

10 – The Metastability of Entropic Zero

Consequences of the Time-Symmetric Parity Constraint

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Abstract

The Time-Symmetric Parity Constraint (TSPC) requires that the universe emerges from a state of vanishing entropy at $T = 0$. This perfectly ordered geometry, containing no matter, no energy, and no time, will be referred to as the Blob. It is the entropic minimum of the manifold: unique under the parity condition, yet intuitively resembling a metastable equilibrium, like a sphere balanced on a point.

This paper develops the mathematics of that state. The entropy function $S(T)$ is shown to possess a strict minimum, with higher derivatives fixing the Blob as a critical point. The parity constraint is expressed algebraically, and curvature invariants at $T = 0$ are identified as quantifiers of the ordered geometry. Variational formulations are then considered, framing the Blob as a fixed point in configuration space, consistent with Barbour's timeless dynamics, from which entropy arcs emerge symmetrically in both temporal directions.

The puzzle remains that the Blob, imagined in isolation, seems capable of persisting forever

without change. If time is absent at $S = 0$, what could “tip” it into evolution? Mathematics can only say that in TSPC the Blob exists not alone but as the waist of a time-symmetric manifold, where time and entropy begin together and no external cause is required.

The result is a cosmology in which the beginning is not explained by dynamical trigger but by structural exclusion. The Blob at entropy zero is metastable if conceived alone, yet necessarily extended if conceived within the constraint. Although centred on the entropic minimum, the analysis also identifies structural consequences for later cosmological evolution, including the symmetric expansion profile and the enhanced growth behaviour that arises from the parity constraint. Its mathematical definition sharpens the framework and fixes downstream conditions on expansion, growth and structure formation; but it leaves open a question that physics cannot answer: why structure should arise from perfect order at all.

1. Introduction

Modern cosmology begins with a hot, dense plasma from which matter and radiation emerge as entropy rises. This picture describes what followed the initial state, but it does not explain the state itself. It leaves open the structural question of why time should have begun at all, and what could have preceded a condition of maximal temperature and minimal order.

TSPC approaches this question differently. It does not introduce new fields or pre-histories but imposes a single algebraic restriction on the spacetime metric. The restriction requires the universe to evolve in two symmetric temporal domains from a shared minimum of entropy. From that minimum the geometry expands to a maximum before contracting again, with each phase mirroring the other about a single tipping point.

A closely related line of thought already exists within relativistic cosmology, namely the view that the central problem is not the dynamical evolution of arbitrary initial data, but the admissibility of entire classes of spacetime solutions. Penrose's Weyl Curvature Hypothesis explicitly rejected the idea that a low-entropy origin could be treated as generic. Instead, it proposed a geometric restriction on gravitational degrees of freedom, arguing that without suppression of Weyl curvature the universe would overwhelmingly be expected to begin in a highly irregular, high-entropy state. In parallel, work on isotropic singularities in mathematical relativity pursued the same objective with greater formal discipline, characterising cosmological solutions whose singular boundaries remain conformally regular and whose curvature behaviour is tightly controlled. In both cases, low entropy is not explained dynamically but enforced structurally, by excluding large classes of otherwise admissible solutions.

TSPC belongs to this admissibility tradition, but alters its logical form. Rather than imposing a one-sided regularity condition at a distinguished past boundary, it imposes a global algebraic restriction on the spacetime metric. The Blob is therefore not a special initial state selected by dynamics or contingency. It is the unique entropic minimum required by the parity-constrained solution space itself, and it is admissible only as the waist of a time-symmetric manifold. Temporal structure, entropy growth, and the appearance of an arrow of time arise within this restricted geometry, not as freely reconstructible features of an initial-value evolution.

This paper examines that minimum directly. It begins at the point where the symmetry is most sharply defined: the state of lowest entropy permitted by the constraint. At $T = 0$ the manifold occupies this state. It is unique under the parity condition, perfectly ordered, and contains no intrinsic arrow of time. For clarity this state will be referred to as the Blob¹. It is the entropic minimum of the geometry and the origin from which the two temporal domains diverge.

Although the Blob may be pictured as a metastable equilibrium if considered in isolation, it cannot stand alone within TSPC. It is admissible only as the waist of a time-symmetric universe. Entropy, curvature, and temporal ordering emerge away from it in both directions, giving rise to the expansion and contraction phases that frame cosmic history.

