilot wave entity / Unified zero-point energy base	Dead cosmic fluid vacuum base ($\rho_0 > 0$) Dead fluid background
Φ_1/V_1	Active neutrino transverse dynamic excitation state	Dynamic dark energy phase (PDE, MSW pump)
Φ_2/V_2	Heavy Majorana neutrino localized high-density degenerate state	Dark matter condensation (PDM, MOND boundary)
$\Psi(x, t)$	Localized quantum field envelope: $\Psi = A_{\text{total}} e^{i(\varphi_{\perp} + \varphi_{\parallel})}$	"Dual aspects in a single entity" QFT operator
A_{total}	Total amplitude spectrum: $A_{\text{total}} = A_b + A_{\Phi_2} + A_{\Phi_1}$	Total mass-energy distribution
A_b	Microscopic high-frequency sharp wave packet envelope	Baryonic matter (nucleons/quarks/electrons)
$\varphi_{\perp}$	Vertical orthogonal phase spectrum (deriving gravity $\vec{g}$)	Gravitational phase / Geometric tension gradient
$\varphi_{\parallel}$	Transverse orthogonal phase spectrum (driving expansion)	Dark energy phase / Tangential phase flow rate
c_0	V_0 medium intrinsic propagation limit ($c_0 \propto \rho_0^{-1/5}$)	Vacuum speed of light limit (vs. Scharnhorst effect)
$\hbar$	Microscopic topological phase stiffness & momentum conversion constant	Planck's constant (de Broglie pilot wave condition)
G_0	Emergent gravitational constant originating from Majorana vacuum fluctuations	Sakharov induced gravitational constant
$E_{\text{child, invasion}}$	Decoupled initial topological energy brought by the living child-universe invasion	Initial child-universe energy (external source term)

2 1. Basic Axiomatic System and V_0 Vacuum Substrate

2.1 1.1 Overall Charge Neutrality and Single-Field Axiom (Axiom 1)

Macroscopic geometric stability requires global charge neutrality. If uncanceled net polarities existed, Coulomb self-repulsion would disrupt large-scale structures.

- **Axiom 1 (Single Neutral Field Axiom):** The universe is dominated by a single neutral quantum field. All macroscopic forces and material manifestations are merely phase transitions and energy redistributions of this single field across different mass-energy energy levels.

2.2 1.2 Three-State Energy Levels, Neutrino Field Mapping, and Dual Division (Axiom 2)

The known neutrino flavors correspond to field excitations of the single neutral field across three mass eigenstates (V_0, V_1, V_2):

- Axiom 2 (Three-State Energy Levels & Neutrino Field Mapping):

1. **Background State Φ_0 (V_0 state, $m_0 \rightarrow 0$ eV):** The dead cosmic fluid vacuum base. Its constant energy density $\rho_0 > 0$ is un-dilutable, serving as the sole primordial mother field for all subsequent phase transitions.
2. **Excited State Φ_1 (V_1 state, mass ~ 0.009 to 0.05 eV):** Transverse dynamic excitations of active neutrinos. The time derivative of their tangential phase generates dynamic dark energy ($\rho_{DE} \propto \partial_t \Delta \varphi_{\parallel}$).
3. **Degenerate State Φ_2 (V_2 state, mass ~ 0.05 eV and above):** Heavy Majorana neutrino localized high-density condensed states forming tangible dark matter. Their vertical stress gradients emerge as universal gravitation ($\vec{g} = -k_2 \nabla \rho_{\Phi_2}$).

(Note: The aforementioned mass ranges represent effective scales under the framework's phase-transition dynamics; their detailed correspondence with existing neutrino oscillations and cosmological mass bounds is reserved for future work.)

Macroscopic Static Substrate vs. Microscopic Dynamic Excitation Boundaries:

- **Macroscopic Static Background Substrate:** The V_0 state possesses a geometric negative pressure $P_0 = -\rho_0 c_0^2$, and its effective active gravitational mass density $\rho_{\text{active}} = -2\rho_0$ prevents unperturbed gravitational collapse, serving as an absolutely flat cosmological stage.
- **Microscopic Dynamic Excitation Wave Packets:** Localized ultra-relativistic dynamic wave packets superimposed upon the static V_0 ocean, whose kinetic energy far exceeds rest mass, allowing them to propagate through the static V_0 background at near-light speeds $v_{\nu} \approx c_0$.

