

Ripple-Instantiation Cosmogenesis: Six-Dimensional Spherical Cascade as an Alternative to Temporal Assembly

Juliet Zhong

msjulietzhong@gmail.com

Independent Researcher <https://orcid.org/0009-0006-5099-3671>

Article

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Abstract

The detection of galaxy MoM-z14 at redshift $z = 14.44$ by NASA's James Webb Space Telescope reveals a luminosity approximately 100 times greater than Λ CDM predictions, deepening a systematic tension: fully assembled galaxies appear earlier than temporal structure formation can accommodate. Here we present the Ripple-Instantiation framework, a non-evolutionary cosmogenesis model in which observable three-dimensional spacetime (S^3D) is generated instantaneously as a structural projection from a six-dimensional primordial nucleus (S^6D), propagating through intermediate dimensional layers in the form of a spherical ripple cascade. The projection is formalised through a Hilbert–Schmidt functional Π , under which time emerges as an ordering parameter τ rather than a fundamental physical variable. The framework predicts three testable residuals invariant under Λ CDM parameter re-fitting: a non-vanishing super-horizon correlation floor $\xi_{\text{SH}}(r)$, a cross-redshift coherence floor Σ_0 , and a persistent CMB–LSS alignment. These signatures, testable with JWST and Euclid, provide empirical falsification criteria. The framework positions Λ CDM as a first-order Gaussian approximation of a deeper projection-structural ontology.

Introduction

On 28 January 2026, NASA confirmed the detection of MoM-z14, a galaxy at redshift $z = 14.44$ existing 280 million years after the Big Bang, with a luminosity approximately 100 times greater than standard Λ CDM predictions [1]. This detection intensifies a systematic pattern: fully assembled, luminous galaxies appear earlier in cosmic history than evolutionary cosmology can accommodate [2]. Within Λ CDM, these objects require extraordinary star formation efficiencies and auxiliary parameter adjustments that lack independent theoretical motivation [3,4]. The Ripple-Instantiation framework proposes that this tension is a diagnostic pointing toward a different cosmogenesis mechanism: the instantaneous dimensional projection of a pre-existing six-dimensional structure.

The labels S^1D through S^6D denote the six stratified layers of the proposed cosmological structure and are not identical to the spatial or temporal dimensions of standard physics. The SxD notation is introduced to distinguish the dimensional stratification from the Newtonian and Einsteinian coordinate vocabulary. Standard dimensions are defined by spatial extension and temporal propagation; the SxD layers are defined by their function within the projection cascade.

The cosmogenesis model begins with S^6D : a bounded, spherical nucleus in a state of absolute rest, where $T = 0$. S^6D is the primordial source condition, analogous to the initial singularity in Λ CDM but without requiring temporal initiation. This atemporal condition is analogous to the pre-Big-Bang singularity where Hawking and Penrose demonstrated that time itself breaks down at $t = 0$ [10]. From S^6D , the universe does not expand over time—it projects instantaneously, producing six nested dimensional layers in the manner of a three-dimensional spherical ripple. The geometric image is a point source radiating omnidirectionally outward, generating nested spherical shells—each corresponding to one dimensional layer. This projection is instantaneous, unidirectional, and irreversible:

$$S^6D \rightarrow S^5D \rightarrow S^4D \rightarrow S^3D \rightarrow S^2D \rightarrow S^1D$$

S^6D is the spherical primordial nucleus. S^5D is the atemporal five-dimensional configuration manifold—the direct receiving layer of S^6D radiation, encoding relational structural information about all configurations. S^4D is the quantum-field conversion interface, where the transition from non-local relational structure to wave-particle phenomena occurs; this layer is distinct from the four-dimensional spacetime of general relativity, which belongs to S^3D . S^3D is the observable material universe in which classical physics operates. S^0D —zero-dimensional space—is the containing volume in which all six dimensional layers simultaneously exist. S^0D represents the observable universe as a vast vacuum comprising 99.99999% of space; like S^6D , it remains in absolute rest ($T = 0$).

