The Layered Causality Hypothesis

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A relativistic reframing of dark matter, dark energy, and the age of the universe

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July 1st, 2025

Prologue: A Thought Experiment on Speed and Causality

Speed Trap

There are two things every student of relativity learns:

1. There is no preferred frame. All speeds are relative.
2. You can never accelerate to the speed of light, because you would need infinite energy to do so.

Imagine this: there's a planet zipping through space at 99.9999% of the speed of light. You want to go there.

A team of scientists builds a powerful accelerator and launches your spaceship to that planet's speed. You arrive. You get out. And when you measure your speed relative to light, guess what? It's still zero. Light still zips away from you at c. So, you fire up the same kind of accelerator again—and accelerate again to 99.9999% of the speed of light. Same result. You're always standing still in your own frame, and light is always one step ahead.

No matter how many times you repeat the process, from your own point of view, you never get closer to light. Yet from the original scientists' frame, watching you through a telescope, you're slowing down in time and approaching invisibility. Eventually, you pass a threshold. You can't receive light from them anymore. You can't entangle, communicate, or chemically bond. You are causally disconnected, a ghost, still held by gravity, but unreachable by every other force.

This, the Layered Causality Hypothesis suggests, is exactly what has happened to the dark matter we observe. It's not hiding in a shadow realm. It's just on the other side of the speed trap.

Abstract

The Layered Causality Hypothesis proposes that dark matter and dark energy are not distinct substances, but observational effects resulting from relativistic separation across continuous causal frames. When matter crosses a critical threshold, termed the *Jones Threshold*, it becomes causally disconnected from a given frame for all forces except gravity. This disconnection produces the illusion of invisible mass and accelerated expansion. Redshift, clock rate variation, and the perceived age of the universe are reframed as consequences of frame divergence rather than physical recession. The model introduces no new forces or particles, but instead reinterprets existing observations through the structure of relativistic causality.

Introduction

For nearly a century, the dominant cosmological model has centered around the idea of a singular origin from which the universe has expanded, evolved, and accelerated. This ubiquitous model, the Big Bang Theory, relies on key observational pillars: the redshift of distant galaxies, the apparent acceleration of that redshift, and the cosmic microwave background. While each of these observations is compelling, each is open to interpretation. Here we consider that their unity may lie in a shared relativistic misreading rather than the explosive origin we have all come to accept.

The Layered Causality Hypothesis proposes a fundamentally different framing of cosmic structure. In stark contrast to an expanding universe born from a singular event, it envisions a relativistically layered cosmos in which infinite causal domains coexist relative to one another. When matter crosses a critical relativistic threshold, it becomes causally disconnected in all forces except gravity. This separation creates the illusion of dark matter, dark energy, and universal expansion, even though the underlying structure remains subluminal and continuous.

This model reinterprets redshift as a function of frame divergence, rather than recessional velocity. It treats cosmic time not as an absolute quantity, but as a frame-dependent construct.

What follows is a comprehensive reframing of cosmological observation; a theory that adheres strictly to special relativity, introduces no new particles or forces, and yet provides new clarity to some of the most persistent mysteries of the cosmos.

Electromagnetic Redshift and Causal Disconnection

One of the earliest and clearest signs of causal disconnection across relativistic thresholds is the redshifting of electromagnetic signals. As objects move at high velocities relative to an observer, the photons they emit become increasingly redshifted. As we will see, this effect is not merely a Doppler phenomenon; it reflects a deeper causal divergence wherein electromagnetic communication itself becomes unsustainable.

Classical Doppler Redshift

In special relativity, the relativistic Doppler shift for light emitted at velocity v is given by[4]:

$$z = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}} - 1$$

This formulation assumes a continuous observational connection between source and observer. However, it breaks down conceptually when the source crosses a velocity threshold at which its signals are no longer observable in any practical or meaningful way.

Redshift as a Causal Limit

As velocity increases, redshift grows without bound. At extreme values (such as $z \approx 0.58$ for hydrogen's spectral lines), the emitted light becomes undetectable in the observer's frame. This is not a result of distance or obstruction, but, as we will demonstrate, a result of relativistic disconnection between causal frames. Importantly, the signal itself continues unchanged; it may still be received by any observer within its own causal range. However, for frames beyond a critical relativistic separation, the conditions required for electromagnetic interaction (including phase and frequency coherence) can no longer be maintained. At this point, signal transmission fails, not just functionally, but physically.

To see this more formally, consider the phase of an electromagnetic wave:

$$\varphi = kx - \omega t$$

For constructive interference to occur (which is necessary for detection and coherence), the phase difference between emitter and observer must remain bounded:

$$\Delta\varphi = |\varphi_{emitter} - \varphi_{observer}| < constant$$

 Where:
φ is the wave phase, k is the wave number (in radians per unit length), x is position, ω is angular frequency (in radians per second), and t is time.

At relativistic separations (beyond the Jones Threshold), time and spatial coordinates diverge such that $\Delta\phi \to \infty.$ This renders phase alignment impossible, and no meaningful electromagnetic

coupling can occur. Thus, signal reception fails as a direct physical consequence of frame divergence.

