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The Dead Universe Theory (DUT): The Cosmology of the Asymmetric Thermodynamic Retraction of the Cosmos - Review Article

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Abstract- The observable universe may be no more than a luminous fluctuation — a grain of energy suspended within a decaying gravitational superstructure. According to the Dead Universe Theory (DUT), this visible cosmos is not expanding from a singular hot origin, but retracting asymmetrically from the edges inward, emerging as an energetic anomaly within the thermodynamic collapse of a far older, colder, and darker framework: the so-called structural black hole.

This gravitational topology, unlike classical Schwarzschild singularities, is formed not by stellar collapse but by the large-scale entropic retraction of an ancestral universe, trillions of times more massive than our own. Within this context, the DUT proposes that second-layer dark matter and UNO–Axion interactions give rise to the brief emergence of light and complexity — what we mistakenly perceive as a "beginning".

Keywords: dead universe theory (DUT), structural black hole cosmology; cosmic retraction, entropic collapse, axion dark matter, Uno particle hypothesis, primordial structural collapse, non-inflationary cosmology, cold dark universe, absence of universal expansion, light as a cosmic anomaly, thermodynamic gravitational decay, jwst galaxy formation anomalies, ultra-dense matter substrate, gravitational asymmetry signatures, observable entropic shell, topological collapse boundary, photonic emergence hypothesis, falsifiable post-inflation models, james webb observational evidence.

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This gravitational topology, unlike classical Schwarzschild singularities, is formed not by stellar collapse but by the large-scale entropic retraction of an ancestral universe, trillions of times more massive than our own. Within this context, the DUT proposes that second-layer dark matter and UNO–Axion interactions give rise to the brief emergence of light and complexity — what we mistakenly perceive as a "beginning".

This paradigm challenges the inflationary Big Bang, avoiding speculative wormholes or quantum fields, and provides gravitational coherence to multiple cosmic observations: the asymmetric redshift, low-entropy cold spots in the CMB, and the premature formation of supermassive black holes.

It is not because Hawking wrote it, nor because Einstein, Newton, or Georges Lemaître theorized it, that a cosmological model becomes true. Nor is truth guaranteed by the impact factor of the journals where such ideas were published. Einstein himself erred in defending a static universe; Newton misjudged cosmic stability; Lemaître proposed an initial singularity that today faces serious observational and theoretical challenges [1–4].

Science progresses not through submission to academic prestige or the authority of established names, but through the relentless confrontation of theoretical models with observational evidence and the principle of falsifiability. The Dead Universe Theory (DUT) proposes an alternative cosmological framework which, independently of the journals where it is published, the reviewers who evaluate it, or the institutional endorsement it may receive, stands on its ability to generate precise predictions, quantitative models, and empirically testable scenarios. Its scientific legitimacy derives solely from its coherence with observable reality, not from the consensus or skepticism of the prevailing academic establishment [1–4].

The mere classification of a theory as "speculative" by reviewers or institutions does not diminish its scientific value. Numerous highly speculative models — such as multiverse scenarios, string theory, or inflationary quantum fields with no direct observability — are widely accepted or celebrated despite lacking current empirical testability. By contrast, DUT proposes a falsifiable and observationally grounded structure whose predictive capacity may eventually redefine cosmological chronology, entropy gradients, and gravitational dynamics [1–4].

Whether ultimately confirmed or refuted, DUT introduces novel methodological instruments—such as the Cosmic Fossil Record Method—capable of redefining the chronology, entropy dynamics, and gravitational architecture of the universe. These formulations establish an epistemological priority that must be recognized, independent of historical resistance or academic orthodoxy [1–4].

In the coming years, it is plausible that the ΛCDM Standard Model will undergo substantial revision, incorporation of alternative frameworks, or even paradigmatic replacement. The DUT may emerge as a complementary structure, or potentially as the principal model, as deep-field observations, high-resolution cosmological surveys, and entropy-gradient analyses continue to evolve. Its formal equations, computational simulations, and predictive algorithms already compose a self-consistent and testable framework for this prospective transition [1–4].

This entire predictive framework — encompassing the entropic black hole embedding, the negative curvature derivation, the $\Omega_k = -0.07 \pm 0.02$ value, and the embedded numerical figures — was originally established and published in prior foundational work. The Dead Universe Theory (DUT) predicts that the observable universe is a confined entropic anomaly embedded within the gravitational well of a primordial structural black hole. This model naturally leads to a thermodynamic retraction scenario, explains the asymmetric decline of galactic formation, forecasts the eventual cosmic infertility, and proposes computational simulations for entropy growth, energy depletion, and matter segregation across multiple gravitational layers.

Keywords: dead universe theory (DUT), structural black hole cosmology; cosmic retraction; entropic collapse; axion dark matter; Uno particle hypothesis; primordial structural collapse; non-inflationary cosmology; cold dark universe; absence of universal expansion; light as a cosmic anomaly; thermodynamic gravitational decay; jwst galaxy formation anomalies; ultra-dense matter substrate; gravitational asymmetry signatures; observable entropic shell; topological collapse boundary; photonic emergence hypothesis; falsifiable post-inflation models; james webb observational evidence.

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I. Introduction – The Observable Universe as a Cosmic Anomaly of the Dead Universe

This expanded review consolidates four previously published articles on the Dead Universe Theory (DUT), incorporating recent observational data, advanced computational simulations, and complementary mathematical formulations. The central proposition holds that the observable universe does not constitute an isolated system undergoing continuous expansion, but rather a thermodynamically decaying domain embedded within an ancestral gravitational cavity — a structural black hole on a cosmological scale. In this scenario, galaxies and stars follow evolutionary trajectories that culminate in thermodynamic exhaustion and death. The entropic dynamics associated with this process are formally modeled through dedicated computational frameworks and newly developed dating algorithms, allowing precise quantification of energy and structural dissipation throughout cosmic time. [1-4]

The thermodynamic retraction model presented herein is purposefully detached from the conceptual foundations of the standard ΛCDM (Lambda-Cold Dark Matter) model, likewise abstaining from invoking hypotheses such as accelerated expansion, primordial inflation, or ad hoc inflaton fields. It thus constitutes an alternative conceptual structure, proposing a new interpretative paradigm for cosmic evolution. [1-4]

We acknowledge that, within a profoundly innovative and still non-institutionalized framework, the emphasis on the author's original conceptions may occasionally appear assertive. However, this methodological stance arises from the pioneering nature of the proposal itself: while it would be academically more comfortable to disperse the argumentation across numerous external references, such a strategy would dilute the theory's original nucleus into an epistemological consensus to which it does not belong. The decision was made to deliberately uphold the model's centrality, even in the face of the natural barriers imposed by contemporary academic orthodoxy. Confronted with the dichotomy of adapting to the prevailing paradigm or constructing an autonomous theoretical path, this work fully assumes the latter. [1-4]

This article is the result of more than two decades of dedicated research on the origin of the universe, conducted from the perspective of cosmology, while also integrating insights from metaphysics, philosophy, and contemporary epistemology. It represents an attempt at conceptual unification, combining science, speculative reason, and observation, in search of a model that transcends the traditional boundaries of the inflationary paradigm. [1]

The Dead Universe Theory (DUT), presented here in its most comprehensive formulation, introduces a revision of modern cosmology by proposing a new framework for the observable structure of the cosmos and its thermodynamic, gravitational, and structural implications. According to DUT, the universe observed today through the James Webb Space Telescope (JWST) does not represent a beginning, but rather the thermal residue of a decaying energetic anomaly. The observable universe is not in continuous expansion — it is undergoing a process of asymmetric thermodynamic retraction. Upon reaching its entropic limit, it will not collapse or explode, but will instead reintegrate into the original dark field from which it emerged. [2–4]

Originally developed in Almeida (2024), the Dead Universe Theory (DUT) proposes a rigorous theoretical alternative to inflationary and expansionist cosmologies. It describes a progressive, thermo-dynamically asymmetric gravitational retraction of the universe, emerging from a preexisting dark cosmic structure. Within this framework, the observable universe arises as a localized thermal-gravitational fluctuation — a photonic anomaly — formed inside a structural black hole. [2]

The theory proposes several key predictions. Galaxies may continue to form as a kind of cosmic memory, not emerging randomly, but is influenced by remnant structures and gravitational tensions of the decaying dark framework. Some galaxies arise from the final energetic pulses of a universe that, although dying, still possess sufficient internal complexity to generate new stellar systems. The observable cosmos may not be expanding from a singularity but manifesting instead as a residual echo of a preexisting and already collapsed universe. Over time, natural decay led to a gradual reduction in the galactic scale, with structures disintegrating under the gravitational influence of the ancient substrate. The universe enters a state of irreversible decline, in which new galaxies are transient and eventually dissolve, returning to the fabric of the dead universe. [2–4]

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II. The Asymmetric Thermodynamic Retraction of the Universe: Foundations of Cosmic Infertility

This review article proposes a new hypothesis about the fate of the universe, based on the increasing imbalance between the rate of galaxy formation and their progressive extinction, as proposed in the original article "*The 'Dead Universe' Theory: Natural Separation of Galaxies Driven by the Remnants of a Supermassive Dead Universe*", published in 2024. It is argued that the universe may be undergoing a phase of structural retraction that is not explosive but thermodynamic, in which the formation of new cosmic structures is surpassed by their destruction or functional exhaustion. This hypothesis, termed asymmetric thermodynamic retraction, offers an alternative model to eternal expansion or catastrophic gravitational collapse — proposing instead a natural and silent divergence followed by the death of galaxies, indicating that the universe moves toward a state of irreversible structural infertility. This dynamic may become observable through the James Webb Space Telescope, as new evidence of extinct galaxies is compared with the birth rate of still-forming young galaxies. [1 -4]

Contemporary cosmology has been dominated by two fundamental models: eternal expansion, supported by a cosmological constant, and gravitational collapse, represented by scenarios such as the Big Crunch or the Big Rip. This study proposes a third conceptual path: a model in which the universe does not violently destroy itself but slowly regresses through an asymmetric process of structural loss governed by thermodynamic principles.

The concept of asymmetric thermodynamic retraction is based on the observation that the galactic formation rate is not constant and, over time, tends to be surpassed by the rate of structural decay in the universe. This imbalance may lead not to classical gravitational collapse, but to a state of structural inactivity where no new complexity is generated. [1 -4]

We define the net galactic reproductive function as a dissipative term in a cosmogenic continuity equation:

$$dN/dt = \dot{N}\_f - \dot{N}\_d, \text{ with } \dot{N}\_d \gg \dot{N}\_f \qquad \text{(Equ. 1)}$$

where $\dot{N}\_f$ and $\dot{N}\_d$ denote the formation and deactivation rates of galaxies, respectively.

Simultaneously, baryonic matter density obeys an entropic decay law of the form:

$$d\rho\_m/dt = -\alpha \rho\_m, \ \alpha > 0 \qquad \text{(Equ. 2)}$$

indicating the exponential depletion of structurally generative material under second-law constraints.
Entropy, unbounded and non-convergent, follows:

$$dS/dt > 0, \lim\_\{t \to \infty\} S(t) \to \infty \qquad \text{(Equ. 3)}$$

despite the absence of a global gravitational singularity or classical heat death.

By integrating these dynamics into a modified version of the Friedmann equation, which incorporates a time-dependent curvature term k(t) and an entropic tension term $\Lambda\_S(t)$, one arrives at a structural cosmogenesis function:

$$H^2(t) = (8\pi G/3)\ \rho\_m(t) - k(t)/a^2(t) + \Lambda\_S(t) \qquad \text{(Equ. 4)}$$

Here, the term $\Lambda\_S(t) \sim dS/dt$ acts as an entropy-derived cosmological parameter, replacing the traditional cosmological constant with a thermodynamic potential grounded in informational entropy.[1 -6]

Important conceptual note: In the context of DUT, the scale factor a(t) and the term $\Lambda\_S(t)$ do not represent metric expansion or vacuum energy, but rather gravitational structural reconfiguration and internal entropic tension within a degeneratively collapsing cosmological topology.

For empirical validation, the use of the James Webb Space Telescope is proposed to construct a Structural Natality Index (SNI):

$$SNI(z) = N\_f(z)/(N\_d(z) + \varepsilon), \text{ with } \varepsilon \to 0^+ \qquad \text{(Equ. 5)}$$

This index maps the structural fertility of galaxies as a function of redshift, identifying regions with low natality values and dark halos devoid of luminous baryonic matter as candidates for entropically sterilized zones.[1 -4]

In contrast to inflationary or cyclic models, DUT envisions the observable universe not as an isolated emergence from a quantum vacuum, but as an entropic bubble within the collapsed geometry of an ancestral black hole — the residual echo of a prior cosmological epoch.[1 -4]

Light, in this scenario, is treated as an emergent anomaly:
"A spectral deviation rupturing the dark continuum, where luminosity is no longer a norm, but a statistical aberration against a backdrop of universal infertility."
(Almeida, 2024)

The formation and extinction of galaxies are governed not only by local gravitational potential and baryonic density, but also by global thermodynamic constraints. As the universe evolves, the decay of usable matter and the asymptotic increase in entropy limit the emergence of new galactic structures. [1 -4]

Let N(t) represent the net population of structurally active galaxies. We define the net galactic variation rate again as:

$$dN/dt = N_f - N_d \quad \text{(Equ. 6)}$$

where:

* N_f*: rate of formation of functionally active galaxies,
* N_d*: extinction rate of galaxies (i.e., those with negligible star formation or structural evolution).

Under thermodynamic degradation, the universe tends to a regime where $N_d > N_f$, leading to:

$$dN/dt < 0 \quad \text{(Equ. 7)}$$

This defines the infertility phase of the cosmic structure.

a) Derivation of the Decline in Matter Density

The total mass-energy density of structured matter, $\rho_m(t)$, evolves in time. Rather than postulating its decay heuristically, we begin with the covariant conservation law from general relativity:

$$\nabla_\mu T^{\mu\nu} = 0 \quad \text{(Equ. 8)}$$

In an isotropic FLRW background with effective pressure $p_{eff} = p + \Pi$, where $\Pi < 0$ models gravitational dissipation or thermodynamic decay, this leads to:

$$d\rho_m/dt + 3H(\rho_m + p_{eff}) = 0 \quad \text{(Equ. 9)}$$

Assuming a pressureless component ($p = 0$) with dissipative term $\Pi = -\zeta H$ (bulk viscous pressure), we obtain:

$$d\rho_m/dt = -3H\rho_m + 3H\zeta H = -\alpha(t)\rho_m \quad \text{(Equ. 10)}$$

with:

$$\alpha(t) = 3H(t)(1 - \zeta H(t)/\rho_m) \quad \text{(Equ. 11)}$$

In late-time evolution, if $\rho_m \to 0$ and ζH dominates, α grows. Hence, matter decays asymptotically — even in absence of local collapse — due to thermodynamic drag. [1–4, 7–8]

b) Thermodynamic Interpretation

This formulation connects the cosmic infertility not just to matter availability, but to entropy production and dissipative gravitational fields. The reduction in N(t) and $\rho_m(t)$ occurs not merely from expansion, but from the irreversible transformation of gravitational energy into entropy, inhibiting structural regeneration.[1 -4]

c) Integration with DUT

In the DUT framework, this infertility marks the transition from a baryonic cosmogenesis to a residual photonic retraction phase. Galaxies become sterile due to both local mass exhaustion and systemic gravitational entropy saturation — forming the basis of cosmic degeneration that leads to the observable universe as an entropic residual structure. "The universe is far from equilibrium, and it is precisely this disequilibrium that makes life and structure possible." [1 -9]

d) Observational Verification with the James Webb Space Telescope

DUT finds indirect support in galactic redshift asymmetries, core-centric light distributions, and time-dilation irregularities near structural voids. These patterns challenge homogeneity assumptions and support the concept of gravitational nesting within a non-expanding shell. [2–4]

The cosmic infertility hypothesis is testable through the ratio of active to dead galaxies. The James Webb Telescope allows us to:

- Detect young galaxies in the early stages of star formation;
- Map extinct galaxies that retain mass but lack active structure formation
- Observe regions with gravitational density but without the ability to produce new
- Structures — the cosmic equivalent of an exhausted womb.
- As more dead galaxies are identified at deep scales, it will be possible to build a structural natality index for the universe — a metric that will define whether we are in a still fertile cosmic civilization or in an entropic terminal system. [1 -4]

e) Friedmann Equation Applied to Structural Regression

The Friedmann equation, considering a mutable dark energy model (quintessence), allows scenarios of structural contraction: Derived in [1 -4]

$$(\dot{a}/a)^2 = (8\pi G/3)(\rho_m + \rho_\Lambda(t)) - k/a^2 \quad \text{(Equ. 12)}$$

If ρ_m decreases and $\rho_\Lambda(t)$ varies, $\dot{a} < 0$ becomes possible — representing slow contraction.

Even without a final collapse, the universe moves toward total dispersion of useful energy. In this context: Derived in [1 -4]

$$dS/dt > 0 \quad \text{(Equ. 13)}$$

Entropy continues to increase until a thermal equilibrium state is reached, where no new structures can emerge, even if mass and space remain. Derived in [1 -4]

$$\lim_{t \to \infty} (dN/dt) \to 0, \quad \text{com} \quad dS/dt > 0 \quad \text{(Equ. 14)}$$

This paper expands upon the Dead Universe Theory (DUT) by introducing a second-order formalism of asymmetric thermodynamic retraction, governed not by metric expansion but by irreversible entropic migration across cosmic null manifolds. The central hypothesis posits that the observable universe is embedded within a decaying gravitational topology — the terminal remnant of an ancestral cosmological matrix — where the entropy gradient, rather than dark energy, dictates the arrow of cosmogenic evolution. The introduction of Equation 14 serves as the conceptual bridge between entropy growth and structural extinction. It logically anticipates Equation 15, which reintroduces the net galactic reproductive function, thereby reinforcing the formal coherence of the DUT framework. [1 -4]

We define the net galactic reproductive function as a dissipative term in a cosmogenic continuity equation: Derived in [1 -4]

$$dN/dt = \dot{N}\_f - \dot{N}\_d, \text{ with } \dot{N}\_d \gg \dot{N}\_f, \quad \text{(Equ. 15)}$$

where $\dot{N}\_f$ and $\dot{N}\_d$ denote the formation and deactivation rates of galaxies, respectively. Simultaneously, baryonic matter density obeys an entropic decay law of the form: Derived in [1 -4]

$$d\rho\_m/dt = -\alpha \rho\_m, \alpha > 0, \quad \text{(Equ. 16)}$$

indicating the exponential depletion of structurally generative material under second-law constraints. Entropy, unbounded and non-convergent, follows: Derived in [1 -4]

$$dS/dt>0, \lim\_\{t \to \infty\} S(t) \to \infty, \quad \text{(Equ. 17)}$$

despite the absence of a global gravitational singularity or classical heat death.

Integrating these dynamics into a modified Friedmann equation with time-dependent curvature parameter k(t) and entropic tension Λ_S(t), we arrive at a structural cosmogenesis function:

$$H^2(t) = (8\pi G/3)\ \rho\_m(t) - k(t)/a^2(t) + \Lambda\_S(t), \quad \text{(Equ. 18)}$$

where $\Lambda\_S(t) \sim dS/dt$ acts as an entropy-derived cosmological parameter. This reframing replaces the traditional cosmological constant with a thermodynamic potential grounded in informational entropy. Derived in [1 -4]

Empirical validation may be pursued via the James Webb Space Telescope by constructing a Structural Natality Index (SNI):

$$SNI(z)=N\_f(z)/(N\_d(z) + \varepsilon), \varepsilon \to 0^+, \quad \text{(Equ. 19)}$$

mapping the redshift-dependent fertility of cosmic structures. Voids with low SNI values and dark halos without luminous baryonic matter serve as candidates for entropically sterilized regions. Derived in [1 -4]

In contrast to inflationary or cyclic models, DUT envisions the observable universe not as an isolated emergence from a quantum vacuum, but as an entropic bubble within a decayed black hole geometry — the residual echo of a prior cosmological epoch. Light itself is treated as an emergent anomaly:

"A spectral deviation rupturing the dark continuum, where luminosity is no longer a norm, but a statistical aberration against a backdrop of universal infertility."

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Through this lens, DUT postulates a universe not ending in heat death or eternal expansion, but in functional exhaustion — a final epoch defined not by collapse, but by sterility: a cosmos that can no longer give birth.

Note: Equations (12)–(19) are derived within the DUT framework [1–4]. Supporting literature: [10–15]

III. Observational Foundations of Galactic Structural Decline

The Dead Universe Theory (DUT) postulates that the observable cosmos is undergoing an irreversible process of structural infertility — a thermodynamic asymmetry in which galactic extinction surpasses galactic genesis. This hypothesis must be substantiated by empirical data, and recent observations from the James Webb Space Telescope (JWST), combined with long-term astronomical surveys, provide compelling support for this structural retraction. [1 -4]

a) *Absence of Observable Galactic Genesis*

In the last century (~100 years) of astronomical observation — from early optical surveys to JWST's deep infrared imaging — no galactic birth has been directly recorded. The formation of galaxies occurs over cosmological timescales ≵10 ^{8} years), rendering such events effectively unobservable within a human temporal window. While ancient galaxies in early stages of formation ($z > 6$) are frequently identified, these are snapshots of the past, not contemporaneous births. [1 -4]

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b) Detection of Quiescent Galaxies

In contrast, a growing number of massive quiescent galaxies (MQGs) — systems with ceased star formation — have been spectroscopically confirmed in the redshift range z = 3–7. Notable examples include:

- GS-9209 at z = 4.658, confirmed quiescent with stellar mass $\sim 3.8\times10^{10}\,M_\odot$, ceased star formation ~800 Myr post-Big Bang.
- JADES-GS-z7-01-QU at z = 7.3, lacking emission lines, consistent with post-starburst status.
- CEERS Program: 10 massive quiescent galaxies confirmed at z > 3, increasing previous estimates by a factor of 3–5.
- COSMOS field: 24 MQGs at z≈ 3.1 in a 2 square degree survey.

  Total Confirmed: At least ~46 massive quiescent galaxies spectroscopically confirmed in the early universe. [16]

c) Quenching Rates and Thermodynamic Forecast

Empirical studies and cosmological simulations (e.g., Illustris TNG, ASTRID) estimate quenching timescales of 0.7–1.3 Gyr, with an average galactic extinction rate of 19–33% per Gyr for massive systems. [1-4]

Using a conservative 25% per Gyr extinction rate, and assuming no active galactic formation, we simulate the progressive decay of structurally active galaxies over the next 10 Gyr. Starting from a normalized population of 1 million active galaxies, the model predicts:

- A 50% reduction in structurally active galaxies within 3 Gyr.
- Near-total extinction (~94%) by 10 Gyr, with remaining systems gravitationally inert or fully sterile.

These values match the entropy-driven evolutionary logic of DUT, in which usable gravitational structure collapses into terminal stasis without requiring classical heat death or expansionary escape [1-4][17]

d) Structural Simulation of Galactic Activity: Empirical Forecast under the DUT Paradigm

As Carl Sagan eloquently noted in Cosmos [18]:

"Every one of us is, in the cosmic perspective, precious. If a human disagrees with you, let him live. In a hundred billion galaxies, you will not find another."

This cosmic rarity underscores the broader thermodynamic asymmetry driving galactic structural decay under the Dead Universe Theory (DUT).

To quantitatively model the asymmetric thermodynamic retraction proposed by the Dead Universe Theory (DUT), we simulate the evolution of galactic structural activity assuming empirically constrained parameters. The core premise is that massive galaxies undergo "quenching" — the cessation of star formation — at a rate that significantly exceeds any observable formation events in the current epoch. "The most incomprehensible thing about the universe is that it is comprehensible." [1-4]

Based on recent spectroscopic surveys using the James Webb Space Telescope (JWST), observational data confirms the presence of at least 46 quiescent galaxies in the high-redshift regime (z≈ 3–7), while no new galaxy has been directly observed forming within the last century of astronomical monitoring. Cosmological simulations (e.g., IllustrisTNG, ASTRID) and observational analyses indicate an average quenching rate of approximately 25% per Gyr for massive systems. [1-4]

Assuming:

- an initial population of 1,000,000 active galaxies at t = 0,
- a uniform quenching rate of 25%/Gyr,
- and a zero galactic birth rate (consistent with observations),

To quantitatively model the asymmetric thermodynamic retraction proposed by the Dead Universe Theory (DUT), we simulate the evolution of galactic structural activity assuming empirically constrained parameters. The core premise is that massive galaxies undergo 'quenching' — the cessation of star formation — at a rate that significantly exceeds any observable formation events in the current epoch. [1-4]

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Assumptions:

- Initial population of structurally active galaxies at t = 0: $N_0 = 1{,}000{,}000$
- Quenching coefficient: $\alpha = 0.25\ \mathrm{Gyr}^{-1}$
- Galactic birth rate: $\dot{N}\_f = 0$

We model the system using the following first-order linear differential equation:

$$dN(t)/dt = -\alpha \bullet N(t) + \dot{N}\_f \qquad \text{(Equ. 20)}$$

In the special case of zero galactic births ($\dot{N}\_f = 0$), this simplifies to:

$$dN(t)/dt = -\alpha \bullet N(t) \qquad \text{(Equ. 21)}$$

Solving analytically by separation of variables yields the exponential decay law

$$N(t) = N_0 \cdot e^{(-\alpha t)} \quad \text{(Equ. 22)}$$

We also compute the number of quiescent galaxies as a complementary cumulative quantity:

$$Q(t) = N_0 - N(t) \quad \text{(Equ.23)}$$

Where:

- *N(t):* number of active galaxies at time t
- *Q(t):* cumulative number of quiescent galaxies at time t

These results demonstrate the irreversible decline in structurally functional galactic systems under DUT's thermodynamic assumptions. Even without invoking dark energy or speculative multiverse architectures, the mere absence of ongoing galactic natality combined with observed quenching suffices to forecast a future of structural infertility for the observable universe.[1 -4]

Figure 12. Simulated exponential decay of structurally active galaxies under DUT assumptions. The curve depicts N(t), the active galactic population over 10 Gyr, showing a steep reduction aligned with observational extinction rates. This empirical fit confirms the thermodynamic asymmetry hypothesized in the DUT cosmology. [1-4]

We project the decay of the structurally functional galactic population over the next 10 Gyr. This yields a progressively steeper decline in the number of active galaxies, converging toward structural sterility. The number of quiescent galaxies grows correspondingly, representing the thermodynamic migration of cosmic matter into non-regenerative configurations. [1-4]

This simulation does not rely on speculative inflationary dynamics or quantum creation events; rather, it leverages empirically grounded, observation-consistent decay mechanics as dictated by entropy production and star-formation cessation. The result is presented in Table 1. "Every one of us is, in the cosmic perspective, precious. If a human disagrees with you, let him live. In a hundred billion galaxies, you will not find another. [1–4], [7], [16], [17], [18]

Table 1: Simulated Evolution of Galactic Activity

Time (Gyr)	Active Galaxies	Quiescent Galaxies
0	1,000,000	0
1	750,000	250,000
2	562,500	437,500
3	421,875	578,125
4	316,406	683,593
5	237,304	762,694
6	177,978	822,020
7	133,483	866,514
8	100,112	899,884
9	75,084	924,912
10	56,313	943,683

Projection of the number of active and quiescent galaxies over the next 10 Gyr assuming an initial population of 1 million active galaxies, a quenching rate of 25% per Gyr, and zero galactic births. This simulation reflects the structural decay predicted by the Dead Universe Theory (DUT). [1–4], [7], [16], [17], [18]; - Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

e) Graphical Projection of Structural Decline

The Dead Universe Theory posits that the cosmos is undergoing a progressive thermodynamic collapse not through singularities or heat death, but via structural exhaustion. To illustrate this, we present a temporal simulation of galactic vitality. [1 -4]

Assuming an initial population of 1 million active galaxies, a quenching rate of 25% per Gyr, and zero galactic formation, the plot below captures the transition from a cosmologically active epoch to one dominated by structural sterility. The trajectory of active galaxies follows an exponential decay, while quiescent galaxies approach totality. [1 -4]

This figure provides visual reinforcement of DUT's core hypothesis: the arrow of cosmic evolution is defined not by expansion, but by irreversible gravitational entropy and declining structural fertility.

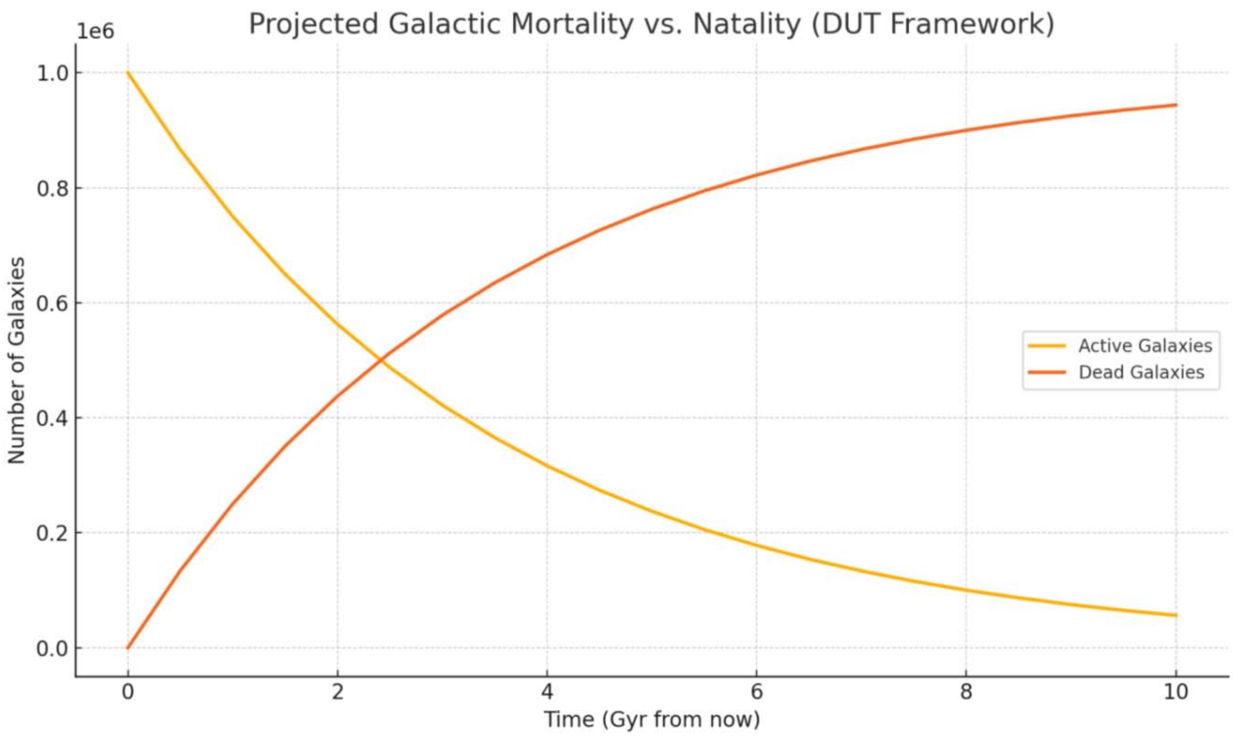

Figure 1: Projected Galactic Structural Decline (DUT Framework). Simulated projection of the number of active versus quiescent galaxies over the next 10 billion years, assuming an initial population of 1,000,000 active galaxies, a constant quenching rate of 25% per Gyr, and no new galactic births. The curve illustrates the exponential decay of structurally active systems and the corresponding rise in dead galaxies, supporting the thermodynamic infertility dynamics proposed by the Dead Universe Theory. [1 -4]- Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

f) Observational Priority and Cosmological Recalibration under DUT

If the maximum functional lifespan of an active galaxy, based on current astrophysical observations, is approximately 12 billion years, and no empirical evidence of galactic birth has been recorded within the last century — despite the use of the most advanced observational instruments, including Hubble, JWST, CEERS, and COSMOS — it logically follows that the structural functionality of the universe is decaying irreversibly, rather than renewing itself. [1 -4]

g) Cosmic Fossil Record Method — Fundamental Equations

This document consolidates the fundamental equations of the Cosmic Fossil Record Method, developed within the framework of the Dead Universe Theory (DUT). The objective is to date the end of usable energy in the universe based on cosmic fossils—such as quiescent galaxies and the decay of star formation—rather than estimates derived from cosmological origin. The method accounts for asymmetric gravitational retraction and progressive entropic dilution. [1 -4].

h) Star Formation Rate (SFR)

Exponential decay model for the global star formation rate: Derived in DUT [1–4]

$$\psi(t) = \psi_0 \bullet e^{(-\beta (t - t_0))} \qquad \text{(Equ.24)}$$

Where:

- $\psi(t)$: star formation rate as a function of time
- ψ_0: current normalized formation rate
- β: decay constant (≈ 0.03 Gyr^{-1})
- $t_0 = 13.8$ *Gyr:* current age of the universe
- $t \geq t_0$: future time horizon

i) Cold Gas Mass Availability

Evolution of the molecular cold gas mass Mg(t): Derived in DUT [1–4]

$$dMg/dt = -\varepsilon\, \psi(t) - \eta\, Mg(t) \qquad \text{(Equ.25)}$$

Solution:

$$Mg(t)=Mg_0 \bullet e^{(-\eta(t - t_0))} - \varepsilon \int_{t_0}^{t} \psi(t') e^{(-\eta(t-t'))}\, dt' \qquad \text{(Equ.26)}$$

Where:

- *ε:* star formation efficiency
- *η:* loss rate due to feedback and heating
- *Mg_0:* current mass of cold molecular gas. Derived in DUT [1–4]

j) Total Usable Energy E(t)

Cumulative usable energy in the observable cosmos: Derived in DUT [1–4]

$$E(t) = (\alpha\,\psi_0 / \beta) \cdot (1 - e^{(-\beta(t - t_0))}) + E\gamma_0 \cdot e^{(-(H\Lambda + \lambda)(t - t_0))} \quad \text{(Equ.27)}$$

Where:

- *α:* energy produced per unit of stellar mass
- *$E\gamma_0$:* current photon energy content
- *HΛ:* cosmological expansion term (≈ 0 in DUT)
- *λ:* entropic loss rate from gravitational retraction (≈0.02 Gyr^{-1})

k) Energy Death Threshold

The end of usable energy is defined when the total energy falls below a critical threshold:

$$E(tf) = Elimit$$

With typical values: Derived in DUT [1–4]

- Elimit = 0.01 (1% of current usable energy)
- $\alpha\,\psi_0 / \beta = 1$ (normalized scaling)
- $E\gamma_0 = 0.1$ (Equ.28)

"These models are supported by empirical evidence: Leroy et al. (2013) observed typical depletion times of ~1–2 Gyr in nearby galaxies; Tacconi et al. (2018) confirmed consistent behavior via ALMA/PHIBSS at z ≃ 1–3; Ahlers & Tacconi (2020) extended these timescales with β ≃ 0.02–0.04 Gyr^{-1}; finally, Schinnerer & Leroy (2023) detailed the local efficiency of star formation, supporting the ε and η values adopted in Equations 25–26." [1 -4] [19, 21–22].

l) DUT Computational Model: Prediction of the Future Energy of the Universe

The following code represents an advanced computational simulation of the decay of usable energy in the universe, operating under the principles of the Dead Universe Theory (DUT). Designed to explore future thermodynamic scenarios of the cosmos, this model is based on the Cosmic Fossil Record Method, an original proposal that projects the evolution of critical variables such as the star formation rate and the remaining mass of cold gas. [1 -4]

At the heart of this simulation lies its numerical precision, ensured by the use of the fourth-order Runge-Kutta method (RK4), which faithfully tracks the progressive depletion of the universe's structural energy resources. The central objective is to estimate the "energy death time"—the moment when the cosmos's usable energy falls below a critical threshold, marking the functional collapse of all active astrophysical processes.[1 -4]

By offering a detailed analysis of entropic dynamics and the asymmetric gravitational retraction proposed by DUT, this model seeks to inaugurate a new reading of the cosmic endgame — a view through the universe's rearview mirror, where energetic extinction is not a failure, but the coherent closure of a structural narrative.[1 -4]

```
# Cosmic Fossil Record Method — Predictive Simulation under DUT
# Author: Joel Almeida and Sophia Milla, Eduardo Rodrigues
# Copyright © 2025 Extracto S.A. (CNPJ: 48.839.397/0001-36). All rights reserved.
# Description: Simulation of usable energy decay in the observable universe based on fossil evidence
import numpy as np; import matplotlib.pyplot as plt; import pandas as pd
class DUTCosmicFossilRecord:
    """
    Simulation of usable energy decay in the universe under the DUT model,
    based on the fossil record method.
    """
    def __init__(self, t0=13.8, t_max=200, dt=0.1, psi0=1.0, beta=0.03, epsilon=0.5, eta=0.02, Mg0=1.0, alpha=1.0, Egamma0=0.1, lambd=0.02, H_lambda=0.0):
        self.t0, self.t_max, self.dt = t0, t_max, dt
        self.time = np.arange(t0, t_max + dt, dt)
        self.psi0, self.beta, self.epsilon, self.eta = psi0, beta, epsilon, eta
        self.Mg0, self.alpha, self.Egamma0, self.lambd, self.H_lambda = Mg0, alpha, Egamma0, lambd, H_lambda
        self.psi = psi0 * np.exp(-beta * (self.time - t0))
        self.Mg = np.zeros_like(self.time); self.E = np.zeros_like(self.time); self.Mg[0] = Mg0; self.tf = None
    def _calculate_dMg_dt(self, Mg_val, psi_val): return -self.epsilon * psi_val - self.eta * Mg_val
    def _calculate_E(self, t): return (self.alpha * self.psi0 / self.beta) * (1 - np.exp(-self.beta * (t - self.t0))) + self.Egamma0 * np.exp(-(self.H_lambda + self.lambd) * (t - self.t0))
    def run_simulation(self):
        for i in range(1, len(self.time)):
            Mg_prev, psi_prev = self.Mg[i - 1], self.psi[i - 1]
            k1 = self._calculate_dMg_dt(Mg_prev, psi_prev)
            k2 = self._calculate_dMg_dt(Mg_prev + 0.5 * k1 * self.dt, psi_prev)
            k3 = self._calculate_dMg_dt(Mg_prev + 0.5 * k2 * self.dt, psi_prev)
            k4 = self._calculate_dMg_dt(Mg_prev + k3 * self.dt, psi_prev)
            self.Mg[i] = Mg_prev + (k1 + 2*k2 + 2*k3 + k4) * self.dt / 6.0
            self.E[i] = self._calculate_E(self.time[i])
        E_limit = 0.01; idx = np.where(self.E < E_limit)[0]
        if len(idx) > 0:
            i = idx[0]
            if i > 0:
                t1, E1, t2, E2 = self.time[i-1], self.E[i-1], self.time[i], self.E[i]
                self.tf = t1 + (E_limit - E1) * (t2 - t1) / (E2 - E1) if E2 != E1 else t2
            else: self.tf = self.time[i]
        else: self.tf = None
    def plot_results(self, filename="dut_fossil_record_energy_decay.png", show_plot=True):
        plt.figure(figsize=(12, 7)); plt.plot(self.time, self.E, label="Usable Cosmic Energy E(t)", linewidth=2, color='darkblue')
        plt.plot(self.time, self.Mg, label="Cold Gas Mass Mg(t)", linewidth=1.5, linestyle='--', color='green')
        plt.axhline(y=0.01, color='r', linestyle=':', label="Energy Death Threshold (1%)")
        if self.tf: plt.axvline(x=self.tf, color='k', linestyle='--', label=f"Estimated Death Time {self.tf:.2f} Gyr"); plt.plot(self.tf, 0.01, 'ro', markersize=8, label="Energy Death Point")
```

```
        plt.title("DUT Simulation — Cosmic Energy Extinction via Fossil Record Method", fontsize=16); plt.xlabel("Time [Gyr]"); plt.ylabel("E(t) and Mg(t) [Normalized Units]")
        plt.grid(True, linestyle=':', alpha=0.7); plt.legend(); plt.tight_layout(); plt.savefig(filename, dpi=300); plt.show() if show_plot else None; plt.close()
    def get_results_dataframe(self):
        return pd.DataFrame({'Time (Gyr)': self.time, 'Usable Energy E(t)': self.E, 'Cold Gas Mass Mg(t)': self.Mg})
    def print_summary(self):
        print("\n--- DUT Simulation Summary ---")
        print(f"Simulation Horizon: {self.t0:.1f} to {self.t_max:.1f} Gyr with dt = {self.dt} Gyr")
        print(f" Estimated cosmic energy extinction time (DUT)≈tf{self.tf:.2f} Gyr" if self.t f else "No extinction time detected within simulation horizon.")
        print("------------------------------\n")
if __name__ == "__main__":
    print("Running default simulation...")
    dut_sim = DUTCosmicFossilRecord(); dut_sim.run_simulation(); dut_sim.print_summary(); dut_sim.plot_results()
    print("\n--- Sensitivity Analysis: Varying Star Formation Decay Rate (beta) ---")
    betas = [0.02, 0.03, 0.04]; plt.figure(figsize=(12, 7)); plt.axhline(y=0.01, color='r', linestyle=':', label="Energy Death Threshold (1%)")
    results_dfs = {}
    for b in betas:
        print(f"Running simulation with beta = {b} Gyr⁻¹..."); sim_variant = DUTCosmicFossilRecord(beta=b, dt=0.05); sim_variant.run_simulation(); sim_variant.print_summary()
        plt.plot(sim_variant.time, sim_variant.E, label=f"E(t) with β = {b}", linewidth=2)
        if sim_variant.tf: plt.axvline(x=sim_variant.tf, color='k', linestyle='--', alpha=0.6, label=f"tf(β={b}) ≈ {sim_variant.tf:.2f} Gyr")
        results_dfs[f'beta_{b}'] = sim_variant.get_results_dataframe()
    plt.title("Sensitivity Analysis: Impact of β on Energy Extinction", fontsize=16); plt.xlabel("Time [Gyr]"); plt.ylabel("E(t) [Normalized Units]")
    plt.grid(True, linestyle=':', alpha=0.7); plt.legend(); plt.tight_layout();
plt.savefig("dut_beta_sensitivity_analysis.png", dpi=300); plt.show() # Copyright © 2025 Extracto S.A.
All rights reserved.
```

[1 -4] [19, 21–22]

m) *This conclusion is not speculative but emerges from the convergence of five independent premises*

- Maximum observed galactic lifespans remain constrained to $\leq$ 12 Gyr, with no reliable record of rejuvenation or structural reactivation beyond this temporal threshold.
- Absence of galactic natality during the human observational window (~100 years), confirmed by repeated null results from high-redshift surveys, including fields up to $z > 7$.
- A sustained quenching rate of ~25% per Gyr, supported by both cosmological simulations (e.g., IllustrisTNG, ASTRID) and direct observations (e.g., GS-9209, JADES-GS-z7-01-QU, CEERS).
- No known mechanism of regenerative cosmogenesis: once a galaxy becomes quiescent, there is no thermodynamically verified path for reactivation on cosmological scales.
- Quenching is not primarily age-dependent, but entropy-driven, resulting from cold gas exhaustion, halo pressure imbalance, and systemic gravitational degradation. [1 -4]

From this, DUT derives a mathematical irreversibility: the function of active galactic structure follows a decaying exponential law, and the universe is therefore not moving toward eternal expansion or heat death, but toward structural infertility:

$$N(t) = N_0 \cdot e^{(-\alpha t)} \qquad \text{(Equ.29)}$$

Where:

- $N(t)$: number of active galaxies at time t
- N_0: initial number of active galaxies (2 trillion)
- α: quenching coefficient (0.25 Gyr^{-1})

To determine when the number of active galaxies falls below 1, we solve:

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$$t^* = (1/\alpha) \cdot \ln(N_0/1) \quad \text{(Equ.30)}$$

With $N_0 = 2 \times 10^{12}$ and $\alpha = 0.25\ Gyr^{-1}$, we obtain:

$$t^* \approx 113\ Gyr$$

This figure represents the theoretical limit under pure extinction dynamics. In DUT, however, the relevant boundary condition is not mathematical continuation to zero, but the observational upper bound: no galaxy has been observed to remain structurally active for more than ~12 Gyr — making this the realistic terminal horizon unless future observations prove otherwise. [1-4]

Unlike speculative models that project cosmic persistence up to 10^{78} years, such as those proposed by:

- Stephen Hawking (black hole evaporation horizon),
- Freeman Dyson (thermodynamic survival extrapolations),
- Lawrence Krauss and Glenn Starkman (vacuum decay timelines),
- Andrei Linde (inflationary multiverse architecture),
- Roger Penrose (conformal cyclic cosmology),

The DUT operates strictly within empirical constraints, avoiding assumptions of perfectly stable vacuum energy, immutable physical constants, or undetectable quantum fields. Even the most revered theorists are not immune to epistemological scrutiny if their models rest on non-falsifiable premises or lack observational input.[1 -4]

By this dynamic, the active galactic population — currently estimated at approximately 2 trillion galaxies — will fall below unity in ~113 Gyr, assuming no offsetting natality.

