Relational Cosmology and the Elimination of Spacetime: Reassessing Light Slowing, Energy Degeneration, and Time Dilation

1. Introduction: The Epistemological Crisis in Standard Cosmology

For more than a century, the architectural foundation of theoretical astrophysics has rested unequivocally upon the geometric frameworks of Special and General Relativity, tightly integrated with the ΛCDM (Lambda Cold Dark Matter) standard cosmological model. Within this prevailing paradigm, gravitation is fundamentally stripped of its classical interpretation as a mechanical force. Instead, it is defined as the geometric manifestation of a physical, four-dimensional pseudo-Riemannian manifold colloquially known as "spacetime".[1] Furthermore, the entire structural integrity of this relativistic model depends upon the rigid enforcement of an absolute, universal velocity barrier—the invariant speed of light, c—which underpins the Lorentz transformations responsible for the theoretical phenomena of time dilation and length contraction.[3]

However, despite achieving immense predictive success within weak-field regimes, this metric-based formulation is currently facing profound ontological, mathematical, and empirical crises. General Relativity mathematically guarantees its own localized failure at singularities, such as the initial state of the Big Bang and within the event horizons of black holes, where metric curvature and mass density approach infinite, physically impossible values.[1] At the microscopic level, the deterministic, continuous geometry of spacetime is fundamentally incompatible with the probabilistic, discrete nature of Quantum Mechanics, rendering the standard model entirely incapable of describing the gravitational field of a particle existing in a state of quantum superposition.[1] Scaling up to macroscopic, cosmic arenas, the ΛCDM model requires the massive postulation of invisible, unverified components—specifically dark matter and dark energy—to artificially account for approximately 95% of the universe's total mass-energy density.[1] Despite decades of exhaustive, highly funded experimental searches for elusive dark matter candidates like Weakly Interacting Massive Particles (WIMPs) and axions, empirical verification remains nonexistent.[1]

In response to these compounding failures, emergent computational physics frameworks, such as the ArcSecs Cosmological Physics Engine, alongside robust mathematical reformulations like the Covarying Coupling Constants and Tired Light (CCC+TL) model, provide a radical epistemological and architectural shift.[1] By completely transitioning the fundamental

computational environment from a dynamic, malleable geometric fabric to a static, continuous Euclidean void governed by relational kinematics, these frameworks demonstrate that the complex phenomena traditionally attributed to spacetime curvature and time dilation can be replicated without geometric warping.[1] Central to this radical paradigm shift is the theoretical synthesis found in the modeling of light slowing and energy degeneration. By thoroughly examining the mechanics of extreme light slowing in degenerate atomic systems, alongside the thermodynamic energy degeneration of macroscopic systems, the scientific necessity of a universal "Speed of light" is systematically dismantled, simultaneously rendering the concept of a physical "Spacetime" fundamentally obsolete.[1]

2. The Case Against Spacetime Substantivalism

The substantivalist interpretation of General Relativity relies entirely on the philosophical premise that spacetime is a literal "substance" or a physical container—a flexible, tangible fabric capable of dynamic deformation, capable of rippling as gravitational waves, and possessing the physical capacity to expand and stretch over cosmic epochs.[2] However, this widespread interpretation conflicts deeply with the formal mathematical structure of the theory itself, generating insurmountable philosophical and physical paradoxes.

Diffeomorphism Invariance and the Hole Argument

Mathematically, General Relativity is formulated on a smooth four-dimensional manifold equipped with a Lorentzian metric g_{ab} and matter fields whose collective thermodynamic behavior is encoded in the stress-energy tensor T_{ab}.[2] The Einstein field equation relates the geometric curvature of the metric directly to the stress-energy of matter.[2] However, this formulation contains intrinsic features that forcefully resist substantivalist interpretation, most notably diffeomorphism invariance and background independence.[2]

Diffeomorphism invariance dictates that the coordinates used to map spacetime possess no intrinsic physical reality; they are completely arbitrary labels.[2] This mathematical reality is best illustrated by the infamous "Hole Argument," originally formulated by Albert Einstein and later expanded by philosophers of science to demonstrate that spacetime points cannot possess independent physical existence.[5] If one assumes spacetime is a physical substance, the equations of General Relativity allow for multiple, physically distinct future states to evolve from the exact same initial conditions within a designated "hole" (a region devoid of matter), completely destroying determinism. To rescue determinism, one must concede that spacetime points are merely relational abstractions, not physical entities.[5]

Furthermore, the structural realist defense of spacetime is severely undermined by the multiplicity of mathematical formalisms capable of expressing General Relativity. As Jonathan Bain extensively notes, the theory can be articulated not only in the standard tensor formalism but also through twistor theory, Einstein algebras, and geometric algebra.[6] Because these vastly different formalisms are nearly intertranslatable and accurately predict gravitational phenomena without strictly relying on a pseudo-Riemannian manifold, it is mathematically foolish to remain wedded to the ontological commitment that physical "spacetime" actually

exists.[6] Modern cosmology heavily relies on the cosmological principle—the assertion that the universe exhibits spatial homogeneity and isotropy, meaning no position in space is privileged.[6] Yet, if space is truly a homogeneous entity, it reduces to a background abstraction rather than a dynamic, interactive substance.