This breakdown can also be understood in terms of energy-based redshift. Using the generalized formulation from Ortiz and Ibarra-Castor[1]:

$$E = \frac{(h^2 f^2)}{(2p^2)}$$

Where E is the specific energy, h is Planck's constant, f is frequency, and p is momentum.

we observe that as frequency f decreases due to redshift, the observable energy E drops proportionally to the square of the frequency. This means even modest reductions in f lead to rapid energy loss; if frequency is halved, energy falls to one-quarter. This relationship shows that redshift leads to a real and irreversible energy loss, not recoverable by shifting observational frame alone. Thus, causal disconnection is not merely observational; it reflects a breakdown in electromagnetic exchange that cannot be resolved by changing reference frame alone.

The Jones Threshold and EM Signal Breakdown

Mathematically, this threshold can be estimated by identifying when spectral lines redshift beyond detectability, using standard redshift relations for atomic transitions. However, the Jones Threshold is not merely an observational limit; it marks a physical boundary beyond which electromagnetic interaction is no longer possible due to frame separation.

This breakdown can now be understood as a *quantum causal limit*, grounded in the Planck-scale constraint:

$$E_{rel} \cdot T_{rel} \leq h^{[5]}$$

Here, E_{rel} represents the energy of the external object (or signal) as perceived from the local frame, and T_{rel} represents the duration over which coherent interaction might occur. When the product of these falls below Planck's constant, no exchange of photons—or any quantum force carriers—is possible. The interaction channel collapses as a direct result of quantum limits on energy–time coherence.

This provides a more rigorous definition of the Jones Threshold: it is the point at which two systems, due to relativistic separation, can no longer meet the energy-time requirement for quantum exchange. From this perspective, the Jones Threshold marks where the quantum grain of causality fails to connect frames. All forces that rely on exchange particles (electromagnetic, strong, and weak), cease to function across this divide.

However, gravity remains.

As described in the Causal Bridge Law (defined later in this paper), gravitational influence persists across the Jones Threshold because it does not require particle exchange. Instead, gravity is the curvature of spacetime itself, and this curvature can still shape the motion of distant objects even when no other form of interaction survives. Thus, the Jones Threshold represents a boundary in quantum connectivity, not in geometric influence.

Coherence Breakdown Across the Jones Threshold

Causal disconnection beyond the Jones Threshold leads to the breakdown of quantum coherence. This conclusion can be reached through multiple independent formalisms, each reinforcing the same physical consequence: systems that are causally disconnected cannot maintain entanglement or phase coherence across frames.

Phase Decoherence Due to Relativistic Drift

Consider two initially entangled quantum systems sharing a synchronized phase evolution. Each system has a wavefunction of the form

$$\psi(x, t) = Ae^{i(kx - \omega t)}$$

where $\psi(x,t)$ is the wavefunction describing the phase-coherent evolution of a quantum system, A is the normalization constant, e is Euler's number (the base of the natural logarithm), i is the imaginary unit, k is the wave number (in radians per unit length), x is position, ω is angular frequency (in radians per second), and t is time.

As one system accelerates to relativistic speed (e.g., beyond 0.8c relative to the other), the coordinate time t in its frame dilates substantially. The resulting desynchronization in the phase factor $(kx - \omega t)$ causes the systems' relative phase to drift. Over time, the phase difference $\Delta\varphi$ grows unbounded, eliminating the conditions required for coherent interference. Thus, phase-based coherence is lost as the systems diverge across relativistic domains.

Entanglement Collapse Through Partial Trace

Suppose two particles are in the maximally entangled Bell state:

$$|\Psi\rangle = \left(\frac{1}{\sqrt{2}}\right)|0\rangle_A |1\rangle_B + |1\rangle_A |0\rangle_B)$$

where $|\Psi\rangle$ is the entangled two-particle state, $|0\rangle$ and $|1\rangle$ are the basis states, and the subscripts A and B label the two entangled particles (or systems) associated with observers A and B, respectively.

If particle B accelerates across the Jones Threshold, it becomes causally inaccessible. To describe the remaining system, one must trace over B's degrees of freedom:

$$\rho_A = Tr_B^{(|\Psi\rangle\langle\Psi|)} = \left(\frac{1}{2}\right)(|0\rangle\langle0| + |1\rangle\langle1|)$$

Where ρ_A is the reduced density matrix of subsystem A, Tr_B denotes the partial trace over subsystem B, $\Psi\,\Psi^\dagger$ represents the outer product of the entangled state with itself, forming the full density matrix, $|0\rangle\langle0|$ and $|1\rangle\langle1|$ are projection operators onto basis states of subsystem A, and ½ is a normalization constant ensuring total probability equals 1.

This reduced density matrix is a classical mixture, not a quantum superposition. The act of tracing over the inaccessible system results in decoherence, mathematically ending entanglement from the perspective of the accessible observer.

Breakdown of Simultaneity and Frame Agreement

Additionally, coherence can be lost through relativistic failure of simultaneity. At relativistic velocities, different frames no longer agree on the order or timing of quantum events. This destroys the unitary evolution required for shared state descriptions in entangled systems. While this mechanism is more conceptual than algebraic, it supports the same conclusion: causal disconnection implies the end of non-gravitational coherence.

Concluding this section, we emphasize that the Jones Threshold is not a boundary of matter or motion, but of meaning: it defines the outer edge of coherent quantum interaction.

Redshift / Time Dilation Without Motion

This section demonstrates that both redshift and time dilation can result from frame-based energy differentials rather than classical motion. Using an energy-based formulation inspired by the work of Ortiz and Ibarra-Castor, in *Generalized Redshift Forula Through an Energy-Based Framework,* (Scientific Reports 2024) we derive expressions that describe how time and frequency shift as a function of relative energy states between frames[1], even when no classical Doppler motion is present.

