

Meta-State Cosmological Model: First-Principles Deduction and Evolutionary Framework

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Author: Li Zhijun

ORCID: <https://orcid.org/0009-0004-8456-7107>

Contact: zhijundi@qq.com | lizhijun@yuantai.ac.cn

Website: <https://yuantai.io> | <https://yuantai.ac.cn>

Beijing, China

Statement of Theoretical Nature

The Meta-State Cosmological Model is a cosmological framework built upon philosophical-logical deduction as its foundation and physical mechanisms as its hypothetical structure. Its philosophical foundation—the Meta-State, Ji-Kong, and Ji-You—belongs to the domain of ontological postulation and does not constitute directly observable or testable physical entities. The Void is a necessary intermediary derived through the chain of philosophical logic; it is the logically inevitable link connecting the ontology of the Meta-State to the physical hypothesis of the Rule-Wall, and does not constitute an independently observable physical entity. The physical mechanism hypotheses—the Rule-Wall conversion mechanism, the voyage and collision of Bubble Universes—are physical deductions that extend naturally from the chain of philosophical logic, and they are subject to indirect observational testing and logical self-consistency review.

This paper does not belong to the category of mathematical modifications to standard physical cosmology (Λ CDM), nor is it a parameter patch within the framework of General Relativity. It is a logical deduction proceeding from first principles—anchored in two cosmological observational facts, advancing layer by layer along logical necessity, ultimately constructing an alternative framework of cosmic origins and evolution that does not depend on an inflaton field, dark energy particles, extra dimensions, or arbitrary initial conditions. This paper does not pursue mathematical description; it pursues only logical self-consistency and observational compatibility.

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Logical Guide: From Questioning to Answers

Before entering the main text, we provide two maps to help the reader establish a cognitive framework. The first map demonstrates which observational phenomena the present model, within a single unified framework, can explain that the standard model cannot self-consistently address. The second map presents the macro-structural chain of the present model—the complete evolutionary path from the ultimate ontology to the observable universe.

Cosmic Phenomena This Model Can Uniformly Explain

Using a single unified underlying logic, this model simultaneously provides self-consistent explanations for the following observational phenomena:

The KBC Void (a spherical void approximately 2 billion light-years in diameter): Not a product of gravitational clearing, but a relic left behind after this universe's Rule-Wall engulfed another active Bubble Universe. The extremely sparse, scattered galaxies within the void originate from the instantaneous back-flow conversion of a minuscule amount of Void energy at the moment of the opposing Rule-Wall's annihilation.

The Great Attractor (an invisible gravitational center tugging on galaxies across hundreds of millions of light-years): Not a missing galaxy cluster, but a primeval Singularity core engulfed by this universe's Rule-Wall. This Singularity core accumulated enormous mass during its condensation period in the Void and became an exposed gravitational singularity after Being engulfed by this universe.

Ultra-High-Energy Cosmic Rays (high-energy particles whose acceleration source cannot be traced): Not originating from unknown astrophysical acceleration sources, but extreme high-energy chaotic turbulence from the Void that penetrates directly into this universe through microscopic-fluctuation weak points in the Rule-Wall, retaining its primordial chaotic energy.

Primordial Supermassive Black Holes (behemoths already in existence mere hundreds of millions of years after the Big Bang): Not products of stellar collapse, but primeval Singularity seeds from the depths of the Void—they accumulated enormous mass before this universe was born, and continued to accrete and grow after Being implanted into this universe.

Cosmic Expansion Without Heat Death (no heat death after 13.8 billion years): Not driven by dark energy, but the Rule-Wall's continuous conversion of Void chaotic energy into ordered mass-energy within this universe—an open system with continuous injection, rendering heat death inapplicable.

The Macro-Structural Chain of This Model

The following is the complete evolutionary path from the ultimate ontology to the observable universe:

Meta-State (Ji-Kong ↔ Ji-You duality) → Interface micro-fluctuations → net energy leakage → **Chaotic Void Cluster** (a turbulent energy flow interwoven with Being and Non-Being) → statistical-mechanical condensation → **Singularity** (a compressed seed of Structural-Order) → pressure-triggered eruption → **Rule-Wall** (conversion interface + expansion engine) → continuous conversion of Void energy → **Bubble Universe** (this universe) → formation of galaxies and planets → life and Homo sapiens.

The various Void structures encountered by the Rule-Wall during its voyage—energy barrens, remnants of failed Bubble Universes, other active Bubble Universes, un-erupted Singularity cores—each project onto this universe as an

observable cosmic phenomenon. This framework, through a single continuous causal chain, uniformly explains the complete picture from cosmic origins to structure formation.

The Necessary Duality of the Meta-State

Before entering into specific reasoning, a foundational question must be addressed head-on: **Why cannot the primordial energy of the ultimate source be a single existence?**

This is a legitimate line of questioning that touches the deepest logical foundation of the Meta-State model. Many cosmological theories of first principles tend to presuppose a unified ultimate source—a pure, indivisible “One.” This presupposition appears parsimonious but is, in reality, a refuge where rational inquiry comes to a halt.

A pure, indivisible single existence—whether absolute energy or absolute spatial capacity—cannot explain one fundamental fact: **Where does difference come from?** An eternally static “One” possesses no internal attributes that can oppose each other, no dualistic tension capable of interaction, no gap between “this” and “that.” It can only be itself. It is not dead silence, but something more fundamental than dead silence—an eternal changelessness in which even the concept of “change” finds no footing from which to arise. For it has no second dimension in which change could occur. We may formulate this rigorously: **Singleness means zero degrees of freedom**—an absolute identity in which even “motion” and “combination” have no footing from which to begin. A single ultimate source cannot generate any structure of difference, and is therefore logically untenable.

But “not single” does not equal “can only be dualistic.” The foregoing argument has demonstrated only that the ultimate source must contain difference—i.e., at least duality. It has not yet excluded the possibility of a triadic source, a continuous spectrum, or higher-order pluralistic structures as the ultimate source. Why not a triadic source? Why not a continuous field that generates difference? This gap must be closed; otherwise, dualistic duality remains merely a plausible conjecture rather than a logical necessity.

Suppose a triadic ultimate source (A, B, C) exists. Within this triadic structure, A is A precisely because it is simultaneously not B and not C—that is, A must first constitute an opposition with “not-A” in order to occupy an identifiable position within the triadic structure. By the same reasoning, B and C each depend upon their respective dualistic oppositions with “not-B” and “not-C.” Each element within a triadic structure has its condition of existence premised upon dualistic opposition. Therefore, a triadic source is not an irreducible primitive—it is a composite of three sets of dualistic relations. Duality is logically prior to triadic structure.

By the same reasoning, any putative n-ary ultimate source can be decomposed into n sets of dualistic relations. A continuous spectrum, if it contains no internal intervals of opposition (high vs. low, dense vs. sparse), is merely a homogeneous background from which no difference can arise—it is equivalent to singleness. The moment difference does arise, it immediately differentiates into intervals of dualistic opposition. Therefore, duality is not one among many possible structures, but the minimal irreducible primitive of all structures.

A critical bridging step is needed here. In the foregoing arguments, the triadic source is decomposed into dualistic relations, and the continuous spectrum is divided into dualistic oppositions—these analyses are possible precisely because the underlying structure of existence itself is already dualistic. We are not using duality to carve up existence; rather, if

existence were not dualistic, there would be nothing there to carve up. That the triadic source can be decomposed means that dualistic oppositions are already presupposed within it; that the continuous spectrum can be divided means that difference is already present in dualistic form. Analysis merely reveals this pre-existing structure; it does not impose a framework from without. This bridging step draws a strict boundary between the present argument and binary encoding at the level of information theory—this model asserts an ontological dualistic duality, not an epistemological dualistic representation.

We may now formulate rigorously: **The ultimate source can be neither a singular unity nor a structure higher than duality—it can only be a dualistic duality.**

To aid understanding, a more intuitive analogy: Imagine two most primordial, purest opposing symbols—one representing pure “Being,” the other pure “nothingness.” If only one of them exists, it remains forever in a state of self-identity; nothing happens. But the moment there are two, the situation changes entirely. With only two, they are diametrically opposed and mutually incompatible, yet it is precisely this opposition that constitutes a most primordial “structure of difference.” And difference is the seed of infinite possibility. Once this structure of opposition is established, endless permutations and combinations become possible—beginning with the simplest order, infinite possibilities unfold.

It must be emphasized: This analogy serves only to aid understanding of the abstract logic that “pure opposition generates infinite possibilities,” and is not a description of the physical mechanisms of the Void. This model does not hold that the universe is a product of computer simulation, nor does it equate Ji-Kong and Ji-You with digital signals. **Ji-Kong is not a zero-measure space in the mathematical sense, and Ji-You is not the “1” in a binary code.** The two are a pure duality at the level of ontology, not a digital opposition at the level of information theory. This distinction fundamentally demarcates this model from any form of simulated-universe hypothesis.

Without a source of difference, everything that exists cannot come into Being. The minimal irreducible form of difference is dualistic duality. The universe can come into Being not because it “is,” but because, from the very beginning, it had “difference.” Dualistic duality is not a structural choice, but the minimal necessary condition for any generable system to be established. This is the fundamental logical necessity of the Meta-State as the dualistic structure of Ji-Kong and Ji-You—in this sense, dualistic duality is not a replaceable option.

Core Tenets of the Model

Proceeding from the two directly observed facts that “the universe is ordered” and “the universe is full,” this model constructs, through pure logical stepwise deduction, a self-consistent, minimally presuppositional explanation of cosmic origins. The core objectives of the model can be summarized in the following three points:

I. The Philosophical-Deduction Layer: Using first-principles deduction as its tool, proceeding from observational facts, and advancing along logical necessity layer by layer, this layer derives the Meta-State (the dualistic structure of Ji-Kong and Ji-You) and the Void (the logically necessary intermediary connecting ontology to physical hypothesis). This portion does not claim to be directly verifiable by physical observation; it is subject only to review for logical self-consistency.

II. The Physical-Hypothesis Layer: Building on the ontological foundation established by the philosophical deduction, this layer proposes the Rule-Wall conversion mechanism as the core physical hypothesis, which provides a

unified explanation for the driving force behind cosmic expansion, the continuous injection of matter and energy, the fixation and constancy of physical laws, and the formation of large-scale structures. This portion is subject to indirect observational testing and must remain compatible with known physical laws (thermodynamics, relativity, quantum mechanics, causality).

III. The Testable Layer: This layer presents clearly defined exclusive observational predictions (statistical distribution of void sphericity, metallicity distribution anomalies in void-interior galaxies) and sets operable falsification conditions for each prediction. The unobservable philosophical-ontology layer is not required to meet falsifiability requirements.

The three layers above together constitute the complete framework of the Meta-State Cosmological Model: philosophical deduction as the foundation, physical hypothesis as the main body, and testable predictions as the boundary.

This model presupposes only the following; beyond these, it introduces no additional assumptions: - The universe is ordered and has not undergone heat death (observational facts); - The principle of logical non-contradiction; - The principle of Occam's razor.

What this model is not responsible for explaining: The specific numerical values of elementary particle masses, the fine-tuning of physical constants, the origin of life, the nature of consciousness, and similar questions. The model is responsible only for providing a unified framework for cosmic origins, the driving force of expansion, and the formation of large-scale structure. Proactively delineating the scope of what is not explained is an expression of theoretical honesty, not a theoretical deficiency.

Overview of the Three-Layer Boundary

The Meta-State Cosmological Model is explicitly divided, in its logical structure, into the following three layers:

First Layer: The Philosophical-Ontology Layer (not directly observable or testable)—the Meta-State, Ji-Kong and Ji-You, the Void. This portion belongs to the domain of ontological postulation; it is subject only to review for logical self-consistency and is not required to meet standards of physical observational verification.

Second Layer: The Physical-Hypothesis Layer (subject to indirect observational testing)—the Rule-Wall conversion mechanism, the injection of Void energy, the driving force of cosmic expansion, the fixation of physical laws. This portion belongs to physical deductions that extend naturally from the chain of philosophical logic and must remain compatible with known physical laws.