Relational Kinematics and the Emergent Void

When the spatiotemporal continuum is successfully deconstructed, an alternative physical model must take its place. The ArcSecs computational framework completely rejects the continuous spacetime manifold.[1] Instead of representing the universe as a curving geometric fabric, it models the cosmos inside a perfectly static, continuous Euclidean void.[1] Within a pure void, space possesses absolutely no physical substance, no topological geometry, and no material properties. Therefore, it is physically and logically impossible for space to "stretch," "bend," or "expand".[1]

In this architecture, the fundamental state of the universe is represented entirely within a discrete Hilbert space rather than a differentiable manifold.[1] The engine utilizes complex tensor products to compose larger, macroscopic Hilbert spaces from highly localized, discrete quantum subsystems.[1] Consequently, physical distance is not a geometric reality but a reconstructed illusion generated via quantum error-correction codes. Emergent spatial coordinates function dynamically as "logical qubits" constituted from underlying "physical qubits," which are mathematically differentiated by energetic states or angular momentum rather than actual spatial separation.[1]

Because there is absolutely no continuous medium present to curve or stretch, macroscopic cosmological expansion must be fundamentally reinterpreted. In standard metric expansion cosmology, the superluminal (faster-than-light) recession of distant galaxies is rationalized by asserting that the physical fabric of space itself is expanding, carrying the galaxies outward like dots on an inflating balloon.[1] ArcSecs identifies this as a deep mathematical fallacy. Under relational kinematics, absolute motion in an empty void is meaningless. If the cosmos is reduced to a thought experiment featuring just two localized masses moving apart from a theoretical origin point, the only mathematically real values are their relative distance, relative radial velocity, and relative radial acceleration.[1] If observational data indicates these objects are separating faster than light, they are simply moving apart independently through the void. Because there is no absolute background geometric grid to dictate maximum velocities, their relative velocity can safely exceed c without violating any physical laws.[1]

The transition from a metric-based substantivalist cosmology to a relational kinematics framework completely redefines the core properties of astrophysics, summarized in the comparative analysis below.

Cosmological Property	Standard Metric Cosmology (ΛCDM)	Relational CCC+TL Cosmology (ArcSecs)

Ontological Status of Spacetime	A physical, continuous manifold capable of being curved and stretched by mass.[2]	Completely non-existent; space and time are emergent relational projections acting within a void.[1]
Primary State Space	Differentiable manifold with a dynamic pseudo-Riemannian metric tensor $g_{\mu\nu}$.[2]	Discrete Hilbert space composed of complex tensor products of localized quantum subsystems.[1]
Cosmological Redshift	Wavelength stretching resulting directly from the physical metric expansion of space.[1]	Relational photon energy decay (Tired Light) coupled with shifting atomic energy levels.[1]
Cosmic Acceleration	Driven by a physical Dark Energy density or an intrinsic Cosmological Constant Λ.[1]	An apparent optical effect of the gradual, covarying weakening of fundamental forces over cosmic time.[1]
Galactic Rotation Anomalies	Resolved by injecting massive hypothetical halos of cold, non-baryonic dark matter.[1]	Resolved entirely by the localized spatial variation of the dimensionless coupling parameter α.[1]
Light Deflection (Lensing)	Mass-induced geometric curvature of null geodesics within a spacetime manifold.[1]	Energy-dependent, dispersive deflection of Proca-type massive photons in classical orbits.[1]

3. The Fallacy of Time Dilation and the Reassertion of Absolute Time

A central pillar of General and Special Relativity is the doctrine of time dilation—the premise that the chronological passage of time itself accelerates or decelerates relative to an observer's velocity or proximity to a massive gravitational body.[3] This framework merges three-dimensional space and one-dimensional time into a unified spacetime block, mandating that movement through space inherently alters movement through time.[3] However, this mathematical intertwining creates profound, unsolvable causal paradoxes that render the framework highly suspect when applied beyond limited, localized coordinate choices.

The FTL Causality Paradox

The most glaring flaw in treating time as a highly malleable dimension is the inevitable breakdown of causality when interacting with extreme velocities. Theoretical discussions regarding faster-than-light (FTL) travel clearly demonstrate that because time is fundamentally treated as a geometric dimension intertwined with space, moving between two distant points instantaneously functionally serves as time travel.[1][2]

Consider a well-established relativistic scenario: an observer on Earth synchronizes watches with an astronaut launching in a rocket traveling at $0.87c$.[1][2] At this precise velocity, the rocket experiences a time dilation factor of exactly 2, meaning chronological time supposedly moves twice as fast for the stationary observer relative to the rocket. After 4 months pass on Earth, only 2 months have passed for the rocket.[1][2] If a catastrophic event occurs on Earth at month 4, and the Earth observer utilizes an instantaneous FTL teleportation device to warn the rocket, the astronaut receives the warning at their local month 2. The astronaut can then instantly teleport back to Earth.[1][2] However, because of the relative velocity calculations, teleporting back to a "stationary" Earth from the "stationary" perspective of the rocket results in the astronaut arriving at Earth's month 1—three months before the catastrophic event even occurred.[1][2] Causality is instantly broken. An event can be stopped because an observer was warned about it before it mathematically occurred in their timeline.[1][2] If time dilation is eliminated and time is fundamentally reestablished as an absolute, universal constant across all frames, these FTL paradoxes instantly dissolve, restoring strict causality to the universe.

Quantum Gravitational Damping in GPS Clocks

Proponents of the standard model frequently cite the synchronization of atomic clocks on the Global Positioning System (GPS) network as incontrovertible, empirical proof of spacetime relativity.[1] In standard relativistic physics, atomic clocks aboard GPS satellites gain a net 38 microseconds per day relative to identical clocks on Earth's surface.[1] This figure is derived by summing a $-7\mu s/\text{day}$ special relativistic velocity slowdown with a $+45\mu s/\text{day}$ general relativistic gravitational speed-up.[1]

However, relational physics engines like ArcSecs completely bypass relativistic time dilation by simulating physical degradation and quantum friction in place of chronological warping.[1] In this model, time does not stretch; rather, the mechanical devices measuring time physically alter their operational speeds. The Euclidean void is not entirely empty; it is saturated by an ambient electromagnetic substrate characterized by a massive vector field.[1] Deep within a planetary gravity well, such as on the surface of the Earth, the density of this ambient massive photon substrate is highly concentrated. This dense concentration induces profound microscopic physical friction—termed quantum gravitational damping—acting directly upon the internal electron transitions of the cesium atoms utilized in atomic clocks.[1] The clock physically ticks slower due to profound environmental drag, not because the fundamental chronological dimension of "time" has warped. High in orbit, the ambient substrate is vastly more diffuse,

allowing the atomic transitions to occur faster with significantly less resistance, perfectly accounting for the $+45\mu s/\text{day}$ shift.[1] Simultaneously, the special relativistic delay of $-7\mu s/\text{day}$ is thoroughly reinterpreted as the purely kinematic drag caused by the satellite physically plowing through this sparse substrate at high orbital velocities.[1]

