

Minimalist Cosmology, Particle Universality, Topological Fault-Tolerance, and Eternal Self-Sustenance in a Bubble Multiverse

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Abstract

As a direct sequel to the emergent cosmology of a two-phase planar-invasion bubble universe, this study constructs a self-sustaining evolutionary model of a global bubble multiverse comprising seven initial seed universes, viewed from a minimalist “Creator’s-Eye View.” To avoid ambiguity, it is explicitly clarified that all bubble universes analyzed hereafter refer specifically to iterative evolutionary generations produced through multi-generation collisions, rather than the original primordial seed universes.

This framework introduces the physical anchors calibrated in Papers 1 and 3—namely, the foundational grid spacing $\lambda_{v0} \approx 5.27 \text{ mm}$ and zero-point energy $E_{v0} \approx 2.35 \times 10^{-4} \text{ eV}$ —as the common baseline for cross-generational energy and grid scales. We establish core physical axioms, topological fault-tolerance laws, and dark energy conservation mechanisms: the primordial Big Bang mechanism terminates independently in the seven initial seed universes in accordance with the second law of thermodynamics, serving as Newton’s first push and engendering subsequent cosmic rotation via non-uniform initial expansion. Global particle universality ensures that all iterative bubble universes share micro-energy levels fixed by foundational constants. The apparent regional accelerated expansion of dark energy is resolved as a kinetic projection of topological potential energy derived from degenerate baseline universes (S_{Dead} , representing pure V_0 fields). Furthermore, the Prime-7 topological law ($N_0 = 7$) and the evolutionary scale sequence ($\{10, 15, 40, 100\}$) act as schematic choices for topological fault-tolerance, driving the extinction probability toward zero under selected parameters.

Concurrently, we introduce the mechanism of “ V_0 space depletion and possible zero-space drift pathways” to explore the geometric origin of the Big Bang and the intergenerational genetic inheritance of cosmic macroscopic rotational structures. Finally, we harmonize this framework with Newton, Spinoza, and ancient Chinese philosophy, concluding with an affirmation of philosophical optimism and cosmic being.

1 Physical Axioms

1.1 Primordial Low-Entropy Big Bang, Newton’s “First Push”, and Framework Energy Alignment

The initial boundary conditions of the global universe were established by seven primary Big Bang events sequentially and asynchronously triggered within a high-dimensional geometric field.

- **Low-Entropy Origin and Boundary Constraints:** Regardless of the underlying excitation mechanism of the initial bubble universes, their physical essence stems from low-entropy boundary states generated via high-dimensional excitation mechanisms within “Empty Zero-Space.” Subject to the second law of thermodynamics ($\Delta S \geq 0$), this spontaneous low-entropy creation mechanism could only occur in the initial seed universes. Subsequent iterative generational energy scales remain consistent with the V_0 grid calibrated in Paper 1. Global energy dynamics thereafter transition completely to multi-generational collisions and phase transitions. During this process, the V_0 density remains constant ($\rho_0 = \text{const}$), with only its spatial volume shrinking due to consumption.
- **Physical Realization of Newton’s “First Push”:** Isaac Newton postulated that cosmic operation requires an initial “First Push” to impart dynamic momentum. In this model, the seven primary Big Bang events fulfill this role. Occurring at distinct spatial coordinates and staggered time nodes, spatial separation endows relative trajectories (initial momentum), while time staggering ensures that each universe enters different evolutionary stages with intrinsic phase shifts.
- **Non-Uniform Expansion and Rotation Generation:** The initial expansion or explosion of each of the seven initial seed universes is inherently non-uniform and asymmetrical. This spatial non-uniformity breaks local spatial isotropy, naturally engendering the initial angular momentum and rotational dynamics of the sub-universes, laying a critical physical foundation for the rotational manifold structures observed in subsequent planar invasions and multi-generational interactions.
- **Energy Conservation and Multi-Generational Cascades:** The primordial sequence closed after establishing the initial seven seed universes. Total global energy remains consistent with the first law of thermodynamics within this framework, cascading sequentially through colliding, splitting, and phase-transitioning bubble universe generations.
- **Heritability of Dark Backgrounds and Microwave Separation:** The observed darkness of the night sky and Cosmic Microwave Background (CMB) noise (belonging to thermal equilibrium products in strong-interaction regions) represent the ultimate thermodynamic remnants left behind by generational cascade energy transfer. Crucially, geometric tensor strain waves do not directly constitute the source of microwaves.