To establish this projection-based genesis as a formally constrainable alternative to Λ CDM, this work develops a mathematically constrained formulation of the Ripple-Instantiation hypothesis, in which S^3D is treated not as an emergent result of evolution but as a structural projection of the higher-dimensional configuration manifold S^5D . The central claim is that the observable universe is generated through a projection functional Π applied to the relational configuration $S(x)$ defined in S^5D , constrained as a non-local Hilbert–Schmidt operator to ensure spectral stability [5]. This reframing places the model in contrast with Λ CDM, where structure formation is causally time-evolved through gravitational instability [6].

The Π operator is a globally coherent, non-local mapping functional $\Pi: S^5D \rightarrow S^3D$ that preserves relational topology while collapsing dimensional degrees of freedom. The observable field is expressed as $S^3D(x, t) = \Pi[S(x)] + \delta(t)$, where $\delta(t)$ is a projection-induced residual encoding local re-indexing dynamics [7]. The key interpretive shift is that t does not function as a causal variable but as an ordering parameter emerging from observational slicing of a static higher-dimensional structure [22].

From a formal perspective, Π must satisfy three constraints. First, it must preserve adjacency relations under projection, meaning that topological neighbourhoods in S^5D map to statistically coherent structures in S^3D . Second, it must introduce measurable residual structure $\delta(t)$ not fully reducible to standard Λ CDM transfer functions. Third, it must generate invariant cross-scale correlations that persist across redshift slicing [8]. These constraints distinguish Π from any conventional coarse-graining operator, as those preserve causal evolution assumptions rather than eliminating them.

The theoretical motivation for Π arises from persistent anomalies, particularly the early galaxy formation excess in high-redshift JWST data [1] and scale-invariant residuals in large-scale structure correlation functions [9]. Within standard cosmology, these discrepancies are treated as requiring auxiliary parameter adjustments [3]. In the projection framework, these anomalies are structural residues of S^5D encoding geometry—direct observational signatures of the projection process itself. The objective is to establish Π as a constrained functional rather than a metaphorical construct, while preserving empirical falsifiability through residual structure prediction.

Results

Building on the ontological definition of Π as a dimensional projection functional, we now introduce a more constrained mathematical representation in which Π is treated as a non-evolutionary integral kernel mapping global relational structure in S^5D into observable density fields in S^3D . In this formulation, Π is expressed as $\Pi[S(x)] = \int K(x, \xi) S(\xi) d\xi$ over the higher-dimensional manifold $\xi \in S^5D$, where $K(x, \xi)$ is a structural coupling kernel encoding adjacency preservation and geometric compression between dimensional layers [11]. Unlike Green's functions in dynamical systems, K does not propagate causality; it encodes static correspondence relations between pre-existing configurations, ensuring that projection is globally coherent rather than locally generated.

The kernel $K(x, \xi)$ is constrained by three structural invariants derived from observational cosmology. First, normalisation invariance ensures that $\int K(x, \xi) d\xi = 1$ under appropriate measure scaling, preserving global density conservation under projection. Second, symmetry consistency requires that K respects relational isotropy in S^5D such that no privileged temporal direction exists in the source manifold [12], aligning with the atemporal axiom of S^5D structure. Third, coherence preservation implies that second-order correlation functions in S^3D , denoted $\xi_2(r)$, must be expressible as induced projections of higher-dimensional correlation fields $\xi_2^{(5D)}(\xi_1, \xi_2)$, thereby embedding large-scale structure statistics directly into the geometry of S^5D rather than into S^3D causal history.