We begin with the energy-based redshift equation proposed by Ortiz:

$$z = \frac{(E_e - E_o)}{E_o}$$

Where z is the redshift measured from the observers frame, E_e is the energy of the emitted signal, and E_o is the energy measured by the observer.

For a photon, energy is related to frequency by $E = hf$. If we assume conservation of photon momentum and apply the energy difference to frame-specific measurements, we can express redshift as:

$$z = \frac{(f_f - f_o)}{f_o}$$

Where f_f is the frequency in the frame where the signal was emitted, and f_o is the frequency measured by the observer.

Solving for f_f:

$$f_f = f_o(1 + z)$$

Now assume a similar dependency exists between proper time in the shifted frame (T_s) and reference frame time (T):

$$T_s = \frac{T}{(1 + z)}$$

Where T_s is the proper time in the shifted frame, T is the proper time measured in the observer's frame, and z is the observed redshift.

This formulation reveals that the reference observer experiences a slower passage of time in the shifted frame, without invoking any motion.

If we define a dimensionless relative momentum parameter M as the velocity relative to the Jones threshold (taken here as 0.8c), then:

$$T = \sqrt{1 - M}$$

Where T is the observed time rate, and M is the fractional motion (v^2/c^2) between frames.

From which:

$$\frac{T_s}{T} = \frac{1}{1 + z} = \sqrt{1 - M}$$

This establishes a mathematical equivalence between redshift, time dilation, and frame-separated (but motionless) structures. From the viewpoint of one frame, the other's time is dilated and signals are redshifted, without requiring either frame to be in classical relative motion.

This formulation complements the Causal Bridge Law, showing that energy and time remain coherently proportioned across frames even when electromagnetic and quantum coherence fail[3].

This framework lays the groundwork for understanding asymmetrical perception between frames, a theme that will reemerge in the discussion of Mirror Divergence and Frame Drag Braking. This frame-based redshift formulation naturally leads to the Relative Interval Principle, which ensures that energy and time remain coherently proportioned across causally disconnected domains[5].

The Relativistic Interval Principle (RIP)
Energy Conservation Across Causally Disconnected Frames

In the following sections, we explore a system of two structures that initially share a causal frame. As one descends into a new frame, causal disconnection occurs, leaving the other behind.

To prepare for that discussion, and to preserve clarity and mathematical rigor, we now introduce the mathematical model we call the Relative Interval Principle (RIP). This principle can be derived either from:

1. First principles of energy and momentum conservation, or
2. The energy-based approach to redshift developed by Drs. Ortiz and Ibarra-Castor.

Derivation from First Principles

We begin with the standard relativistic energy-momentum relation:

$$E^2 = (pc)^2 + (m_0c^2)^2$$

Where E is the total energy of an object or system, p is its momentum, c is the speed of light, and m_0 is its rest mass.

In a rotating system with relative motion across frames, energy naturally separates into two components:
- E_{rot}: the rotational or internal energy
- E_{rel}: the relativistic energy associated with motion relative to the observer
Assuming the system's total energy remains conserved:

$$E^2_{total} = E^2_{rot} + E^2_{rel}$$

This expression defines the Relative Interval Principle: a system's total energetic identity is preserved through internal redistribution, even as causal disconnection occurs. Energy does not vanish, it shifts form within a conserved structure.

Derivation via OrtizIbarra-Castor Redshift Formalism

Ortiz and Ibarra-Castor present a generalized framework for redshift based on intrinsic energy differences rather than spatial motion. Their formulation begins with the quantum energy relation:

$$E = hf$$

A change in observed frequency implies a change in measurable energy:

$$z = \frac{(f_f - f_o)}{f_o}$$

Again, where f_f is the frequency in the frame where the signal was emitted, f_o is the frequency measured by the observer and z is the observed redshift.

In this framework, the observed redshift is not due to recession but to a redistribution of energy from one component to another. If internal spin decreases (E^2_{rot} goes down), the relative motion component must increase (E^2_{rel} goes up), or vice versa, preserving:

$$E^2_{total} = E^2_{rot} + E^2_{rel}$$

Thus, RIP is recoverable from both classical conservation and quantum-energy-based redshift. In both views, redshift is a reflection of internal structural rebalancing, not necessarily motion.

The basic form of the Relative Interval Principle (RIP) has now been derived from both classical and energy-based formulations. However, its full implications reach beyond any single system. What follows is a generalized version of RIP, showing how this principle can apply not only to total energy, but to a wide range of conserved quantities across causal frames.

Relative Interval Principle (RIP): Generalized Form

Based on the energy-based redshift formulation introduced by Ortiz & Ibarra-Castor, RIP reinterprets redshift not as a loss of energy, but as a redistribution of conserved quantities into an inaccessible causal domain.