1.2 Global Particle Universality and Generational Iteration

All bubble universes inherit a unified energy field injected during the primary Big Bang; a subset of these universes ultimately evolves into degenerate, massless quantum matrices remaining after cosmic degeneration.

- **Scope Clarification:** All bubble universes analyzed and modeled hereafter denote iterative generations (S_{Active}) formed through multi-generational collision, shear, and split iteration, rather than the primordial seed universes at the moment of creation.
- **Micro-Energy Level Consistency:** All iterative bubbles share micro-energy levels fixed by $E_{v0} \approx 2.35 \times 10^{-4} \text{ eV}$ and $\lambda_{v0} \approx 5.27 \text{ mm}$ calibrated in Paper 1, ensuring that the intrinsic physical properties of elementary particles remain uniform across the entire global multiverse.

- **Seamless Fluid Fusion:** Identical micro-particle physics and vacuum states eliminate topological friction during collisions, enabling seamless fluid-like fusion and realizing dual-generation shear and tidal tail tearing ($1 + 1 \rightarrow 3$).

1.3 Dark Energy Phenomena and Global Energy Conservation

Building upon the topological energy storage framework established in Paper 1, the apparent paradox of dark energy is resolved:

- **Illusion of Local Non-Conservation:** When observed within a single independent iterative bubble universe, as planar invasions cut through the degenerate medium, the topological potential energy stored by previous generations is continuously converted into kinetic energy to drive sub-universe expansion. Locally, this manifests as a kinetic projection driving the accelerated expansion of dark energy.
- **Global Conservation Entity:** The degenerate universe (S_{Dead} , i.e., the pure V_0 field) stores energy depleted by previous generations as latent topological potential energy. When active universes or visible matter bodies cut into dead universes, the expansion energy driving the composite universe transfers across cosmic boundaries. On a global scale, this remains consistent with the first law of thermodynamics within the framework.

2 Three-State Cosmic Phase Transitions, Evolutionary Scales, and High-Dimensional Potential Locking

During multi-generational evolution, each independent iterative bubble universe undergoes a minimalist three-state phase space parameterized by an evolutionary scale sequence ($\{10, 15, 40, 100\}$, adopted here as schematic choices):

$$S \in \{S_{\text{Active}}, S_{\text{Radiative}}, S_{\text{Dead}}\} \quad (1)$$

$$R(S_{\text{Active}}) < R(S_{\text{Radiative}}) \ll R_{\text{max}}(S_{\text{Dead}}) \quad (2)$$

1. **Iterative Active / High-Speed Expansion Phase (S_{Active} , Characteristic Scale 10):** Geometric planes invade and consume the degenerate medium. An abundant neutrino background powers rapid matter creation and high-speed expansion, endowing the universe with high-dimensional kinetic energy and collision-branching potential.
2. **Iterative Semi-Dead Radiation / Expansion Arrest Transition & Starlit Peak Phase ($S_{\text{Radiative}}$, Characteristic Scale $15 \rightarrow 40$):** The neutrino background depletes, weakening planar invasion dynamics. The universe first enters an expansion arrest transition phase (Scale 15); subsequently, maximum baryonic luminosity fills the plane, reaching the thermodynamic peak of the starlit phase (Scale 40).
3. **Iterative Dead / Heat Death Degenerate Death Phase (S_{Dead} , Characteristic Scale 100):** Luminous matter completely decays, wavelengths stretch to infinity ($v \rightarrow 0$), and spatial volume reaches its historical maximum ($R_{\text{Dead}} = R_{\text{max}}$). Energy is fully converted into latent topological potential energy.
4. **Collision Cross-Section Locking and Vacuum Boundary Generation:** According to the geometric scattering cross-section scaling ($\sigma \propto R^2$), the scale-100 dead universe ($R_{\text{Dead}} \gg R_{\text{Active}}$) presents the largest spatial geometric target and is preferentially

struck and reactivated by smaller active universes or high-energy matter clusters traversing vast distances across space.