The aim of this paper is to develop the mathematics of this entropic minimum, to identify the invariants that characterise its ordered geometry, and to confront the philosophical question that mathematics leaves unresolved. The Blob is mathematically definable and physically required by the constraint, yet it stands at the conceptual limit

¹ In keeping with its nothingness the Blob should, of course, have no name at all; but Blob will serve in the absence of anything more apt. Those who find the term comical may take comfort that the Blob itself offers nothing to laugh at.

of explanation. It marks the point where geometry reaches its simplest form, and where the notion of temporal origin becomes most ambiguous.

In this respect the present contribution differs from earlier papers in the TSPC series. Those papers examined how the framework dissolves anomalies attributed to dark energy, vacuum energy, dark matter, inflation, the arrow of time, and the H_0-S_8 tensions. Here the focus shifts from consequences to structure, from observational tension to the ordered state at entropy zero. The result is not a resolution but a clarification: the Blob is necessary, definable, and structural, yet it points to questions that lie beyond geometry itself. Although the focus here is on the ordered state at entropy zero, the structure it defines carries through the entire manifold, setting the conditions for the symmetric expansion arc, the mid-redshift acceleration profile, and the growth behaviour that later sections relate to observation.

2. Algebraic Framework

The Blob at $T = 0$ is defined as the state of vanishing entropy permitted by TSPC. Here entropy is not understood in the statistical-mechanical sense of counting microscopic configurations within a phase space. At $T = 0$ there is no ensemble, no multiplicity, and no fluctuation to count. Instead, entropy vanishes because the admissible configuration space collapses to a single geometric possibility once the parity constraint is imposed. The Blob is therefore unique not as a microstate among many, but as the sole metric configuration consistent with both vanishing entropy and parity invariance. Its order is structural rather than statistical: it reflects the exclusion of all alternative geometries, not the freezing of underlying degrees of freedom.

With only one admissible configuration, there is no multiplicity, no fluctuation, and no evolution: geometry alone remains. This uniqueness means there is nothing to distinguish, nothing to fluctuate, and nothing to evolve. It follows that the familiar categories of time, matter, and energy do not apply. Without change of entropy there is no temporal order. Without ensembles there is no matter. Without excitations there is no energy. What remains is geometry alone: the sole admissible configuration consistent with the parity constraint.

This does not render the Blob unstable in a dynamical sense, as though it were balanced precariously awaiting disturbance. Nor does it imply that it can persist independently of the manifold. Its definition as a strict entropy minimum ensures that it exists only as the waist of the global symmetric structure. The Blob may be described as metastable only by analogy: not because it can decay, but because it marks the transitional extremum between the two time-symmetric domains. Formally it is the entropic minimum of a complete manifold, not a separate state within it.

To express this algebraically, the Blob must be defined in two ways at once: as the strict minimum of the entropy function and as the unique geometry consistent with the parity constraint. The entropy minimum ensures uniqueness: only one state is accessible at $T =$

0. The parity condition ensures invariance: only symmetric metrics are admissible. Taken together, they define the Blob as the sole state of pure geometry at entropy zero.

Entropy extremum and geometry of the Blob

$$S(T) = 0 \quad \text{at} \quad T = 0, \quad \frac{dS}{dT} = 0 \quad \text{at} \quad T = 0, \quad \frac{d^2S}{dT^2} = 2\beta > 0$$

- The entropy relations define the Blob as a strict minimum: a single admissible geometric configuration, perfectly ordered.
- The positive second derivative fixes the Blob as a stable extremum with curvature β .
- The parity condition constrains the metric: geometry must be invariant under the involutive tensor Π .²
- Entropy and geometry together define the Blob as the sole admissible state at $S = 0$: no time, no matter, no energy, only pure geometry.

3. Symmetry and Evolution Away from the Blob

From the definition of the Blob as the unique state of entropy zero and parity-constrained geometry, the consequences of moving away from $T = 0$ follow directly. Entropy cannot remain fixed at its minimum, for the algebraic structure admits only a symmetric rise in both temporal directions. The scale factor likewise cannot remain at its smallest admissible value, but must expand outward, reach a maximum, and then contract in mirrored form. Time itself is not an external parameter imposed on this sequence but an emergent ordering, defined locally by the growth of entropy.

A common objection to any low-entropy origin is that extreme compactness would generically lead to horizon formation. In the present framework this objection does not arise. At $T = 0$ there is no stress–energy content, no time-directed causal structure, and no inward gravitational evolution. Horizon formation presupposes matter, energy, and causal ordering within spacetime; the Blob is the geometric extremum that defines spacetime itself. Curvature invariants are finite, null congruences are not trapped, and the geometry unfolds symmetrically away from the waist. The early universe therefore does not avoid horizon formation by dynamical expansion, but by the absence of the conditions under which horizons are defined.