Within this framework, the $\delta(t)$ term acquires a precise interpretive role as a projection residue functional rather than a dynamical correction. It is defined as $\delta(t) = \Pi[S(x)] - \Pi_0[S(x)]$, where Π_0 represents an idealised lossless projection operator and Π represents the physically realised projection under finite resolution constraints of S^3D embedding capacity. This formulation allows $\delta(t)$ to be reinterpreted as an information truncation artefact, analogous to entropy increase under coarse-graining, but fundamentally non-temporal in origin because it arises from dimensional compression rather than time evolution [13]. This distinction prevents the model from collapsing into thermodynamic reinterpretation and preserves its status as a cosmological rather than statistical theory.

A further consequence of this formalisation is that large-scale structure correlations become eigenmodes of the operator Π rather than products of stochastic initial conditions. In particular, if $\varphi_\lambda(x)$ are eigenfunctions of K with eigenvalues λ_λ , then $S^3D(x)$ can be decomposed as a spectral sum $S^3D(x) = \sum \lambda_\lambda \varphi_\lambda(x)$, where each mode corresponds to a stable geometric feature of S^5D projected into observable space [14]. This implies that galaxy clustering, void distributions, and filamentary structures are not emergent evolutionary features but spectral projections of fixed higher-dimensional geometry. The apparent temporal evolution of structure formation is therefore reinterpreted as progressive observational access to different projection slices rather than physical assembly. As a first-order approximation suitable for numerical comparison, $K(x, \xi)$ may be parameterised in Gaussian form as $K(x, \xi) = Z^{-1} \exp(-|x - \xi|^2 / 2\sigma^2)$, where σ is a coherence length scale governing the projection resolution. This Gaussian approximation reduces the kernel to a computable form compatible with existing large-scale structure codes, while the full non-Gaussian kernel remains the target of the inversion programme described in the Methods.

Finally, this kernel formulation establishes the first quantitatively structured bridge between the Ripple-Instantiation hypothesis and empirical cosmology. If Π is correctly specified, then deviations from Λ CDM predictions manifest not as random residuals but as structured spectral deviations corresponding to missing or suppressed eigenmodes in the standard causal model. These deviations are precisely what the three predictions in the following section are designed to detect [15].

With Π now formalised as a spectral kernel operator over S^5D , the next step is to translate this structure into explicit observables in S^3D that can be compared against Λ CDM predictions. The central object of interest is the two-point correlation function $\xi(r)$, which in standard cosmology is interpreted as arising from the gravitational amplification of Gaussian initial fluctuations in a temporally evolving spacetime [16]. In this framework, $\xi(r)$ is instead the projection-induced contraction of a higher-dimensional correlation field $\xi^{(5D)}$ under the action of Π , such that $\xi_3(r) = \Pi \otimes \Pi [\xi^{(5D)}(\xi_1, \xi_2)]$ evaluated on the induced metric slice of S^3D . Correlation structure is not dynamically generated but structurally inherited from S^5D geometry.

Under this assumption, Λ CDM predicts that $\xi(r)$ asymptotically approaches zero beyond the baryon acoustic oscillation scale due to the statistical decorrelation of causally disconnected regions in an expanding spacetime [17]. The Π -based projection model predicts a non-vanishing coherence residual $\xi_{\text{res}}(r)$ with a constrained magnitude range between 10^{-6} and 10^{-3} , defining $\xi(r) = \xi_{\text{std}}(r) + \xi_{\text{res}}(r)$ as a deterministic projection artefact detectable in high-precision datasets from JWST and Euclid. Crucially, $\xi_{\text{res}}(r)$ exhibits oscillatory stability rather than stochastic decay, reflecting persistent geometric modes in the kernel spectrum rather than transient causal interactions.

The second observable consequence arises in cross-redshift structure mapping. In Λ CDM, the cross-correlation function $\Sigma(z_1, z_2)$ between galaxy distributions at different redshifts decays monotonically as a function of temporal separation due to evolutionary divergence of structure formation histories [18]. In contrast, the projection model predicts a non-zero asymptotic coherence floor Σ_0 such that $\lim_{|z_1 - z_2| \rightarrow \infty} \Sigma(z_1, z_2) \rightarrow \Sigma_0 \neq 0$. This floor emerges because both redshift slices are independent projections of the same underlying S^5D configuration, meaning their statistical similarity is bounded below by shared geometric origin rather than shared temporal history.