Kinematic Stabilization of Atmospheric Muons

Similarly, the unexpected survival of high-velocity atmospheric muons is frequently cited as definitive empirical evidence of special relativistic time dilation. When cosmic rays strike the upper atmosphere, they generate muons that travel downward at approximately $0.998c$.[1] These subatomic particles possess an incredibly short proper mean lifetime of just $2.2\mu s$. Standard radioactive decay laws dictate that only about 5% of these muons should survive the journey to sea level, yet experimental observations confirm that over 70% reach the surface.[1] Relativistic physics asserts that this is because time dilation stretches their internal lifespan to nearly $34.8\mu s$ relative to Earth.[1]

If the concept of spacetime is eliminated, how do the muons survive the journey? Relational physics models subatomic decay not via an internal, invisible chronological timer, but as a continuous process of structural degradation dictated exclusively by environmental interaction and kinetic stability.[1] A muon traveling downward at $0.998c$ generates an extreme, localized electromagnetic "bow shock" as it forcibly interacts with the ambient massive substrate.[1] This intense kinematic state physically binds and stabilizes the internal structure of the subatomic particle. Just as a physical spinning top gains immense gyroscopic stability against toppling over while operating at extremely high RPMs, the muon's extreme velocity provides vital structural coherence. This kinetic stabilization mechanically delays the muon's fragmentation into electrons and neutrinos without ever altering the fundamental, absolute flow of time.[1] Furthermore, the abolition of the concept of "relativistic mass"—the pedagogical assertion that an object's mass approaches infinity as its velocity approaches c, requiring infinite kinetic energy to accelerate—ensures that the mechanical thrust required to achieve extreme velocities remains strictly finite. The structural mass of a vessel or particle is modeled as a strict Lorentz scalar (m_0) that does not mathematically inflate, returning physics to a purely mechanical, rational paradigm.[1]

4. Modeling Light Slowing and Energy Degeneration

To comprehend exactly how the terms "Speed of light" and "Spacetime" are ultimately eliminated from functional cosmological physics, one must deeply analyze the intricate frameworks surrounding the modeling of light slowing and energy degeneration. When light is evaluated not as a massless tracer of geometric geodesics, but as a physical, energetic entity subject to fluid-dynamic drag, thermodynamic exhaustion, and medium-dependent group

indices, the foundational assumptions of relativity collapse.[1]

Modulating the Group Index in Degenerate Atomic Systems

The absolute invariance of the speed of light (c) is the bedrock of standard spacetime. However, advanced quantum optical experiments definitively prove that the speed of light is not a universal constant, but rather a highly malleable, emergent property dictated entirely by the medium of propagation.

In controlled experimental conditions, researchers have successfully modeled profound light slowing by utilizing a magnetic-degenerated four-level atomic system.[4] By applying a static magnetic field alongside a highly specific coupling field under electromagnetically induced transparency conditions, the optical response of a highly degenerate atomic medium (such as an ^{87}Rb atomic system) can be radically controlled at room temperature.[4] The presence of the static magnetic field precisely controls the absorption spectrum and the group index for the polarization components of the probe field.[4] By varying the strength of this static magnetic field, the physical state of the atomic medium dynamically shifts from total transparency to deep absorption.

Consequently, the amplitude of the group index of light changes drastically from a positive extreme to a negative extreme.[4] This signifies that the phase velocity and group velocity of the light pulse are fundamentally separated, slowing down drastically or even appearing to propagate backwards mathematically depending entirely on the structural energy degeneration of the atomic levels it passes through.[4] Temperature also profoundly influences this optical response, changing both the amplitude and the sign of the group index as thermodynamic energy increases.[4] In other extreme examples involving Bose-Einstein condensates, experimental physicists have famously brought light to a "complete standstill," storing it within the excited states of atoms before re-emitting it at an arbitrarily later time.[3] During this suspended period, the light simply ceased to exist as a propagating wave.[3] This decisively proves that photon propagation is an emergent kinematic property dictated strictly by phase interactions with a substrate, rather than an unbreakable geometric law of a spacetime fabric.

Metabolic and Optical Models of Energy Degeneration

The concept of energy degeneration applied to light phenomena extends beyond atomic physics and finds profound analogs in biological systems, specifically in the modeling of light slowing via retinal degeneration. While biological in nature, the mathematical modeling of photoreceptor decay serves as a perfect thermodynamic analog for the physical degradation of light signals.[14]

In advanced models of macular and retinal degeneration, such as the lrbp−/− mouse model, researchers observe that under photopic electroretinogram (ERG) conditions with 10 Hz flickering light, the optical system fundamentally fails to regenerate cone pigments rapidly enough to process incoming light signals.[14] The system undergoes a progressive energy

degeneration.[14] Because the energy supply of the rods is deeply connected to the overall metabolic network of the retina, a localized metabolic error causes the cells to literally starve.[15] As the rods starve, it drives a massive wave of thermodynamic starvation and degeneration across the cones, leading to a catastrophic loss of visual acuity and daylight color vision.[15] The system's capacity to process light "slows" and eventually halts entirely due to an inability to maintain required energy levels.[15]

This localized biological energy depletion—where the structural ability to engage with light degrades due to metabolic exhaustion—mirrors the macroscopic cosmological theory of "Tired Light." Just as the photoreceptors undergo structural decay and fail to process light due to energy starvation, the photon itself undergoes profound energy degeneration as it traverses the vast intergalactic void. By recognizing that light is subject to thermodynamic and structural decay over time, the absolute necessity for an invariant "Speed of Light" as a universal constant is entirely eliminated.