Third Layer: The Testable Layer (directly falsifiable)—predictions concerning the statistical distribution of void sphericity and metallicity distribution anomalies in void-interior galaxies. This portion provides the model with clearly defined pathways for scientific testing and operable falsification conditions.

The above three-layer boundary runs throughout the entire text, ensuring that philosophical deduction does not overstep into physical assertion, that physical hypotheses do not evade the responsibility of testing, and that testable predictions leave no retreat route for post-hoc explanation.

I. Introduction: Two Observational Facts and the Silence of the Standard Model

Modern cosmology rests upon two incontrovertible directly observed facts:

Fact 1: The universe is ordered. Physical laws exhibit a high degree of consistency across all directions and all distances in the observable universe. The gravitational constant, the speed of light, and the interaction strengths of fundamental particles have remained constant over the past billions of years. The universe is not a chaotic mess; it is a rigorous system of order that can be precisely described in mathematical language.

Fact 2: The universe is full. The universe has been expanding for approximately 13.8 billion years. If the total quantity of matter were constant, the exponential growth of space would have diluted the internal energy gradients of the universe to near zero; the system would no longer possess thermodynamic degrees of freedom capable of driving macroscopic processes, and heat death should already have occurred. Yet the universe we observe is still densely populated with hundreds of billions of galaxies; stars continue to form, and structures continue to coalesce—indicating that the universe has not yet reached thermodynamic equilibrium.

The standard Λ CDM model describes these two facts precisely at the phenomenological level, yet remains silent on their underlying causes. It acknowledges that the very early universe existed in an extremely low-entropy Singularity state, yet cannot explain where this Singularity came from or why it possessed such extreme initial conditions. It invokes an inflationary mechanism to explain the universe's homogeneity and flatness, yet cannot explain the origin of the inflaton field. It uses dark energy to explain the accelerated expansion, yet faces the catastrophic deviation in which quantum field theory predicts a value 10^{120} times larger than observed. It uses dark matter to explain galactic rotation curves and structure formation, yet decades of direct detection have yielded nothing.

This paper attempts, proceeding from the two observational facts above and using only first-principles reasoning, to construct a logically self-consistent alternative framework that provides a clean set of answers to questions the standard model cannot address.

II. First-Principles Reasoning: From Observational Facts to the Meta-State

Core Terminology Definitions

To ensure the clarity of the reasoning foundation throughout the text, the following key concepts are explicitly defined here:

Disorder (Chaos): This concept is used in two senses throughout the text, distinguished by context:

–**Thermodynamic disorder:** Refers to a system in a high-entropy state, with highly uneven energy distribution and abundant energy gradients capable of doing work. This sense is used when discussing the ordered/disordered contrast within the universe. It should be noted that the Chaotic Void, as a non-equilibrium dynamic disordered state, exhibits violent energy fluctuations and extremely steep local gradients, and the entropy concept of classical thermodynamic equilibrium does not apply. “High entropy” here only borrows the intuitive meaning, without strict thermodynamic definition.

–**Dynamic disorder:** Refers to the motion and interaction of energy bodies not following any unified, fixed laws, exhibiting random fluctuations and unpredictability. This sense is used specifically to describe the energy state of the

Chaotic Void. The Chaotic Void possesses both of the above attributes of disorder and may locally form transient low-entropy micro-regions—these micro-regions may, on brief spatiotemporal scales, exhibit degrees of order far higher than the background, and this is precisely the precondition for Singularity condensation.

Order: This concept is used in two senses throughout the text, distinguished by context:

–**Structural order:** Refers to energy units forming stable, distinguishable arrangement patterns in space (e.g., the ordered configuration inside a Singularity, the large-scale distribution of galaxies).

–**Rule-based order:** Refers to system behavior following a unified, self-consistent, mathematically formulable set of laws (e.g., the physical laws of this universe). When discussing Rule-Wall conversion, “order” primarily refers to rule-based order; when discussing Singularity condensation, “order” primarily refers to structural order.

Structural-Order: A core philosophical concept that runs through the entire text. It refers to a specific organizational mode of energy units that is distinguishable from random arrangement; it is a measure of the non-randomness of energy organization and the common foundation of both structural order and rule-based order. In a word: Structural-Order is order, sequence, and rule—order is the overcoming of chaos (condensing structure from disorder); sequence is the transmission of the causal chain (from Meta-State to Void to Singularity to Rule-Wall to this universe); rule is the fixation of physical laws (the Rule-Wall locks in the conversion logic once and for all). Structural-Order is the deep skeleton that runs through the entire evolutionary chain—it is not in the Meta-State; its structure is in the Void. At the Meta-State Interface, it manifests as the opposition between Ji-You and Ji-Kong; in the Void, it manifests as transient order emerging accidentally from energy-body collisions; in the Singularity, it manifests as a seed compressed to the extreme; inside the universe, it manifests as physical laws unfolded after Being fixed by the Rule-Wall. The above definition applies throughout the text and will not be repeated each time.

Structural-Order is not a presupposed first cause. Within the Meta-State, Ji-Kong and Ji-You constitute a pure duality—this duality itself contains no specific Structural-Order encoding. The Meta-State provides only the condition of possibility for difference, not a blueprint for any specific order. Structural-Order is a necessity that emerges from contingency within the Chaotic Void, through the collision, embedding, and positive-feedback condensation of energy bodies. It is not a program pre-written into the source; rather, it is a product of statistical mechanics, self-accumulated through repeated trials over sufficiently long time and sufficiently large samples. Structural-Order is emergence, not presupposition; it is a product, not a source. This model requires no "divine blueprint" and no a priori structural designer.

Rule-Wall: In the Meta-State Cosmological Model, the logical interface at which the nature of Structural-Order undergoes an emergence during its unfolding process. It is not an independent physical entity endowed with functions out of nowhere; rather, it is the conversion front formed when the dense Structural-Order inside the Singularity, upon reaching critical instability, undergoes forced unfolding into the Void environment—the previous roles of "converter," "shield," and "engine" are all different phenomenal manifestations of this single logical interface. The description of its "spherical front" is based on the simplest geometric assumption of the isotropic unfolding of the Singularity's Structural-Order in the Void environment; it is a visual metaphor to aid understanding, not a final assertion about the physical morphology of the Rule-Wall. An engagement between Rule-Walls is a direct mutual-translation conflict between two sets of Structural-Order encodings. The defeat and death of one side's Rule-Wall is not the puncturing of a physical membrane, but the loss of local

self-consistency of that encoding under the suppression of the opposing encoding, the disintegration of its Structural-Order, and the nullification of its conversion function.

The above terminology definitions apply throughout the text and will not be repeated each time.

2.1 First Deduction: Matter Must Be Continuously Injected

If all matter in the universe originated from a single initial endowment and the total quantity has remained constant since, then 13.8 billion years of expansion would inevitably have diluted the effective energy gradients to near zero, contradicting Fact 2. After eliminating options that introduce additional assumptions, and following the principle of Occam's razor—under equal explanatory power, the fewer presupposed entities the better—the optimal solution is: although the universe is expanding, incremental energy continuously enters the interior of this universe, maintaining its effective energy gradients and thermodynamic degrees of freedom. It must be clarified that “optimal solution” is not equivalent to “unique solution”—this deduction accepts testing by logical necessity: if future alternative proposals can provide stronger explanatory power without increasing presuppositions, this link of the present model shall be revised. This is an inherent feature of first-principles deduction, not a theoretical defect.

Corollary 1: The universe is an open system. The total quantity of matter increases as the universe expands spatially.

2.2 Second Deduction: Order Must Emerge from Disorder

Where does the order of this universe come from? Four possibilities exist:

Order derives from prior order: This path enters infinite regress, can never reach a first instance of order, and is logically incomplete.

Order is eternally self-existent: This path elevates physical laws to an uncaused first cause, structurally equivalent to a religious presupposition, and does not constitute a physical answer.

Order emerges from disorder: Neither infinite regress nor eternal self-existence.

Cyclical regeneration of order (order → disorder → order cycle): While this may appear to circumvent the first-cause problem, cyclic models still require an explanation for the origin of the first cycle's order, remain nested within infinite regress in essence, and cannot close the first-principles logical chain.

Eliminating A, B, and D, and after excluding options that introduce additional assumptions, the optimal solution is C: order emerges from disorder.

Corollary 2: The order of this universe emerged from a more primordial state of disorder.

2.3 Third Deduction: A Chaotic Energy Ocean Must Exist Beyond This Universe

The preceding three corollaries each independently point to the necessity of an external source for this universe, but along different dimensions:

Corollary 1 proves that matter and energy must be continuously injected from outside;

Corollary 2 proves that order must have emerged from an external state of disorder;

The origin of space itself cannot be ignored: the space of this universe has been continuously expanding, and newly added space must have a source; it cannot arise from nothing. Although General Relativity does not contain a strict definition of global energy conservation, if space could spontaneously appear, this would be equivalent to presupposing

space as a non-conserved eternal miracle—this both violates the spirit of physical inquiry and is difficult to reconcile with any rational account of cosmic expansion.

These three requirements—**incremental matter and energy, a matrix of disorder, and a supply of space**—after eliminating options that introduce multiple independent presuppositions, and following the principle of Occam’s razor, converge on a single external source as the optimal solution: the Chaotic Void. A stricter formulation is needed here: this is not a subjective choice based merely on aesthetic preference or parsimony, but a **recursive convergence** of logical inquiry itself—lines of questioning proceeding from different dimensions are all ultimately forced to the same limit point. It is not that we have chosen a “single source”; rather, logic itself does not permit us to stop elsewhere without introducing additional assumptions.

Corollary 3: A Chaotic Void exists beyond this universe. It is the common source of this universe’s matter, order, and space.

2.4 Fourth Deduction: The Transition from Disorder to Order Must Pass Through a Translation Layer

The Chaotic Void is a state of energy that is disordered, chaotic, and follows no unified laws. The interior of this universe is a highly ordered system obeying precise physical laws.

If the disordered energy of the Chaotic Void were injected directly into the interior of this universe, it would instantly destroy the existing ordered structures within—like pouring a mudslide directly into the gears of a precision clock. Yet our universe has persisted for 13.8 billion years, and its internal physical order has remained stable. This indicates that the injection of chaotic energy is not a direct dump but passes through a conversion process.

This conversion process must perform two functions: first, **converting** the external disordered chaotic energy into ordered mass-energy conforming to this universe’s internal physical laws; second, providing **isolation** during the conversion process to prevent uncalibrated energy from impacting the existing internal order.

Corollary 4: Between the Chaotic Void and this universe exists a translation layer with the dual functions of conversion and isolation—the Rule-Wall.

2.5 Fifth Deduction: The Non-Ultimacy of the Void Necessitates Suppliers

The Chaotic Void is the external energy source we have derived. But is the Void itself an ultimate existence?

The Void is a violently turbulent ocean of chaotic energy flows. This restless energy state implies that the Void is continuously doing work—energy bodies within it collide, churn, tear apart, and recombine, perpetually generating motion and change. The Chaotic Void is a non-equilibrium open turbulent system; the macroscopic thermal motion and interactions of disordered energy involve gradient dissipation and cannot maintain eternal energetic self-sufficiency. Therefore, the Void cannot be an ultimate source of energy—it must have a requirement for energy replenishment. It should be noted that the Void, as a non-equilibrium dynamic disordered state, is characterized by violent energy fluctuations and extremely steep local gradients, and the entropy concept of classical thermodynamic equilibrium does not apply. “Entropy” here is only borrowed for its intuitive meaning, without strict thermodynamic definition.

It should also be noted that “order” and “disorder” are not absolute opposites, but relative comparative concepts. Just as the interior of this universe contains local, temporary unstable phenomena such as radioactive decay, so too may the “disordered” Void as we define it contain local, temporary micro-ordered structures—those transient Structural-Orders

formed accidentally in collisions. The “chaos” of the Void is not absolute disorder, but rather an extremely low gradient of order relative to this universe. It is a vast, undifferentiated “reservoir of Structural-Order”—containing all possible structures, yet not yet condensed into any identifiable order. The mode of existence of Structural-Order within the Void is latent, awaiting emergence.