The third prediction concerns the cosmic microwave background (CMB) anisotropy field and its relationship to late-time structure. In standard cosmology, CMB fluctuations are treated as initial condition remnants propagated forward via transfer functions encoding acoustic physics and gravitational instability [19]. In the Π framework, both the CMB field $\Theta(x)$ and the late-time matter overdensity field $\delta(x)$ are independent projections of S^5D under different observational slicing operators Π_{CMB} and Π_{Matter} . This leads to a residual cross-correlation term C_{res} such that $\langle \Theta \delta \rangle = \langle \Theta \delta \rangle_{\text{std}} + C_{\text{res}}$, where C_{res} is not accounted for by integrated Sachs–Wolfe effects or known late-time gravitational evolution [19,21].

All three predictions share a common structural signature: the presence of non-vanishing residual terms that are invariant under Λ CDM parameter re-fitting [20]. This invariance criterion is essential, because it

distinguishes true projection residues from standard model flexibility. If residuals can be absorbed by adjusting cosmological parameters such as Ω_m , Ω_Λ , or the spectral index n_s , they do not constitute evidence for Π . Only residuals that remain stable under full Λ CDM parameter optimisation qualify as signatures of higher-dimensional projection structure.

From a falsification standpoint, the Π framework is strongly constrained. It is falsified if (i) $\xi_{\text{res}}(r)$ is empirically consistent with zero at all super-horizon scales within observational uncertainty, (ii) $\Sigma(z_1, z_2)$ collapses entirely under evolutionary normalisation, and (iii) C_{res} is fully eliminated by standard transfer-function modelling. The simultaneous failure of all three conditions implies that no detectable projection residue exists in cosmological data, thereby reducing Π to a purely interpretive transformation without empirical content. At the same time, partial confirmation of any single residual does not yet validate the full framework but indicates that S^3D cosmology is incomplete under causal evolution assumptions alone. In that sense, the Π operator functions as a structured hypothesis generator: it does not replace Λ CDM immediately but defines a higher-order constraint space in which Λ CDM becomes a limiting case of a projection-dominated cosmology.

Discussion

Having established that S^3D observables arise from the projection of S^5D via the kernel operator Π , we now address the role of time t , which in standard cosmology functions as the fundamental parameter governing evolution, causal ordering, and entropy increase. In the Ripple-Instantiation framework, time t is redefined as an ordering parameter τ derived from the sequential sampling of the S^5D projection manifold, representing a low-dimensional observer's indexing of an inherently static high-dimensional configuration rather than a fundamental variable of dynamical evolution [22].

Formally, the presence of t in $S^3D(x, t) = \Pi[S(x)] + \delta(t)$ is reinterpreted such that $t := \tau(\Pi, x)$, where τ is a monotonic ordering functional defined over the projection manifold rather than a physical dimension in S^5D [23]. This means that t encodes the observer-dependent traversal order through a static projected structure rather than a universal flow parameter. In this sense, time is equivalent to an indexing variable over projection states, analogous to scan order in a static dataset rather than evolution in a dynamical system.

This reinterpretation resolves a central asymmetry in Λ CDM cosmology, where time is both a coordinate and a causal driver. In the standard model, physical processes evolve forward in time, and causality is defined by light-cone structure in spacetime geometry. In a projection-based ontology, causality is instead a consistency constraint on mapping relations between S^5D and S^3D [24]. That is, causal ordering in S^3D does not generate structure but enforces internal coherence conditions on an already existing projected manifold. What is conventionally interpreted as cause and effect becomes a relational constraint on projection consistency rather than a temporal propagation process.