Where standard energy equations account only for observable quantities within a single inertial frame, RIP posits that the total energy and momentum of a system remain conserved via interval-like structures, even when part of that system becomes causally displaced. These quantities are expressed in a squared-sum form analogous to the spacetime interval:

$$E_{\text{total}}^2 = E_{\text{rot}}^2 + E_{\text{rel}}^2$$

$$p_{\text{total}}^2 = p_{\text{local}}^2 + p_{\text{rel}}^2$$

This interval form applies not only to total energy and momentum, but to other frame-sensitive domains:

- **Kinetic** $\qquad\qquad E_{\text{kin}}^2 = E_{\text{linear}}^2 + E_{\text{rel}}^2$
- **Thermal**: $\qquad\qquad E_{\text{thermal}}^2 = E_{temp}^2 + E_{\text{rel}}^2$
- **Photon**: $\qquad\qquad E_{\text{photon}}^2 = E_{\text{freq}}^2 + E_{\text{rel}}^2$
- **Potential**: $\qquad\qquad E_{\text{pot}}^2 = E_{\text{field}}^2 + E_{\text{rel}}^2$
- **Angular Momentum** $\qquad L_{\text{total}}^2 = L_{\text{orbit}}^2 + L_{\text{rel}}^2$

This framework provides a way to preserve conservation laws across the Jones Threshold, explaining why redshifted systems may appear to lose energy, spin, or coherence while retaining an underlying conserved total. It also reinforces the idea that causal descent redistributes energy geometrically rather than dissipatively.

The full formulation and derivation of RIP, including its relation to the Ortiz-Ibarra-Castor energy model and its application to layered causal domains, is presented in a separate paper:

The Relativistic Interval Principle.

The Causal Bridge Law and Gravitational Coherence

The Causal Bridge Law: a proposed invariant relationship between energy and time across relativistically separated frames:

$$E \cdot T = h$$

Where E is the total energy of the combined system within a shared causal frame, T is the shared proper time interval over which that energy remains entangled or coherently exchanged , and h is Plank's constant.

This reframes Planck's constant as a structural constraint that governs inter-frame energy–time scaling, expanding on its understood role as the minimum unit of action.

This equation describes the last moment of synchronized causality between two structures before they cross the Jones Threshold and become mutually unobservable via electromagnetic or quantum interactions. After disconnection, this relationship no longer holds from either local frame; decoherence and redshift sever quantum coupling, and time itself proceeds independently within each new domain. Gravitational interactions, being geometric and not mediated by force carriers, may, however, continue to reflect a form of conserved influence even after causal disconnection.

Building on this, we introduce the concept of **gravitational coherence**. This term refers to the sustained gravitational relationship between systems that are no longer in causal contact through quantum or electromagnetic means, illuminating how structures like galaxies remain gravitationally bound to dark matter frameworks even after redshifted disconnection.

Gravitational Coherence: A persistent structural relationship between systems that have become causally disconnected, maintained through gravitational interaction and conserved physical invariants such as the Causal Bridge Law. Gravitational coherence contrasts with quantum coherence, which fails at the Jones Threshold, by persisting through geometric continuity and the invariance of the energy–time product.

Significance

This relationship offers a compelling explanation for how dark matter structures can continue to gravitationally influence galaxies after causal disconnection. It bridges concepts from general relativity and quantum mechanics without requiring new particles, fields, or forces. The Causal Bridge Law is proposed as a foundational structural constraint for any framework seeking to unify gravity with quantum behavior through frame-based analysis.

Gravity and the Causal Reach of Dark Matter

We propose that what is commonly referred to as dark matter is not an exotic substance, but ordinary matter that exists in a higher causal range than our own. This frame separation is not merely spatial or temporal, but structural, defined by the breakdown of causal interaction across what we call the Jones Threshold.

We further propose that gravity is distinct among the fundamental interactions in that it does not require direct quantum or electromagnetic coherence. Instead, it emerges from the geometric curvature of spacetime itself, and may remain causally effective even when all other forces fail. This property makes gravity uniquely capable of interacting across causally disconnected frames.

Recent formulation of the Causal Bridge Law, which asserts that the product of energy and time remains invariant across relativistically separated frames ($E \cdot T = h$), helps to mathematically explain this persistence. While quantum and electromagnetic interactions rely on phase coherence, gravity relies on this deeper invariance.

Observational evidence aligns with this idea. We detect strong gravitational effects, such as anomalous galactic rotation curves, gravitational lensing, and cosmic structure formation, that suggest the presence of mass we cannot otherwise detect. *This is precisely what we would expect* if matter exists beyond the Jones Threshold—causally disconnected in every respect but still gravitationally linked through $E \cdot T$ invariance.

Gravitational waves also support this perspective. Their massless propagation at c and geometric origin suggest that gravitational interaction need not be mediated by localized particles. It is continuous, even in the absence of direct signal exchange, providing a mechanism for the inter-frame gravitational influence that defines gravitational coherence.

In this model, the "dark matter" component of the cosmos may consist of structures residing in higher causal frames. From our perspective, they appear redshifted beyond quantum and electromagnetic interaction due to relativistic divergence, rather than spatial recession. Their separation reflects a difference in causal range rather than physical distance or motion through space.

From a thermodynamic standpoint, causal descent is far more probable than ascent. A structure entering a lower causal frame must lose relativistic energy—an outcome fully consistent with the second law of thermodynamics,[2] which favors entropy increase through energy dissipation. By contrast, causal ascension would require an unexplained energy input to move structures upward across the Jones Threshold. Conservation of energy also favors descent, as it involves a reduction in velocity and energy rather than a mysterious gain. Therefore, it is far more plausible that visible matter descended from a dark matter frame than that dark matter ascended from ours.

This thermodynamic flow suggests that visible structures like galaxies and stars are remnants of systems that once occupied higher causal frames.