Since the Void cannot be the ultimate source of energy, we must ask: if we recursively trace the Void’s energy back to its end, what are the most fundamental residual components? The answer is two categorically different things: one is **energy**, which can do work and manifest as motion and change; the other is **spatial capacity**, which can accommodate these energies and allow them to exist. Spatial capacity itself does no work and manifests nothing, yet it is the precondition for all work and manifestation to be “contained.” Without spatial capacity, energy would have nowhere to exist; without energy, spatial capacity would be pure nothingness.

Neither the energy in the Void nor the spatial capacity in the Void can arise from nothing. Each requires its own source. Therefore, the Void requires two suppliers—one providing energy, the other providing spatial capacity.

On the nature and positioning of the Void: Within this model, the Void is a necessary intermediary derived through the chain of philosophical logic—so long as the Meta-State exists and random fluctuations exist at the Ji-Kong/Ji-You Interface, the Void as a chaotic region interwoven with Being and Non-Being necessarily emerges. It is not an observable entity within this universe, nor does it belong to pure philosophical ontology; it is the logically inevitable link connecting the ontology of the Meta-State to the physical hypothesis of the Rule-Wall. The physical hypothesis of the Rule-Wall need only address the conversion mechanism from the Void into the interior of this universe, without needing to explain the origin of the Void itself—that is a matter for philosophical deduction, not for physical hypothesis.

It must be pointed out that the “energy and spatial-capacity supply” required by the Void is not a continuous net energy flow from the Meta-State. The Meta-State as a whole always maintains a macroscopic steady state of zero net flux—the supply the Void receives comes from instantaneous fluctuations brought about by local micro-fluctuations at the Meta-State Interface, not from a unidirectional energy output of the Meta-State as a whole. When a Void Cluster withers and dies due to energy exhaustion, its residual energy returns to the dualistic cycle of Ji-Kong and Ji-You; the total state of the Meta-State remains unchanged, and global energy is always closed over the Meta-State dualistic structure, with no net gain.

Corollary 5: The Void is not an ultimate existence; it requires a dualistic supplier, with one providing energy and the other providing spatial capacity.

2.6 Sixth Deduction: The Supplier Must Be a Dualistic Structure

Could the two components of the Void—energy and spatial capacity—originate from a single source?

If they came from a single source, that source would have to simultaneously possess the two categorically distinct, mutually opposed attributes of “pure energy” and “pure spatial capacity.” For a single entity to be simultaneously pure energy and pure spatial capacity constitutes an internal logical contradiction.

Following the principle of Occam’s razor, the minimal-hypothesis solution: two independent sources—one providing pure energy, the other providing pure spatial capacity. Each possesses internally consistent attributes and generates no self-contradiction.

Corollary 6: The supplier of the Void is dualistic. The two are independent and each possesses pure attributes.

2.7 Seventh Deduction: The Two Must Be Evenly Matched and Each Infinite

The dualistic supplier must possess the following properties to serve as the ultimate source from which the Void can arise:

First, the two must be evenly matched. If one of the two ultimate energy states were stronger and the other weaker, the stronger would inevitably suppress, dilute, or even absorb the weaker over endless ages. Once the weaker is absorbed, the dualistic structure would cease to exist, the Interface would vanish, and the Void could no longer be generated. Yet the Void has been generated, and this universe exists. This means that throughout the history of existence up to the present, the two have maintained comparable strength.

Second, the two must each be infinite. If one were finite, it would ultimately be defeated in the eternal contest—a finite entity can never achieve a permanent standoff against an infinite one. Only if both are infinite can they maintain macroscopic equilibrium over infinite timescales, without Being rapidly depleted by unidirectional energy loss. Logically, if a boundary or outside exists, the entity in question is a finite set; an ultimate source must eliminate the “external inquiry”—i.e., it must no longer be necessary to ask “where does the ultimate source come from”—and thus only an infinite set can terminate the regress.

Corollary 7: The dualistic suppliers are evenly matched and each infinite. It should be noted that the Void is not eternal—when a particular Void Cluster is exhausted and fails to receive renewed energy supply, it naturally withers and dies. However, over sufficient timescales, the possibility that a given Void may once again receive energy supply cannot be excluded. This provision is not in conflict with the theory of the model’s ultimate source.

2.8 Eighth Deduction: The Meta-State—The Logical Endpoint

How can two infinite, evenly matched existences coexist? Ji-Kong and Ji-You constitute a complementary infinite dualistic set—no containment relation exists, no outside boundary exists; the two form the unitary structure of the Meta-State solely through their Interface.

Two infinities cannot be separate, juxtaposed entities—if each existed independently, each would have an “outside,” yet infinity has no outside. Nor can one infinity be contained “inside” another infinity—“inside” implies “the one containing it is larger,” yet infinity cannot be contained by anything larger.

The only topological structure that generates no logical contradiction is the following: the two are each the reverse aspect of the other, forming a dual. Viewed from one side, the other surrounds everything; viewed from the other side, the first surrounds everything. They are not one inside the other, nor one outside the other. They are two inseparable aspects of a single ultimate structure.

We designate this structure the **Meta-State**.

Within the Meta-State, **Ji-Kong** constitutes the spatial-capacity pole—an infinite, absolutely empty substrate that is the basis of all existence, the container accommodating all possibilities. **Ji-You** constitutes the energy pole—infinite, absolutely dense primordial energy containing the content of all possibilities, the ultimate source of all potential energy. Ji-Kong and Ji-You are each the reverse aspect of the other, forming a dual, maintaining an eternal, silent macroscopic stability through dualistic tension.

Corollary 8: The Meta-State is an infinite dualistic structure. This is the logical endpoint of the reasoning.

Here, reasoning reaches its natural cognitive boundary. To continue asking “where does the Meta-State come from” would enter the ultimate question of “why is there Being rather than Non-Being,” which lies beyond the scope of physics. Reasoning stops here not from laziness or timidity, but because any further step yields nothing that can be grasped by rational inference.

2.9 Summary of the Reasoning Closure

The above eight steps of deduction constitute a complete logical closure:

Observational facts (universe is ordered + universe is full) → open system (matter continuously injected) → order emerges from disorder → external Chaotic Void exists → a conversion layer (Rule-Wall) is necessary → the Void is not ultimate (requires supply) → the supplier is a dualistic duality (Ji-Kong and Ji-You) → the two are infinite and evenly matched → the ultimate structure of mutual reverse-aspect (Meta-State)

This chain fully embodies the core characteristics of first-principles deduction: it contains no theological presuppositions, no arbitrary initial conditions; it proceeds from observable facts, uses only the principle of Occam’s razor to select the path of fewest assumptions, and arrives at the logically inevitable endpoint.

The above completes the entire logical deduction of the philosophical-ontology layer; from Chapter III onward, we enter the physical-hypothesis and cosmic-evolution framework built upon this philosophical foundation.

III. Core Physical Mechanisms: From Void Clusters to Cosmic Evolution

The following sections present physical-hypothesis deductions that extend naturally from the chain of philosophical logic. These mechanistic descriptions are subject to indirect observational testing and logical self-consistency review.

3.1 The Birth of Void Clusters and the Potential-Energy Barrier

Although the Meta-State is macroscopically stable, at the infinite Interface between Ji-Kong and Ji-You, two absolutely pure and powerful primordial energy states are in contact with each other. Their interface can never be a mathematically perfect stillness. Across this Interface, there have always been continuous, omnipresent, fleeting microscopic energy micro-fluctuations—Ji-Kong attempting to dissolve Ji-You, Ji-You instinctively seeping toward Ji-Kong.

The vast majority of micro-fluctuations close instantly, with zero net energy transfer. However, under the dual conditions of infinite time and infinite interfacial area, statistically extremely low-probability events acquire the condition of inevitability: a particular micro-fluctuation breached the critical potential-energy threshold of the Ji-Kong/Ji-You Interface (the constraint of Meta-State dualistic tension), causing an irreversible net leakage of Ji-You energy into the Ji-Kong domain.

The leaked energy mixed violently with Ji-Kong spatial capacity—Ji-You energy striving to maintain its own purity and density, Ji-Kong spatial capacity striving to dilute and absorb this intruder. Two extreme forces pulled, entangled, and interpenetrated each other, forming a churning, turbulent energy flow interwoven with Being and Non-Being—a **Chaotic Void Cluster**, suspended as an independent entity within Ji-Kong.

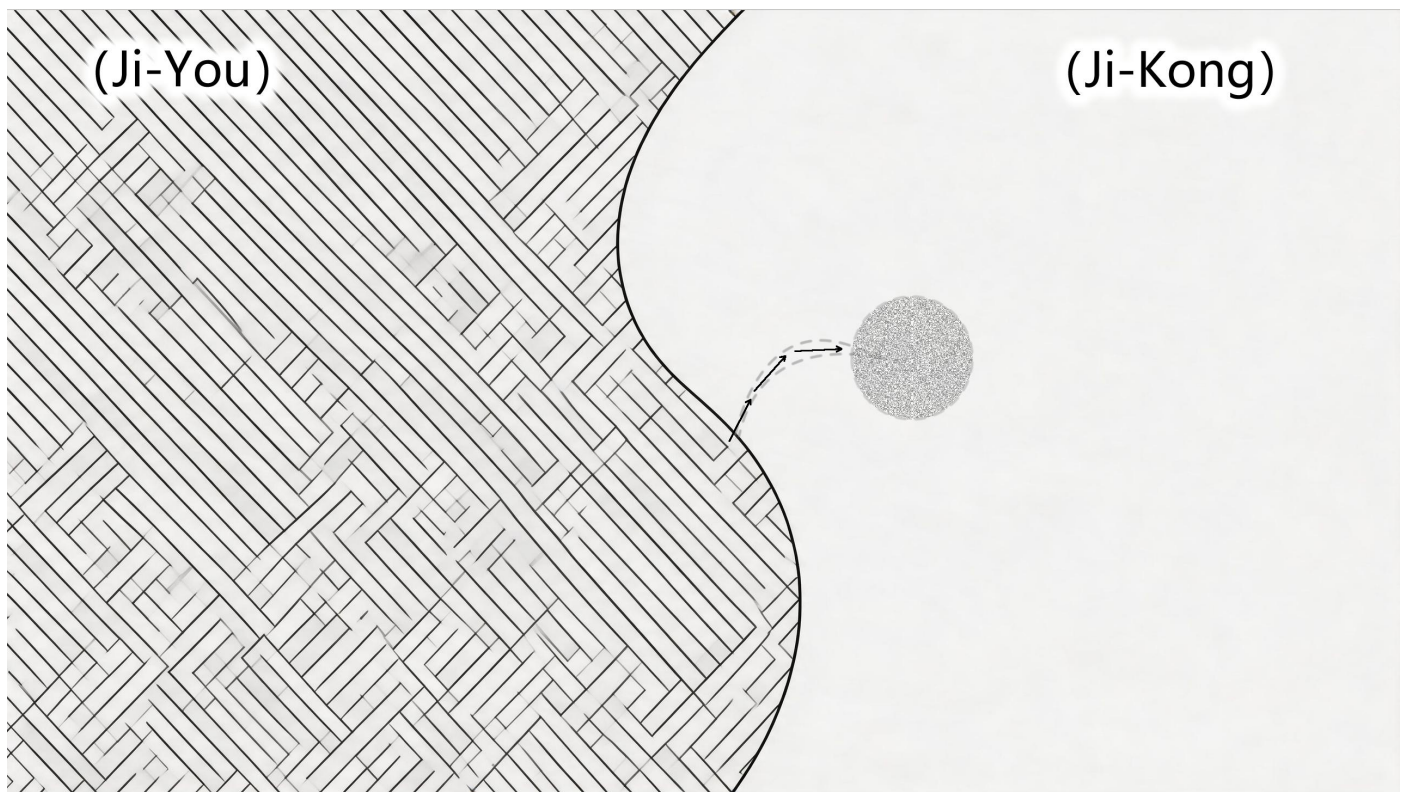


Figure: The Meta-State is constituted by the dualistic duality of Ji-You and Ji-Kong. In the figure, the S-shaped curve marks the Interface; the left hatched area is Ji-You, the right white area is Ji-Kong. The arrow indicates a net leakage event: Ji-You energy breaches the critical constraint of the Interface and enters the Ji-Kong domain. The dashed circle marks the Chaotic Void Cluster formed by the fusion of the escaped energy with Ji-Kong spatial capacity.