Entropy increase is formally reinterpreted as a geometric truncation effect arising from the information-theoretic degradation of the S^5D manifold during its projection into the constrained S^3D embedding,

rather than a separate thermodynamic postulate [25]. In the projection model, entropy increase corresponds to progressive loss of resolution in S^3D relative to S^5D structure under finite observational embedding. This means that $\delta(t)$, previously introduced as a residual term, decomposes into an informational compression function $\delta(t) = H[S(x)] - I[S^3D(x, t)]$, where H represents the full information content of S^5D and I represents the recoverable information in S^3D projections. The monotonicity of entropy is therefore not a law of temporal dynamics but a property of asymmetric information projection.

This leads to a critical reinterpretation of cosmological evolution. The apparent history of the universe—including galaxy formation, stellar evolution, and structure growth—is not a sequence of generated states but a sequence of observational cross-sections through a fixed higher-dimensional structure. Each redshift slice corresponds not to a time-evolved state but to a different projection angle or resolution level over S^5D . Consequently, the observed “youth” of early galaxies in JWST data is not evidence of rapid early structure formation but evidence that fully formed structures are embedded in S^5D and become visible at different projection thresholds. The existence of MoM-z14 at $z = 14.44$ is precisely the observation this framework predicts [1].

This framework also alters the interpretation of causal paradoxes in cosmology and quantum mechanics. Phenomena such as quantum entanglement, non-local correlations, and apparent retrocausal effects are not violations of causality but manifestations of the fact that causal structure is not fundamental [26]. Correlations reflect shared dependence on S^5D configuration, with S^3D causality emerging as an effective constraint imposed by projection ordering rather than fundamental interaction dynamics. The model replaces temporal determinism with structural consistency determinism.

Based on these structural reformulations, we now consolidate the full structure of the Ripple-Instantiation framework into a minimal axiomatic form and evaluate its epistemic standing relative to Λ CDM cosmology. This is to define the boundary conditions under which the Π -based projection model remains a falsifiable physical theory rather than a purely interpretive metaphysical reformulation of existing cosmology.

The minimal axiom set reduces to three core statements. First, there exists a six-dimensional primordial nucleus S^6D that is absolutely at rest ($T = 0$) and constitutes the primordial source condition for the entire dimensional cascade; it does not require generation by a prior process within this framework. Second, from S^6D , a five-dimensional atemporal configuration manifold S^5D is generated instantaneously, containing complete relational structural information about all configurations that appear in S^3D ; the projection functional Π maps S^5D into S^3D without temporal evolution in the source space. Third, all apparent temporal evolution, causal ordering, and thermodynamic irreversibility in S^3D are emergent properties of projection ordering and information truncation rather than fundamental dynamics [29].

From these axioms, all previously derived results follow: the kernel formulation of Π , the spectral decomposition of observable structure, the non-vanishing correlation residuals, the cross-redshift coherence floor, the CMB–large-scale structure residual alignment, and the reinterpretation of time as an

ordering parameter $\tau(\Pi, x)$. None of these results requires the introduction of dynamical laws in S^5D ; all dynamics are confined to S^3D as projection artefacts rather than fundamental processes.

The minimal comparison with Λ CDM reveals a precise structural distinction. Λ CDM assumes (i) a temporally evolving spacetime manifold, (ii) local causality governed by relativistic field equations [31], and (iii) stochastic initial conditions encoded in a primordial power spectrum. The Π framework replaces these with (i) a static six-dimensional source structure cascading into lower-dimensional layers, (ii) global non-local projection consistency constraints, and (iii) deterministic structural encoding in S^5D . The two theories are not perturbative variations of each other but belong to different ontological classes: one is evolutionary-dynamical, the other is projection-structural.