Accordingly, dark matter may be the result of structural coherence preserved by the Causal Bridge Law. It arises naturally from the combination of relativistic geometry, causal separation, and energy–time invariance, without requiring any new particles or unknown fields.

Angular Momentum, Frame Drag Braking, and the RIP

In the model developed so far, dark matter is understood as ordinary matter residing in a higher causal frame, separated from our own frame by relativistic divergence. This divergence prevents quantum and electromagnetic interaction but leaves gravitational coherence intact.

Within this framework, we can now propose a mechanism by which galaxies reveal themselves as emergent structures shaped by angular momentum and energy redistribution across frames.

Rather than thinking of visible galaxies as primary or fundamental, we may interpret them as emerging from relativistically separated domains into a new causal range, where their energy becomes coherent with the local frame. These structures do not slow in any absolute sense, but transition into a domain where their signals–their photons, fields, and phase-based interactions– become detectable within a new frame. From the standpoint of any given observer in the new frame, this transition marks the moment when interaction becomes possible, locally, for the members of that specific relativistic domain.

This descent occurs within an environment where gravitational frame dragging is present, but resisted[6] by the surrounding (dark) matter. The inability of a rotating gravitational structure to fully impose its rotational influence on surrounding spacetime[7] may initially arise as weak coupling between frames, and may intensify as the Jones Threshold is approached. The rotational influence of a massive gravitational structure on surrounding spacetime may not manifest instantly or uniformly. Instead, it can emerge progressively, beginning as a localized perturbation and strengthening as surrounding frames adjust to the imposed angular momentum. This gradual entrainment may reflect the transition from passive spacetime curvature to a more coherent rotational regime, potentially marking the onset of large-scale frame dragging. This resistance preserves angular momentum in the descending structure, allowing it to retain spin despite energy dissipation, thereby anchoring its form within the new frame. Once the system begins to lose energy into this new frame, we can describe the redistribution using the Relative Interval Principle (RIP). The total energy of the system is not lost, but split:

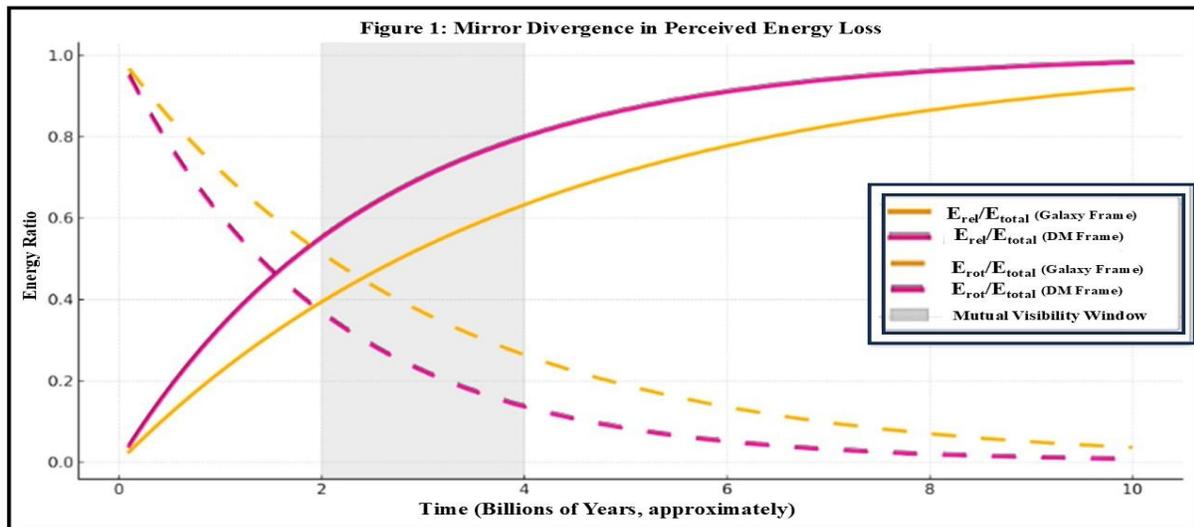$$E^2{}_{total} = E^2{}_{rot} + E^2{}_{rel}$$

This equation does not reflect the destruction of energy, but its orthogonal redistribution between the domain of rotation and the domain of relativistic descent. As rotational energy decreases, redshift and time dilation rise in correspondence, preserving the total interval.

From each frame, energy appears to be conserved—but the interpretation differs. To the dark matter frame, the descending galaxy's time accelerates and its rotation appears to slow. To the galaxy itself, rotation remains stable, but external structures fade and redshift away. Each frame interprets the energy shift through its own changing coherence. This asymmetry of interpretation is what we call *Mirror Divergence*, a relativistic illusion not unlike the familiar experience of sitting in a parked car as the vehicle next to you begins to back out, briefly creating the sensation that you yourself are moving. In the same way, as our galaxy descends into a lower causal frame, it appears instead that all others are accelerating away.

This interpretive asymmetry is visualized in **Figure 1**, which shows how each frame perceives a divergent energy distribution over time, despite total energy remaining conserved across both domains.

The RIP formulation resolves this divergence by expressing conservation across both domains simultaneously. The energy budget is not frame-dependent, but frame-structured; its distribution appears differently, depending on the observer, but the interval remains invariant.

Thus, causal descent is not a motion through space at all, but a re-expression of structure governed by the interplay between angular momentum and relativistic separation. Galaxies become visible within our frame when their descent allows their light to reach us.