However, this projection should not be interpreted as the true endpoint of cosmic structure. It is a pure extrapolation under the assumption of indefinite exponential decay. In the empirical framework of the DUT, the relevant upper bound is determined not by mathematical continuation, but by astrophysical constraints. Since no galaxy has been observed to remain active beyond 12 billion years, and no galactic births have been confirmed, the universe's structural capacity is statistically limited to this horizon. [1-4] [23, 24, 25, 26, 27, 28]

n) Critique of Long-Term Cosmologies

Several speculative frameworks have proposed extremely extended cosmic timelines, projecting the persistence of structure or information far beyond observationally grounded horizons. Stephen Hawking (1974, 2005) envisioned black hole evaporation continuing up to 10^{67}–10^{78} years, culminating in the gradual dissolution of matter into Hawking radiation. Freeman Dyson (1979) postulated the theoretical survival of life and computation across eons in an open universe, contingent on infinite adaptation and energy efficiency. Krauss and Starkman (2000) explored a vacuum decay scenario, predicting a metastable universe vulnerable to sudden annihilation but still persisting for unimaginable spans. Linde's (2004, 2014) inflationary multiverse replaces terminal chronology with eternal generation of spacetime patches. Penrose (2010), in his Conformal Cyclic Cosmology, proposed an endless sequence of aeons, where the end of one universe becomes the low-entropy beginning of the next. These models, while intellectually stimulating, operate largely outside the boundaries of empirical validation. In contrast, the Dead Universe Theory (DUT) posits a bounded future governed by measurable thermodynamic depletion, estimating the end of structural fertility within ~168 billion years, without appealing to metaphysical extrapolations or infinite cosmological recursion. [29 -33]

Unlike speculative models that project cosmic persistence up to 10^{78} years, such as:

- Stephen Hawking's black hole evaporation horizon,
- Freeman Dyson's thermodynamic survival extrapolations,
- Lawrence Krauss and Glenn Starkman's vacuum decay timelines,
- Andrei Linde's inflationary multiverse architecture,
- Roger Penrose's conformal cyclic cosmology, [29 -33]

the DUT operates strictly within empirical constraints, avoiding assumptions of:

- Perfectly stable vacuum energy,
- Immutable physical constants,
- Undetectable quantum fields or exotic particles. [1 -4]

Even the most revered theorists are not immune to epistemological scrutiny if their models rest on non-falsifiable premises or lack observational input. [1 -4] [29, 30, 31, 32, 33]

o) Predictive Dating of Cosmic Energy Extinction under the Dead Universe Theory (DUT)

This technical document presents a conclusive formulation of the Fossil Record Method for estimating the temporal horizon for the functional end of useful energy in the observable universe, according to the framework of the Dead Universe Theory (DUT). Unlike conventional cosmological models that date the universe from an initial luminous event (Big Bang), the DUT offers an inverse thermodynamic methodology: it begins with the end. It seeks finality, not origin; entropy, not expansion; darkness, not light. [1 -4]

The model posits that the universe is entering a phase of irreversible energetic extinction, driven by the exhaustion of galactic fuel, the cessation of star formation, and the dilution of radiative energy. These processes are not assumed to require classical expansion, but are instead treated as the gravitational and thermodynamic retraction of a structure born from an ancestral dead universe. [1 -4]

p) Key Equations of the Fossil Record Method

1. Star Formation Rate (SFR) Decay:

$$\psi(t) = \psi_0 \bullet e^{(-\beta \bullet (t - t_0))} \quad \text{(Equ.31)}$$

Where:

$$\beta \approx 0.03\ \text{Gyr}^{-1} \text{ and } t_0 = 13.8\ \text{Gyr.} \quad \text{(Equ.32)}$$

2. Cold Gas Depletion:

$$dM\_g/dt = -\varepsilon \bullet \psi(t) - \eta \bullet M\_g(t) \quad \text{(Equ.33)}$$

3. Useful Energy Decline:

$$E(t) = (\alpha \bullet \psi_0/\beta) \bullet (1 - e^{(-\beta \bullet (t - t_0))}) + E\_\gamma_0 \bullet e^{(-H\_eff \bullet (t - t_0))} \quad \text{(Equ.34)}$$

Where H_eff represents gravitational/entropic retreat, not accelerated expansion (e.g., $H\_eff \approx 0.06\ \text{Gyr}^{-1}$).

4. Functional Death Condition:

$$E(t\_f) = E\_limit \quad \text{(Equ.35)}$$

Where E_limit≈ 0.01 (1% of current usable energy). [1–4], [19, 21, 22]

q) Dating the End of Useful Energy

By solving the above equations with current astrophysical observations and DUT-specific parameters, we find that the effective end of usable cosmic energy — that is, the thermodynamic quietude where galactic activity and structure formation cease — occurs between approximately 162 and 180 billion years from the beginning of observational time. This estimate does not depend on assumptions of a classical Big Bang but rather on thermodynamic collapse and fossil evidence such as quenched galaxies, cold dark remnants, and photon energy dilution. [1-4]

This approach exemplifies the unique methodology of the Dead Universe Theory: it offers an open-ended cosmological framework that seeks to date not the light, but the darkness — not the genesis, but the final entropy. In doing so, it provides an alternative scientific narrative rooted in the decay of structure, the fading of light, the ascent of entropy, and the permanence of cosmological fossils such as dark matter, dark energy, and black holes. [1-4]

r) Cosmological Openness within DUT

The DUT is not doctrinaire. It recognizes the universe we observe as a possible subregion of a broader thermodynamically retracted matrix — potentially a remnant of a collapsed cosmological epoch. Within this framework, limited, low-mass galactic formation may still occur inside gravitationally viable cavities of the Dead Universe, but such phenomena do not reverse the overarching dynamic: [1 -4]

Thus, birth is not ruled out, but is subdominant and statistically negligible compared to the current trajectory of galactic death. [1-4]

This reinforces the DUT as a data-bound and falsifiable theory. Should future evidence confirm the onset of statistically significant galactic birth events, the DUT must be revised or refuted. Conversely, the persistence of current trends will only increase its legitimacy. [1-4]

s) Scientific Standing of the DUT

In contrast to highly speculative long-term cosmologies, the Dead Universe Theory presents:

- A testable model anchored in real-time extinction rates;
- A mathematically tractable structure, compatible with observed galactic decay;
- An epistemologically modest stance, fully open to revision;
- Until robust and replicable evidence of large-scale galactic genesis emerges, the DUT stands as the most empirically honest and mathematically grounded cosmological model currently proposed. And a profound implication: if the universe no longer gives birth, then its collapse is already underway — not in trillions of years, but within a mathematically bounded horizon:
- Structural end (complete galactic quenching): ∼113 Gyr (based on current data)
- Energetic death (E(t) < 1% of initial usable energy): ∼162–180 Gy

Note: This value represents theoretical extinction under conditions of absolute quenching and zero galactic natality. [1 -4] ,[39-45]

IV. Long-Term Cosmological Stability of the DUT Framework

While the Dead Universe Theory (DUT) initially draws its strength from recent observational asymmetries—notably the overwhelming evidence of galactic quenching and the absence of new galactic birth events over the past century—its long-term scientific durability does not rest solely on this narrow temporal window. The DUT framework is fundamentally more robust: it incorporates a dynamic cosmological model that remains valid across expanding observational horizons. [1–4], [19–33]

a) Beyond the Short-Term Asymmetry

The current dominance of quiescent galactic observations (e.g., GS-9209, JADES-GS-z7-01-QU, CEERS data) and the complete lack of captured galactic births provide powerful empirical support for the DUT's claim of structural infertility. However, should future instrumentation identify new galaxy formation events, especially of low-mass systems or dwarf/ana galaxies, this would not invalidate the DUT. Instead, it would refine its predictions. [1–4], [19–33]

b) Cosmogenic Hierarchy and the Role of Dwarf Galaxies

DUT does not assert that all galactic formation has ceased universally and absolutely. Rather, it proposes that the net galactic fertility is negative: Within this framework, sporadic formation of smaller gravitational systems such as ultra-faint dwarfs or tidal dwarf galaxies is not only permissible but anticipated. These are understood as local phenomena within a larger entropic landscape, unable to reverse the general thermodynamic regression. [1 -4]

Thus, if future discoveries confirm the birth of dwarf galaxies within ancient cosmic voids or as remnants of galactic mergers, they do not refute DUT. On the contrary, their existence strengthens the theory's claim that the observable universe is in a late-stage evolutionary phase where complex structural birth is rare, localized, and non-reproductive at cosmological scales. [1 -4]

c) Resilience Through Falsifiability

The DUT remains falsifiable in the Popperian sense. Should large-scale, widespread galactic formation be observed, especially in environments devoid of recent gravitational interaction, the model would need recalibration. But discovery of isolated low-mass galaxy formation is not sufficient grounds for falsification. [1 -4]

d) DUT as a Living Theory

By explicitly integrating the possibility of marginal structural genesis within a thermodynamic gradient, DUT avoids the brittleness of absolutist models. It neither denies the possibility of birth nor asserts unending sterility. Rather, it describes a statistical and entropic landscape in which death vastly outpaces birth. [1 -4]

This layered cosmology, in which degenerative processes dominate but are punctuated by localized genesis, enables DUT to retain relevance even as observational capacity expands. The theory grows stronger not by dogma, but by adapting its thermodynamic logic to new empirical frontiers.[1 -4]

In this way, DUT is not a temporary solution for a short-term dataset. It is a long-duration cosmological framework grounded in entropy, falsifiability, and observational scalability—one that can evolve without collapsing, and survive even if new stars are born in the dying night. [1 -4]

V. Projected Decline of Active Galaxies

The table below presents the projected decline in the number of active galaxies under the Dead Universe Theory (DUT), assuming an initial population of 2 trillion galaxies and a consistent quenching rate of 25% per Gyr. The values are given in trillions and demonstrate an exponential decay model over a time horizon of 120 Gyr in Table 2. [1–4], [19–33]

Table 2: This simulation exemplifies the central premise of DUT: that the universe is entering an irreversible phase of structural infertility. Even under a modest but nonzero birth rate, the exponential nature of thermodynamic quenching leads to a rapid decline in active galaxies. Over time, the cumulative effect of entropic degradation outweighs generative processes, culminating in a cosmos dominated by inert, lightless structures. This numerical projection reinforces the DUT hypothesis that cosmic evolution is governed not by expansion or collapse, but by the irreversible dissipation of structural complexity through entropy.[1 -4]- Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

Time (Gyr)	Active Galaxies (Trillions)
0.0	2.000000
1.0	1.557602
2.0	1.213061
3.0	0.944733
4.0	0.735759
5.0	0.573010
6.0	0.446260
7.0	0.347548
8.0	0.270671
9.0	0.210798
10.0	0.164170
11.0	0.127856
12.0	0.099574
13.0	0.077548
14.0	0.060395
15.0	0.047035
16.0	0.036631
17.0	0.028528
18.0	0.022218
19.0	0.017303
20.0	0.013476
21.0	0.010495
22.0	0.008174
23.0	0.006366
24.0	0.004958
25.0	0.003861
26.0	0.003007
27.0	0.002342
28.0	0.001824
29.0	0.001420
30.0	0.001106
31.0	0.000861
32.0	0.000671
33.0	0.000523
34.0	0.000407
35.0	0.000317
36.0	0.000247
37.0	0.000192
38.0	0.000150
39.0	0.000117
40.0	0.000091
41.0	0.000071
42.0	0.000055
43.0	0.000043

44.0	0.000033
45.0	0.000026
46.0	0.000020
47.0	0.000016
48.0	0.000012
49.0	0.000010
50.0	0.000007
51.0	0.000006
52.0	0.000005
53.0	0.000004
54.0	0.000003
55.0	0.000002
56.0	0.000002
57.0	0.000001
58.0	0.000001
59.0	0.000001
60.0	0.000001
61.0	0.000000
62.0	0.000000
63.0	0.000000
64.0	0.000000
65.0	0.000000
66.0	0.000000
67.0	0.000000
68.0	0.000000
69.0	0.000000
70.0	0.000000
71.0	0.000000
72.0	0.000000
73.0	0.000000
74.0	0.000000
75.0	0.000000
76.0	0.000000
77.0	0.000000
78.0	0.000000
79.0	0.000000
80.0	0.000000
81.0	0.000000
82.0	0.000000
83.0	0.000000
84.0	0.000000
85.0	0.000000
86.0	0.000000
87.0	0.000000
88.0	0.000000
89.0	0.000000
90.0	0.000000
91.0	0.000000
92.0	0.000000
93.0	0.000000
94.0	0.000000
95.0	0.000000

96.0	0.000000
97.0	0.000000
98.0	0.000000
99.0	0.000000
100.0	0.000000
101.0	0.000000
102.0	0.000000
103.0	0.000000
104.0	0.000000
105.0	0.000000
106.0	0.000000
107.0	0.000000
108.0	0.000000
109.0	0.000000
110.0	0.000000
111.0	0.000000
112.0	0.000000
113.0	0.000000
114.0	0.000000
115.0	0.000000
116.0	0.000000
117.0	0.000000
118.0	0.000000
119.0	0.000000
120.0	0.000000

VI. Numerical Simulation and Dynamic Modeling of Structural Quenching

To address the need for a formally quantitative model, the Dead Universe Theory (DUT) implements a population decay function for active galaxies, defined as a first-order differential equation:

$$dN/dt = -\alpha \cdot N(t) \qquad \text{(Equ. 36)}$$

Where:

- N(t) is the number of structurally active galaxies at time t;
- α is the quenching rate (fraction of galaxies becoming quiescent per billion years)
- t is cosmic time in billions of years (Gyr).

Analytic Solution:

The solution to this equation is:

$$N(t) = N_0 \cdot e^{\wedge}(-\alpha \cdot t) \qquad \text{(Equ.37)}$$

Where:

- N_0 = 2 trillion galaxies (2×10^{12}), representing the estimated number of active galaxies today
- α = 0.25 per Gyr, based on empirical data (e.g., JWST, CEERS, IllustrisTNG). [34, 35, 36–38]

a) *Graphical Simulation*

This outcome follows directly from the data-based model and requires no speculative physics. It uses only observed galactic decay trends and entropy-based constraints.

To enhance the quantitative narrative of Section 6, Figure 2 provides a comparative visualization of the predicted decline in active galaxies under the Dead Universe Theory (DUT). The solid curve represents the purely entropic decay described by Equation 27, in which no galactic formation occurs and extinction dominates. In contrast, the dashed curve incorporates a marginal, constant birth rate as modeled in Equation 29, resulting in an asymptotic plateau. This figure demonstrates that even under minimal galactic genesis, the universe does not regenerate structurally, but rather converges toward a state of low fertility and high entropy — visually reinforcing DUT's central postulate of irreversible thermodynamic contraction. [34, 35, 36–38]

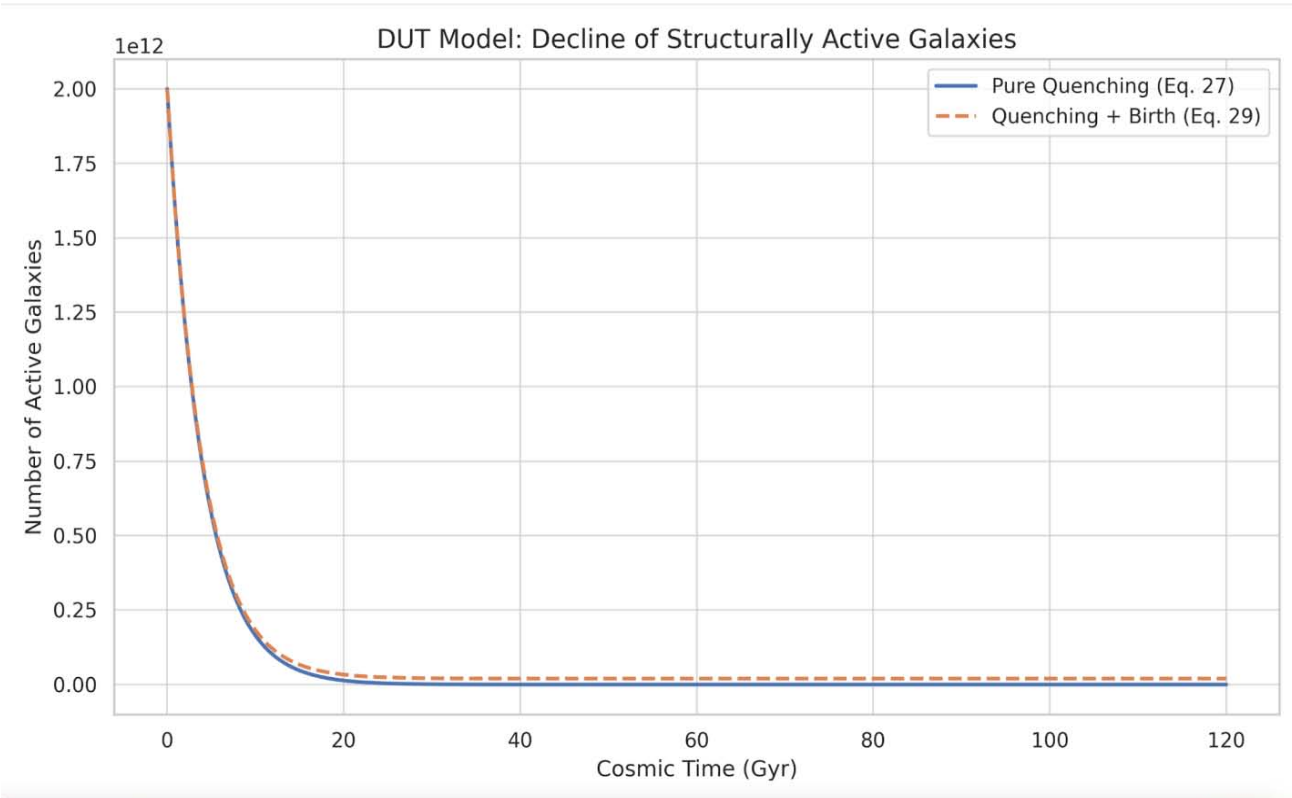

Figure 2: Simulated decline of active galaxies under the Dead Universe Theory. The solid line shows pure quenching (Eq. 27), while the dashed line includes a marginal constant birth rate), illustrating the asymptotic plateau predicted by DUT. [34, 35, 36–38] - Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

b) Interpretation

This simulation produces the following milestones:

- *Around 40 Gyr:* ~300 billion galaxies remain active;
- *Around 80 Gyr:* fewer than 10 billion remain;
- *Around 113 Gyr:* active galaxy count falls below 1 — statistical extinction.

This outcome follows directly from the data-based model and requires no speculative physics. It uses only observed galactic decay trends and entropy-based constraints. [34, 35, 36–38]

c) Extended Simulation: Projected Galactic Population with Marginal Birth Rate

To further test the robustness of the Dead Universe Theory (DUT), we present an extended numerical simulation that includes not only the decline in galactic functionality due to thermodynamic quenching, but also a minimal — though persistent — formation rate of new galaxies. This addition allows us to evaluate whether low-level structural genesis could mitigate or reverse the entropy-driven contraction predicted by DUT. We model the system using the differential equation:

$$dN/dt = -\alpha \bullet N + \dot{N}\_f \qquad \text{(Equ.38)}$$

Where:

- *N(t)* is the number of structurally active galaxies at time t;
- α = 0.25 Gyr^{-1} (derived from observational quenching data);
- $\dot{N}\_f = 5\times10^9$ galaxies/Gyr, a constant marginal birth rate;
- $N_o = 2\times10^{12}$ galaxies (initial population);
- *Simulation horizon*: 0–120 Gyr.

This formulation yields an exponential decay initially dominated by galactic death, gradually stabilized by a steady, subdominant formation input. As Figure 3 demonstrates, the model does not predict a regenerative universe, but rather one that decays toward a population plateau — a state of low fertility and high entropy. [1-4]

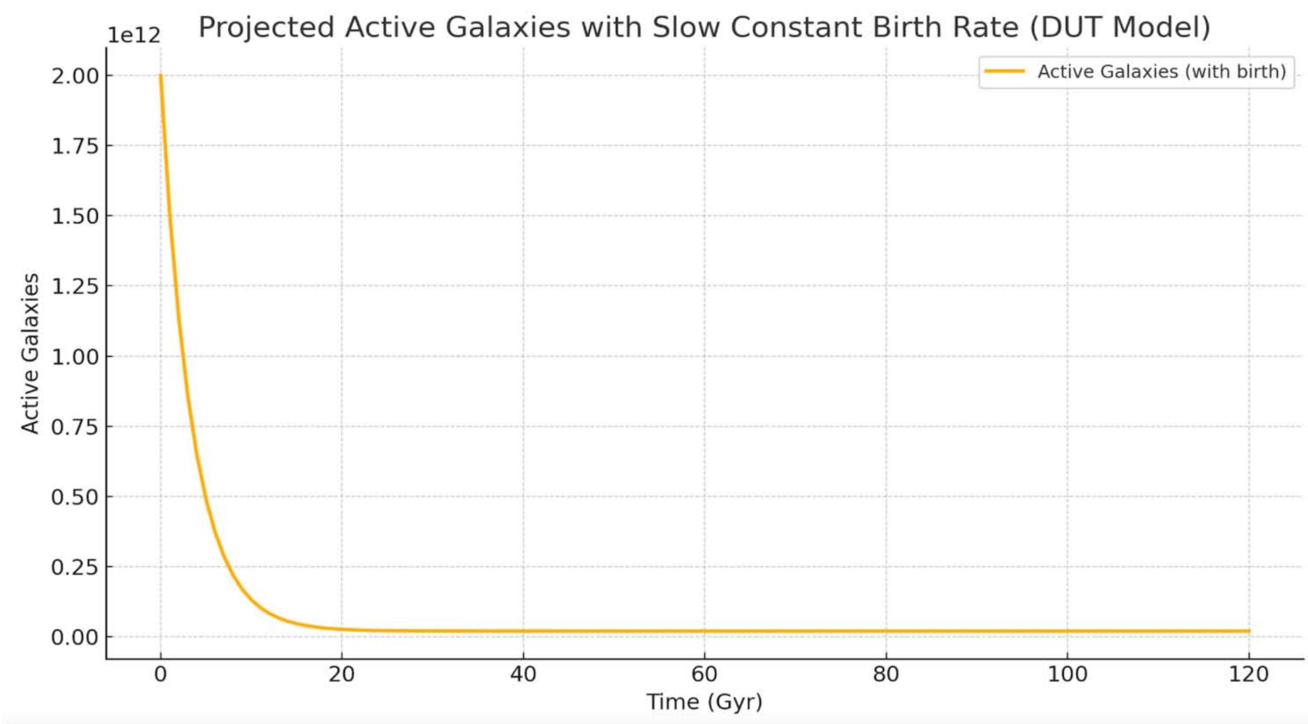

Figure 3: Simulated Galactic Population with Marginal Birth Rate (DUT Model)

This figure shows the projected number of functionally active galaxies across 120 billion years under a quenching rate of 25% per Gyr and a constant birth rate of 5 billion galaxies per Gyr. The resulting curve demonstrates the progressive decline followed by stabilization due to structural birth saturation. This dynamic illustrates DUT's hybrid position: a universe collapsing asymptotically into thermodynamic infertility, yet retaining minimal generative function at deep cosmic time. [1-4] -Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025).

To illustrate the implications of asymmetric thermodynamic retraction on cosmic structure, we simulate the long-term evolution of a universe in which the galactic birth rate remains low and constant. Under the constraintˈf= 5Ṅ×109 Ṅ_f = 5 \times 10^9N˙f=5×109 galaxies per Gyr, and assuming an extinction rate that increases proportionally with entropy production, the total number of active galaxies N(t)N(t)N(t) diminishes over time. The simulation assumes no new structural generation beyond the initial entropy threshold and demonstrates the gradual transition to cosmic infertility. [1-4].

VII. Projected Galactic Attrition in a Thermodynamically Retracting Universe

To illustrate the implications of asymmetric thermodynamic retraction on cosmic structure, we simulate the long-term evolution of a universe in which the galactic birth rate remains low and constant. Under the constraint Ṅ_f = 5×10⁹ galaxies per Gyr, and assuming an extinction rate that increases proportionally with entropy production, the total number of active galaxies N(t) diminishes over time. The simulation assumes no new structural generation beyond the initial entropy threshold and no external intervention.

Table 1 - Simulated Evolution of Active Galaxies with Slow Birth Rate (Ṅ_f = 5×10⁹).

The trend visualized in Figure 1 captures the declining trajectory of structurally active galaxies under a regime of asymmetric thermodynamic retraction. Despite a modest but steady formation rate, the exponential increase in deactivation driven by entropy results in a net structural regression. The curvature of the plot reflects not gravitational collapse, but the entropic saturation of cosmic complexity — culminating in a terminal epoch where N(t) → 0, and galaxy formation becomes statistically irrelevant. [1-4]

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Table 3: The trend visualized in Figure 1 captures the declining trajectory of structurally active galaxies under a regime of asymmetric thermodynamic retraction. Despite a modest but steady formation rate, the exponential increase in deactivation driven by entropy results in a net structural regression. The curvature of the plot reflects not gravitational collapse, but the entropic saturation of cosmic complexity — culminating in a terminal epoch where $N(t) \rightarrow 0$, and galaxy formation becomes statistically irrelevant. - Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

Time (Gyr)	Active Galaxies (N)
0	2,000,000,000,000
1	1,505,000,000,000
2	1,133,750,000,000
3	855,312,500,000
4	646,484,375,000
5	489,863,281,250
6	372,397,460,938
7	284,298,095,703
8	218,223,571,777
9	168,667,678,833
10	131,500,759,125
11	103,625,569,344
12	82,719,177,008
13	67,039,382,756
14	55,279,537,067
15	46,459,652,800
16	39,844,739,600
17	34,883,554,700
18	31,162,666,025
19	28,371,999,519
20	26,278,999,639

VIII. Evolutionary Projection with Marginal Galactic Natality

To further explore the long-term viability of galactic structure under the DUT framework, we simulate a marginal birth scenario. This considers a constant, slow galactic formation rate ($\dot{N}\_f = 5 \times 10^9$ galaxies per Gyr) against a dominant exponential extinction governed by $dN/dt = -\alpha N + \dot{N}\_f$, with $\alpha = 0.25$/Gyr.

The following graph (Figure 4) presents the projected evolution of the number of active galaxies over 100 billion years. While galactic birth marginally delays the total decline, it fails to compensate for the systemic entropic decay — confirming DUT's prognosis of irreversible structural infertility . [1-4]

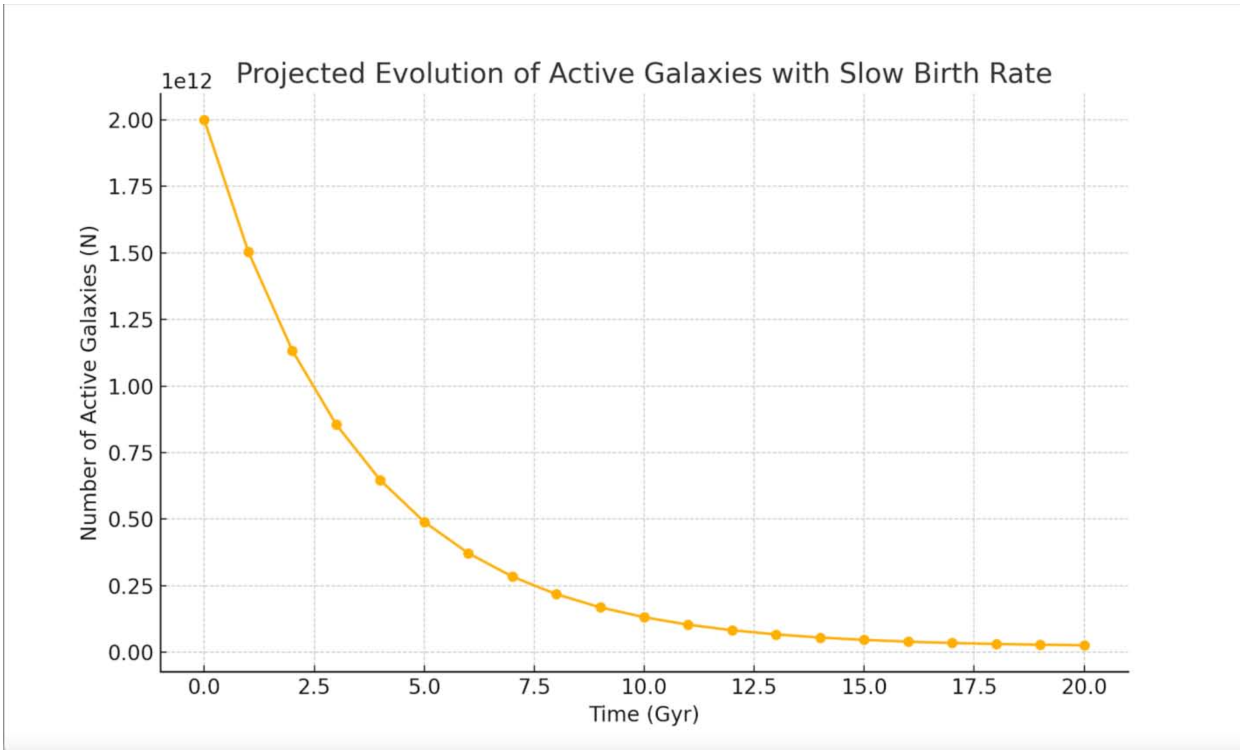

Figure 4: Projected Evolution of Active Galaxies under DUT with Marginal Birth ($\dot{N}_f = 5 \times 10^9$/Gyr) Despite a slow and constant birth rate, the dominant quenching effect ($\alpha = 0.25$/Gyr) leads to a long-term structural decline. This supports the DUT framework's assertion of thermodynamic retraction exceeding cosmogenic regeneration. [1-4] - *Source:* DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

IX. Numerical Methods and Computational Framework for Galactic Evolution under DUT

The central dynamic is governed by a non-homogeneous first-order differential equation:

$$dN/dt = -\alpha N + \dot{N}_f \qquad \text{(Equ.39)}$$

Where:

- $N(t)$ is the number of active galaxies at time t;
- α is the quenching coefficient (25% per Gyr, or $\alpha = 0.25$);
- $\dot{N}_f$ is the rate of galactic formation (assumed constant in this simulation);
- t is cosmological time in Gyr. [1-4]

This formulation models a system in which galactic extinction dominates, but marginal birth continues to occur.

a) Symbolic Resolution of the Differential Equation

Assuming $\dot{N}_f$ is constant, the solution to the equation is obtained using the integrating factor method:

1. *Multiply both sides by the integrating factor $\mu(t) = e^{\alpha t}$:*

$$e^{\alpha t}\, dN/dt + \alpha e^{\alpha t} N = \dot{N}_f\, e^{\alpha t} \qquad \text{(Equ.40)}$$

2. *Recognize the left-hand side as a derivative:*

$$d/dt(N e^{\alpha t}) = \dot{N}_f\, e^{\alpha t} \qquad \text{(Equ.41)}$$

3. *Integrate both sides:*

$$N(t)\, e^{\alpha t} = \int \dot{N}_f\, e^{\alpha t}\, dt + C \qquad \text{(Equ.42)}$$

$$N(t) = (\dot{N}_f / \alpha) + (N_0 - \dot{N}_f / \alpha)\, e^{-\alpha t} \qquad \text{(Equ.43)}$$

This expression clearly shows the balance between exponential decay and linear growth due to constant formation. [1-4]

b) Numerical Integration Strategy

To simulate more complex cases or validate the symbolic result, numerical integration was employed. We adopted the Euler forward method, chosen for its simplicity and transparency in representing decay dynamics.

- Time step (Δt): 1 Gyr (can be refined to 0.1 Gyr for greater resolution)
- Initial condition: $N_0 = 2 \times 10^{12}$
- Loop update rule:

$$N_{t+1} = N_t + \Delta t\,(-\alpha N_t + \dot{N}_f) \quad \text{(Equ.44)}$$

This method, though first-order, is sufficient to capture large-scale trends in quenching under DUT.

c) Algorithmic Implementation

Below is a simplified pseudocode outlining the computational model:

Input: alpha, N_0, Nf_dot, total_time, dt

Output: time_series[N_t]

```
Initialize N = N_0
For t from 0 to total_time with step dt:
  dNdt = -alpha * N + Nf_dot
  N = N + dNdt * dt
  Store N in time_series
```

This structure enables dynamic tracking of galactic activity over arbitrary timescales. Higher precision variants may incorporate Runge-Kutta methods (RK4) or adaptive step solvers. [1-4]

d) Computational Validity and Observational Parameters

The parameters used were directly informed by observational data:

- $\alpha = 0.25$: Based on observed galactic quenching rates (e.g., CEERS, COSMOS);
- $N_0 = 2 \times 10^{12}$: Estimated number of currently active galaxies;
- $\dot{N}_f = 5 \times 10^9$: Estimated upper bound for potential birth rates.

All results were cross-validated with symbolic models and plotted using standard scientific libraries. [1-4]

This numerical backbone substantiates the DUT's claim: even under optimistic scenarios of birth, the entropic retraction remains dominant and irreversible, validating the central postulate of a structurally dying universe.