The Π framework does not supersede Λ CDM unless it produces unique, non-reducible empirical predictions. The critical criterion is non-reducibility: if even one class of residual structure (ξ_{res} , Σ_0 , or C_{res}) persists under full Λ CDM calibration, then Π becomes empirically distinguishable and therefore scientifically substantive. A second epistemic boundary condition concerns underdetermination. The theory remains scientifically meaningful only if the structural degeneracy class $D(\Pi)$ is sufficiently constrained such that independent observational channels (CMB, large-scale structure, high-redshift galaxy surveys) intersect to reduce degeneracy to a finite or bounded set [33].

Finally, the epistemic status of projection cosmology is defined as a higher-order generative hypothesis: a structural model that explains why Λ CDM works within its domain of validity while also predicting systematic residuals outside that domain. In this sense, Λ CDM becomes a limiting projection approximation of a deeper structural theory rather than a fundamentally incorrect model—analogous to how Newtonian mechanics emerges as a limiting case of relativistic mechanics under low-velocity conditions [34]. If future observational campaigns detect stable, non-absorbed residual structures consistent with Π predictions, cosmology transitions from temporal evolution theory to projection-based structural theory [35].

Methods

Kernel Construction and Spectral Inversion

Π is represented as a non-evolutionary integral kernel: $\Pi[S(x)] = \int K(x, \xi) S(\xi) d\xi$ over $\xi \in S^5D$, where $K(x, \xi)$ encodes adjacency preservation and geometric compression between dimensional layers [11]. Unlike Green's functions, K does not propagate causality but encodes static correspondence relations between pre-existing configurations. Three structural invariants constrain K : (i) normalisation $\int K(x, \xi) d\xi = 1$, preserving global density conservation; (ii) relational isotropy in S^5D with no privileged temporal direction [12]; (iii) coherence preservation, requiring that second-order correlation functions in S^3D are expressible as induced projections of higher-dimensional fields $\xi_2^{(5D)}(\xi_1, \xi_2)$. The residual $\delta(t) = \Pi[S(x)] - \Pi_0[S(x)]$ is an information truncation artefact arising from dimensional compression; its decomposition as $\delta(t) = H[S(x)] - I[S^3D(x, t)]$ renders the second law a property of asymmetric projection rather than fundamental thermodynamics [13,25].

The first-order Gaussian form $K(x, \xi) = Z^{-1} \exp(-|x - \xi|^2 / 2\sigma^2)$ is compatible with existing large-scale structure codes, with σ governing projection resolution. The spectral decomposition $S^3D(x) = \sum \lambda_i \varphi_i(x)$ implies that galaxy clustering, void distributions, and filamentary structures are spectral projections of fixed S^5D geometry [14]. For the full non-Gaussian kernel, S^5D is treated as a relational adjacency network: $\xi \in S^5D$ are nodes in a hypergraph whose edges encode non-local structural dependencies, and K takes the form $K(x, \xi) = Z^{-1} \exp(-\lambda d(x, \xi))$, where $d(x, \xi)$ is a generalised structural distance over relational connectivity and λ a compression parameter [37]. Small variations in λ correspond to measurable differences in large-scale structure amplitude, enabling in-principle inversion of observational data to reconstruct S^5D geometry. The formal bridge to renormalisation group methods [38] is structural rather than ontological: renormalisation integrates out dynamical fluctuations, whereas Π compresses static global structure without assuming temporal flow.

The inversion problem—reconstructing $K(x, \xi)$ from observable S^3D datasets—is formally ill-posed but tractable under isotropy and scale invariance assumptions [39]. It is formulated as a constrained optimisation: minimise the discrepancy between observed correlation functions and projected S^5D models under Π , subject to consistency across redshift, spectral, and anisotropy domains [36]. S^5D is treated as a latent structural space inferred from projection consistency constraints, analogous to quantum state tomography [43], but with a geometric rather than probabilistic reconstructed object. If the reconstruction converges to a unique or bounded degeneracy class, it constitutes strong evidence for the projection hypothesis. Further development requires either a derivation of S^5D from more fundamental principles—supplied in part by the S^6D source condition—or an embedding of Π within a broader theory of dimensional emergence [44].

Declarations

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