Figure 1: Mirror Divergence in Perceived Energy Loss

Legend:
E_{rel}/E_{total} (Galaxy Frame)
E_{rel}/E_{total} (DM Frame)
E_{rot}/E_{total} (Galaxy Frame)
E_{rot}/E_{total} (DM Frame)
Mutual Visibility Window

Y-axis: Energy Ratio
X-axis: Time (Billions of Years, approximately)

This chart illustrates the asymmetric perception of energy ratios between the Galaxy Frame and the Dark Matter (DM) Frame over time. Solid lines represent the ratio of relativistic energy E_{rel}/E_{total}, while dashed lines represent the localized or retained energy E_{rot}/E_{total} as perceived within each frame. The shaded region marks the Mutual Visibility Window—an approximate temporal span during which both structures remain causally visible to each other. After divergence, each frame perceives the other as increasingly energy-depleted due to redshift, though **total energy is conserved across both frames** via geometric continuity in spacetime.

Mirror Divergence & the Illusion of Dark Energy

The phenomenon of asymmetric interpretation of redshift and clock rate between two causally disconnected frames, will be referred to as *Mirror Divergence*.

Mirror Divergence describes the breakdown in mutual perception that occurs when two material structures become causally separated across the Jones Threshold. Although both frames observe a redshift in the other, they interpret that redshift in fundamentally different ways due to their divergent causal contexts.

Non-gravitational forces cease to function between these frames, while gravitational influence continues, leading to the divergent redshift and clock-rate interpretations in each frame.

Frame-Dependent Redshift and Clock Rate

To better understand Mirror Divergence, we examine the perceived redshift and clock rate from both the dark matter (DM) frame and the galaxy frame as causal separation progresses (see figure 2).
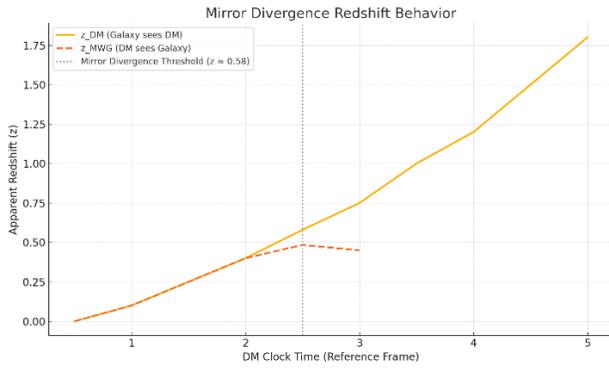

Figure 2. *Perceived Redshift Over Time.* This graph compares how redshift evolves over time as perceived from the galaxy frame (viewing dark matter) and the dark matter frame (viewing the galaxy). The asymmetric slope reflects Mirror Divergence: each frame perceives the other as redshifting, but interprets the amount and cause differently due to causal separation.

Below are the respective equations and their interpretations:

From the galaxy's frame, the dark matter (DM) structure is observed as redshifted, and its clock appears to tick more slowly. This is modeled by the equation:

$$z_{DM} = \ln(1 + t) \cdot k_1$$

$$clock_{DM} = \frac{1}{1 + z_{DM}}$$

Conversely:

From the dark matter's frame, the galaxy is *also* observed as redshifted. However, the DM frame interprets this redshift as temporal *acceleration*, an effect of the galaxy descending into a lower causal range. This is expressed as:

$$z_{\text{galaxy}} = \ln(1 + t) \cdot k_2$$

$$\text{clock}_{\text{galaxy}} = 1 + z_{\text{galaxy}}$$

Where z_{DM} is the redshift observed by the galaxy when looking at the DM, and z_{galaxy} is the redshift observed by the DM when looking at the galaxy. t is the time separation (or time since causal separation), shared as a common variable across frames. k_1 and k_2 are frame-dependent scaling constants galaxy frame, and $\text{clock}_{\text{galaxy}}$ expresses how fast the galaxy's clock appears from the DM frame.

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that determine how redshift accumulates in each frame. clock_{DM} expresses how slow the DM clock appears from the
reinforcing the directional asymmetry: the descending galaxy perceives extreme slowdown in the DM structure, while the DM sees the galaxy's clock accelerating.

If $(k_2 < k_1)$, the DM frame perceives less redshift per unit time separation than the galaxy frame does. This asymmetry reinforces the directional nature of frame descent: the descending galaxy frame sees the DM structure as deeply redshifted and temporally slowed, while the causally stable DM frame sees the galaxy's descending structure as temporally accelerating.

Although both frames *may* agree on the magnitude of the divergence (e.g., a factor of 5), they interpret its direction oppositely:

- The galaxy says: "The DM clock is slower than mine."
- The DM says: "The galaxy clock is faster than mine."

This mutual conclusion:

"One clock is faster than the other"

is not a contradiction. It is a reflection of broken causal reciprocity. Each frame centers its own clock as the baseline and interprets divergence through its own internal coherence.

Thus, Mirror Divergence is not about disagreement in measurement, but about a disagreement in the **interpretation of what redshift means**. It arises only after causal separation, where gravitational coherence persists but quantum and electromagnetic symmetry no longer apply.