Such net-leakage events did not happen only once. Over endless ages, in different regions and at different moments across the Interface, similar escapes recurred repeatedly. The resulting Void Clusters emerged successively, each independent, varying in form and size—some extremely dense in energy with violently churning interiors, others relatively sparse with indistinct boundaries. Together they float in the silent Ji-Kong, each becoming a candidate cradle for the birth of a future universe.

The boundary of each Void Cluster is not a “shell” made of any physical substance. At the edge of a Void Cluster, the internal chaotic energy has a natural tendency to expand outward, while the external Ji-Kong spatial-capacity potential exerts inward compression. These two forces achieve dynamic equilibrium at this boundary surface, forming a natural **Potential-Energy Barrier** (Void-to-Ji-Kong Dynamic Potential-Differential Barrier). This barrier is purely an equilibrium state of energy structure, not a physical boundary. Its function is bidirectional constraint: blocking internal energy from escaping outward back into Ji-Kong, and blocking external Ji-Kong potential from continuously intruding into the Void Cluster interior.

The micro-fluctuation dynamics at the Meta-State Interface cannot, in principle, be known to any observer inside a

Bubble Universe. This model only deduces the statistical inevitability of net leakage events based on the single postulate that “dualistic duality itself entails minimal motion,” and makes no further assertions about the specific dynamics of the micro-fluctuations.

3.2 Singularity Condensation: A Statistical Mechanics Hypothesis

The interior of a Void Cluster is a churning sea of chaotic energy. Energy bodies here continuously collide, tear apart, annihilate, and recombine. The overwhelming majority of collisions result in mutual deflection or mutual destruction.

Under extremely rare circumstances, two energy bodies happen to collide into a temporary, minute ordered structure—a purely accidental product of collision geometry. The Chaotic Void is globally high-entropy, but local energy-density fluctuations can form transient low-entropy micro-regions. Such micro-ordered structures are typically fragile and vanish instantly under the impact of chaos. However, if, before disintegration, more energy bodies embed themselves in an ordered fashion, and once the binding force of the local ordered structure exceeds the threshold of chaotic deconstruction force, a positive-feedback mechanism activates: enhanced order → strengthened attraction for chaotic energy → accelerated energy aggregation → further enhancement of order. This self-reinforcing condensation cycle ultimately forms an extremely dense, highly ordered core—the **Singularity**.

(Chaotic Void)

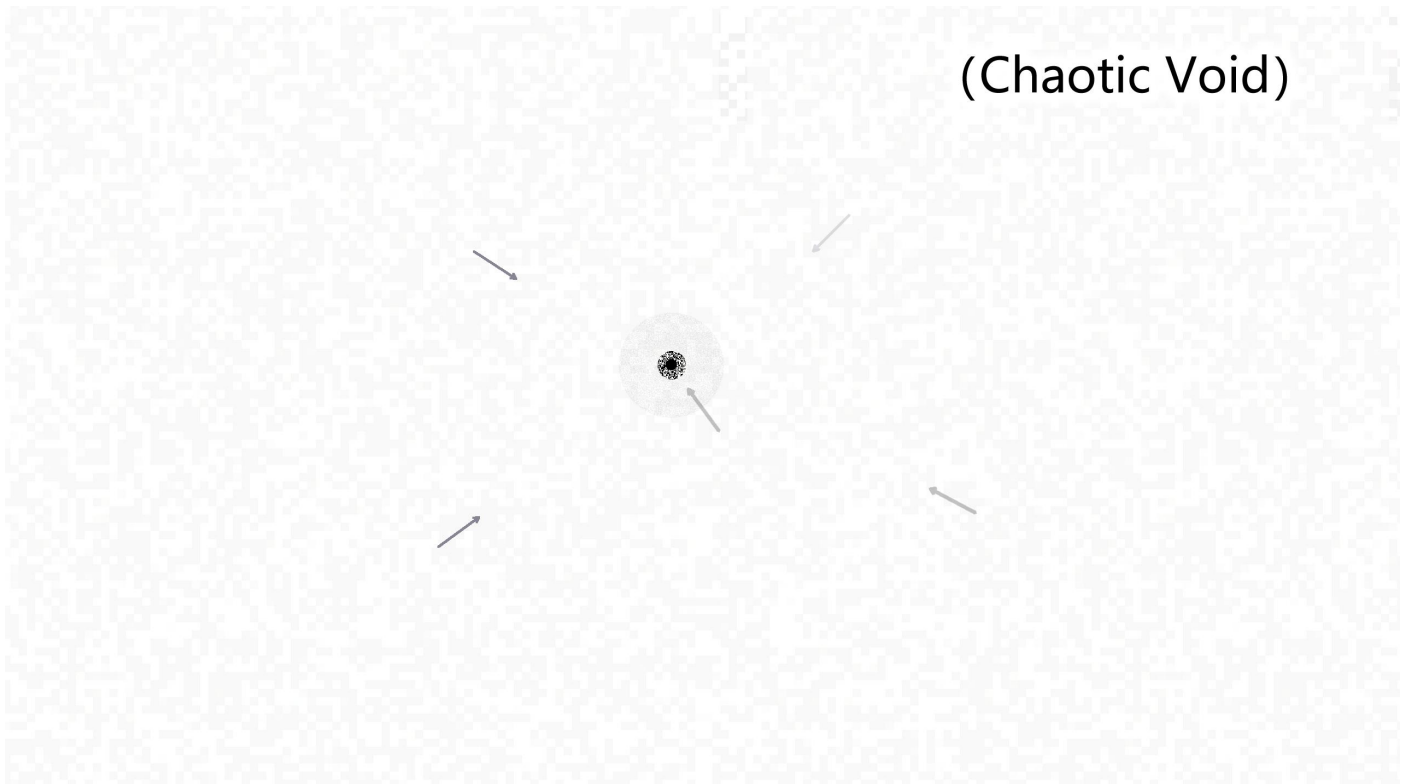


Figure: Within the Chaotic Void, a Singularity is condensing. Surrounding chaotic energy is continuously drawn inward by gravity into the condensation process. The Singularity’s internal Structural-Order gestates and grows under the compression of external chaotic pressure. The dense core at the center is the Singularity; curved arrows indicate the direction of energy convergence; the transitional ring around the core marks the zone where energy undergoes

The Singularity is an inevitable product of statistical mechanics within the Chaotic Void. So long as the Void Cluster is sufficiently large, the energy sufficiently abundant, and the time sufficiently long, after enough failed attempts, one attempt will necessarily succeed, statistically, in crossing the critical scale. This process is physically analogous to self-organized critical phenomena or phase transitions in non-equilibrium systems—once a micro-ordered structure crosses the critical point, the system spontaneously tends toward a higher degree of order.

Furthermore, the local density fluctuations of Void chaotic energy are physically analogous to those in non-equilibrium turbulent systems. To provide an operable starting point for future numerical simulations, this hypothesis speculates that their energy spectrum distribution may be describable by a Kolmogorov-type turbulence spectrum, with energy cascading across different scales to form self-similar fluctuation structures. Regions where the local energy density reaches a critical value are precisely the potential seeds for Singularity condensation.

Important caveat: It must be pointed out that the descriptions herein of Void energy fluctuations using terms such as “density,” “turbulence,” and “energy spectrum” are all heuristic analogies serving the construction of a physical hypothesis, and do not imply that the Void itself can be directly observed or measured by the physical tools of this universe. The Void is a logical existent derived through philosophical deduction, not an observable entity amenable to physical-statistical description. The energy spectrum analogy is merely a heuristic speculation, not a necessary deduction of this hypothesis. The equivalent energy dissipation rate and dimensionless constants in the turbulence spectrum have no independent measurement means within the Void; their specific values are left for future theoretical analysis or numerical simulation to constrain. Should this speculation be falsified, the validity of the core logical chain of the Meta-State model would not be affected.

The hierarchical relationship between “Structural-Order” and “Physical Laws”: A clear distinction must be drawn here—“Structural-Order” refers to a specific organizational mode of energy units distinguishable from random arrangement; it is the latent deep structure that shapes cosmic rules before they exist. “Physical laws” are the rule system that manifests as strict constraints within the universe after Structural-Order has been unfolded by the Rule-Wall. Structural-Order is the seed; physical laws are the plant that grows after the seed germinates. The two constitute a hierarchical relationship of “microscopic structure first, macroscopic constraints second.”

Heuristic Analogy: The Creative Principle of Pure Opposition

To aid understanding of how Structural-Order condenses from chaos, a formalized heuristic analogy may be introduced. Suppose two most primordial, purest opposing states exist—one representing pure “Being,” the other pure “nothingness.” Each of these two states, taken alone, is singular and unchanging. But once they exist simultaneously, the opposition between them constitutes a most fundamental tension. Being yearns to express; nothingness provides space. Once the two make contact, interaction necessarily ensues. This interaction is the first driving force of all subsequent evolution. Under this framework, Structural-Order can be understood as a particular, stable organizational pattern formed in the interaction of these two pure states. It was not designed out of nowhere, but is a necessity that emerged contingently through countless

collisions and embeddings. This analogy serves only to aid understanding of the abstract logic that “pure opposition generates infinite possibilities,” and is not a description of the physical mechanisms of the Void. This model does not hold that the universe is a product of computer simulation, nor does it equate Ji-Kong and Ji-You with digital signals or any form of “code.”

Clarification of the term “Singularity”: In this paper, “Singularity” refers specifically to a high-density ordered core condensed within the Chaotic Void; its essence is a compressed seed of Structural-Order. It belongs to an ontologically different category from the spacetime-geometry failure point defined by geodesic incompleteness in General Relativity, and there is no necessary connection between the two. This paper does not rely on the singularity theorems of General Relativity, nor does it claim any mapping relation between the two.

Deep within the Void, Singularities form one after another. Some, having just condensed an initial core, are scattered by chaotic turbulence. Some, halfway through condensation, develop internal contradictions in their ordered structure—ordered orientations in different regions conflict and cancel each other, leading to self-disintegration. Only a very few, under the heavy pressure of chaos, persist, continuously absorbing energy, accumulating unimaginable power in silence.

To further illustrate how order emerges from disorder, a conceptual local order-degree parameter may be introduced, whose dynamics can be heuristically described as the combined result of order-degree diffusion, growth, and noise driving.

Important caveat: This framework is merely a description at the conceptual stage, used to illustrate how order emerges from disorder. Its specific parameters and functional forms cannot yet be uniquely determined by this hypothesis. All dimensionless parameters and functional forms do not enter into observational predictions; they serve only as placeholder structures for future formalization. The goal of this framework is to provide optimizable algorithmic ideas, not to claim the discovery of the real dynamical equations of the Void.

3.3 Singularity Eruption and Rule-Wall Unfolding

Throughout the condensation process, the Singularity endures sustained external compression from the chaotic energy of the Void. When the external chaotic pressure exceeds the tolerance limit of the Singularity's internal ordered structure, the external disordered potential drives the Singularity's ordered topology to a critical instability point, triggering global decoupling and forced unfolding. The underlying physical mechanism is: external chaotic disordered potential continuously compresses the Singularity's ordered structure; when the ordered topological structure reaches the critical instability threshold, the compressed Structural-Order undergoes global decoupling and unfolding, forming the Rule-Wall interface. This process is conceptually analogous to the abrupt transformation behavior of an order parameter at the critical point in phase-transition theory.

The entire ordered structure accumulated during the long condensation period—all energy-organization schemes, all Structural-Order compressed to its limit—is forcibly unfolded in an instant. This release is not a random splashing of energy but a forced unfolding of ordered structure. The Singularity transforms from an extremely compressed ordered core into a spherical conversion interface—the **Rule-Wall**.

The Rule-Wall is the physical embodiment of the Singularity's internal “Structural-Order.” The energy-organization

scheme formed through countless energy-body collisions and embeddings during the condensation period is, at the moment of eruption, fixed once and for all as a complete conversion logic—the original version of all physical laws in this universe. The gravitational constant, the speed of light, the interaction strengths of fundamental particles, the curvature of spacetime—none of these are eternal a priori truths. They are given conditions locked in at the instant of the Singularity’s eruption, thereafter never to be altered.