This framework posits that this vast dead background (V_0 physical mother field) possesses superfluid properties characterized by macroscopic near-incompressibility and microscopic non-zero effective shear modulus. When massive matter clusters arriving across zero-space strike this dead medium, volumetric contraction cannot fully buffer the impact kinetic energy. The extreme impact kinetic energy surpasses the linear elastic transmission limit, triggering non-linear gravitational shockwaves and geometric strain accumulation at the contact interface, constituting the local ignition mechanism of a “Big Bang.” Via effective framework excitation mechanisms (such as equivalent phase transitions accompanied by extreme density/pressure gradients and MSW resonances), localized dynamic spacetime curvature excites the otherwise dead V_0 background into massive active entities (such as V_1 dark energy and V_2 dark matter).

3 Seven-Pole Topological Fault-Tolerance Law and Dynamic Equilibrium Derivation

3.1 Geometric Envelope and Spacetime Dynamic Model ($N_0 = 7$)

1. **Octahedral Stable Envelope Lower Bound ($N_{\min} = 6$):** In three and higher dimensions, six nodes form an octahedron, providing a minimum structural tension envelope baseline to prevent collapse into low-dimensional planes.
2. **Initial Topological Fault-Tolerance and Odd Symmetry Breaking ($N(0) = 7 > N_{\min}$):** As a schematic choice for topological fault-tolerance, a seventh bubble is introduced as an asymmetric dynamic symmetry-breaking point and initial fault-tolerance buffer core.
3. **Spacetime Staggered Network:** Seven initial sub-universes ignited at staggered spacetime coordinates maintain phase shifts throughout their life cycles, preventing collective heat death and sustaining a perpetual collision network.

3.2 Extinction Probability Approaching Zero and N_{eq} System Steady State

Inheriting the collision dynamics established in Paper 1, violent collisions between two iterative active universes trigger boundary shear and tidal ejection, yielding two sub-embryo universes:

$$\mathcal{S}_{\text{Active}}^{(1)} + \mathcal{S}_{\text{Active}}^{(2)} \rightarrow \mathcal{S}_{\text{Surviving}} + 2\mathcal{S}_{\text{Embryo}} \quad (3)$$

Corresponding to a net production rate of $1 + 1 \rightarrow 3$.

During this process, collisions can occur in regions where V_0 is extremely thin, and a portion of tidal-tail fragments may break free from local V_0 encasement to drift into zero-space (a non-mandatory process). The schematic detachment probability is quantified as:

$$P_{\text{detach}} \sim \Theta(E_{\text{kin}} - \kappa\rho_0 d) \quad (4)$$

(where Θ is a step or smooth transition function, E_{kin} is fragment kinetic energy, ρ_0 is the constant mother-field density, d is the remaining V_0 thickness between collision interfaces, and κ is the topological binding strength parameter.)

When conditions are met, a portion of tidal-tail fragments may break free. Once in zero-space, fragments encounter no V_0 medium drag, and energy remains conserved across generational transfers.

The master rate equation governing the total bubble count $N(t)$ is expressed as:

$$\frac{dN(t)}{dt} = \lambda_{\text{collision}}N(t) - \gamma_{\text{decay}}N(t) - \mu_{\text{merge}}N(t)^2 \quad (5)$$

Given a branching multiplier $\eta = 3/2 > 1$ and initial condition $N(0) = 7 > N_{\text{min}}$, under selected model parameters and schematic scales, the global extinction probability approaches zero over evolutionary time:

$$\lim_{t \rightarrow \infty} P(N(t) = 0) = 0 \quad (6)$$

As $N(t)$ grows, the quadratic merging loss term acts as a density constraint. Growth and merging balance at a critical equilibrium capacity $N_{\text{eq}} > 7$, where $dN/dt = 0$. The global multiverse constitutes a self-sustaining non-equilibrium steady state (SNESS).