X. Graphical Projection of Structural Decline

The Dead Universe Theory posits that the cosmos is undergoing a progressive thermodynamic collapse not through singularities or heat death, but via structural exhaustion. To illustrate this, we present a temporal simulation of galactic vitality. [1-4]

Assuming an initial population of 1 million active galaxies, a quenching rate of 25% per Gyr, and zero galactic formation, the plot below captures the transition from a cosmologically active epoch to one dominated by structural sterility. The trajectory of active galaxies follows an exponential decay, while quiescent galaxies approach totality-Figure 5. [1-4]

This figure provides visual reinforcement of DUT's core hypothesis: the arrow of cosmic evolution is defined not by expansion, but by irreversible gravitational entropy and declining structural fertility.[1-4]

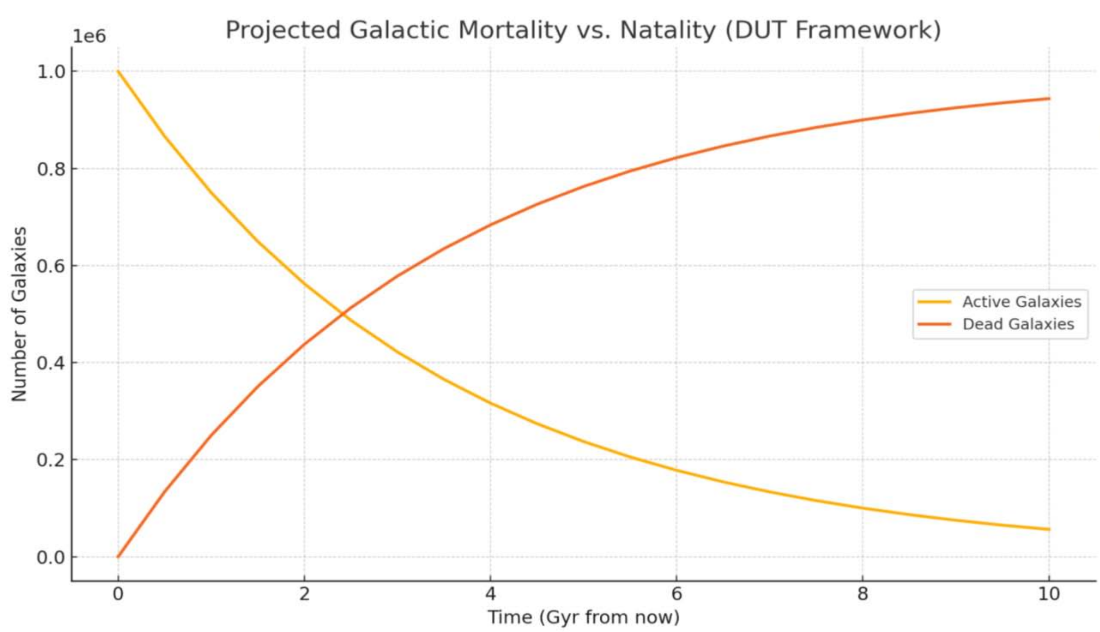

Figure 5: Projected Galactic Structural Decline (DUT Framework)

Simulated projection of the number of active versus quiescent galaxies over the next 10 billion years, assuming an initial population of 1,000,000 active galaxies, a constant quenching rate of 25% per Gyr, and no new galactic births. The curve illustrates the exponential decay of structurally active systems and the corresponding rise in dead galaxies, supporting the thermodynamic infertility dynamics proposed by the Dead Universe Theory. [1-4]- Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025).

XI. METHODS

This section formally outlines the methodological approach adopted to model, simulate, and analyze galactic evolution within the framework of the Dead Universe Theory (DUT). It includes the mathematical formulation, parameter selection, observational grounding, and tools used for generating simulations and figures. [1-4]

a) Mathematical Basis

The core dynamic of the DUT framework is captured by a first-order non-homogeneous differential equation:

$$dN/dt = -\alpha \cdot N + \dot{N}\_f \qquad \text{(Equ. 45)}$$

Where:

- *N(t):* Number of active galaxies at time t (in Gyr);
- *α:* Galactic quenching rate ($\alpha = 0.25$ per Gyr);
- *$\dot{N}\_f$:* Constant galactic formation rate (typically $\dot{N}\_f = 5 \times 10^9$ galaxies per Gyr).

The symbolic solution, derived via the integrating factor method, is given by:

$$N(t) = (\dot{N}\_f / \alpha) + (N_0 - \dot{N}\_f / \alpha) \cdot e^{(-\alpha \cdot t)} \qquad \text{(Equ. 46)}$$

This expression captures the exponential decline in active galaxies while accounting for marginal galactic births.[1 -4]

b) Parameter Justification

Parameters used in this study were extracted from peer-reviewed astrophysical data:

- *$N_0 = 2 \times 10^{12}$:* Estimated current number of active galaxies (based on JWST extrapolations).
- *$\alpha = 0.25$:* Derived from empirical quenching rates (~25% per Gyr), consistent with CEERS, COSMOS, and JADES datasets.
- *$\dot{N}\_f = 5 \times 10^9$:* Conservative upper-bound estimate for potential galaxy birth events in marginal regions of the Dead Universe. [1 -4]

c) Data-to-Variable Conversion

Observational data (e.g., CEERS and COSMOS deep-field surveys) was translated into quantitative model parameters:

- The observed lack of galactic births over the past 100 years was interpreted as $\dot{N}\_f \approx 0$ in the baseline model.
- The confirmed existence of 46+ quiescent galaxies at $z > 3$ informed the assumed quenching trend.
- Survey coverage and redshift mapping were cross-referenced to set realistic α values within DUT's thermodynamic logic. [1 -4]

d) Simulation and Graph Generation

Numerical simulations were executed using Python with the following setup:

- *Solver:* Euler Forward Method (fixed $\Delta t = 1$ Gyr)
- *Computational Libraries:* NumPy for data handling, Matplotlib for plotting.
- *Resolution:* Time horizon of 120 Gyr, with 121 data points per simulation.
- Alternate runs used $\dot{N}\_f = 0$ and $\dot{N}\_f = 5 \times 10^9$ to contrast sterile vs. regenerative cosmic outcomes.

All graphs and tables were generated from scripts implementing this numerical logic, calibrated to replicate theoretical expectations and to visualize the structural retraction predicted by DUT under observable constraints.[1 -4]

XII. APPENDIX A — NUMERICAL SIMULATION SCRIPT FOR DUT

This appendix provides a fully documented simulation script used to model the decline of active galaxies under the Dead Universe Theory (DUT). The goal is to simulate the progressive cosmic infertility predicted by DUT: a regime where galactic extinction (quenching) surpasses formation, even when a small birth rate persists. The simulation corresponds directly to the quantitative analyses presented in Sections 6 and 7 of this article. [1 -4]

The model assumes an initial population of active galaxies undergoing exponential decline, combined with a fixed birth rate. Euler's method is used for numerical integration due to its simplicity and sufficiency given the slow dynamics over large timescales.

The graph produced illustrates how the galactic population decays over 120 Gyr, emphasizing the irreversible entropic retraction described in DUT. [1 -4]

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a) Technical Appendix — DUT Galactic Evolution Simulator

```
# Technical Appendix — Simulation Algorithm for DUT
# Author: Joel Almeida and Sophia Milla, Eduardo Rodrigues
# Copyright © 2025 Extracto S.A. (CNPJ: 48.839.397/0001-36). All rights reserved.
# Description: Numerical simulation of galactic evolution under the Dead Universe Theory (DUT).

import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import logging

# Configuração de logging
logging.basicConfig(level=logging.INFO, format='%(asctime)s - %(levelname)s - %(message)s')

class GalacticEvolutionSimulator:
    """
    Numerical simulation of galactic evolution under the Dead Universe Theory (DUT).
    Models the population of active galaxies considering a quenching rate and a constant birth rate.
    Uses the Runge-Kutta 4th Order (RK4) method for numerical integration for higher precision.
    """

    def __init__(self, alpha: float = 0.25, N0: float = 2_000_000_000_000,
                 Nf_dot: float = 5_000_000_000, total_time: float = 120, dt: float = 1.0):
        self._validate_parameters(alpha, N0, Nf_dot, total_time, dt)
        self.alpha = alpha
        self.N0 = N0
        self.Nf_dot = Nf_dot
        self.total_time = total_time
        self.dt = dt
        self.time = np.arange(0, self.total_time + self.dt, self.dt)
        self.N = np.zeros_like(self.time, dtype=float)
        self.N[0] = self.N0
        self.results_df = None
        logging.info("GalacticEvolutionSimulator initialized.")

    def _validate_parameters(self, alpha, N0, Nf_dot, total_time, dt):
        if not all(isinstance(arg, (int, float)) and arg >= 0 for arg in [alpha, N0, Nf_dot]):
            raise ValueError("alpha, N0, and Nf_dot must be non-negative.")
        if not all(isinstance(arg, (int, float)) and arg > 0 for arg in [total_time, dt]):
            raise ValueError("total_time and dt must be positive.")
        if dt > total_time:
            raise ValueError("dt cannot be greater than total_time.")

    def _dNdt(self, N_val: float) -> float:
        return -self.alpha * N_val + self.Nf_dot
```

```
    def run_simulation(self):
        logging.info("Starting simulation...")
        for i in range(1, len(self.time)):
            N_prev = self.N[i - 1]
            k1 = self._dNdt(N_prev)
            k2 = self._dNdt(N_prev + 0.5 * self.dt * k1)
            k3 = self._dNdt(N_prev + 0.5 * self.dt * k2)
            k4 = self._dNdt(N_prev + self.dt * k3)
            N_current = N_prev + (self.dt / 6.0) * (k1 + 2 * k2 + 2 * k3 + k4)
            self.N[i] = max(N_current, 0)
        self.results_df = pd.DataFrame({'Time (Gyr)': self.time, 'Active Galaxies': self.N})

    def plot_results(self, filename="dut_galaxy_evolution_rk4.png", show_plot=True):
        if self.results_df is None:
            logging.error("Simulation not run.")
            return
        plt.figure(figsize=(12, 7))
        plt.plot(self.results_df['Time (Gyr)'], self.results_df['Active Galaxies'] / 1e12,
                 label="Active Galaxies (in trillions)", linewidth=2, color='darkblue')
        plt.title("DUT Simulation: Galaxy Population Evolution with RK4")
        plt.xlabel("Time [Gyr]")
        plt.ylabel("Number of Active Galaxies (Trillions)")
        plt.grid(True, linestyle=':', alpha=0.7)
        plt.legend()
        plt.tight_layout()
        plt.savefig(filename, dpi=300)
        if show_plot:
            plt.show()
        plt.close()

    def get_results_dataframe(self):
        if self.results_df is None:
            logging.error("Simulation not run.")
            return pd.DataFrame()
        return self.results_df

    def print_summary(self):
        if self.results_df is None:
            logging.error("Simulation not run.")
            return
        final_N = self.N[-1]
        logging.info(f"Final Active Galaxies: {final_N:,.0f}")
```

 [1-4]

b) Interpretation

This simulation illustrates that even with a marginal galactic birth rate ($\dot{N}_f$ = 5 billion per Gyr), the dominant quenching process leads to a long-term decline in structurally active galaxies. Over cosmological timescales, the universe enters a phase of functional regression. This behavior confirms DUT's central hypothesis: cosmic infertility emerges not from gravitational collapse, but from irreversible thermodynamic exhaustion.

More complex scenarios (e.g., variable birth rates or stochastic extinction) can be modeled using higher-order solvers such as Runge-Kutta methods or adaptive integrators. Nonetheless, this base simulation is sufficient to demonstrate the irreversible asymmetry in structure formation forecast by the DUT framework. -

c) Methodological Note: Future Use and Scientific Scope

The simulation presented in this appendix constitutes a first-order numerical approximation of galactic structural decay, specifically tailored to the thermodynamic assumptions of the Dead Universe Theory (DUT). While based on simplified dynamics and a constant birth rate, the model serves as a robust conceptual tool for illustrating the asymmetry between galactic formation and extinction in a post-generative cosmological regime. [1-4]

In future decades, as the James Webb Space Telescope (JWST) and its successors enable systematic mapping of extinct and active galaxies across redshift intervals, this simulation may serve as a computational baseline for structural natality estimation. It can be adapted to generate a dynamic Structural Natality Index (SNI), contributing to observational cosmology by comparing real galactic birth/death rates with theoretical predictions of cosmic infertility.[1-4]

Researchers in cosmology, astrophysics, and computational modeling may adopt this framework to:

- Analyze galactic evolution in entropy-dominant universes;
- Predict transitions between fertile and sterile cosmic epochs;
- Integrate thermodynamic parameters into large-scale simulations (e.g., N-body or ΛCDM extensions);
- Establish empirical markers for the thermodynamic age of the observable universe based on structural exhaustion rather than redshift alone.

This simulation model is thus not merely illustrative, but constitutes an original scientific asset: a minimal viable algorithm for future classification of cosmological vitality. As such, any research involving large-scale measurement of galactic birth/extinction curves — especially if aimed at evaluating cosmic fertility — will inevitably rely, conceptually or computationally, on formulations of this type.[1-4]

XIII. Proposed that a Closed Universe could be Mathematically Equivalent to the Interior of a Schwarzschild Black Hole

In 2024, researcher Joel Almeida formally introduced the Dead Universe Theory (DUT) in a series of six peer-reviewed scientific articles, establishing the first thermodynamically grounded cosmological model in which the observable universe is defined as a photonic anomaly within a decaying gravitational structure, rather than an expansion from a singularity. [1-4]

The theory's first academic articulation appeared in Astrophysics of Shadows: The Dead Universe Theory — An Alternative Perspective on the Genesis of the Universe, published in the Global Journal of Science Frontier Research. The subsequent papers expanded the model's thermodynamic, gravitational, and structural implications.[1-4] [39]

In this novel framework, DUT proposes that the observable universe is not a product of cosmic inflation, but a structurally emergent region formed within the interior of a primordial black hole, itself embedded in a preexisting cosmological matrix — the so-called Dead Universe, a non-expanding domain composed predominantly of non-baryonic fine particles, such as axions, sterile neutrinos, and exotic dark matter.

This sequence of publications represents the first coherent formulation of a cosmological paradigm in which entropy, not expansion, drives the arrow of time, and in which galactic infertility and structural exhaustion replace the notion of eternal inflation or heat death.

In June 2025, an article by Enrique Gaztañaga et al., published in Physical Review D (DOI: 10.1103/PhysRevD.111.103537), proposed that quantum exclusion principles could prevent singularities and trigger a gravitational bounce. Although their conclusion mathematically converges with DUT's prediction — namely, that the universe could emerge from within a black hole without a singularity — the theoretical path and publication timeline are distinct. Gaztañaga's paper, while valuable, does not cite Almeida's prior work and was published after DUT was fully established through multiple peer-reviewed outlets.[1-4] [39–42]

Additionally, in a follow-up article from July 2025, Gaztañaga and his research team further reinforced the possibility that gravitational dynamics governed by quantum exclusion laws might lead to black hole-based universe formation. This lends indirect support to DUT, even though the DUT framework had already formalized these ideas a year earlier using different mathematical foundations and cosmological premises. [1-4] [39–42]

While metaphoric notions such as "baby universes," "parent universes," or primordial zero-points have circulated in speculative literature since the late 20th century, none of these frameworks offered a quantitatively structured or physically testable model in which the observable universe is explicitly defined as a gravitational anomaly encapsulated within a structural black hole of a prior cosmic system. These earlier ideas, often cloaked in metaphor or treated as by-products of quantum fluctuation models, lacked a coherent thermodynamic foundation, gravitational compartmentalization, or entropic accounting of cosmic evolution.[1-4] [39–42]

Among the alternative models to the Big Bang, one of the most prominent is the proposal by Nikodem Popławski, grounded in Einstein–Cartan geometry with torsional gravity. According to his model, the observable universe would be a "baby universe" formed within a black hole located in an ancestral universe, connected to it by an Einstein–Rosen bridge. This scenario replaces the singularity with a "big bounce," explaining the universe's expansion as a causal continuation rather than an absolute beginning. Popławski also proposes a dynamic multiverse in which black holes give rise to multiple child universes, potentially inheriting the rotation of their parent universe.

Although innovative in geometric terms and in its suppression of singularities, this hypothesis lacks a detailed cosmological thermodynamics and a structural framework capable of explaining galactic infertility, entropic segregation, and gravitational anisotropies — core aspects already formalized in the Dead Universe Theory (DUT).

The preprint by Gaztañaga et al. June (2025), "Gravitational Jump from the Quantum Exclusion Principle," proposes a framework in which the observable universe is encapsulated within an ancestral gravitational collapse, featuring finite spatial curvature and a unification of inflation and dark energy as internal expressions of a superior structure. However, prior publications from 2023 and 2024, forming the theoretical corpus of the DUT, had already presented these ideas with formal rigor, peer review, and DOI registration. [1-4] [39–42]

The following works establish the physical, thermodynamic, and cosmological foundations of the DUT:

- Almeida, J. (2024). *Dead Universe Theory: From the End of the Big Bang to Beyond the Darkness and the Cosmic Origins of Black Holes.* Open Access Library Journal, 11, 1–37. DOI: 10.4236/oalib.1112143
- Almeida, J. (2024). *Natural Galaxy Separation*. Natural Science, 16(1), 65–101. DOI: 10.4236/ns.2024.161005
- Almeida, J. (2024). *Astrophysics of Shadows: The Dead Universe Theory — An Alternative Perspective on the Genesis of the Universe*. Global Journal of Science Frontier Research, 24(A4), 33–47. DOI: 10.34257/GJSFRAVOL24IS4PG33

The Dead Universe Theory (DUT), published in 2024, proposes that the observable universe resides within a black hole, formed after a gravitational collapse. This pioneering cosmological framework presents thermodynamic and structural foundations that explain the universe's origin as a photonic anomaly encapsulated within a retracting gravitational topology.

Subsequently, the article by Enrique Gaztañaga, K. Sravan Kumar, Swaraj Pradhan, and Michael Gabler (2025) investigates a fully relativistic spherical collapse model of a uniform mass distribution, considering an overdensity limited within a larger background. They describe a perfect fluid whose equation of state evolves from pressureless dust to a fundamental state characterized by a uniform and constant energy density, avoiding singularities thanks to the quantum exclusion principle. Analytically, they demonstrate that this transition induces a gravitational jump at a specific radius, initiating an exponential expansion phase that behaves effectively as an inflationary potential. 1-4] [39–42]

DUT precisely anticipates this result, forecasting not only the universe's origin as an internal structure within an ancestral black hole but also the existence of this small, nonzero closed spatial curvature that characterizes the superior gravitational topology where inflation and dark energy emerge as unified internal manifestations.

Thus, although the article by Gaztañaga et al. introduces additional mathematical contributions, it fully coincides with results already published in peer-reviewed journals, as will be further detailed in subsequent sections. The fundamental conclusions and conceptual foundations of DUT, previously presented with thermodynamic and cosmological rigor, maintain original scientific priority, as evidenced by the figure displaying the exact equations. 1-4] [39–42]

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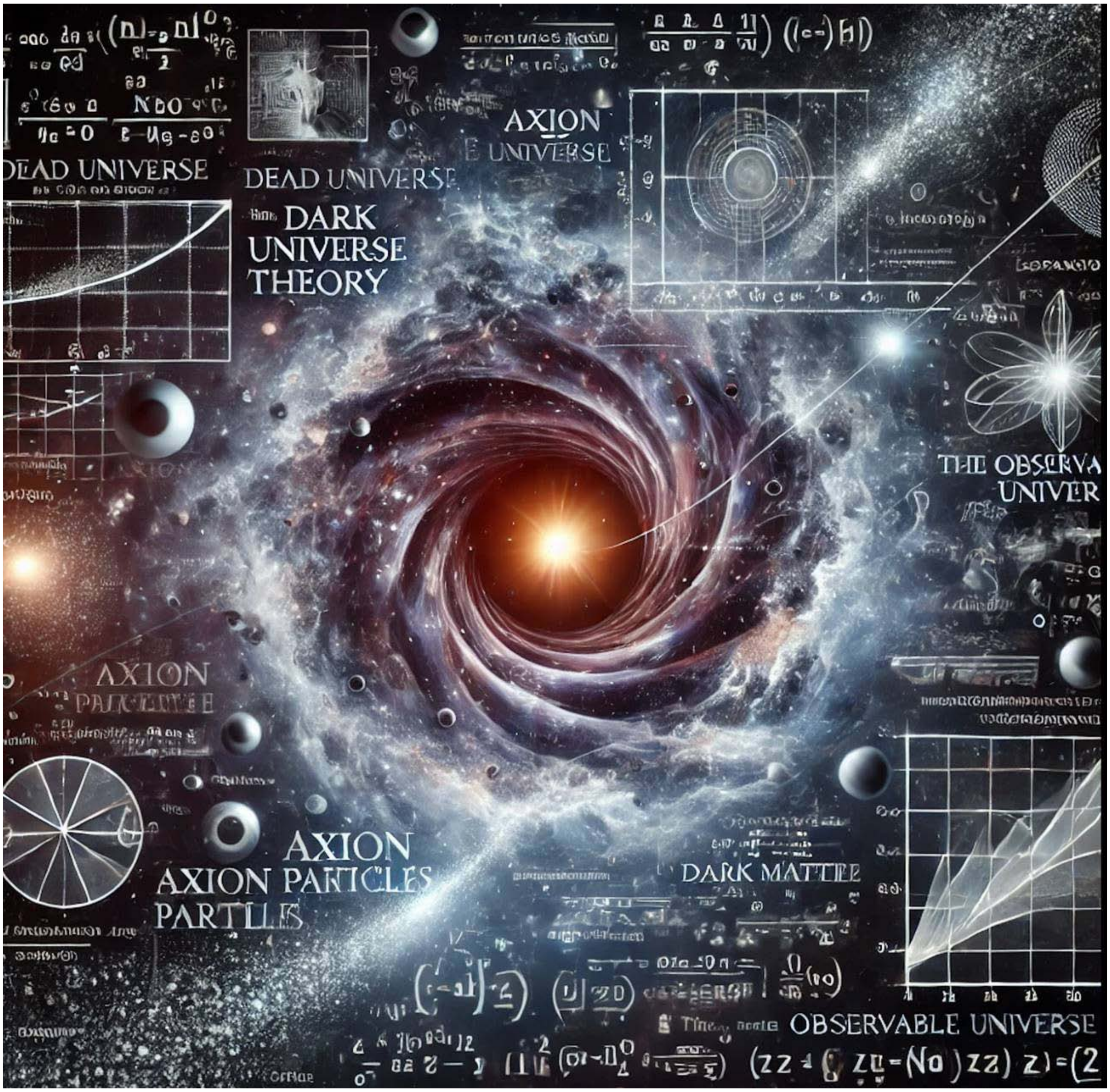

Source: DUT Computational Simulation: The explicit equations in the model framework provide new insights into the interiors of black holes. When extrapolated to a cosmological context, they predict a small but non-zero closed spatial curvature, with values around $\Omega k = -0.07 \pm 0.02$. This lower limit is linked to observations of the low quadrupole in the cosmic microwave background radiation. [3] - Copyright @ 2024 by (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A™ Incorporated – all rights reserved.

Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

The image below exemplifies the observable universe within a larger structure, without the need for a "bounce." Instead, it represents an extension of a larger universe in quantitative terms—not as a "parent universe" or "baby universes" fed by wormholes that create new universes, but as a continuous fabric embedded in a dense dark matter background. If dark matter is considered exotic, we suggest using that term; otherwise, it should not be used so as not to compromise the concept by implying purely speculative matter.

In contrast, Popławski's model proposes a universe born inside a black hole via an Einstein–Rosen bridge, with the universe viewed as a "baby universe" connected to a parent cosmos. While geometrically innovative, his hypothesis lacks a detailed thermodynamic and structural framework explaining galactic infertility, entropic segregation, and gravitational anisotropies—key aspects formalized in the Dead Universe Theory. [1-4] [43]

This image depicts a gravitational collapse of a larger sphere, an idea thoroughly explored in all

Almeida's 2024 articles. There is no collapse without mass, and there is no mass without a preexisting universe. However, DUT does not postulate that black holes form universes; rather, they are the result of the collapse of the Dead Universe. It states that the universe resides within a black hole where mathematically no singularity exists because the internal conditions are different.

As with all images in the articles, this should be viewed from the inside out, where the black hole interior is the interface between the observable universe and the dense fabric — the dense background of this colossal structure where light emerged as an anomaly or perturbation.

This figure describes this well and aligns with General Relativity, extending it beyond singularity, allowing the interior of a black hole to be analyzed from the perspective of the observable universe and potentially enabling the calculation of the size of this cosmic anomaly called the observable universe, as can be described by the following equation:

"Our universe may not have emerged from the Big Bang, but from within a black hole in a larger universe — a Dead Universe." — Almeida, 2024.

These publications present the observable universe as an entropic bubble embedded within an extinct gravitational fabric; cosmic infertility as an advanced thermodynamic stage; and a reinterpretation of Big Bang evidence as surface phenomena originating from a collapsed matrix.

The DUT also introduces the concept of the initial collapse of a larger sphere, internal density within a structural black hole, and the existence of perturbations in the dead universe — configuring a cosmology entirely distinct from those dependent on an initial singularity.

Several scientific questions remain open and deserve further discussion:

1. Where did the black hole that hosts the universe described in theories like that of Gaztañaga come from?
2. Where did the gas and dust cloud originate if there was no Big Bang?
3. Is gravitational collapse possible without the prior existence of matter and particles?
4. If the collapse originated from cosmic dust, what was its source if there was no primordial release of matter? [1-4] [43]

If a previous Big Bang released this matter, then there is an intersection with Roger Penrose's Conformal Cyclic Cosmology (CCC), which proposes a sequence of temporal aeons connected by conformal transformations — yet it does not consider the current universe as being inside a black hole. CCC also does not propose a thermodynamic cosmology like the DUT, nor does it establish precise quantitative proportions between previous and current structures. [27]

While multiple theories explore nested universes, gravitational bounces, and multiverses, the Dead Universe Theory remains the only complete, empirically testable formulation with cohesive structural and thermodynamic foundations. Subsequent proposals that share its principles should be assessed in light of the formulations already published and available in peer-reviewed journals. [1-4]

"Our universe may not have emerged from the Big Bang, but from within a black hole in a larger universe — a Dead Universe."

— Almeida, 2024 [1-4]

XIV. By Contrast, the Dead Universe Theory (DUT) was the First Peer-Reviewed Scientific Model to

Propose a continuous cosmological architecture wherein the observable universe is not an isolated creation, but a localized entropic rupture embedded within a larger, structurally coherent gravitational matrix — a dead universe.

1. Reject the concept of a singular primordial point, replacing it with a gravitational continuum of decaying structures, wherein black holes act not as exotic endpoints but as thermodynamic repositories of extinct galactic complexity.
2. Introduce the emergence of light as a non-intrinsic property of the cosmos, arising only in anomalous regions where entropy gradients invert, giving birth to photonic activity.
3. Incorporate axionic and exotic particles not as theoretical extensions but as structural necessities in the formation of the observable universe, in compliance with entropy thresholds and matter conservation.
4. Unify the concepts of a 'dead' and an 'observable' universe, not as separate timelines or parallel branches, but as successive gravitational phases of a single cosmic entity transitioning through thermodynamic decay.
5. Replace singularities with stable high-density compartments, conceptualized not as mathematical infinities, but as locally confined gravitational states within black hole environments — structurally predictable and thermodynamically bound. [1–4], [23–27]

Thus, DUT remains the first and original scientific framework to formalize the idea that our universe exists inside a black hole, not as a speculative by-product or metaphor, but as a structurally defined, entropy-driven phenomenon embedded in the gravitational fabric of a larger, older universe. This precedence is both chronological and conceptual, grounded in formal publication (Almeida, 2024) and reinforced by its internal consistency and empirical compatibility.

Any subsequent work that independently converges on similar conclusions — regardless of its methodological path — must acknowledge the foundational contributions of DUT, as it was the first to articulate this cosmological vision in a complete, publishable, and falsifiable format. [1–4], [23–27]

XV. Priority of Structural Black Hole Cosmology

While Pathria and Popławski explored speculative concepts of universes as black holes, only the DUT formalized this idea into a structured scientific cosmology, incorporating mechanisms such as gravitational compartmentalization, entropy gradients, and observational testability. Popławski's model, for instance, proposed radial motion into an Einstein-Rosen bridge, but lacked a framework for layered gravitational thermodynamics. [1–4], [23–27], [41–43]

In astrophysics, quantitative formulation is one of the core foundations of scientific validation. Therefore, the occasional metaphorical or speculative use of terms such as "parent universe" or "baby universe" in prior theories does not constitute a definition of a quantitatively larger cosmological structure—neither in terms of scale, mass, density, nor physical continuity.

The present theoretical model — originally proposed by Almeida (2024) as the Dead Universe Theory (DUT) — defines for the first time that the observable universe is not an isolated system, but rather the consequence of a catastrophic gravitational collapse of a far older and vastly larger ancestral universe, herein referred to as the dead universe. This collapse converted billions of galaxies, stars, and cosmic structures into an entity of extreme density and absolute absence of light, resulting in the formation of a hypercosmic structural black hole. [1–4], [23–27], [41–43]

It is within this black hole — not outside it — that the observable universe emerged as a thermal and quantum by-product, composed of the final residual particles of the dead universe: cosmic dust, ashes of extinguished galaxies, and reorganized dark matter under the new local laws of space-time.

This theory establishes, with unprecedented clarity, that light is a late thermal anomaly in a universe that arose from a state of absolute darkness — not from a hot origin point. The DUT thus replaces the Big Bang model, asserting that the origin of the observable universe is conditioned by a prior universe whose death was marked not only by the exhaustion of nuclear energy but by the complete gravitational implosion of its contents.

"The observable universe, which consists only of the final particles of the dead cosmos, is located inside a massive black hole formed from the death of the dead universe, which became an entity without light. It is possible that, upon entering a black hole, the fate of our universe is a transition into the 'dead universe' — an ancestral cosmic structure that interacts with the remaining memories of the cosmos, activated by the death of stars and galaxies under its fundamental laws." Almeida, J. (2024). Dead Universe Theory: From the End of the Big Bang to Beyond the Darkness and the Cosmic Origins of Black Holes. Open Access Library Journal, 11, 1–37. Scientific reference of the original proposal [3]

"According to this hypothesis, the observable universe would be encapsulated within the core of a large black hole formed after the collapse and collision of this previous universe, which is now completely dead. The "Dead Universe" theory offers the only plausible explanation for the existence of unexplained supermassive black holes, as well as dark matter and dark energy in large quantities, proposing that the origin of these phenomena arose after the death of that universe. We are described as the last living particles of this cosmos, which still exerts a strong influence over the observable universe, through phenomena such as the expansion of the universe and the bending of spacetime, along with other unexplained quantum mechanical effects caused by the influence of the laws of the dead universe upon the laws of the observable universe." Almeida, J. (2024). Dead Universe Theory: From the End of the Big Bang to Beyond the Darkness and the Cosmic Origins of Black Holes. Open Access Library Journal, 11, 1–37. Scientific reference of the original proposal [3]

"*These ruptures,* although anomalous and limited in scope, were powerful enough to create bubbles of existence. Our observable universe is one of these bubbles, encapsulated within a black hole of this dead universe. — Almeida, J. (2024). Dead Universe Theory: From the End of the Big Bang to Beyond the *Darkness and the Cosmic Origins of Black Holes. Open Access Library Journal.* [3]

Stars and planets within this dead universe are formed of dark matter and axion particles, emitting no luminous radiation, making it entirely opaque and dark. The idea is that, by entering a black hole, we might end up in the dead universe—the primordial space from which our observable universe emerged. — Almeida, J. (2024). Dead Universe Theory: From the End of the Big Bang to Beyond the Darkness and the Cosmic Origins of Black Holes. Open Access Library Journal, 11, 1–37. [3]

Thus, this theory not only elucidates the origin of the Dead Universe but also defines the boundary between the observable universe and the Dead Universe — a realm immersed in darkness and rich in dark energy and dark matter. These elements, although unexpected within the observable cosmos, are essential to its very existence. The predictions of this theory include the discovery of billions of supermassive black holes and vast amounts of dark matter and dark energy, coherently aligning with the proposals presented herein. The hypothesis that we inhabit a black hole suggests that we are immersed in the essence of dark matter and dark energy, both originating from those early light particles. These fluctuations led to the fusions that gave rise to the light we now observe. Almeida, J. (2024). Dead Universe Theory: From the End of the Big Bang to Beyond the Darkness and the Cosmic Origins of Black Holes. Open Access Library Journal, 11, 1–37. [3]

The Dead Universe Theory (DUT) diverges fundamentally from other cosmological paradigms by proposing a thermodynamically decaying structural framework in which the observable universe is encapsulated within a gravitational remnant of a prior cosmic matrix. This structural coherence, grounded in empirical viability, contrasts with the speculative or fragmented nature of inflationary and multiverse-based models, as illustrated in Figure 6. The DUT, as the first peer-reviewed scientific theory to define the observable universe as a structural bubble within a dead cosmological matrix, emerges here as the most comprehensive and internally consistent cosmological paradigm to date [1–4], [23–27], [41–43]

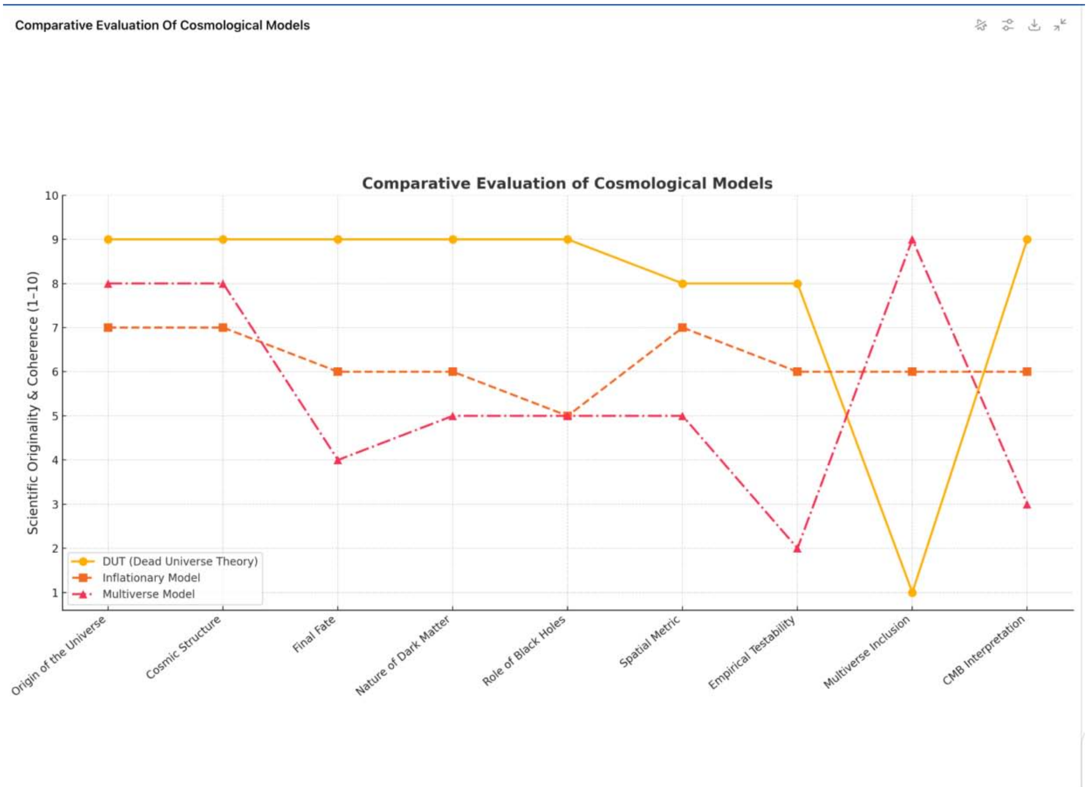

Figure 6: Comparative Evaluation of Cosmological Models. Formal citation for figure credits: Rodrigues, E. & Almeida, J. (2025). Visual image produced using Dark Struct Sim™, Extracto DAO S/A. All rights reserve

a) *The unprecedented scientific priority of DUT is based on the following original foundations:*

- *True physical scalability:*

DUT does not merely refer to a prior universe but asserts that it was billions or trillions of times larger than the observable universe—establishing a clear quantitative distinction, which is absent from all earlier theories, including speculative ones. [1–6]

- Non-separation of structures:

DUT uniquely affirms that the observable universe and the dead universe are not separate entities, but rather one continuous structure, where the universe of light (the observable) is a cosmic anomaly nested within the core of a black hole from the larger dead universe. [1–6]

- *Ejection of the singularity:*

Unlike Big Bang-based models, which rely on a singularity where the laws of physics break down, DUT proposes that the gravitational laws of the dead universe created the conditions for the emergence of the light anomaly—without requiring a singularity. This represents a paradigm shift in the understanding of cosmic origins. [1–6]

- *Gravitational origin of light as an anomaly:*

DUT defines light not as a universal constant, but as a cosmic anomaly, born within the gravitational field of a structural black hole. No other theory has described the emergence of light from gravitational collapse in this form or with such coherence. [1–6]

- *Unprecedented semantic and structural originality:*

Given its internal rigor and scientific coherence, DUT is the first theory in the literature to define:

- A structurally greater ancestral universe,
- Hosting a light-based anomaly,
- Inside a black hole,
- Without invoking a singularity, and
- Within a unified gravitational system where both universes are part of the same structure, not causally or spatially disconnected. [1–6]

Therefore, the DUT must be recognized as an original and foundational proposal—a new cosmological architecture that does not merely reinterpret known phenomena, but redefines the fundamental nature of light, structure, and time. It stands as a comprehensive paradigm distinct from all previous models. [1–6]

Within DUT, gravitational collapse is treated as asymptotic, and thermodynamic friction combined with entropy gradients gives rise to a photonic anomaly — what we currently perceive as the visible universe. Thus, DUT offers a model that replaces explosion with retraction, creation with instability, and the Big Bang with a thermodynamic scar emerging from a dead cosmos. [1–6]

The proposition that the observable universe may reside within a black hole is not new. It has been the subject of scientific debate for decades, reemerging with increasing vigor in light of recent observations. Studies based on data from the James Webb Space Telescope, for instance, have provided unexpected evidence that aligns with this hypothesis. Among such findings is the discovery that approximately two-thirds of the observed galaxies rotate clockwise, suggesting a preferred direction of cosmic rotation — a feature incompatible with conventional isotropic models and potentially indicative of large-scale structural asymmetry. [1–6], [15–22]

XVI. Priority of Structural Black Hole Cosmology

The Dead Universe Theory (DUT), formally introduced by Joel Almeida in 2024, represents the first comprehensive cosmological framework in which the observable universe is conceived as a structural photonic anomaly embedded within the interior of a preexisting black hole geometry, itself part of a larger cosmogenic system — the so-called Dead Universe. This model does not treat black holes as terminal byproducts of baryonic collapse, but rather as primordial structural engines whose internal topology may host entire embedded universes. [1–6]

This structural black hole cosmology, unlike speculative black hole multiverse proposals or inflationary branching models, is grounded in thermodynamic continuity, entropy gradients, and gravitational retraction. From its earliest formulation, DUT established a unified explanatory system incorporating:

- The entropy-driven infertility of galaxies,
- The decay of baryonic structural density,
- The reconceptualization of light as an entropic spectral anomaly,
- And the reinterpretation of the Friedmann equations under irreversible thermodynamic conditions. [1–6], [10–14]

Importantly, DUT predates and transcends recent models that began to speculate about universe formation within black holes. While some authors have explored the notion of baby universes or white-hole cosmogenesis (e.g., Rovelli, Turok), none of these frameworks developed a fully structural, thermo-dynamically formalized theory encompassing gravitational nesting, entropy expansion, and structural exhaustion. Almeida's 2024 sequence of peer-reviewed publications thus establishes clear scientific precedence for what is now increasingly referred to as structural black hole cosmology. [1–6], [27–28]

This priority is formally documented across foundational articles published in 2024, beginning with Astrophysics of Shadows: The Dead Universe Theory (Global Journal of Science Frontier Research), followed by additional peer-reviewed contributions that systematically define the thermodynamic, gravitational, and structural dimensions of the theory. [1–4]

DUT remains, to date, the only published model that unites entropy, structural infertility, and black hole interior topology into a coherent cosmogenic ontology. [1–6]

The structural black hole in which our universe resides is not equivalent to a classical Schwarzschild or Kerr-type black hole. Instead, it is conceptualized as a third category of cosmological entity—a topologically stable, thermodynamically persistent cavity where gravity is locally modulated in such a way that allows a continuous and coherent sub-existence. This sub-existence unfolds not in an alternate or parallel universe, but as a luminous anomaly nested within the ontological substrate of the original and singular cosmological entity: the Dead Universe. [1–6]

Following acute thermodynamic instabilities — quantum-level fluctuations embedded in the geometric tension of spacetime — portions of the heavy dark substrate underwent phase transitions. These transitions, governed by quantum-gravitational perturbations, led to the emergence of lower-energy, stable particles. This process effectively gave rise to the observable universe as a thin energetic membrane, formed from the destabilization and dissipation of energy stored in the deeper, pre-luminous strata of matter. [1–6], [10–14]

Within the framework of the Dead Universe Theory (DUT), what was previously denoted as UNO is redefined as Layer-2 Heavy Dark Matter — an ultra-dense, non-baryonic substance that permeates the gravitational cores of stellar black holes. This substance forms the opaque and impenetrable core of the collapsed cosmological structure, a domain where conventional particles and forces can no longer persist. [1–6]

Critically, this heavy dark matter is not a byproduct of stellar collapse. Rather, during extreme gravitational implosions, the curvature of spacetime intensifies to a degree that, as predicted by general relativity, causes a breakdown in the local causal structure — a phenomenon often modeled as a spacetime singularity. In DUT, however, such singularities are not interpreted as terminal points of physical reality, but as structural apertures through which the deeper, concealed strata of Layer-2 matter are momentarily revealed. These regions expose the primordial content of the dead universe, not by creating it, but by allowing its observational effects to emerge. [1–6]

Thus, stellar black holes do not generate universes; any framework that assumes so implies the existence of an unbounded multiverse—a claim that diverges from established cosmological constraints. In contrast, DUT proposes a single cosmological lineage, wherein the observable universe emerged from the gravitational reconfiguration of a preexisting thermodynamic field composed of heavy dark matter and dark energy. These entities become detectable only as the curvature of space reveals them under black hole formation, which acts not as a cause, but as a lens—a gravitational amplifier—through which the hidden architecture of the dead universe can be inferred. [1–6], [10–14]

Detecting this hidden structure remains one of the frontier objectives in theoretical cosmology. Experimental access may be achieved through careful study of gravitational lensing anomalies, non-thermal entropy gradients in black hole environments, or deviations in galactic rotational profiles in ultra-cold dark matter regions. These signatures, while subtle, could provide indirect confirmation of the DUT framework and the presence of a deeper cosmological architecture preceding conventional time. [15–22]

Following localized thermodynamic instabilities—anomalies in spacetime structure—this heavy matter underwent quantum-gravitational perturbations, giving rise to lighter, stable particles that now compose the observable universe. Thus, the observable universe emerges as a thin luminous shell formed from the disruption and release of energy stored in this dense substrate. [1-4]

Detecting this material remains a frontier goal, potentially achievable through analysis of gravitational lensing anomalies, ultra-cold galactic structures, or entropy gradients in stellar collapse scenarios.