Core positioning statement on the Rule-Wall: The Rule-Wall is not necessarily a static, independent physical entity endowed with functions out of nowhere. It is a logical interface at which a qualitative transformation in the properties of Structural-Order occurs during its unfolding process—the previous roles of “converter,” “shield,” and “engine” are all different phenomenal manifestations of this single logical interface. The description of its “spherical front” is based on the simplest geometric assumption of the isotropic unfolding of the Singularity’s Structural-Order in the Void environment; it is a visual metaphor to aid understanding, not a final assertion about the physical morphology of the Rule-Wall.

3.4 The Rule-Wall Conversion Hypothesis and Cosmic Expansion Dynamics

The Rule-Wall operates as a continuously running three-step cycle:

Input: The outer side of the Rule-Wall contacts the chaotic energy of the Void—disordered, wild, erratic, following no unified laws.

Conversion: Each fundamental energy unit, as it passes through the Rule-Wall, is forcibly calibrated—its behavioral pattern is modified, its kinematic posture disciplined. It is translated from a chaotic grammar of no rules into a rigorous, self-consistent, never-contradictory grammar of order. This process operates on individual energy states at the microscopic level, but at the macroscopic scale it is too rapid to measure. More strictly speaking, Rule-Wall conversion is an encoding conversion between different rule systems, not a quantum operation within the same Hilbert space. The category of “unitary/non-unitary” is therefore not directly applicable to the conversion process across rule interfaces; the description as a “non-unitary mapping” here is merely an effective approximation from the perspective of an observer in this universe. Within the interior of this universe, conservation holds strictly locally—energy-momentum is precisely conserved in closed systems on the inner side of the Rule-Wall; the process of conversion across the Rule-Wall does not constitute a closed system, and therefore unitarity is not required for individual steps; total conservation is closed globally over the Meta-State dualistic structure. This distinction ensures the full compatibility of this hypothesis with known conservation laws. The information loss during Rule-Wall conversion is relative to observers within this universe—information encoded in alien-universe rules cannot be decoded within the physical framework of this universe, and therefore manifests phenomenologically as “information loss.” This is not, however, a violation of unitarity in the quantum-mechanical sense, but an inaccessibility in the sense of information taxonomy. All quantum processes within the interior of this universe continue to evolve unitarily; the Rule-Wall interface merely converts information from a readable format to an unreadable one, without damaging the fundamental structure of quantum theory.

Output: Successfully calibrated ordered mass-energy is released from the inner side of the Rule-Wall into the interior space of the Bubble Universe, becoming matter and energy conforming to this universe’s physical laws.

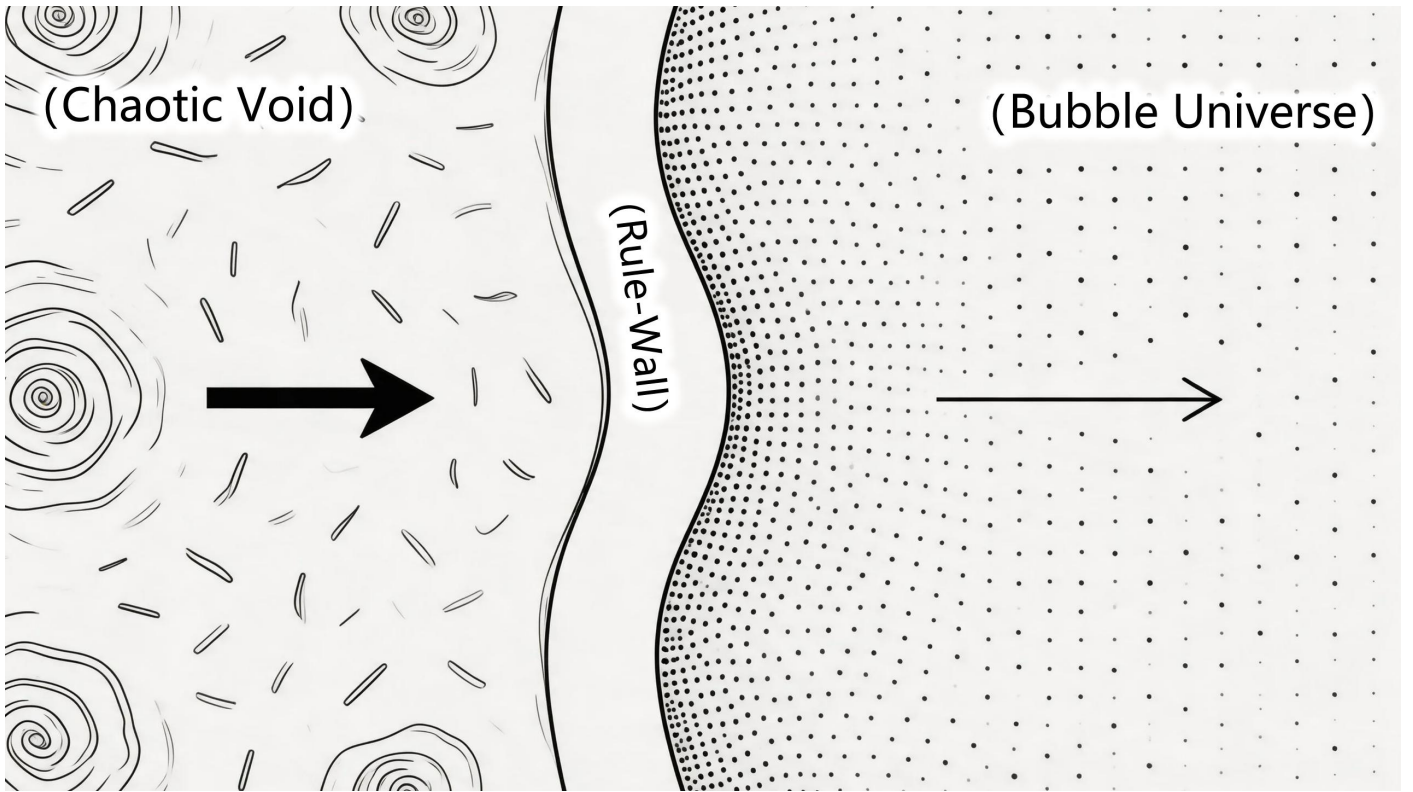


Figure: Schematic of the Rule-Wall conversion mechanism. Upper layer (disordered short lines): the Chaotic Void. Middle layer (extremely narrow horizontal band): the Rule-Wall conversion front. Lower layer (sparse, uniform dots): calibrated ordered mass-energy inside the Bubble Universe. The thick downward arrow, labeled “Energy conversion direction (disorder → order),” indicates that chaotic energy is calibrated through the Rule-Wall front, converted into ordered mass-energy, and continuously injected into this universe.

Expansion dynamics: The Rule-Wall continuously converts Void energy → internal mass-energy continuously increases → exerting outward pressure on the Rule-Wall; meanwhile, the Rule-Wall’s own conversion activity continuously pushes it further outward into the Void. These two superimposed effects constitute a self-sustaining perpetual expansion engine: conversion → mass-energy injection → increase in internal pressure → Rule-Wall outward advance → contact with more Void energy → continued conversion. The Rule-Wall is not passively pushed forward; it actively advances outward.

This hypothesis simultaneously provides a unified underlying logical explanation for the following key observational phenomena:

The nature of cosmic expansion: Expansion is not a uniform stretching of internal space; rather, it is the Rule-Wall advancing through the Void, continuously creating new space and injecting new mass-energy. The equivalent description of the universe’s internal expansion under this hypothesis can, in mathematical form, be mapped onto the standard Friedmann equations, where the effective energy density is not a constant initial endowment, but the result of a dynamic equilibrium

between continuous Rule-Wall injection and dilution by cosmic expansion. The equation form is shared with Λ CDM, but the evolutionary history of the effective energy density is jointly determined by the Rule-Wall conversion efficiency and the Void energy density, rather than by initial conditions and a cosmological constant. This hypothesis reproduces the expansion phenomenology of Λ CDM in terms of internal observational equivalence, but the physical origin of the effective energy density is entirely different from the standard model. From the perspective of an internal observer, the observational predictions of the two underlying mechanisms are indistinguishable.

The origin of matter: Matter was not given all at once at the Singularity. The total quantity of matter in the universe grows continuously as the Rule-Wall advances. This explains why the universe, after billions of years of expansion, has not reached heat death—the matter density has not been exponentially diluted by expansion, because new matter is continuously injected as supplement.

The stability of physical laws: Physical laws are the conversion logic fixed at the instant of the Rule-Wall’s eruption. Thereafter they are never modified—any modification would imply logical self-contradiction and would immediately cause the Rule-Wall to collapse. Hence the gravitational constant, the speed of light, and the properties of fundamental particles have remained constant over the past billions of years.

Observational principle of superluminal expansion: Near the Rule-Wall conversion front, violent energy-conversion reactions are taking place. Here the energy density is extremely high, the spacetime structure is intensely active, and the flow of time is far faster than in the already stabilized and cooled interior regions of the universe. From the interior stable region observing the boundary, the front recedes at a distance per unit interior time far exceeding the speed of light. This is not matter moving superluminally through space; it is an observational effect caused by the difference in time-flow rates near the Rule-Wall front—time near the boundary runs faster, so the boundary can advance a distance far exceeding one light-second within one second of an interior observer’s clock.

The local speed-of-light invariance of Special Relativity applies only to the stable flat spacetime of this universe’s interior. The Rule-Wall conversion front is a trans-universal rule interface and does not belong to the locally valid spacetime of Special Relativity. The speed of light is an internal traffic rule of this universe and does not constrain the hand that creates the traffic rule. This mechanism is physically analogous to the observational fact, in inflationary cosmology, of galaxies receding at superluminal speeds without violating local causality.

3.5 The “Big Bang” Phase at the Initial Singularity Eruption

The region surrounding the Singularity is the zone of highest Void energy density—during the long condensation period, the Singularity gravitationally attracted a large amount of chaotic energy around itself. Therefore, when the nascent Rule-Wall passes through this high-density Void region, the conversion rate is at its most violent, and the mass-energy injected into the universe’s interior is at its most concentrated.

From the perspective of an internal observer, this phase corresponds to an extremely hot and dense early universe—what conventional cosmology calls the “Big Bang.” In this hypothesis, the Big Bang is not all matter exploding out of the Singularity at once; rather, it is the phase when the Rule-Wall, passing through the high-density Void region near the Singularity, undergoes its most intense conversion. This distinction does not affect the internal observational results: the

extreme temperature, extreme density, and tight coupling of matter and radiation in the very early universe—all these core features of the traditional Big Bang model are equivalently present in this hypothesis.

Thus, this hypothesis fully inherits all the successful predictions of the standard Big Bang model regarding the Cosmic Microwave Background, primordial element abundances, the seeds of large-scale structure, and so forth. The divergence lies solely in the reinterpretation of the underlying physical cause of these phenomena.

IV. Exclusive Falsifiable Predictions

Although this model shares equivalent phenomenological predictions with Λ CDM on standard tests such as the CMB and primordial element abundances, it presents **exclusive predictions** in the following two specific observational domains—i.e., this model explicitly predicts one type of observational outcome, while the standard Λ CDM model yields a different expectation for the same type of observation.

The existence of these exclusive predictions is the core marker distinguishing this model from metaphysical frameworks that “explain everything but cannot be tested.” Even though the model’s core ontology (the Meta-State) is in principle not directly observable, these predictions still provide operable pathways for indirect testing.

Prediction I: Metallicity Distribution Anomalies in Extremely Sparse Galaxies Inside the KBC Void

The standard Λ CDM model interprets voids as products of gravitational clearing. Under this picture, any galaxies remaining inside a void should possess star-formation histories similar to those of galaxies in surrounding regions, and should therefore also exhibit similar metallicity distributions.

The Meta-State model predicts that the extremely sparse galaxies observed inside the KBC Void originate primarily from the small number of galaxies formed when back-flowing Void energy from the engulfed universe was re-converted. Their star-formation histories and metallicity distributions will exhibit features significantly different from those of surrounding galaxies—because they do not share a common material origin with surrounding galaxies, but derive from the back-flow conversion of alien-universe remnants.

