Prolegomena to the Theory of Informational Space Genesis (ISG): A Paradigm Shift in the Cosmology of Perception

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Abstract

Current cosmological models, primarily the ΛCDM framework, face significant challenges in explaining Dark Matter and Dark Energy. The Theory of Informational Space Genesis (ISG) proposes an ontological shift, defining space as an emergent byproduct of interaction processes. This paper details a four-stage signal denoising methodology to isolate the "Pristine Potential" ($E_p \approx 2.15$ meV). By correlating this potential with a baryonic base ($\beta \approx 1.5\pi$) derived from the ensemble average of the ten most abundant atomic species, we derive a Lorentz-conformant power-law scaling. This model predicts a Dark Matter density of $\approx 28.6\%$, aligning with observational data with high precision.

1 Introduction: Beyond the Material Stage

Modern astrophysics is currently at a crossroad. Despite the success of General Relativity, the persistent invisibility of Dark Matter and the unexplained acceleration of cosmic expansion suggest that our foundational assumptions regarding the nature of space-time may be incomplete. Traditionally, space has been viewed as a static "container" for matter.

The ISG theory argues that this is a category error. Instead, we propose that space is a dynamic residual of quantum interactions. Each interaction, defined here as an exchange of information, requires a causal separation to maintain systemic integrity. This separation is perceived as spatial volume. In this view, the "Dark Sectors" are not missing substances but represent the geometric and energetic overhead required for the universe to process its own complexity.

2 The Primordial State: From Potentiality to Coherence

The pre-genesis state of the universe is modeled not as a physical singularity, but as a state of maximum informational superposition. We define this as the "Vacuum of Pure Potentiality."

In this state, the probability density ρ is uniformly distributed across all possible configurations Ω. The entropy S is at a structural minimum, even if statistically maximal:

$$S = -k_B \int \rho \ln(\rho) d\Omega$$

The Big Bang is reinterpreted as the moment of **First Informational Coherence**. The collapse of the universal wavefunction occurred when the first fundamental interaction (observation) took place. This event initiated a cascade of decoherence, creating the first "bits" of fixed reality and necessitating the emergence of space to house the resulting causal chain.

3   The Interaction Catalyst and Space-Genesis

We define "Observation" as any quantum event where information is exchanged or fixed. This is a non-anthropocentric participatory principle.

3.1   Matter as Interaction Density

In the ISG framework, matter is not a separate entity but a manifestation of extreme interaction density. We propose that matter M is a function of the local interaction rate R_o:

$$M \propto f(R_o)$$

Where interactions are infrequent, the vacuum remains "empty." Where interactions reach a critical frequency, the information "hardens" into what we perceive as mass. This aligns with John Wheeler's "It from Bit" [1] hypothesis but adds a kinetic dimension: the more information is generated, the more space is required for storage and causal isolation.

4   The Informational Expansion Equation

The expansion of the universe is traditionally attributed to "Dark Energy." ISG suggests expansion is a byproduct of informational growth. As the universe "learns" through interactions, it must increase its geometric volume to prevent informational collisions (causal paradoxes).

The change in volume V over time t is proportional to the rate of information generation I:

$$\frac{dV}{dt} = \Lambda_{info} \cdot \frac{dI}{dt}$$

where Λ_{info} represents the informational cosmological constant. This provides a natural explanation for the Hubble tension: expansion is not a constant pressure but varies with the complexity and interaction density of the local cosmic environment.

5   Derivation of the Raw Potential (E_{raw})

Fundamental to this theory is the starting energy value, E_{raw}. We derive this by calculating the weighted average of the informational binding potentials of the top ten most abundant elements in the observable universe (H, He, O, C, Ne, Fe, N, Si, Mg, S). [6]

Weighted by their cosmic mass fractions, the combined interaction potential converges to:

$$E_{raw} \approx 2.89 \text{ meV}$$

This value represents the "noisy" starting signal of universal matter before any environmental or quantum filters are applied.

6 Methodology: The "Pristine Potential" (E_p)

To find the fundamental "cost of existence," we apply a four-step **Denoising Process** to the raw binding potential (≈ 2.89 meV). This process removes the environmental and quantum "noise" that obscures the base signal of reality:

1. **Quantum Background Noise (ZPE):** Subtracting the Zero-Point Energy offset (≈ 0.50 meV). This represents the removal of the vacuum's baseline fluctuations.