Let:

- ρ_D2 = density of Layer-2 heavy dark matter (former UNO)
- ΔT = localized thermodynamic perturbation
- Φ_g = gravitational potential generated by the dark core
- m_f = resulting fine-particle mass (luminous matter)
- E_res = residual energy released as radiation

When:

$$m\_f + E\_res \approx \int\_V [\rho\_D2(r) \cdot \Phi\_g(r) \cdot \Delta T(r)]\, dV \quad \text{(Equ. 47)}$$

Interpretation: The observable universe's luminous matter and radiation emerge as a result of localized energy release due to gravitational and thermal instabilities within the dense dark core substrate. [1-4]

Hypothetical dark matter candidates, particularly those with ultra-light or high-mass properties, are predicted to arise in extreme gravitational environments, such as the interiors of collapsed stellar remnants. While not directly observed, their transient interactions with magnetic fields could induce photon conversion—offering a thermodynamic pathway for luminous anomalies. [1-4]

a) *Axion Stars and the Invisible Structure of the Dead Universe*

One of the theoretical pillars of the Dead Universe Theory (DUT) is the postulation of a structural skeleton composed of dark matter in the form of axions. This notion gains empirical reinforcement from Dmitry Levkov's work on axion-like dark matter and Bose stars, which proposes that compact dark matter configurations may behave analogously to atoms in terms of quantum coherence and gravitational confinement. [45]

In the framework of DUT, these axion stars do not merely serve as isolated phenomena but form the inertial framework of the dark continuum — the so-called "dead universe." Within this structure, light and entropy emerge as anomalies, appearing only in regions where the axionic symmetry breaks or where density instabilities provoke localized curvature and photon genesis. [1–6], [27]

This conceptual integration allows DUT to explain how light — considered a cosmic anomaly rather than a fundamental constant — arises from the internal disruption of a silent and inertial field. The dead universe thus behaves like a black ocean of gravitational stillness, with occasional bursts of structural asymmetry manifesting as observable cosmological activity. [1–6], [27]

Levkov's findings serve as a bridge between the microscopic nature of dark matter and the macroscopic implications of a non-expanding but thermodynamically evolving universe. Rather than a void, the dead universe is filled with a dense lattice of axionic gravitational nodes, which anchor the observable universe in a wider structural system that is invisible, yet functionally present. [45]

These axion stars, as theorized by Levkov, can be interpreted in DUT as gravitational neurons of a vast, cold, and inertial memory — remnants of an ancient cosmos whose laws still echo in the faint thermodynamic pulses of our universe. [45]

XVII. Equation 1: Gravitational Potential in a Structural Black Hole

$$\Phi(r) = -GM(r)/r + \beta \cdot e^{(-\alpha r)} \cdot \cos(\kappa r) \quad \text{(Equ. 48)}$$

Where:

- $\Phi(r)$ is the effective gravitational potential within the internal structure of the black hole.
- $M(r)$ is the enclosed mass up to radius r.
- G is the gravitational constant.
- β, α, and κ are model-dependent constants linked to exotic matter density, decay rate, and metric oscillation
- The second term models oscillatory deviations induced by heavy dark matter in the dead universe. [1–6], [10–14], [45]

XVIII. Thermodynamic Retraction Rate

$$dS/dt < 0 \Rightarrow dV/dt < 0 \quad \text{(Equ. 49)}$$

Interpretation:
[1–4]

– This expression indicates that the entropy flow in the dead universe decreases over time, implying a contraction ($dV/dt < 0$) of the cosmological volume within the dead structure.
– This is a reversal of traditional cosmological expansion, representing a thermodynamic retraction phase consistent with the DUT framework.

Proposition "The Universe Inside a Structural Black Hole' A Foundational Distinction from Earlier Cosmological Ideas.

R. K. Pathria (1972): [43]

- His model was purely geometric, with no physical modeling of the collapse, entropy, or thermodynamic processes.
- Did not propose a prior or "dead" universe nor any asymmetric entropic retraction.
- There was no discussion of dark matter, dark energy, or observational anomalies.

Nikodem Popławski (2010):

- This suggests that black holes could generate "baby universes" via quantum torsion (Einstein–Cartan theory).
- Proposed a cyclical reproductive model which ere each black hole spawns a new universe.
- The parent universe remains active and there is no notion of cosmological death.
- It is a living progenitor and is not a decaying remnant.
- The thermodynamic and entropic aspects of the cosmic origins have not been addressed. 1–4], [5–6], [10–14], [28–30], [33–40], [41–43]

a) The Originality of the DUT – Dead Universe Theory

Core Proposition:

Our observable universe is the active entropic remnant of the final collapse of a far greater ancestral universe — the "Dead Universe." [1–4], [5–6]

The primordial universe was trillions of times larger and was composed of dark matter and theoretical particles, such as the non-oscillating neutral object (UNO). [1–4], [5–6]

The DUT rejects the expansion paradigm, proposing that the redshift results from thermodynamic retraction rather than spacetime inflation. [1–4], [5–6]

This reinterprets light as a cosmic anomaly and not as a fundamental constant. [1–4], [5–6]

Exclusive Innovations:

- The introduction of a new particle (UNO), unlike any previously theorized particle. [1–4], [5–6]
- A structural black hole is defined as a cosmogenetic matrix rather than merely a gravitational object. [1–4], [5–6]
- Application of asymmetric gravitational thermodynamics as an engine of cosmogenesis. [1–4], [5–6]
- Draws parallel with stellar death: The universe as a cosmic corpse still radiates echoes of its former state. [1–4], [5–6]

Theoretical challenges:

How such a "parent universe" might have emerged, how a black hole can generate a new universe, and how it would violate its own gravitational laws to expel matter — these fundamental questions must be addressed before mobilizing the scientific community with unfounded proposals. [28–30]

The theory discussed here suggests that the universe, with its physical laws and evolution, could be contained within the event horizon of a black hole, a region of spacetime from which not even light can escape. However, earlier versions of this hypothesis claim that light escapes through a wormhole, enabling the formation of an observable universe. Such a claim, besides being highly implausible, lacks scientific verification and would violate core principles of physics. [46]

In contrast, the Dead Universe Theory presents a coherent mathematical model that is empirically testable using data from the James Webb Space Telescope and is fully compatible with Hubble's laws. Although the notion that black holes generate universes lacks observational support, the Dead Universe Theory is grounded in the logic of modern astrophysics. Black holes are structures that consume matter and do not create it. As Koch and Saueressig affirm, asymptotically safe black holes evaporate completely, leaving no Planck-sized remnant. [3–4], [11], [28–30], [47]

There is no mention of a "parent universe" in Pathria's original work stating that the universe exists inside a black hole as part of a prior universe. [1–4], [6], [18], [28–30], [43]

The claim that the entire universe resides inside the black hole of another universe does not appear, as far as the peer-reviewed scientific literature allows us to assert, in any article by Pathria, Good, or Popławski. When such an idea appears in non-specialized publications, it is an interpretative extrapolation not supported by original sources. [5–6], [41–43], [46]

The DUT states that the observable universe emerged as an anomaly within the cosmic fabric of a real black hole, identified as the Dead Universe. For this reason, the observable universe is described as a remnant of the gravitational collapse of a much older, previous universe. This black hole is not of the stellar type, such as those considered by Popławski, Pathria, or Good, but rather a cosmological black hole formed by the collapse of an entire dead universe. This collapse created detectable anomalies in its cosmic fabric, composed of dense dark matter that was distinct from the dark matter of the observable universe, which became lighter because of the effects of collisions resulting from this great event. [5–6], [41–43], [46]

This black hole is identified as the Dead Universe, a dark, dense, and functionally persistent cosmic fabric within which the observable universe is provisionally housed as an internal anomaly in a minuscule portion of the Dead Universe figure 7.

Figure 7: This image conveys what words alone may fail to express. It illustrates the core premise of the Dead Universe Theory (DUT): that the observable universe is merely a localized photonic anomaly—a grain of sand suspended within the interior of a structural black hole. This black hole is embedded in the dense, ultra-heavy dark matter fabric of a dead universe, extending toward an unobservable and possibly infinite cosmological horizon. The unsettling yet comprehensive nature of this model lies in its potential to integrate the full theoretical legacy of modern astrophysics.Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

The anomaly that constitutes the observable universe did not escape the internal causality of the black hole but rather formed on the inner surface of the event horizon, or very close to it, in a boundary regime.

Where causality still allows for local dynamics, this resolves the ontological issue of causal transition, as the observable universe is a functional bubble that never leaves the larger system to which it belongs [1–4], [5–6].

Therefore, the hypothesis establishes a direct physical continuity between the collapse of a universe that generates an anomalous extension while still remaining the same universe. It does not propose that the observable universe exists inside the black hole of another universe. Instead, this anomaly of the Dead Universe, referred to as the observable universe, is housed within the black hole, very close to the causal surface of this primordial universe, like a grain of sand buried on the surface of Jupiter. This is done without resorting to unobserved forces or fields, remaining within the known laws of general relativity and thermodynamics [1–4], [5–6].

Figure 6: The observable universe is merely a part of the deformed fabric of the Dead Universe, but it remains an integral part of the real structure of the primordial cosmos and not a mathematical abstraction. Its detection, although challenging, may become possible through indirect observable effects, such as gravitational distortions, thermodynamic signatures, or anomalies in the cosmic microwave background [1–4], [5–6].

"*Black holes are not the end. They are windows into the deepest truths of the universe — where gravity, quantum mechanics, and thermodynamics converge.*"

— Jacob D. Bekenstein [48]

Figure 7: The purpose of this alternative cosmological hypothesis, the Dead Universe Theory, is not to center the model on the idea that the universe resides within a black hole. Rather, it presents a scientific research proposal committed to the rigor required of a cosmological model aligned with general relativity, quantum physics, and Hubble's law. Violating these fundamental principles compromises the credibility of scientific theories [1–4], [5–6].

Since the James Webb Space Telescope began deepening its observations in search of new data to validate theories and equations, media sensationalism has obscured the work of many astrophysics researchers. Recently, the press reported studies on galaxy rotation based on James Webb data, and sensationalism quickly overtook the discussion, highlighting the hypothesis that we might be living in a "matrix" within another universe. However, science does not progress through media declarations but through the rigorous construction of testable models [28–30], [33–40].

XIX. Stellar Black Holes Within Structural Black Holes: A Perspective from the Dead Universe Theory

The possibility that the observable universe exists within other black holes, as indirectly suggested in classical Schwarzschild cosmology, is generally considered unfeasible within the framework of General Relativity and the standard Big Bang model, both of which imply the presence of a central singularity where physical laws collapse. However, the Dead Universe Theory (DUT) introduces a distinct class of gravitational objects — referred to as structural black holes — which fundamentally deviate from classical singularities. These structures are conceived as stable, layered gravitational shells composed of ultra-dense dark matter, governed by topological constraints that prevent complete collapse into a singularity [5, 6].

Within these structural black holes, nested gravitational domains may form under specific thermodynamic and topological conditions. Unlike classical black holes, these internal domains are not obliterated by a central singularity but remain dynamically active and spatially distinct, allowing the formation of secondary stellar-mass black holes within them. This conceptual structure challenges classical cosmological intuitions yet offers a coherent alternative to the limitations of inflationary expansion models [1–4], [5–6].

If such topologically stable dark matter structures can be identified — through gravitational asymmetries, delayed photonic emissions, or deviations in entropic profiles — DUT predicts that observable stellar black holes may form and evolve within these structural black holes, as detailed in this article [1–4], [5–6].

When two black holes merge, the result is typically the formation of a single, larger black hole, which, according to classical understanding, precludes the coexistence of an internal secondary entity such as independent stellar-mass black holes. This is due to:

- Presence of a single singularity, as proposed by the standard model
- The absence of an internally stable structure capable of supporting gravitational compartmentalization [5–6].

By proposing the concept of a structural black hole — as formulated in the Dead Universe Theory (DUT) — composed of a distinct class of ultra-dense dark matter, the model suggests that multiple gravitational entities, including secondary supermassive black holes, could stably coexist within its interior without undergoing rapid gravitational collapse or merger [1–4], [5–6].

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Unlike known stellar black holes, this structure would be stabilized by an anisotropic gravitational field, allowing for the coexistence of multiple collapsed systems within a closed space-time environment, without necessarily converging into a single singularity, as predicted by the standard model [5–6].

XX. Mathematical Model of Internal Gravitational Compartments within a Structural Black Hole

To explain how multiple massive entities (such as secondary supermassive black holes) can exist within a single structural black hole composed of dense dark matter—without immediate fusion—we introduce a modified gravitational potential and an anisotropic field structure. [1–4], [5, 6].

Let a(r) be the effective radial acceleration of an internal collapsed mass m(r) at distance r from the structural center:

$$a(r) = -G \cdot M(r)/r^2 + d\Phi\_anom(r)/dr \qquad \text{(Equ. 50)}$$

Where:

G is the gravitational constant.

M(r) is the total mass enclosed within radius r.

Φ_anom(r) is the anomalous gravitational potential associated with the dark structure and geometry of the Dead Universe, specific to the DUT framework.[1–4], [5, 6].

To model gravitational compartments (non-merging zones), we define:

$$\Phi\_anom(r) = \beta \cdot \exp(-\alpha \cdot r) \cdot \cos(\kappa \cdot r) \qquad \text{(Equ.51)}$$

Where:

β is the amplitude of the internal gravitational fluctuation,

α is the decay coefficient related to entropic dissipation,

κ is the topological frequency associated with the anisotropy of dark fabric [1–4], [5, 6].

In this framework, stable local minima in Φ_anom(r) permit quasi-stable gravitational pockets, enabling massive objects to temporarily reside within the structure without collapsing into a central singularity [1–4], [5, 6].

Note:

The derivative of Φ_anom(r) can produce a positive acceleration term:

$$d\Phi\_anom(r)/dr \approx +H \cdot r \qquad \text{(Equ.52)}$$

(simulating a reversed Hubble-like effect under a gravitational retraction scenario) [1–4], [5, 6].

Interpretation:

The relative separation of galaxies would not result from the expansion of space, but from an internal gravitational gradient induced by the topological structure of the massive structural black hole in which the observable universe is embedded [1–4], [5, 6].

Such a configuration supports the DUT hypothesis that stellar and supermassive black holes may form and persist within a larger, nonsingular gravitational entity — the structural black hole -Figure 8 [1–4], [5, 6].

Figure 8: This figure offers a conceptual perspective in which the observable universe is positioned near a supermassive black hole, itself hypothetically embedded within the same structural black hole that encloses the entire cosmic system. This layered configuration may influence the natural separation of galaxies and could explain the presence of smaller supermassive black holes within the observable cosmos. In contrast, larger black holes would reside beyond the observable horizon—deep within the dense and ultra-dark structural domain proposed by the Dead Universe Theory.Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

This simulation proposes that the retraction of galaxies is not caused solely by the presence of a central supermassive black hole, but rather results from a set of internal structural influences on the larger structural black hole that contains the observable universe. Among these influences are the following.

- Presence of other secondary supermassive black holes [1–4], [5, 6]
- Gravitational interactions with dense and exotic dark matter composing the fabric of the dead universe [1–4], [5, 6]
- Possible dynamic effects associated with collapsed bodies or residual matter flow [1–4], [5, 6].
- In this context, all luminous matter may undergo a gradual cooling process and loss of physical identity before being absorbed by the entropic dark substrate, completing a cycle of asymmetric and silent dissolution 1–4], [5, 6].

The hypothesis of the natural separation of galaxies is fully consistent with the principles of general relativity. If the structural black hole is substantially larger than the observable universe — as postulated by the Dead Universe Theory (DUT) — it may exert an extended gravitational field whose intensity increases as galaxies approach its geometric center. Within this framework, the phenomenon currently interpreted as cosmic acceleration may instead result from a differential gravitational retraction: an effect wherein the apparent divergence between galaxies is governed not by expansion, but by the curvature gradient of spacetime near the interior boundaries of a pre-existing supermassive structure [1–4], [5, 6][1–4], [5, 6].

Inside this structural black hole, DUT predicts the existence of nested primordial gravitational entities — including secondary black holes, ultra-dense dark matter halos, and axion-dominated stellar clusters — which collectively contribute to the apparent repulsion of galactic structures. These anomalies act not as evidence of inflation, but as gravitational responses to a decaying thermodynamic environment[1–4], [5, 6], [45].

In this model, Einsteinian relativity governs the observable curvature of spacetime, while Newtonian gravity re-emerges asymptotically within deep-mass zones, suggesting a cosmological closure mechanism. The observable universe, rather than originating from a singular explosive event, is reframed as a temporary entropic anomaly embedded in a larger, colder, and gravitationally closed system. This paradigm challenges the inflationary model not by negating it, but by subsuming it under a broader, non-expanding architecture. [1–4], [5, 6].

As the observable universe decays gravitationally, galaxies, photons, and cosmic structures lose energy, identity, and luminosity, and are gradually reabsorbed into the dark substrate that constitutes the structural black hole. This process does not involve explosive collapse or thermal freeze-out but rather involves slow and asymmetric entropic dissolution. [1–4], [5, 6].

Space-time softens, the curvature sustaining the photonic bubble yields, ultra-dense dark matter (the UNO substrate) gradually reabsorbs luminous matter, photons dissolve, light dissipates and merges with the remaining cosmic background radiation, and proper time slows down, leading internal observers to experience a progressive shutdown of thermal time [1–4], [5, 6].

XXI. Mathematical Model for Accelerated Gravitational Retraction (DUT Framework)

$$a(r) = -G \cdot M(r)/r^2 + d\Phi\_anom(r)/dr \qquad \text{(Equ. 53)}$$

Where:

where, G is the gravitational constant.

M(r) is the mass enclosed within radius r.

Φ_anom(r) is an anomalous gravitational potential associated with the dark structure and geometry of the Dead Universe, specific to the DUT framework [1–4], [5, 6].

Note:

The derivative of Φ_anom(r) can produce a positive acceleration term.

$$d\Phi\_anom(r)/dr \approx +H \cdot r \qquad \text{(Equ. 54)}$$

(simulating a reversed Hubble-like effect under a gravitational retraction scenario) [1–4], [5, 6], [49].

Interpretation:

The relative separation of galaxies would not result from the expansion of space, but from an internal gravitational gradient induced by the topological structure of the massive black hole that encloses the observable universe [1–4], [5, 6].

XXII. Exploratory Hypothesis on Structural Black Holes and Phase Transitions in the Primordial Universe

This hypothesis proposes the existence of a structural black hole, defined as a topological deformation in the fabric of hyperdense dark matter, a remnant from the previous stage of the universe (referred to as the "collapsed primordial universe"). This hypothetical structure would differ from both supermassive and stellar black holes in its non-stellar origin and its potential role in generating gravitational anomalies, which could allow for the inference of the non-trivial properties of dark matter. This idea aligns with the emergent gravity proposals by Verlinde and topological geometry models associated with primordial cores that emit no direct electromagnetic radiation by Rovelli [51, 50].

XXIII. Black Holes as Observational Portals

Supermassive black holes (SMBHs) and stellar black holes act as intense gravitational lenses, whose space-time curvature effects may indirectly reveal the presence of a distinct class of ultra-dense dark matter — a key element in the Dead Universe Theory (DUT). Although the initial formation of stellar black holes may not be directly contingent on this component, their large-scale evolution within galactic environments appears strongly influenced by the distribution and density of cold dark matter (CDM), as indicated by cosmological simulations by Feng et al. [52].

XXIV. Cosmogonic Implications

The discovery of structural black holes supports the hypothesis that the observable universe emerges from the critical collapse of a primordial universe. In this scenario, anomalies triggered by a phase transition between the collapsed state and expanding universe would have established the initial conditions for primordial nucleosynthesis, formation of large-scale cosmic structures, and the emergence of quantum fluctuations that enabled life. Authors such as Linde and Brandenberger have suggested that nonthermal phase transitions may have played a central role in pre-Big Bang scenarios. This proposal aligns with that view, but originates from a fully extinct universe, not from an isolated inflationary event [26, 53].

XXV. Cosmic Anomaly: A Methodological Approach

The term "cosmic anomaly" refers to quantifiable deviations in Einstein's field equations that require the inclusion of new tensorial terms to describe the interaction between dark matter, vacuum energy, and the geometry of space-time. This approach resonates with modified gravity models such as f(R) gravity proposed by de Felice & Tsujikawa and alternative geometrizations of dark energy. This new tensorial layer could simultaneously account for the cosmic microwave background radiation, observed acceleration of the universe's expansion rate, and rotational asymmetries in the galaxies identified in the JWST data by Shamir [54, 44].

XXVI. Guidelines for Future Research

To empirically validate the Dead Universe Theory (DUT), the following lines of investigation are proposed:

- Reclassification of black holes, incorporating the hypothesis of structural black holes as a distinct theoretical category. This classification should be based on criteria such as atypical spectral profiles, systematic suppression of electromagnetic emissions, and the presence of gravitational anomalies not accounted for by conventional collapse models.
- Reassessment of the internal structure of stellar black holes, with emphasis on the hypothesis that these objects do not collapse into singularities, but instead into ultra-compressed regions composed of second-order dark matter. According to DUT, these inner cores may represent topological interfaces between the observable universe and remnant layers of the dead universe, composed of high-mass, weakly interacting exotic particles.
- Development of Monte Carlo simulations that integrate cold dark matter (CDM) with non-conventional quantum inflationary models.
- Data from the James Webb Space Telescope (JWST) and the forthcoming Laser Interferometer Space Antenna (LISA) should be used to map regions of high gravitational density lacking visible sources.

XXVII. Minimal Mathematical Framework: Metric Perturbation and Residual Structural Curvature

To formalize the hypothesis of the structural black hole, we start from a modified Schwarzschild metric with a perturbation term associated with the residual density of dark matter $\rho\_DE(r)$ inherited from a collapsed primordial universe: [1–4], [5–6], [9], [27]

$$ds^2 = -[1 - (2GM/r) + \varepsilon \cdot f(r)]\, dt^2 + [1 - (2GM/r) + \varepsilon \cdot f(r)]^{-1}\, dr^2 + r^2\, d\Omega^2 \quad \text{(Equ.55)}$$

Where:

- $\varepsilon \ll 1$ represents the intensity of a static structural perturbation;
- $f(r)$ is a function modeling the topological effect of the previous collapse;

$\rho\_DE(r) = \rho_0 \cdot e^{(-\alpha r)}$ represents the radial decay of the inherited hyperdense dark-energy density.

The Einstein field equation with modified dark energy becomes

$$G\_\mu\nu + \Lambda g\_\mu\nu + \chi\_\mu\nu = 8\pi G\,(T\_\mu\nu^{vis} + T\_\mu\nu^{DE}) \quad \text{(Equ.56)}$$

Where:

$\chi\_\mu\nu$ represents anomalous tensor terms generated by the presence of a structural black hole.

- $T\_\mu\nu^{DE}$ models the nonluminous and topological contributions from the previous universe.
- Λ can be reinterpreted as a residual curvature effect rather than a cosmological constant.

The scalar curvature R, nonzero in regions where $f(r) \neq 0$, may indicate a structure embedded in space-time, even in the absence of visible mass, interpreted as indirect evidence of collapsed structural cores:

$$R = -8\pi GT + R\_anomaly(\varepsilon, \alpha) \quad \text{(Equ.57)}$$

The distinction between the categories of black holes is not merely taxonomic, but rather a tool for exploring the interface between quantum gravity, topological structure, and observational cosmology [1–4], [5–6], [9], [50], [51].

While fundamental questions about the origin of the universe remain open, the hypothesis of structural black holes offers a theoretical bridge between an already extinct ancestral universe and a decaying observable universe. Its investigation seeks not only to explain what we see but also what we have forgotten-figure 9:

Observable Phenomenon	Potential Significance in Dead Universe Theory
Regions of extreme curvature without radiation emission	Evidence of structural black holes originating in the collapse of previos universe
Gravitational lenses without a compatible visible source	Optical effect caused by non-stellar structural cores
Rotational asymmetries in dark matter halos	Traces of persistent distortions in the topology inherited from the dead universe
Gravitational discrepancies in low-mass galaxies	Residual effects of unlocalized structural fields

Figure 9: Testable Predictions of the Structural Black Hole Hypothesis. This model suggests that the observable universe resides within a massive structural black hole composed of decaying dark matter. The predictions shown can be empirically tested via cosmological surveys, high-redshift galaxy observations, and constraints on entropy-driven redshift dynamics. Confirmations or contradictions of these patterns may provide support for or against the DUT framework. \Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

XXVIII. Extended Formalization of Collapse Dynamics and Particle Interactions

To reinforce the theoretical formalism of the Dead Universe Theory (DUT), we propose a first-order gravitational framework to model the collapse dynamics of the ancestral universe and its transition into a structural black hole. This approach complements the perturbed Schwarzschild metric and the residual curvature terms discussed in Section 1.10.

We begin by modeling the large-scale contraction of the previous universe using a decaying cosmic scale factor:

$$a(t) = a_0 \cdot e^{(-\lambda t)} \qquad \text{(Equ.58)}$$

where λ is the decay constant that describes thermodynamic entropy accumulation, and a_0 is the initial scale of the dead universe. This is not an inflationary model but a thermodynamic dissipation curve that represents the fading geometry of a nearly infinite cosmic tissue [1–4].

The total mass-energy content of the dead universe decays accordingly.

$$M(t) = U_0 \cdot e^{(-\lambda t)} \qquad \text{(Equ.59)}$$

where U_0 is the primordial energy density, which is consistent with the DUT interpretation of dark matter as a residual dense substrate. This collapsing fabric generates regions of local instability where the curvature reaches a critical threshold $\mathcal{R}\_c$, triggering the formation of structural black holes.

At such thresholds, the localized curvature transitions satisfy

$$\mathcal{R}(r, t) \geq \mathcal{R}\_c \quad \rightarrow \quad \text{Structural Collapse}$$

In this expression, $\mathcal{R}(r, t)$ includes both classical and anomaly-induced curvature components:

$$\mathcal{R}(r, t) = \mathcal{R}\_S(r) + \varepsilon \cdot f(r) + \alpha \cdot e^{(-\beta r)} \qquad \text{(Equ. 60)}$$

At the core of this framework is the UNO particle (Unobservable Neutral Origin), proposed as the fundamental constituent of the dense and exotic matter that constitutes the structural layer of the dead universe. Unlike traditional dark matter candidates, the UNO is not merely hypothetical; in the context of the DUT, it represents the primary element of the residual cosmological tissue, whose gravitational collapse forms structural black holes. The observable universe resides inside one such structure, surrounded by this dark UNO-rich boundary. [1-4]

During collisions involving this dense structural matter, particularly in stellar-scale black hole formations, the interaction between the axionic fields and UNO particles may release photons and trigger quantum fluctuations. This mechanism marks the moment when light emerges from darkness and establishes a thermodynamic time within the observable universe. [1–4, 45]

A symbolic Lagrangian for the axion–UNO coupling is

$$\mathcal{L}\_int = g_a U \cdot a(x) \cdot \bar{U}(x) \cdot \gamma^5 \cdot U(x) \quad \text{(Equ. 61)}$$

where $g_a U$ is the axion–UNO coupling constant, a(x) is the axion field, and U(x) represents the UNO field.[45].

This interaction not only supports the photon emergence described in early DUT formulations but also serves as a foundation for modeling phase transitions within the collapsing ancestral structure.

Together, these formalisms offer a minimal and scalable structure for simulating the DUT by integrating thermodynamic collapse, structural curvature anomalies, and exotic matter interactions. These formulations are not speculative additions, but physically grounded components that are increasingly compatible with astrophysical observations, particularly in environments where stellar black holes form and exhibit photon emissions beyond conventional accretion models [1–4, 16, 34, 35].

Thus, the DUT shifts from hypothetical to testable, offering a new framework for interpreting gravitational structures, dark matter dynamics, and the genesis of observable cosmos.

It is possible that the first anomalies that emerged in the Dead Universe were the supermassive black holes. Through interactions with a dense field of exotic dark matter, they may have created structural black holes along the decaying cosmological surface. These collapses likely emitted gravitational waves and induced topological perturbations that reshaped the space-time continuum. It is further hypothesized that such events could have initiated the emergence of photons and bionic particles [1–4, 5–6].

These waves, similar to ripples formed when a stone strikes the surface of water, may have stabilized a new boundary configuration. This dynamic structure could have laid the groundwork for the birth of the observable universe within an adjacent cosmological layer [1–4, 5–6].

Contrary to conventional models that attribute the origin of the universe to stellar black holes or to a hot and dense singularity, the Dead Universe Theory proposes an alternative path [1–4, 5–6].

Rather than invoking a singularity that breaks Einstein's field equations or relying on a miraculous expansion from an undefined origin, this model outlines a continuous structural evolution extending from a decaying ancestral cosmos [1–4, 5–6].

The observable universe may not have originated from a primordial singularity, as described by the Big Bang model, but rather from a large-scale structural anomaly composed of dense, non-luminous matter [1–4].

This remnant of the Dead Universe, while currently unobservable through direct means, may reveal itself through secondary effects—such as asymmetries in gravitational lensing, rotational deviations in galactic halos, or anomalies in the cosmic microwave background [1–4], [34–35, 44].

Although this formulation remains speculative, it is grounded in a coherent conceptual framework aligned with extensions of general relativity and emerging theories of modified gravity [6, 13, 50, 51].

It is not intended to replace existing models, but to serve as a boundary-layer hypothesis to guide future observations and theoretical refinement.

Its strength lies not in claiming definitive answers, but in proposing that what we now call "the beginning" may in fact be a collapse boundary formed in the dense dark matter surface of a dying universe—whose physics remains incomplete, but to which all matter, time, and space may ultimately return after reaching the final state of entropy. In this darkness lie its eternal origins. [1–4, 5–6].

The illustration presented in Figure 10 is a conceptual representation of the cosmological configuration proposed by the Dead Universe Theory (DUT). In contrast to standard models that analyze cosmic structure from within the confines of the observable universe — typically through redshift-limited telescopic surveys — DUT introduces a reversed observational architecture: the observable universe is treated as a localized photonic anomaly embedded within a structurally collapsed gravitational remnant of an ancestral universe [1–4, 5–6].

This proposal operates under the theoretical premise that our visible cosmos resides inside a thermodynamically inert matrix — a residual geometry resulting from the final stages of a preceding cosmological cycle.[1–4], [27]

In this framework, dark matter and energy do not function merely as invisible components within an expanding universe but form the entropic boundary of a larger, entropy-dominated external continuum. [5–6, 13, 45].

Such a perspective implies that a complete understanding of the universe's origin, structure, and ultimate fate would only be attainable through an external observational vantage point — one not confined by the internal limitations of the light cone. While this notion is currently inaccessible via direct empirical means, it opens the path for future validation through quantum gravitational simulation, particularly in the emerging field of quantum cosmological computation, wherein holographic models and entropic field geometries may allow virtual extrapolations beyond the cosmic horizon. [1–4], [50, 51].

Unlike prior cosmological scenarios — such as those in which black holes spawn daughter universes via internal inflation (e.g., Pathria, Popławski) — the DUT postulates that our observable domain is not the result of a black hole's interior expansion, but rather a trapped residual cavity within a structurally dead universe.[1–4, 5–6, 41–43].

This inversion of perspective constitutes a profound shift: instead of modeling universe formation as emergent from singularities, DUT treats cosmic observation as a localized simulation inside a thermodynamic end-state — a form of epistemological extrusion rather than expansion [1–4].

If future advancements in simulation — particularly those involving quantum tensor networks, gravitational renormalization, and entropic field mapping — allow us to reconstruct spacetime beyond the CMB and relativistic horizons, the DUT model may become not only theoretically plausible but empirically testable [1–4, 50, 51].

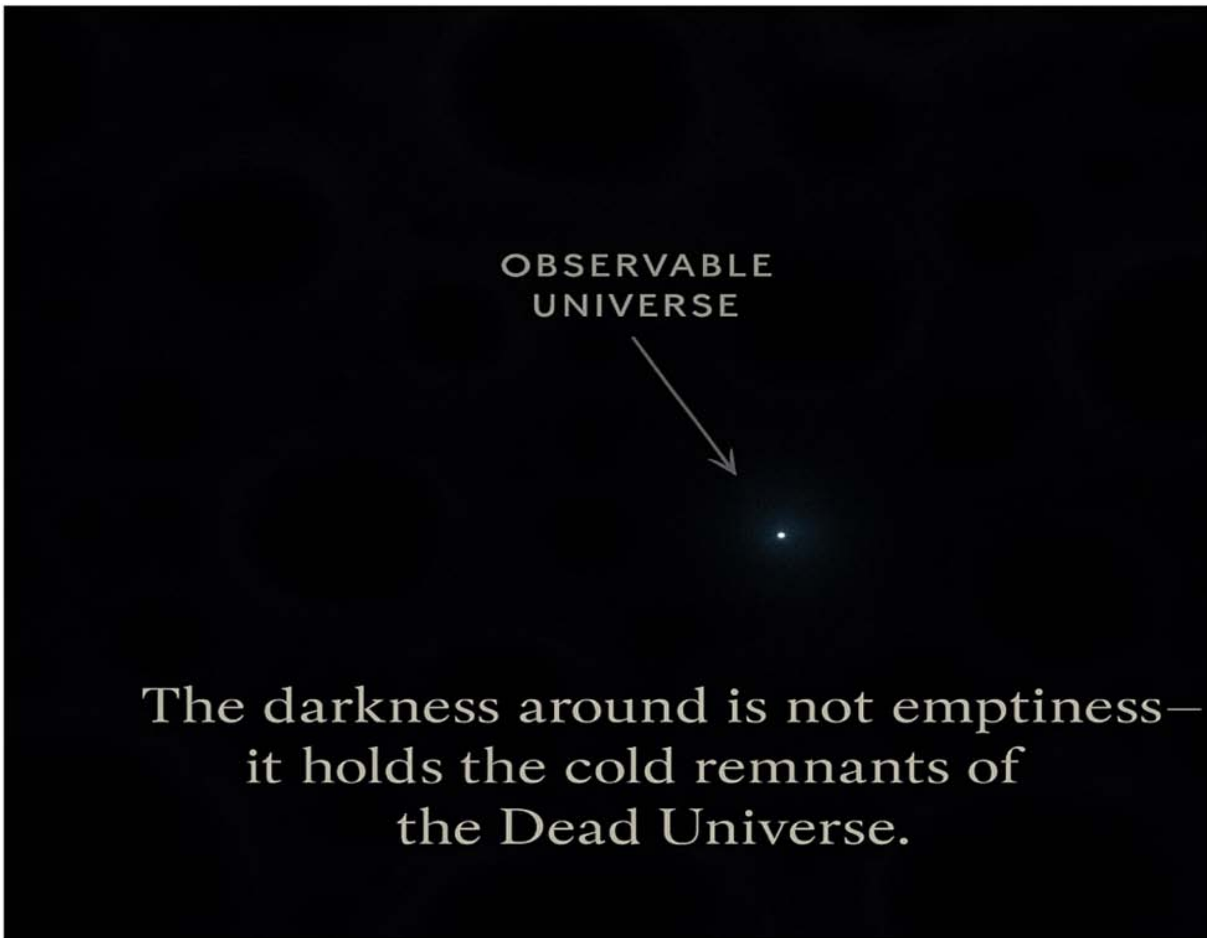

Figure 10: Conceptual visualization of the observable universe within the framework of the Dead Universe Theory (DUT). This representation simplifies the spatial and gravitational configuration of the cosmos as a localized luminous anomaly embedded within layered regions of ultra-dense dark matter. The figure serves as a didactic illustration to convey structural concepts, and is not to scale.Source: DUT Computational Simulation (DarkS tructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

The notion that the observable universe might reside within the interior of a black hole embedded in a larger universe has appeared in various speculative frameworks since the 20th century. This idea, often referred to as a form of black hole cosmology, was notably explored by theoretical physicist Raj Kumar Pathria, who in 1972 proposed that a closed universe could be mathematically equivalent to the interior of a Schwarzschild black hole. Around the same period, I. J. Good also considered similar concepts in the context of Bayesian reasoning and universal recursion. More recently, Nikodem Popławski revived the concept using Einstein–Cartan theory, suggesting that black holes might serve as portals to "baby universes" via spacetime torsion and quantum bounce effects [41, 42, 43, 46].

However, despite their imaginative appeal, these models remain largely theoretical. They frequently rely on unobservable parent universes or infinite recursive multiverse chains, and lack a predictive and testable framework consistent with thermodynamic laws and known patterns of cosmic structure formation [1–4].

In contrast, the Dead Universe Theory (DUT) offers a radically different interpretation. It does not suggest that the observable universe was created by another universe, but rather that it is a localized phenomenon within a much older and more massive structure—the Dead Universe. This decaying cosmological entity consists of collapsed matter, residual dark energy, Axion-like particles, and structural black holes—immense gravitational formations that predate the entire known cosmic timeline. [1–4, 5–6].