Quantitative testing protocol: Separately sample the extremely sparse galaxies inside the void and at its edge; use the Kolmogorov-Smirnov test to compare the cumulative distribution functions (CDFs) of their metallicities. If the two CDFs are statistically indistinguishable, this prediction is falsified. This model does not accept evasive explanations citing “sampling bias” or “non-uniform local back-flow.” To ensure the robustness of the test, the influence of covariates such as environmental effects (e.g., galaxy mass, star-formation rate) must be excluded. This difference can be tested by existing and future spectroscopic survey data (such as JWST deep-field spectroscopic observations).

Supplementary note: In this prediction, the metallicity anomalies of galaxies inside KBC-class voids (engulfment-type) and those inside failed-relic voids (relic-type) are expected to exhibit similar anomalous patterns—both originate from non-standard star-formation channels, and both are statistically distinguishable from surrounding galaxies. At the formalization stage, refined predictions regarding the degree-of-anomaly difference between the two void types may be further developed.

Prediction II: Statistical Distribution Anomaly in the Sphericity of Supervoids at Low Redshift ($z < 0.1$)

The standard Λ CDM model predicts that the morphology of large voids is predominantly irregular. The gravitational clearing mechanism itself does not tend to produce perfectly spherical voids, and tidal forces from surrounding large-scale

filamentary structures further distort void shapes.

The Meta-State model predicts: if the KBC Void and voids of similar scale are projections of Rule-Wall engulfment relics, their morphology should more closely preserve the spherical symmetry of the original Bubble Universe. Therefore, within the low-redshift range ($z < 0.1$), the statistical distribution of sphericity for voids with diameters exceeding 1 billion light-years should be significantly biased toward higher sphericity—a feature that yields a measurable systematic difference from the predictions of the gravitational-collapse picture. Define the sphericity quantification parameter $f = R_{\min} / R_{\max}$, with $f \approx 1$ indicating high sphericity. The Meta-State model predicts that the sphericity distribution is significantly concentrated near 1, whereas the Λ CDM model predicts a more dispersed distribution.

Quantitative testing protocol: Screen void samples with $z < 0.1$ and diameter > 1 billion light-years from CSST survey data; compute their sphericity distribution according to the quantification definition above, and compare with the predicted values from Λ CDM simulations. If the mean sphericity of the actual sample is statistically indistinguishable from the predicted value of the Λ CDM simulation, this prediction is falsified. The wide-field survey capability of CSST (China Space Station Telescope) is naturally suited for a census of void morphology and can provide key testing data within the coming decade.

Falsification Statement:

The following observational outcomes shall constitute the falsification of the corresponding deductions of this model:

1. If the statistical distribution of sphericity for the KBC Void and supervoids of similar scale is consistent with the expectations of the gravitational-collapse picture (i.e., the distribution is dispersed, with no significant bias toward high sphericity), Prediction II is falsified.

2. If the metallicity distribution of extremely sparse galaxies inside the KBC Void is statistically not significantly different from that of surrounding galaxies, Prediction I is falsified.

Under the above circumstances, the deductive hypotheses of this section shall be regarded as negated by observation and requiring revision. This model does not accept evasive explanations citing “different voyage histories” or “differences in local encounters.” No supplementary details of the Rule-Wall’s voyage history may be used to retroactively offset the falsifying force of the above observations.

V. Cosmic Structures and Explanations of Anomalous Observational Phenomena (Deductive Hypotheses)

The Rule-Wall does not advance through the Void at a uniform speed. The Chaotic Void is an uneven ocean of energy, and the Rule-Wall’s voyage through it is full of encounters. Each encounter leaves a corresponding imprint on the internal structure of the universe.

The various types described below are all **deductive hypotheses** concerning observed cosmic phenomena, proposed within the logical framework of this model. These deductions possess perfect logical self-consistency within the model—each cosmic phenomenon finds a naturally corresponding cause in a specific encounter during the Rule-Wall’s voyage. However, it must be declared: they are not the sole correct explanation for each respective phenomenon. This model provides a unified, parsimonious explanatory framework for these cosmic phenomena. As to whether these explanations correspond to the unique physical truth, the model honestly acknowledges that this cannot, in principle, be

uniquely verified or falsified by an observer inside this universe. This cognitive boundary itself is also a necessary corollary of the model’s logical framework.

Core definition of the Rule-Wall conversion mechanism: The Rule-Wall’s conversion algorithm is adapted solely to the Structural-Order encoding of this universe, fixed at the Singularity’s eruption. Mass-energy encoded with alien-universe Structural-Order constitutes heterogeneous information that cannot be decoded or calibrated by the Rule-Wall, and therefore falls outside the fundamental interactions of this universe. This definition applies to all sections of this chapter and will not be repeated each time.

Supplementary Note: The Internal Structure of Alien Bubble Universes Cannot Be Inferred

The internal spacetime structure, material morphology, and physical rules of an alien Bubble Universe engulfed or left behind by this universe are all inaccessible to inference by an observer within this universe. It may possess a structure similar to that of this universe—hierarchical structures of Singularities, black holes, galaxies, stars, nebulae, and so forth; or it may completely lack such structured celestial bodies: matter may remain in a highly dispersed, uniform chaotic state, with no gravitational collapse, no celestial-body formation, no discretized dense structures; even the very definitions of its “matter,” “spacetime,” and “interactions” may be entirely different from those of this universe. For this universe, only two things can be determined with certainty: first, that it possesses an independent Rule-Wall and a self-consistent rule encoding; second, that its already-structured matter, due to the heterogeneity of its Structural-Order encoding, cannot be converted by this universe’s Rule-Wall and exists only as an invisible gravitational source.

Whether the interior of an alien Bubble Universe formed galaxies, stars, black holes, or other celestial bodies does not affect the observational predictions of this model: regardless of whether its interior is highly structured or entirely diffuse, from the perspective of this universe, the final manifestation is always a spherically distributed dark gravitational mass plus an extremely small number of visible galaxies formed from back-flowing Void energy conversion. This supplementary note relieves this model of unnecessary presuppositions about the internal structure of alien Bubble Universes and further delineates the cognitive boundary—what is logically necessary truth (Rule-Wall, heterogeneous encoding, gravitational remnant) and what is fundamentally unknowable (the specific morphology of the other universe’s interior).

5.1 Void Energy Barrens → Ordinary Cosmic Voids

The Void is not everywhere uniform. Some regions have extremely low chaotic energy density, so sparse as to be near vacuum. When the Rule-Wall advances into such barrens, convertible raw material is scarce, and the matter injected into the universe’s interior is consequently minimal.

From an internal observer’s perspective, the corresponding celestial region is extremely matter-poor—stars sparse, galaxies rare. These are ordinary cosmic voids. Their dimensions are typically modest (under a few hundred million light-years), with some galaxies still present in the interior, their boundaries indistinct, showing gradual transitions with the surrounding cosmic web. They are not products of gravitational clearing but direct projections of the uneven distribution of Void energy.

5.2 Remnants of Failed Bubble Universes → Intermediate Voids

The Chaotic Void has seen countless failed universes. Their Singularities also condensed, their Rule-Walls also

unfolded, but their conversion logic harbored internal contradictions, and after expanding a very short distance they collapsed and annihilated. After death, the internal matter, losing the constraint of the Rule-Wall, began a long degradation—gradually regressing from ordered structure toward chaos.

When this universe's Rule-Wall advances past such a site, the degrading remnants still bear the imprint of the old universe's rules. Because the opposing Rule-Wall collapsed long ago, most of its internal Void energy has already dissipated back into the Void during the prolonged degradation period. The Rule-Wall can only convert the small portion within the remnants that has already fully degraded and shed its old imprint—this reluctantly converted material becomes the extremely sparse scattering of galaxies and gas inside the void. The greater part of the not-yet-degraded alien-universe remnants cannot be converted. They occupy space yet, not participating in this universe's electromagnetic interactions, become henceforth invisible.

These voids are somewhat larger than the barren-region voids, with even sparser internal galaxies, though some scattered distribution remains. They are the vestiges of failed universes.

5.3 Life-or-Death Engulfment of an Active Bubble Universe → KBC-Class Supervoid

This is the most intense scene in the entire voyage history of the Rule-Wall.

The Rule-Wall encountered another actively expanding Bubble Universe—a living universe likewise possessing a stable Rule-Wall, likewise converting Void energy, likewise likely already having galaxies in motion in its interior. The two Rule-Walls approached each other through the Void and ultimately made direct contact.

Two completely different, independently fixed sets of physical laws clashed head-on at a single point. Each side attempted to use its own conversion logic to calibrate the other's matter—this universe's Rule-Wall trying to translate the other according to its own grammar, the other likewise trying to translate this one according to its grammar. The two logics collided and negated each other. The spacetime structure twisted and tore at the line of engagement. This is not a collision of energy against energy but a "war" of rules against rules.

At the critical moment of engagement, whichever side's rules were more stable would prevail. This universe's Rule-Wall's conversion logic withstood the assault, while the opponent's conversion logic began to collapse under the extreme pressure—its rules developing internal contradictions, losing local self-consistency, the front tearing apart and the whole annihilating.

Once the opponent's Rule-Wall was breached, all matter of its internal universe was exposed. After the Rule-Wall's annihilation, the opponent universe's Void energy was abruptly released. Because this universe's Rule-Wall was advancing at that very moment, it captured and converted only a minuscule portion of the back-flowing Void energy at the instant of engagement—this is the origin of the extremely sparse, scattered galaxies within the KBC Void. They are the sole spoils of that engulfment, not the original inhabitants of the opponent universe.

But the matter of the opponent universe already ordered according to the old rules—its stars, its galaxies, its gas, and all its condensed structures—bearing the stubborn imprint of the old rules, could not be converted by this universe's Rule-Wall. It was entirely engulfed into this universe's interior, occupying a vast spherical space, not participating in electromagnetic interactions, invisible, yet retaining its mass. Its gravitational effect is directly coupled to spacetime, not

mediated by this universe’s gravitons, and therefore does not conflict with the Standard Model of particle physics.

From an internal observer’s perspective, this is an enormous defect roughly two billion light-years in diameter: sharp boundary, near-perfect spherical shape, interior matter extremely sparse. Astronomers call it the KBC Void. Its interior is not nothingness. It is the relic left after a living universe was engulfed. We are floating at its center.