In summary, while each observer perceives increasing redshift, their interpretation of the other's clock rate diverges. The DM frame sees the galaxy's clock as accelerating (see Figure 3), while the galaxy sees the DM frame's clock as slowing. This mutual misperception simulates the effect of universal acceleration, giving rise to the illusion of dark energy.
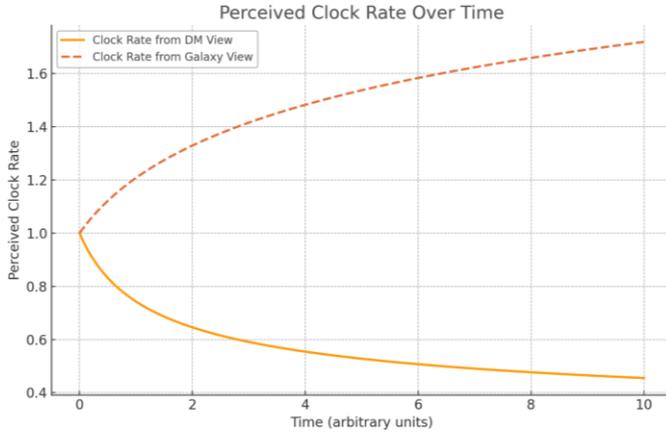
Figure 3. *Perceived Clock Rate Over Time.* This graph shows how each frame perceives the other's clock rate after causal separation. The galaxy sees the DM clock slowing, while the DM frame sees the galaxy's clock accelerating—an asymmetric effect central to the illusion of dark energy**..**

The Relative Age of the Universe

If causal frames perceive redshift and time differently, then any attempt to assign a singular "age" to the universe must be frame-relative. The canonical figure of 13.8 billion years emerges from our own frame, under the assumption of a coherent and continuous causal chain stretching backward in time. But if our frame is merely the current state of a descending causal sequence, formed by matter slowing into causal coherence, then what we interpret as a beginning may simply mark the point at which our frame became locally connected, or it may represent a deeper misunderstanding of redshift itself. In this view, 13.8 billion years may not correspond to any significant universal event.

From the causally higher frame of the dark matter structure, where time flows more slowly, our entire history might pass in what seems like a moment. From our own frame, descended into faster temporal progression, the dark matter appears frozen or ancient. Just as relativistic time dilation disrupts simultaneity, mirror divergence across causally separated frames breaks any shared sense of chronology. There is no universal clock, only local clocks ticking in sync within their own causal range.

Frame Age Equation:

We can express this relativistic age distortion using a modified logarithmic time function that reflects divergence:

$$\text{Age}_{\text{perceived, lower frame}} = \frac{ln(1+t)}{k}$$

where t is the local time in our frame and k is a scaling constant based on the degree of causal separation.

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For example, a higher frame (our local dark matter) might perceive our entire cosmic timeline as:

$$\mathbf{Age_{DM}} = \frac{ln(1+152)}{0.5} \approx \mathbf{10\ \textit{units}}$$

While from our point of view, the universe is: $\mathbf{Age_{US} = 152}$

In this example, when the Dark Matter sees the universe as 10 billion years Old, we would see it as 152 billion years old.

The asymmetry is not a contradiction it, is a matter of frame-based interpretation, shaped by relativistic redshift, perceived clock rate, and causal coherence.

Testable Predictions and Empirical Implications

1. Gravitational Lensing from Extremely Redshifted Objects

Prediction: Galaxies or structures with redshift values exceeding $z \approx 12$ will still produce strong gravitational lensing observable from our frame.

Test: Compare lensing signatures of z ~12+ objects (e.g. JADES-GS-z14-0) with the absence of corresponding visible or EM signals. If gravitational effects persist but no other forces are detectable, this supports LCH.

2. Angular Size Anomaly at High Redshift

Prediction: Objects with extremely high redshift (z > 10) may not show the angular size reduction expected from classical expansion. If redshift is due to causal frame divergence, angular size could appear larger than expected.

Test: Plot angular size vs. redshift; deviation from the ΛCDM prediction curve at high-z may indicate frame-based redshift.

3. No Detection of Quantum Coherence Across the Jones Threshold

Prediction: Quantum coherence (e.g., entanglement or phase alignment) will not persist across frame separation corresponding to $z \approx 0.58$ or velocities near 0.8c.

Test: Test long-distance entanglement over relativistic velocity separations. Loss of coherence near the Jones Threshold would confirm LCH predictions about inter-frame decoherence.

4. Asymmetry in Clock Rate Perception (Mirror Divergence)

Prediction: Observers in two causally disconnected frames will perceive opposite effects on the other's clock: one appears to slow, the other to accelerate.

Test: Analyze timekeeping in high-velocity probes or systems approaching relativistic separation. Look for asymmetries in clock drift that defy standard symmetric time dilation.

5. Cosmic Microwave Background (CMB) Reinterpretation

Prediction: CMB may show small directional anisotropies or spectral distortions correlated with known dark matter structures, as it represents energy leakage across causal frames.

Test: Cross-correlate CMB anomalies with large-scale structure maps. Consistent alignment could support causal leakage rather than Big Bang origin.

6. RIP Conservation Across Frame Descent

Prediction: Galaxies losing angular momentum will show a proportional increase in redshift or clock-rate shift, preserving the total energy interval per $E^2\_total = E^2\_rot + E^2\_rel$.

Test: Observe galaxies with declining spin; track correlated increases in external redshift or inferred temporal shift.

7. Time Perception Compression in Higher Frames

Prediction: Higher causal frames will perceive our entire cosmic history as compressed, with lower observable event complexity per unit time.

Test: Simulate observations from causally elevated frames and analyze predicted entropy growth rates or observable timeline complexity.