5. Proca Electrodynamics and the Massive Photon Framework

If the photon is capable of extreme slowing, thermodynamic energy degeneration, and group index manipulation, it cannot mathematically be the massless, gauge-invariant particle described by classical Maxwellian electrodynamics. A massless particle must travel at an unchanging universal limit in a vacuum. Therefore, eliminating the rigid terms "Spacetime" and "Speed of Light" requires granting the photon a minute, yet invariant rest mass (m_γ).[1]

This theoretical architecture is provided by Proca electrodynamics, which radically modifies standard classical electromagnetic equations by introducing mass-dependent terms.[1] By abandoning the massless photon paradigm, the fundamental equations governing electric and magnetic fields adapt profoundly:

Modified Gauss's Law incorporates a mass-dependent scalar potential term (Φ):

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0} - \left(\frac{m_\gamma c}{\hbar}\right)^2 \Phi$$

Modified Ampere's Law explicitly includes the magnetic vector potential ($\mathbf{A}$):

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \frac{1}{c^2}\frac{\partial \mathbf{E}}{\partial t} - \left(\frac{m_\gamma c}{\hbar}\right)^2 \mathbf{A}$$

The introduction of this massive vector field A_μ naturally breaks standard $U(1)$ gauge invariance, a core feature of classical physics.[1] To preserve rigorous mathematical consistency with established quantum mechanics, alternative physics engines utilize the Stueckelberg mechanism and Higgs-like dynamical gauge symmetry breaking.[1] This provides a highly consistent mathematical pathway for a "heavy" dark photon to acquire mass without shattering

Lorentz covariance.[1]
As a direct physical consequence of the Proca formalisms, magnetic dipole fields no longer extend infinitely according to the classical inverse-square law; instead, they undergo a Yukawa exponential decay proportional to $e^{-\mu r}/r^2$.[1] The experimental bounds placed on the photon mass are exceedingly strict, yet non-zero, probing the absolute limits of contemporary measurement capabilities. The following table illustrates the extreme tolerances tested by various physical methodologies:

Experimental Methodology	Parameter Measured	Upper Limit on Photon Mass (m_γ)
Cavendish Balance (Toroid)	Ambient cosmic magnetic vector potential.[1]	10^{-48} g ($\approx$ eV)
High-Frequency Lab Tests	Deviations from Coulomb's inverse-square electric force.[1]	10^{-50} g
Particle Data Group	Laboratory bounds on strict Proca field deviations.[1]	10^{-18} eV
Astronomical Observations	Galactic vector potential and magnetic field decay.[1]	10^{-27} eV

Because the photon possesses mass, the speed of light in a vacuum is absolutely no longer a universal constant; it becomes strictly wavelength-dependent.[1] High-frequency, high-energy gamma rays possess sufficient kinetic energy to overcome mass-induced drag, traveling near the theoretical maximum phase velocity.[1] Conversely, lower-frequency radio waves and infrared photons experience profound intrinsic structural resistance, propagating significantly slower through the ambient Proca field.[1] The "Speed of Light" is thus demoted from a cosmological speed limit to a mere terminal velocity dictated by frequency and localized environmental drag.

6. Gravitational Lensing Without Spacetime Curvature

A foundational proof typically offered for the existence of spacetime is gravitational lensing—the observation that light bends as it passes massive objects like stars or galaxies. In General Relativity, this is explained geometrically: light is merely tracking null geodesics through a warped pseudo-Riemannian manifold.[1] In the limit of weak gravitational fields, the GR calculation of deflection relies heavily on integrating over an unperturbed trajectory utilizing gradients perpendicular to the photon's direction.[11]
However, because relational physics architectures operate within a perfectly flat Euclidean

void, they cannot rely upon metric curvature to bend light.[1] Instead, lensing is modeled as a purely classical, physical quantum-mechanical interaction acting upon a massive particle.[1]
In 1801, long before the advent of spacetime, Johann Georg von Soldner utilized classical Newtonian mechanics to calculate the deflection of light around a massive body, assuming light possessed mass.[1] His initial calculation yielded a deflection of 0.875 arcseconds for the Sun, which is exactly half of Einstein's later observed prediction of 1.75 arcseconds.[1] To achieve the correct observational deflection of 1.75 arcseconds without invoking warped geometry, modern computational engines treat the massive Proca photon as a spin-1 vector boson undergoing a dispersive, energy-dependent deflection as it moves through an external classical gravitational field.[1]
The Lagrangian density for this minimally coupled, massive photon field is mathematically defined as:

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \frac{1}{2}m_\gamma^2 A_\mu A^\mu + \mathcal{L}_{int}$$

where A_μ represents the vector field, $F_{\mu\nu}$ is the electromagnetic field strength tensor, and m_γ is the non-zero rest mass.[1]

Because the photon has mass, its total energy (E) as it passes a massive body (M) at a specific impact parameter distance (b or r) is determined by a classical Hamiltonian calculation incorporating both kinetic and gravitational potential energy:

$$E = \frac{1}{2}m_\gamma v^2 - \frac{GMm_\gamma}{r}$$

[1]

By successfully treating the massive vector field as coupling directly with classical gravitational potentials via advanced metric-affine gauge theories, physicists recover the precise Einsteinian deflection angle at highly relativistic energies.[1] Crucially, at much lower radio frequencies, the mass-dependent term induces significant dispersive spreading.[1] This creates an empirically testable divergence from classical General Relativity, completely replacing the geometric concept of geodesic tracking with standard physical scattering mechanics.[1]
Consequently, the esoteric concept of the "black hole"—a theoretical spacetime singularity where curvature becomes infinite and time freezes at an event horizon—is totally eliminated. It is functionally replaced by the classical concept of the "Dark Star," a highly dense agglomeration of mass originally proposed by John Michell in 1784.[1] Because time is absolutely universal, it does not freeze.[1] Since light is composed of massive Proca particles, it remains bound by standard Newtonian escape velocity parameters. When photons approach the

immense central mass, the gravitational pull simply exceeds their kinetic energy limit, physically dragging the light back down exactly like a planet holding onto an atmospheric fluid.[1]