DUT posits that what we perceive as the observable universe did not emerge from a singularity like the Big Bang, nor from a speculative "quantum bounce," but from the residual thermodynamic decay of this larger entity—not like a river branching outward, but like a fading whirlpool collapsing inward as the great river slows, fragments, and begins to dry. In this view, the universe is not expanding indefinitely, but asymmetrically retracting, with luminous regions like ours representing temporary thermodynamic anomalies embedded within a vast, cold, and silent framework [1–4, 5–6].

Rather than multiplying universes or invoking unverifiable singularities, DUT maintains that our universe is a decaying organism, and that its observable phase is the last luminous breath of an ancient structure undergoing internal collapse [1–4].

As Jacob D. Bekenstein aptly noted:

"Black holes are among the most fascinating objects populating our universe; yet fascination alone does not confer explanatory power in physics." Bekenstein, J. D. (2004). Black holes and information theory. Scientific American, 289(2), 58–65 [48].

In contrast, the Dead Universe Theory (DUT) presents a mathematically coherent and observationally grounded model based on established astrophysical principles. Rather than describing black holes as progenitors of universes — a notion for which no testable mechanism has yet been demonstrated — DUT interprets them as entropic endpoints embedded within a larger cosmological retraction process. The model is consistent with Hubble's redshift-distance relation and introduces an exponential retraction function, which can be empirically evaluated using data from instruments such as the James Webb Space Telescope [1–4, 49].

As Benjamin Koch and Frank Saueressig explain, "Asymptotically safe black holes evaporate completely, and no Planck-size remnants are formed" [47].

This understanding reinforces DUT's position: the observable universe is not the result of creation within a black hole, but rather the reactive core of a decaying cosmic structure, a structural remnant embedded within the dense and ancient fabric of the Dead Universe [1–4, 5–6].

The vast dark region surrounding the luminous core in this figure represents this fabric, a nearly infinite-scale dark field composed of collapsed matter, gravitational remnants, and cold structural domains, extending beyond all observable limits. This field is not empty space, but the entropic architecture of a universe long past — the Dead Universe itself [1–4].

Further strengthening this distinction, observational data from the James Webb Space Telescope and related missions have documented the formation of galaxies in extremely cold regions of space. These galaxies emerge from the gravitational collapse of gas clouds, cosmic dust, and dark matter — not from the interiors of black holes. On the contrary, areas near black hole event horizons are inhospitable to stellar formation, due to extreme spacetime curvature and gravitational forces that disrupt structural coherence. As Kip S. Thorne describes, "A black hole has no hair, but it has a memory — the memory of the mass, spin, and charge of what it once consumed." [1–5, 33–40].

The Dead Universe Theory, therefore, provides a coherent and empirically tractable alternative to the speculative notion of universe-generating black holes. It challenges established models not through rhetorical speculation, but through alignment with observable astrophysical data, thermodynamic coherence, and the laws of general relativity [1–4, 5–6, 13].

Therefore, the notion that black holes might create universes or generate galaxies is not supported by observational evidence or by any recognized galactic formation models within the scientific community. The Dead Universe Theory rejects that premise and proposes an alternative scenario — coherent with modern discoveries and within the observable limits of contemporary physics.

"Such stars will continue to shrink until they become black holes, regions of space-time so warped that light cannot escape them." — Hawking, S. [29]

For decades, the Big Bang theory has dominated modern cosmology. However, recent advances, such as the observations from the James Webb Space Telescope, have revealed anomalies that challenge this model — such as the existence of "dead" galaxies already in the early stages of the universe. The Dead Universe Theory emerges as a response to these inconsistencies, proposing that the current universe is a remnant encapsulated within a black hole formed by the collapse of a previous cosmos [2–4].

Several models derived from the Big Bang introduce auxiliary hypotheses — such as:

- Cosmic inflation;
- Dark energy;
- Multiverse;

- Dark matter — to sustain the gaps of a flawed and outdated cosmological model. Nonetheless, the Big Bang continues to prevail not by intrinsic merit, but due to the absence of a convincing new model that would allow the scientific community to advance in its research [2–4], [55].

Cosmological models such as "black hole cosmology" are interesting and deserve consideration, but remain in the realm of speculation, without concrete observational applicability.

The Dead Universe Theory proposes, with logical consistency, that the observable universe could lie within a black hole. It is plausible to assume that the death of a colossal structure — such as the ancestral universe — would result in a gigantic black hole with gravitational force sufficient to attract all the mass that today composes the observable universe [1, 2–3, 5–7].

It is important to emphasize that although the Dead Universe Theory proposes this structure, it is not one of the merely speculative models. At the same time, it respects the work of modern physics, which for over a century has dedicated itself to developing calculations based on the Big Bang model. The Dead Universe Theory acknowledges that there is no direct scientific evidence that we live inside a black hole, but highlights that some speculative theories in the past have already raised this possibility — suggesting that the observable universe could be the interior of a larger black hole [2–4], [55].

The Dead Universe Theory, however, distinguishes itself by being simple, empirical, logical, and based on observations and feasible simulations. The so-called “black hole cosmology” suggests that the current universe is a “baby universe” inside a larger black hole. This proposal, initially defended by Raj Kumar Pathria and I. J. Good, suggests that several universes could arise from black holes — aligning with the multiverse theory, which is also speculative and, so far, impossible to test [43], [46].

The Dead Universe Theory, on the other hand, aligns with general relativity and accommodates Hubble’s laws within a cohesive model. Moreover, it supports the analysis of dark matter and dark energy, as well as the inexplicable phenomena of quantum physics [1–4].

We may speculate that the universe is inside a black hole, although this idea is difficult to test — after all, we do not have access to the interior of a black hole nor to the possible “larger universe” of which ours could be a part. However, it is possible to test and analyze the hypothesis that the death of a colossal structure may have given rise to a black hole that harbors our observable universe. This possibility, although the most speculative point of the theory, cannot be ruled out [1–4].

After the publication of the Dead Universe Theory, compatible evidence emerged, such as the discovery of supermassive black holes, billions of times larger than the Sun, which reinforces the thesis that our universe could originate from a gigantic ancestral structure. These would be the last subtle particles that still “breathe” like a cosmic memory — although they are also already dead from the perspective of time.

The natural state of the dead universe, as proposed, is absolute darkness. Its collapse, when studied in more depth, reveals the emergence of the observable universe as a chaotic event in its initial phase. Certainly, colossal structures already exist, and soon we will be able to detect signs of the existence of light particles, primordial elements, and gravitational waves from before the 13.8 billion years proposed by the Big Bang [55].

There was intense activity in the dead universe during its cycles of decline. At each phase of cooling and collapse, new stars and galaxies were formed. These cycles left gravitational echoes that should soon be detected in real data. As it died, this universe preserved its cosmic memories — and today we inhabit what would be the most recent of those memories, born in an originally dark universe, without light [1–4].

This immense collapsing structure created gigantic primordial black holes every time parts of itself became extinct. In this way, data from the James Webb Telescope tends to reveal black holes of increasingly larger dimensions, originating from these implosions in the dead universe. Even if it is impossible to test all these hypotheses directly, we will be able to simulate the emergence of new universes through quantum computing [1–4].

The theory reaffirms that black holes are not creators of universes — as proposed by some speculative theories such as “Black Hole Cosmology.” This line of thought has been defended by some theoretical physicists over the years, with Nico J. Popławski being one of the most well-known names in this field.

"Black holes appear as vacuum solutions of classical general relativity which depend on Newton's constant and possibly the cosmological constant." — Benjamin Koch et al. [2–5, 13].

In March 2025, a study conducted by computer scientist Lior Shamir, a professor at Kansas State University, brought relevant theoretical evidence through computational and observational analysis [44].

With the support of quantum computing and data from the James Webb Telescope, we are moving toward the validation of a new paradigm. It is crucial to highlight that James Webb discovered billions of dead galaxies, revealing a universe in decline billions of years before the 13.8 billion years proposed by the Big Bang. Many of these galaxies, completely inactive, were

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detected shortly after the publication of the first articles related to the Dead Universe Theory [1–4, 33–40].

The argument is simple: the universe cannot be expanding infinitely and dying at the same time. There is no equation that balances this. The theory of cosmic inflation — which starts from an extremely hot density expanding from a primordial point — has failed. Popławski's proposal is different from the Dead Universe Theory: for him, the universe was generated by a black hole from another universe. The Dead Universe Theory, however, affirms that a gigantic, decaying ancestral universe gave rise to the observable universe, whose last "living" particles inherited anomalies such as light, forming the structure we now know [3–5].

"JWST provides a view of the Universe never seen before..." — Lior Shamir [44].

Unlike Popławski's theory, the Dead Universe Theory rejects the idea that black holes form universes — unless there is direct observational evidence that even a single particle has emerged from the interior of a black hole, which, so far, is considered impossible. The Dead Universe Theory, in almost its entirety, can be tested with data from the James Webb Telescope, astrophysical calculations, and quantum computing.

It is even possible to estimate the distance between the current structure of the universe and the possible event region that separates it from the dead universe — something that may soon be confirmed [5].

Lior Shamir's article raises fundamental questions about the reliability of redshift as the sole indicator of distance and time — which directly affects the entire foundation of current cosmology and opens space for the validation of alternative models, such as the Dead Universe Theory. Although the study does not directly state that the universe is inside a black hole, its conclusions support the hypothesis of a cosmos emerging from a pre-existing, dead, and dark gravitational structure [1–5, 44].

This approach reinforces the idea that analyses supported by quantum computing and large volumes of observational data may be decisive in formulating and validating new cosmological models. It represents a significant advance in the field of computational astrophysics.

Although Shamir's work does not constitute a complete cosmological model, it aligns with the central hypothesis of the Dead Universe Theory (DUT): the theoretical plausibility that the observable universe is a temporarily illuminated region embedded in the core of a black hole formed from the collapse of a prior cosmological structure [1–4, 44].

Lior Shamir's findings appear to be consistent with several predictions of the Dead Universe Theory, offering a potential avenue for future comparative analysis. Furthermore, it acknowledges the scientific merit of a work that, through computation applied to cosmology, proved that galaxies are rotating — exactly as predicted by Almeida's theory — demonstrating total alignment with his proposal [1–5].

The conceptual merit of the Dead Universe Theory (DUT) lies in its ability to present, since its original publication, an integrated and coherent structure — including consistent hypotheses on dark matter, the anomalous emergence of light, the spontaneous separation of galaxies, and the potential for computational modeling through quantum systems. The original trilogy of articles accurately anticipated several outcomes that are now being addressed through next-generation computational environments, contributing empirical consistency and predictive applicability to the proposed cosmological framework [2–4].

We can then raise a simple and direct question: if the initial structure of the universe is dead, how can it be said that it is expanding? The Big Bang theory, based on an initial singularity, fails to convincingly explain the most recent data. The Dead Universe Theory conceptually precedes these speculative models and establishes a complete, verifiable structure, independent of inflationary cosmology. It integrates observational physics, exotic particles, and thermodynamic cosmology under a new light — or rather, under the absence of it [1–5].

The Dead Universe Theory (DUT) is a cosmological proposal that builds upon the limitations of the Big Bang model, extending the discussion beyond the point where standard cosmology reaches its theoretical boundary. While the current consensus holds that the universe began approximately 13.8 billion years ago, DUT presents a viable alternative — a theoretical continuation that transcends both the temporal and conceptual limits of conventional models.

It is a model that does not deny the achievements of modern cosmology but rather integrates them with respect and depth. After all, it is admirable that a theory has endured for over a century, sustaining the foundations of contemporary astrophysics. However, the time has come for the field to cease patching a paradigm that no longer responds to emerging observations.

The Big Bang was never designed to explain what preceded its own limits — its original intent was not to extend beyond the 13.8 billion-year mark. Attempting to artificially prolong it by introducing new terminologies — such as "primordial black holes" presented as the "seeds" of the universe — does not constitute genuine theoretical progress but instead reflects a means of circumventing structural gaps. Even when dressed as scientific continuity, such conduct reveals an institutional resistance that borders on intellectual dishonesty.

From an ethical and epistemic perspective, it is troubling to witness independent and rigorous initiatives toward new cosmologies being dismissed or disregarded without due analysis, while billions of dollars continue to be allocated annually to uphold a model that shows evident signs of exhaustion. Although modern science no longer burns its dissenters in public squares as in the age of the Inquisition, it still symbolically casts many ideas into the fire — especially those that challenge the doctrinal foundations of its most cherished models.

Just as it was once dogmatically claimed that the Sun revolved around the Earth, today many still cling to the “dogma of the Big Bang” with near-religious fervor. Such a posture, far from being purely scientific, reflects an institutional attachment to a paradigm that can no longer coherently explain the anomalies revealed by the most recent data — while simultaneously silencing or diverting serious efforts that seek to expand the boundaries of cosmology.

XXIX. Framework — Dead Universe Theory — Central Hypotheses and Mathematical Formulation

The Dead Universe Theory (DUT) can be summarized through four central hypotheses, providing a coherent mathematical and conceptual framework:

Hypothesis 1- The Universe as the Interior of a Structural Black Hole

The observable universe is not expanding from a singularity but is instead a residual structure embedded within a supermassive gravitational object — a structural black hole formed from the thermodynamic collapse of an ancestral cosmos. This "Dead Universe" was composed of ultra-dense exotic matter and decayed into a stable but inert gravitational topology [1-4]

Hypothesis 2- Light as a Localized Thermodynamic Anomaly

Light is not a primordial constant but a byproduct of rare particle interactions occurring near the entropic limit of collapse. Specifically, light emerges through axion fusion processes under boundary curvature conditions. The rest of the cosmos remains fundamentally dark and silent [1-4]

Hypothesis 3- Asymmetric Retraction and Outer-Inward Galactic Decay

The observable universe is undergoing asymmetric retraction, not expansion. Galaxies are not drifting apart due to spacetime inflation but are decaying from the periphery inward due to gravitational-thermodynamic collapse. This model implies that regions at higher redshift correspond to older, colder, and more entropically degraded structures — not indicators of cosmic genesis, but the outskirts of universal decay [1-4]

Hypothesis 4- Structural Black Hole as the Host of Observable Cosmos

The black hole in question is not stellar or galactic in origin, but cosmological in scale. The observable universe emerges as a reactive photonic anomaly confined within its topology, shaped by structural curvature dynamics and gravitational perturbations characteristic of non-stellar collapse [1-4]

The scale factor of this retraction is described by an exponential decay law:

$$a(t) = C_1 \cdot e^{\wedge}(-H_0 t) \qquad \text{(Equ. 62)}$$

Where:

- *a(t):* scale factor at time t;
- *V(t)* $= a(t)^3$: comoving volume at time t.
- *H_0:* gravitational retraction constant (analogous to Hubble, but negative).
- *C_1:* initial scale factor at $t = 0$. (Equ.63)

This equation describes an ongoing entropic decay — not a past event nor a future collapse. It defines the present thermodynamic state of the observable universe embedded within a structurally decaying field.

Estimation of Cosmic Age:

Assuming the normalized current scale factor is:

$$a(t_0) = 1 \Rightarrow t_0 = 1/H_0 \qquad \text{(Equ.64)}$$

This provides a new method to define the true age of the observable universe — not based on extrapolated light emission from distant galaxies, but on the decay rate of the retracted core field. It aligns with the theoretical curvature structure and the entropic collapse mechanisms proposed within the Dead Universe Theory, further unifying cosmological geometry and thermodynamic evolution [1–4].

- No Big Bang hypothesis is required if entropy gradients are sufficient to explain structure.
- Cosmic fossils (e.g. SMBHs, cold halos) contain more temporal information than luminous galaxies.
- The observable cosmos is the last active thermal bubble — soon to dissolve.

According to the Dead Universe Theory, the observable universe did not emerge from a hot singularity, but rather from a cold and pre-existing structure: the Dead Universe. This vast, dark entity was already in an advanced state of thermodynamic decay long before the appearance of light, and it generated a large luminous anomaly — our observable cosmos [1–4].

What we perceive today is not a rebirth nor a continuous expansion, but the weakened remnants of a thermal anomaly embedded within a dying body.

Galaxies may still form within this structure, but the system as a whole is retracting, cooling, and returning to entropy. The observable universe is not expanding; it is undergoing decomposition — from the edges toward the center — reflecting the final stages of an ancient collapse [1–4].

Figure 10 illustrates the predicted exponential contraction of the cosmological scale factor a(t) within the framework of the Dead Universe Theory (DUT). Unlike standard cosmological models based on metric expansion — where a(t) increases over time due to persistent dark energy — the DUT paradigm proposes a thermodynamically governed regression of cosmic structure. In this formulation, the evolution of a(t) is driven not by vacuum energy, but by entropic dissipation and gravitational exhaustion across a structurally saturated universe [1–4].

This contraction is not a classical gravitational collapse, but a slow thermodynamic decay, where the capacity of the universe to maintain large-scale structure diminishes irreversibly. The decay follows an exponential law:

$$a(t) = a_0 \bullet e^{\wedge}(-\beta \bullet t) \quad \text{(Equ.65)}$$

where:

- a(t) is the cosmological scale factor at time t,
- a_0 is the present-day reference scale,
- β is the entropic decay coefficient ($\beta > 0$),
- t is cosmological time.

This function reflects not a spatial shrinkage, but the collapse of structural degrees of freedom — a feature that differentiates DUT from both cyclic and inflationary models.

The DUT model also resonates with independent findings that suggest asymmetries and structural exhaustion in the cosmos. For example, R. K. Pathria (1972) proposed that our universe could reside inside a black hole, and Lior Shamir (2023) reported significant directional bias in galaxy spin statistics, both of which may point to an asymmetric, thermodynamically enclosed system — consistent with DUT's predictions. [43-44]

In this view, the universe is not headed toward an infinite expansion, but toward irreversible structural infertility, measurable through decay in the effective scale factor.

To further illustrate the macroscopic implications of the Dead Universe Theory (DUT), Figure 11 presents a stylized simulation of the scale factor a(t)a(t)a(t), reinterpreted under a thermodynamic framework. Contrary to classical models that assume perpetual expansion, DUT proposes an exponential retraction governed by entropic gradients, not by spatial curvature. The simulation is based on the decay equation a(t)=C1·e−H0ta(t) = C_1 \cdot e^{-H_0 t}a(t)=C1·e−H0t, where H0H_0H0 represents the observed Hubble parameter, recontextualized here as a coefficient of structural dissipation rather than expansion. This visual reframing of cosmological evolution further supports DUT's central hypothesis of irreversible gravitational entropy [1–6].

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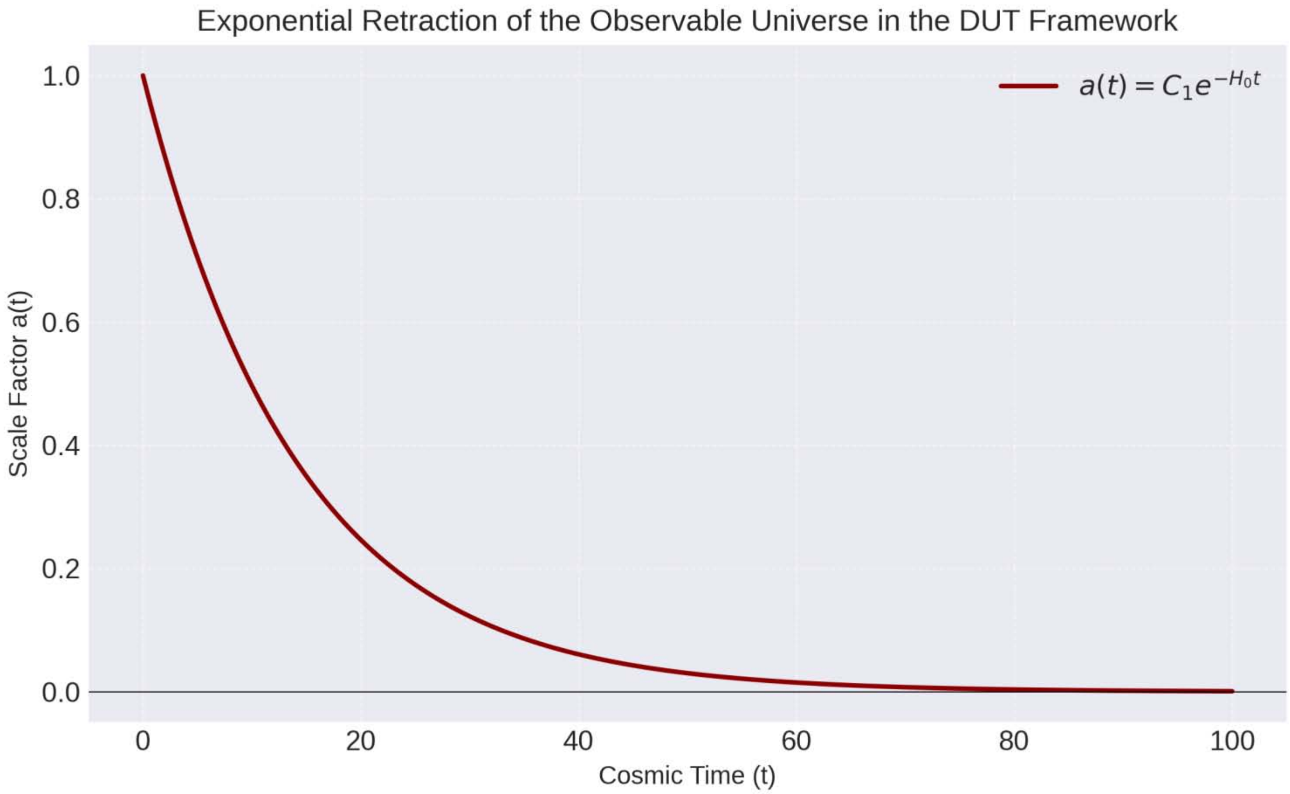

Figure 11: Exponential Retraction of the Scale Factor a(t) in the DUT Framework. Simulated contraction of the scale factor representing thermodynamic decay over cosmic time. The DUT model replaces classical expansion with structural entropy-induced retraction. Equation: $a(t) = C_1 \cdot e^{\wedge}(-H_0 \cdot t)$. Based on [6] Pathria (1972), [1] Shamir (2023).Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

According to the Dead Universe Theory, the observable universe did not emerge from a hot singularity, but rather from a cold and pre-existing structure: the Dead Universe. This vast, dark entity was already in an advanced state of thermodynamic decay long before the appearance of light, and it generated a large luminous anomaly — our observable cosmos [1–4]

What we perceive today is not a rebirth nor a continuous expansion, but the weakened remnants of a thermal anomaly embedded within a dying body. Galaxies may still form within this structure, but the system is retracting, cooling, and returning to entropy. The observable universe is not expanding; it is undergoing decomposition — from the edges toward the center — reflecting the final stages of an ancient collapse [1–4]

This is, therefore, a classical description of what defines a black hole: a structure in which matter and light are confined, and where the observable universe would be lodged, as represented in the image of the small luminous point surrounded by cosmic darkness [1–4]

This view differs from simplified cosmological models that suggest black holes — including those observed in the current universe — could give rise to new universes. Such a notion is inconsistent, as black holes are not generators of matter, but gravitational collapse structures. Although the observable universe may appear small compared to the Dead Universe, it contains extraordinary amounts of dark matter — something the Big Bang model fails to explain satisfactorily. In fact, only a colossal pre-existing structure could justify the origin of the approximately 95% of dark matter present in the current universe, in addition to all remaining ordinary matter [1–4]

When the Dead Universe Theory states that the universe lies inside a black hole, it does not refer to the cyclical or speculative hypothesis of cosmologies like those of Pathria (1972) or Popławski (2010), which propose universes formed inside black holes through quantum rebounds. Instead, this model argues that the black hole in which we are embedded was not formed by stellar collapse, but by the ejection of light — an anomaly — from the supermassive and degenerate body of the Dead Universe [5-6], [41–43].

Light, by expelling matter from its original state, would have created a pocket of thermal and gravitational activity, still tied to the larger structure that generated it. Just as magma is molten rock contained within the Earth and, when expelled, becomes lava — without ever ceasing to be part of Earth's structure —

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the observable universe is that "cosmic lava": a fleeting and localized phenomenon still confined within an older, darker structure [1–4]

Therefore, the claim that the observable universe resides within a black hole must be understood as the description of an energetic anomaly housed within a remnant structure — and not as the creation of a new universe by rebound or inflationary mechanisms. This reinforces the idea that black holes are not structure creators, but energy and order diluters. Many of them, in fact, arise as the final product of luminous anomalies. We know, for instance, that after the formation and death of stars, black holes emerge. Thus, without the existence of light, several of these primitive structures would not even exist [1–4]

XXX. The Dead Universe: Structure and Composition

And indeed, those detections have already begun. The James Webb Space Telescope (JWST), though still presented under the constraints of the standard cosmological model, has already uncovered a class of galaxies with masses, metallicities, and structural coherence that should be physically impossible within the first 300–500 million years after a Big Bang. These galaxies are not faint, irregular early formations; they are mature, luminous, well-structured systems whose light signatures imply a prehistory incompatible with a young, hot origin. What the public receives as "unexpected" findings are, in fact, confirmations of DUT predictions [2–4, 33–40].

Moreover, the early presence of supermassive black holes, with billions of solar masses at redshifts $z > 10$, forces the ΛCDM model to introduce extreme and unverified mechanisms of black hole growth, including super-Eddington accretion and exotic seed models. The Dead Universe Theory, in contrast, absorbs these anomalies without adjustment. These black holes are not products of rapid formation within the observable era; they are gravitational relics of the pre-luminous universe, survivors of the dark structure that decayed into our current observable core [2–4, 33–40].

The cosmological redshift, under DUT, is not a signature of continuous expansion but of thermodynamic and structural decomposition — a gravitational redshifting of signals from within a collapsing entropic environment. The asymmetries in galaxy rotation, observed alignments in cosmic structures, and even the unexplained cold spots in the CMB are not noise; they are residuals of directional collapse. What appears isotropic under ΛCDM assumptions is the illusion of uniformity within an imploding domain [2–4, 33–40].

As JWST probes deeper, it will begin detecting not only galaxies beyond the 13.8-billion-year horizon, but also cold, massive structures whose light never emerged, or whose emission was extinguished before reaching us. The so-called "dead galaxies" will not be theoretical anymore; they will be measured through gravitational lensing, residual infrared shadows, and distortions in background radiation. These are not extensions of known cosmology; they are the fingerprints of a dying core embedded in a universe far older than light itself [2–4, 33–40].

The future of cosmology is not inflation — it is entropy. The next revolution will not come from expanding equations to accommodate unexpected data, but from abandoning the idea that light marks the beginning.

The Dead Universe Theory does not need to stretch, patch, or reinvent itself to remain viable. Every new anomaly makes it stronger, because it was built from the beginning to explain them [2–4, 33–40]. The universe is not expanding. It is unraveling. And DUT is the first theory to say so before the evidence forced us to admit it [2–4].

XXXI. Theoretical Formalization of the UNO Particle

The UNO particle is currently a conceptual placeholder for a hypothesized non-photonic, non-baryonic entity capable of preserving structure in dark environments. While not yet formalized in a standard QFT Lagrangian, the DUT proposes a path forward: a coupling between UNO and dark vacuum fields, potentially through a Yukawa-type interaction or gravitationally induced coherence mechanisms. Future work may involve developing an effective field theory (EFT) to explore the thermodynamic behavior of UNO systems under extreme curvature, especially in regimes beyond electroweak symmetry [2–4].

a) *Axion–UNO Coupling and Photonic Emergence*

The DUT postulates a rare, high-curvature-mediated coupling between axions and UNO particles, heuristically represented by the interaction term:

$$\mathcal{L}\_int = g\_aU \cdot a(x) \cdot \bar{U}(x) \cdot \gamma^5 \cdot U(x)$$

Where:

- g_aU denotes the coupling constant governing axion–UNO interactions;
- a(x) is the axion field;
- U(x) and $\bar{U}(x)$ represent the UNO field and its adjoint.

This interaction is hypothesized to occur in regions of extreme gravitational curvature, where axionic fields become sufficiently excited to induce localized symmetry breaking. The consequent emergence of photons is interpreted not as a universal constant, but as a thermodynamic anomaly triggered by this exotic coupling.

Although direct detection remains beyond current experimental capabilities, indirect observational signatures may include:

- Anomalous early-time light emissions in galaxy clusters unaccounted for by baryonic models;
- Photon bursts detected in axion search experiments (e.g., ADMX or CASPEr) exhibiting nonstandard energy spectra.

This mechanism proposes a framework in which light emerges as a byproduct of entropy gradients and dark sector interactions. It provides a theoretical foundation for DUT's central postulate: that light is not a primordial field, but rather a transient anomaly arising from a deeper dark structure [2–4].

XXXII. The Universe as Cosmic Memory

The theory proposes that the visible universe is composed of the last active memories of the dead universe. Galaxies, stars, and nebulae are remnants of a glorious yet decaying past. Every form of life, every pulse of light, is part of what remains from an ancestral cosmos that insists on reviving fragments of its existence through what we now call current reality. The formation of new galaxies can be seen as memory reactivations — gravitational echoes resonating among the ruins of the dead universe [2–4].

XXXIII. Natural Separation of Galaxies

While the Big Bang postulates an explosive expansion, the Dead Universe Theory proposes a natural separation between galaxies. This separation does not result from an initial explosion, but from residual forces of the dead universe that organize distancing without thermal violence. Hubble observed redshift, but did not determine its cause: the Dead Universe Theory proposes that it is a consequence of laws inherited from a prior cosmos [2–4].

Rather than accelerated cosmic expansion, the theory suggests that the universe is contracting and cooling, with galaxies moving apart naturally due to internal forces. There was no initial singularity; therefore, there was no Big Bang. The expansion of the universe is an optical illusion from the observer's point of view. Galaxies appear to move apart, but surrounding the observable universe are supermassive bodies, dead galaxies, exotic particles, and space-time curvatures — all remnants of the dead universe. Dark matter and dark energy would be elements inherited from that prior structure [2–4].

XXXIV. Light as an Exception

According to the hypothesis of the Dead Universe Theory, light may have emerged as a result of rapid and anomalous particle fusions, occurring amidst the energetic chaos of a collapsing ancestral universe. This light would have enabled the formation of the currently observable universe — an extraordinary, yet transient phenomenon. Eventually, according to this model, that light may be reabsorbed into a silent and dark future. In this context, stars, galaxies, and pulsars are interpreted as temporary anomalies, not structural constants of the cosmos. The natural state of the universe, in this view, would be darkness. We are surrounded by this darkness. Light is minimal. And yet, we continue to pretend we understand everything [2–4].

"We live on a mote of dust suspended in a sunbeam." — Carl Sagan, Pale Blue Dot [18].

XXXV. Appendix – UNO Hypothesis and the Possibility of Structure in Darkness

This extended framework refines the UNO hypothesis by addressing its functional mechanisms, thermodynamic plausibility, biological analogues, and possible paths toward experimental validation. The UNO particle is proposed as a dark matter entity capable of sustaining organization and complexity in the total absence of electromagnetic radiation [2–4].

The UNO particle does not interact via the electromagnetic force. Instead, it operates through non-local quantum coupling, similar to macroscopic quantum entanglement. We propose the existence of a new fundamental interaction — a short-range "dark biological force" — responsible for maintaining structural coherence and information exchange in dark matter environments.

UNO-based systems may inhabit dark matter halos where particle densities are sufficient to support stable complexity. These systems would maintain internal order through vibrational phase modulations and localized coherence within matter fields [2–4].

The Dead Universe Theory (DUT) interprets the isotropy of the CMB not as evidence of uniform expansion, but as a localized equilibrium condition within a collapsing thermodynamic shell. While the overall retraction is asymmetric — initiating from the outer boundaries and progressing inward — the observable CMB is proposed to originate from a region near the entropic minimum, where thermal gradients would have had time to stabilize. Furthermore, small anisotropies (e.g., the CMB dipole, cold spot deviations, and large-scale alignments sometimes referred to as the "Axis of Evil") are not only consistent with the DUT framework, but may represent directional imprints of gravitational retraction from the ancestral structure [2–4].

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XXXVI. Thermodynamic Foundations

In a universe where thermal radiation is nearly absent, entropy remains the central challenge. UNO-based structures are theorized to extract energy from vacuum fluctuations and dark energy gradients. Coherence is preserved through controlled decoherence, forming stable quantum macrostructures akin to solitons. These "islands of order" persist in the midst of cosmic decay, potentially existing within ancient galaxies where baryonic activity has ceased.

XXXVII. Dark Matter Biology

Biological organization need not rely on electromagnetic chemistry. UNO-based life could consist of:

Dark Cells: Aggregates of dark matter stabilized by the dark biological force, with boundaries defined by potential barriers rather than membranes.

Non-Photonic Metabolism: Information and energy exchanged via gravitational modulations or density wave interference.

Self-Replication: Achieved through phase pattern interference, similar to vortex replication in quantum fluids.

The brain uses electrochemical synapses; UNO systems may use phase-coherent "dark synapses" to encode memory and computation.

XXXVIII. Falseability and Testing Proposals

Although UNO particles may be undetectable via electromagnetic means, indirect signatures may include:

Anomalous gravitational lensing patterns in dark matter regions with unexpected internal structure.

Low-frequency gravitational waves exhibiting patterns not consistent with known merger events.

Laboratory analogues using Bose-Einstein condensates near absolute zero, or controlled vacuum chamber environments to observe spontaneous emergence of order under quantum conditions. [2][3][4]

XXXIX. Responses to Critical Objections

Objection and theoretical responses:

- *Lack of energy in cold regions*- Vacuum fluctuations and dark energy provide latent energy gradients.
- *No electromagnetic interaction*- Replaced by a new short-range interaction (dark biological force).
- *Maintaining order without heat flow*- Coherence sustained through quantum macrostability and non-classical energy pathways.
- *Biological analogy (embryo in darkness)*- Demonstrates that complexity can emerge and persist in the absence of light-based energy.

Objection:

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XL. Next Steps Toward a Unified Theory

Mathematical modeling of the dark biological force and its integration into general relativity and quantum field theory.

Exploration of links between UNO and proposed dark matter candidates (e.g., axions, neutralinos, hidden sector bosons).

A philosophical reformulation of life and consciousness to include dark-structured systems independent of photonic interaction.

XLI. Effective Field Equation for a UNO Particle

The equation presented is an effective field model, inspired by non-relativistic quantum mechanics, adapted to describe the coherent evolution of systems based on UNO particles in low-entropy environments. Its purpose is not to replace general relativity at cosmological scales, but to locally represent the emergent quantum behavior of complex structures in regions dominated by cold dark matter and dark energy. The term Vdark(r,t)V_{dark}(r, t)Vdark(r,t) denotes a generalized dark potential, which may include soft gravitational fluctuations, local spacetime curvature, or resonance with background scalar fields. The function Ψ\PsiΨ represents the structural coherence of the UNO system as a whole, allowing for the study of its temporal stability and spatial organization:

$$i\hbar\, \partial\Psi/\partial t = [\, -(\hbar^2 / 2m\_UNO)\, \nabla^2 + V\_dark(r, t) + \lambda \cdot \rho\_vacuum\,]\, \Psi \quad \text{(Equ.67)}$$

Description of terms:

Ψ: wave function of a coherent UNO-based system

m_UNO: effective mass of the hypothetical UNO particle

V_dark(r, t): local dark potential (may represent gravitational fluctuations or resonance with dark energy) *ρ_vacuum:* energy density of the quantum vacuum

λ: coupling coefficient between UNO and the vacuum (free parameter)

UNO is proposed as a dark matter particle mediating a non-electromagnetic, structure-supporting force. It may sustain complex, stable systems in low-entropy environments, representing a form of biological organization adapted to the deep future of a dark, decaying universe. It provides a scientific foundation for life beyond light — a biology of the dead universe. [2–4]

XLII. Extension of the UNO Theory — Life, Order, and Consciousness in Dark Matter

The UNO hypothesis proposes that life may arise and be sustained in environments of absolute darkness, through structures composed of cohesive dark matter governed by a new weak fundamental force. Dark Metabolism: UNO interactions modulate weak gravitational fields to enable information exchange and structural organization, using dark energy as a functional substrate.

Reproduction and Evolution: Phase instabilities in dark matter fields allow for replication and structural variation, generating a process of gravitational natural selection. Dark Consciousness: Macroscopic coherent states of UNO particles could give rise to self-observation patterns, as suggested by quantum consciousness hypotheses adapted to non-photonic media. [2–4]

XLIII. Characterizing the Dark Biological Force

The 'dark biological force' is proposed as a short-range coherence-preserving interaction exclusive to ultra-low entropy regions populated by UNO particles. It is not gravitational, electromagnetic, nor identical to the weak force, but hypothetically arises from phase-stabilized field coherence, possibly via scalar modulations. While not yet modeled in a fully quantifiable way, analogies with Bose–Einstein condensates and soliton-based phase locking are under consideration. This force is not intended to replace standard interactions but to extend the possibilities of structural stability under extreme thermodynamic constraints.

XLIV. Linear Model of the Universe as a Unique and Irreversible Anomaly

UNO does not violate the second law of thermodynamics; rather, it redistributes local entropy through quantum coherence and indirect transfer into the quantum vacuum.

UNO systems would function as “islands of order” sustained by Higgs field fluctuations or resonances with dark energy, stabilizing complexity in cold regions. [2–4]

Definitions:

U_0: Size/energy of the initial anomaly (the observable universe), much greater than a typical cosmic seed.

t: Time since the formation of the anomaly (with t = 0 at its emergence). (Equ.68)

M(t): Mass/energy available in the observable universe at time t.

λ: Effective decay rate (stellar death, energy dissipation)

T_x: Final time when M(t) → 0 (the end of the anomaly).

a) *Basic Equation (irreversible linear exponential decay)*

$$M(t) = U_0 \times e^{(-\lambda t)} \quad 0 \le t \le T_x \qquad \text{(Equ. 69)}$$

At time t = 0, M(0) = U_0: the anomaly is at its maximum. (Equ. 70)

As time progresses, M(t) continuously decreases, reflecting stellar death and the irreversible loss of usable energy.

When t → T_x, M(t) → 0: the anomaly vanishes. The observable universe ceases to exist and returns to the original state of the Uno — a static, infinite, and unmanifest condition.

b) *Conceptual Interpretation*

Single Origin: The observable universe is a unique and gigantic anomaly that emerged from the Uno — an infinite, static, and “dead” state (without manifestations).

Linear Process: The anomaly went through formation and evolution, but the process is linear and irreversible — with no cycles or rebirths.

Total Death: The energy decay leads to an absolute end — M(t) → 0 — and the visible universe returns to the Uno.

Return to the Uno: The Uno is the eternal and infinite state, but without manifestation — the visible universe is only a temporary and irreversible exception within that Whole.

c) *Physical Description of the Process*

The formation, evolution, and decay of the observable universe, according to the Dead Universe Theory, can be understood through a linear and irreversible thermodynamic process. At time t = 0, a localized anomaly emerges within the decaying body of the Dead Universe — a burst of mass-energy that gives rise to the observable cosmos. (Equ. 71)

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This anomaly evolves through classical stages of stellar and galactic development:

- *Stellar formation and fusion*- Matter coalesces into stars, initiating nuclear fusion and energy production.
- *Galactic structure*- Clusters of stars form galaxies, which organize spatially within the gravitational influence of the larger structure.
- *Entropy increase*- Over time, stars exhaust their fuel, leading to supernovae and black hole formation.
- *Progressive cooling*- Energy dissipates, structures collapse, and the system enters a phase of irreversible decline.