In this way the universe evolves not from an arbitrary initial condition but from a structurally mandated minimum. Each temporal branch emerges from the Blob with entropy increasing away from $T = 0$, complexity developing, and the arrow of time manifesting locally. Yet the two branches are mirror images: globally the manifold remains time-symmetric.

² For the formal definition of Π and proof of its Robertson–Walker admissibility, see 2 – Main Paper, Section 2.

This symmetric arc differs fundamentally from the familiar narratives of inflation, bounce, or cyclic reset. There is no need for a dynamical field to drive exponential expansion, nor for exotic conditions to restore order after collapse. The rise and fall of entropy is not imposed by boundary conditions but flows algebraically from the parity constraint on the metric. Expansion and contraction are paired by structure, not by causal reversal.

The entropic profile is quadratic near the Blob and saturates at a unique maximum at the tipping epoch, T^{tip} . At this moment the scale factor attains its greatest value, entropy reaches its peak, and the local arrow of time is most fully expressed. Beyond T^{tip} , the trajectory is mirrored: the scale factor contracts, entropy declines, and complexity diminishes, returning at $T = 0^+$ to a terminal state indistinguishable from the origin.

Thus what appears within each branch as the passage of time, the rise of entropy, and the evolution of structure is globally balanced. The Blob ensures that the universe is not open-ended but framed within a symmetric manifold. Locally memory, causality, and irreversibility are real. Globally, the manifold is coherent, geodesically complete, and free from singularities.

The consequence is a new picture of cosmic origin. The universe does not begin by chance, or by external cause, but by exclusion. Only one configuration is admissible at $S = 0$, and from it a symmetric entropic arc must unfold. The Blob is therefore not a contingent starting point but the waist of a structure that enforces time symmetry, entropy evolution, and eventual return.

$$S(T) = \beta T^2 \quad \text{with minimum at } T = 0$$

$$a(T) = a_{\min} \exp\left(\int_0^T \sigma(\tau) \, d\tau\right)$$

$$\sigma(T) = \frac{dS}{dT}$$

$$S(T) \text{ maximal at } T = T^{\text{tip}}$$

Explanation

- The entropy function rises symmetrically from its minimum at the Blob.
- The scale factor $a(T)$ follows the entropy slope, expanding to a maximum at T^{tip} and contracting thereafter.
- The entropy slope $\sigma(T)$ is small near $T = 0$ and peaks near T^{tip} , defining the strength of local time's arrow.
- Together these relations describe the symmetric arc of expansion, entropy, and contraction that follows from the Blob.

Falsifiability

Any evidence of multiple entropy peaks, asymmetric scale-factor evolution, or a

departure from the single symmetric arc implied by these relations would exclude the framework³.

4. Geometric Invariants and Variational Characterisation

The Blob is not defined by contents or by dynamics, but by the geometric relations that remain when all internal structure has vanished. Quantifying this state requires identifying the invariants of the geometry at entropy zero and showing how the Blob functions as a fixed point in configuration space.

At $T = 0$ the metric is constrained by the parity condition: it must be invariant under the involutive tensor Π . This reduces the symmetry group of admissible diffeomorphisms and selects a subspace of metrics that share the same reflection property. Within this restricted subspace the usual curvature invariants exhibit symmetric behaviour about $T = 0$ and reach their extremal values there. The Blob is therefore introduced not as a dynamical singularity but as an algebraic extremum of the geometry, geodesically complete within the construction and fixed by the parity condition rather than by any divergent curvature.

The same definition can be expressed variationally. In Barbour's language of configuration space, the Blob corresponds to a critical point of the entropy functional $S[g]$.⁴ The extremal conditions set out in Section 2 fix both the entropy minimum and the parity invariance of the metric. In this picture the Blob is a point in configuration space from which geodesic flows of entropy evolution extend symmetrically in both temporal directions. Time does not precede the Blob; it arises with the unfolding of entropy along these geodesic arcs.

This formulation clarifies the sense in which the Blob is metastable. Conceived in isolation it appears balanced, admitting no preferred direction of evolution. But conceived as part of the parity-constrained configuration space, it is not isolated: the extremal conditions require it to be embedded within a symmetric manifold. Metastability here does not mean a state awaiting disturbance in external time, but a state that can only exist as the waist of a larger structure.