4 Mother Field Space Depletion and Extreme Collisions in Zero-Space

In the multiverse evolutionary cycle, continuous expansion of sub-universes occurs at the expense of invading and converting the dead mother field. When multiple independently developed iterative sub-universes exhaust the V_0 in their periphery, physical mechanisms enter an extreme critical state. Since the density ρ_0 of V_0 remains constant, the geometric volume of the spatial entity itself approaches zero due to consumption:

$$V_0\text{-space} \rightarrow 0 \quad (7)$$

With V_0 spatial margins between sub-universes drained, the spatial buffer and negative-pressure balance originally provided by V_0 cease to exist. Driven by negative pressure pulls and individual rotational inertias, the contraction of space forces these sub-universes to collide.

Regarding the geometric outcome of such limit collisions, this framework explores a specific physical pathway: extreme collisions occur in regions where residual V_0 is extremely thin, and fragments entering zero-space is one of the possible results. In this process, because the residual V_0 is exhausted and converted into baryonic matter during collision, the ultimate collision effectively takes place within zero-space.

The macro-geometric features of the newborn universe—such as rotational structures and angular momentum—are inherited directly from the parental rotational inertia, while impact asymmetry dictates initial micro-perturbations and the subsequent evolution of large-scale structure.

5 Ontological Philosophical Interpretation: The Creator, Newton, Spinoza, and Eastern Wisdom’s “Beginning of the Unbeginning”

(Note: This section constitutes human and philosophical interpretation, independent of the physical dynamical framework)

This minimalist model addresses the first-cause dilemma philosophically:

1. **Newton’s “First Push” and Spinoza’s Creator:** Newton’s required “First Push” is identified as the spacetime ignition of the seven initial low-entropy Big Bangs. The Creator is not a personalized entity outside physical reality, but the global entity itself (Spinoza’s pantheism / *Causa Sui*).

2. Ancient Chinese “Beginningless Beginning” Topological View:

- Zhuangzi noted: “There is a beginning. There is a not yet beginning to be a beginning. There is a not yet beginning to be a not yet beginning to be a beginning.”
- Laozi wrote: “Man models himself on earth, earth on heaven, heaven on the way, and the way on that which is naturally so.”

3. **High-Dimensional Spacetime Metaphor of the “Seven Days of Creation”:** Seven dynamic seed universes placed at asymmetric spacetime coordinates; the first six established the three-dimensional structural envelope, while the seventh broke static deadlock, initiating perpetual self-sustaining motion.

6 Conclusion and Human Elevation: Philosophical Optimism and the Grace of Cosmic Being

“Minimalism is ultimate beauty; geometry is eternity.” Relying on the primordial continuous low-entropy Big Bang (First Push), global particle universality, $N_0 = 7$ topological fault-tolerance schematic choices, three-state phase transitions ($\{10, 15, 40, 100\}$), and $1 + 1 \rightarrow 3$ branching, the global multiverse locks its extinction probability near zero under macroscopic energy conservation within the framework.

This eternally self-sustaining cosmic entity forms the foundation of philosophical optimism. As conscious entities born from regional cosmic evolution, we can observe and comprehend this harmonious cosmic order and geometric mathematical beauty. Humanity’s ultimate reverence and response to the cosmic entity should be to live meaningful, dignified, free, and happy lives within this harmonious and eternally flowing universe.

Postscript: Version Note

Version 1 of this paper was originally completed on September 11, 2026. Version 2 was completed on October 18, 2026. The current manuscript represents the upgraded **Third Edition (Version 3)**, completed on **October 31, 2026**. In this third edition, we have systematically aligned V_0 grid parameter calibration, microwave/strain wave separation, shear rigidity, the zero-space drift probability model, and topological fault-tolerance assumptions with Papers 1 and 3, ensuring full cross-paper logical consistency.

References

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Online Link to Second Edition: <http://ai.vixra.org/abs/2609.0026>