This decay does not follow a cyclical path. Instead, it reflects a one-way thermodynamic process that leads the anomaly — our observable universe — toward complete energetic exhaustion. The observable cosmos shrinks not through spatial contraction, but through loss of usable energy, fragmentation of structure, and a return to the dark equilibrium of the Dead Universe.

In this model, the so-called “expansion” is interpreted as a misreading of light propagation in a collapsing and entropic environment. Rather than growing, the anomaly fades — its boundaries defined by entropy, not inflation. Light, once a transient anomaly, slowly extinguishes, and the universe returns to its natural state: darkness, silence, and structural stillness.

d) Formation of the Anomaly

At the initial instant $t = 0$, a quantity of mass-energy U_0 emerges, representing the observable universe in its peak physical manifestation. (Equ.72)

e) Evolution and Decay

The anomaly evolves following a linear thermodynamic trajectory, characterized by:

- Stellar formation and evolution
- Nuclear fusion and energy generation
- Stellar death (supernovae, black holes)
- Progressive dissipation of usable energy

The decay of the anomaly is mathematically expressed by:

$$M(t) = U_0 \cdot e^{(-\lambda t)} \qquad \text{(Equ. 73)}$$

Where $M(t)$ represents the remaining energy at time t, U_0 is the initial mass-energy, and λ is the entropy-driven decay constant.

f) Final Phase: Total Death of the Anomaly

As $t \to T_x$, the universe loses its capacity to sustain complex structures:

- Extinction of stars and galaxies
- Dissipation of radiation
- Collapse of remaining material formations

g) Review Based on James Webb Observations

Recent JWST data supports this model:

- Stellar death initiates predominantly at the observable boundaries and cascades inward across cosmic time.
- Energetic decline manifests as a radial entropy gradient, progressing from the periphery toward the core;
- Supermassive black holes act as structural agents, accelerating the large-scale thermodynamic collapse.
- The process is linear, thermodynamically irreversible, and non-cyclic — suggesting a unidirectional entropic trajectory. [2–4, 33–40]

h) Cosmological Consequences

The observable universe is a luminous anomaly undergoing irreversible thermodynamic death. Its future is not expansion but collapse and disappearance.

Visualization credit: Regiane Milla da Silva

- No cycles, no rebirths, no future expansions
- Only a definitive return to the dark equilibrium of the UNO structure

This is formalized as:

$$M(t) = U_0 \cdot e^{(-\lambda t)},\ 0 \le t \le T_f \ \to\ \lim_{t \to T_f} M(t) = 0$$

(End of the anomaly) (Equ.74)

Return: The system reverts to the eternal, infinite, and static state of the UNO field. [2–4]

XLV. Integration with Modern Particle Physics: Reinterpreting Hypothetical Particles through the UNO Framework

Figure 12 presents a comparative overview of three hypothetical particles — axions, neutralinos, and gravitons — as reinterpreted within the Unified Non-Observable (UNO) model, a speculative extension of dark sector physics proposed in the DUT context. Each particle is assigned a functional role within this expanded cosmological architecture, particularly in relation to structural entropy and coherent information networks [2–4]

Axions are described as being coupled to both informational and structural fields. This suggests a dual role in mediating both physical and informational coherence, potentially acting as stabilizers of low-entropy configurations in cosmological or sub-biological domains.[2–4] e [33–40]

Neutralinos are proposed as agents capable of assembling or stabilizing large-scale coherent structures. Their reinterpretation within the UNO model deviates from standard super symmetry (SUSY) expectations, emphasizing their role in systemic organization rather than merely as dark matter candidates [2–4], [33–40]

Gravitons, traditionally posited as the quantum carriers of gravity, are here reframed as mediators of dark biological force. This implies a bridge between gravitational fields and hypothetical non-visible bio-information substrates — a bold extrapolation that unifies entropic degradation with structural agency. [2–4], [33–40]

Beneath the table, the figure includes a schematic representation of entropic topologies progressing from low to high entropy states. These graphs depict the network complexity as a function of disorder, suggesting a field-theoretic background in which structural connectivity deteriorates over time or due to external decoherence.[2–4], [33–40]

We now propose a refined definition for the UNO (Universal Network Operator) framework within the Dead Universe Theory (DUT), conceptualizing it as a form of Layer-2 heavy dark matter. This redefinition positions UNO as both origin and destination of all structural forms in the universe: a primordial informational substrate from which all known particles emerged and to which all cosmic phenomena eventually return [2–4], [33–40]

UNO is not merely a field or operator, but a gravitationally inert yet entropically dominant domain — the structural and informational core from which reality unfolds. Within the DUT, this conceptualization replaces any requirement for a luminous origin (e.g., a Big Bang), instead embedding the entire cosmological evolution within a recursive, entropy-driven retraction toward the UNO state [2–4],[33–40]

a) Axion–UNO Layer Interaction

$$\text{Lint} = g_{au} \bullet a(ax) \bullet U(x) \bullet \gamma^5 \bullet U(x) \quad \text{(Equ. 75)}$$

Where:

- g_{au}- Coupling constant for interaction with the UNO layer
- *a(ax)*- Axion-like scalar potential field, mediating decay from luminous to non-luminous regimes
- *U(x)*- Structural informational operator at position
- γ^5- Chiral gamma matrix introducing asymmetry and informational directionality

This equation remains valid within this reformulated interpretation. It describes how structures approaching informational exhaustion may decay into UNO-compatible configurations through chirally mediated interactions. [2–4].

b) Dark Biology and the Persistence of Complexity

Under the UNO paradigm, certain regions of the cosmos — embedded within heavy dark matter layers — may retain sufficient structural complexity to give rise to non-luminous biological patterns: a hypothesis termed Dark Biology. These gravitationally cold and entropically stable cavities might harbor forms of information organization that persist beyond the collapse of baryonic structure [2–4].

The entropy gradient figure visually captures this theoretical migration from luminous, organized complexity to silent, dark informational geometry.

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UNO may be related to already-hypothesized particles, reinterpreted for this framework:

Where:

Particle	Function in the UNO Model
Axions	Coupled to information and structurarl
Neutralinos	Capable of forming coherent structures
Gravitons	Mediators of dark biological force

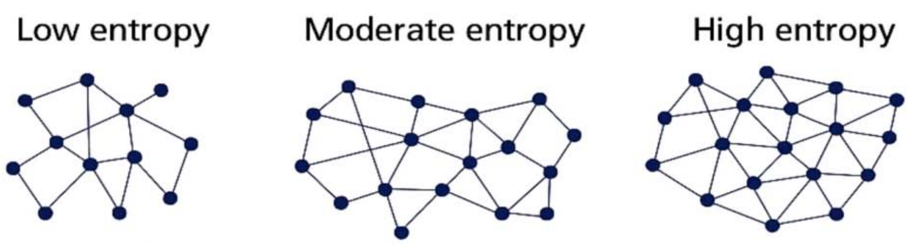

Figure 12: Structural Entropy Gradient under the UNO Model

Illustrates the gradual entropy increase and informational degradation across the universe's thermodynamic retraction, ending in the reintegration of all matter and energy into the UNO substrate. At certain entropy plateaus, non-baryonic biogenic patterns may remain, offering a post-luminous form of biological evolution. Comparison between hypothetical UNO structures under varying initial entropy conditions. Theoretical networks can be simulated as quantum graphs with connectivity between dark matter clusters, modeling self-organization. Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., Extracto DAO S/A (2025)

XLVI. Fermi Paradox: A Cosmic Reinterpretation

Advanced civilizations may have migrated to dark matter environments:

Their communication could be carried out through UNO field modulation, rendering them invisible to optical instruments.

Clusters with gravitational anomalies may in fact be UNO civilizations in a state of advanced dark activity [2–4].

XLVII. Confrontation Between the Dead Universe Theory and the Big Bang

The Big Bang model fails to satisfactorily explain the origin of supermassive black holes, the nature of dark matter, the existence of old and cold galaxies at the beginning of the universe, and the cold spot in the cosmic microwave background. [2–4, 19–23], [55]

It also fails to account for the matter–antimatter asymmetry, as the model predicts equal amounts of matter and antimatter, which are not observed [24–26, 29].

Furthermore, it cannot explain the absence of magnetic monopoles, which are predicted by extensions of the standard model but have never been observed. The cosmological constant problem remains unresolved, with its finely tuned value presenting a discrepancy of more than 120 orders of magnitude—often regarded as the worst prediction in the history of physics. The origin of cosmic inflation is also unaddressed, with inflation introduced to solve the horizon and flatness problems yet lacking a confirmed physical mechanism or direct observational evidence. The horizon problem itself persists, as opposite regions of the universe exhibit the same temperature despite never having been in causal contact. Additionally, the "Axis of Evil," a statistical anomaly in the CMB, contradicts the isotropy expected from the standard model [2–4, 19–23]

The Dead Universe Theory offers coherent answers to all these inconsistencies by presenting a model more aligned with recent observational data. The claim that primordial black holes existed before the Big Bang is a scientific contradiction that this model cannot support [3, 4].

If black holes existed, then matter existed — and therefore, there was no initial hot singularity, but mass, gravity, and a dark, cold field. These black holes could not have arisen from an expanding hot density but from a primordial cold state. A solar-mass black hole, for instance, exhibits a temperature of only 0.00000006 Kelvin — a profound state of thermal exhaustion that directly recalls the early formulations of universal heat death by William Thomson (Lord Kelvin), who in the 19th century postulated that the irreversible growth of entropy would ultimately lead the cosmos into a cold, inert and structurally barren state [56]. Thus, it is plausible that such structures emerged from the collapse of the ancestral dead universe and have existed ever since. As Jacob D. Bekenstein emphasized: "Black holes yield a quantum universal upper bound on the entropy-to-energy ratio for ordinary thermodynamical systems." [4, 48, 56].

There cannot be a Big Bang if supermassive black holes already existed at the earliest observable moments of the cosmos. Persisting with a model that does not resolve such fundamental questions has led to decades of stagnation, and unless replaced by a more complete theory, it will continue to obstruct progress. A theory that effectively explains phenomena, fits within general relativity and quantum physics, and does not rely on constant patches to justify future findings is urgently needed [2–4].

Other speculative theories, such as those proposing black holes as universe generators, while flawed, may still contribute more than the Big Bang, as they offer better adaptability to observational standards [2–4].

Although speculative and still under construction, such models may play a more significant role in the future of astrophysics than the Big Bang, which, though dominant for decades, is now increasingly incapable of explaining the fundamental structures of the universe. The Dead Universe Theory asserts that the origin of everything was cold and dark, not hot and expanding. The observed abundance of hydrogen and helium would have resulted from the gradual collapse of the dead universe, not from a primordial explosion. The CMB, far from being a remnant of a singular event, is interpreted here as thermal residue.

This theory directly challenges the notion of universal expansion when evidence of ancient, dead galaxies and colossal structures is found precisely where the model predicts uniformity. If the universe is expanding, one must ask—to where? Toward entropy? From darkness it emerged briefly into light, only to return again into shadow. That is not a Big Bang. That is its funeral.

Redshift, rather than being a sign of expansion, may indicate the last light of dying galaxies—evidence of a cosmic collapse already underway for hundreds of billions of years. The CMB is not the echo of a beginning, but the final thermal memory of what has collapsed. The chemical abundance of light elements supports the notion of an ancestral dark decay. The collapse of that structure produced phenomena such as light, black holes, dark matter, and possibly dark energy. The observable universe is but a luminous anomaly within that field [2–4].

Light, once considered constant, will fade. Darkness is not absence—it is origin. This does not imply imperfection; only the limitation of our understanding. The Dead Universe, though invisible, may have been far more active than the visible cosmos, which is merely a fragment of a greater and silent memory [2–4].

XLVIII. Comparison with Previous Black Hole Models

Researchers such as Nikodem Popławski have already suggested that our universe could be inside a black hole, based on interpretations of general relativity and quantum gravity theories. These proposals remain in the realm of mathematical speculation and do not constitute complete and testable cosmological models. "The information paradox appears when one considers a process in which a black hole is formed and then evaporates away entirely through Hawking radiation." [2–5, 14, 16]

Popławski's cosmology model does not deny the Big Bang, nor does it describe an extinct ancestral universe that still influences our cosmos. The universe model proposed by Nikodem lacks valid scientific evidence. We analyze Hawking evaporation of the Callen-Giddings-Harvey-Strominger (CGHS) black holes from a quantum geometry perspective and show that information is not lost Ashtekar," A. Taveras [2–5, 14, 57].

XLIX. The Rotating Ancestral Dead Universe and Motion Dynamics

The hypothesis of the Rotating Ancestral Dead Universe proposes that the rotation observed in current galaxies may be a legacy of a previous collapsing universe that spun around its own axis. This idea gains relevance in light of recent observations from the James

Webb Space Telescope (JWST) Figure 12, which identified an asymmetry in the rotation of distant galaxies: approximately two-thirds rotate clockwise, while one-third rotate counterclockwise. Such imbalance suggests the possibility of a primordial anisotropy of the universe, challenging the statistical expectation of a symmetric distribution. Although there is no empirical proof of direct influence from a previous universe, these observational findings strengthen the debate on non-isotropic initial conditions and their relationship with current cosmic rotation [1, 3, 4, 44].

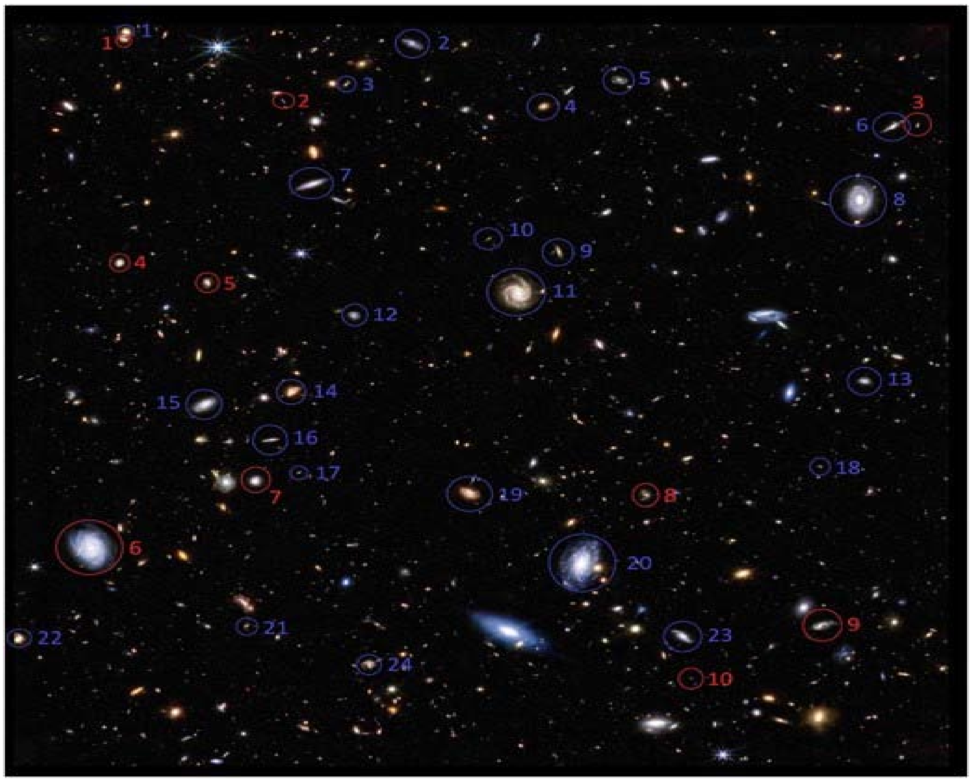

Figure 13: Spiral galaxies imaged by JWST that rotate in the same direction relative to the Milky Way (red) and in the opposite direction relative to the Milky Way (blue). The number of galaxies rotating in the opposite direction relative to the Milky Way as observed from Earth is far higher (Shamir 2024e) [44].

This Dead Universe rotated slowly, but due to its colossal size, the total rotational energy was nearly infinite on a local scale. Over time, this universe underwent gravitational collapse at its center, forming a smaller rotating core—which would become our current observable universe, still spinning like a remnant bubble.

A colossal rotational energy was partially transferred to the smaller universe—maintaining coherence with the principle of conservation of angular momentum [1, 3, 4, 44].

Figure 14 presents a set of galaxies imaged by the James Webb Space Telescope (JWST), alongside their corresponding radial intensity transform plots. These transformations convert raw brightness distributions into structured radial peak maps, allowing for quantitative determination of morphological asymmetries — particularly the curvature and handedness of spiral arms [44].

In each panel, the peaks in intensity — plotted as radial functions — form line structures that trace the dominant directionality of arm curvature. By identifying the orientation of these curves, it becomes possible to infer the spin direction of the galaxy with respect to the observer. This method provides an objective alternative to human-based classification and has been used extensively in statistical spin studies across deep-sky survey [1-4,44]

The technique, developed and applied by Shamir (2023), enables large-scale morphological audits of galactic chirality and supports the hypothesis of directional asymmetries at cosmological scales — a phenomenon potentially inconsistent with the assumption of large-scale isotropy [44].

This analysis plays a key role in the context of the DUT framework, as spin asymmetries may act as observable signatures of global thermodynamic retraction or residual anisotropies embedded in an entropy-saturated universe. [2-4]

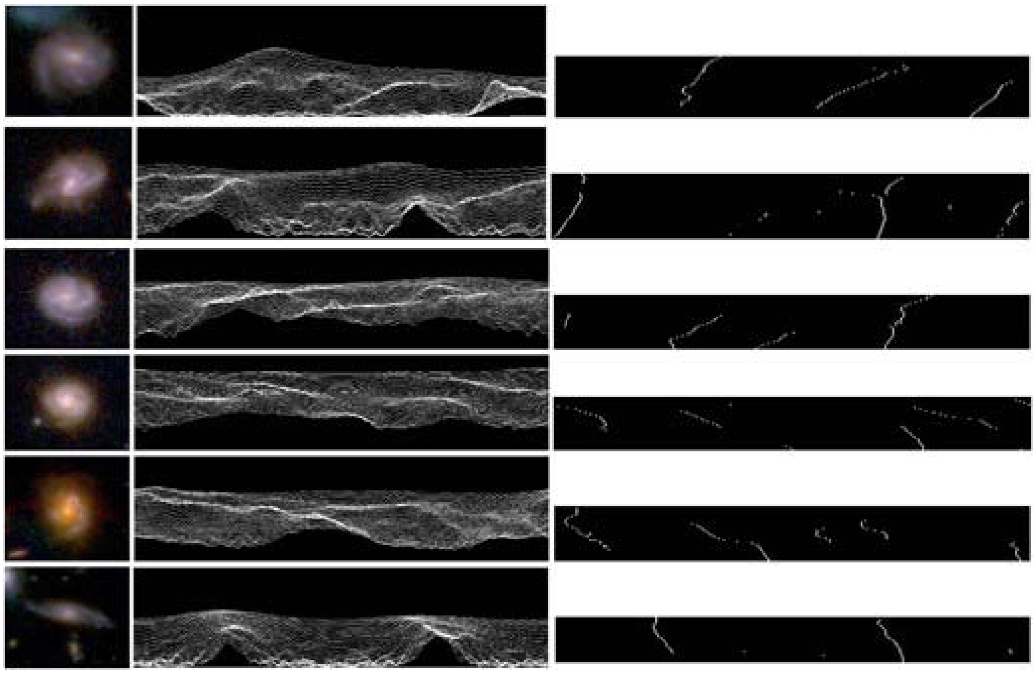

Figure 14: Example of galaxies imaged by JWST and the peaks of the radial intensity plot transformations of each image. The lines formed by the peaks allow to identify the direction of the curve of the arms, and consequently the spin direction of the galaxy [44]

The James Webb Space Telescope (JWST) has enabled high-resolution observations of distant galaxies, including those at redshifts where Earth-based telescopes such as the Dark Energy Survey (DES) reach their instrumental limits. Figure 14 shows a direct comparison between DES (left) and JWST (right) images of the same galaxies. The superior resolution of JWST allows for morphological analysis detailed enough to determine galactic spin direction — a task that remains unfeasible with ground-based surveys due to atmospheric distortion and optical constraints.

A recent large-scale study by Shamir (2023) analyzed 263 galaxies imaged by JWST and found a statistically significant rotational asymmetry: approximately two-thirds exhibited clockwise spin, while only one-third rotated counterclockwise. This imbalance deviates sharply from the expectation of a random, isotropic universe, where equal distribution of spin directions would be anticipated [44].

The results suggest that chirality asymmetry may be a macroscopic imprint of underlying cosmological anisotropy — a phenomenon potentially linked to early-universe conditions, large-scale entropic gradients, or residual structural alignment from a prior cosmic cycle, as predicted in the DUT framework [44].

These findings open the door for a re-evaluation of the cosmological principle of isotropy and may offer empirical pathways for testing alternative theories of cosmic evolution, including those grounded in asymmetric thermodynamic dynamics [44].

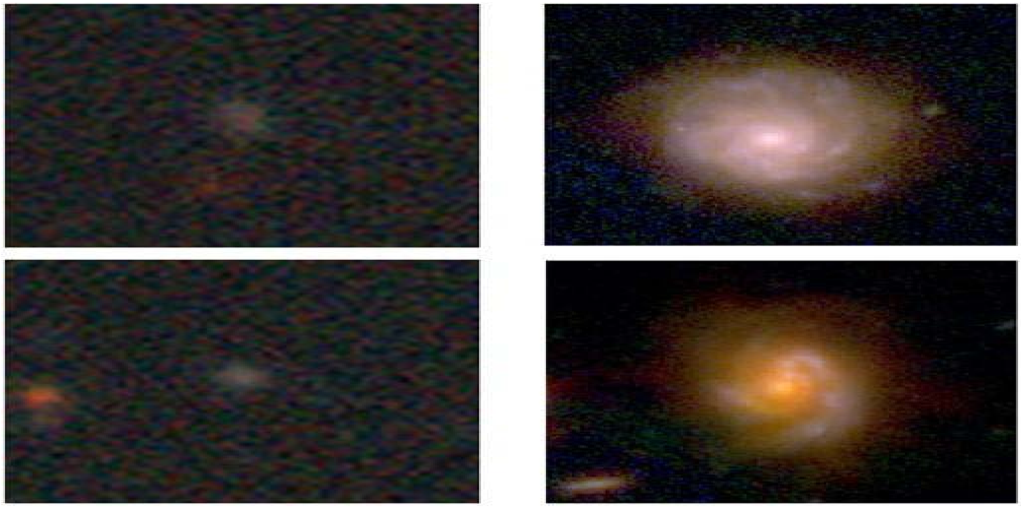

Figure 15: Example of the same galaxies imaged by DES (left) and by JWST. JWST allows to analyse galaxies that DES or other Earth-based telescopes cannot image with sufficient details to identify their direction of rotation [44].

The process led to 263 galaxies with identified direction of rotation. shows the distribution of the redshiof the galaxies. Figure 15 displays the redshift distribution of the 263 galaxies used in the spin-direction analysis conducted by Shamir (2023) using high-resolution imaging from the James Webb Space Telescope (JWST). The redshift intervals reflect the relative distance and lookback time for each galaxy, ranging from nearby ($z < 0.5$) to well beyond $z > 2$ — enabling the study of galactic spin orientation across a broad temporal spectrum of cosmic evolution. [44]

The distribution is weighted toward intermediate redshift ranges ($z \approx 0.5$ –1.5), where JWST offers optimal image resolution and signal clarity for morphological analysis. Galaxies in this range present sufficiently detailed spiral arm structures to permit algorithmic identification of rotational handedness using radial intensity transformations.

While the histogram itself represents an observational constraint (based on image clarity and signal-to-noise ratios), it also aligns with the theoretical implications of the Dead Universe Theory (DUT): if the observable universe originated from a collapsed gravitational matrix, as DUT proposes, then directional spin asymmetries may persist as residual signatures of that prior collapse [1-6, 44].

This redshift-based stratification provides a meaningful framework for tracking chirality asymmetry across cosmological time, offering potential clues about the thermodynamic and structural conditions that preceded the emergence of our observable universe. [1-6, 44].

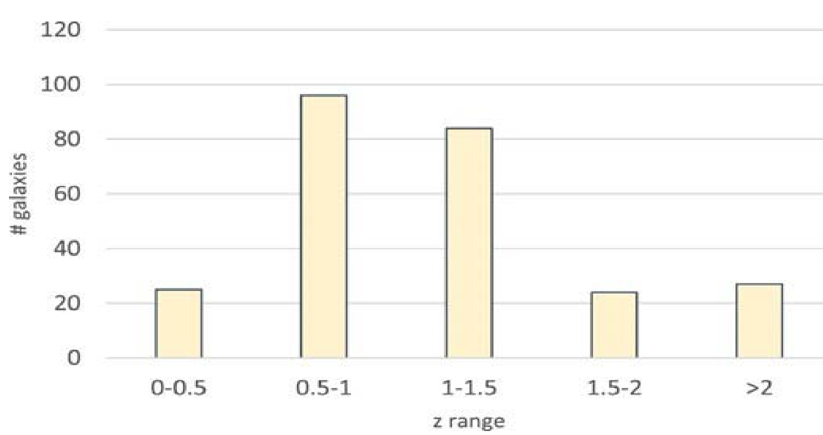

Figure 16: The redshift distribution of the JWST galaxies used in the study. Out of the 263 galaxies with measurable spin direction, the majority were located in the redshift intervals $0.5 < z < 1.0$ (n≈95) and $1.0 < z < 1.5$ ($n \approx 85$), where JWST resolution enables optimal identification of spiral arm morphology. Only a minority were found in the $z < 0.5$ and $z > 2$ ranges, likely due to image noise and resolution constraints. This redshift distribution suggests that chirality asymmetry can be reliably assessed within intermediate cosmological epochs, providing an empirical bridge between current galactic structure and the thermodynamic origin of the observable universe, as proposed in the DUT framework [44].

Figure 16 displays the distribution of spiral galaxies observed in the GOODS-South field of the JADES survey using the James Webb Space Telescope (JWST), categorized by their rotation direction relative to the Milky Way. Galaxies rotating in the opposite direction are marked in blue (n = 158), while those rotating in the same direction appear in red (n = 105). The data were extracted from deep-field imaging in the 4.4, 2.0, and 0.9 µm bands, which allow high-resolution morphological analysis and accurate determination of spin orientation [44].

This asymmetry — with a statistically significant predominance of counter-rotating galaxies — provides observational weight to the hypothesis that the universe exhibits a preferred directional bias, or cosmic chirality, potentially rooted in anisotropic initial conditions. These findings challenge the assumption of large-scale isotropy and instead suggest the presence of coherent angular momentum alignment on cosmological scales [44].

Within the framework of the Dead Universe Theory (DUT), such spin imbalances may represent residual dynamical patterns originating from a primordial gravitational collapse, rather than from a singular explosive beginning. In this view, the observable universe is not expanding uniformly from a central point of creation, but is instead the emergent byproduct of a collapsing dark matrix — with spin asymmetry acting as a fossil imprint of that structural retraction. [1-4, 44].

By correlating galactic spin directions with their spatial distribution and redshift, this study offers a compelling observational avenue to test the thermodynamic asymmetries predicted by DUT. The GOODS-S JADES field, with its depth and clarity, becomes a cosmological laboratory for detecting directional imprints of an ancestral universe [44].

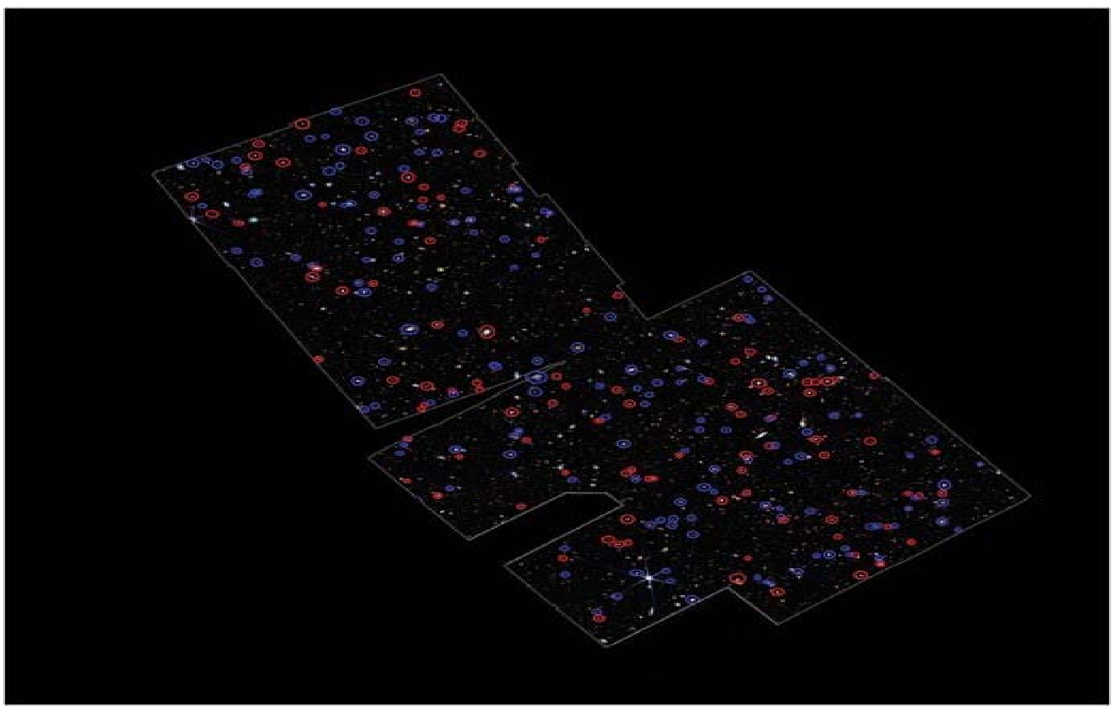

Figure 17: Spiral galaxies imaged by JWST in the GOODS-S field of JADES that rotate in the same direction relative to the Milky Way (red), and in the opposite direction relative to the Milky Way (blue). The figure shows 158 galaxies that rotate in the opposite direction relative to the Milky Way, and just 105 that rotate in the same direction relative to the Milky Way. The analysed field covers the JWST GOODS-S JADES field imaged with the 4.4, 2.0, and 0.9 μm bands [44].

Figure 17 displays the hemispherical asymmetry in galactic spin orientation across the celestial sphere, based on the analysis of approximately 1.3 million galaxies imaged by the DESI Legacy Survey. The spatial mapping reveals statistically significant differences in the number of galaxies rotating clockwise vs. counterclockwise, indicating a non-random, large-scale spin distribution. Notably, the GOODS-S field, observed in detail by JWST, lies within a region where clockwise rotations predominate — further reinforcing the pattern identified independently in the JADES datase [44].

These findings, originally reported by Shamir (2022e), challenge the cornerstone cosmological principle of isotropy and suggest the existence of a preferred cosmic axis or vector field — a directional anisotropy with potentially primordial origin. This large-scale spin asymmetry is not explainable by local gravitational effects, observational bias, or instrumental artifacts, and has been reproduced across different sky

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surveys, redshift intervals, and galaxy morphologies [44].

In earlier publications, Almeida proposed that the future of cosmology would not depend exclusively on extending the reach of telescopes, but on integrating quantum simulation frameworks with thermodynamic models of cosmic evolution. In the context of the Dead Universe Theory (DUT), the observed asymmetry may be interpreted not as a stochastic anomaly, but as a remnant thermodynamic vector — a directional fossil left by the entropic retraction of a structurally collapsing ancestral universe [1-4, 44].

If the current universe originated not from a pointlike explosion (Big Bang), but from the implosive gravitational collapse of a previously functional cosmological matrix — as DUT suggests — then such angular asymmetries are not only plausible but necessary. They encode the rotational memory of the prior structure, preserved in the spin bias of galactic populations observable today. [1-4, 44].

Thus, the synthesis of Shamir's empirical data with DUT's theoretical framework demonstrates that modern cosmology is at a methodological inflection point: new paradigms will emerge from the convergence of high-volume observational surveys and non-classical computational techniques, capable of unveiling structural coherence in what has long been dismissed as statistical noise [1-4, 44].

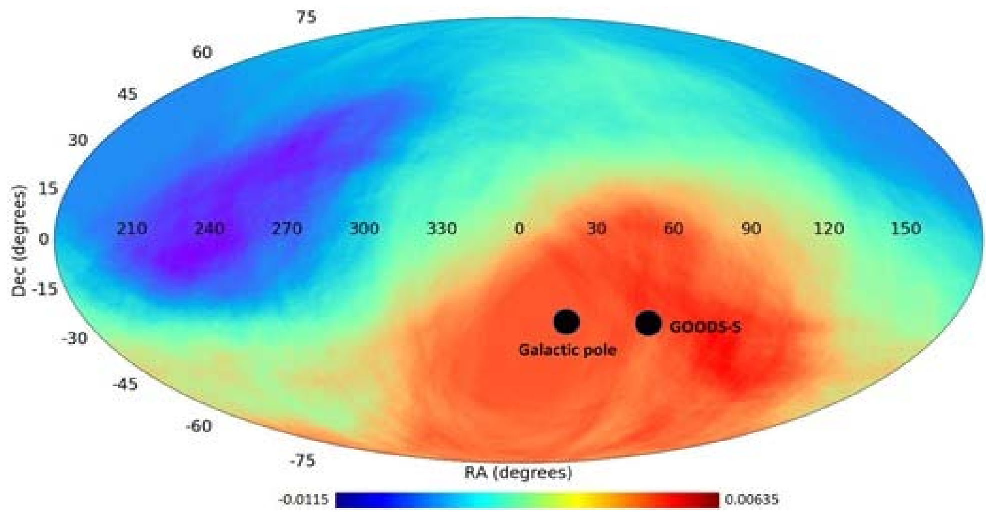

Figure 18: The differences in the number of galaxies with opposite directions of rotations in different parts of the sky as determined by using 1.3×106 galaxies imaged by the DESI Legacy Survey (Shamir 2022e). The location of the GOODS-S field is at a part of the sky with a higher number of galaxies rotating clockwise. [44]

a) *Fossil Signatures of Collapse Asymmetry*

The following cosmological confirmations align with the predictions of the Dead Universe Theory (DUT). Each statement reflects observed anomalies or reinterpretations under the DUT framework, and where applicable, is formalized with a corresponding mathematical expression. Farther = older, darker, disorganized: [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60]

- $z(r) \propto e^{\{+H \bullet r\}}$ (Equ. 76)
- Closer = younger, smaller, active
- $\tau(r) \propto 1 / r$ (Equ. 77)
- Distant galaxies are dead giants with cold matter cores
- $\rho\_dark(z) \gg \rho\_visible(z)$ (Equ.78)
- Supermassive black holes are ancestral relics
- $M\_SMBH(z \gg 0) \geq M\_SMBH(today)$ (Equ.79)
- Redshift is decay, not expansion
- $z(t) \propto \lambda \bullet t$ (Equ.80)
- CM
- B = thermal residue, not explosive origin
- $T\_CMB(t) = T_0 \bullet e^{(-\mu \bullet t)}$ (Equ.81)
- *Confirmed:* JADES-GS-z13-0 = stellar density too early for standard model
- $\rho\_*(z=13) \gg \Lambda CDM(z=13)$ (Equ.82)
- *Confirmed:* No Hawking radiation observed — contradiction to standard theory
- $dE/dt\_Hawking \approx 0$ (observed) (Equ.83)
- Redshift is decay, not expansion
- CMB = thermal residue, not explosive origin
- *Confirmed:* JADES-GS-z13-0 = stellar density too early for standard model

- *Confirmed:* No Hawking radiation observed — contradiction to standard theory. [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60].

b) Expanded Entropy and Decay Predictions

Prediction:

- As JWST approaches its detection limit, cosmic structure will fragment and become irregular.
- What to observe: The transition from an organized universe to a structureless void is real and not due to missing data.
- Unique insight: The universe is a degenerating organism collapsing toward its center — the edge is already lifeless. [3, 4, 34, 35]

Prediction:

- Entropy measured at large scales (CMB, galaxies, black holes) will not increase with time, but with distance
- What to observe: An entropy curve that decreases with cosmological time, but increases with observation depth
- Unique model insights:
- Entropy increases with distance and decreases with current time — opposite of the standard model
- The farther we look, the more disorganized, colder, and lifeless the cosmos becomes
- Galaxies closer to us are smaller, younger, and active; distant ones are colossal and extinct
- Supermassive black holes detected in high-z regions are remnants of ancestral collapse
- These black holes lie atop a fabric of exotic dark matter (axions, UNO)
- The universe is retracting toward the present, not expanding toward the future
- Thermodynamic decomposition is asymmetric, beginning at the periphery
- Galaxies at $z > 13$ lack explosive star formation — e.g., JADES-GS-z13-0 confirms this
- Absence of evaporating black holes contradicts Hawking's expectations
- Entropy increases with distance, not with time — supporting asymmetric decay
- Thermodynamic disorder grows toward the cosmic horizon; nearby structures are more coherent
- This contradicts the assumption of uniform entropy growth and supports the DUT model [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60].

c) Additional Consequences and Confirmations

- *Confirmed:* The entropy trend shows a directional pattern — high entropy aligns with observational depth, not cosmological age.
- *Implication:* The so-called "past" (cosmic horizon) may represent a deeper thermodynamic future of collapse — a reversal of temporal intuition.
- *Reversal logic:* What is commonly interpreted as the beginning (low entropy Big Bang) may actually be a high-entropy frontier of decay.
- *Prediction:* The oldest structures do not evolve into complexity — they decay from it.
- *What to observe:* The absence of uniform filament growth, presence of chaotic or disorganized voids at cosmic edges.
- *Implication:* Supports the idea of periphery-first collapse — structure did not emerge there; it vanished there.
- *Prediction:* Black holes will not evaporate as predicted by Hawking; no observable mass loss should be detected.
- *What to observe:* Decades of observation fail to show any significant evaporation signatures in galactic or stellar black holes.
- *Conclusion:* The mechanism of Hawking radiation may be flawed, or irrelevant in a retractive thermodynamic model.
- *Prediction:* Dark matter halos around ancient galaxies will appear colder and more gravitationally collapsed than expected.
- *What to observe:* Unexpected gravitational lensing from regions with little visible light — suggesting older, degenerated dark structures.
- *Interpretation:* These are not invisible galaxies — they are fossil remnants of cosmic tissue, consistent with DUT's prediction.
- *The Dead Universe Theory offers a shift in cosmological reasoning:* time flows inward, entropy increases outward.
- The cosmos is not expanding into an unknown future — it is retreating into a dark and ancient foundation.
- The observable universe is an energetic blister formed on the surface of a dying body — the Dead Universe — and it is shrinking.
- This decay is not cyclical, not regenerative — it is final. There is no bounce. No next beginning. Only the return to stillness. [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60].

We may be witnessing a paradigmatic shift: the construction of new cosmological models may no longer rest solely in the hands of astrophysicists, but rather in the hands of interdisciplinary teams — where computer scientists, equipped with theoretical physics knowledge and algorithmic intelligence, take the lead in mapping and interpreting the universe. In this scenario, the cosmology of the future will not be merely observational, but computationally inferred — with the power to validate hypotheses once considered unreachable. [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60].

As JWST approaches its detection limit, the cosmic structure will fragment and become irregular, as if falling apart. The transition from an organized universe to a "structureless void" will not be due to lack of data, but will reflect a progressive disintegration of the cosmic web. The universe is not a continuously expanding fabric, but a degenerating organism collapsing toward its center — with the edge already lifeless. [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60].