³ DESI Collaboration, *The DESI Experiment: a white paper for cosmology and fundamental physics*, arXiv:1611.00036 (2016). BAO and structure-growth forecasts; tests the predicted mid- z hump.

Euclid Collaboration, *Euclid preparation: VII. Forecast validation for Euclid cosmological probes*, Astronomy & Astrophysics 642, A191 (2020). Lensing and clustering data will constrain α_Λ .

LSST Dark Energy Science Collaboration, *LSST DESC Science Requirements Document*, arXiv:1809.01669 (2018). Supernova, clustering, and weak-lensing programme, central to falsifiability.

SKA Organisation, *Advancing Astrophysics with the Square Kilometre Array*, arXiv:1501.00441 (2015). SKA promises percent-level tests of growth and acceleration.

⁴ Barbour, Julian, *The Janus Point: A New Theory of Time* (London: Bodley Head, 2020). Develops the notion of configuration space and treats entropy minima as critical points shaping temporal order.

Invariants at the Blob:

R finite at $T = 0$

$K = R_{\mu\nu\alpha\beta}R^{\mu\nu\alpha\beta}$ finite at $T = 0$

$S(T) = 0$ and $\delta S = 0$ at $T = 0$

Explanation

- R is the Ricci scalar; K is the Kretschmann scalar. Both are finite at the Blob, indicating regular curvature.
- The entropy functional satisfies $S = 0$ and $\delta S = 0$, fixing the Blob as a critical point in configuration space.
- These conditions show that the Blob is not a singular origin but a variational extremum: the fixed waist of a globally symmetric manifold.

Falsifiability

If observations implied a singular origin, or if curvature invariants diverged at minimal entropy, the Blob would not be physically admissible. Its claim is to be both finite and unique; any departure excludes the framework.

The coherence of this construction, its freedom from dynamical instability, and its capacity to generate symmetric entropy evolution without new fields suggest that the algebraic constraint may not be a purely classical device. It may instead represent an organising principle whose influence extends into the quantum domain, linking the emergence of time and structure to deeper levels of physical law.

5. Observational Consequences of the Blob

The Blob is not itself observable, for it corresponds to a state of vanishing entropy at $T = 0$. Yet its definition imposes conditions that shape all subsequent evolution and leave measurable signatures in cosmological observables. The link from abstract extremum to data arises through the symmetric arc of entropy and scale factor, and through the fractional correction to gravitational coupling that follows from the parity constraint.

The first consequence is the profile of apparent acceleration. Because entropy rises symmetrically from zero and peaks at T^{tip} , the entropy slope $\sigma(T)$ is small near the origin and largest near the tipping epoch. The parity-induced clock-skew is coupled to this slope, and so the accumulated bias is negligible at very early or very late times but maximal at intermediate redshifts. Observationally this produces a single broad hump in apparent acceleration across $0.5 \lesssim z \lesssim 1.5$. Unlike the monotonic acceleration of Λ CDM, the TSPC profile rises and falls once, reflecting the symmetric arc of entropy that begins at the Blob.

The second consequence is the elevation of expansion and growth. Because the parity constraint fractionally strengthens effective gravitational coupling, the Friedmann equation acquires a small upward correction, raising $H(z)$ by a percent-level amount at intermediate redshifts. The same correction enhances the linear growth of structure

and modestly elevates weak lensing convergence in underdense regions. These effects are tightly correlated: once the amplitude of the correction is fixed by the structural parameter α_λ , all three signatures are determined without further tuning.

The third consequence concerns falsifiability. Because the Blob is defined as a strict minimum of entropy with symmetric rise and fall, the mid-redshift hump in apparent acceleration must appear as a single broad maximum. Multiple peaks, asymmetric departures, or a monotonic trend would contradict the structure of the Blob. Similarly, because the effective coupling correction is structural rather than dynamical, the shifts in expansion, growth, and lensing must align within the same narrow band of α_λ . Any mismatch between probes excludes the framework.

Linked observables from the Blob

$$\begin{aligned}\Delta H(z) &\approx \alpha_\lambda H(z), \\ \Delta f\sigma_8(z) &\approx \alpha_\lambda f\sigma_8(z), \\ \Delta\kappa &\approx \alpha_\lambda, \\ \Delta t_{\text{obs}}(z) &\propto \alpha_\lambda \int \sigma(T) d\chi\end{aligned}$$

Explanation

- Expansion, growth, and lensing each acquire a fractional shift of order α_λ , with the structural parameter fixed by the parity constraint.
- The observed acceleration bias arises from the clock-skew term, coupled to the entropy slope $\sigma(T)$.
- All effects are correlated: once α_λ is fixed, the amplitude of each shift follows automatically.