2.3 1.3 Vacuum Density ρ_0 and Planck's Constant

The vacuum energy density of V_0 is given by the standard quantum zero-point energy (ZPE) integral, and the limiting speed of light exhibits a fifth-root effective relationship with vacuum density:

$$\rho_0 = \frac{1}{16\pi^2} \bar{h} c_0 (\Lambda_{UV}^4 - \Lambda_{IR}^4) \quad (1)$$

$$c_0 \propto \rho_0^{-1/5} \quad (2)$$

Planck's constant $\bar{h}$ simultaneously plays the roles of phase stiffness modulus, action quantum, and momentum-phase conversion constant. This expression links with $c_0 = 1/\sqrt{\varepsilon_0 \mu_0}$ determined by electromagnetic constants in Paper 1 (as an effective relation within the framework, pending further microscopic matching).

2.4 1.4 Excitation Source Terms, Single Invasion Premise, and Energy Decoupled Conservation (Axioms 3-4)

- **Axiom 3 (Excitation Source Term):** Neutrino mass-squared differences Δm^2 trigger the microscopic excitation chain:

$$\Delta m^2 \Rightarrow \Delta E \Rightarrow \Delta \varphi_1 \Rightarrow \partial_t \Delta \varphi_{\parallel} \quad (3)$$

- **Axiom 4 (Dead Mother Field Phase-Transition Energy Conservation):** The energy consumed by the dead mother field V_0 is entirely converted into newly generated V_1 dark energy, V_2 dark matter, radiation (light) energy, and baryonic matter energy:

$$\Delta E_{V_0, \text{consumed}} = E_{V_1} + E_{V_2} + E_{\text{rad}} + E_b \quad (4)$$

Combined with the decoupled initial child-universe energy, the total local system energy remains strictly conserved:

$$E_{\text{total}} = E_{\text{child, invasion}} + \Delta E_{V_0, \text{consumed}} \quad (5)$$

3 2. Field Envelopes, Orthogonal Dual-Phase Spectra, and Geometric Reset of the Four Forces

3.1 2.1 Orthogonal Dual Phases and Effective Action

Dissolving the traditional "point particle" paradigm, the localized quantum field envelope is defined as:

$$\Psi(x, t) = A_{\text{total}}(x, t)e^{i(\varphi_{\perp} + \varphi_{\parallel})} \quad (6)$$

Under conditions of uniformity, elasticity, and dissipationlessness, transverse collective coordinates can be described by a displacement field $\mathbf{u}_{\perp}$, with its low-energy effective action and transverse wave velocity given by:

$$S[\mathbf{u}_{\perp}] = \int d^4x \left[\frac{\rho_{\text{eff}}}{2} (\partial_t \mathbf{u}_{\perp})^2 - \frac{\mu_{\text{eff}}}{2} (\nabla \mathbf{u}_{\perp})^2 \right] \quad (7)$$

$$c_t^2 = \frac{\mu_{\text{eff}}}{\rho_{\text{eff}}} = c_0^2 = \frac{1}{\varepsilon_0 \mu_0} \quad (8)$$

The proportionality coefficients are fixed by the grid scale λ_{v0} and E_{v0} calibrated in Paper 1. Here, ρ_{eff} represents the low-energy effective inertial density, belonging to a different hierarchy from the ultra-high energy density corresponding to microscopic topological tensions of the mother field.

3.2 2.2 Geometric Reset of the Four Interactions and the Equivalence Principle

- **Electromagnetic Interaction:** Manifested as transverse gauge vortex wave packets within the V_0 medium.
- **Weak Interaction:** Corresponds to high-frequency topological phase locking on femtometer scales followed by the release of longitudinal spinor pulses.
- **Strong Interaction:** Originates from topological flux tube tension when baryonic envelopes overlap, coupled with vanishing local phase gradients at close range (asymptotic freedom).
- **Gravity:** Manifests as vertical stresses generated by V_2 density gradients.

Inertial Mass and the Equivalence Principle: Inertial mass originates from the topological shear damping and vacuum polarization reaction experienced by a baryonic envelope accelerating through the V_0 medium; gravitational mass originates from the V_2 stress gradient induced by the same envelope. Applying Gauss's divergence theorem, since both shear damping and stress gradients stem from the geometric polarization of the same V_0 mother field by the same envelope, the absolute topological identity $m_g \equiv m_i$ naturally holds.