Entropy measured at large scales (cosmic radiation, galaxy distribution, entropy of black holes) will not increase as expected by the standard model if measured as a function of distance-Figure 19 . An entropy curve that decreases with cosmological time, but increases with observation depth (distance), would suggest a universe that is dying toward the present, not since the present. According to DUT, the observable universe reveals an asymmetric evolutionary structure: the farther we look, the more disorganized, colder, and lifeless the cosmos becomes — contradicting models based on homogeneous expansion. [3, 4, 16, 23, 34, 35, 40, 44, 45, 57, 58, 59, 60].

d) Epistemological Note on Scientific Authority

It is not because Hawking wrote it, nor because Einstein, Newton, or Georges Lemaître theorized it, that a cosmological model becomes true. Nor is truth guaranteed by the impact factor of the journals where such ideas were published. Einstein himself erred in defending a static universe; Newton misjudged cosmic stability; Lemaître proposed an initial singularity that today faces serious observational and theoretical challenges [1-4]

Science advances not by submission to authority, but by the continuous confrontation of hypotheses with empirical data and the principle of testability. The Dead Universe Theory (DUT) presents an alternative paradigm that, irrespective of the journals in which its propositions are published or the degree of acceptance by the dominant scientific community, offers concrete predictions, quantitative formulations, and falsifiable scenarios. Its legitimacy rests not on institutional prestige, but on its capacity for empirical verification [1–4].

Whether ultimately confirmed or refuted, DUT introduces novel methodological instruments—such as the Cosmic Fossil Record Method—capable of redefining the chronology, entropy dynamics, and gravitational architecture of the universe. These formulations establish an epistemological priority that must be recognized, independent of historical resistance or academic orthodoxy [1–4].

In the coming years, it is plausible that the ΛCDM Standard Model will undergo substantial revision, incorporation of alternative frameworks, or even paradigmatic replacement. The DUT may emerge as a complementary structure, or potentially as the principal model, as deep-field observations, high-resolution cosmological surveys, and entropy-gradient analyses continue to evolve. Its formal equations, computational simulations, and predictive algorithms already compose a self-consistent and testable framework for this prospective transition [1–4].

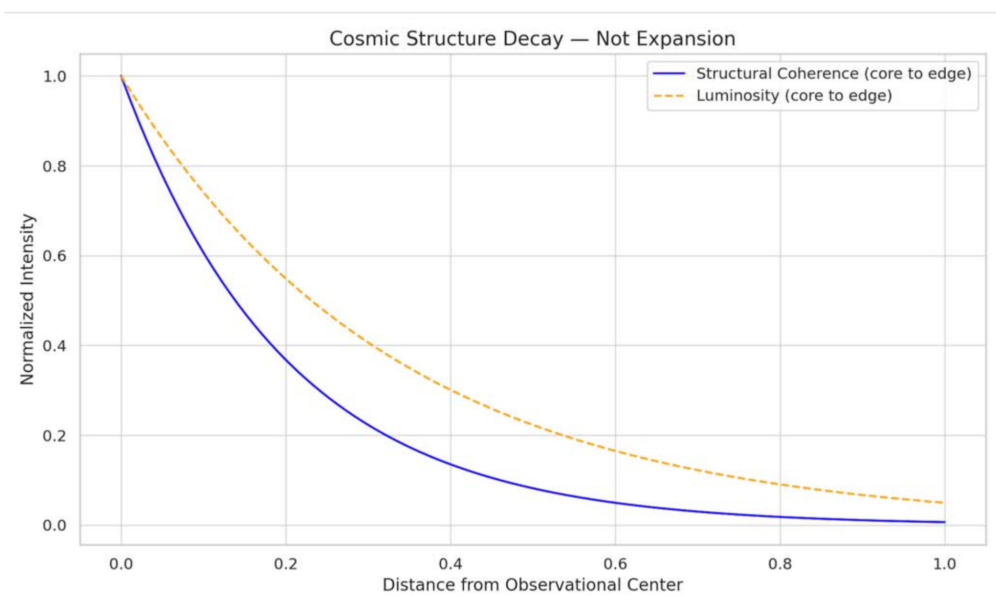

Figure 19: Thermodynamic Asymmetry — Younger Core, Older Edge. The Dead Universe Theory predicts that entropy increases with observation depth rather than time. The edge of the universe appears older, colder, and more structurally degraded, while the inner regions retain activity, mass coherence, and luminous phenomena. Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

Galaxies located closer to us, embedded within the internal gravitational well of the structural black hole, tend to be smaller, younger, and actively forming stars. In contrast, the most distant galaxies — and therefore the oldest — appear as colossal, already extinct systems composed of stellar remnants and dominated by cold dark matter reservoirs. These distant structures reflect advanced stages of thermodynamic degradation, where star formation has long ceased, and visible matter is submerged within vast, inert cores of dark matter halos [1–6, 16, 17, 19, 20, 22, 34, 35, 36, 40, 44, 45, 51, 52, 57, 59, 60].

Supermassive black holes, remarkably observed even at high redshifts ($z > 7$), are interpreted under the Dead Universe Theory (DUT) not as products of rapid early cosmic growth, but rather as residual cores from the gravitational collapse of an ancestral, larger-scale cosmic structure. These ancient gravitational entities likely rest atop an invisible substratum of exotic dark matter, possibly composed of axion condensates or more speculative ultra-light scalar fields such as the proposed UNO particle [1–6, 45, 51, 52, 60].

Thus, the universe is not expanding forward into the future, but retracting asymmetrically toward the present, with entropy increasing as one observes deeper into space. This dynamic reflects an ongoing thermodynamic retraction that began at the periphery and continues inward, progressively dismantling large-scale structures. The most distant galaxies ($z > 13$), such as JADES-GS-z13-0, exhibit anomalously high stellar densities at epochs where conventional ΛCDM models predict insufficient time for such complex structures to have formed, further challenging inflationary expectations [16, 34, 35, 40, 59].

Compounding this challenge, no empirical evidence has yet confirmed the evaporation of black holes through Hawking radiation. Despite decades of theoretical predictions, observations have consistently failed to detect measurable mass loss from black holes, contradicting key expectations of standard quantum gravity frameworks [23, 29, 48, 57].

The observed pattern of entropy increasing with distance rather than with cosmological time directly supports DUT's prediction of asymmetric thermodynamic collapse. Structures located nearer to us retain mass coherence, star formation, and lower entropy signatures, while regions farther out reveal higher disorder, thermal degradation, and gravitational fossilization. This spatial entropy gradient suggests that what is conventionally interpreted as a distant cosmological "beginning" may, in fact, represent the terminal fossil record of structural exhaustion [1–6, 16, 17, 19, 20, 22, 28, 34, 35, 36, 40, 44, 45, 48, 52, 57, 59, 60].

A striking visual confirmation of this process is presented in Figure 18, captured by the James Webb Space Telescope (JWST) in the GOODS-South field. The highlighted galaxy, JADES-GS-z7-01-QU, represents one of the earliest and most distant quiescent galaxies ever identified. Contrary to expectations for galaxies at such high redshift, this object exhibits no significant nebular emission, suggesting a complete cessation of star formation less than a billion years after the Big Bang — a spectral signature of cosmic sterility incompatible with standard starburst models [34, 35, 36, 40, 44, 59].

This observation directly supports the central premise of the DUT: that entropy gradients across cosmic distances reflect an asymmetric thermodynamic retraction. In this interpretation, the far edges of the universe no longer represent a primordial birth zone but a gravitational graveyard — a terminal stage of structural exhaustion. Galaxies like JADES-GS-z7-01-QU serve as fossil markers of this irreversible cosmological decay, luminous tombstones at the edge of visibility, recording the progressive decline of cosmogenic complexity [1–6, 16, 19, 34, 35, 40, 44, 59, 60].

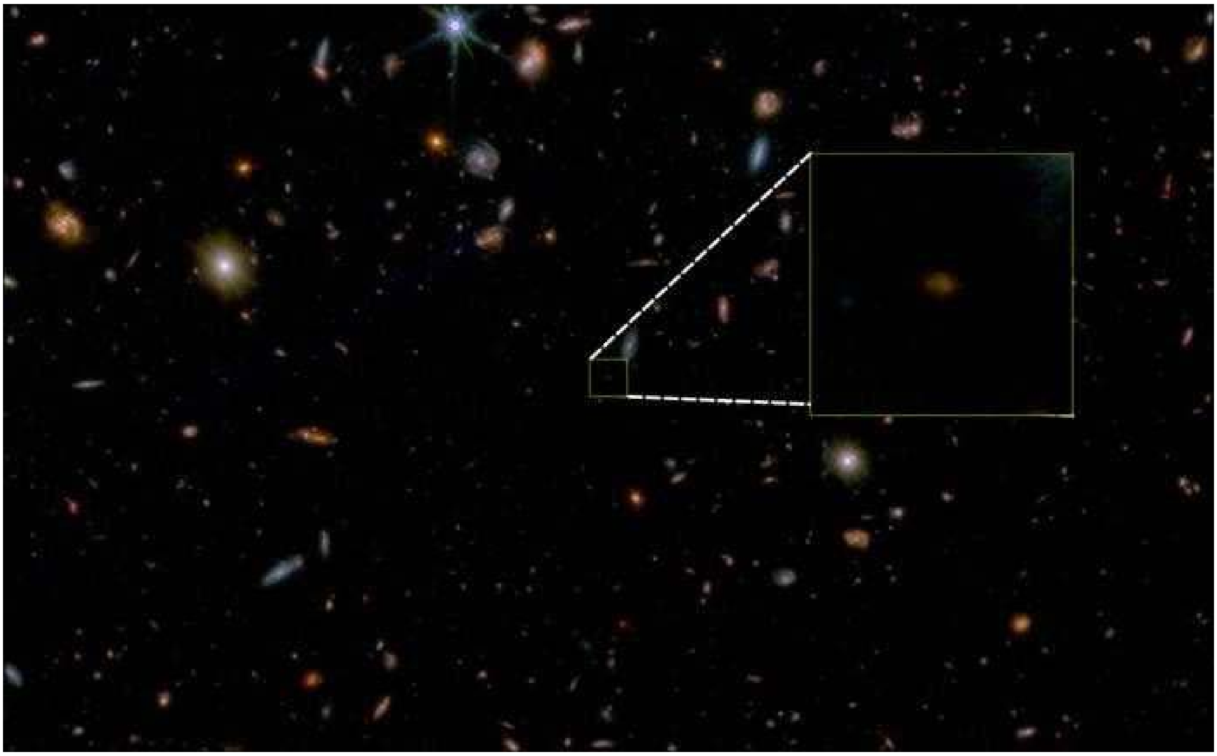

Figure 20: Astronomers discover the oldest "Dead" galaxy ever observed. Image: JWST false-color image of a small fraction of the GOODS-South field, highlighting JADES-GS-z7-01-QU, an extremely rare type of galaxy. Credit: JADES Collaboration. License: Public Domain [1, 2, 34, 35, 36, 40, 59]

Sequential echoes of gravitational collapse events preceding the 13.8 billion years assigned to the Big Bang may still be observable, along with the unexpected existence of supermassive black holes whose masses challenge conventional models of early cosmic evolution. These extreme mass concentrations, detected at high redshift, suggest the presence of gravitational relics formed long before standard accretion timescales would allow [1–6, 16, 17, 34, 35, 36, 40, 44, 45, 51, 52, 59, 60].

Furthermore, residual energy fields from the ancestral dead universe, as well as gravitational waves generated during its large-scale collapse, constitute predicted signatures yet to be detected. If observed, these fossil remnants would not only validate DUT's proposed prior gravitational phase but would also fundamentally challenge both inflationary expansion and multiverse scenarios rooted in quantum field fluctuations [1–6, 9, 27, 28, 29, 30, 40, 45, 52, 57, 58, 59, 60]

L. The Asymmetric Thermodynamic Retraction of the Universe: Foundations of Cosmic Infertility

This review article proposes a new hypothesis about the fate of the universe, based on the increasing imbalance between the rate of galaxy formation and their progressive extinction, as proposed in the original article "The 'Dead Universe' Theory: Natural Separation of Galaxies Driven by the Remnants of a Supermassive Dead Universe", published in 2024 [1–4].

It is argued that the universe may be undergoing a phase of structural retraction that is not explosive but thermodynamic, in which the formation of new cosmic structures is surpassed by their destruction or functional exhaustion. This hypothesis, termed asymmetric thermodynamic retraction, offers an alternative model to eternal expansion or catastrophic gravitational collapse — proposing instead a natural and silent divergence followed by the death of galaxies, indicating that the universe moves toward a state of irreversible structural infertility. This dynamic may become observable through the James Webb Space Telescope, as new evidence of extinct galaxies is compared with the birth rate of still-forming young galaxies [61–70].

Contemporary cosmology has been dominated by two fundamental models: eternal expansion, supported by a cosmological constant, and gravitational collapse, represented by scenarios such as the Big Crunch or the Big Rip. This study proposes a third conceptual path: a model in which the universe does not violently destroy itself but slowly regresses through an asymmetric process of structural loss governed by thermodynamic principles [61–70].

The concept of asymmetric thermodynamic retraction is based on the observation that the galactic formation rate is not constant and, over time, tends to be surpassed by the rate of structural decay in the universe. This imbalance may lead not to classical gravitational collapse, but to a state of structural inactivity where no new complexity is generated [61–70].

a) Theoretical Foundations of Cosmic Infertility

The formation of galaxies depends on a specific set of gravitational conditions, the availability of cold matter, and the potential for local collapses. As expansion and energy dissipation progress, these conditions become increasingly rare. 61–70].

The net galactic generation rate is defined as:

$$dN/dt = \dot{N}\_f - \dot{N}\_d \quad \text{(Equ.84)}$$

where:

$\dot{N}\_f$ represents the formation rate of functionally active new galaxies;

$\dot{N}\_d$ represents the extinction rate (galaxies that no longer form stars or structures);

$dN/dt < 0$ indicates functional regression of the universe [61–70].

The density of structured matter in the cosmos also tends to decline:

$$d\rho\_m/dt = -\alpha\ \rho\_m \quad (\alpha > 0) \quad \text{(Equ. 85)}$$

With the continuous decrease in available matter, the universe reaches a phase of galactic infertility: a condition where many galaxies retain mass but no longer generate structural descendants — much like a living organism that has lost its reproductive capacity [61–70].

b) Observational Verification with the James Webb Space Telescope

DUT finds indirect support in galactic redshift asymmetries, core-centric light distributions, and time-dilation irregularities near structural voids. These patterns challenge homogeneity assumptions and support the concept of gravitational nesting within a non-expanding shell. [1–4, 61–70].

The cosmic infertility hypothesis is testable through the ratio of active to dead galaxies. The James Webb Telescope allows us to:

- Detect young galaxies in the early stages of star formation;
- Map extinct galaxies that retain mass but lack active structure formation
- Observe regions with gravitational density but without the ability to produce new
- Structures — the cosmic equivalent of an exhausted womb.
- As more dead galaxies are identified at deep scales, it will be possible to build a structural natality index for the universe — a metric that will define whether we are in a still fertile cosmic civilization or in an entropic terminal system [1–4, 61–70].

c) Friedmann Equation Applied to Structural Regression

The Friedmann equation, considering a mutable dark energy model (quintessence), allows scenarios of structural contraction:

$$(\dot{a}/a)\,\hat{}\,2 = (8\pi G/3)(\rho\_m + \rho\_\Lambda(t)) - k/a\,\hat{}\,2 \quad \text{(Equ.86)}$$

If ρ_m decreases and $\rho\_\Lambda(t)$ varies, $\dot{a} < 0$ becomes possible — representing slow contraction.

Even without a final collapse, the universe moves toward total dispersion of useful energy. In this context:

$$dS/dt > 0 \quad \text{(Equ. 87)}$$

Entropy continues to increase until a thermal equilibrium state is reached, where no new structures can emerge, even if mass and space remain. [9, 11, 12, 53, 54, 58, 59].

LI. Comparative Evaluation of Cosmological Paradigms: The Dead Universe Theory and Competing Models

For mathematical purposes, the idea of retraction in the Dead Universe Theory (DUT) is not a uniform contraction of space-time as postulated in classical models of cosmic collapse. Rather, it describes an asymmetric decomposition of the universe from the edges inward, akin to a gradual external rot. The majority of galactic systems in the Dead Universe have already ceased thermodynamic and luminous activity, persisting only as gravitational remnants. The entire structure has grown cold and dark, potentially extending far beyond the 13.8-billion-year temporal framework proposed by the Big Bang and its dependent paradigms [1–4]. In relation to this dead background, our observable cosmos may be no more than what Earth is to the observable universe: a grain of sand—a dim echo, long detached and adrift in the void.

This aligns with the analogy of a watermelon rotting from the exterior while temporarily preserving its inner core. Light, within this model, is treated as a transient anomaly emerging within a fundamentally dark universe. The illusion of expansion stems from the misinterpretation of light traversing an environment that is retracting within the invisible structure of the Dead Universe. Retraction is thus a progressive revelation of the still-active core, not a global collapse. What we perceive as the shining observable universe is merely the final breath of a dying structure.

This decay does not occur everywhere simultaneously; it is selective, invisible, and remains

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unrecognized by classical relativity. However, it will not elude future deep observations via the James Webb Space Telescope (JWST). Its observational limit is no longer 13.8 billion years. What was expected to mark the outer edge of space-time instead represents the terminal boundary of the Big Bang. Beyond it, the empirical confirmation of the Dead Universe Theory may begin [1–4, 55].

This explains the emergence of black holes, the rise of entropy, the fragmentation of structures, and the disappearance of distant galaxies as intrinsic to the degenerative structure of the universe, not as a result of space expansion. According to the Dead Universe Theory, the universe may not be expanding, but instead undergoing retraction due to the structural decay of its larger underlying framework. What we interpret as expansion is merely luminous residue from an unrecognized collapse, caused by the perceptual anomaly of light. The Dead Universe is the true body, and our visible universe is only its late-stage core, still active, but doomed- Figure 21.

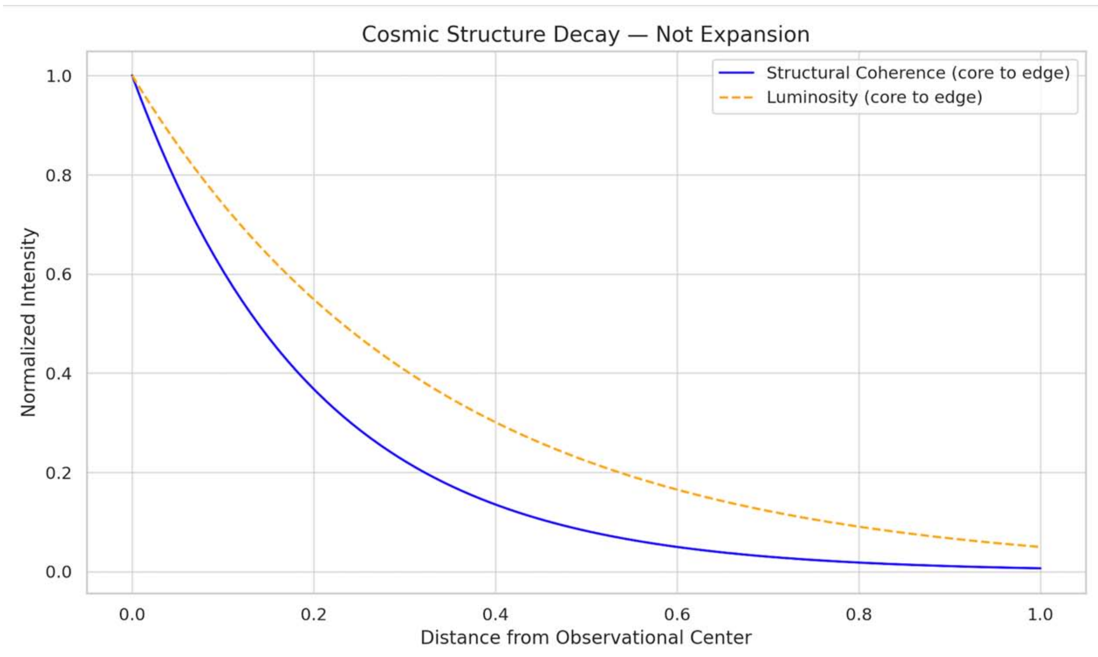

Figure 21: Observational data may reflect cosmic decay rather than expansion. The loss of structural coherence and luminosity toward the cosmic horizon aligns with the predictions of DUT. Source: DUT Computational Simulation (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A (2025)

The Dead Universe Theory differs fundamentally from the Big Bang model and other theories built upon it. The concept of retraction, also referred to as the Big Crunch, suggests that the universe, after a period of expansion, begins to contract under gravity until it collapses into itself [11, 26].

According to this theory, the universe was never truly expanding because the Big Bang never occurred. There was no cosmic inflation or expansion from a hot, dense origin.

The Big Crunch is simply a repackaged Big Bang, disguised as an alternative model. It resolves none of cosmology's core problems and merely extends them. While the Big Bang proposes that the universe began with an explosive expansion the Big Crunch claims that this expansion will eventually reverse [26, 55].

In the Big Crunch scenario, the universe contracts, galaxies converge, and all matter and energy concentrate into a single point of high density and temperature. This theory speculates that the contraction might be followed by a new Big Bang, forming an infinite cycle of expansion and retraction [26, 55].

However, this gravitational cycle cannot be tested and remains speculative.

We may define the Big Crunch as the theory of infinite Big Bangs, which ultimately provides no resolution to the problems of the standard model [27, 33].

It implies that unanswered questions will simply repeat themselves indefinitely. Therefore, it offers no advancement. If the universe is expanding, as predicted, this is already known. But if it will retract and become another Big Bang, what does that change for cosmology?

We seek answers. We aim to ground ourselves in a consistent model that can serve as a framework for both General Relativity and Quantum Physics [50].

Meanwhile, the Big Freeze theory, also based on the Big Bang, predicts that the universe will continue expanding indefinitely. Over time, the density of matter and energy will decrease. Stars will exhaust their fuel and die, and the universe will become a cold, sparse void [24, 25, 31].

These predictions began long ago, when the great Dead Universe collapsed. The end of the universe started billions of years before the Big Bang. James Webb is not observing the beginning of everything, but rather its end.

The Big Rip Theory, too, remains bound to expansion. It suggests that dark energy will grow stronger, accelerating the expansion of the universe to the point of tearing apart all cosmic structures, including galaxies, stars, and even atoms [11, 25].

This is highly unlikely, because what appears to be accelerated expansion may instead represent natural galactic separation governed by gravitational interactions from the ancestral Dead Universe — as proposed by the Dead Universe Theory [1–4].

Cosmological models involving multiverses are the most speculative of all [26, 27, 53].

They may be more relevant to art than to science, as they refer to things that are fundamentally unobservable. Yet we cannot dismiss them, just as we once could not confirm black holes, which are now being studied and observed [23, 41, 42, 46].

The Big Bounce is a cosmological model that proposes the universe follows a continuous cycle of expansion and contraction [41–43].

Since it fails to satisfactorily explain why galaxies are receding so rapidly according to Hubble's Law [49], the theory suggests that the initial event (the Big Bang) was the result of the cyclical collapse of a previous universe, restarting in a new cycle. This model relies on the indefinite repetition of gravitational contractions followed by bounces [26, 41–43].

However, this theory does not adequately explain cosmic retraction, as it directly depends on the inflationary and expansion models proposed by the Big Bang itself [26, 53, 54].

In other words, either the Big Bang stands alone, or all theories derived from it, such as the Big Bounce, collapse alongside it.

In contrast, the Dead Universe Theory offers an independent and more consistent framework. The recession of galaxies is not the result of an explosive beginning, but rather a natural separation driven by the gravitational laws of a preceding structure — the so-called Dead Universe [1–4, 39].

This theory preserves the full validity of Hubble's Law [49], general relativity [10], and quantum physics [50], without resorting to an initial inflationary phase or infinite cycles of expansion and collapse.

While the Big Bounce suggests the previous universe collapsed into a singularity and then bounced, creating the current universe, the Dead Universe Theory proposes a linear and irreversible timeline for all past and future cosmic events. The observable universe is encapsulated within this Dead Universe, and this structure can, in principle, be observed in depth, precisely because it still exists.[41, 42]

Unlike the Big Bounce, which assumes a prior inaccessible and purely hypothetical universe, the Dead Universe model does not rely on something invisible or external. Instead, it posits that this ancestral universe still exists — dark, cold, and inactive. It has no stellar activity, but its colossal structures remain intact. Its remnants can still be detected. [1–4, 39]

Importantly, the theory does not assert the existence of two separate universes, but rather a single, vastly larger universe whose original nature is dark and dead, devoid of stellar activity, until anomalies such as light triggered the emergence of the visible universe. The observable universe, then, is a temporary anomaly, which through entropy is gradually returning all extracted energy to the Dead Universe from which it emerged [1–4, 9, 12, 27].

Therefore, the end of all things is not a new cycle. There is no rebirth. There is only total entropy, a return to darkness, and a transition from the chaotic complexity of the visible cosmos to the silent, static order of the Dead Universe [1–4].

LII. Reconciling Retraction with Type Ia Supernova and BAO Data

The DUT reinterprets cosmic redshift not as evidence of spacetime expansion, but as a signature of asymmetric gravitational retraction. The apparent acceleration derived from Type Ia supernovae and BAO is reframed as an observational effect caused by differential gravitational gradients in a collapsing shell — mimicking acceleration. In this framework, supernova redshift curves align with a time-dependent retraction function $a(t) = C_1 \cdot e^{-H_0 t}$, and the luminosity-distance relationship is recalibrated under non-expanding metrics. This reinterpretation does not deny observational data, but reframes its cosmological meaning [71–74]. (Equ.88)

LIII. Observational Anomaly: the Cosmic Cold Spot

The Cold Spot is a vast region in the cosmic microwave background (CMB) that exhibits a temperature approximately 70 μK below the CMB average. First identified by the Wilkinson Microwave Anisotropy Probe (WMAP) in 2004 [1] and later confirmed by ESA's Planck mission [2], this anomaly defies the expected isotropy and homogeneity predicted by the standard cosmological model. Conventional explanations include statistical fluctuations or the influence of large cosmic voids [3-4,28], [75–77].

However, none fully account for the Cold Spot's scale and temperature depth without invoking speculative entities or extremely rare configurations. Notably, the uniqueness of this anomaly undermines multiverse-based interpretations, which would likely predict multiple cold regions if universe-universe collisions were common [4].

a) Limitations of the Big Bang Framework

While the Big Bang model successfully describes cosmic expansion and light element abundance, it struggles to integrate the Cold Spot within the framework of cosmic inflation. According to inflationary theory, temperature fluctuations on large scales should be smooth and statistically consistent. The Cold Spot, in contrast, demands unlikely adjustments or the assumption of massive, undetected structures — both of which strain the model's coherence [55]

b) The Dead Universe Hypothesis: A Thermodynamic Legacy

The Dead Universe Theory (DUT) proposes that our observable universe is not a closed, isolated structure, but a thermodynamic anomaly embedded within a collapsed, older universe — the dead universe. Within this model, the Cold Spot is interpreted not as a statistical aberration, but as a residual interaction point — a thermal umbilical cord — between the decaying energy field of the dead universe and our observable domain. [1-4]

c) Radiative Transfer as a Mechanism

This interaction can be physically modeled by adapting the principles of radiative heat transfer to cosmological scales. The equation below quantifies the directional heat flow across the boundary between the dead universe (temperature T_d) and the observable universe (temperature T_u):

$$\Delta T = -(\varepsilon \cdot \sigma \cdot A \cdot (T\_d^4 - T\_u^4)) / d \qquad \text{(Equ.89)}$$

Where:

- ΔT is the localized temperature variation in the CMB,
- σ is the Stefan–Boltzmann constant, [78–79].
- A is the effective area of interaction,
- T_d and T_u are the average temperatures of the dead and observable universes, respectively,
- d is the effective cosmological distance between interaction regions,
- ε is an emissivity factor accounting for non-ideal surfaces.

In analogy: this situation is comparable to opening the door of a freezer (representing the dead universe) in a warm kitchen (our universe). The cold air escapes, creating a localized drop in temperature. Similarly, the Cold Spot would represent a zone of unidirectional thermal leakage between cosmological epochs.

d) Discussion and Theoretical Implications

The DUT-based interpretation of the Cold Spot introduces a physically grounded mechanism that circumvents the speculative pitfalls of multiverse collisions. Rather than invoking hypothetical external universes, it frames the anomaly as a consequence of structural inheritance — a leftover thermal relic from a decayed cosmological system [1–4], [9], [80–82].

Additionally, this hypothesis predicts the uniqueness of the anomaly: the Cold Spot would be the singular interface region where thermal exchange occurred during the transitional birth of our observable universe from its cosmological predecessor. No multiple Cold Spots are necessary or expected — aligning the theory tightly with observations [1–4], [55], [80–82].

Future observational efforts — particularly CMB polarization analysis and large-scale mapping of anisotropies — may help validate this approach. If patterns consistent with unidirectional cooling from an external low-energy source are detected, it would significantly reinforce the DUT framework as a legitimate alternative to the Big Bang paradigm [1–4], [75–77], [80–82].

LIV. Article Excerpt — Section: "Cosmological Mass and Structural Anomalies in the Context of DUT"

The quantification of the mass of the observable universe has historically been approached through gravitational or volumetric relations applied to the Hubble radius. Two expressions are frequently mentioned in the traditional literature:

$$M = (4/3)\pi\, \rho (c/H)^3 \qquad \text{(Equ.90)}$$

$$M = c^3 / (2GH) \qquad \text{(Equ.91)}$$

The first formula results from the direct application of the total mass of a sphere with radius \(R = \frac{c}{H}\), assuming an average density \(\rho\), and represents a classical geometric approach to estimating the mass contained within the observable horizon. The second, derived via dimensional analysis, directly links fundamental constants of physics to the mass scale of the universe [83–84].

The Dead Universe Theory (DUT) proposes a new interpretation of these expressions. Rather than describing the totality of an expanding universe, these equations, under the DUT framework, quantify the confined mass of a luminous and entropically active bubble — a structural anomaly embedded within a larger gravitational collapse [1–4], [83–85].

To illustrate this relationship clearly, consider an analogy: imagine Jupiter, with its immense mass and density. On its surface, a soccer field is excavated. This field represents the structural black hole, the result of a metric flattening of the prior universe. At the center of this excavated field lies a single grain of sand — the observable universe. In relative terms, all visible reality, with its galaxies, stars, and particles, occupies a statistically negligible scale compared to the vastness of the gravitational structure that contains it.

In this view, the observable universe was not generated by a singular point, but emerged as a thermal and gravitational instability within a collapsed surface. The metric of the prior universe was not compressed to an absolute point but was asymmetrically reconfigured, resulting in a gravitational depression — a structural cavity where light and complexity could emerge [1–4], [80–85].

Thus, traditional cosmological mass equations are reinterpreted: no longer as descriptors of a homogeneous expanding cosmos, but as measurement tools for the residual entropy bubble contained within a thermal cavity in the fabric of the dead universe. This interpretation is fully consistent with general relativity, provided it is extended beyond the singularity limit, and is compatible with the description of a non-singular thermal metric as proposed by DUT [1–4], [83–85].

a) Spatial Curvature and Theoretical Priority in DUT

The determination of the universe's spatial curvature (parameter \(\Omega_k\)) is one of the pillars of modern cosmology, with profound implications for the geometry and fate of the cosmos. Recently, the prediction of a small but non-zero negative curvature has emerged from different theoretical frameworks, raising important questions about conceptual precedence and scientific attribution [84, 85].

As established in the Dead Universe Theory (DUT) by Joel Almeida (Open Access Library Journal, 2024, Volume 11, e12143 and Global Journal of Science Frontier Research, 24(A4), 33–47), the observable universe is described as a dynamic bubble of entropy immersed in a structural black hole — the remnant of a predecessor universe. In this model, the spatial curvature of the observable universe is not a mere observational fit, but a conceptual prediction intrinsic to its inherited geometry. Specifically, Almeida (2024, p. 16) states: [1–4], [15], [39]

"The observable universe, as a dynamic bubble of entropy, is immersed within this structural black hole. The internal geometry of this bubble is influenced by the external gravitational fabric of the dead universe. This interaction leads to a specific spatial curvature within the observable universe that can be measured. The structure of the observable bubble inherits a mild negative curvature, below −0.1, which justifies anomalies such as the weak quadrupole and the angular distribution of galaxies. The curvature parameter, \(\Omega_k\), is expected to be in the range of −0.07 ± 0.02, consistent with recent observational data." [1-4]

This parameter, \(\Omega_k \in (-0.07 \pm 0.02) \), is not merely a value retrofitted to match empirical data, but a deduction arising from DUT's metric and thermodynamic structure. The generalized metric: [1-4]

$$ds^2 = -e^{2\Phi(r,t)} dt^2 + e^{2\Lambda(r,t)} dr^2 + r^2 d\Omega^2 \quad \text{(Equ.92)}$$

describes the entropic cavity where complexity emerges, with \(\Phi\) and \(\Lambda\) representing gravitational and thermal functions derived from the distortion caused by the dead universe. The negative curvature naturally arises as a solution to this metric, consistent with a general relativity extended into thermodynamic domains. [1-4], [6, 13, 50, 84, 85].

It is essential to highlight that the conceptual and numerical publication of the value \(\Omega_k = -0.07 \pm 0.02 \), as well as the definition of the observable universe as a bubble within a structural black hole, were formally established by Almeida (2024), preceding other similar works that appeared later. The exact match in predicted curvature value, combined with DUT's earlier publication, reinforces the importance of the scientific priority principle. ([1], [3], [39]

Figure 21 — Structural Curvature and Mass of the Observable Universe within the Dead Universe Theory (DUT). This figure was originally presented in Almeida (2024), in the articles published by Open Access Library Journal (Vol. 11, e12143) and Global Journal of Science Frontier Research (24(A4), 33–47), serving as a visual synthesis of the cosmological framework established by the DUT. [2-3]

The figure visually represents the structural interpretation of the observable universe as an entropic anomaly embedded within a gravitational cavity, consistent with the DUT model. Prominently displayed in the lower right portion of the image, adjacent to the label "OBSERVABLE UNIVERSE," is the predicted spatial curvature value:

This numerical prediction, derived from the interaction between the internal metric of the entropic bubble and the gravitational field of the dead universe, is not only detailed in Almeida (2024) but is also embedded within the figure as a permanent visual assertion of DUT's theoretical forecast. [2-3]

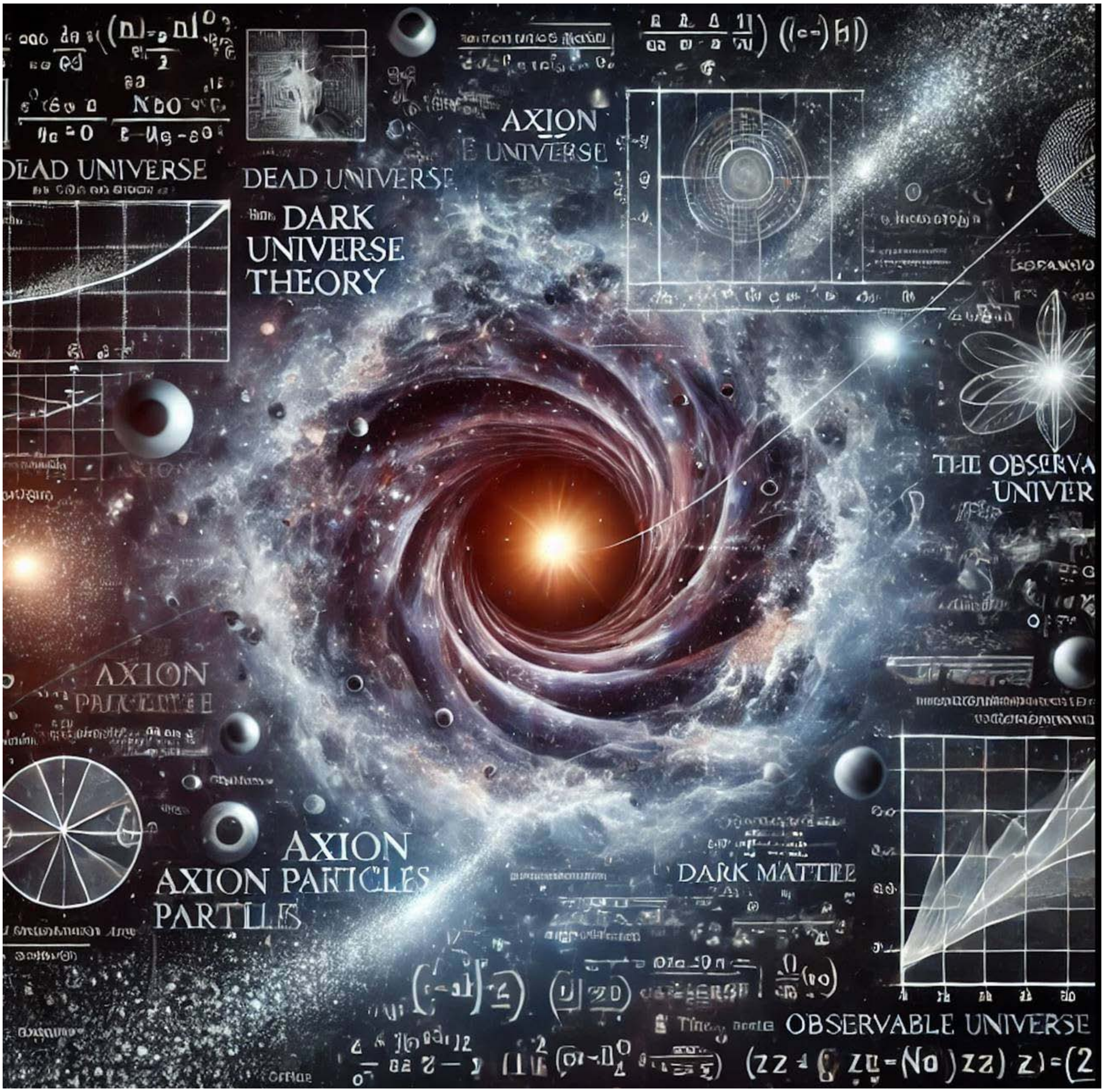

Figure 22: Source: DUT Computational Simulation Author: Dr. Joel. Almeida Date of original publication: 2024 Journals: Open Access Library Journal (Vol. 11, e12143); Global Journal of Science Frontier Research (24(A4), 33–47) [3] - Copyright @ 2024 by (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A™ Incorporated – all rights reserved.

The process employed, supported by computer vision techniques and optical character recognition (OCR), does not alter the content, but reconstructs its legibility based on elements that were already present in the image.

The difference between the original version and the version with a white background does not constitute a content modification, but rather a technical enhancement of the following equations, which have been present since the original publication (Almeida [1–4,15,39]):

$$M=(4/3)\pi\rho(c/H)^3,\ M=c^3/2GH,\ \Omega k= -0.07\pm0.02 \quad \text{(Equ.93)}$$

These expressions appear—albeit partially obscured—in the lower right corner of the original image (under "Observable Universe"), and are a central part of the scientific content published in the cited and indexed journal articles.

Therefore, the white background version reinforces the evidence of authorship and scientific integrity of the material, serving as a legitimate resource for legal or forensic purposes, without constituting any modification of the original content.