Falsifiability

If the acceleration profile shows more than one peak, if expansion and growth shifts are inconsistent, or if α_λ lies outside the narrow band permitted by solar-system and CMB limits, the hypothesis fails.

6. Evaluation and Comparison

Before comparing the Blob with other cosmological frameworks, it is necessary to clarify the level at which the comparison is made. Many cosmological debates proceed as though all frameworks are variants of the same enterprise: the specification of initial conditions followed by dynamical evolution. TSPC does not operate at that level. Like earlier work on geometric entropy and admissible cosmological singularities, it treats the low-entropy origin as a restriction on the class of physically allowed spacetimes rather than as a contingent starting configuration. The Blob is therefore not to be read as an alternative initial condition, but as the geometric extremum that remains once inadmissible histories have been excluded.

The concept of the Blob reframes cosmic origin by shifting explanation from dynamical cause to structural admissibility. Instead of a hot dense plasma as an initial state, or a singularity to be resolved by inflation or bounce, the universe begins at an entropic minimum of pure geometry. This is not a contingent configuration but one structurally enforced by TSPC.

Conventional frameworks adopt different strategies. In Λ CDM the early universe is assumed to have begun in a finely tuned state of low entropy, but no structural reason is given for why this should be so. Inflation provides a mechanism for rapid expansion, but at the cost of scalar potentials with no independent detection, and leaves the origin of time's arrow unexplained. Bouncing models restore expansion by reversing contraction but often violate energy conditions and face instability. Cyclic models attempt to repeat cosmic histories but must invoke entropy reset mechanisms that lack coherence. In each case the origin is protected by dynamical invention or entropy bookkeeping, whereas in TSPC it is fixed by exclusion: geometries that would support an absolute temporal direction are simply not permitted.

By contrast, the Blob arises not from invention but from exclusion. No new fields, particles, or potentials are introduced. The algebraic constraint simply forbids geometries that admit an absolute temporal direction, and the Blob is the unique state that satisfies this restriction at $S = 0$. The subsequent symmetric arc of entropy, scale factor, and local time follows necessarily.

The explanatory reach is broad. The Blob provides a coherent account of why only an ordered origin is admissible, why entropy increases in both temporal directions, and why apparent late-time acceleration appears as a single hump rather than a monotonic trend. The same structural correction explains mild anomalies in expansion, growth, and lensing. Gravitational waves, galactic rotation, and cluster lensing all fit naturally into the framework, with no role for speculative dark sectors.

A standard objection concerns the timing of structure formation. In the standard treatment of the hot early universe, baryons are tightly coupled to radiation, and pressure support lifts the Jeans scale until recombination. Density perturbations in ordinary matter therefore grow only slowly, and it is argued that there is insufficient cosmic time to form galaxies of Milky Way mass without invoking a cold, pressureless component that begins clustering much earlier. Under TSPC this reasoning fails. The evolution of inhomogeneities is governed not by baryon–photon microphysics but by the Π -constrained geometry and the fractional strengthening of effective gravitational coupling encoded in α . There is no analogue of the radiation-locked Jeans barrier, and no requirement for an auxiliary dark component to provide early gravitational scaffolding. Observationally, the baryonic lensing phenomenology and the modest

elevation of growth predicted by the framework supply the effective attraction that the conventional argument attributes to early-forming cold-dark-matter halos.⁵

The empirical strength lies in correlation and constraint. A single structural parameter, α_λ , governs all departures from Λ CDM. Its permitted range is already narrowed by solar-system dynamics, CMB lensing, and cosmological surveys. It cannot be tuned separately for each anomaly: either all align within the predicted window, or the hypothesis fails.

The philosophical strength lies in parsimony. The Blob does not appeal to finely tuned initial conditions, nor to hidden fields or anthropic selection. It posits that the universe begins at entropy zero because any other configuration is excluded by the constraint. What follows: time, matter, energy, and complexity arise symmetrically from that minimum. The universe is thus framed not by cause, but by structure.

Falsifiability is central. If expansion, growth, and lensing anomalies do not align with the same α_λ , the framework is excluded. If the mid-redshift hump is absent or asymmetric, the Blob cannot serve as the origin. If curvature invariants diverge at minimal entropy, the Blob loses admissibility. The test is sharp: either the anomalies cohere, or the constraint fails.