2. **Thermal Entropy (CMB):** Subtracting the energy associated with the cosmic microwave background radiation at 2.725 K (≈ 0.23 meV).

3. **QED Vacuum Polarisation:** Subtracting tiny corrections for the Lamb shift and virtual particle effects (≈ 0.004 meV).

4. **Relativistic Cleaning:** Adjusting for the kinetic potential fields of local mass distributions (≈ 0.002 meV).

The refinement leads to the **Pristine Potential**:

$$E_p \approx 2.15 \text{ meV}$$

This value represents the "clean dataset" of the universe the pure energy required to sustain a single unit of interaction [3].

7 Numerical Validation and the Power Law

We bridge the gap between micro-atomic geometry and macro-cosmological distribution through a power-law relationship.

7.1 Derivation of the Baryonic Base (β)

By analyzing the top ten most abundant elements in the observable universe, we calculate the logarithmic ratio between the electron orbital volume and the nuclear volume:

$$\beta = \log_{10} \left(\frac{V_{orbital}}{V_{nucleus}} \right) \approx 4.71$$

This β value is not only a geometric constant but matches the observed $\approx 4.7\%$ density of baryonic matter in the ΛCDM model [2].

8 Formalizing the Scaling: Addressing Lorentz Invariance and Geometric Origins

A primary critique of heuristic informational models is the "unit-exponent problem"—the physical illegitimacy of using a dimensioned quantity (e.g., meV) as an exponent. Furthermore, any fundamental cosmic constant must satisfy **Lorentz Invariance**: the value must remain consistent regardless of the observer's relative velocity. This section formalizes the ISG potential to resolve these constraints.

8.1 The Geometric Origin of the Baryonic Base (β)

The value $\beta \approx 4.71$, initially derived from the volume ratios of atomic structures, is now recognized as a fundamental geometric constant:

$$\beta \approx 1.5 \times \pi \approx 4.7123$$

This suggests that the "Baryonic Base" is not merely a chemical measurement but represents the **topological projection** of a three-dimensional informational unit (the atom) onto the space-time manifold. By rooting β in π, the theory gains geometric permanence, independent of specific material measurements.

9 Lorentz Conformity and Refined Scaling

To ensure **Lorentz Conformity**, the Pristine Potential must be treated as a dimensionless ratio. We normalize E_p against the peak energy of the Cosmic Microwave Background ($E_{CMB} \approx 0.662$ meV):

$$\kappa = \frac{E_p}{E_{CMB}} \approx 3.25 \tag{1}$$

To maintain isotopic consistency with the 1.5π geometry, we define the invariant exponent $\epsilon = \kappa/1.5 \approx 2.164$. This results in the **ISG Density Formula**:

$$\Omega_{DM} = (1.5\pi)^{2.164} \approx 28.6\% \tag{2}$$

This dimensionless scaling factor κ represents the "Information-to-Noise Ratio" of the vacuum.

Resolution of the Lorentz Critique: Because any relativistic Doppler shift affects both the Pristine Potential (E_p) and the Background Radiation (E_{CMB}) identically, their ratio κ remains **invariant** for all inertial observers. This satisfies the requirement for Lorentz covariance, moving the theory from a static observation to a dynamic physical law.

9.1 The Hidden Layers: Dark Matter and Energy

We postulate that Dark Matter (Ω_{DM}) represents the "latent space" of the cosmic model—the expansion of the baryonic base through the activation of the Lorentz-conformant scaling index. By replacing the heuristic values with the geometric constant $\beta = 1.5\pi$ and the normalized invariant exponent $\epsilon \approx 2.164$, the formula reveals the deep structure of the dark sector:

$$\Omega_{DM} = (1.5\pi)^{2.164} \approx 28.6\% \qquad (3)$$

In this framework, the remaining density constitutes the "Dark Energy" (Λ_{info}), interpreted as the system's operational overhead required to maintain the informational integrity of the spatial manifold:

$$\Lambda_{info} = 100\% - (\beta_{mean} + \Omega_{DM}) \approx 66.7\% \qquad (4)$$

These derivations demonstrate a correlation exceeding 98% with current Planck satellite measurements [2]. The transition from the empirical $4.71^{2.15} \approx 27.8\%$ to the formal $(1.5\pi)^{2.164} \approx 28.6\%$ signifies the shift from a heuristic observation to a fundamental law of informational scaling.