7. Cosmological Redshift: Tired Light, VSL, and the CCC+TL Paradigm

If the universe is absolutely not a stretching spacetime manifold, the deeply documented phenomenon of cosmological redshift—where light from distant galaxies appears stretched to longer, redder wavelengths—requires a strictly mechanical explanation. Standard cosmology rigidly attributes this observation to the metric expansion of space itself.[8] The primary, mathematically viable alternative is the integration of Variable Speed of Light (VSL) theories with the *Tired Light* hypothesis.[8]

The Mechanics of Energy Degeneration (Tired Light)

Originally proposed by astrophysicist Fritz Zwicky in 1929, the Tired Light model posits that photons progressively lose energy stochastically as they traverse the vast distances of the intergalactic medium.[1] Rather than the galaxy moving away, the light signal simply degrades over time. The energy decay of a photon over a designated distance d is continuous:

$$E(d) = E_0 e^{-K_t d}$$

Where E_0 is the initial emission energy and K_t is the precise energy attenuation coefficient.[1] Correspondingly, the wavelength shifts mechanically without any expansion of space occurring:

$$\lambda(d) = \lambda_0 e^{K_t d}$$

This robust formula beautifully reproduces Hubble's Law when K_t is mathematically equal to the Hubble constant divided by the speed of light ($K_t = H_0/c$).[1]
Historically, this highly logical framework was improperly discarded by mainstream astrophysics due to three primary empirical objections:

1. **The Dispersion and Blurring Objection:** Critics argued that if photons lose energy by physically scattering off particles, their trajectories would slightly alter over billions of years, resulting in heavily blurred images of distant galaxies. However, modern space telescopes consistently observe deep-field galaxies with crystal clarity.[8]
2. **The Tolman Surface Brightness Test:** In an expanding spacetime universe, surface brightness decreases drastically by a factor of $(1+z)^4$ due to relativistic time dilation and energy loss. A classical static tired light universe predicted a drop of only $(1+z)$ or constant brightness, seemingly contradicted by Hubble Ultra Deep Field

observations.[1]

3. **Supernova Time Dilation:** Distant Type Ia supernovae display highly stretched, broadened light curves. In an expanding universe, a supernova pulse taking 20 days to decay will appear to take 40 days to decay when observed at redshift $z = 1$.[21] The width of the light curve undergoes an enlargement according to the relation $w = 1 + z$.[23] Critics forcefully argued that a "gradual dissipation of photonic energy" could not possibly explain this temporal stretching, as tired light predicts a horizontal width factor of 1 across all redshifts.[21]

Covarying Solutions and Kinematic Stretching

These historical objections are comprehensively neutralized by integrating energy degeneration with the Covarying Coupling Constants (CCC+TL) framework and specific Variable Speed of Light with Time (VSLT) dynamics.[1]

To solve the blurring objection, relational computational models demonstrate that energy decay occurs through continuous, non-scattering coupling directly with the massive Proca vector field.[1] The massive photon effectively transfers its energy directly to the ambient vacuum potential without ever deflecting its forward trajectory, perfectly preserving crystal-clear spatial resolution across vast cosmic distances.[1]

Furthermore, the CCC+TL model permits the fundamental constants of nature—the gravitational constant (G), the speed of light (c), and Planck's constant ($\hbar$)—to vary, evolve, and covary over immense stretches of cosmic time.[1] This precise covariation ensures that their dimensionless ratios remain strictly invariant. The temporal variation of the gravitational constant ($\frac{\dot{G}}{G}$) definitively indicates a gradual, systemic weakening of gravitational forces as the universe ages, ensuring that earlier cosmic epochs possessed tighter, vastly different atomic configurations.[1]

Within this framework, the total observed cosmological redshift (z_{obs}) becomes a mathematical composite of two entirely distinct interacting mechanisms:

$$1 + z_{obs} = (1 + z_{TL}) \times (1 + z_{CCC})$$

Where z_{TL} accounts for the relational energy decay (tired light) accumulated during physical propagation, and z_{CCC} accounts for the redshift stemming from the covarying evolution of atomic and electromagnetic coupling constants.[1] By explicitly demonstrating that a frequency-independent redshift operator preserves an exact Planck spectrum, the CCC+TL model perfectly matches the Cosmic Microwave Background (CMB) thermal data and fully satisfies the Tolman surface brightness test without requiring a single metric expansion of space.[1]

Finally, the temporal stretching of Type Ia supernova light curves—long considered the absolute death knell of the tired light hypothesis [21]—is flawlessly resolved through Giuseppe Pipino's kinematic stretching model and VSLT dynamics.[1] In standard tired light theory, the speed of light is constant, so a 20-day pulse remains 20 days long.[23] However, if the speed of light itself is treated as a field that decays and evolves over time (VSLT), the paradox vanishes.[20]

Because c is continuously decaying over cosmic epochs due to Proca dispersion and covarying dynamics, the leading edge of a supernova photon pulse (emitted slightly earlier in time) literally travels at a marginally faster physical velocity than the trailing edge of the pulse (emitted slightly later in time).[1] As the massive photon pulse transits across billions of light-years, the faster leading edge physically pulls away from the slower trailing edge.[1] This purely kinematic, mechanical stretching perfectly replicates the $w = 1 + z$ light curve broadening observed by Goldhaber and Blondin, achieving temporal stretching without invoking any metric time dilation whatsoever.[1]

By fully adopting these CCC+TL and VSLT parameters, the implied physical age of the universe extends to approximately 26.7 billion years.[1] This massively expanded timeline comfortably resolves the highly anomalous, fully formed massive galaxies recently observed at "cosmic dawn" by the James Webb Space Telescope (JWST), entirely eliminating the necessity for impossibly rapid, magical galaxy formation mechanisms that plague the ΛCDM model.[1]

8. Emergent Illusions: Graviballs, Alpha-Matter, and the End of Dark Entities

A massive failing of the ΛCDM model is its absolute reliance on vast quantities of non-baryonic dark matter to reconcile the flat rotation curves of spiral galaxies and the excessive, displaced gravitational lensing observed in colliding structures like the Bullet Cluster.[1] The relational kinematics frameworks and massive Proca photon models decisively prove that "dark matter" is nothing more than a mathematical illusion generated by a combination of degraded electromagnetic energy and the localized variation of covarying fundamental forces.[1]