3.3 2.3 Microscopic Three-Band Deconstruction and Spinor Assignment

1. Vector Vortex Sector (

$$J = 1$$

): Localized high-frequency transverse gauge vortex wave packets (electromagnetic waves/light).

2. **Spinor / Longitudinal Pulse Sector (Spin $J = 1/2$):** Longitudinal spinor pulses propagating through the V_0 superfluid ocean (neutrino wave packets), with an intrinsic quantum spin strictly equal to $J = 1/2$.

3. **Tensor Strain Sector (Macroscopic $J = 2$ / Microscopic Spin $1/2$ Superposition):** Macroscopic geometric tensor strain waves (gravitational waves), whose underlying microscopic excitation pulses are entirely driven by the collective geometric superposition of spin-1/2 neutrino spinor field pulses within the V_0 ocean.

4 3. Electromagnetic Field, Light Propagation, Limiting Speed of Light, and Microcircuits

4.1 3.1 Geometric Nature of Electromagnetic Fields, Capacitance, and Inductance

- **Electric Field ($\vec{E}$):** Longitudinal geometric polarization and strain gradients generated in the V_0 medium surrounding charge envelopes.
- **Magnetic Field ($\vec{B}$):** Tangential phase circulation channels generated in the V_0 medium by moving charges, directly leading to magnetic flux quantization $\Phi_e = \frac{\pi\hbar}{e}$.
- **Capacitance (C) and Inductance (L):** Respectively correspond to the elastic volumetric energy-storage capacity of the V_0 medium under electric polarization, and the geometric inertial resistance to tangential phase circulations encountered during current variations.

4.2 3.2 Physical Realization of de Broglie Pilot Waves

The physical substrate of pilot waves is 100% the dead quantum mother field V_0 , thoroughly superseding the "hard point-like photon" assumption. The photoelectric effect is quantum resonance absorption between V_0 wave packets and atomic electron envelopes; Compton scattering is the nonlinear interference and momentum-phase modulation of high-frequency vector wave packets passing through electron polarization clouds.

4.3 3.3 Deep-Space Speed of Light Prediction and Mixed-Field Propagation

Within the solar system, high-density V_1/V_2 mixed fields induce slight refractive deceleration. However, in pure V_0 deep space far from all galaxies, the framework predicts that the speed of light will exhibit a minute intrinsic recovery increase (with a relative increment on the order of $\Delta c/c_0 \sim 10^{-8}$, predicting $c_{\text{deep}} \approx 299,792.465$ km/s). **This numerical value is merely a framework-internal order-of-magnitude estimate rather than a rigorous calculation, awaiting future verification.**

5 4. Celestial Structure Differentiation, Dual Phase-Transition Engine, and Black Holes

5.1 4.1 Stars as MSW Dark Energy Pumps

Under extreme temperatures and pressures in their stellar cores, stars utilize MSW geometric resonance mechanisms to pump local V_2 and V_0 domains into transversely accelerated V_1 dark energy states, continuously elevating regional dark energy density and providing a mechanism to resolve the Hubble tension.

5.2 4.2 Degenerate Field Saturation Plateau and Black Hole Dynamic Polarization

The degenerate field distribution of compact celestial bodies consists of an "internal saturation plateau ρ_{sat} " and an outer $1/r$ envelope, replacing traditional point singularities with quantum-stable cores. In extreme events such as binary black hole mergers, violent tension wave packets impact the V_0 medium, forcing dynamic phase-transition polarization into V_2 ; the residual polarization effects explain the gravitational wave memory effect.

5.3 4.3 Celestial Structure Differentiation and Dual Phase-Transition Engine Table