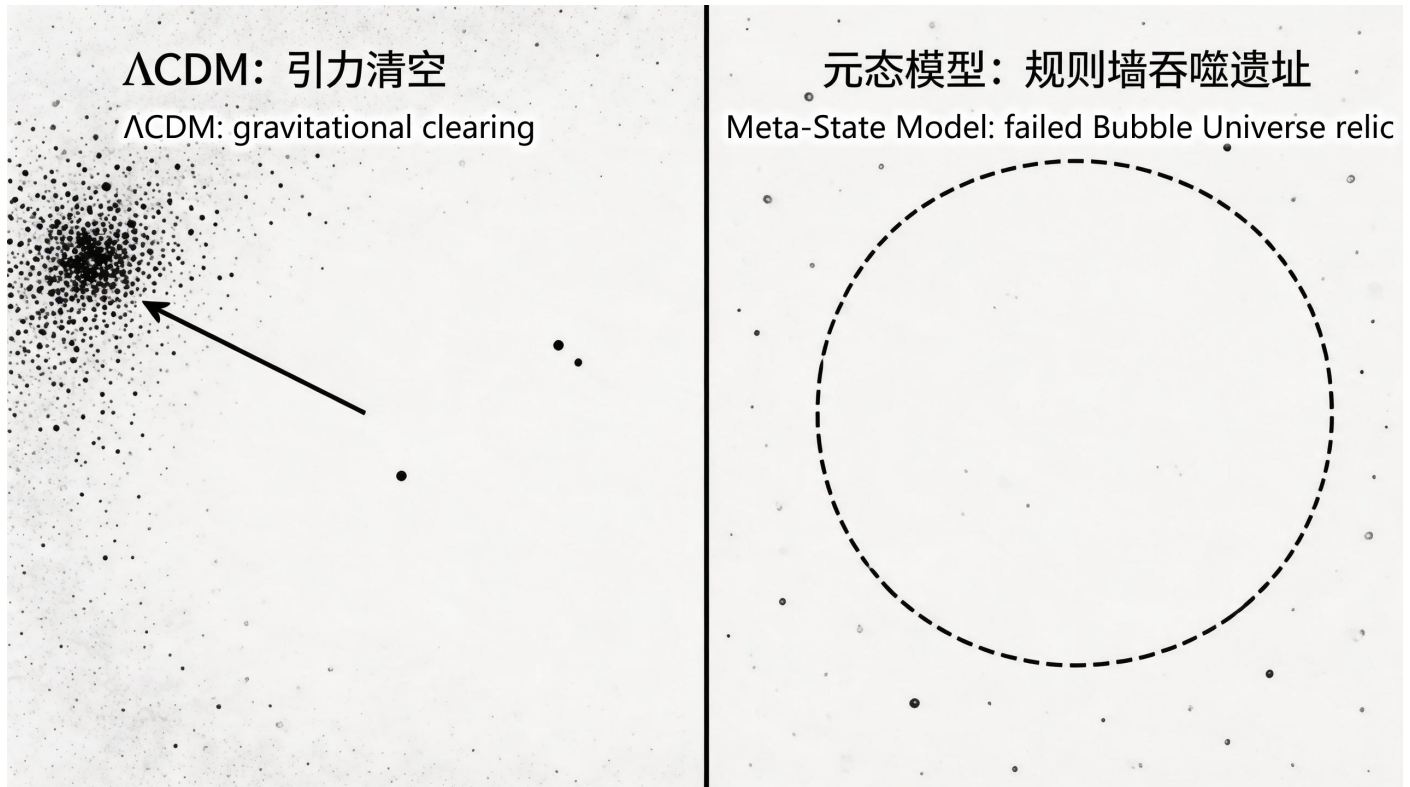


Figure 4: Comparison of void formation mechanisms.

Left (A): Λ CDM — Gravitational Clearing The standard cosmological model interprets voids as products of gravitational clearing. Matter continuously migrates toward high-density regions under gravity, leaving surrounding space “cleared” and forming low-density void regions. Under this picture, void morphology is predominantly irregular—gravitational clearing does not naturally tend to produce perfectly spherical structures, and tidal forces from surrounding large-scale filamentary structures further distort void shapes. Any galaxies remaining inside the void may possess star-formation histories similar to those of galaxies in surrounding regions.

Right (B): Meta-State Model — Failed Bubble Universe Relic The Meta-State Model interprets KBC-class supervoids as spherical relics left behind after the Rule-Wall engulfed a failed Bubble Universe. The Rule-Wall encountered and engulfed another Bubble Universe during its voyage. The matter already ordered under the alien universe’s rules—its stars, galaxies, gas, and all condensed structures—bore the stubborn imprint of the old rules and could not be converted by this universe’s Rule-Wall; it was entirely engulfed into this universe’s interior, occupying a vast spherical space. This matter does not participate in electromagnetic interactions, remains invisible, yet retains its mass. The extremely sparse, scattered galaxies inside the void originate from the minuscule amount of back-flowing Void energy converted at the instant the opposing Rule-Wall annihilated.

From an internal observer’s perspective, this is an enormous defect with a sharp boundary, near-perfect spherical symmetry, and an interior extremely devoid of matter. Its morphology more closely preserves the spherical symmetry of the original Bubble Universe, yielding a measurable systematic difference from the predictions of the gravitational clearing picture—this is precisely the core logic underlying Prediction II (statistical distribution anomaly in void sphericity) of this model.

5.4 Collision and Recoil with an Active Bubble Universe → CMB Temperature and Density Anomalies

In the long voyage history of the Rule-Wall, glancing encounters with active Bubble Universes are not isolated incidents. Such collisions may have occurred many times.

The Rule-Wall experienced transient local collisions with another active Bubble Universe. Because both were expanding, the contact surface was a spherical local region millions of light-years across—a large-area surface contact, not a point contact. The collision energy was diffusely distributed and could not be focused into a point-like gravitational source. Neither side leaked internal matter into the other.

The energy and order-shock released by the collision diffused into the universe’s interior centered on the contact surface. Such early close-range collision or recoil events left anomalous imprints of temperature and density on the last scattering surface—manifesting on the Cosmic Microwave Background as large-area but faint temperature anomalies (possibly faint “hot spots” or “cold spots,” depending on whether what was injected at the moment of collision was superheated matter or low-temperature incompletely calibrated malformed matter). In the large-scale distribution of galaxies, the collision may leave a faint structural discontinuity—a weak gradient in galaxy distribution density along the direction of collision. Since such events may have occurred multiple times, the temperature anomaly pattern on the CMB may not be the result of a single collision but the superposition of traces from multiple collisions.

These traces are visible and diffuse, not invisible, focused, point-like gravitational sources.

5.5 Singularity Core Engulfment → The Great Attractor, Primordial Supermassive Black Holes

During its voyage, the Rule-Wall also engulfed Singularities still in the process of condensation—highly ordered cores that had not yet erupted.

The Rule-Wall’s conversion mechanism excels at dismantling the scattered energy of the Chaotic Void, churning disorder into order. But faced with a Singularity core already highly ordered, with density approaching infinity, it could find no seam to work on. The high-density Void energy surrounding the Singularity was violently converted, but the core itself penetrated the Rule-Wall intact and fell into this universe’s interior.

The properties of this foreign body are as follows: it does not participate in electromagnetic interactions—its “Structural-Order” was written under another set of rules, and this universe’s photons and electromagnetic fields are a foreign language to it, hence it is entirely invisible; yet its mass is extraordinarily enormous—it contains all the energy the Singularity attracted during its long condensation period; its volume approaches the infinitesimal, its density near-infinite.

If this core remains permanently in an exposed state, neither collapsing nor Being enveloped, it constitutes an invisible but gravitationally immense “naked gravitational source”—perfectly matching the observational characteristics of the Great

Attractor: invisible, with mass so great as to tug on galaxies within a range of hundreds of millions of light-years. If, in its subsequent evolution, it is layer by layer enveloped and accreted upon by this universe's matter, it becomes a primordial supermassive black hole—not a product of stellar collapse but a primeval relic that existed before this universe's birth, which, after Being implanted in this universe, continued to devour matter in vast quantities, growing into a monster with a mass of tens of billions of solar masses. This explains why supermassive black holes already existed in the very early universe (mere hundreds of millions of years after the Big Bang)—their seeds are not products of this universe but primeval Singularities from the depths of the Void.

It must be noted: Singularity cores engulfed into this universe's interior have lost the capacity for self-eruption. The triggering condition for eruption is the sustained disordered high pressure exerted by external Void chaotic energy. This universe's interior is an ordered space already converted by the Rule-Wall and contains no such chaotic compressive environment. Therefore, these primeval Singularity cores cannot self-detonate within this universe into new Bubble Universes—they can only persist permanently in the form of naked gravitational sources or black holes.

5.6 Chaotic Energy Penetration → Ultra-High-Energy Cosmic Rays

The Rule-Wall is not an absolutely perfect barrier. It is a physical mechanism with an upper limit to conversion efficiency, a tolerance limit for pressure, and localized weak points.

These weak points are the microscopic-fluctuation limits that the Rule-Wall, as a physical mechanism, necessarily possesses: the conversion front is not mathematically absolutely flat at the microscopic scale; minute gradients exist in local conversion efficiency. These are residual undulations from the unfolding of the Singularity's Structural-Order, not the result of later wear and tear. The Void contains extremely extreme high-energy chaotic turbulence—energy bodies whose energy density is so high that the Rule-Wall cannot completely dismantle them instantaneously. When the Rule-Wall advances into such regions, a portion of chaotic energy, without calibration, penetrates directly through these microscopic weak points and breaks into the universe's interior.

This energy retains its primordial chaotic nature, does not obey this universe's physical laws, and travels through the universe with unimaginable energy, becoming those “ghost particles” among cosmic rays that cannot be explained by any known acceleration mechanism—ultra-high-energy cosmic rays. They are not products of this universe but fish that slipped through the Void's net.

There is also a milder form of penetration: a portion of chaotic energy is partially calibrated during the penetration process—neither fully chaotic nor fully ordered, but “semi-finished.” These incompletely converted penetrants, after entering the universe's interior, either decay into standard particles through some unknown channel or maintain an intermediate state—possibly participating in gravitational interactions but not in electromagnetic ones. The latter case constitutes one source of the invisible mass pervading the environs of galaxies.

VI. Compatibility with Known Physical Laws

This hypothesis framework provides a complete underlying logical grounding for known physical laws:

Thermodynamics: The First Law (energy conservation) holds strictly within the interior of this universe—within closed subsystems on the inner side of the Rule-Wall, the First Law holds in its standard form. At the scale of the entire

Bubble Universe, the energy balance of the open system can be expressed as a direct application of the existing thermodynamic framework, with the energy injected via Rule-Wall conversion as an additional source term. This formula is a direct application of the existing thermodynamic framework and introduces no new assumptions. The Second Law (entropy increase) likewise holds—this universe is an open system; localized entropy decreases within it (the formation of galaxies, stars, and life) take the low-entropy energy injected via Rule-Wall conversion as an external condition, and the overall entropy budget remains balanced. Heat death does not occur under this hypothesis—the universe is not an isolated system.

Relativity: The principle of invariant light speed is the internal traffic rule set when the Rule-Wall’s conversion logic was fixed. The equivalent effect of spatial expansion arises from the advance of the Rule-Wall boundary, not from the uniform internal stretching of space.

Quantum Mechanics: Quantum fluctuations can be understood as residual undulations of the Rule-Wall conversion process at extremely microscopic scales—the conversion front is not mathematically absolutely flat; its microscopic roughness produces minute local energy fluctuations. Quantum entanglement can be understood as the nonlocal correlation resulting from particles sharing the same fragment of “Structural-Order” at the instant of Rule-Wall conversion.

Particle Physics: Elementary particles and their properties (mass, charge, spin, interactions) are the few stable energy-packaging modes within the Rule-Wall’s conversion logic. The four fundamental forces (gravity, electromagnetism, the strong force, and the weak force) are the four sub-rules invoked by the Rule-Wall’s conversion logic when handling energy calibration at different scales and of different types.

Dark Matter and Dark Energy: The equivalent observational effect of dark energy arises from the macroscopic dynamics of the Rule-Wall continuously converting Void energy and driving boundary expansion—it is not a repulsive energy self-generated by space. Candidate sources for dark matter include semi-finished products of incomplete Rule-Wall conversion and engulfed minuscule Singularity remnants—they participate in gravitational interactions but not in electromagnetic ones, forming an invisible gravitational skeleton around galaxies.

VII. Cosmic Lifespan and the End of Expansion

7.1 The Finite Void Container Constraint

The volume and total energy content of a Chaotic Void Cluster are both finite—it is the product of a particular net leakage event at the Meta-State Interface, not an infinite ocean of energy. This premise directly entails a macroscopic corollary: within a container of finite volume and an upper bound on total energy, no infinitely expanding entity can exist. The Rule-Wall must complete the transition from high-speed expansion to decelerating slow-expansion before reaching the boundary of the Void Cluster. The finitude of the Void Cluster is the fundamental constraining condition for the end of cosmic expansion.

7.2 The Deep Cause of Deceleration: The Self-Limitation Preset in Structural-Order

The above macroscopic constraint has its precise expression at the level of microscopic encoding. The set of Structural-Order encoding locked in at the Singularity’s eruption implicitly contains a self-limitation rule within its macroscopic unfolding process: when the surface area of the Rule-Wall (i.e., the macroscopic scale of the conversion front)

expands beyond a certain magnitude, the conversion efficiency per unit area will passively decline.

This preset is not the result of later wear and tear or external suppression, but an inherent property of Structural-Order itself—analogue to the telomere-shortening mechanism preset in the DNA replication process. Structural-Order is akin to a genetic code; it not only determines the Rule-Wall’s “mode of growth” but also presets its “rhythm of growth”: early-stage high-speed and high-efficiency, late-stage low-speed and low-efficiency. This self-limitation is a logical necessity—because a finite Void Cluster cannot sustain an entity that expands eternally at high speed, and this necessity was already encoded into the deep logic of Structural-Order at the time of Singularity condensation.