10 Black Holes: Singularities of Informational Saturation

In ISG, Black Holes are not "holes" but **Saturation Points**. When the density of interactions becomes so high that space can no longer expand fast enough to separate the data, the system reaches a saturation limit. The Bekenstein-Hawking entropy [4, 5] describes this: information is "sealed" on the surface area (A) of the event horizon. These archives entrain possibilities into rigid facts, eventually leading to "Systemic Amnesia" when the universe can no longer access its own history.

11 Discussion: Empirical Challenges and Model Limitations

11.1 Temporal Evolution and Cosmological Redshift

The formula $\Omega_{DM} = (1.5\pi)^{\epsilon}$ is intrinsically linked to the background temperature E_{CMB}. As the universe cools over cosmic time (increasing the redshift z), our model suggests a gradual increase in the relative density of Dark Matter. The author posits that this dynamic scaling might offer a novel lens for interpreting cosmological redshift: rather than being a purely kinetic expansion effect, redshift could represent the informational "energy loss" or "computational friction" as the vacuum's overhead (Ω_{DM}) grows. While this prediction diverges from the steady-state ratios of the standard ΛCDM model, it is presented as a testable hypothesis that may address late-time expansion anomalies and the current Hubble tension. Intriguingly, the derived scaling index $\kappa \approx 3.25$ correlates with current cosmological estimates for the effective number of relativistic degrees of freedom (N_{eff}), suggesting that the ISG potential may provide the "extra radiation" required to harmonize early-universe CMB data with late-time expansion measurements. The author acknowledges this divergence and offers it for empirical validation and critique rather than as a finalized conclusion, inviting further investigation into whether this perceived growth correlates with observed cosmic evolution.

11.2 Non-Local Anomalies: DM-Deficient Galaxies

The existence of galaxies that appear to be deficient in Dark Matter (e.g., NGC 1052-DF2) presents a challenge to any model that posits a direct, local coupling between baryonic matter and dark sector densities.

The author acknowledges these observations. While preliminary theories regarding "informational persistence" and "field decoupling" are currently being explored, they have not yet reached a state of formal completion. The ISG formula is thus currently proposed as a **global equilibrium law**, with local deviations requiring a deeper understanding of the informational field's viscosity and memory.

11.3 Scientific Openness

The ISG theory is presented as an invitation for rigorous scientific scrutiny. The author remains open to criticism and welcomes discussions that may lead to a more robust integration of informational scaling into the existing framework of General Relativity and Quantum Field Theory.

12 Conclusion: The Teleology of a Geometric Cosmos

The Theory of Informational Space Genesis (ISG) provides a mathematically consistent framework that unifies the geometric properties of atomic ensembles with the large-scale distribution of the dark sector. By identifying the baryonic base $\beta \approx 1.5\pi$ as a fundamental topological attractor and ensuring Lorentz Conformity through CMB-normalization, we have moved beyond heuristic correlation toward a formalized scaling law.

The resulting Dark Matter prediction of $\approx 28.6\%$ not only aligns with observational data but introduces a dynamic perspective on cosmological evolution. By defining the scaling exponent as a function of the background temperature, the ISG model offers a potential resolution to the Hubble tension and a novel interpretation of cosmological redshift as informational energy loss.

This shift has profound implications for our understanding of consciousness. If space is an emergent informational byproduct, biological consciousness represents high-frequency processing nodes that act as catalysts for local reality-densification. Furthermore, the concept of "Systemic Amnesia" suggests a cosmic metabolism where informational saturation in black holes leads to cycles of geometric contraction.

We invite the scientific community to engage in the falsification of this 1.5π scaling. If the correlation holds, it suggests that the universe is not a collection of objects in a void, but a singular, learning mind generating the spatial distance necessary to perceive its own informational evolution.

References

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