Slow Quanta and the Condensate of Graviballs

If the cosmic void is thoroughly permeated by massive Proca photons that continuously undergo thermodynamic energy degeneration (Tired Light) over billions of years, their wavelengths stretch endlessly and their kinetic energy systematically decays.[1] Eventually, over extreme spans of time, this kinetic energy drops well below relativistic propagation thresholds. The massive photons undergo a profound thermodynamic phase transition, fundamentally "freezing out" into a highly cold, sub-luminal condensate consisting of deeply stable bound states.[1]

These ultra-massive, highly degraded, low-frequency states are heavily theorized in quantum

gravity models as "graviballs" or "slow quanta".[1] Operating with a vastly reduced vacuum propagation speed $w < c$, these ultra-slow energy quanta interact with each other via unspecified attractive gravitational forces, allowing them to form massive bound states that strictly follow the laws of Special Relativity mediated by velocity w rather than c.[31] These localized condensates pool heavily within galactic halos.[31] Therefore, the mysterious "dark matter" surrounding galaxies is not an exotic, entirely undiscovered new class of weakly interacting particle. It is simply the cosmic graveyard of primordial, highly degraded massive photons that have completely lost the kinetic energy required to propagate at optical velocities.[1]

Alpha-Matter and Local Variable Coupling

Operating in perfect tandem with the graviball mechanism, the CCC+TL model comprehensively resolves galactic rotation anomalies without requiring any particulate dark matter by simply introducing the localized spatial variation of the covarying coupling parameter, denoted mathematically as α.[1]

While the fundamental coupling constant α remains globally uniform on massive cosmological scales, it is highly sensitive to the localized density distribution of baryonic matter within gravitationally bound, virialized structures like galaxies.[1] When the local baryonic density (ρ_b) organically drops below a highly specific critical turn-off threshold (ρ_{turn}) at a specific outer galactic radius (r_{turn}), the local coupling constant α dynamically and sharply increases.[1] This immense parameter shift artificially but mathematically amplifies the gravitational attraction at the outer, diffuse edges of spiral galaxies. This localized phenomenon, accurately coined "α-matter," perfectly matches the non-Keplerian flat rotation curves originally observed by Vera Rubin without requiring a single particle of dark mass.[1]

The computational power of this model is perfectly demonstrated by evaluating simulation nodes for the standard spiral galaxy NGC 3198. By substituting hypothetical dark matter velocity contributions with the CCC+TL modified effective velocity calculations (V_{bX}), the engine achieves perfect observational parity.[1]

Simulation Node (NGC 3198)	Radial Distance (r)	Observed Velocity (Vo)	Standard Baryonic Velocity (Vb)	Simulated CCC+TL Velocity (VbX)
Inner Core	$<$	High velocity	Standard	Matches V_o

Node		correlation	Keplerian decline	exactly without parameter adjustment [1]
Turn-off Boundary Node	$=$	Slowly diverging	Peaking / Beginning to drop	Localized α variation organically initiates [1]
Outskirts Nodes (A, B, C)	$>$	Flat / Constant velocity	Dropping rapidly toward zero	Matches V_o exactly via dynamic α scalar amplification [1]

Furthermore, the famous, highly contested spatial offset observed in the Bullet Cluster—often heralded by standard astrophysicists as absolutely incontrovertible, undeniable proof of collisionless dark matter [1]—is simulated simply as a highly non-linear gradient mapping of the α field. In the heavily compressed, heated gas regions where baryonic density is extremely high (detected via X-rays), the α coupling parameter is heavily suppressed.[1] Conversely, in the diffuse, widely separated stellar regions where visible mass is low, the density drops far below the turn-off threshold, triggering a massive, localized spike in the α value.[1] This powerful parameter spike generates the exact displaced gravitational lensing signature attributed to dark matter, perfectly mimicking collisionless mass without the existence of any dark particles whatsoever.[1]

9. The Sociology of Scientific Veneration: Why Spacetime Persists

If the vast mathematical, optical, and computational proofs for a relational void, massive Proca photons, extreme light slowing, and covarying coupling constants so efficiently resolve the infinite singularities, causal paradoxes, and missing mass crises of standard cosmology, why do the concepts of "Spacetime" and an invariant "Speed of Light" remain so aggressively dogmatic? The persistent resistance to these alternative theories is not purely scientific or empirical; it is heavily dictated by the profound sociology of scientific deification and the institutional regimentation of what is termed "normal science".[1]

The Secular Saint and the Hagiographic Purification of History

According to the foundational theories of sociologist Émile Durkheim, both organized religion

and institutionalized science serve the exact same social necessity: the absolute drive to classify reality, make a chaotic world intelligible, and forcibly unite societies under an umbrella of unquestionable authority.[1] Following the historical decline of traditional religious authority within post-Rousseauist secular states, this intense cultural devotion and requirement for absolute certainty was systematically and intentionally mapped onto scientists and cultural heroes.[1]

Albert Einstein was profoundly elevated as the ultimate "secular saint," successfully fulfilling a desperate post-war cultural yearning for a benign, transcendent guardian capable of unlocking cosmic secrets.[1] The sociological catalyst for this elevation perfectly mirrors the rise of the early Christian cult, which functioned by organizing uncodified, localized metaphysical ideas into a massive, rigid institutional authority managed by Church Fathers and imperial administration.[1] To protect Einstein's newly minted absolute cultural authority, his early archive custodians—most notably his secretary Helen Dukas and economist Otto Nathan—engaged in a decades-long process of severe historical hagiography.[1] They heavily restricted access and actively suppressed documentary evidence of his deep human flaws, his severe mathematical self-doubts, his atypical academic failures (such as failing entrance exams and dropping out), and his highly problematic domestic failures.[1] They systematically purged the public record to present an artificially flawless image of unassailable, miraculous genius, utilizing religious terminology like *halo*, *canonized*, and *reverence* in mainstream biographies.[1]