Conclusion

If redshift can arise from causal descent rather than spatial recession, and if dark matter and dark energy are simply the gravitational shadows of relativistically separated frames, then the universe may not be expanding at all. If, on the other hand, the universe is continuum of overlapping ranges of causal connectivity, entanglement, and coherence, then the observable cosmos becomes a relativistic lattice, and not a singular explosion. What we see as distance may be difference in frame; what we see as acceleration may be the byproduct of our own descent. In this view, the story of the universe is not one of outward flight, but of relational separation—a slow unraveling of causality itself.

The End of the Big Bang

If the Big Bang never happened as a singular event, but as a myth born of frame-limited perception, then nearly every major inference drawn from it must be reconsidered.

If there is no Big Bang…

- …then there is no universal expansion.
- …then there is no cosmic acceleration.
- …then the universe does not have a singular age.
- …then spacetime cannot expand faster than light, only appear to do so across disconnected causal domains.
- …then warp drives are likely impossible, because space cannot be manipulated to exceed light speed, even "indirectly."
- …then dark energy is not a force, but a misreading of frame divergence.
- …then the cosmic microwave background is not the afterglow of a singular origin, but the accumulated leakage of uncertainty and residual energy across infinite causal ranges; scraps of interaction from an unknowable and possibly infinite past.
- …then we must reimagine the entire visible cosmos not as the origin, but as a structured expression of something larger, faster, and more causally distant.

References

1. Ortiz, C., & Ibarra-Castor, F. (2024). *Generalized redshift formula through an energy-based framework*. Scientific Reports. https://doi.org/10.1038/s41598-024-56188-1

2. Gray, N., & Dunning-Davies, J. (2008). *Entropy and velocity: A reconsideration*. arXiv preprint arXiv:0811.2541.

3. Vagnozzi, S. (2024). *Reinterpreting cosmic redshift in modified frameworks*. arXiv:2407.10622.

4. Einstein, A. (1905). *Zur Elektrodynamik bewegter Körper*. Annalen der Physik, 17, 891–921. [Special Relativity]

5. Planck, M. (1901). *On the Law of Distribution of Energy in the Normal Spectrum*. Annalen der Physik.

6. Lense, J., & Thirring, H. (1918). *On the influence of the proper rotation of central bodies on the motion of planets and moons according to Einstein's theory of gravitation*. Physikalische Zeitschrift, 19, 156–163.

7. Kerr, R. P. (1963). *Gravitational field of a spinning mass as an example of algebraically special metrics*. Physical Review Letters, 11(5), 237–238.

Appendix:
Milky Way vs. Dark Matter Simulation

This appendix presents a stepwise simulation of causal divergence between the Milky Way Galaxy (MWG) and its surrounding Dark Matter (DM) structure, modeled from first principles (wherever possible) and available theoretical data, using inertial-frame redshift behavior, time dilation, and relativistic causality.

The Dark Matter frame is treated as a linear reference clock, while the Milky Way frame accelerates due to causal descent. At each step, the galaxy perceives increasing redshift in the DM frame, while the DM's ability to observe the galaxy gradually degrades, culminating in the loss of electromagnetic coherence at the Mirror Divergence threshold ($z \approx 0.58$).

This model:

- Uses redshift thresholds (e.g., hydrogen at $z \approx 0.58$) to define physical events like spectral loss, coherence failure, and gravitational-only visibility.
- Calculates each step's galaxy clock rate from $\textbf{rate} = \frac{1}{1+z}$
- Applies the energy-time constraint $\textbf{\textit{E·T=h}}$ to support asymmetrical perception.
- Demonstrates that non-gravitational disconnection could occur within ~**8 Gyr** of DM clock time, well within the expected lifespan of the Milky Way.

Limitations:

- This model is a relativistic simulation, not a fit to observed galactic data.
- Time intervals are illustrative, not derived from astrophysical timescales.
- The galaxy's acceleration curve is idealized; real acceleration would vary due to complex gravitational and frame-drag interactions.

Despite these simplifications, the simulation illustrates that relativistic frame divergence alone may account for many of the effects traditionally attributed to dark matter and dark energy. These include observed phenomena such as redshift and coherence loss, as well as theoretical implications like asymmetric timeflow between diverging frames. By modeling these consequences, the simulation demonstrates how a layered relativistic framework can reinterpret the cosmic acceleration and signal dimming typically ascribed to expansion-based models.

Step	DM Clock	MWG Clock	ΔT_{MWG} per Step	z_{DM} (MWG view)	z_{MWG} (DM's view)	Notes
1	0.5	0.5	0.5	0	0	Initial Coherence
2	1	1.05	0.55	0.1	0.1	Photon Delay Noticed
3	1.5	1.675	0.625	0.25	0.25	Visible Redshifting Starts
4	2	2.375	0.7	0.4	0.4	Spectral Coherence Weakens
5	2.5	3.165	0.79	0.58	0.484	Hydrogen Disconnection (Lyman-α)
6	3	4.04	0.875	0.75	0.45	Strong Signal Degradation
7	3.5	5.04	1	1	incoherent	Full EM Decoherence
8	4	6.14	1.1	1.2	incoherent	Quantum Entanglement Loss
9	4.5	7.39	1.25	1.5	incoherent	Only Gravitational Lensing Remains
10	5	8.79	1.4	1.8	incoherent	Only Gravitational Lensing Remains