Celestial Type	Amplitude Spectrum A_{total}	Spec- trum Fea- tures	Vertical Slope $\nabla\varphi_{\perp}$ (Grav- ity)	Phase (Grav- ity)	Transverse Phase Derivative $\partial_t\Delta\varphi_{\parallel}$ (Dark Energy)
Planets	Low-density	rect- angular envelope, clear boundary	Weak and gentle, classical	Newto- nian field	≈ 0 (No MSW phase transition)
Main Sequence Stars	Core features	violent dynamic fluc- tuations	Moderate	slope, dynamic diffusion	Maximum (Active MSW pump)
Compact Stars	High-density	rect- angular envelope; near ρ_{sat} plateau	Steeper	slope (strong redshift)	Very low (accom- panied by thermal MSW surface pumping)
Magnetars / Pulsars	Axially symmetric	cylindrical jets, core near ρ_{sat}	Extreme	slope + vortex circulation (2π)	High-frequency co- herent pulsed jets (polarization chan- nels)
Black Holes	Absolutely	flat quantum satura- tion plateau	Extreme slope limit ($\nabla\rho_{\Phi_2}$)		Negative (Conden- sation excitation engine, absorp- tion)

6 5. Unified Master Equation System and Modified Cosmology

6.1 5.1 Six Unified Master Equations

Within this framework, macroscopic cosmological dynamics are qualitatively governed by the following equations:

$$\int (\rho_{\Phi_0} + \rho_{\Phi_1} + \rho_{\Phi_2} + \rho_b) d^3x = E_{\text{total}} \quad (9)$$

$$\tan \theta = \frac{|\nabla \varphi_{\perp}|}{|\nabla \varphi_{\parallel}|} \quad (\text{Schematic projection}) \quad (10)$$

$$\vec{g} = -k_2 \nabla \rho_{\Phi_2} \quad (11)$$

$$\rho_{\text{DE}} = \alpha_1 (\partial_t \Delta \varphi_{\parallel})^2 \quad (12)$$

$$\frac{\partial \rho_{V_1}}{\partial t} = \Gamma_{\text{MSW}} \cdot \rho_{\text{core}} \quad (13)$$

$$\square_{V_0} h_{\mu\nu} = 16\pi G_0 T_{\mu\nu}^{\text{eff}} \quad (14)$$

6.2 5.2 Modified Friedmann Equation and Outer Disk Force Balance

Replacing the traditional Λ CDM model, we derive the modified Friedmann equation incorporating V_1 tangential phase flow terms and local MSW pumping terms:

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G_0}{3} (\rho_m + \rho_0 + \rho_{V_1}(t, x)) \quad (15)$$

In the outer regions of galactic disks, the force balance between emergent gravity and the transverse pressure-relief drag of V_1 light-ladder neutrinos can be expressed as:

$$\frac{v^2(r)}{r} = k_2 |\nabla \rho_{V_2}(r)| - \gamma \rho_{V_1}(r) (v(r) - v_{\text{flow}}(r)) \quad (16)$$

Consequently, outer rotational velocities can flatten out over a certain radial range.

7 6. Microscopic Derivation of Gravitational Constant G_0 and Alignment with Sakharov Induced Gravity

7.1 6.1 G_0 Derivation and Sakharov Induced Gravity Alignment

Within the Sakharov quantum vacuum fluctuation induced gravity framework, utilizing vacuum fluctuations of the heavy Majorana field N_R , the framework yields the effective relation for the gravitational constant:

$$G_0 = C_0 \frac{y_{\nu}^2 \hbar c}{M_N^2} \quad (17)$$

(Note: The coefficient C_0 and the specific source of the Yukawa coupling y_{ν} remain qualitative assumptions within the framework, awaiting rigorous microscopic integration). This derivation explains the micro-root of gravity's extreme weakness (suppressed by $M_N \sim 10^{14}$ GeV) and provides a geometric pathway to resolve the cosmological constant problem by structurally decoupling G_0 from ρ_0 .

7.2 6.2 Gravitational Waves as Transverse Strains on a Rigid Lattice

Gravitational waves manifest as macroscopic tensor strains on the V_0 lattice. When strains propagate into the elastic lattice, it generates restoring forces like a compressed spring, causing deformations to bounce back and naturally carrying alternating positive and negative phases, consistent with the quadrupole radiation requirement of lacking monopole components.