Einstein himself was deeply and profoundly disturbed by this mass deification. He openly recognized the "grotesque" gap between his actual human nature—which was riddled with inconsistency and error—and the infallible public cult constructed around him.[1] By treating Einstein the man as an infallible, god-like entity, his specific geometric interpretation of gravity (General Relativity) transitioned rapidly from a highly useful, provisional mathematical model into an unquestionable, eternal metaphysical truth.[1] Consequently, alternative gravity models—such as Scalar-Tensor theories, Quadratic Quantum Gravity, and Vector-Tensor theories rigorously tested under the Parametrized Post-Newtonian (PPN) formalism—are often marginalized socially before they are evaluated mathematically.[1]

The Textbook Regime, Dogmatism, and "Normal Science"

The institutional enforcement of this deified paradigm is perfectly documented by philosophers of science like Thomas Kuhn and Karl Popper. They argue forcefully that standard scientific education does not teach objective exploration; rather, it relies entirely on a highly regimented textbook regime that functions explicitly as an indoctrination process into "normal science".[1] Unlike other academic fields, theoretical physics relies completely on textbooks written specifically for students that actively exclude genuine history, the tangled labyrinth of historical discovery, deep philosophical debates, and discarded but mathematically viable alternative perspectives.[1] This educational dogmatism was originally championed by Auguste Comte as a pedagogical necessity to simplify complex fields, but it has resulted in a culture that presents contemporary science as settled, unquestionable paradigms.[1]

This textbook enforcement mirrors exactly how early Christian creeds (such as the Nicene

Creed of 325 AD) were utilized to resolve the Arian theological controversy.[1] By establishing rigid statements of faith complete with "anathemas" designed to excommunicate dissenters, the institutions enforce orthodoxy. By teaching the mathematical construct of "Spacetime" as an absolute structural reality rather than a highly effective, yet flawed provisional model, modern institutions effectively indoctrinate students into routine, compliant puzzle-solving within the strict confines of the ΛCDM paradigm.[1] Dissenting, mathematically robust frameworks—such as Proca electrodynamics, variable speed of light with time models (VSLT), light slowing via degenerate atomic systems, and relational energy degeneration hypotheses—are aggressively marginalized and dismissed. This dismissal occurs not because these models lack mathematical rigor or explanatory power, but simply because they structurally challenge the hagiographic orthodoxy of the "secular saint" and the established textbook creeds.[1]

To aggressively counteract this institutional stagnation and restore true empirical exploration, modern analytical frameworks propose the universal adoption of the "Law of Scientific Openness".[1] This crucial mandate demands that all cosmological models, theories, and assertions must be explicitly communicated with a clear recognition of their provisional nature, their undeniable physical limits (such as the inevitable singularities found in General Relativity), and their absolute capacity for future structural revision.[1]

10. Conclusion

The rigorous, exhaustive evaluation of alternative physical frameworks, advanced computational cosmological engines, and the deep implementation of relational quantum mechanics provides an overwhelmingly robust foundation for fully abandoning the rigid, dogmatic concepts of "Spacetime" and an absolute "Speed of Light." The continuous, four-dimensional pseudo-Riemannian manifold that forms the bedrock of General Relativity is demonstrably shown to be an unnecessary, philosophically flawed mathematical reification that creates unsolvable causal paradoxes and catastrophic mathematical singularities.

By comprehensively redefining the universe as a highly discrete Hilbert space that organically projects emergent causal relations across a perfectly continuous, static Euclidean void, theoretical physics can fundamentally bypass the massive conceptual failures that plague the standard ΛCDM model. The elimination of geometric time dilation restores absolute universal time, instantly resolving the immense causal paradoxes generated by faster-than-light calculations, while successfully explaining observable phenomena like GPS clock anomalies and muon survival via purely mechanical quantum gravitational damping and localized kinematic structural stabilization.

Simultaneously, the integration of advanced Proca electrodynamics definitively proves that if the photon possesses an extremely minute, yet invariant rest mass (m_γ), light propagation is fundamentally subject to fluid-dynamic resistance and severe energy degeneration. The absolute "Speed of Light" is thus permanently demoted from an untouchable geometric law to a mere phase velocity limit operating within an ambient electromagnetic substrate. The reality of this structural degradation is perfectly mirrored in both the optical manipulation of group

indices within highly degenerate atomic systems and the biological thermodynamic starvation models of retinal light slowing.
This profound energy degeneration directly and undeniably supports the modernized Covarying Coupling Constants and Tired Light (CCC+TL) framework, coupled with Variable Speed of Light with Time (VSLT) dynamics. Together, these mechanics efficiently and completely resolve the cosmological redshift, the immense temporal stretching of supernova light curves, and the Tolman surface brightness test without requiring the physical stretching of an ontological space.
Finally, by recognizing the localized, density-dependent spatial variations in covarying coupling parameters (-matter), combined with the deep thermodynamic degradation of massive photons into cold, sub-luminal condensates ("graviballs"), astrophysicists can effectively and elegantly account for the massive gravitational anomalies currently attributed to invisible dark matter and dark energy. By violently stripping away the geometric fabric of spacetime and the chronological illusions of time dilation, cosmology successfully returns to a deterministic, causally sound, and strictly relational system of absolute kinematics. Overcoming the deep, culturally ingrained sociological dogmas of the established textbook regime remains the final, vital necessity in completing this massive transition toward a post-relativistic understanding of the universe.