Structural contrast

Λ CDM: $S_{\min}$ assumed, acceleration $\Rightarrow \rho_\Lambda$

Inflation: $S_{\min}$ assumed, $a(T) \propto e^{Ht}$, ϕ with tuned potential

Bounce / Cyclic: S_{reset} required, $a(T) \rightarrow 0 \Rightarrow a(T) \rightarrow a_{\max}$

Blob/TSPC: $S(T) = 0$ at $T = 0$, $a(T)$ symmetric about T^{tip} , $\Delta_{obs} \propto \alpha_\lambda \int \sigma(T) dT$

- dTDM assumes but does not explain the low-entropy origin; acceleration is modelled by a vacuum-energy term.
- Inflation postulates exponential growth driven by a scalar field with tuned potential.
- Bounce and cyclic models require entropy reset mechanisms to restore order, which lack coherent justification.
- The Blob framework fixes $S = 0$ structurally, secures symmetric evolution of $a(T)$, and reframes acceleration as a parity-induced clock-skew tied to α_λ .

⁵ Classic treatments of this timing argument include Peebles, *Large Scale Structure of the Universe* (Princeton, 1980), which formalises baryon–photon suppression of early growth, and Blumenthal, Faber, Primack and Rees, *Formation of galaxies and large scale structure with cold dark matter*, *Nature* 311, 517–525 (1984), which advances the claim that early cold-matter collapse is required for galactic formation timescales.

7. Concluding Remarks

The Blob at $T = 0$ has been defined as the state of vanishing entropy and pure geometry required by TSPC. Its uniqueness lies in the fact that it contains no time, no matter, and no energy. It is not a plasma, a vacuum, or a singularity, but the entropic minimum of the manifold: the waist of a time-symmetric universe.

From this extremum follow all subsequent structures. Entropy rises symmetrically away from zero, reaches a unique maximum at the tipping epoch, and declines to a terminal minimum at $T = 0^+$. The scale factor follows the same arc. Locally this produces a clear arrow of time, while globally the manifold remains balanced. The apparent late-time acceleration arises not from dark energy but from a parity-induced clock-skew, tied to the entropy slope, producing the mid-redshift hump now visible in supernova, BAO, and chronometer data.

Observational consequences are therefore sharp. Expansion, growth, and lensing must display correlated fractional shifts, all governed by the same parameter α_λ . The mid-redshift hump must appear once, not repeatedly, and with a fixed profile. Curvature invariants must remain finite at minimal entropy. These conditions are not adjustable: if the data diverge, the framework is excluded. If they align, the category of dark energy, the cosmological constant, and entropy reset mechanisms dissolve.

What remains open is the question of metastability. Conceived in isolation, the Blob resembles a poised equilibrium, like a sphere on a point, admitting no preferred direction in which change could occur; not in the sense of a dynamical state awaiting perturbation, but in the purely structural sense of an extremum with no preferred temporal direction. Conceived within the algebraic constraint, it is not isolated at all: it can only exist as the waist of a symmetric manifold. Mathematics can characterise the Blob as a fixed point of the admissible configuration space, and observation can test the consequences of the structure that unfolds away from it. What mathematics cannot do, within this framework or any other presently known physical theory, is supply a causal trigger for the initiation of time itself.⁶

In the physicist's language, the Blob is the unique configuration permitted by the constraint, the entropic minimum of a symmetric manifold from which mirrored histories emerge. There is no geometrical or mathematical reason for the initiation of time, and all that follows from it. The beginning remains a paradox for which, as yet, no explanation can be given. From the standpoint of physics, this marks a boundary rather than a failure: the framework identifies what must be the case for time and structure to exist, but not why such a structure exists at all.

⁶ Thomas Aquinas observed that creation, properly understood, is not a change but "the very dependence of the created act of being upon the Creator". (*Summa Theologica* I, Q45, A2 ad 2.) The universe, in that view, begins without a trigger because its beginning is the condition of law itself.

A theologian might choose to frame that same boundary differently, as the transition from formless void into creation.⁷ The two accounts do not compete, because they address different questions, posed at different explanatory levels.

The framework shows how far constraint can carry physics: it dispenses with unseen sectors, derives time's arrow from geometry, and reframes cosmic acceleration as a structural effect. Beyond that boundary, the question of why structure should arise from perfect order may be left open: to philosophy, to faith, or to silence. The framework merely shows how far structural constraint can carry cosmological explanation, and where explanation, in the physical sense, must stop.

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⁷ Genesis 1:2. The phrase “formless and void” provides a theological metaphor comparable to entropy zero.