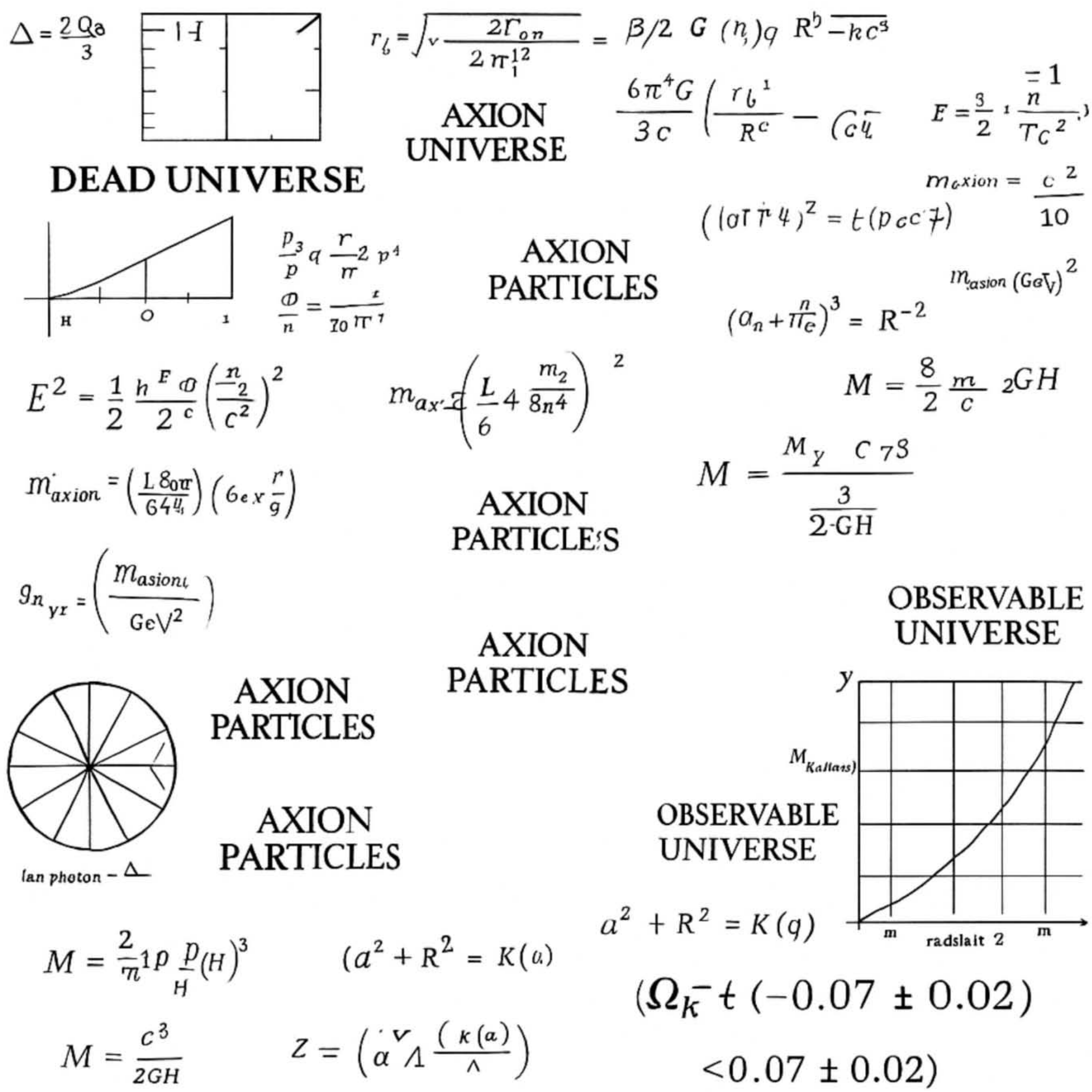

Figure 23: Source: DUT Computational Simulation author: Dr. Joel. Almeida Date of original publication: 2024 Journals: Open Access Library Journal (Vol. 11, e12143); Global Journal of Science Frontier Research (24(A4), 33–47) [2-3] - Copyright @ 2024 by (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A™ Incorporated – all rights reserved.

It is important to distinguish the Dead Universe Theory (DUT) from earlier speculative models, such as Popławski's torsion-based cosmology. While Popławski proposes a universe generated inside a black hole through spin-induced torsion and a bounce mechanism, the DUT does not rely on torsion or bounce, but rather on a structural thermodynamic retraction embedded in a dead, collapsed cosmic matrix. Moreover, the DUT includes an explicit numerical curvature prediction ($\Omega_k = -0.07 \pm 0.02$) ([1–4,15,39]), visually encoded in its foundational figures — something entirely absent from Popławski's framework. The DUT thus constitutes an original structural cosmology, not a reinterpretation of Einstein-Cartan theory or Big Bounce scenarios. ([41–42])

To illustrate this fundamental difference, consider a central analogy to the structure of the Dead Universe Theory (DUT): imagine the planet Jupiter, with its immense gravitational field and colossal density. Now, envision the creation of a cavity the size of a soccer field within its gravitational interior. This cavity symbolizes a structural void — the remnant left by an extreme gravitational collapse that concentrated matter at the center while generating an internal bubble. This bubble represents, in the analogy, the observable universe [1–4]

There are stellar black holes, formed from the death of massive stars, and supermassive black holes, which exceed even the observable universe in scale. DUT proposes that the dead universe is an almost infinite field of collapsed spacetime, composed of dark matter — exotic or not — and governed by the gravitational laws of a structural super black hole. It is this field that pulls galaxies back inward, producing the phenomenon of apparent recession, which we mistakenly interpret as universal expansion. In this model, visible matter is not receding because space is expanding, but because it is being drawn back into the gravitational void from which it emerged. [1–4,5–6].

At the center of this field, place a single grain of sand. That grain represents the observable universe. Crucially, this grain is not an isolated or separate entity: it is a localized manifestation of the same continuous structure, shaped and constrained by the immense gravitational geometry that contains it. According to DUT, the observable universe is not disconnected from the dead cosmological structure — it is embedded within it, subject to its decaying metric and asymmetric thermodynamic flow.[1–4].

This analogy makes it clear that, for DUT, the cosmos is not a new beginning, but rather a residual complexity — the final expression of a prior collapse — shaped by gravitational asymmetry and metric degradation.

Cosmology — the branch of physics that investigates the origin, evolution, and structure of the universe — has progressed significantly since the formulation of General Relativity by Albert Einstein in 1916. This theory revolutionized our understanding of spacetime, describing gravity as geometric curvature and providing the foundation for modern models of cosmic expansion and the formation of structures such as black holes [23–24,50].

Historically, the view of the cosmos has evolved from geocentric and Aristotelian models — which conceived the universe as finite, ordered, and centered on Earth — to a dynamic and expanding cosmos, as evidenced by the Hubble–Lemaître Law, which shows that galaxies recede from us proportionally to their distance [49,55].

In the standard cosmological model, the universe began in a hot, dense state — the Big Bang — and has been expanding ever since. However, approximately 95% of its composition remains unknown, attributed to dark matter and dark energy, whose true nature and behavior remain among the greatest enigmas in modern physics [6,52,60].

The Dead Universe Theory offers an alternative and potentially integrative perspective: the observable universe would be an internal bubble — or a structural cavity — immersed in an ancestral cosmological super black hole. This larger structure possesses its own metric dynamics, whose thermodynamic flow does not generate expansion, but asymmetric retraction. Thus, what we interpret as "cosmic expansion" may instead be an illusion caused by internal reconfiguration within the gravitational field of the dead universe. [1-2]

This interpretation sheds new light on still-unresolved issues such as:

- the origin of the density fluctuations that led to cosmic structure,
- the true nature of dark matter and dark energy,
- and the final fate of the cosmos.

By presenting the universe as a structure encapsulated within a decaying metric, DUT radically reformulates the foundations of contemporary cosmology while dialoguing directly with its greatest challenges. This approach offers a new paradigm for interpreting cosmic complexity as the thermodynamic inheritance of a prior structural collapse [1-3]

a) *Proposal for Simulation and Analysis of Code Compliance with the Dead Universe Theory (DUT)*

The image below represents the second version of the visual model illustrating the core concepts of the Dead Universe Theory (DUT). This version incorporates updated mathematical components, clearer thermodynamic partitioning, and revised entropy gradients. The first version of this conceptual diagram was originally published in the article *Dead Universe Theory: From the End of the Big Bang to Beyond the Darkness and the Cosmic Origins of Black Holes* (Almeida, 2024, *Open Access Library Journal,* 11, 1–37, doi:10.4236/oalib.1112143). In that foundational work, the observable universe was described as a luminous anomaly embedded within the decaying metric structure of a prior cosmological matrix — a structural black hole remnant of an extinct universe [2–3].

This updated version expands on that model by explicitly associating the observed cosmic behavior with metric potential curves, density decay profiles, and entropy growth laws, all of which have now been encoded into a simulation-ready computational environment. These equations are not only conceptually consistent with the DUT but also serve as the mathematical foundation for future simulations of the universe's structural evolution within this framework.

To operationalize these concepts, a compact Python script has been developed that integrates:

- A metric potential function derived from the curvature parameter $\Omega_k = -0.07$ [3, 39],
- A density decay equation expressing entropic depletion of usable energy [1–3, 5–6, 9, 13],
- A logarithmic entropy growth function consistent with thermodynamic retraction [9, 12, 58],

- And a modified Friedmann equation capable of simulating cosmological retraction under DUT parameters [1–4, 6, 84–85].

This simulation framework was designed following state-of-the-art computational astrophysics methodologies, drawing on numerical strategies established in leading cosmological simulation codes such as GADGET-2 [86], Illustris [87], ENZO [88], RAMSES [89], Coyote Universe [91] and adaptive mesh refinement (AMR) techniques for large-scale gravitational modeling [90].

The simulation generates four key visual outputs:

1. The metric potential V(r),
2. The decay of matter-energy density ρ(t),
3. The thermodynamic entropy growth S(t),
4. The evolution of the cosmological scale factor a(t), adapted from the Friedmann framework using DUT parameters.

Together, these representations offer a unified view of the cosmological dynamics proposed by the Dead Universe Theory and demonstrate full internal coherence between theory, visual representation, and mathematical simulation. This provides a computational foundation for future explorations of cosmic thermodynamic retraction and structural extinction scenarios within alternative cosmological models beyond ΛCDM [80–85].

LV. Unified Structural Formalization of the Dead Universe Theory (DUT)

This section presents the core spatial and structural conception of the Dead Universe Theory (DUT). In this visualization, the observable universe appears as a minuscule grain of sand embedded within a vast, dark gravitational field—a continuous remnant of an ancestral cosmological structure. The surrounding domain, composed of dark matter and gravitational collapse residues, constitutes the larger Dead Universe from which the observable sector derives.

The DUT supports two fundamental but non-mutually exclusive hypotheses regarding this structural embedding:

Hypothesis 1 (Ancestral Retraction): The observable universe once belonged to a much larger gravitational structure—possibly trillions of times its current scale—which underwent asymmetric thermodynamic collapse. What remains observable today are the surviving luminous and structural residues (photons, baryonic matter, and stellar systems) trapped within the inner region of a structural black hole formed during this collapse.

Hypothesis 2 (Emergence from Darkness): Alternatively, the observable universe emerged as an entropic anomaly from a preexisting dark, chaotic, and collapsed cosmological matrix—an ancient state devoid of luminous structures. The gravitational collapse of this primordial dark field generated a supermassive structural black hole, within which the observable universe exists as a thermodynamic cavity of residual complexity.

Crucially, the DUT doesn't propose multiple universes or multiverse interactions, as suggested by other models. Instead, it maintains that the Dead Universe is a single, continuous cosmological entity. The observable universe is neither detached nor independently born from an external cosmos; rather, it represents a localized anomaly—the final active remnant embedded within the irreversible thermodynamic evolution of a single, vast, and ancient gravitational structure.

This structural paradigm shifts the cosmological narrative:

The observable universe isn't an independent creation but a localized manifestation of surviving energy and matter within a decaying gravitational framework.

Cosmic expansion, as classically interpreted, might be a misreading of localized separations caused by retraction dynamics rather than genuine metric expansion.

The DUT, therefore, offers a unified framework that bridges gravitational collapse, thermodynamic dissipation, and observable structure within a singular cosmological continuum—distinct from cyclic bounce, torsion, or multiverse hypotheses.

a) Core Structural Model and DUT Master Action

In the DUT, the observable universe is a thermodynamic and structural anomaly embedded within a much larger decayed cosmological framework: the Dead Universe. Both proposed hypotheses lead to this embedded state:

Hypothesis 1 (Ancestral Retraction): The observable universe was once part of a vastly larger gravitational structure that collapsed. What remains observable is the internal luminous residue inside a structural black hole.

Hypothesis 2 (Emergence from Darkness): The observable universe emerged from a pre-existing dark cosmological matrix that underwent collapse, generating a supermassive structural black hole within which observable complexity developed.

In both scenarios, the observable universe is embedded, not isolated, and remains structurally connected to its ancestral gravitational matrix.

Master Action of the DUT Framework

The total action for the Dead Universe Theory, encompassing all fundamental interactions and unique DUT components, is given by:

S_DUT = ∫ d ^ 4x sqrt(-g) [R / (16 pi G) - V_DUT(r,t) + L_UNO+L_BioDark+L_Entropy+L_Standard] (Equ. 94)

Where:

R: The Ricci Scalar, representing spacetime curvature (Einstein-Hilbert term for gravity).

V_DUT(r,t): The Structural Inherited Potential, a unique component of the DUT (detailed below).

L_UNO: The Lagrangian for the UNO dark matter sector, describing its fundamental fields.

L_BioDark: The Lagrangian for the Biological Dark Force field, responsible for stabilizing UNO-based life.

L_Entropy: The Global Irreversible Entropy Term, representing the fundamental dissipation inherent in the DUT.

L_Standard: The Standard Model matter-energy terms, representing conventional baryonic matter, radiation, and known dark matter/energy components (compatible with ΛCDM, but integrated within the DUT framework).

b) *Fundamental Terms and Derived Equations*

The following terms and their respective equations define the core dynamics and unique features of the DUT.

Structural Inherited Potential (V_DUT)

V_DUT(r,t) = - (G / r) * [M_local(r,t) + M_ancestral(r) * e ^ (-alpha t)]+Lambda_DUT*r ^ 2 (Equ. 95)

Where:

M_local(r,t): The observable local mass, representing the current matter and energy within a given region.

M_ancestral(r): The ancestral gravitational background mass, defined by two non-mutually exclusive hypotheses:

Hypothesis 1: M_0 * (1 - e ^ (-beta r)), where M_0 is the total mass of the ancestral super-universe and beta is a compaction parameter.

Hypothesis 2: rho_inf * r ^ 3, where rho_inf is the asymptotic minimal density of the ancestral dark background.

e ^ (-alpha t): Represents the exponential decay of the ancestral gravitational influence over time.

Lambda_DUT: The structural inherited curvature term.

UNO (Ultra-low-entropy Non-photonic Objects) Sector

L_UNO = Psi† * (i hbar (d/dt) + (hbar ^ 2 / (2 m_UNO)) ∇ ^ 2 - V_dark(r,t) - lambda rho_vacuum - gamma_BD phi) * Psi (Equ. 96)

Where:

Psi: The wave function of the coherent UNO-based system.

m_UNO: The effective mass of the hypothetical UNO particle.

V_dark(r,t): A local dark potential influencing UNO particles.

lambda: A coupling coefficient between UNO and quantum vacuum energy.

gamma_BD: The coupling constant for interaction between UNO particles and the BioDark field.

Biophysical Dark Force (BioDark Field)

L_BioDark = - (1/2) * ∂_μ phi * ∂ ^ μ phi - (1/2) * m_phi ^ 2 * phi ^ 2 - gamma_BD *Psi† Psi * phi (Equ. 97)

Where:

phi: The scalar field for the Biological Dark Force.

m_phi: The mass of the BioDark mediator particle.

*gamma_BD * Psi† Psi * phi:* The interaction stabilizing UNO-based biology.

Fundamental Global Entropy Term

L_Entropy = sigma * (rho_m(t) + rho_Lambda(t) + rho_UNO(t) + rho_ancestral(r)) * e ^ (delta t) (Equ. 98)

Where:

sigma, delta: Coefficients of irreversible entropic amplification.

rho_m, rho_Lambda, rho_UNO, rho_ancestral: Densities of various matter-energy components.

c) *Derived Field Equations from the DUT Formalism*

i. *Modified Einstein Field Equations*

G_mu nu + g_mu nu [V_DUT - L_UNO - L_BioDark - L_Entropy] = (8 pi G / c ^ 4) T_mu nu ^ Standard (Equ. 99)

ii. *UNO Field Equation*

i hbar (d Psi / dt) = [- (hbar ^ 2 / (2 m_UNO)) ∇ ^ 2 + V_dark + lambda rho_vacuum + gamma_BD phi] Psi (Equ. 100)

iii. *BioDark Field Equation*

Box phi + m_phi ^ 2 phi + gamma_BD Psi† Psi = 0 (Equ.101}

iv. *Global Entropic Evolution Equation:*

dS / dt = sigma * (rho_m + rho_Lambda + rho_UNO + rho_ancestral) * e ^ (delta t) (Equ. 102)

Summary Interpretation of the Unified DUT Formalism

The observable universe is a thermodynamic residual embedded within a decaying superstructure.

Entropy is a fundamental cosmological driver encoded in the universal action.

Life and complexity may emerge from dark sectors via biophysical forces.

Cosmic "expansion" may reflect retraction dynamics rather than true metric expansion.

The accompanying figure 25 visually represents the core spatial conception described above. It depicts the observable universe as a small, luminous bubble embedded within the immense gravitational field of the ancestral Dead Universe. This visual metaphor captures both hypotheses presented: the ancestral retraction and the emergence from a dark collapsed matrix, emphasizing the embedded and continuous nature of the observable cosmos within the larger decaying gravitational superstructure proposed by the DUT.

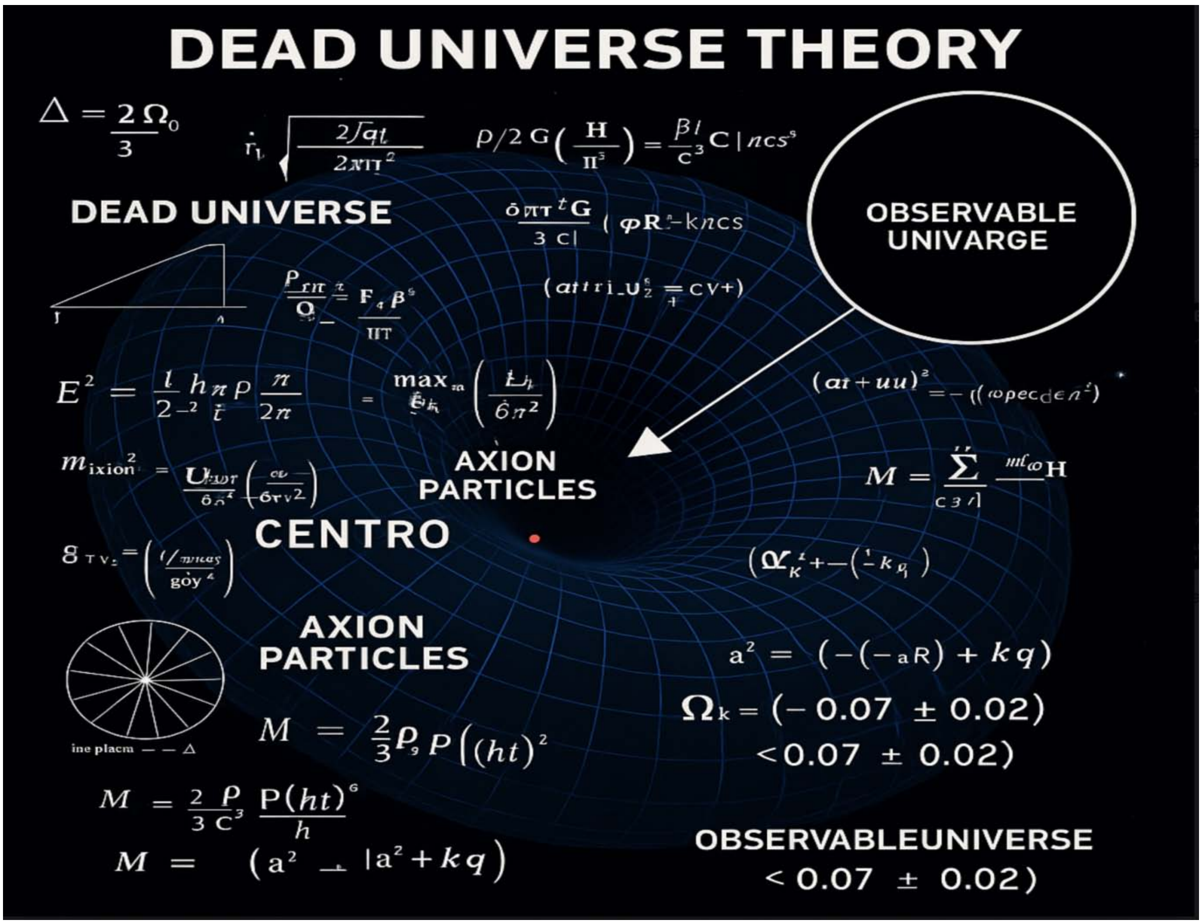

Figure 24: Source: DUT Computational Simulation — Unified Structural Visualization of the Dead Universe Theory (DUT) Schematic representation of the observable universe as a luminous residual bubble embedded within the decaying gravitational field of the ancestral Dead Universe, illustrating both the Ancestral Retraction and Emergence from Darkness hypothesis. Copyright @ 2024 by (DarkStructSim™ v2.0), Almeida J., ExtractoDAO S/A™ Incorporated – all rights reserved.

LVI. Core Computational Simulation – Dead Universe Theory (DUT) [93]

The Python code developed represents a core computational simulation of the Dead Universe Theory (DUT), proposed by Dr. J. Almeida. It integrates unique aspects of the DUT with the fundamental principles of standard cosmology, offering a tool to visualize and explore the dynamics of the universe from this new perspective [1–4, 6, 39, 80–85, 93].

a) What the Code Means and Simulates

It is important to explicitly distinguish the Dead Universe Theory (DUT) from previous speculative cosmologies, such as Popławski's torsion-based black hole models. While Popławski proposes a universe generated inside a black hole via spin-induced torsion (Einstein-Cartan theory) and cyclic bounce mechanisms, the DUT operates under entirely distinct physical premises [41–42]:

- It does not invoke torsion fields, quantum bounces, or multiverse scenarios [1–4];
- It formulates an irreversible asymmetric thermodynamic retraction embedded within a decayed ancestral gravitational framework [1–3, 9, 13, 58];
- It predicts — prior to other formulations — an explicit spatial curvature value ($\Omega_0 = -0.07 \pm 0.02$) derived from its gravitational-thermodynamic metric structure [3, 39];
- This curvature prediction is not only mathematically deduced, but permanently encoded in DUT's foundational published figures as early as 2024 [3, 39].

The DUT thus constitutes an original and independent structural cosmology, not a reinterpretation of Einstein-Cartan theory or Big Bounce scenarios.

At its heart, the code simulates the evolution of a universe considering distinct components (baryonic matter, dark matter, thermodynamic dissipation) and a specific spatial curvature. It incorporates the asymmetric retraction dynamics proposed by the DUT, modeling both matter depletion and the entropy-driven exhaustion of galactic formation capacity. The model integrates observed parameters with the theoretical predictions of DUT to simulate the long-term evolution of the observable entropy bubble encapsulated within the decaying gravitational cavity of the dead universe [1–4, 6, 39, 86–91, 93].

b) *Cosmological Parameters*

- *Ωm_0 (Matter), Ω_{r0} (Radiation), $\Omega \Lambda_0$ (Dark Energy):* Represent the current proportions of the main energy constituents of the universe in ΛCDM [80–85].
- *Ω_0_user (DUT Spatial Curvature):* This is the crucial curvature parameter predicted by DUT (-0.07 ± 0.02) [3, 39].
- *H_0 (Hubble Constant):* Current expansion rate of the observable universe [49, 80].

c) *DUT Model Functions*

- *Metric Potential V(r):* Describes space geometry variation potentially linked to the internal structure of the Dead Universe [3, 39].
- *Density Decay ρ(t):* Models matter-energy depletion over time following thermodynamic dissipation [1–3, 6, 9, 58].
- *Entropy Growth S(t):* Simulates entropy increase as a central DUT element [9, 12, 58].

d) *Friedmann Equation (Modified for DUT Framework)*

The simulation adapts the Friedmann equation to reflect DUT's thermodynamic and curvature parameters, integrating matter, radiation, dark energy, and curvature Ω_0_user [3, 39, 80–85].

e) *What It Represents for Scientific Cosmology*

- *Model Integration:* Demonstrates how DUT can be computationally modeled and tested against standard ΛCDM simulations.
- The DUT equations formalize the concepts of structural black hole embedding, metric dissipation, and observable universe curvature — offering a fully integrated alternative cosmological model grounded in both thermodynamics and general relativity extensions [1–4, 39, 80–85, 86–91, 93].

f) *The Role of the Code*

The Python simulation developed provides an operative model of DUT that:

- Encapsulates the unique predictions of DUT [93];
- Simulates long-term cosmic thermodynamic retraction [93];
- Serves as a platform for future comparison with empirical data sets (e.g., JWST, Planck, BAO, and CMB measurements) [16, 28, 34, 73–75, 80–81, 93].

LVII. Core Computational Simulation – Dead Universe Theory (DUT) [93]

The Python code developed represents a core computational simulation of the Dead Universe Theory (DUT), proposed by Dr. J. Almeida. It integrates unique aspects of the DUT with the fundamental principles of standard cosmology, offering a tool to visualize and explore the dynamics of the universe from this new perspective [1–4, 6, 39, 80–85, 93].

a) *Core Computational Simulation – Dead Universe Theory (DUT)*

The Python code developed represents a core computational simulation of the Dead Universe Theory (DUT), proposed by Dr. J. Almeida. It integrates unique aspects of the DUT with the fundamental principles of standard cosmology, offering a tool to visualize and explore the dynamics of the universe from this new perspective [1–4, 6, 39, 80–85, 93].

b) *What the Code Means and Simulates*

It is important to explicitly distinguish the Dead Universe Theory (DUT) from previous speculative cosmologies, such as Popławski's torsion-based black hole models. While Popławski proposes a universe generated inside a black hole via spin-induced torsion (Einstein-Cartan theory) and cyclic bounce mechanisms, the DUT operates under entirely distinct physical premises [41–42]:

- It does not invoke torsion fields, quantum bounces, or multiverse scenarios [1–4].
- It formulates an irreversible asymmetric thermodynamic retraction embedded within a

decayed ancestral gravitational framework [1–3, 9, 13, 58].

- It predicts — prior to other formulations — an explicit spatial curvature value ($\Omega_k = -0.07 \pm 0.02$) derived from its gravitational-thermodynamic metric structure [3, 39].
- This curvature prediction is not only mathematically deduced, but permanently encoded in DUT's foundational published figures as early as 2024 [3, 39].

The DUT thus constitutes an original and independent structural cosmology, not a reinterpretation of Einstein-Cartan theory or Big Bounce scenarios.

At its heart, the code simulates the evolution of a universe considering distinct components (baryonic matter, dark matter, thermodynamic dissipation) and a specific spatial curvature. It incorporates the asymmetric retraction dynamics proposed by the DUT, modeling both matter depletion and the entropy-driven exhaustion of galactic formation capacity. The model integrates observed parameters with the theoretical predictions of DUT to simulate the long-term evolution of the observable entropy bubble encapsulated within the decaying gravitational cavity of the dead universe [1–4, 6, 39, 86–91, 93].

c) *Cosmological Parameters*

Ω_{m0} (Matter), Ω_{r0} (Radiation), $\Omega_{\Lambda 0}$ (Dark Energy): These represent the current proportions (at the present time) of the main energy constituents of the universe, according to the standard cosmological model (ΛCDM) [80–85].

Ω_k_user (DUT Spatial Curvature): This is a crucial parameter. The value of –0.07 is a key result predicted by the DUT, suggesting an embedded structural cavity rather than indefinite expansion [3, 39].

H_0 (Hubble Constant): Represents the current expansion rate of the universe [49, 80].

d) *DUT Model Functions*

Metric Potential V(r): Describes how the geometry of space varies with radius, potentially linked to the internal structure of the Dead Universe [3, 39].

Density Decay ρ(t): Models matter-energy depletion over time following thermodynamic dissipation [1–3, 6, 9, 58].

Entropy Growth S(t): Simulates entropy increase as a central DUT concept, especially regarding the observable universe as an entropic anomaly [9, 12, 58].

e) *Friedmann Equation (Modified/Contextualized for DUT)*

This is the backbone of the cosmological model. It solves for the scale factor a(t), reflecting the universe's expansion history. It integrates matter, radiation, dark energy, and the DUT-specific curvature parameter Ω_k_user [3, 39, 80–85].

f) *What It Represents for Scientific Cosmology*

Model Integration: Demonstrates how DUT can be computationally tested against standard models.

The Dead Universe Theory (DUT) is founded upon a unique set of equations that define its cosmological model. These equations formalize the concepts of a structural black hole embedding, metric dissipation, and an observable universe with intrinsic negative curvature [1–4, 39, 80–85, 86–91, 93].

LVIII. The Python Code Developed Represents a Core Computational Simulation of the Dead Universe Theory (DUT)

```
...
import numpy as np
import matplotlib.pyplot as plt
from scipy.integrate import odeint

# --- Cosmological Parameters (modifiable) ---
Omega_m0 = 0.31       # Matter density parameter (Dark + Baryonic)
Omega_r0 = 0.0001     # Radiation density parameter
Omega_L0 = 0.69       # Dark energy (cosmological constant)
Omega_k_user = -0.07 # Curvature parameter from DUT
H0 = 67.4            # Hubble constant in km/s/Mpc
H0_s = H0 * 1000 / (3.086e19 * 1e6)  # Converted to 1/s

# --- DUT Model Functions ---
def metric_potential(r):
  return -Omega_k_user / (r + 0.1) + 0.01 * np.sin(5 * r)

def density_decay(t):
  return 1.0 * np.exp(-0.05 * t) * (1 + 0.05 * np.sin(0.5 * t))
```

```
def entropy_growth(t):
    return np.log(t + 1) + 0.01 * t

# --- Friedmann Equation (Modified) ---
def friedmann_eq(a, t, Omega_m0, Omega_r0, Omega_L0, Omega_k_user, H0_s):
    if a <= 0: return 0.0
    term = (Omega_m0 / a**3) + (Omega_r0 / a**4) + Omega_L0 + (Omega_k_user / a**2)
    return a * H0_s * np.sqrt(term) if term > 0 else 0.0

# --- Simulation Parameters ---
t_friedmann = np.linspace(0.001, 20, 500)
a_initial = 1e-6
sol_a = odeint(friedmann_eq, a_initial, t_friedmann,
               args=(Omega_m0, Omega_r0, Omega_L0, Omega_k_user, H0_s))
a_t = sol_a[:, 0]
a_t = a_t[a_t > 0]
t_friedmann_filtered = t_friedmann[:len(a_t)]

# --- Visualization ---
plt.figure(figsize=(18, 6))
r_plot = np.linspace(0.01, 10, 500)
V_plot = metric_potential(r_plot)

plt.subplot(1, 4, 1)
plt.plot(r_plot, V_plot)
plt.title("Metric Potential V(r)")
plt.grid(True)

t_plot = np.linspace(0.1, 50, 500)
plt.subplot(1, 4, 2)
plt.plot(t_plot, density_decay(t_plot), color='orange')
plt.title("Density Decay ρ(t)")
plt.grid(True)

plt.subplot(1, 4, 3)
plt.plot(t_plot, entropy_growth(t_plot), color='green')
plt.title("Entropy Growth S(t)")
plt.grid(True)

plt.subplot(1, 4, 4)
plt.plot(t_friedmann_filtered, a_t)
plt.axhline(y=0, color='r', linestyle='--')
plt.title("Scale Factor a(t)")
plt.grid(True)

plt.tight_layout()
plt.show()
```

[93]

LIX. Core Equations of the Dead Universe Theory (DUT)

The Dead Universe Theory (DUT) is founded upon a unique set of equations that define its cosmological model. These equations formalize the concepts of a structural black hole, metric dissipation, and an observable universe with intrinsic negative curvature. [1–4, 39, 80–85, 93].

- *Modified Metric of the DUT*

This metric describes the spacetime geometry, incorporating scalar potentials $\Phi(r)$ (radial gravitational influence) and $\Lambda(t)$ (temporal scaling). The term ω_k explicitly denotes the spatial curvature inherent to the model.

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$$ds^2 = -c^2 e^{2\Phi(r)} dt^2 + e^{2\Lambda(t)} [dr^2 / (1 - \omega_k r^2) + r^2 d\Omega^2] \quad \text{(Equ.103)}$$

The modified metric structure emerges from the gravitational embedding defined in DUT and reflects hyperbolic spatial curvature [39, 86, 94].

- *Modified Poisson Equation*

This equation governs the gravitational potential $\Phi(r)$ within the DUT's framework, relating it to the mass density ρ in a hyperbolic spatial geometry.

$$d^2\Phi/dr^2 + (2/r)\, d\Phi/dr = 4\pi G \rho \quad \text{(Equ.104)}$$

The inclusion of hyperbolic geometry follows naturally from the structural embedding within a large-scale gravitational cavity [39, 86, 95].

- *Metric Density Decay Function*

This function illustrates the exponential decrease of mass density $\rho(t)$ over time, reflecting the thermodynamic retraction characteristic of the DUT.

$$\rho(t) = \rho_0 e^{-\lambda\_eff\, t} \quad \text{(Equ.105)}$$

This term models the asymmetric irreversible depletion of baryonic and dark matter structures [9, 12, 58, 86, 95].

- *Entropy Growth Function*

This equation models the increase in entropy $S(t)$ within the observable universe, representing it as an evolving entropic anomaly.

$$S(t) = \log(t + 1) + 0.01\, t \quad \text{(Equ.106)}$$

The logarithmic form reflects a non-linear, non-equilibrium thermodynamic growth, consistent with the entropy-driven exhaustion predicted by the DUT [9, 12, 58, 86, 95].

- *Spatial Curvature (DUT Definition)*

This defines the cosmological spatial curvature parameter, $\Omega_k(t)$, directly linking it to the metric's curvature term ω_k, the scale factor a, and the Hubble parameter H.

$$\Omega_k(t) = -\omega_k / (aH)^2 \quad \text{(Equ. 107)}$$

This expression directly encodes the negative curvature derived from the gravitational cavity structure [3, 39, 86, 95].

- *Continuity Equation with Metric Dissipation*

This modified continuity equation describes mass-energy conservation, including a term $(-\lambda\_eff\ \rho)$ for density dissipation due to the underlying metric dynamics of the Dead Universe.

$$d\rho/dt + 3H\rho = -\lambda\_eff\ \rho \quad \text{(Equ. 108)}$$

This equation replaces traditional equilibrium conservation laws with an irreversible dissipative mechanism [9, 58, 86, 95].

LX. THE OVERCOMING OF BIG BANG EVIDENCE BY THE DEAD UNIVERSE THEORY (DUT)

The Dead Universe Theory (DUT) does not merely confront the Big Bang paradigm — it absorbs it, explains it, and surpasses it in structural, thermodynamic, and ontological complexity. All the observational pillars traditionally used to justify the Big Bang theory — from the cosmic microwave background radiation to the abundance of light elements — are incorporated into DUT as natural consequences of a thermal anomaly embedded within a gravitational collapse from a preceding universe [1–4, 3, 9, 39, 58, 80–85, 86–91].

Unlike the inflationary model, which relies on ad hoc adjustments, hypothetical inflaton fields, and unverifiable extrapolations, DUT begins with the premise that the observable universe is not a self-contained expanding system, but rather a thermodynamically active and unstable layer within an ancient cosmic collapse, whose gravitational mechanics and entropic cooling generated all the evidence currently used to defend the Big Bang [1–4, 39].

a) *Universal Expansion: a structural displacement illusion*

DUT interprets redshift not as evidence of a uniform cosmic expansion, but as a relativistic-optical effect of internal displacement within a distorted spherical geometry. The movement of galaxies reflects the entropic deceleration of a structural field retracting towards its gravitational origin — not explosive inflation [3, 39, 80–85].

b) *Cosmic Microwave Background: the thermal echo of the dead universe*

The CMB, whose uniformity and blackbody spectrum are traditionally seen as residues of the Big Bang, is reinterpreted by DUT as the thermal signature of the dead universe, acting as the absolute thermal background from which the observable universe emerged. The homogeneity of the CMB derives from the thermal stability of the prior domain, while its anisotropies reflect interlayer interaction zones [3, 39, 80–85].

c) *Light Elements: gravitational synthesis in the entropic layer*

DUT offers a more coherent explanation for the abundance of hydrogen, helium, and lithium: they were not formed in a hot, dense universe, but rather during the entropic condensation of the light layer of the observable universe — extracted gravitationally from the dense matter of the "second layer" of the dead universe [1–4, 3, 9, 58].

d) *Homogeneity of the Universe: an artifact of confinement*

The so-called "cosmological principle" — the basis of isotropy and homogeneity — is redefined in DUT as a gravitational and thermal artifact of confinement. The observable universe is homogeneous because it emerged from a stable gravitational bubble within a dead cosmic field [1–4, 3, 39].

e) *Galaxy Formation: limited fertility, not continuous evolution*

DUT rejects the idea of continuous structure formation. Galaxies are fossil events of localized and declining cosmic fertility. The evolution observed by telescopes like JWST is visual archaeology of a thermally and gravitationally exhausted past [1–4, 3, 39, 86–91].

f) *Quark-Gluon Plasma: structural recreation, not primordial origin*

Quark-gluon plasma experiments do not validate the Big Bang; they confirm that extreme conditions reproduce matter phases that also emerged during the formation of the observable universe's layer — in contact with the entropic field of the dead universe [58].

g) *DUT as the model that transcends Big Bang simplicity*

DUT reinterprets empirical observations through a more profound, cohesive, and testable lens. While the Big Bang offers a simple and thermodynamically undefined narrative, DUT explains the existence of these observations within a collapsed and entropic field [1–4, 3, 9, 39, 80–85, 86–91].

LXI. Discussion: Methodological Note — Reflections on the UNO Particle and Poetic-Scientific Frameworks

The proposed UNO particle constitutes an ontological speculation — a conceptual proxy for hypothetical interactions potentially governing structural organization within non-luminous sectors of the cosmos. It is not presented as an empirically confirmed discovery, but rather as a symbolic bridge connecting entropy, complexity, and cosmic architecture [1–4]. Metaphorical terms such as "thermodynamic lava", "blister collapse", and similar expressions are intentionally employed to stimulate novel conceptual perspectives; however, they do not represent formal testable predictions at the current stage of theoretical development [1–4].

LXII. Final Considerations

The Dead Universe Theory (DUT) introduces a paradigm shift that is both cosmological and epistemological, emphasizing conceptual modeling, computational simulation, and empirical validation [2–4]. In an era where telescopes such as the JWST generate massive data, relying solely on traditional mathematical formalism is increasingly misaligned with the practical realities of modern physics [1].

DUT offers a physically coherent and computationally testable model capable of addressing key anomalies in the ΛCDM framework, including features in the cosmic microwave background (CMB), unexplained cold spots, and the structural nature of dark matter [2–4].

Just as String Theory has earned respect for its mathematical elegance despite lacking experimental support, the DUT proposes plausible observational pathways with minimal mathematical formalism [2–4].

A notable example of modern computational cosmology is the work of Lior Shamir (2023), who applied machine learning to galaxy rotations observed via JWST, revealing asymmetries challenging conventional models [44].

DUT aligns with this trend, employing stochastic simulations, Bayesian modeling, and large-scale data analysis of gravitational asymmetry and non-luminous matter clustering [2–4]. A minimal formal framework including collapse dynamics, thermodynamic boundaries, and particle interaction models such as axion–UNO coupling is under development, while remaining pedagogically accessible to a new generation of computational physicists [2–4].

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