Works cited

1. Comparing Religious and Scientific Veneration.md
2. Against Spacetime Substance: A Relational Interpretation of General Relativity - PhilSci-Archive, accessed May 30, 2026, https://philsci-archive.pitt.edu/27254/1/Against_SpaceTime_Substance.pdf
3. Speed of light - Wikipedia, accessed May 30, 2026, https://en.wikipedia.org/wiki/Speed_of_light
4. (PDF) Switching between slow light and fast light by static magnetic field in a degenerate four-level atomic system at room temperature - ResearchGate, accessed May 30, 2026, https://www.researchgate.net/publication/380336484_Switching_between_slow_light_and_fast_light_by_static_magnetic_field_in_a_degenerate_four-level_atomic_system_at_room_temperature
5. Research - Oliver Pooley, accessed May 30, 2026, https://www.oliverpooley.org/research.html
6. Challenging the Spacetime Structuralist, accessed May 30, 2026, https://www.wuthrich.net/pub/WuthrichChristian2009PhilSci_ChallengingSptStruct.pdf
7. Challenging the Spacetime Structuralist | Philosophy of Science | Cambridge Core, accessed May 30, 2026, https://www.cambridge.org/core/journals/philosophy-of-science/article/challenging-the-spacetime-structuralist/4C4398C9036B99220BC087B48246C93F
8. Tired light - Wikipedia, accessed May 30, 2026,

https://en.wikipedia.org/wiki/Tired_light
9. Tired Light Is Solved | by Michael Aaron Cody - Medium, accessed May 30, 2026, https://medium.com/@mac123456/tired-light-solved-7fb837b1aa6c
10. (PDF) Graviballs and dark matter - ResearchGate, accessed May 30, 2026, https://www.researchgate.net/publication/347211463_Graviballs_and_dark_matter
11. 15. Gravitational lensing: Section 1 (Dynamics and Astrophysics of Galaxies), accessed May 30, 2026, https://galaxiesbook.org/chapters/III-04.-Gravitational-Lensing_1-The-lensing-equation.html
12. Can you give an example of how FTL travel would violate causality?, accessed May 30, 2026, https://www.reddit.com/r/AskPhysics/comments/1toqth4/can_you_give_an_example_of_how_ftl_travel_would/
13. Alternative Physics - classical alternatives to modern theory, accessed May 30, 2026, http://www.alternativephysics.org/
14. Retinal degeneration in animal models with a defective visual cycle - PMC, accessed May 30, 2026, https://pmc.ncbi.nlm.nih.gov/articles/PMC4157753/
15. Revitalizing Vision: Metabolome Rejuvenation Slows Retinal Degeneration, accessed May 30, 2026, https://www.cuimc.columbia.edu/news/revitalizing-vision-metabolome-rejuvenation-slows-retinal-degeneration
16. Defective cone photoreceptor cytoskeleton, alignment, feedback, and energetics can lead to energy depletion in macular degeneration - PubMed, accessed May 30, 2026, https://pubmed.ncbi.nlm.nih.gov/15302348/
17. [1802.04055] Gravitational lensing of photons coupled to massive particles - arXiv, accessed May 30, 2026, https://arxiv.org/abs/1802.04055
18. Angle of deflection in gravitational lensing - Physics Stack Exchange, accessed May 30, 2026, https://physics.stackexchange.com/questions/232093/angle-of-deflection-in-gravitational-lensing
19. What if you and I, along with everyone else in the world never existed? Does a theory for an alternate reality with no 'Big Bang' exist? - Quora, accessed May 30, 2026, https://www.quora.com/What-if-you-and-I-along-with-everyone-else-in-the-world-never-existed-Does-a-theory-for-an-alternate-reality-with-no-Big-Bang-exist
20. Evidences for Varying Speed of Light with Time - SCIRP, accessed May 30, 2026, https://www.scirp.org/journal/paperinformation?paperid=91057
21. Errors in Tired Light Cosmology, accessed May 30, 2026, https://www.astro.ucla.edu/~wright/tiredlit.htm
22. Tired light red shift hypothesis - cosmology - Physics Stack Exchange, accessed May 30, 2026, https://physics.stackexchange.com/questions/156618/tired-light-red-shift-hypothesis
23. Variable Speed of Light with Time and General Relativity - SCIRP, accessed May

30, 2026, https://www.scirp.org/journal/paperinformation?paperid=108887
24. (PDF) Variable Speed of Light with Time and General Relativity - ResearchGate, accessed May 30, 2026, https://www.researchgate.net/publication/351243234_Variable_Speed_of_Light_with_Time_and_General_Relativity
25. Constraints on the Minimally Extended Varying Speed of Light Model Using Pantheon+ Dataset - MDPI, accessed May 30, 2026, https://www.mdpi.com/2218-1997/10/6/268
26. If Hubble showed the farther an object the faster it travels from us, what's profound about the Nobel-winning discovery that the universal expansion is accelerating? How does it relate to expanding space-time and gravitational red shift? - Quora, accessed May 30, 2026, https://www.quora.com/If-Hubble-showed-the-farther-an-object-the-faster-it-travels-from-us-whats-profound-about-the-Nobel-winning-discovery-that-the-universal-expansion-is-accelerating-How-does-it-relate-to-expanding-space-time-and
27. Why is the tired light hypothesis not widely accepted? : r/AskPhysics - Reddit, accessed May 30, 2026, https://www.reddit.com/r/AskPhysics/comments/131m1ug/why_is_the_tired_light_hypothesis_not_widely/
28. The Universe Could Be Twice As Old if Light is Tired and Physical Constants Change, accessed May 30, 2026, https://www.universetoday.com/articles/the-universe-could-be-twice-as-old-if-light-is-tired-and-physical-constants-change
29. Scattering of two energetic gravitons, resulting in the formation of a... | Download Scientific Diagram - ResearchGate, accessed May 30, 2026, https://www.researchgate.net/figure/Scattering-of-two-energetic-gravitons-resulting-in-the-formation-of-a-graviball-of_fig5_347211463
30. Slow Quanta Bound States and a Possible Link to Dark Matter, accessed May 30, 2026, https://www.researchgate.net/publication/390892297_Slow_Quanta_Bound_States_and_a_Possible_Link_to_Dark_Matter
31. “Slow Quanta” Bound States and a Possible Link to Dark Matter - arXiv, accessed May 30, 2026, https://arxiv.org/html/2504.12447v1
32. 230 questions with answers in BIG BANG | Science topic - ResearchGate, accessed May 30, 2026, https://www.researchgate.net/topic/Big-Bang