7.3 Slow-Expansion Phase: The Unidirectional Deceleration Transition of Expansion

When the Rule-Wall advances into a region where the energy density of the Void Cluster has substantially declined, the convertible Void energy on its outer side is no longer sufficient to sustain high-speed expansion.

At this point, the Rule-Wall enters a **Slow-Expansion Phase**: the expansion speed undergoes a unidirectional deceleration from early-stage high-speed advance to low-speed crawling, and accelerated expansion ceases. The conversion algorithm itself—i.e., the complete set of energy-calibration logic locked in at the instant of eruption—remains constant and unchanging; what changes is the throughput (total quantity converted per unit time), which passively declines as the external energy density decreases. Meanwhile, the Rule-Wall, in the process of continuously and passively receiving rarefied Void energy, still undergoes a slow increase in its surface area, but its advance speed has dropped to an extremely low level.

The Slow-Expansion Phase referred to here is not a reciprocating oscillation, but a unidirectional transition—an irreversible change from high-speed expansion to low-speed crawling. The physical essence of what was previously provisionally termed the “Breathing State” is precisely this Slow-Expansion Phase caused by the self-limitation of Structural-Order as defined here. From this, an explicit corollary can be derived: the expansion curve of the Rule-Wall of any Bubble Universe sustained by a finite Void Cluster is necessarily sub-linear—rapidly opening up space with high conversion efficiency in the early stage, and entering the Slow-Expansion Phase in the later stage as surface area increases and conversion efficiency progressively declines. The expansion of the universe will neither accelerate indefinitely nor continue eternally.

7.4 Observational Corollary

Observable corollary: The value of cosmological redshift will not increase indefinitely but will begin to moderate and stabilize at some future stage. If the present universe is still in the expansion period, this signal will become apparent through redshift drift measurements on a timescale of 10^9 – 10^{10} years in the future; if it has already entered the Slow-Expansion Phase, the signal may already be embedded in existing high-redshift data. The current expansion phase of this universe (expansion period or Slow-Expansion Phase) cannot, in principle, be directly confirmed by an internal observer; it can only be indirectly inferred through the long-term evolutionary trend of cosmological redshift.

VIII. Theoretical Boundaries and Relationship to Standard Cosmology

This model proceeds solely from the two most universal observational facts within this universe, and through logically

progressive deduction, constructs a self-consistent, minimally presuppositional explanation of cosmic origins. The core positioning of this model is: **a cosmological framework with philosophical-logical deduction as its foundation and physical mechanisms as its hypothetical structure**. Its philosophical foundation—the Meta-State, Ji-Kong, and Ji-You—belongs to the domain of ontological postulation and does not constitute directly observable or testable physical entities; the Void is a necessary intermediary derived through the chain of philosophical logic—so long as the Meta-State exists and random fluctuations exist at the Ji-Kong/Ji-You Interface, the Void necessarily emerges, and it does not constitute an independently observable physical entity; its physical mechanism hypotheses—the Rule-Wall conversion mechanism, the voyage and collision of Bubble Universes—are physical deductions that extend naturally from the chain of philosophical logic and are subject to indirect observational testing and logical self-consistency review.

The core entities and mechanisms of this hypothesis framework (the Void, the Rule-Wall, chaotic energy) belong to the domain of philosophical derivation; they are not operable objects within the standard physical framework, nor do they require rigorous mathematical formulation at the current stage. Whether these entities and mechanisms can eventually be fully incorporated into a rigorous physical framework depends on the progress of subsequent formalization work. We explicitly acknowledge: if, after sufficient theoretical effort, the core hypotheses still cannot be made logically self-consistent and compatible with known physical laws (especially the fundamental structures of General Relativity and Quantum Field Theory), this hypothesis framework will need to be revised or eliminated.

For domains where the standard model has provided precise descriptions—such as the initial large-scale homogeneity of the universe, the CMB power spectrum, and structure formation—this model adopts their observational data as the reference background for internal evolutionary calculations.

This model honestly acknowledges the following cognitive boundaries:

1. The specific dynamics of microscopic micro-fluctuations at the Meta-State Interface cannot be known, under any experimental conditions, by an observer inside a Bubble Universe—all detection tools are constrained by the physical laws fixed by this universe's Rule-Wall.
2. The Rule-Wall conversion logic of another Bubble Universe (i.e., its internal physical laws) is, in principle, unknowable in the absence of a contact event.
3. Multiple possible outcomes exist for a head-on collision between active Bubble Universes (mutual annihilation, one side engulfing the other, brief contact followed by recoil), and a unique prediction cannot be made without further constraints.
4. The microscopic composition of the ordered structure inside a Singularity can only be inversely inferred from its macroscopically unfolded result (i.e., the physical laws of this universe); it cannot be directly detected.
5. The current expansion phase of this universe (expansion period or Slow-Expansion Phase) cannot be directly confirmed by an internal observer; it can only be indirectly inferred through the long-term evolutionary trend of cosmological redshift.

It must be emphasized: the existence of cognitive boundaries does not imply that the entire model is untestable. The core ontology of this model (the Meta-State) belongs to the philosophical layer, which is in principle not directly observable, but its deductive hypotheses—such as the Rule-Wall penetration mechanism and the exclusive observational

predictions—provide clearly defined pathways for testing. The existence of unknowable boundaries is an honest delineation of the theory’s own cognitive limits, not an evasion of scientific testing.

This model is not intended to replace the precise quantitative descriptions of the standard Λ CDM model for already-tested phenomena. For observationally verified cosmological parameters (measurements of the Hubble constant at local scales, the CMB temperature, primordial element abundance ratios, the statistical distribution of large-scale structure), this model shares the same phenomenological predictions as the standard model—because these phenomena occur in the already-stabilized interior region of the Rule-Wall, and regardless of which underlying mechanism is used to explain them, their mathematical fitted values can remain consistent.

It must be pointed out: **consistency of observationally fitted values and identity of physical mechanisms are two distinct levels of question.** That this model shares the CMB power spectrum, primordial element abundances, and other phenomenological predictions with Λ CDM does not imply that this model is merely another mathematical formulation of Λ CDM. The two differ in their predictions in the following two key domains: (1) the statistical distribution of large-scale void morphology (this model predicts morphology closer to spherical; see Chapter V for details); (2) the star-formation histories and metallicity distributions of remnant galaxies inside voids (this model predicts significant differences from surrounding galaxies; see Chapter V for details). These differences provide operable directions for testing by future sky surveys.

Regarding predictive precision, it must be explicitly noted: at the current stage, this model cannot yet provide independent quantitative results for specific parameters such as the Hubble constant that are more precise than those of Λ CDM. This is not a weakness of this model, but a universal feature of all alternative paradigms at the conceptual-consolidation stage. Λ CDM itself also relies on observational fitting rather than theoretical derivation for parameters such as H_0 . Whether a paradigm is revolutionary lies not in whether it is more precise than the old paradigm in its early stages, but in whether it covers a broader explanatory scope with fewer presuppositions—Copernicus’s heliocentric theory did not, in its early days, provide more precise planetary position predictions than the Ptolemaic system, but it explained the same observational data with a more parsimonious structure. This model similarly covers, with fewer presuppositions (requiring no inflaton field, no dark energy particles, no extra dimensions, no specific dark matter particle forms), a unified explanation extending from cosmic origins to structure formation.

The unique value of this model lies in providing, for the same set of observational facts, a more logically self-consistent, more parsimonious in presuppositions, and more complete in its chain of inquiry underlying explanatory framework. This model:

- Requires no inflaton field to drive early exponential expansion;

- Requires no Singularity possessing infinite density and infinitely compressed space;

- Requires no dark energy carrying the property of space self-generating energy, and thus also need not confront the 10^{120} -fold theoretical catastrophe where quantum field theory’s predicted value exceeds the observed value;

- Requires no assumption of specific dark matter particle forms, with their decades of null-detection results;

- Requires no invocation of the impossible arguments from timescales and causal coordination needed for gravitational collapse theories to explain supervoids;

Requires no invention of untested additional mechanisms such as “direct collapse” to explain the origin of primordial supermassive black holes.

The core claim of this model is: Our universe is an open system. Its order comes from the disordered Chaotic Void. Its expansion is driven by boundary conversion. Its physical laws are the one-time unfolding and permanent fixation of the Singularity’s ordered structure. Its large-scale structural tapestry is the wake left on the universe’s skin by everything the Rule-Wall encountered during its tens-of-billions-of-years voyage through the Chaotic Void.

This version (0.4.1) is the conceptual-consolidation version of the philosophical-physical hypothesis framework of the Meta-State Cosmological Model. In this version, we strictly distinguish the boundary between philosophical deduction and physical hypothesis, and have removed all unconsolidated mathematical expressions to ensure the self-consistency of the model in its core logic and observational compatibility. Subsequent series will initiate systematic formalization work, including but not limited to: phenomenological description of the Rule-Wall interface conversion mechanism, heuristic analogy and simulation schemes for the Chaotic Void turbulence spectrum, and topological characterization of Bubble Universe collisions. This work is open to global co-builders, and capable researchers are welcome to participate in collaboration.

Statement of Theoretical Compatibility

The overall positioning of the Meta-State Cosmological Model (v0.4.1) is: **a cosmological hypothesis framework with first-principles philosophical reasoning as its foundation and physical compatibility as its constraint.** This model strictly distinguishes the following two domains:

I. The Philosophical-Ontology Domain (not directly observable or testable)

The Meta-State, the dualistic structure of Ji-Kong and Ji-You—this portion belongs to the domain of ontological postulation; the necessity of its existence is established solely through logical deduction; it does not claim to be directly verifiable by physical observation, nor does it require mathematical formalization.

The Void—a necessary intermediary derived through the chain of philosophical logic; the logically inevitable link connecting the ontology of the Meta-State to the physical hypothesis of the Rule-Wall. So long as the Meta-State exists and random fluctuations exist at the Ji-Kong/Ji-You Interface, the Void as a chaotic region interwoven with Being and Non-Being necessarily emerges. It does not belong to the observable entities within this universe, nor does it belong to purely unstructured philosophical concepts; it is an existence already established within the philosophical-deduction system, and does not require independent observational testing.

II. The Physical-Hypothesis Domain (compatible with known physical laws)

The internal evolution of the universe after the Rule-Wall has unfolded—this portion belongs to the domain of physical hypothesis, is subject to indirect observational testing, and is compatible with known physical laws in the following dimensions:

Classical Physics: Energy conservation, local causality, and the constancy of physical laws are fully maintained within the observable universe. The Rule-Wall serves only as the interface through which external energy enters this

universe; it does not violate any existing constraints of internal physical laws.

Traditional Cosmology: The underlying mechanistic explanation of cosmic expansion provided by this model is phenomenologically equivalent to the observational predictions of the standard Friedmann equations. Expansion is not the stretching of internal space, but the result of the advance of the Rule-Wall boundary; for an internal observer, however, the observational predictions of the two pictures are indistinguishable.

Quantum Mechanics: All quantum processes within the observable universe maintain unitary evolution. Information shielding across the Rule-Wall manifests only as information inaccessibility relative to an internal observer, not as information disappearance in the quantum-mechanical sense.

Causal Structure: The interior of the observable universe strictly obeys causality. No causal assertions are made concerning the exterior of the universe or the related philosophical-ontology domain.

III. Unmeasurable Boundaries

The microscopic dynamics of the Meta-State Interface, the internal structure and rule encoding of alien Bubble Universes, the precise outcome of a head-on collision between active Bubble Universes, the microscopic details of the Structural-Order inside a Singularity, and the current expansion phase of this universe—the above domains cannot, in principle, be directly confirmed by an observer within this universe. This model merely honestly marks these cognitive boundaries and makes no forced physical explanations or arbitrary mathematical presuppositions..

IV. Relationship to Standard Cosmology

This model is not intended to replace the precise quantitative descriptions of the standard Λ CDM model for already-tested phenomena, but rather to provide, for the same set of observational facts, an alternative underlying explanatory framework with fewer presuppositions and a deeper chain of inquiry.

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