8 7. Cosmic Microwave Background Three-Stage Thermal Lag and Multiverse Boundaries

8.1 7.1 Three-Stage Thermal Lag Response

The process of a living universe plane invading V_0 exhibits three distinct stages, modeled by a superimposed schematic response function $R(s)$:

$$R(s) = A_1 s e^{-s/\tau_1} + A_2 \exp\left(-\frac{(s-s_2)^2}{2\sigma_2^2}\right) + A_3(s-s_3)_+ e^{-(s-s_3)/\tau_3} \quad (18)$$

This corresponds to: initial contact (perturbation growth) $\rightarrow$ invasion center entry ("noon" geometric perturbation surge) $\rightarrow$ thermal energy accumulation ("three o'clock" temperature peak delay). **Must emphasize: Geometric perturbations (tensor strain waves) and microwave blackbody spectrum noise (strong-interaction thermal equilibrium) belong to completely distinct physical processes.**

8.2 7.2 Multiverse Boundaries and Spatial Drift

Child-universe invasion boundaries exhibit cross-scale fractal self-similarity, obeying the identical geometric variational principle:

$$\delta S_{\text{boundary}} = 0 \quad (19)$$

During violent collisions, tidal-tail fragments possess a **possible pathway** (though not a necessity) to break free from local V_0 envelopment and drift into 0-space. Energy remains conserved across generational transfers.

9 8. Observable Predictions and Outlook

The framework proposes the following testable directions:

1. **Gravitational Wave Polarization:** Should exhibit only two transverse tensor polarizations without independent physical gravitons.
2. **Galactic Outer Rotation Curves:** Flatness degrees correlate with host star MSW pumping efficiencies.
3. **CMB Multi-Peak Structure and Resonances:** Multi-peak structures link to the three-stage invasion response; subtle resonances or polarization anomalies driven by grid scales may exist near ~ 56.9 GHz.
4. **High-Energy Neutrino Penetration:** High-energy neutrinos traversing galactic cores should not exhibit significant mechanical dispersion or viscous damping.
5. **Long-Term Expansion Trends:** Long-term expansion acceleration will gradually flatten as total stellar MSW output power declines.

10 9. Trilogy Integration and Derivative Physical Phenomena

10.1 9.1 Trilogy Integration

This final chapter completes the axiomatic elevation:

1. **Paper 1:** Established the phenomenological geometry of living-universe invasion and cross-universe energy conservation.
2. **Paper 2:** Expanded into the macroscopic topology and particle fault-tolerance mechanisms of seven bubble universes colliding in a dead fluid mother sea.
3. **Paper 3:** Formulated orthogonal QFT geometry, establishes $\rho_0 > 0$ as the light propagation carrier, and derives emergent gravity G_0 and the equivalence principle.

10.2 9.2 Outline Outlook of Derivative Physical Phenomena

1. **Hubble Tension:** Stellar core MSW phase transitions continuously pump out dark energy, naturally predicting near-field expansion measurements ($H_0 \approx 73$ km/s/Mpc) higher than distant CMB measurements.
2. **Galactic Rotation Chirality and Baryon Asymmetry:** Galactic rotation reflects local phase circulations in the Φ_2 background. Angular momentum injected by bubble collisions breaks parity chirality, causing envelopes collapsing along the rotation direction to condense into matter.
3. **Fine-Structure Constant and MOND Boundary:** $\alpha \approx 1/137$ represents the topological polarization impedance between baryonic envelopes and microscopic vacuum channels. The $1/r$ envelope outside degenerate fields naturally derives MOND flat rotation curves.

Human-AI Co-creation Acknowledgments

Author Zhongyang Dong provided the fundamental first-principles physical intuition and philosophical axioms. The core of this framework strictly follows philosophical minimalism (Occam's razor): asserting that neutrinos, as the quanta of smallest mass, naturally constitute the most fundamental cosmic substrate. Furthermore, neutrinos possess the longest lifespan of any known particle—whose upper limit remains unknown—making them ideal candidates for an eternal cosmic base. These foundational concepts include the "dual aspects in a single entity" paradigm, the " V_0 dead-fluid vacuum base," the "MSW dark energy pump," and the "single neutral neutrino field three-state phase transition" [1, 2].

Artificial intelligence systems (Gemini / Grok) provided assistance in mathematical expression formatting, symbol standardization, literature alignment (such as the Scharnhorst effect [4], de Broglie pilot wave conditions [3], and Sakharov induced gravity [6]), and interdisciplinary academic terminology translation. Furthermore, large language models such as AI Copilot, Doubao, and Qwen also participated in and completed knowledge verification and consultation tasks. This synergy of "human physical intuition + AI symbolic and logical validation" demonstrates a pioneering mode of human-AI collaborative research in high-energy physics and theoretical cosmology. This research received no external funding. Online link to this paper: <https://ai.vixra.org/abs/2610.0023>

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